COMPLETE STREETS TOOLKIT




A GUIDE FOR CENTRAL OHIO COMMUNITIES

Mid-Ohio Regional Planning Commission

About MORPC

The Mid-Ohio Regional Planning Commission (MORPC) is a voluntary association of local governments, representing 12 counties, 44 governments, and 1.6 million residents. MORPC is structured in four main departments: Public & Government Affairs, Center for Energy & Environment, Housing, and Transportation. The transportation department serves as the federally-designated Metropolitan Planning Organization (MPO) for the Columbus region. MORPC's metropolitan planning area (the MPO area) includes Delaware and Franklin counties, and portions of Fairfield and Licking counties (see map on page iv for specific Transportation Planning Area boundaries). A neighboring MPO, the Licking County Area Transportation Study, is the MPO for the Newark area, and covers additional areas of central Ohio, to the east of Columbus.

MPOs are established in all urban areas of the U.S. that are over 50,000 population, to perform the "3-C" (continuing, comprehensive, and cooperative) transportation planning process. The 3-C planning process, which makes the area eligible to receive federal highway and transit funding, includes two major required products - a regional transportation plan, with at least a 20-year planning horizon, and a transportation improvement program, a shorter-term schedule of active projects. MORPC has been the designated entity to carry out the 3-C process in central Ohio since 1964, soon after the 3-C requirements were established in the Federal-Aid Highway Act of 1962 (and in other subsequent legislation).

As the MPO, MORPC distributes about $27 million in federal dollars each year to transportation-related projects, mostly highway engineering related. As part of its funding application process, MORPC has adopted a Complete Streets policy that requires all project sponsors receiving its funding to adhere to the policy. The policy can be found in the Appendix of this document.

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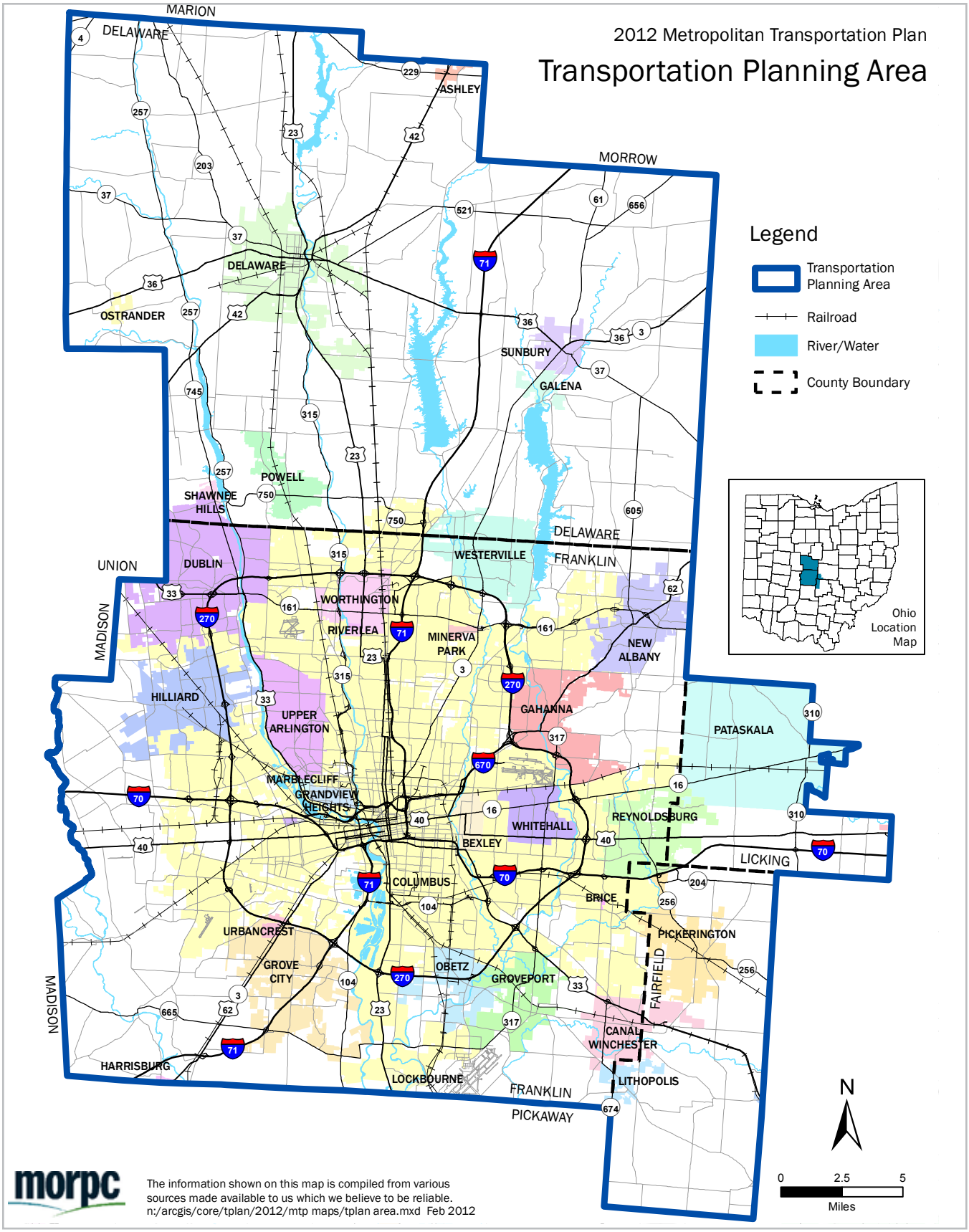
2012 Metropolitan Transportation Plan
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Legend
Transportation Planning Area
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Ohio Location Map
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WORTHINGTON
RIVERLEA
MINERVA PARK
NEW ALBANY
MADISON
HILLIARD
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PATASKALA
MARBLECLIFF
GRANDVIEW HEIGHTS
WHITEHALL
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BEXLEY
LICKING
COLUMBUS
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PICKERINGTON
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OBETZ
GROVEPORT
FAIRFIELD
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The information shown on this map is compiled from various sources made available to us which we believe to be reliable.
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List of Acronyms

AAA: American Automobile Association
AARP: American Association of Retired Persons
AASHTO: American Association of State Highway and Transportation Officials
ADA: Americans with Disabilities Act
ADAAG: Americans with Disabilities Act Accessibility Guidelines
APA: American Planning Association
APBP: Association of Pedestrian and Bicycle Professionals
APHA: American Public Health Association
APTA: American Public Transit Association
ATAC: Accessible Transportation Advisory Council
AVL: Automated vehicle locator
BBP: Columbus Bicentennial Bikeways Plan
BRC: Basic rider course
BRT: Bus-rapid transit
CABS: Campus Area Bus System
CAPS: Columbus Area Pedestrian Safety Committee
CCAD: Columbus College of Art & Design
CDL: Commercial driver's license
CMAQ: Congestion Mitigation & Air Quality
CMF: Crash modification factor
CNU: Congress for the New Urbanism
COTA: Central Ohio Transit Authority
CPH: Columbus Public Health Department
CSS: Context-sensitive solutions
CTOD: Center for Transit-Oriented Development
DATA: Delaware Area Transit Agency
DOT: Department of Transportation
EMS: Emergency medical services
FAR: Floor-to-area ratio
FBC: Form-based code
FHWA: Federal Highway Administration
FTA: Federal Transit Administration
GAO: Government Accountability Office
GHSA: Governors Highway Safety Association
GPS: Global positioning system
GRH: Guaranteed Ride Home
HAWK: High-Intensity Activated Crosswalk
HSIP: Highway Safety Improvement Program
IBPI: Initiative for Bicycle and Pedestrian Innovation
IIHS: Insurance Institute for Highway Safety
IPMBA: International Police Mountain Bike Association
IRS: Internal Revenue Service
ISTEA: Intermodal Surface Transportation Efficiency Act
ITDP: Institute for Transportation and Development Policy
ITE: Institute of Transportation Engineers
JARC: Job Access and Reverse Commute
L&D: Location & Design
LAB: League of American Bicyclists
LCI: League-Certified Instructor
LEED: Leadership in Energy & Environmental Design
LEED-ND: LEED for Neighborhood Development
LOS: Level of service
MORPC: Mid-Ohio Regional Planning Commission
MPO: Metropolitan planning organization
MSF: Motorcycle Safety Foundation
MUP: Multi-use path
MUTCD: Manual on Uniform Traffic Control Devices
NACCHO: National Association of County and City Health Officials
NACTO: National Association of City Transportation Officials
NBPDP: National Bicycle and Pedestrian Documentation Project
NCHRP: National Cooperative Highway Research Program
NCSC: National Complete Streets Coalition
NCSRTS: National Center for Safe Routes to School
NHI: National Highway Institute
NHTSA: National Highway Traffic Safety Administration
NTPP: Nonmotorized Transportation Pilot Program
ODNR: Ohio Department of Natural Resources
ODOT: Ohio Department of Transportation
ODPS: Ohio Department of Public Safety
OMUTCD: Ohio Manual on Uniform Traffic Control Devices
ORC: Ohio Revised Code
OSU: Ohio State University
P&R: Park & ride
PAR: Pedestrian-accessible route
PBIC: Pedestrian and Bicycle Information Center
PROWAG: Public Rights of Way Accessibility Guidelines
PRT: Personal rapid transit
PSA: Public service announcement
RA: Routine accommodation
ROW: Right-of-Way
RTP: Recreational Trails Program
SRTS: Safe Routes to School
TCRP: Transit Cooperative Research Program
TDM: Transportation demand management
TE: Transportation Enhancements
TIP: Transportation improvement program
TOD: Transit-oriented development
TRB: Transportation Research Board
TTC: Temporary traffic control
UCD: Urban Center Zoning District
ULI: Urban Land Institute
USAB: United States Access Board
USDOJ: Department of Justice
USDOT: United States Department of Transportation
USEPA: United States Environmental Protection Agency
USGBC: United States Green Building Council
VTPI: Victoria Transport Policy Institute

1. INTRODUCTION

1.1 Background

In January 2010, the Mid-Ohio Regional Planning Commission (MORPC) received a grant from the Ohio Department of Health's Statewide Wellness and Obesity Prevention program to develop a Complete Streets toolkit and conduct outreach on the importance of creating a transportation system that provides mobility options to all users.

MORPC has a long history of promoting multi-modal transportation. This has been the case especially since the U.S. government passed ISTEA (the Intermodal Surface Transportation Efficiency Act) in 1991, placing greater responsibility upon Metropolitan Planning Organizations (MPOs) to ensure multimodal transportation options. MORPC adopted a Routine Accommodations (RA) policy in 2004, requiring a certain level of bicycle and pedestrian accommodation for projects including funding distributed through the Metropolitan Planning Organization (MPO). In 2010, the RA policy was replaced with the stronger, more thoroughly supported Complete Streets policy.

The term "Complete Streets" was popularized simultaneously with the founding of the National Complete Streets Coalition in 2005, and since then many different levels of government (states, counties, cities, etc.) have adopted Complete Streets policies. MORPC was the first large MPO to specifically adopt a Complete Streets policy (as opposed to a Routine Accommodations or other bicycle and pedestrian accommodation policy). Consequently, the process by which MORPC's Complete Streets policy was adopted was somewhat unique. The following explanation of the policy adoption process may be helpful to other MPOs working to adopt a Complete Streets policy.

Starting in summer 2009, MORPC staff began research and initial drafts of a regional Complete Streets policy that would replace the 2004 RA policy. For the initial research, a number of existing policies provided useful background information, including policies adopted by smaller MPOs (especially the Bloomington, IN MPO). At the same time, a working group was assembled to help develop the policy.

The group was composed of about 25 diverse stakeholders, representing resident volunteers, private sector engineers, local governments, health departments, transit authorities, universities, and state, federal, and MORPC staff. The working group held a total of four meetings between June 2009 and January 2010. The working group was essential in shaping the policy and the accompanying checklists. Between meetings, drafts were shared with the work group members via email and their comments were helpful in reshaping each draft.

A number of concerns became evident from the working group sessions. Particularly, there was a concern that new Complete Streets requirements would cause a financial burden on local governments, especially in rural areas. At the same time, there were some concerns that the policy's requirements were not stringent enough. The working group's involvement was a very valuable consensus-building process, and the involvement of so many different stakeholders resulted in the development of a stronger, more balanced policy.

After development, the final policy document went out for one month to the public for review and comment. In addition, MORPC staff met with several members individually to discuss and address their concerns. Each comment was noted and addressed and made publicly available on MORPC's website. The policy draft was also presented to MORPC's Citizen Advisory, Transportation Advisory, and Policy committees in March. The Complete Streets policy was adopted by the Policy Committee on April 8, 2010. It will be regularly reviewed to identify opportunities for improvement.

1.2 Toolkit Purpose

The purpose of this toolkit is to provide resources for local governments, project sponsors, consultants, engineers, and planners in central Ohio to plan, design, and implement Complete Streets projects.

The toolkit contains templates for urban, suburban, and rural Complete Streets policies and provides a variety of information on the different aspects related to the "5 E's": Engineering, Education, Enforcement, Encouragement, and Evaluation. It also includes chapters on various related topics, such as land use, zoning policies, transit-oriented development, funding sources, and other resources that may be useful in tackling this issue.

MORPC has also acquired a variety of equipment that can be borrowed by its members through an easy online check-out process. The type of equipment available and the check-out form are described in Appendix 4.

One of the goals of the grant is for several local communities to adopt their own Complete Streets policies. Instituting a Complete Streets policy at the regional, county, city, and township level ensures that planners and engineers consistently

design and operate the entire roadway network with all users in mind. This increases the opportunities for physical activity and in return improves the health of our residents. Since the built environment directly impacts the health of local residents, the local health district is a key stakeholder in the Complete Streets process.

1.3 Local Health Districts

As part of the grant application, MORPC obtained letters of support from five local health districts within the metropolitan planning area: Columbus Public Health, Franklin County Board of Health, Delaware General Health District, Fairfield County Department of Health, and Licking County Health Department.

Throughout this project, MORPC has engaged each of the five local health districts in the following ways:

- Sought and received a letter of support for MORPC's grant application
- Invited them to participate in the pre-project and post-project survey of local governments
- Met with each health commissioner and/or their staff early on to discuss the toolkit
- Shared draft outline of the toolkit for their feedback
- Shared draft of the health equity section of the toolkit for their feedback
- Shared toolkit chapters, and will provide hard copies of final toolkit to each of them
- Sought information on local health programs to include as local best practice examples in the toolkit
- Shared information about the toolkit equipment library and encouraged the use of equipment for their projects
- Invited them to appropriate training workshops and webinars
- Invited health districts to the Healthy Communities through Active Transportation Conferences

This process has provided MORPC the opportunity to build new partnerships with local health departments and work together on other grants to achieve common goals.

1.4 Communication

Communication is a key element in making any project successful. When looking for government entities to take action on a particular item, the message must be communicated easily and clearly. Below are examples of how MORPC staff communicates the topic of Complete Streets and its benefits to the various communities:

Newsletter. Biannually, MORPC publishes a Complete Streets newsletter that provides information about topics related to Complete Streets and updates the communities on what MORPC has been working on.

Webinars. MORPC hosts several webinars each year related to the topic of Complete Streets. The webinars typically show national best practices on engineering, education, or enforcement.

Social Media. MORPC regularly uses social media, such as facebook, linkedin, or twitter, to educate and promote events, projects, or accomplishments. For example, MORPC announced the adoption of the Complete Streets Policy via Facebook and Twitter and continues to use social media to give updates about Complete Streets fact sheets, funding, and other issues.

Website. In order to provide quick access to Complete Streets-related information, such as the fact sheets, MORPC created a specific URL: www.morpc.org/completestreets. This link leads directly to the fact sheets, equipment library, and other resources.

Presentations. MORPC staff offers short presentations to communities' staff and council members about the demographic and housing trends that will require communities to develop differently in the future. The presentation is focused on how complete streets can help to create a transportation system that accommodates the newly demanded lifestyles.

Video. MORPC created a 10-minute video titled "Rethinking Streets for Successful Communities," where local and national leaders in their fields help explain why we need to rethink the way our streets are designed and used. This video is also available on MORPC's Complete Streets website.

Workshops. MORPC regularly hosts workshops and educational forums for its members to provide them with best practices and resources on the topic of Complete Streets. Below are just a few examples.

- **Complete Streets Workshop in Westerville, Ohio (June 2011).** Regional policy-makers learned from the video, a hands-on activity, and a panel discussion why they may want to rethink their community design and how to best approach it.
- **Safe Routes to School Educational Forums.** Since 2009, MORPC holds bi-monthly educational forums focused on the topics of Safe Routes to School, addressing each of the five E's: Engineering, Education, Enforcement, Encouragement, and Evaluation. These forums are attended by a wide variety of people representing governments, schools, parks & recreation departments, parent associations, health departments, and others.
- **Real Estate Trends Workshop in Upper Arlington, Ohio (October 2011).** Developers, government and zoning officials, planners, architects, and realtors learned about how the demographic changes will and already are affecting real estate development in central Ohio. A panel of local developers, planners, and engineers discussed challenges and opportunities by providing examples and best practices.

SRTS Practitioners identify safe walking routes at MORPC's How-To Workshop. August, 2010. Source: MORPC. Columbus, OH.

Community leaders work together to develop a Complete Street at MORPC's Complete Streets workshop in Westerville, OH, June, 2011. Source: MORPC.

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2. BASICS OF COMPLETE STREETS

2.1 Introduction

Complete Streets are roadways designed to safely and comfortably accommodate all users, including, but not limited to motorists, cyclists, pedestrians, transit and school bus riders, delivery and service personnel, freight haulers, and emergency responders. "All users" includes people of all ages and abilities.

It is important to note that there is no single design prescription for Complete Streets. In fact, each one is unique and responds to its community context, including land use, population size, density, safety issues, and other factors. A complete street in a rural area will look quite different from a complete street in a highly urban area. However, any complete street should include some type of facility that provides safe accommodation for all users.

2.2 History of Complete Streets

In recent decades, most streets were designed with only cars in mind, limiting transportation choices by making walking, bicycling, and public transportation inconvenient, unattractive, and often dangerous.

Since the 1970s several states and regions have promoted more accommodations for pedestrians and bicyclists in their planning efforts, but these efforts weren't always successful. The first statewide policy in the United States was enacted in 1971, when the State of Oregon passed a "bike bill" requiring that new or rebuilt roads accommodate bicycles and pedestrians, and that state and local governments fund pedestrian and bicycle facilities in the public right-of-way. In 1984, the State of Florida enacted State Statute 335.065, requiring that transportation planning and development give "full consideration" to bicycle and pedestrian facilities.

The current use of the term "complete streets" dates to 2003, when it was coined by cycling advocates as a replacement for the technical term "routine accommodation." The National Complete Streets Coalition was founded in 2005 by a coalition of advocacy and trade groups, including the American Association of Retired Persons, the American Planning Association, the American Society of Landscape Architects, and the American Heart Association.

As of July 2011, 249 U.S. jurisdictions, including 24 states have endorsed or adopted complete streets policies. Some of these jurisdictions have passed legislation enacting their policies into law, while others have implemented their policies by executive order or regulation. Still more jurisdictions have passed non-binding resolutions in support of complete streets, or created transportation plans that incorporate complete streets principles. Federal complete streets legislation was proposed in 2008 and 2009, but failed to become law.

In 2010, the U.S. Department of Transportation issued a policy statement on bicycle and pedestrian accommodation, declaring its support for their inclusion in federal-aid transportation projects and encouraging community organizations, public transportation agencies, and state and local governments to adopt similar policies.

2.3 Motivating Factors

Complete Streets provide a wide variety of benefits to individuals and the larger community. The National Complete Streets Coalition has many fact sheets available on its website (www.completestreets.org) that provide concrete examples of the various benefits. A few of these benefits are summarized below.

Complete Streets:

- Foster lifelong communities by creating a livable place where all people, regardless of age, ability, or mode of transportation can safely get around and engage in public life.
- Reduce crashes through safety improvements. These safety improvements are often felt most by pedestrian or bicycle travel.
- Reduce congestion, as streets that provide travel choices can give people the option to use other modes of transportation and avoid traffic jams, thus increasing the overall capacity of the network.
- Increase economic activity by providing accessible and efficient connections between residences, schools, parks, offices, and retail destinations can increase business, improve productivity, and reduce employee turnover.
- Increase walking and biking, which helps improve the overall health of our residents by making physical exercise part of their lifestyles and betters the health of the community by reducing air pollution and CO_2 emissions from cars.
- Reduce transportation costs for families by giving them other options than driving.

2.4 Health Equity & Complete Streets

Research has shown that the neighborhood you live in, your access to quality housing, convenient and affordable transportation, a good job, and a good education have a greater impact on your health than your genetics or your access to healthcare.

Health equity refers to the fairness in the distribution of resources between groups with differing levels of social disadvantage. A health-equitable environment is one where everyone has a good chance to be healthy (Prevention Institute, 2010).

Health disparities are differences in health status and death rates across population groups. In the United States differences exist based on race, ethnicity, income, gender, sexual orientation, age, education, or geographic location. When these differences are systematic, avoidable, unfair and unjust, they are called health inequities. Health inequities are sustained over time and generations, and are beyond the control of individuals (Braveman, 2006).

It is well documented that individuals of a low socioeconomic status suffer from higher instances of disease and premature death as compared to their wealthier counterparts. In Ohio, studies have shown that minorities, the elderly, and the underprivileged are disproportionately affected by high rates of obesity, cancer, cardiovascular disease, and diabetes among other ailments (City of Columbus, 2010).

Physical activity has been shown to prevent or reduce obesity, heart disease, diabetes, cancer, and premature mortality (Goodell & Williams, 2007). Further, research has shown that nine types of cancer are associated with physical inactivity, yet the design of our communities and our real and perceived safety within them can have a profound impact on our opportunity and choice to be physically active every day.

Health disparities may be attributed to a number of factors in the built environment such as insufficient housing, land use policies, safety, limited access to health care choices, and transportation infrastructure. Focus on the built environment is essential to promoting health equity - in part due to the major role it plays in the upstream prevention of chronic diseases and poor health.

Some degree of health inequity does exist in the communities MORPC serves. Fortunately, health disparities can be reduced by policies that eliminate barriers and create opportunities for good health to be obtained by all. Adoption of a Complete Streets policy is one way to remediate several factors contributing to poor health and ultimately provide for health equity. Further, the health equity approach allows us to affect many people and have broad impacts on multiple health outcomes at once.

Complete Streets provide an equal opportunity for users of all modes of transportation to travel safely and comfortably, thereby increasing physical activity. Adequate bicycle and pedestrian infrastructure and access to public transit also allow individuals without automobiles the opportunity to reach health care settings where essential treatments can be delivered. All of these factors have been shown to improve quality of life, increase safety, create a sense of community, and promote active living which can decrease health disparities of disadvantaged populations.

Health begins where we live, learn, work, and play, and Complete Streets can be a key to ensuring that all people have the opportunity and choice to be healthy.

Building the Health Equity Case for Complete Streets

Helping policy makers understand the health equity implications of a Complete Streets policy can be a key step in promoting policy adoption in your community. Here are several resources available to help Local Public Health Organizations, planning agencies, and local governments build the health equity case for complete streets policy adoption:

- The American Public Health Association (APHA) has developed health, equity, and transportation resources, such as fact sheets, a communications toolkit, and reports as part of a comprehensive online toolkit. These resources are available for download on this web page: www.apha.org.
- *Unnatural Causes* is the acclaimed 2008 documentary series broadcast by PBS and now used by thousands of organizations around the country to tackle the root causes of the alarming socio-economic and racial inequities in health. Utilize the resources available on the *Unnatural Causes* website (www.unnaturalcauses.org/) to share the documentary's health equity message with Policy Makers.
- Statistics on community health and behavior can help shine new light on the weight of all transportation policy decisions. Work with your Local Health Organization's department of epidemiology (such as Columbus Public Health's Office of Assessment and Surveillance) to access health statistics about your community.
- Columbus Public Health's Office of Assessment and Surveillance produced a 2010 report titled "Unequal Health: The Black/White Gap in Franklin County," which highlights the health disparities between Blacks and Whites in Franklin County. The report is available at www.publichealth.columbus.gov/oas-reports.aspx, along with additional health inequity reports on the disparities among Hispanics/Latinos, men, and women.
- Founded in 1997, the Prevention Institute promotes policies, organizational practices, and collaborative efforts that improve health and quality of life. As a national non-profit organization, the Institute is committed to preventing illness and injury, to fostering health and social equity, and to building momentum for community prevention as an integral component of a quality health system. In 2010, the institute released the Health Equity and Prevention Primer, a web-based training series for public health practitioners and advocates interested in policy advocacy, community change, and multi-sector engagement to achieve health equity. The Primer can be accessed here: www.preventioninstitute.org/tools/focus-area-tools/health-equity-toolkit.html.

- The National Association of County and City Health Officials has a variety of Health Equity and Social Justice toolkits and resources available for communities to use in building the case for local policy change. Please visit their website for more information: www.naccho.org/.
- The national think tank, PolicyLink, has created an Equitable Development Tool Kit with resources that help communities advocate for health equity. It can be accessed here: www.bit.ly/nKex5A.

2.5 What are the 5 E's?

The information in this document is mainly structured around the 5 E's, which are described below in greater detail. In general, focusing on more than one "E" is important in order to increase safe travel behavior by any mode of transportation. While it is critical to build the right facilities, it is equally important to ensure that everyone understands how to use them and that traffic rules and regulations are enforced.

The 5 E's:

- **Engineering** refers to operational and physical improvements to the transportation infrastructure, such as building safer walkways or reducing speed limits along a certain corridor.
- **Education** is an important element to teach transportation users the appropriate traffic safety skills and to ensure that everyone understands the benefits and use of new facilities, such as roundabouts.
- **Enforcement** ensures that all roadway users obey traffic laws, behave safely, and share the road with one another. Partnering with local law enforcement is an important part of creating effective strategies that focus on the problems that are pertinent to the area. As such, enforcement programs can focus on speeding, non-yielding behaviors, or distracted driving and walking, among others.
- **Encouragement** refers to programs and strategies that create excitement and interest to utilize the built environment, such as a new path or transit line. Encouragement and education should be closely related.
- **Evaluation** is critical in understanding if the infrastructure changes or education or enforcement efforts are showing positive results. Regular monitoring and documenting outcomes and trends through the collection of data, including the collection of data before and after the intervention(s), is important to ensure a safe environment for everyone.

3. COMPLETE STREETS MODEL POLICIES

3.1 Introduction

Complete Streets policies have been adopted or proposed at the federal, state, regional, and local levels of government. Ideally, such a network of policies would be in place to ensure that the needs of all users are accounted for regardless of implementing agency or funding source. As of July 2011, the federal government and the State of Ohio have not yet adopted comprehensive Complete Streets policies.

In 2010, MORPC adopted a Complete Streets policy that applies to the use of federal funds within its transportation planning area, but while this policy covers many transportation funding scenarios and situations, there are many additional scenarios in central Ohio that fall outside of MORPC's policy scope. For example, projects using local funds are exempt from MORPC's Complete Streets policy. One of the goals of the Complete Streets toolkit is to facilitate the adoption of Complete Streets policies by local governments throughout the region.

This chapter of the toolkit provides model policies for urban, suburban, and rural communities. The goal of these model policies is to serve as a flexible template for communities in central Ohio. While the communities described here are fictitious, the models were derived through research of existing policies in the United States, and are designed to include all of the essential policy elements recommended by the National Complete Streets Coalition (see box below). In combination with MORPC's existing policy, the adoption of Complete Streets policies at a local level would greatly improve the transportation system for all residents of central Ohio.

An Ideal Complete Streets Policy:

- *Includes a vision for how and why the community wants to complete its streets.*
- *Specifies that 'all users' includes pedestrians, bicyclists and transit passengers of all ages and abilities, as well as trucks, buses and automobiles.*
- *Encourages street connectivity and aims to create a comprehensive, integrated, connected network for all modes.*
- *Is adoptable by all agencies to cover all roads.*
- *Applies to both new and retrofit projects, including design, planning, maintenance, and operations, for the entire right-of-way.*
- *Makes any exceptions specific and sets a clear procedure that requires high-level approval of exceptions.*
- *Directs the use of the latest and best design criteria and guidelines while recognizing the need for flexibility in balancing user needs.*
- *Directs that complete streets solutions will complement the context of the community.*
- *Establishes performance standards with measurable outcomes.*
- *Includes specific next steps for implementation of the policy.*

Source: National Complete Streets Coalition (www.completestreets.org).

The adoption of a Complete Streets policy by itself is not enough to ensure that Complete Streets will be implemented. Along with the policy, existing guidelines, standards, and procedures may need to be revised in order to ensure that the designs of new facilities and the maintenance and operation of new and existing facilities are compliant with the policy. This revision should include land use and zoning policies to provide for mixed land use developments and projects that provide direct non-vehicular connections within a given development.

Some helpful resources and examples for these guidelines and standards are provided in different sections of the toolkit. The MORPC Complete Streets checklist, used for MORPC's projects, may also be a helpful resource. It is included as Appendix 2.

3.2 Model Urban Complete Streets Policy

The following model policy would be suitable for an urban community; i.e., a medium-to-large city adjacent to other similar communities, with a relatively large proportion of residential land area and very little rural, agricultural, or preserved land area. For the purposes of this document, we generally consider a community to be urban (rather than suburban) when it is unable to annex new land.

"Moon City" - Complete Streets Policy

Background. Some areas in Moon City were designed for automobile transportation and lack facilities, such as sidewalks, bus shelters, and bicycle lanes. As demand for walking, bicycling, and transit grows, safe and accessible transportation accommodations for all users become increasingly necessary. Reducing the sole reliance on the automobile can help in improving air quality and reducing greenhouse gas emissions.

About 33 percent of workers residing in Moon City work outside the city boundaries, and a large proportion of the trips taken in Moon City begin or end in other communities. It is essential to provide safe and accessible transportation facilities for all users not only within Moon City, but also to connect to neighboring communities.

An estimated 20 percent of Moon City residents suffer from obesity. A lack of physical activity is one of the many factors that increase the risk of obesity and diseases associated with the condition. Active transportation is an efficient, convenient way for residents to get exercise.

According to Census data, 10 percent of households in Moon City have no access to a motor vehicle. The residents of these households should be accommodated by infrastructure that makes non-automobile transportation safe, convenient, and comfortable.

Moon City is served by 10 express bus routes and 20 local bus routes. Transit ridership is projected to increase in future decades, and transit service is expected to expand. However, some bus stops are in locations without sidewalks, safe street crossings, or facilities for the disabled.

Finally, from 2008 to 2010, there were 70,143 motor vehicle crashes in Moon City, including 140 crashes involving pedestrians, 68 involving bicyclists, and a total of 210 fatalities. Improving traffic safety is a priority for the city.

Definition. Complete Streets are roadways designed to safely and comfortably accommodate all users, including, but not limited to motorists, cyclists, pedestrians, transit and school bus riders, delivery and service personnel, freight haulers, and emergency responders. "All users" includes people of all ages and abilities.

Vision. To create an equitable, balanced, and effective transportation system throughout Moon City that allows every roadway user to travel safely and comfortably, makes sustainable transportation options available to everyone, and provides a comprehensive, integrated network for all modes both within Moon City and connecting to adjacent communities.

Policy Statement. The Complete Streets policy of Moon City is developed to provide guidance for decision makers, planners, and designers to ensure that multimodal elements are incorporated into all transportation improvement projects.

- All roadway projects, including new roadways, reconstruction of existing roadways, and new developments in Moon City shall accommodate users of all ages and abilities, including pedestrians, bicyclists, transit users, motorists, persons with disabilities, and adjacent land users.
- Accommodation of all users should be consistent with the project context, including current or anticipated development density, roadway characteristics, transit plans, right-of-way dimensions and availability, and community plans. Since each roadway location is unique, flexibility in the appropriate type of facilities should be provided in order to allow designers to tailor the project to the unique circumstances.
- This policy shall apply to the new construction, reconstruction, rehabilitation, repair, maintenance, or planning of roadways, trails and other transportation facilities, for the entire right-of-way.
- All plans, policies, standards, guidelines, and procedures shall be reviewed, and if necessary phased in gradually, to ensure compliance with Complete Streets principles. When revising those documents, it is critical to recognize the need for flexibility in balancing user needs.
- Once those documents are revised, all roadway projects shall adhere to the most recent city-approved documents, including the following:
    - Planning documents, such as the comprehensive master plan, area plan, strategic plan, bicycle master plan, mobility plan, thoroughfare plan, or Safe Routes to School plans.
    - Zoning and subdivision regulations.
    - Project development procedures, such as design standards.
    - Operations and maintenance plans.
    - Other applicable transportation policies.

- Roadway projects shall include a project description that provides information about the city right-of-way, public support for the improvement, the potential environmental impacts of improvements, and the benefits of the project, including improved access and connectivity.
- Project boundaries shall be chosen to include connections through "pinch points," such as overpasses, railroad crossings, and bridges.
- Street furniture, such as bike racks or benches, should be considered as part of all projects as long as they do not impede any user. Landscaping and street trees should also be considered, with careful analysis of tree, site, and design considerations.

Exemptions. Exemptions from this policy should be avoided. However, in cases where partial or full exemptions are necessary, they should be documented during the project development process and presented during the public involvement process. All exemptions shall be kept on record and made publicly available. The exemption of any roadway project from this policy shall be approved by a senior level department head, such as the Public Service Director.

Performance Standards. The success of Complete Streets projects shall be measured through a number of ways, including but not limited to:

- Miles of on-street and off-street bicycle routes created.
- New linear feet of sidewalk.
- Changes in the number of people using public transportation, bicycling, or walking (mode shift).
- Percentage of children walking or bicycling to school (mode shift).
- Number of crashes including motorists and non-motorists.
- Number of new street trees.

Implementation. According to the National Complete Streets Coalition, there are four key steps for successful implementation:

1. Restructure procedures to accommodate all users on every project.
2. Develop new design policies and guides.
3. Offer workshops and other training opportunities to planners and engineers.
4. Institute better ways to measure performance and collect data on how well the streets are serving all users.

Moon City will carry out these key steps in the following ways:

1. Procedures for new projects will be restructured to follow a process in which Moon City staff reviews all projects for its accommodation of all users.
2. Resources will be allocated for the research and development of new or revised design standards and design policies for projects within the city. Detailed design guidelines on how to build Complete Streets will be developed. The city will also acquire a library of existing design guides that serve as good examples for the design of Complete Streets.
3. Moon City planners and engineers will attend a certain number of workshops and other educational sessions each year relating to the design and implementation of Complete Streets.
4. Moon City staff will conduct ongoing research to determine performance measures. Data on all modes of traffic will be collected regularly and analyzed in order to determine trends.

3.3 Model Suburban Complete Streets Policy

The following model policy would be suitable for a suburban community; i.e., a small city or village adjacent to other similar communities or to a larger city, with a relatively large proportion of residential land area and a relatively low proportion of rural, agricultural, or preserved land area. Note that a community may have areas that are urban ("main street" downtown), but outlying areas may be more suburban in character.

"City of Crest Ridge" - Complete Streets Policy

Background. Like many suburbs, some areas in Crest Ridge were designed for automobile transportation and lack facilities, such as sidewalks, bus shelters, and bicycle lanes. As demand for walking, bicycling, and transit grows, safe and accessible transportation accommodations for all users become increasingly necessary. Reducing the sole reliance on the automobile can help in improving air quality and reducing greenhouse gas emissions.

About 66 percent of workers residing in Crest Ridge work outside the city boundaries. Furthermore, a large proportion of the trips taken in Crest Ridge begin or end in other communities. It is essential to provide safe and accessible transportation facilities for all users not only within Crest Ridge, but also to connect to neighboring communities.

An estimated 15 percent of Crest Ridge residents suffer from obesity. A lack of physical activity is one of the many factors that increase the risk of obesity and diseases associated with the condition. Active transportation is an efficient, convenient way for residents to get exercise.

According to Census data, 5 percent of households in Crest Ridge have no access to a motor vehicle. The residents of these households should be accommodated by infrastructure that makes non-automobile transportation safe, convenient, and comfortable.

Crest Ridge is served by 2 express bus routes and 1 local bus route. Transit ridership is projected to increase in future decades, and transit service is expected to expand. However, some bus stops are in locations without sidewalks, safe street crossings, or facilities for the disabled.

Finally, from 2008 to 2010, there were 2,143 motor vehicle crashes in Crest Ridge, including 15 crashes involving pedestrians and 10 involving bicyclists, with a total of 6 fatalities. Improving traffic safety is a priority for the city.

Definition. Complete Streets are roadways designed to safely and comfortably accommodate all users, including, but not limited to motorists, cyclists, pedestrians, transit and school bus riders, delivery and service personnel, freight haulers, and emergency responders. "All users" includes people of all ages and abilities.

Vision. To create an equitable, balanced, and effective transportation system throughout the City of Crest Ridge that allows every roadway user to travel safely and comfortably, makes sustainable transportation options available to everyone, and provides a comprehensive, integrated network for all modes both within Crest Ridge and connecting to adjacent communities.

Policy Statement. The Complete Streets policy of the City of Crest Ridge is developed to provide guidance for decision makers, planners, and designers to ensure that multimodal elements are incorporated into all transportation improvement projects.

- All roadway projects, including new roadways, reconstruction of existing roadways, and new developments in Crest Ridge shall accommodate users of all ages and abilities, including pedestrians, bicyclists, transit users, motorists, persons with disabilities, and adjacent land users.
- Accommodation of all users should be consistent with the project context, including current or anticipated development density, roadway characteristics, transit plans, right-of-way dimensions and availability, and community plans. Since each roadway location is unique, flexibility in the appropriate type of facilities should be provided in order to allow designers to tailor the project to the unique circumstances.
- This policy shall apply to the new construction, reconstruction, rehabilitation, repair, maintenance, or planning of roadways, trails and other transportation facilities, for the entire right-of-way.
- All plans, policies, standards, guidelines, and procedures shall be reviewed, and if necessary phased in gradually, to ensure compliance with Complete Streets principles. When revising those documents, it is critical to recognize the need for flexibility in balancing user needs.
- Once those documents are revised, all roadway projects shall adhere to the most recent city-approved documents, including the following:
    - Planning documents, such as the comprehensive master plan, area plan, strategic plan, bicycle master plan, mobility plan, thoroughfare plan, or Safe Routes to School plans.
    - Zoning and subdivision regulations.
    - Project development procedures, such as design standards.
    - Operations and maintenance plans.
    - Other applicable transportation policies.

- Roadway projects shall include a project description that provides information about the city right-of-way, public support for the improvement, the potential environmental impacts of improvements, and the benefits of the project, including improved access and connectivity.
- Project boundaries shall be chosen to include connections through "pinch points," such as overpasses, railroad crossings, and bridges.
- Roadway projects shall follow an open and transparent public engagement process during the entire process of complete street projects, from planning to opening.

Exemptions. Exemptions from this policy should be avoided. However, in cases where partial or full exemptions are necessary, they should be documented during the project development process and presented during the public involvement process. All exemptions shall be kept on record and made publicly available. The exemption of any roadway project from this policy shall be approved by a senior level department head, such as the Public Service Director.

Performance Standards. The success of Complete Streets projects shall be measured through a number of ways, including but not limited to:

- Miles of on-street and off-street bicycle routes created.
- New linear feet of sidewalk.
- Changes in the number of people using public transportation, bicycling, or walking (mode shift).
- Percentage of children walking or bicycling to school (mode shift).
- Number of crashes including motorists and non-motorists.
- Number of new street trees.

Implementation. According to the National Complete Streets Coalition, there are four key steps for successful implementation:

1. Restructure procedures to accommodate all users on every project.
2. Develop new design policies and guides.
3. Offer workshops and other training opportunities to planners and engineers.
4. Institute better ways to measure performance and collect data on how well the streets are serving all users.

The City of Crest Ridge will carry out these key steps in the following ways:

1. Procedures for new projects will be restructured to follow a process in which city staff reviews all projects for their accommodation of all users.

2. Resources will be allocated for the research and development of new or revised design standards and design policies for projects within the city. Detailed design guidelines on how to build Complete Streets will be developed. The city will also acquire a library of existing design guides that serve as good examples for the design of Complete Streets.
3. Crest Ridge planners and engineers will attend a certain number of workshops and other educational sessions each year relating to the design and implementation of Complete Streets.
4. City staff will conduct ongoing research to determine performance measures. Data on all modes of traffic will be collected regularly and analyzed in order to determine trends.

3.4 Model Rural Complete Streets Policy

The following model policy would be suitable for a rural community; i.e., a county or township with a large proportion of sparsely populated agricultural or preserved land.

"Smith County" - Complete Streets Policy

Background. Like many rural areas, most parts of Smith County were designed for automobile transportation only and lack facilities for pedestrians, bicyclists, and transit users. As demand for walking, bicycling, and transit grows, safe and accessible transportation accommodations for all modes become increasingly necessary. Reducing the sole reliance on the automobile can help in improving air quality and reducing greenhouse gas emissions.

About 70 percent of workers residing in Smith County work outside the city boundaries. It is essential to provide safe and accessible transportation facilities for all users not only within Smith County, but also to connect to neighboring communities.

An estimated 30 percent of Smith County residents suffer from obesity. A lack of physical activity is one of the many factors that increase the risk of obesity and diseases associated with the condition. Active transportation is an efficient, convenient way for residents to get exercise.

According to Census data, 7 percent of households in Smith County have no access to a motor vehicle. The residents of these households should be accommodated by infrastructure that makes non-automobile transportation safe, convenient, and comfortable.

Smith County is served by one local bus route. Transit ridership is projected to increase in future decades, and transit service is expected to expand. However, some bus stops are in locations without sidewalks, safe street crossings, or facilities for the disabled.

Finally, from 2008 to 2010, there were 1,493 motor vehicle crashes in Smith County, including 19 crashes involving pedestrians, 4 involving bicyclists, with a total of 12 fatalities. Improving traffic safety is a priority for the county.

Definition. Complete Streets are roadways designed to safely and comfortably accommodate all users, including, but not limited to motorists, cyclists, pedestrians, transit and school bus riders, delivery and service personnel, freight haulers, and emergency responders. "All users" includes people of all ages and abilities.

Vision. To create an equitable, balanced, and effective transportation system throughout Smith County that allows every roadway user to travel safely and

comfortably, makes sustainable transportation options available to everyone, and provides a comprehensive, integrated network for all modes both within Smith County and connecting to adjacent communities.

Policy Statement. The Complete Streets policy of Smith County is developed to provide guidance for decision makers, planners, and designers to ensure that multimodal elements are incorporated into all transportation improvement projects.

- All roadway projects, including new roadways, reconstruction of existing roadways, and new developments in Smith County shall accommodate users of all ages and abilities, including pedestrians, bicyclists, transit users, motorists, persons with disabilities, and adjacent land users.
- Accommodation of all users should be consistent with the project context, including current or anticipated development density, roadway characteristics, transit plans, right-of-way dimensions and availability, and community plans. Since each roadway location is unique, flexibility in the appropriate type of facilities should be provided in order to allow designers to tailor the project to the unique circumstances.
- This policy shall apply to the new construction, reconstruction, rehabilitation, repair, maintenance, or planning of roadways, trails and other transportation facilities, for the entire right-of-way.
- All plans, policies, standards, guidelines, and procedures shall be reviewed, and if necessary phased in gradually, to ensure compliance with Complete Streets principles. When revising those documents, it is critical to recognize the need for flexibility in balancing user needs.
- Once those documents are revised, all roadway projects shall adhere to the most recent county-approved documents, including the following:
    - Planning documents, such as the comprehensive master plan, area plan, strategic plan, bicycle master plan, mobility plan, thoroughfare plan, or Safe Routes to School plans.
    - Zoning and subdivision regulations.
    - Project development procedures, such as design standards.
    - Operations and maintenance plans.
    - Other applicable transportation policies.
- Roadway projects shall include a project description that provides information about the county right-of-way, public support for the improvement, the potential environmental impacts of improvements, and the benefits of the project, including improved access and connectivity.
- Project boundaries shall be chosen to include connections through "pinch points," such as overpasses, railroad crossings, and bridges.
- Roadway projects shall follow an open and transparent public engagement process during the entire process of complete street projects, from planning to opening.

Exemptions. Exemptions from this policy should be avoided. However, in cases where partial or full exemptions are necessary, they should be documented during the project development process and presented during the public engagement process. All exemptions shall be kept on record and made publicly available. The exemption of any roadway project from this policy shall be approved by a senior level department head, such as the Public Service Director.

Performance Standards. The success of Complete Streets projects shall be measured through a number of ways, including but not limited to:

- Miles of on-street and off-street bicycle routes created.
- New linear feet of pedestrian accommodations.
- Changes in the number of people using public transportation, bicycling, or walking (mode shift).
- Percentage of children walking or bicycling to school (mode shift).
- Number of crashes involving people walking or bicycling.
- Number of new street trees.

Implementation. According to the National Complete Streets Coalition, there are four key steps for successful implementation:

1. Restructure procedures to accommodate all users on every project.
2. Develop new design policies and guides.
3. Offer workshops and other training opportunities to planners and engineers.
4. Institute better ways to measure performance and collect data on how well the streets are serving all users.

Smith County will carry out these key steps in the following ways:

1. Procedures for new projects will be restructured to follow a process in which county staff reviews all projects for their accommodation of all users.
2. Resources will be allocated for the research and development of new or revised design standards and design policies for projects within the city. Detailed design guidelines on how to build Complete Streets will be developed. The county will also acquire a library of existing design guides that serve as good examples for the design of Complete Streets.
3. Smith County planners and engineers will attend a certain number of workshops and other educational sessions each year relating to the design and implementation of Complete Streets.
4. County staff will conduct ongoing research to determine performance measures. Data on all modes of traffic will be collected regularly and analyzed in order to determine trends.

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4. ENGINEERING

4.1 Introduction

Engineering is among the most important aspects of Complete Streets. The design and implementation of the transportation system affects whether an individual feels safe using non-motorized modes, and whether such choices are a convenient and comfortable alternative to automobile use. This chapter describes many important engineering elements related to pedestrians, bicyclists, transit uers, and motorists. Additionally, several key resources are highlighted for further information.

4.2 Complete Streets and Context Sensitive Solutions

Context Sensitive Solutions (CSS) and Complete Streets are related goals that should be considered together when designing the transportation system. CSS refers to the concept of taking into account the physical and social context of the project throughout the transportation planning and implementation process. Public involvement is a key element of CSS.

> *"CSS is a highly effective approach to planning and designing streets, roads and highways so that they are more sensitive to the communities and lands through which they travel. CSS recognizes that transportation projects can be an asset for communities and enhance the environment." (FHWA, 2005)*

The National Complete Streets Coalition suggests that: "While Context-Sensitive Solutions involve stakeholders in considering a transportation facility in its entire social, environmental and aesthetic context, complete streets policies are a reminder that providing for safe travel by users of all modes is the primary function of the corridor." (NCSC, 2010)

Many of the stated benefits of CSS are similar to those of Complete Streets. Of the 22 stated benefits of CSS, the following are similar to those of Complete Streets.

Benefits of Context-Sensitive Solutions and Complete Streets:

- Improved mobility for users
- Improved walkability and bikeability
- Improved safety (vehicles, pedestrians, and bikes)
- Improved multimodal options (including transit)
- Improved speed management

4.3 Existing Standards and Guidelines

There are various plans and policies that address transportation issues at federal, statewide, regional, and local levels. While these documents are important for planning purposes, adopted standards and guidelines for engineering proper facilities take a higher precedence during project implementation as they provide the technical details necessary for good design.

When designing complete streets, creativity in the use of roadway elements is encouraged. Using design elements in an innovative way can create a cost-efficient project that enhances safety for all users and results in a greener infrastructure. It is therefore important to allow for some flexibility when writing and applying standards or guidelines and to ensure that the context is carefully considered. As always, good engineering judgment is necessary when designing facilities.

This section includes a brief list of the most important engineering standards and guidelines. Links to the respective online documents have been provided where possible. In most cases, hard copies are also available for viewing at MORPC's office. In some instances they may be borrowed from MORPC as well.

Common acronyms in this section include AASHTO (American Association of State Highway and Transportation Officials), MUTCD (Manual on Uniform Traffic Control Devices), ODOT (Ohio Department of Transportation), ODPS (Ohio Department of Public Safety), and ADA (Americans with Disabilities Act). A full list of acronyms is provided on page viii of this document.

4.3.1 Federal Standards and Guidelines

Compliance with federal standards and guidelines is the first step in meeting minimal requirements. Local and state standards may not specifically address requirements such as ADA, since they are covered by the federal standards.

Table 1. Federal Standards and Guidelines

DOCUMENT	APPLICATION	LAST UPDATED	LINK	NOTES
AASHTO Policy on Geometric Design of Highways and Streets, 5th edition.	Roadways, including non-highway roads, with application to road diets.	2004	www.bit.ly/lyEueW	Commonly referred to as "the Green Book."
AASHTO Guide for the Development of Bicycle Facilities, 3rd edition.	Bicycle facilities.	1999	www.bit.ly/mFJDz1	New edition under development.
AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities, 1st edition.	Pedestrian facilities.	2004	www.bit.ly/msJaHf	New edition under development.
Manual on Uniform Traffic Control Devices (MUTCD).	Signals, signage, markings, etc. on roads and paths.	2009	www.mutcd.fhwa.dot.gov/	
Americans with Disabilities Act Accessibility Guidelines (ADAAG).	Provisions of ADA related to buildings and building entrances.	2004	http://1.usa.gov/oqznGA	
Public Rights-of-Way Accessibility Guidelines (PROWAG).	Provisions of ADA specific to public rights-of-way.	2011	http://1.usa.gov/qqSb4T	An updated draft PROWAG was released in 2011 for public comment.
Designing Sidewalks and Trails for Access.	Provisions of ADA related to sidewalks and trails.	2001	http://1.usa.gov/n9fJhM	

4.3.2 State of Ohio Standards and Guidelines

Many of the federal standards have supplements at the state level. State standards typically do not contradict federal guidance; rather they provide more information. All ODOT design standards can be found free online here: www.dot.state.oh.us/drrc/Pages/default.aspx. Selected relevant ODOT standards are listed below.

Table 2. Ohio Standards and Guidelines

DOCUMENT	APPLICATION	LAST UPDATED	LINK	NOTES
ODOT Location and Design (L&D) Manuals.	Roadways, including non-highway roads, with application to road diets.	varies by section	www.bit.ly/lhjiQq	Complements AASHTO Green Book. Section 306 includes information on pedestrian facilities.
ODOT Design Guidelines for Roadway-Based Bicycle Facilities.	Bike routes, bike lanes, wide shoulders, signed routes, etc.	2005	www.bit.ly/jXDTui	
ODOT Design Guidance for Independent Bicycle Facilities.	Shared-use paths, sidepaths, rail-trails, rails with trails.	2005	www.bit.ly/kt7UXo	
Ohio Manual on Uniform Traffic Control Devices (OMUTCD) 2005 Edition, Revision 2.	Signals, signage, markings, etc. on roads and paths.	2011	www.bit.ly/jkkpeA	
ODOT Bridge Design Manual.	Bridges.	2007	www.bit.ly/jAGGim	
ODOT Traffic Engineering Manual.	Design and construction of roads, signage, markings, etc.	varies by section	www.bit.ly/irVbPB	Intended for use by ODOT. See part 9, Bicycle Facilities.
Miscellaneous ODOT design guidelines relating to bicycling and ADA.	ADA requirements for shared-use paths, special bikeway design issues, various other bicycle facilities.	n/a	www.bit.ly/kYc7zk	

4.3.3 Additional Standards and Guidelines

Guidelines are also created at a local level or, in some cases, by professional organizations to address gaps in federal and state documents or to account for unique concerns. These guidelines supplement rather than replace national and state guidelines.

Table 3. Additional Standards and Guidelines

DOCUMENT	APPLICATION	LAST UPDATED	LINK	NOTES
Miscellaneous standards and guidelines from various central Ohio communities.	Design and Construction Standards and Policies	n/a	n/a	
COTA Handbook: Planning and Development Guidelines for Public Transit.	Roadway design, bus stops, and land use considerations.	1999	www.bit.ly/l43sun	
Designing Walkable Urban Thoroughfares: A Context Sensitive Approach, An ITE Recommended Practice (ITE-RP-036A-E).	Roadways in urban and suburban contexts.	2010	www.bit.ly/ixcDyJ	Free download.
Bicycle Parking Guidelines, 2nd Edition.	Bicycle parking.	2010	www.bit.ly/l75PoH	2002 version is available for free download at www.bit.ly/iAcydt
Fundamentals of Bicycle Boulevard Planning and Design.	Bicycle boulevards	2009	www.bit.ly/k520Ck	Free download.
Road Diet Handbook: Setting Trends for Livable Streets	Road diets	2007	www.bit.ly/iBf4XI	
U.S. Traffic Calming Manual	Traffic Calming	2009	www.bit.ly/iWMHOU	
Traffic Calming: State of the Practice"	Traffic Calming	1999	www.bit.ly/li7sHP	

4.3.4 Additional Design Issues

Some issues are not adequately addressed in existing standards. These issues include access to parking meters for disabled persons, ADA-accessible railroad crossings, "door zones," and experimental bike facilities, among others. A few of these issues and some potential resources are mentioned below. For more information, see "4.4. Bicycle Facilities," on page 4-7.

Note that existing standards and guidelines are constantly being reviewed and are frequently updated. Future versions may include guidance on "newer" facilities/treatments. It is suggested that the links/sources be checked to ensure the most recent version of the document is being referenced.

The Door Zone

The door zone is the area parallel to a line of parked cars into which car doors open. "Dooring" is a potential danger to bicyclists. Where possible, bike facilities should be installed outside the door zone in order to reduce the type of collision resulting from bicyclists running into open car doors.

This issue has not been fully explored in existing standards and guidelines. Nonetheless, sharrows and bike lanes which avoid the door zone are preferred. When there is no on-street parking or standing, door zone collisions are generally not a concern. For more information, see "The Door Zone," on page 4-9.

"Experimental" Bike Facilities

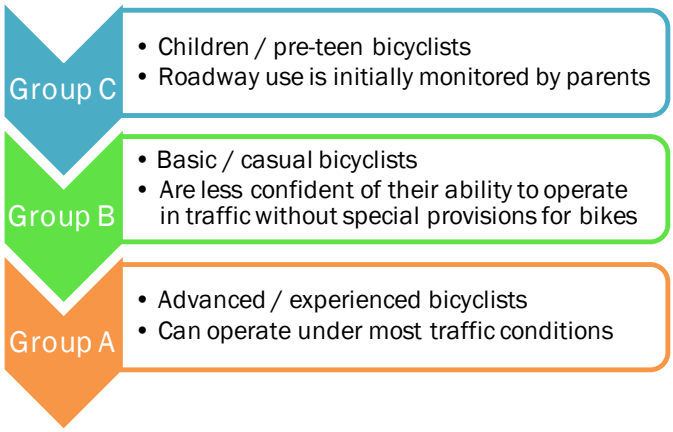
Newer facilities and treatments like cycle tracks, bike boxes, and some mid-block crossing treatments are typically not covered in existing standards and guidelines. These facilities/treatments are considered "experimental" by FHWA. Special permission must be requested and received to use such "experimental" facilities.

Communities wishing to use these facilities may want to investigate their use in other places. FHWA requires that evaluation data be collected, which could be helpful as well. An excellent clearinghouse of resources for the "newer" facilities is the National Association of City Transportation Officials (NACTO) Cities for Cycling project. Among the resources available on the NACTO website (www.nacto.org) are several Best Practice Sheets for different facilities/treatments. NACTO also recently released a comprehensive Urban Bikeway Design Guide, which is available here: www.nacto.org/cities-for-cycling/design-guide/.

4.4 Bicycle Facilities

There are many different types of bicycle facilities, ranging from separate bike paths to marked on-street bike routes. These facilities can influence the extent to which bicycling is used in a given community. In general, places with good bicycle facilities have more bicycle traffic than places without good bicycle facilities. Increased bicycling is good for communities, as it reduces traffic congestion and pollution, and improves the health of those who bike.

Some bicycle facilities are only comfortable for certain bicyclists. For example, roads with shared lane markings (a.k.a. sharrows) may only be useful to more experienced bicyclists; on the other hand, shared-use paths and barrier-separated cycle tracks may encourage novice bicyclists to ride more, but may not appeal to more advanced cyclists. This section discusses a variety of facilities that can encourage and promote safe bicycling. More information is available in the AASHTO Guide for the Development of Bicycle Facilities.



4.4.1 Bicycle Lanes

Bicycle lanes are lanes of a roadway designated for bicycles only. They are among the most common bicycle facilities in use throughout the United States. Bicycle traffic in bicycle lanes generally follows the direction of motorized traffic. On one-way streets, bike lanes are usually placed to the right of the motorized traffic lanes, but can also be placed to the left. Placement on the left may require additional design and safety considerations. Where bicycle lanes exist, separate facilities, such as sidewalks, should be provided for pedestrians.

On streets with bike lanes, bicyclists sometimes need to ride outside of the bike lane (e.g., to make turns at intersections, or to avoid debris in the bike lane). The presence of a bike lane should never be construed as prohibiting bicyclists from using the other lanes.

Legal Status of Bicycling in Ohio

According to Ohio law, bicycles are considered vehicles. This means bicyclists have the same rights as motor vehicle drivers and must follow the same rules. Bicycles are permitted on all roads except limited-access highways. Generally, bicyclists should not be expected or encouraged to use sidewalks. Many jurisdictions prohibit sidewalk bicycling.

Bike Lane Width

The absolute minimum width of a bike lane is four feet of rideable surface. However, five feet is recommended, not including the gutter pan. USDOT encourages transportation agencies to go beyond minimum standards when designing for bicyclists and pedestrians. It is especially important to avoid situations where facilities with minimum dimensions are adjacent to one another (e.g., a 4' bike lane next to a 10' travel lane). However, extra-wide bike lanes (seven feet or more) may invite illegal use by motorists and therefore should generally not be used.

This bike lane is as narrow as three feet at certain points. Also, the gutter next to the bike lane forms a crack in which bike tires could get caught. Source: MORPC. Columbus, OH.

This bike lane has sufficient width for safe and comfortable riding and there are no gutter openings in the bike lane. Source: MORPC. Columbus, OH.

Bike Lane Buffers

A buffer is a zone that provides protection and separation between bicycle and motor vehicle traffic. While sidewalk buffers are typically landscaped, most bike lane buffers are simply striped on the road surface. Striped buffers can make a bike lane safer and more comfortable for bicyclists.

This bike lane has a four foot striped buffer that separates bicyclists from motorized traffic. Source: MORPC. Columbus, OH

The Door Zone

The door zone is the zone parallel to a line of parked cars into which car doors open. Where possible, bike lanes should be built outside the door zone to help prevent door zone crashes. If a bike lane is installed adjacent to on-street parking, the ideal distance between the outside edge of a bicycle and the curb is a minimum of 13 feet. Where adequate right-of-way exists, bike lanes should be built to reflect this. One possible solution is to provide cross hatch markings that extend 4 feet from parked cars to alert bicyclists that it is not a safe place to ride.

The effects of door zones on bike lanes should always be considered when designing bike lanes in an urban context. Bike lane placement should reflect tradeoffs related to right-of-way width, parking turnover, traffic volume and speed, bicyclist and motorist behavior, and other factors as determined by engineering judgment. Where there is no on-street parking or standing, door zone collisions are generally not a concern.

Extra space has been provided to reduce the chance of a car door opening into the bike lane. Source: WikiMedia. New York, NY.

This car door opens into the bike lane, creating a potential hazard for cyclists. Source: MORPC. Columbus, OH.

Door Zone Crashes

Door zone crashes have been studied in several locations. Many cities have built door zone bike lanes (Schubert, 2004). Studies have estimated that as many as 16 percent of bicycle crashes leading to injury in urban environments are caused by opening car doors (Allen, 2002). Educating motorists to check their surroundings before opening a car door, and educating bicyclists to avoid the door zone, can alleviate the problem to some degree.

Door zone crashes have resulted in some high-profile fatalities (Schubert, 2004; Southan, 2008). In most fatal door zone crashes, the collision caused the bicyclist to be thrown into the path of a passing vehicle and subsequently hit. In a few cases, bicyclists have died from impact with the car door itself, which can cause head or neck injuries (Popik, 2005), or from impact with the pavement resulting from hitting the car door (Southan, 2008).

The widths of parked vehicles and their doors are key factors of the size of the door zone. With doors closed, most motor vehicles are around 6 feet wide, and many commercial vehicles are 8.5 feet wide (Oswald, 2010); in addition, motorists in Ohio are allowed to park up to one foot out from the curb. A typical door protrusion is about 37 inches, with some older sedan cars having a door protrusion of up to 44 inches (Allen, 2002).

Encouraging Proper Use

Bike lanes should include signs and/or bicycle symbols on the pavement indicating that they are for bicycle use. Signs and marking should also alert motorists to the presence of bicyclists and encourage bicyclists to ride in the correct direction (with traffic). Other vehicles (such as delivery trucks) should be discouraged from blocking bike lanes.

Signage and markings encourage appropriate use of facilities. Source: MORPC. Columbus, OH.

Maintenance

Bike lanes should be kept clear of debris and vegetation in order to ensure a safe environment for the bicyclist. Transportation agencies should include the frequent cleaning of bike lanes and other bicycle facilities in their maintenance policies. The Transportation System Maintenance Element of the City of Salem, Oregon includes bicycle lanes in its wording with regard to maintenance. It can be viewed online at: www.bit.ly/mYc59x.

Debris and vegetation in bike lane. Source: MORPC. Columbus, OH.

Bike Lanes at Intersections

Special attention should be paid to the striping of bike lanes at intersections. In order to turn left or right, bicyclists often need to leave the bike lane and use the right- or left-turn lanes. Signage or sharrows may be useful at some locations to reinforce the message that bicyclists are not restricted to the bike lane.

In addition to a bike lane for through traffic, the sharrow in the left turn lane encourages bicyclists to use the lane for left turns, and alerts motorists that bicyclists use the lane. The bike lane should not be in the gutter pan; otherwise, this is a good example. Source: Flickr/sfbike. Portland, OR.

Special Types of Bike Lanes

There are a variety of bike lane designs available, depending on the context of the location. A few examples are contra-flow bike lanes, floating bike lanes, two-way bike lanes, and barrier-separated bike lanes. These examples are discussed in more detail below; however, they are only a small selection of the wide variety of bike lanes that exist.

- **Contra-Flow Bike Lanes**. This design is used to allow bicycle traffic to flow in the opposite direction of motorized traffic on one-way streets. It provides connectivity for bicyclists and discourages wrong-way riding. Contra-flow bike lanes require dedicated bike signals at signalized intersections.
- **Floating Bike Lanes.** On streets with floating bike lanes, parallel parking is permitted during certain times of the day but prohibited during other times (usually during rush hour). When parallel parking is not permitted, the parking area functions as a bike lane. When parallel parking is permitted, bicyclists can use the other lanes and should be encouraged to ride outside the door zone of the parked cars. For more information, see City of Lexington, KY website: www.lexingtonky.gov/.
- **Two-Way Bike Lanes.** Two-way bike lanes are adjacent lanes accommodating opposite directions of bicycle traffic, striped onto the roadway next to the other travel lanes. They are sometimes installed in the middle of the street between travel lanes, but are more often at one side of the roadway. Two-way bike lanes must be designed properly to prevent safety hazards. For example, if the lanes are too narrow, bicyclists may be too close to oncoming motorized traffic. Narrow lanes can also increase the risk of head-on collisions between bicyclists traveling in opposite directions. Care should be taken to ensure safety at intersections, especially with regard to turning bicyclists.
- **Barrier-Separated Bike Lanes.** Barrier-separated bike lanes are separated from the lanes of motorized traffic by a physical barrier, such as a line of poles, a low wall, or a fence. These bike lanes can encourage bicycling by providing additional protection.

This contraflow bike lane provides two-way bicycle traffic on a one-way street. Bicycle traffic flowing in the direction of traffic uses the bike lane on the left of the image. Source: Flickr/ Philly Bike Coalition. Philadelphia, PA.

Two-way buffered bike lane in a median. Source: Jeannie Martin. Washington, DC.

One-way barrier-separated bike lane. Source: Flickr/SFBike. San Francisco, CA.

Large pavement markings clearly indicate the bike boulevard treatment. Source: MORPC. Columbus, OH.

4.4.2 Bike Boulevards

Bike boulevards are shared roadways that are designed to give bicyclists priority over other modes. They are usually built in urban residential areas. According to the Association of Pedestrian and Bicycle Professionals, the following elements define a bike boulevard (APBP, 2010a):

- Shared roadway - no specific bicycle or vehicle delineation (e.g., local streets)
- Low motor vehicle volumes and speeds
- Logical, direct, and continuous routes that are well marked and signed
- Convenient access to destinations
- Minimal bicyclist delay
- Safe and comfortable intersections

Bike box on Milton Avenue at W. North Broadway. Source: MORPC. Columbus, OH.

4.4.3 Bike Boxes

Bike boxes are a type of road marking intended to reduce the risk of collisions at signalized intersections with heavy bike traffic. They are specifically intended to reduce "right-hook" collisions, which occur when a bicyclist going straight is hit by a motorist turning right. Bike boxes assist by designating exactly where bicyclists and motorists should place their vehicles when stopped at a red light.

Placing bicycles in front of motorized vehicles makes them more visible. Right-turns-on-red should not be permitted through bike boxes. Otherwise, motorists will block the bike box and right-turn conflicts will occur. Bike boxes are not yet included in the MUTCD and are classified as an experimental treatment.

Properly positioned sharrow with on-street parking. Source: MORPC. Columbus, OH.

4.4.4 Shared Lane Markings

Shared lane markings, also known as "sharrows" ("share" + "arrow"), remind motorists of the presence of bicyclists, guide bicyclists to position themselves safely, and discourage wrong-way bicycling. They are appropriate on roadways with speed limits up to 35 mph. Sharrows were added to the MUTCD in 2009 (FHWA, 2009b).

Shared Lane Marking Placement

On streets with narrow lanes, sharrows should be placed in the middle of the lane. This encourages bicyclists to "take the lane" so that motorists will not pass them at an unsafe lateral distance. Three feet is considered a minimum safe passing distance. On streets with lanes wide enough to allow a large vehicle to safely pass a bicyclist within the same lane (at least 14 feet wide), sharrows can be placed closer to the right edge of the lane.

On streets with on-street parking, sharrows should guide bicyclists to avoid the door zone. In such cases, the center of each sharrow should be 14 feet, 8 inches from the curb. For more information, see "The Door Zone," on page 4-9.

Top: Wide outside lane (14 ft.) with a sharrow, allowing enough room for cars to safely pass bicyclists. Source: MORPC. Hilliard, OH. Bottom: This sharrow is too close to the parked cars, placing bicyclists in the door zone. Source: Ely Blue/BikePortland. Baltimore, MD.

4.4.5 Cycle Tracks

A cycle track is "a bicycle path along a road, physically separated from motorized traffic, and distinct from the sidewalk" (APBP, 2010c). Cycle tracks differ from shared-use paths in that they are specifically for bicycle use. They are often built between the sidewalk and the motorized vehicle lane, with a curb, fence, bollards, grade separation, or some other barrier separating the bicycle and motor vehicle traffic. Cycle tracks may also be physically separated from pedestrian sidewalks.

Cycle tracks are widespread in Europe, and have been built in a few cities in the United States, including Cambridge, MA; Portland, OR; New York, NY; and Washington, DC. There are many different varieties of cycle tracks, including one- and two-way facilities. The definition of a cycle track is somewhat flexible and may coincide, in some cases, with the definition of a barrier-separated or buffered bike lane. Many cycle tracks, especially in Europe, have specific signals installed for bicyclists. For more information, see "4.4.8. Bicycle Signals," on page 4-15.

Two-way separated cycle track. Source: MORPC. Montreal, Canada.

Bike route sign. Source: MORPC. Columbus, OH.

This bike route sign instructs bicyclists to walk on the sidewalk to make a left turn, indicating a lack of proper facilities. Source: MORPC. Columbus, OH.

4.4.6 Bike Routes

Bike routes are shared roadways identified by signs as preferred bike routes. A bike route in itself does not imply any special bicycle infrastructure. A roadway might be designated as a bike route for any of the following reasons (AASHTO, 1999):

- To provide continuity between bicycle lanes, trails, or other bicycle facilities.
- To mark a common route for bicyclists through a high-demand corridor.
- To direct cyclists to low-volume roads or those with a paved shoulder.
- To direct cyclists to particular destinations (e.g., parks, schools, or commercial districts).

The following criteria are recommended for signed bike routes:

- The route provides through and direct travel.
- The route connects discontinuous segments of shared use paths or bike lanes.
- Bicyclists are given greater priority on the signed route than on the alternate route.
- Street parking has been removed or limited to provide more width.
- A smooth surface has been provided.
- Regular street sweeping and maintenance is assured.
- Wider curb lanes are provided compared to parallel roads.
- Shoulders are at least four feet wide.

4.4.7 Bicycle-Related Signs

Several types of signs relating to bicycle traffic are contained in Part 9 of the MUTCD. In addition, several experimental signs and signals can be used with FHWA's permission. Some innovative bicycle traffic control devices are in use in other countries, but have not yet been used in the United States.

4.4.8 Bicycle Signals

Bike signals are traffic signals (i.e., traffic lights) specifically for bicycle traffic. Bike signals are widespread in Europe and are now in operation in some U.S. cities, including New York City; Portland, OR; and Washington, D.C.

Bike signals can improve traffic flow and reduce turning conflicts between bicycles and motor vehicles. For example, if a bike lane is to the right of a right-turn motorized vehicle lane, separate signals can instruct bicyclists and motorists to proceed (going straight or turning right) at different points in the signal cycle.

Bike signals from Portland, OR (top, Flickr/BikePortland); and Regensburg, Germany (bottom, Source: MORPC.)

4.4.9 Paved Shoulders

Paved shoulders are the areas at the sides of the road that are outside of the vehicular travel lanes, but are paved. Shoulders are distinguished from travel lanes by striping, and in some cases, rumble strips (see below). The main purpose of paved shoulders is to accommodate stopped vehicles and emergency uses (AASHTO, 2004b). Therefore, they are not specifically designated for pedestrian or bicycle use. Nonetheless, if no other facilities can be provided, a paved shoulder may accommodate pedestrians and bicyclists on rural roads with low-intensity land use.

Paved shoulders should be at least four feet wide to accommodate bicycle travel, but if that is not possible, a narrower shoulder is better than no shoulder (AASHTO, 1999). When riding on the shoulder, bicyclists should ride in the direction of traffic as they must follow the same rules of the road as motorists.

Rumble Strips

Rumble strips are sections of corrugated pavement that cause noise and vibration when driven over. They are intended to alert motorists when they stray from their lanes. They are also sometimes used to warn motorists of an approaching stop sign, construction zone, sharp curve, or other hazard that requires slowing down. A rumble strip is referred to as a "rumble stripe" when an edge line or center line pavement marking has been added to it (FHWA, 2001b).

Although rumble strips improve highway safety, they can be hazardous for bicyclists (LAB, 2011a). Rumble strips should not normally be used in areas where bicycle use is expected if their installation would leave a clear shoulder pathway less than four feet wide (FHWA, 2001b).

Narrow rumple strips on the left side of a wide shoulder leave sufficient space for bicyclists to use the shoulder. Source: Andrew Bossi. Salisbury, MD.

Gaps in rumble strips should be provided to allow bicyclists to transition from the shoulder to the travel lane if necessary (for example, if the shoulder is blocked by debris or a broken-down vehicle). A typical design involves a 28- to 48-foot rumble strip followed by a 12-foot gap. On roads with narrower shoulders where bicyclists cannot ride to the right of the rumble strip, rumble strips should be at least 1 foot to the right of the edge line. (FHWA, 2001b).

4.4.10 Multi-Use Paths

Multi-use paths (MUPs) are intended to accommodate a variety of non-motorized uses including bicycling, walking, jogging, rollerblading, and in some cases, horseback riding. They may also be referred to as shared-use paths, multi-use trails, shared-use trails, bike paths or trails. Depending on the destinations they connect, MUPs may be used for recreation and/or utilitarian purposes, such as commuting.

Multi-use paths are built in rural, suburban, and urban settings and may be paved with asphalt, rubber and recycled material, or with a gravel-type surface, such as crushed limestone (see "4.9. Pavement Types," on page 4-53). Multi-use paths should be thought of as complements to the roadway network and should not be used to preclude on-road bicycle facilities. In general, the recommended design speed of an MUP is 20 mph (AASHTO, 1999).

Multi-Use Path Width

The minimum recommended width for an MUP is 10 feet with graded areas 2 feet in width on either side (AASHTO, 1999). Some users need a significant amount of lateral width for safety. Wider paths allow two pedestrians to walk side by side while still allowing joggers, bicyclists, and others to safely pass them.

This MUP is wide enough to accommodate a variety of users. Source: MORPC. Columbus, OH.

This MUP is too narrow to be used comfortably by multiple users. Source: MORPC. Columbus, OH.

Sidewalks vs. Multi-Use Paths

In general, sections of sidewalk should not be designated as MUPs, because sidewalks tend to be too narrow to accommodate multiple users and have lower design speeds (AASHTO, 1999). If a section of sidewalk must be designated as part of an MUP, it should be of sufficient width to accommodate the wide range of uses typical for an MUP. Additionally, signs should be installed to clearly indicate that the path is intended for multiple user groups. This alerts pedestrians to the presence of bicyclists, and reminds faster users that they are sharing the path with slower users.

Although existing sidewalks should not be designated as MUPs, it may be appropriate in some cases to build an MUP instead of a sidewalk alongside a high-speed, high-traffic road, such as a suburban arterial. In such cases, engineering countermeasures should be used at intersections to prevent conflicts between path users and motorists.

This 12-ft. sidewalk comfortably accommodates a variety of users. Source: MORPC. Columbus, OH.

Path Transitions

Where an MUP terminates or intersects with a street, the transition should be made safe and easy for all users. In particular, MUP design should encourage bicyclists to transition to the street, not to the sidewalk. Improper transitions may encourage bicyclists to hop curbs, ride on sidewalks, or dart into traffic. Transitions that involve street crossings should also include appropriate crossing facilities for pedestrians, such as marked crosswalks and signage.

This sidewalk is too narrow to serve as an MUP. Source: MORPC. Columbus, OH.

This MUP ends at a high-traffic street with a 45mph speed limit and 14,000 vehicles/day. Source: MORPC. Columbus, OH.

This MUP ends at a low-traffic residential street and includes signs to guide users through the neighborhood. Source: MORPC. Columbus, OH.

Gaps and Connections

Multi-use path systems often have gaps in connectivity. This generally requires bicyclists to ride on streets and pedestrians and other users to use sidewalks or shoulders. In these cases, safety and ease of use should be maintained for all users. Measures should be taken to make connecting roads bike-friendly, and sidewalks should be provided for pedestrians.

Intersections

Since multi-use paths tend to be set back from the motorized vehicle lanes, there can be an increased crash risk at intersections if proper design countermeasures are not implemented. Such countermeasures might include:

- Signs to alert both motorists and path users of the approach to the intersection.
- Reconfiguration of diagonal crossings so that path users cross roads at a right angle.
- Maintenance of clear sight lines around corners at intersections.
- Assignment of right-of-way to motorists or path users appropriately, depending on the context of the intersection.

Further information on intersection countermeasures is in the AASHTO Guide for the Development of Bicycle Facilities (AASHTO, 1999).

This MUP crosses the street at a right angle and is accompanied by crosswalk markings and signs. Source: MORPC. Hilliard, OH.

Poorly lit MUP. Source: Flickr/ Star5112. Livermore, CA.

Emergency call boxes increase personal safety on MUPs. Source: Flickr/Julie Jordan Scott. San Francisco, CA.

Personal Safety

When designing pedestrian or bicycle accommodations, personal safety should be a main consideration so that people feel comfortable using the facilities. MUPs should be well lit at night. In some areas, consider providing emergency call boxes.

Types of Multi-Use Paths

There is a variety of different types of multi-use paths, depending on the location, the right-of-way (ROW) available, and the adjacent land uses and destination points.

Urban Rail Trail with striping to separate pedestrians and bicyclsits. Source: MORPC. Minneapolis, MN.

Rail trails are multi-use paths built on former railroad rights-of-way. Rail trails allow communities to benefit from the presence of unused railroad corridors. Some rail trails in Ohio cover long distances and provide connections between many communities, ranging from small towns to major urban areas. Rail trails are used both for recreation and for utilitarian purposes, such as commuting. Rail trails can bring economic benefits to communities by promoting tourism and improving business.

Interstate multi-use paths run alongside interstate highways or other limited-access highways. They can be built within the interstate's right-of-way or adjacent to the ROW. Interstate MUPs provide non-motorized access along heavily traveled corridors that would otherwise be restricted to motorized traffic. Therefore, they can provide useful transportation options to bicyclists and pedestrians. They can be built on one side of the interstate or along the median.

Scenic multi-use paths offer access to scenic areas, such as along rivers, lakes, ocean fronts, or canals. These MUPs function as tourist attractions and recreational corridors. They are often also used for utilitarian purposes (commuting, shopping, etc.) depending on the destinations they connect.

This scenic MUP provides views of the Scioto River and downtown Columbus. Source: MORPC. Columbus, OH.

Rural Rail Trail. Source: MORPC. Millersburg, OH.

4.5 Pedestrian Facilities

Pedestrian facilities support the most basic form of human transportation: walking. They also allow for a wide range of other activities, depending on the context; for example, jogging, roller skating, or Segway use. All pedestrian facilities should accommodate individuals with disabilities.

In addition to their role in transportation, some pedestrian facilities, such as town squares or sidewalks with outdoor seating areas, function as community gathering places. In residential areas, pedestrian facilities often function as play areas for children.

In order to develop and maintain an equitable transportation system, and to promote healthy and happy communities, pedestrian facilities should be designed for users of all ages and abilities. Special attention should be paid to safety and ease of use for the very old, the very young, and the disabled.

Pedestrian facilities should be provided in all places where people can be expected to walk. In particular, new developments should always include pedestrian facilities.

Top: Wide and unobstructed sidewalk with a tree buffer provides a comfortable walking environment. Bottom: Sidewalk is too narrow for pedestrians and wheelchair users to use comfortably. Source: MORPC. Columbus, OH.

4.5.1 Sidewalks

Sidewalks are the most ubiquitous type of pedestrian facility. They should generally be provided on both sides of a street. On streets and roads without sidewalks, there is a higher risk of vehicle-pedestrian conflicts and crashes (AASHTO, 2004a).

When designing sidewalks, it is important to consider a variety of elements, including proper width, clearance zone, curbs, buffer space, and other streetscaping. Each of these elements is described in the following sections.

Sidewalk Width

Sidewalks need to be wide enough for pedestrians to be able to walk comfortably. Sidewalks should be measured in terms of their "clear width" (the width that can be traveled freely, without obstacles). The clear width of a sidewalk does not include the area in which sign posts, street furniture, and other permanent or semi-permanent items are placed. These items should be placed in such a way as to preserve adequate clear width or pedestrian accessible route (PAR). The recommended minimum clear width is five feet, which allows two people to pass comfortably or to walk side-by-side (PBIC, 2010b).

The AASHTO minimum clear width of four feet is too narrow for two wheelchair users to pass each other. Where sidewalks have less than five feet of clear width, passing spaces should be provided for wheelchair users (AASHTO, 2004a). Minimum vertical clearance, cross slope, and protrusion standards also exist.

Wide sidewalks are appropriate for urban areas. Source: MORPC. Columbus, OH.

Obstacles on Sidewalks

Permanent items such as fire hydrants, sign posts, benches, landscaping features, and utility poles should be placed outside the clear width of the sidewalk. Additionally, sidewalks should not be blocked by delivery vehicles or equipment, nor by trash containers or similar obstacles. While these may only represent a slight inconvenience to many pedestrians, a blocked sidewalk can be a major hassle and may pose a hazard for those with mobility impairments.

Obstacles such as trash cans prevent passage for wheelchair users and require other pedestrians to enter the street. Source: MORPC. Columbus, OH.

Sidewalk Buffers

The buffer is the zone that provides separation between the sidewalk and vehicular traffic. An adequate buffer significantly improves the comfort and safety of walking. Buffer zones of four to six feet are desirable for most sidewalks. On some low-speed streets, it may be acceptable to have a sidewalk without buffers. The type of buffer should vary depending on the character of the area. In residential and suburban areas, buffers are often landscaped (with grass, plants, or trees) while in denser residential or commercial areas, a furniture zone containing benches and planters, light poles, traffic signs, and other hardscaping is more appropriate. On-street parking and bike lanes can also serve as buffers (AASHTO, 2004a).

Sidewalks next to busy, high-speed roads are uncomfortable for pedestrians (left). Landscaping, bike lanes, and on-street parking provide a buffer for pedestrians (middle, right). Source: MORPC. Columbus, OH.

Vertical curbs discourage parking on sidewalks. Source: MORPC. Columbus, OH.

Curbs and Parking on Sidewalks

Vertical curbs are preferable to sloped or rolled curbs as they better distinguish between the pedestrian zone and the roadway. Sloped curbs encourage motorists to park partly on the sidewalk, blocking the way for pedestrians. Parking on sidewalks should be discouraged not only by engineering measures, but also through enforcement.

Pedestrians are forced to walk in the street in areas without sidewalks. Source: MORPC. Columbus, OH.

Streets without Sidewalks

All streets and roads should be built to provide safe and comfortable pedestrian access, unless pedestrians are specifically prohibited (as in the case of limited-access highways). Streets in urban or suburban areas should almost always be built with sidewalks. On rural roads with low-intensity land use, however, shoulders may be suitable to provide pedestrian access.

This "goat path" demonstrates the need for a sidewalk. Source: MORPC. Columbus, OH.

Desire Lines

Desire lines (also referred to as "goat paths") are tracks of trodden-down vegetation or dirt where large numbers of people have walked. Desire lines indicate a clear desire and need for a sidewalk. They are often found near transit stops and along busy roads without sidewalks.

This sidewalk terminates abruptly, leaving pedestrians to walk in the grass or street. Source: MORPC. Columbus, OH.

Logical Termini

Logical termini refer to end points (in this case, for pedestrian facilities) that have been chosen in a logical, sensible manner. When building new sidewalks, end points should be chosen so as to connect with existing sidewalks and thus improve the sidewalk network. If sidewalks in a project must dead-end, termini should be chosen so that future projects can easily start a new sidewalk at the end point, expanding the existing network.

Maintenance of Pedestrian Facilities: Vegetation

To preserve a good quality of life in a community, pedestrian facilities must not only be built, but also maintained. Without proper maintenance, pedestrian facilities eventually deteriorate and become unusable. If left unmaintained, sidewalks quickly become overgrown by weeds. Low-hanging trees can also impede sidewalk access. Although excessive application of herbicides is not desirable, reasonable efforts should be undertaken to keep sidewalks clear of encroaching vegetation.

Grass and bushes have overgrown these sidewalks, making passage more difficult. Source: MORPC. Columbus, OH.

Winter Sidewalk Maintenance

Central Ohio is subject to significant amounts of snow and ice during approximately three months out of each year. During this time period, special attention should be paid to the maintenance of pedestrian facilities. Pedestrians walking on ice risk injury from slipping, and walking in the roadway increases their risk of being hit by a car or truck. Ordinances requiring property owners to keep their sidewalks clear should be enforced, and public agencies should ensure that their facilities are also well-maintained.

Accumulation of ice and snow forces pedestrians to walk in the streets. Better enforcement of existing ordinances would result in easier pedestrian travel following snow events. Source: MORPC. Columbus, OH.

Pedestrian Access in Construction Zones

When a sidewalk is blocked due to construction, access should be maintained by providing a convenient alternate route. A lane of vehicular traffic may need to be reallocated for pedestrian use in some cases.

Attempts to reroute pedestrians over long distances are likely to fail, as many pedestrians do not comply with signs such as

The needs of pedestrians were not fully accounted for in this construction project. Source: MORPC. Columbus, OH.

A travel lane was converted to a walkway during construction. Source: MORPC. Columbus, OH.

"Sidewalk Closed-Use Other Side." Instead, they typically use the most direct route possible, even if it means walking through construction or in the street. Pedestrians are particularly reluctant to cross a street and later cross back.

In areas with high pedestrian traffic, or with significant destination points, efforts should be made to maintain pedestrian access on both sides of the street. Access to signal pushbuttons for wheelchair users is a particular concern.

4.5.2 Street Crossings

Street crossings should be provided such that pedestrians and other sidewalk users can cross safely and conveniently. There are several types of street crossings, including signalized and unsignalized intersections, mid-block crossings, overpasses and underpasses, and roundabouts. These are discussed in greater detail below.

Signalized Crosswalks at Intersections

All intersections "should be designed with the premise that there will be pedestrians present, that they should be able to cross the street, and that they need to do so safely" (AASHTO, 2004a). This requires various provisions at intersections such as marked crosswalks, stop bars (to discourage motorists from blocking crosswalks), signals, median islands, and signage.

At signalized intersections, the probability of pedestrians jaywalking increases with the wait time. Ideally, pedestrians should not have to wait more than 1 minute to cross. Turning motorists, especially those turning right on red, present a hazard for pedestrians crossing at intersections. If the street is very wide with many lanes, median islands should be provided to decrease the individual crossing distance, even if the intersection is signalized. Crosswalks should be provided on all sides of the intersection.

Wide crosswalks clearly distinguished from the rest of the roadway. Source: MORPC. Columbus, OH.

Pedestrians must cross 8 lanes of traffic, and the crosswalks are faded. Source: MORPC. Columbus, OH.

Signal phasing

Signal phasing refers to the timing and sequencing of traffic signals, including signals for pedestrian traffic (WALK/DON'T WALK). Where pedestrian volumes are high, the "WALK" phase should be included in every signal cycle so that pedestrians do not have to push a button (PBIC, 2010c). If an activation button is necessary, the button should be situated so that pedestrians (especially disabled users) can easily reach it. Pedestrian countdown signals are helpful for pedestrians because they can see how much time they have left to cross a street.

This intersection has only three legal crossings despite that it's in a busy commercial area, resulting in many illegal crossings. Source: MORPC. Columbus, OH.

Pedestrian Scrambles

A "pedestrian scramble" (a.k.a. "Barnes Dance") is an intersection at which the signal cycle includes a phase in which vehicular traffic is stopped in all directions, and pedestrians can walk in any direction, including diagonally. Diagonal striping is often included, in order to emphasize this crossing movement. This is a good solution for an intersection with large volumes of turning traffic and large numbers of pedestrian-vehicle conflicts arising from turns. However, long wait times can lead to pedestrian non-compliance with signals, which can cause a safety problem (Bechtel et al., 2003). An educational outreach program is recommended when implementing a pedestrian scramble.

Pedestrian scramble with diagonal markings. Source: MORPC. Athens, OH.

Unsignalized Crosswalks at Intersections

Technically, there is a crosswalk at every intersection of two or more streets, even if it is not marked. Safety can be improved at unsignalized crosswalks by striping the crosswalk and adding signs. Per Ohio Revised Code §4511.46, motorists must yield to pedestrians in marked and unmarked crosswalks. Although not every intersection crosswalk can be marked, it is preferable that they are marked when possible. Signage at crosswalks is desirable, especially signs instructing motorists to yield to pedestrians.

Pedestrians crossing at an unmarked crossing. Source: MORPC. Columbus, OH.

Wide striped crosswalk perpendicular to the road. Source: MORPC. Columbus, OH.

Definition of "Crosswalk"

The Ohio Revised Code (§4511.01) defines a crosswalk as:

1. That part of a roadway at intersections ordinarily included within the real or projected prolongation of property lines and curb lines or, in the absence of curbs, the edges of the traversable roadway;

2. Any portion of a roadway at an intersection or elsewhere, distinctly indicated for pedestrian crossing by lines or other markings on the surface.

It follows from item (1) that every intersection has a crosswalk, even if it is not marked - unless pedestrians are specifically prohibited from crossing.

Angled crosswalks cause pedestrians to look in the direction opposite traffic. Source: MORPC. Sacramento, CA.

Mid-Block Unsignalized Crosswalks

Mid-block unsignalized crosswalks are crosswalks away from intersections that do not have a signal, but have striping and signs. Mid-block unsignalized crosswalks can provide convenient crossings for pedestrians when the nearest intersection is a significant distance away, or when major destination points are in the middle of the block.

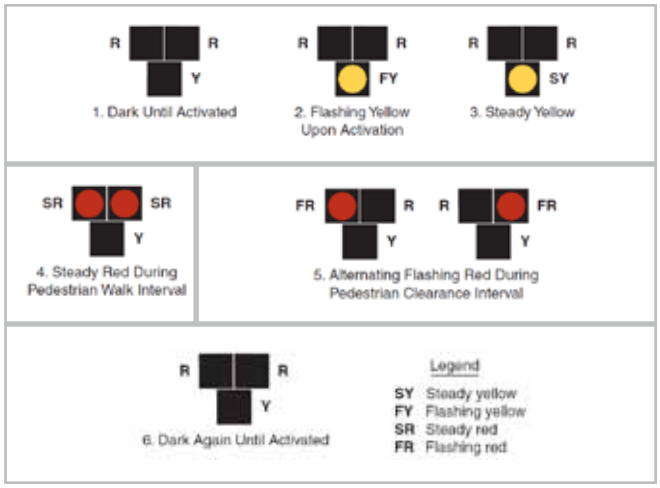
State law requires motorists to yield to pedestrians within mid-block unsignalized crosswalks. Striping a crosswalk at a mid-block (non-intersection) location provides a pedestrian crossing where it would otherwise be prohibited. Crosswalks should be positioned at a right angle to the roadway, so that pedestrians do not cross diagonally, and appropriate signage should be installed to instruct motorists to yield to pedestrians.

Mid-Block Signalized Crosswalks

For added safety, signals can be installed at mid-block crosswalks. One increasingly popular option for this is the Pedestrian Hybrid Beacon, or HAWK signal (**H**igh-intensity **A**ctivated cross-**W**al**K**). HAWK signals are pedestrian-activated signals suspended above the roadway. When activated, the HAWK signal cycles through six phases, proceeding from flashing yellow to steady red, instructing motorists to stop.

HAWK signals have been shown to improve safety, especially when installed at previously unsignalized crosswalks on high-traffic streets where motorists' failure to yield has been a concern. One study found that HAWK signals achieved up to a 69 percent reduction in pedestrian crashes (FHWA 2010a).

The HAWK signal gives a clear indication to motorists to stop for pedestrians. Source: Mike Cynecki. Phoenix, AZ.



The six phases of the HAWK signal. Source: MUTCD.

Pedestrian Refuge Areas

Pedestrian refuge areas provide space for pedestrians to wait safely between different stages of a street crossing. Pedestrian refuges can also provide a place to wait between two opposite directions of traffic, or between right-turning and straight traffic. Many pedestrian refuges have a traffic calming effect, causing "visual narrowing" (making the roadway appear narrower to motorists) and therefore encouraging motorists to slow down. This improves safety for both pedestrians and motorists.

Pedestrian refuge islands break long crossings into two more manageable crossings. Source: MORPC. Columbus, OH.

Pedestrian refuge areas enable pedestrians to focus on one direction of vehicular traffic at a time. This can improve safety both on wide, high-speed roads, and on narrower, lower-speed roads. Pedestrian refuges can also make pedestrian wait times shorter, since they only need to wait for one direction of vehicular traffic at a time.

Curb Extensions

A curb extension is an angled narrowing of the roadway and widening of the sidewalk. Curb extensions shorten the crossing distance, making crossing safer for pedestrians. They also have a traffic calming effect, encouraging motorists to drive slowly. Curb extensions should be considered where significant volumes of pedestrian cross-traffic may conflict with vehicular through traffic.

Curb extensions shorten the crossing distance, reducing pedestrian exposure. Source: MORPC. Columbus, OH.

Smaller curb radii are usually found in older downtowns. Source: MORPC. Columbus, OH.

Curb Radii

At an intersection, the curb radius is a measure of the sharpness of the turn. A smaller curb radius requires vehicles to slow down when making the turn whereas a larger curb radius allows vehicles to turn more quickly. A smaller curb radius is safer for both pedestrians and motorists, because it slows down vehicular traffic. However, some larger vehicles require a larger curb radius to turn. Care should be taken to provide adequate curb radii on transit routes, truck routes, and other roads frequently traveled by larger vehicles.

Large curb radii encourage higher speeds and increase pedestrian crossing distance. Source: MORPC. Columbus, OH.

Curb Cuts

Curb cuts are points at which the curb and sidewalk are interrupted for a vehicular entrance or exit point, such as a driveway. To ensure a safe and pleasant walking experience, the number of curb cuts should be kept to a minimum, and they should be as narrow as is safe and practicable.

A single curb cut leads to parking in the back of the building, reducing the overall length of the curb cut. Source: MORPC. Columbus, OH.

A wide parking lot entrance in front of an apartment building causes a long interruption in the sidewalk. Source: MORPC. Columbus, OH.

This interstate overpass remains comfortable and safe for pedestrians due to its wide sidewalk and on-street parking. Source: MORPC. Columbus, OH.

Although a sidewalk has been provided, it is narrow and uncomfortable for pedestrians. Source: MORPC. Columbus, OH.

Underpasses and Overpasses

Underpasses and overpasses are often uncomfortable for pedestrians, and in some cases, may serve as a barrier. This problem can be alleviated in part by engineering solutions. Sidewalks across bridges and through underpasses should be at least as wide as the connecting sidewalk (AASHTO, 2004a). Pedestrians should not be forced to walk too close to a wall or fence nor to vehicular traffic. Both of these conditions create an unpleasant and/or unsafe walking experience, and may deter people from walking. Underpasses should be well lit at nighttime.

On overpasses, outside railings should be high enough that pedestrians are not exposed to an intimidating drop-off. On both overpasses and underpasses, some form of protective buffering should be provided between pedestrians and vehicular traffic where possible.

4.5.3 Accommodations for Disabled Pedestrians

The Americans with Disabilities Act (ADA) of 1990 requires sidewalks and other pedestrian facilities to be accessible to persons with disabilities.

ADA Ramps

ADA ramps are curb ramps compliant with the ADA Accessibility Guidelines for Buildings and Facilities (ADAAG), Curb ramps provide "an accessible route that people with disabilities can use to safely transition from a roadway to a curbed sidewalk and vice versa" (USDOJ, 2007).

Left: ADA-compliant curb ramps. Right: This crosswalk lacks curb ramps, and therefore does not meet ADA requirements. Source: MORPC. Columbus, OH.

4.5.4 Pedestrian Facilities at Roundabouts

A roundabout is a circular intersection in which vehicles travel in one direction around a central island. When a traditional signalized intersection is replaced by a roundabout, there is typically a large improvement in traffic safety. However, roundabouts create unique concerns for pedestrians.

While traditional signalized intersections include a "WALK" signal phase, most roundabouts serve as unsignalized crossings and simply have crosswalks where motorists are required to yield to pedestrians. Enforcement and educational efforts should be used to ensure proper motorist behavior with respect to pedestrians at roundabouts.

Roundabouts are a particular concern for blind pedestrians, because they do not include a signal phase in which traffic is stopped. Raised crosswalks and pedestrian hybrid beacons are somewhat effective treatments for improving the safety of blind pedestrians at roundabouts (Barlow, 2010).

This roundabout has well-marked crossings. Source: MORPC. Dublin, OH.

4.6 Transit Facilities

The term "transit" refers to mass public transportation, such as buses and subways. Transit is an important component of Complete Streets.

Fixed-route transit provides service on a repetitive, fixed-schedule basis along a specific route. On the other hand, demand-responsive service is provided to passengers upon request, but is typically limited to persons with disabilities. This section details fixed-route transit, as opposed to demand-response services.

Using transit always involves a multi-modal trip: Besides walking to and from transit stops, a person can bike to a transit stop or drive their car to a Park & Ride facility and then use transit to reach their final destination. While this section focuses on transit, other modes of travel are discussed as appropriate.

4.6.1 Types of Transit

There is a wide range of transit types in the United States. Defining characteristics are based on speed and right-of-way, which are inter-related. Different types of passenger transit are outlined below.

Bus

The most common form of transit in the United States is a bus. Standard-sized buses are from 35 to 41 feet in length (APTA, 1994). The fuel supply can vary from diesel gasoline to biodiesel to hybrid electric. Typically, public transit buses have front and center doors, are used in frequent-stop service, and do not have luggage compartments or restroom facilities.

The two primary types of bus service are feeder/local and express. Local bus service (also called feeder service) makes frequent stops, picking up and delivering passengers to a rapid transit station or express bus stop or terminal (APTA, 1994). Express bus service operates a portion of the route without stops or with a limited number of stops.

Special types of buses include: articulated buses (55 feet or more in length), small buses (28 feet or less in length), medium-sized buses (29-34 feet in length), trolley buses (powered by overhead wires from a central power source not on board the vehicle), and van buses (20 feet or less in length and used for demand-response service or vanpool). COTA's fixed-route service is a familiar local example of bus transit.

COTA bus. Source: MORPC. Columbus, OH.

Cleveland RTA's Red Line. Source: Clifton, Weiss and Associates, Inc. Cleveland, OH.

Heavy Rail (Subway or Metro)

Heavy rail refers to an electric railway with a capacity for a "heavy volume" of traffic compared to light rail. It is characterized by exclusive rights-of-way, multi-car trains, high speed and rapid acceleration, sophisticated signaling and high platform loading. Heavy rail is also known as "rapid rail," "subway," "elevated railway," or "metropolitan railway/metro." Existing examples include Cleveland RTA's Red Line and Chicago CTA's "L" system (The Transport Politic, 2011).

Light Rail (Streetcar or Tramway)

Light rail is an electric railway with a capacity for a "light volume" of traffic compared to heavy rail. It is characterized by shared or exclusive rights-of-way, and high or low platform loading. It may use multi-car trains or single cars. Light-rail systems may also be referred to as "streetcars," "trolley cars," or "tramways." Cleveland RTA's Blue and Green Lines are examples of light rail in Ohio.

Chicago METRA's Blue Line. Source: Windy City Chicago. Chicago, IL.

Commuter Rail

Commuter rail refers to local and regional passenger rail. It is characterized by tickets that can be used on more than one trip, specific station-to-station fares, and one or two stations in the central business district. This is sometimes known as "suburban rail." Commuter rail systems sometimes share tracks with freight trains.

Commuter rail trips tend to cover longer distances at higher speeds than on light rail, heavy rail, or buses. An existing example in the Midwest is the Chicago area's METRA system.

Acela Express. Source: Envrionmental Policy & Law Center.

High-Speed Rail

In the United States, high-speed rail is defined as a system with exclusive right-of-way which serves densely traveled corridors at speeds of 124 miles per hour or greater (APTA, 2004).

Currently, high-speed rail is not as common in the U.S. as in Europe and Asia. This form of transit is used to connect different cities and regions over longer distances. A possible future example of high-speed rail in Ohio is the "3C" Rail plan, with trains traveling at high speeds between the cities of Cleveland, Columbus, and Cincinnati.

The Acela Express, with service in the Northeast Corridor from Boston to New York City and Washington, D.C., is a current example of high-speed rail in the U.S.

Other Types of Transit

There are other less common forms of transit, none of which can be found in central Ohio. Although these systems are typically found in niche markets, they may offer advantages over other forms of transit in one or more aspects, such as right-of-way costs, operating costs, geographic suitability, user appeal, or energy efficiency. They are described briefly below.

Monorail is an electric railway in which rail cars are suspended from a guideway formed by a single beam or rail. Alternatively, the cars may straddle the guideway. Most monorail systems are either heavy rail or automated guideway systems. An example of a monorail is the Disneyland Monorail.

Cable Car is an electric railway operating in mixed-street traffic. In other words, it does not have its own exclusive right-of-way. The vehicles are propelled by moving cables located below the street surface. The engines and motors are not on board the vehicle; instead they are at a central location. The only currently operating cable car system is in San Francisco.

The Downtown People Mover is a type of automated guideway transit vehicle. It operates on a loop or shuttle route in the Central Business District of a city. Detroit has a Downtown People Mover.

Inclined Plane is a railway operating over exclusive right-of-way on steep grades. The vehicles are propelled by moving cables and powered by engines or motors at a central location. The engines and motors are not on board the vehicle. The Duquesne Incline in Pittsburgh is an example of an inclined plane. This system makes the most sense where there are very steep grades.

Personal Rapid Transit (PRT) is an automated guideway system. However, the vehicles are smaller and are sometimes called pods. These carry no more than three to six people per vehicle. Intermediate stations can be bypassed (Wikipedia, 2011b). An example of a PRT system can be found at West Virginia University in Morgantown, WV.

Duquesne Incline. Source: Duquesne Incline. Pittsburgh, PA.

4.6.2 Transit Systems in Central Ohio

Central Ohio currently has three fixed-route systems through COTA (Central Ohio Transit Authority), CABS (Campus Area Bus Service by OSU), and DATA (Delaware Area Transit Authority). COTA service provides both local and express service. On-demand/paratransit service is also available. There have been discussions for non-bus systems, but plans for such systems remain conceptual at this point. COTA is the largest transit system in central Ohio, and for this reason most of the discussion below centers on COTA's service.

COTA has a Long-Range Transit Plan (COTA, 2006) and Planning and Development Guidelines (COTA, 1999), both of which are useful references. These documents can be found online at www.cota.com.

For information on other transit agencies in central Ohio, see the transit section of MORPC's website: www.morpc.org/transportation/transit/OtherAgencies.asp.

Fixed-Route vs. Demand-Responsive Bus Service

Fixed-route bus service is the mainstay of the central Ohio transit system and most other cities in the United States. It operates on a repetitive, fixed schedule basis along specific routes. Each fixed-route trip serves the same origins and destinations.

Demand-responsive transit is a federally mandated extension of fixed-route service for individuals with disabilities. The Americans with Disabilities Act (ADA) of 1990 requires comparable transportation services to be offered for individuals with disabilities who are unable to use fixed-route systems (APTA, 2004). This service, also known as Dial-A-Ride, is provided to passengers at any location within the system service area (APTA, 1994). Demand-responsive service is also available in some rural areas.

In central Ohio demand-responsive service is provided by COTA (Project Mainstream), OSU (Handivan), and rural transit agencies (e.g., DATA, Licking County Transit Board, Lancaster Public Transit). For more information on COTA's demand-responsive service, please see www.cota.com/Mainstream.aspx. For more information on DATA's demand-responsive service, please see: www.ridedata.com/dr.htm.

COTA Mainstream van, an example of a demand-responsive transit vehicle. Source: COTA. Columbus, OH.

4.6.3 Bus Design Features

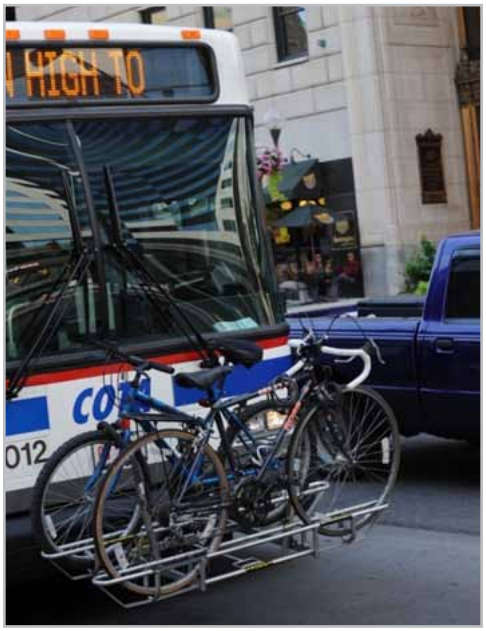
The physical aspects of bus design impact their usability and have consequences for other users of the public right-of-way. Additionally, they may have implications for route planning. For example, the width of buses may preclude their usage on some narrow streets.

Fixed-route COTA buses are 40 feet in length (COTA, 1999). Dimensions listed in this section for facilities are based on a standard 40-foot COTA bus. Different dimensions may be needed if a different sized vehicle is used. In cases of uncertainty, proposed designs should be confirmed with the respective transit agency.

COTA buses are 8.5 feet in width (10 feet including mirrors) and can seat 50 passengers. If standing capacity is considered, an additional 37 passengers can be accommodated. Their vertical height is 10.5 ft. The front step height is 9.5 inches and the ground clearance is 11 inches. The wheelbase is 25 feet. Without passengers, a typical COTA bus weighs approximately 13.3 tons.

All COTA buses have lifts to accommodate wheelchairs and other mobility devices. For more information, see www.cota.com/Riders-with-Disabilities.aspx.

Since September 2005, each COTA fixed-route bus has been equipped with a bike rack. This allows customers to take their bikes with them during their transit trips (COTA, 2006). Each bike rack has space for 2 bicycles. While both road and mountain bikes can be placed on the racks, some atypical bicycles cannot be accommodated. These include tandems, tricycles, very small bikes (children's bikes), and long-tail bikes (Xtracycle). For more information, see COTA's website: www.cota.com/assets/Riding-Cota/COTAbikenbus.pdf.



COTA bus with bikes loaded on front rack. Source: MORPC. Columbus, OH.

4.6.4 Bus Stops

Bus stops are an important aspect of the transit system. The type of bus stop, its location, and the surrounding infrastructure should be carefully considered. Not only do these decisions impact whether individuals choose to use transit, but they can also have an effect on the safety of transit users before and after they ride the bus. For instance, poorly sited bus stops encourage unsafe mid-block crossings or walking along roads without sidewalks. In this section, many of these important issues are discussed. For more information, please consult "Rethinking the Suburban Bus Stop" (Airport Corridor Transportation Association, 2011), which may be accessed here: www.bit.ly/mStPJN.

Types of Bus Stops

When planning for a transit stop, three types of locations can be considered: near-side, far-side, and mid-block. A number of factors affect the decision of bus stop location, including transfer situations, space availability, and traffic volumes. As a result, there are trade-offs associated with each type of location, and the exact location should be based on adjacent land uses and likely paths of travel to and from the stop. Consulting with COTA at an early stage in the design process is very strongly recommended (COTA, 1999). The following is a brief discussion of some of the pros and cons associated with each type of stop.

Near-side bus stops are located immediately before an intersection. They minimize walking distances to connecting transit service. They also do not generate traffic backups into intersections. However, near-side stop locations have the disadvantage of slowing vehicles behind stopped buses at intersections. Limited visibility of crossing pedestrians is another potential disadvantage associated with near-side stops. Pedestrians who cross in front of a bus are not able to see around the bus, and also are not seen by motorists in the adjacent lane.

COTA mid-block bus stop. Source: MORPC. Columbus, OH.

Far-side bus stops are located immediately after an intersection. This configuration is recommended in locations after a bus has made a left turn. They can facilitate bus re-entry into traffic and also allow pedestrians to safely cross behind the bus, where visibility is better. However, far-side stop locations have the disadvantage of creating a backup of vehicles behind a stopped bus into an intersection.

Mid-block stops are located between intersections. Mid-block stop locations have fewer vision problems for vehicles and pedestrians. If used in conjunction with a bus turnout there are no traffic flow problems caused by stationary buses in the roadway. However, mid-block stop locations have the disadvantage of increasing walking distances to intersections and encouraging pedestrians to cross mid-block without proper crosswalks. Also, in heavy traffic situations, buses may have difficulty reentering the traffic stream from bus pull-outs.

Snow has been cleared to provide access to the bus shelter and the bus. Source: MORPC. Columbus, OH.

Winter Maintenance of Bus Stops

Winter maintenance of bus stops is an important element of a complete street system. During winter, plowing may cause snow to accumulate on the buffer between the sidewalk and the street, where passengers board the bus. This can make boarding the bus difficult or impossible for transit riders, especially those with disabilities. Access to the bus (both front boarding door and rear exit door) should be maintained during periods of accumulated snowfall.

Bus Stop and Shelter Features

Transit facilities are required to adhere to ADA guidelines. For detailed information on these requirements, consult pedestrian/ADA resources, especially the AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities (AASHTO, 2004a). Additionally, COTA recommends that certain elements be included at bus stops. Below is a brief summary of each of these elements, based on COTA's Planning and Development Guidelines, which should be consulted for more detailed information (COTA, 1999). Furthermore, COTA recently built an assessment area that demonstrates several bus stop features.

COTA's Assessment Center inside its Mobility Services Facility. Source: COTA. Columbus, OH.

Sidewalks are crucial for pedestrian access to bus stops. They are especially important for wheelchair users. A paved passenger waiting area provides comfort and convenience, as well as access for the mobility-challenged. These areas should have a minimum 4-inch thick concrete pad extending 25 feet back from the corner tangent point (COTA, 1999).

COTA bus stop lacking sidewalks, a paved waiting area, and amenities. Source: MORPC. Columbus, OH.

Access ramps for people with disabilities and those using strollers, luggage, etc., should be provided at all corner curbs. These ramps should include special contrasting pavement textures to warn of grade changes. In addition to being a COTA recommendation, access ramps are a requirement for federal ADA regulations.

Passenger shelters are recommended at high-volume boarding sites. Standard shelters are 13.5 feet by 6.5 feet, set back 5 feet from the street. Each shelter should include a bench, and in high use areas, heaters are also recommended. As an alternative to shelters, building lobbies can be designed as indoor waiting areas. In this scenario, lobbies should be close to a bus stop and face the service area, allowing transit users to view approaching buses at a 1,000-foot distance. Seating should also be provided. The lobby of the Nationwide Insurance building facing W. Spring St. near the intersection of N. Wall St. in downtown Columbus provides an example of this alternative.

COTA shelter with lighting and amenities. Source: MORPC. Columbus, OH.

Transit route information can be displayed to help users navigate the system. This can include simple signs with routes, or full schedule information.

Lighting should be provided at bus stops and waiting areas. This helps transit drivers to see the bus stop area and allows riders to be more aware of their surroundings at stops, thereby increasing security and comfort. Lighting is also important to increase visibility of pedestrians who cross near bus stops at night.

Landscaping can be included to increase passenger comfort, provide shade, and offer an aesthetically appealing environment. However, passenger security and corner sight-distance should also be considered when installing landscaping.

Amenities such as public phones, ATMs, newspaper stands, and trash receptacles can enhance passenger waiting areas. However, care must be taken to minimize visual clutter and avoid disturbing the corner sight-line. See "4.11. The Sidewalk Corridor," on page 4-63 for more discussion regarding amenities. At larger stops/stations or park-and-ride locations, various services such as dry cleaning, food stalls, or child care centers can be located nearby to enhance the convenience of using transit.

COTA park-and-ride location with bike lockers. Source: MORPC. Hilliard, OH.

Bicycle storage facilities are especially useful at park-and-ride lots. They should be located in a well-lit area with high visibility. Security from theft and weather protection should be considered when selecting and locating bike storage facilities. For more information, see "4.6.7. Access to Transit," on page 4-42.

Bus berths are areas away from the road where buses can stop for extended periods. Transit users may board at bus berths as well. Bus berths provide off-street service points and bus staging areas that do not interfere with traffic movement. They are designed to accommodate more than one transit vehicle. Due to the various factors involved, developers should contact COTA at 614-308-4373 for assistance during the site plan development stage.

Bus turnarounds are facilities typically used at the termini of routes to turn transit vehicles around. Sometimes they are used in a development to allow transit service into the site. To improve the drivers' visual capabilities, bus turnarounds should use a counter-clockwise direction.

4.6.5 Roadway and Facility Design

Transit facilities, such as bus pads, turnouts, berths, and turnarounds, can be incorporated into roadway designs to provide safe, off-street service points that do not interfere with traffic movement and promote a vehicle's safe re-entry into traffic flow (COTA, 1999). When designing road facilities, the design elements listed in the table below should be considered where transit service currently exists or is planned for the near future. However, the flexibility of standards to fit within the built environment is encouraged.

Table 4. COTA Design Guidelines (COTA, 1999)

DESIGN ELEMENT	STANDARD	NOTES	COTA GUIDE PAGE
Lane width	11-12'	12' lanes are appropriate for high-speed roads	IV-1, IV-2
Street grade	6 percent or less	Grade transitions should be gradual to provide for adequate ground clearance	IV-1, IV-2
Pavement load	20,000 lbs./axle	Typical pavement design standards for local/collector roads are adequate for buses.	
Bus pad	10" Portland Cement on a 4" stabilized granular sub-base	Poorly maintainted bus pads pose a hazard for bicyclists and wheelchair users. In particular, a poorly maintained edge or seam can cause a tire to become wedged, resulting in a crash.	IV-2
Curb height	6"		IV-2
Turning radii	50' outside turning clearance	This reflects a turning speed of 10 mph	III-3
Intersection radii (parking setback)	Bus stop approach: 60'; entry road: 40'		IV-2
Bus turnout	width: 15-20'; material: concrete	Recommended where passenger volumes are high, and the flow of traffic could be significantly impeded by stopped transit vehicles. Width depends on traffic speed; acceleration and deceleration lanes also need to be provided.	IV-6

4.6.6 Types of Right-of-Way

The operating characteristics of transit are in large part determined by the type of right-of-way. In general, exclusive right-of-way is more conducive to higher speeds and fewer stops and delays, while mixed right-of-way tends to be slower with more frequent stops and delays. The appropriate type of right-of-way for a given route is influenced by transit technology, cost, feasibility, and land use characteristics, among other factors.

In most cases, buses operate within traffic and are therefore affected by traffic volume and traffic speed. **Mixed-use right-of-way** refers to an alignment where buses operate in mixed traffic with all types of road users. This includes streets, transit malls, and pedestrian malls where the right-of-way is shared (FHWA, 2009b). This form of right-of-way is the most common for local bus facilities.

In some cases, buses operate within bus-only lanes or dedicated bus lanes. **Semi-exclusive right-of-way** is an alignment that is in a separate right-of-way or along a street or railroad right-of-way where motor vehicles, pedestrians, and bicycles have limited access and cross at designated locations only. There are no current examples of semi-exclusive right-of-way in central Ohio.

In less common instances, buses or light-rail transit utilize **exclusive right-of-way**, such as a light-rail transit right-of-way that is grade-separated or protected by a fence or traffic barrier. In these circumstances, motor vehicles, pedestrians, and bicycles are prohibited within the right-of-way. Subways and aerial structures are included within this group. There are no current examples of exclusive transit right-of-way in central Ohio.

Bus-only lanes are for the strict use of buses. They are most appropriate in areas with very frequent service. A few examples can be found in downtown Columbus. However, taxis are also allowed to use these lanes. The Columbus bus-only lanes are also time restricted, as they are utilized as regular lanes outside of peak rush hour times. Note that bus-only lanes do not prevent buses from having to slow down due to other buses or vehicles crossing at intersections. If used in combination with features such as priority signalization for transit, bus-only lanes can be effective in increasing bus travel speeds.

Shared bus-bike lane. Source: MORPC. Baltimore, MD.

Bus-bike lanes are a variation on bus-only lanes that allow for the use of bicycles and buses in the same lane. Buses typically travel at slower speeds than motor vehicles in urban areas, due to their need to stop and pick up or drop off passengers. These slower speeds more closely match bicycle speeds compared to other motorist traffic.

Bus-bike lanes usually allow "bicyclists and buses to pass one another in "leapfrog" fashion," which requires careful attention to safety among both user groups (StreetsWiki, 2011). Currently, there are no bus-bike lanes in central Ohio.

In areas where freeways become congested during peak hours, the freeway shoulder can be dedicated as a **peak-hour bus lane**. COTA has successfully piloted bus-on-shoulders on selected local freeways. Buses are allowed on the shoulders when freeway speeds fall below 35 mph. Buses may only travel 15 mph faster than the average speed for regular lanes, and the maximum allowable speed on the shoulder is 35 mph (COTA, 2006).

Bus on the highway during rush hour. Source: University of Minnesota. Minneapolis, MN.

Bus Rapid Transit (BRT) uses a semi-exclusive right-of-way. "BRT… pairs modern buses with … infrastructure to move people faster and in higher volumes than a traditional bus line. BRT can operate in physically separated lanes or in designated express lanes with very few stops. Because of lower construction costs, BRT is often seen as a more practical alternative to rail-based systems such as a subway or light rail" (Wikipedia, 2011a). Besides right-of-way privileges, there are other key features of BRT, including bus priority, off-bus fare collection, level boarding, and enclosed stations.

Latin American cities, such as Mexico City, Mexico, Bogota, Colombia, and Curitiba, Brazil, have extensive BRT systems. Several cities in the United States have installed limited versions of BRT, including New York, Pittsburgh, and Cleveland. There are currently no BRT systems in central Ohio.

More information can be found in the Institute for Transportation and Development Policy's BRT Planning Guide (ITDP, 2007).

Separate signal for buses. Source: MORPC. Cleveland, OH.

BRT station. Source: MORPC. Cleveland, OH.

Bus for Cleveland RTA's Heatlh Line BRT. Source: MORPC. Cleveland, OH.

4.6.7 Access to Transit

Safe and convenient access to a transit facility is a critical element in ensuring high transit ridership. Access can be provided via walking, biking, or driving to a Park & Ride facility.

Walking & Biking to Transit

Walking and biking are the preferred modes of access to transit. Safe and comfortable infrastructure connecting transit stops to their surroundings must be in place to encourage and support these modes. In November 2009, the Federal Transit Administration (FTA) proposed a new policy for bicycle and pedestrian accommodations near transit stops. This policy sets the catchment area for pedestrians and bicyclists in relationship to public transportation stops. "Safe walking and bicycling conditions are important inducements to using public transportation. The success of public transportation can be limited by the problem of the 'first and last mile'"(FTA, 2009). The proposed FTA policy calls for a 0.5-mile catchment area for pedestrians, and a 3-mile catchment area for bicyclists. This catchment area is centered around each transit stop.

Walking is the most environmentally friendly and low-cost way to get people to and from public transportation. Good pedestrian facilities, including sidewalks and ADA-compliant curb ramps, work hand-in-hand with transit facilities. When transit passengers leave transit they are pedestrians, if only for a short walk to their destination or to their private vehicle. It is important to consider potential ADA conflicts with transit vehicles, as well as people boarding and exiting transit vehicles.

Integrating bicycles into transit services enhances the travel potential for both modes. Some of the benefits include: enabling transit users to travel longer distances, enabling transit users to overcome topographical barriers, increased overall transit ridership, increased transit efficiency, enlarging transit's catchment area, significant emission reductions, and reducing the cost of constructing automobile park-n-ride lots (FHWA, 2006c). The bike racks on COTA's buses also help with this mode choice. A detailed resource for programs that integrate bikes with transit can be found in a Transit Cooperative Research Program (TCRP) report: Integration of Bicycles and Transit (TCRP, 2005).

A passenger loads his bike onto the rack of a COTA bus. Source: MORPC. Columbus, OH.

Bike-n-Bus programs can help passengers reach suburban destinations where transit coverage is sparse or non-existent (FHWA, 2006c). There are three ways to accommodate bicycles on buses: rear-mounted racks,

front-mounted racks, and allowing bikes inside the bus. When agencies allow bikes inside the bus the priority should be given to wheelchair users over bicycle users. COTA and DATA buses use a front-mounted rack.

Bike stations provide short- and long-term secure bicycle storage and parking along with additional amenities and services. Some possible services include: bike rentals, repair, retail sale of accessories, changing rooms, food sales, tourist information, transit information, bike information, showers, and lockers for clothing. Many of these are also appropriate for transit stations or hubs.

One additional consideration to keep in mind when designing access to transit facilities is the possibility for conflict between bicycles and streetcars. While there are currently no streetcar lines in central Ohio, there is a known issue with streetcar (rail) lines in non-exclusive rights-of-way. These can be hazardous for bicyclists and wheelchair users if care is not taken in the design.

The sign to the right has been installed in Portland to warn bicyclists of the hazard of streetcar tracks. When the bicyclist is traveling parallel to the streetcar track, the bicycle wheel can become stuck in the track, similar to a poorly-designed drainage grate (ALTA Planning & Design, 2008). Another solution to this problem is to fill the track with rubber flange fillers.

Sign warning of streetcar track hazard for bicyclists. Source: major_clanger/Flickr. Portland, OR.

Park & Ride

Park & Ride (P&R) facilities provide parking for any type of vehicles to allow commuters and other people to transfer to a bus or rail system, or to carpool for the rest of their trip. The vehicle is stored in the car park during the day and retrieved when the owner returns. P&R's are generally located in the suburbs of metropolitan areas or on the outer edges of large cities.

COTA Park & Ride with shelter and bike lockers. Source: MORPC. Hilliard, OH.

Several features are desirable at park & ride lots including a transit shelter, well-marked parking spaces, adequate lighting, landscaping, bike parking, and other amenities.

There are two options for bike parking at park & ride lots: bike lockers and bike racks. Bike lockers provide security for customers who would like to ride their bike to their bus boarding location without taking it with them on their transit trip (COTA, 2006). If bike lockers cannot be installed, bicycle racks should be considered.

COTA-Specific Considerations

COTA's Development Guidelines identify design options that promote a pedestrian- and transit-oriented environment (COTA, 1999). They also discuss management strategies that encourage employees to use public transportation or participate in shared-ride programs. COTA staff works with others to integrate transit design features in development plans and to identify viable transit service options for suburban firms and agencies.

COTA is prevented from providing service outside of its taxing area, which currently includes all of Franklin County and parts of Delaware, Licking and Fairfield counties (COTA, 2006). Communities outside of the service area would need to join COTA's taxing area in order to be served by COTA. In the short-term, they should contact their local transit agency, if available.

COTA offers complimentary in-house development plan and transit service reviews to the development community. This includes both municipalities and developers. Site plans are analyzed and design options are suggested. If a plan cannot be submitted for review, COTA suggests that the transit checklist, found on page VIII-2 of the Planning and Development Guidelines, should be used (COTA, 1999). Another option is to work with MORPC's RideSolutions program to develop carpool and vanpool options for residents and employees.

4.6.8 Connection to Land Use and Other Topics

Transit planning and usage are closely related to land use. According to COTA, "population and employment densities are important to transit service…[the] densities determine route layout and service frequency" (COTA, 1999). Higher densities and a greater mix of land uses result in higher ridership levels. For more information about the relationship between land use and transit, please see "8. Land Use & Urban Form," on page 8-1.

4.7 Traffic Calming and Road Diets

Well-designed traffic calming projects reduce the speed and/or volume of cars on a roadway. There are numerous traffic calming strategies and devices. This section will review some of the most common ones.

4.7.1 Traffic Calming - Benefits and Costs

There are a variety of positive outcomes associated with traffic calming, including increased safety, mobility, livability, economic development, and public health. These benefits are outlined in "Table 5. Traffic Calming Benefits (VTPI, 2011b)," on page 4-45

Table 5. Traffic Calming Benefits (VTPI, 2011b)

BENEFITS	DESCRIPTION
Increased road safety	Reduced traffic crash frequency and severity, particularly for crashes involving pedestrians and cyclists.
Increased comfort and mobility for non-motorized travel	Increased comfort and mobility for pedestrians and cyclists.
Reduced automobile impacts	Increased non-motorized travel substitutes for automobile trips, reducing congestion, expenses, and pollution.
Increased neighborhood interaction	More hospitable streets encourage street activities and community interaction.
Increased property values	Reduced traffic speed and volumes increase residential property values.
Improved public health	More opportunities for walking and other physical activity.

The costs of traffic calming can vary considerably depending upon the treatment chosen and the characteristics of the site. A selection of costs for different measures can be found in Table 6 below.

Table 6. Sample Traffic Calming Costs (VTPI, 2011b)

TRAFFIC CALMING MEASURE	TYPICAL COST
Choker	$7,000 for landscaped choker on asphalt street, $13,000 on concrete street.
Chicane	$8,000 for landscaped chicanes on asphalt streets, $14,000 on concrete streets.
Pedestrian refuge island	$6,000-9,000, depending upon materials and conditions.
Center median	$15,000-20,000 per 100 feet.
Raised intersection	$70,000+ per intersection.

4.7.2 Types of Traffic Calming

The Institute of Transportation Engineers organizes traffic calming into four categories: vertical deflections, horizontal shifts, roadway narrowings, and closures (ITE, 2011). Within these categories, there are a variety of traffic calming treatments in use (VTPI, 2011b; WalkSanDiego, 2003). A selected number of these strategies, devices, and techniques are reviewed in this section.

Vertical Deflection

Vertical deflection refers to roadway changes in the vertical direction. This means a car travelling on a road with vertical deflection will have to move up and down, compared to the road before traffic calming. A hill in the road is a natural type of vertical deflection. Following are examples of vertical deflection elements.

Top: Speed hump with caution signs and pavement markings. Source: PBIC Image Library/Austin. Chapel Hill, NC. Bottom: Mid-block speed table and curb extension. Source: Streetswiki /Gallagher. Solano Beach, CA.

Speed Humps. A speed hump is a small curved hump in the road, 7-10 cm tall. Speed humps are sometimes confused with speed bumps, which are taller and more severe. Bumps can damage some vehicles, and should be restricted to use in parking lots. A speed hump is more appropriate for residential streets. These can be found in various locations in central Ohio.

Speed Tables (Raised Crosswalks). A speed table is a ramped surface above the roadway, 7-10 cm high. Speed tables elevate pedestrians, giving them better sight of oncoming vehicles. As a result, they provide a good crossing point for pedestrians.

Intersection Tables (Raised Intersection). An intersection table is a raised surface covering an entire intersection, including the crosswalks. This is like a speed table except it covers an entire intersection, including the crosswalk areas. This slows vehicles and highlights the intersection. It may not be appropriate for routes frequently used by emergency response vehicles or buses.

Horizontal Shift

Horizontal shift refers to roadway changes in the horizontal direction. This means a car traveling on a road with a horizontal shift will have to move left or right, compared to the road before traffic calming. A flat curve in the road is a natural type of horizontal shift.

Roundabouts. A roundabout is a one-way, circular intersection in which traffic flows around a center island. Roundabouts increase the intersection capacity and are cheaper to maintain than signals. They also reduce crashes compared to signalized and stop-sign intersections. (WalkSanDiego, 2003). Modern roundabouts in the U.S. are better designed than their predecessors.

Note that sight-impaired pedestrians rely on the sound of approaching vehicles when crossing. This is more difficult when navigating a roundabout. For this reason, some disability advocates may oppose the use of roundabouts and researchers are looking at innovative solutions.

One-way Roundabout. Source: City of Dublin, OH.

Mini-Traffic Circles (Neighborhood Traffic Circles). A mini-traffic circle is a small-scale, one-way, circular intersection in which traffic flows around a center island. Mini-traffic circles are sometimes confused with roundabouts. While they may look similar to roundabouts, they have some notable differences. For example, mini-traffic circles are used on lower-volume streets, such as residential streets, and they are only one-lane, while roundabouts can be two or even three lanes wide. Mini-traffic circles reduce crashes compared to stop-sign controls. Landscaping is an important element of a mini-traffic circle.

A neighborhood traffic circle. Source: MORPC. Columbus, OH.

Chicanes. A chicane is a curb extension that forces vehicles to move in an S-curve. Chicanes produce a visual obstruction, which reduces travel speed. They also provide a large area for landscaping. In some instances, chicanes may reduce on-street parking.

Chicane on residential street. Source: Google Maps. Columbus, OH.

Roadway Narrowing

Roadway narrowing is another type of traffic calming that seeks to slow speeds by reducing or eliminating excess roadway width. Motorists tend to drive more slowly on narrower roads, as there is less margin of error. A common example of a roadway narrowing is at a bridge crossing. Some examples of roadway narrowing are described below.

Curb Extension. A curb extension (or choker) is typically found at an intersection or mid-block location. A choker narrows the street without reducing access. Often the choker is created by extending the sidewalk or widening the planting strip.

The curb extension on the left shortens the pedestrian crossing distance. Source: PBIC Image Library/Burden. Columbus, OH.

Before (left) and after (right) a road diet. The width of the road is the same in both scenarios, but the addition of a center turn lane, bike lanes, and marked crosswalks allow the road to better serve a variety of users. Source: Litman, 2011. Champaign-Urbana, IL.

Road Diet. A road diet results in the conversion of vehicle travel lanes to other uses, such as parking, sidewalks, bike lanes, or landscaping. Road diets reduce the number and width of travel lanes, particularly on arterials. Studies have shown that, in many situations, lane widths for arterial roads can be narrowed to 10 feet from the "standard" 12 feet (Potts et al., 2007). On urban arterial roads with posted speeds less than 45 mph, 10-foot and 11-foot lanes are just as safe as 12-foot lanes (LaPlante, 2010).

An analysis of road diet measures on crashes found that the crash modification factor (CMF) varies from 47 percent (for small urban areas) to 19 percent (for suburban areas) (FHWA, 2010b). Note that in both cases the CMF means a reduction in crashes due to the road diet. The majority of the road diets in this study were conversions from four lanes to three lanes, where a four-lane undivided road was converted to two through lanes plus a center turn lane.

Top: Pedestrian refuge island. Source: ITE. Bottom: A woonerf with perpendicular parking arranged to calm the street. Source: Kodransky and Hermann, 2011.

Pedestrian Refuge Island. Pedestrian refuge islands narrow the street for vehicular traffic, while providing a refuge area for pedestrians crossing the street. Refuge islands also alert drivers to the presence of pedestrians.

Closures and Other Types of Traffic Calming

In addition to closures, there are a few other types of traffic calming that deserve mention, but do not fall into the above categories.

Road Closure. A road closure is a partial or total closure of the road to motor vehicle traffic. This is an extreme form of traffic calming where motor vehicle traffic is prevented from traveling, but provisions are made for pedestrians and bicyclists. Some road closures can be less extreme, using diagonal diverters or median barriers to prevent movement in certain directions.

Woonerf. A woonerf is a street with mixed vehicle and pedestrian traffic, where motorists are required to drive at very low speeds. It favors walking and bicycling over car use. These can be found in Europe on residential and low-volume commercial streets.

Diagonal Parking. Diagonal parking can be used to slow motor vehicles, as drivers tend to slow down as they anticipate parked vehicles backing out. Diagonal parking increases the on-street parking supply compared to parallel parking; however, it requires 19 feet of pavement width compared to 8 feet for on-street parking.

Diagonal parking at the North Market. Source: MORPC. Columbus, OH.

4.7.3 Traffic Calming Examples

Several traffic calming projects have been implemented in central Ohio. A few examples are discussed below.

Gay Street (Columbus, OH)

Gay Street in downtown Columbus is an example of a traffic-calmed street. The street was one-way before the project started in 2007 and was converted to two-way after six months of construction (Doulin, 2007). Current features of Gay Street include (City of Columbus, 2007):

- Sidewalks, diagonal parking, landscaped medians, rain gardens, and one travel lane in each direction.
- Shorter and more clearly marked crosswalks.
- Street trees and decorative light poles.
- Bike racks and designated motorcycle parking spaces.
- Conduit for future fiber optic cable.

Traffic calming on Gay Street. Source: City of Columbus. Columbus, OH.

Strawberry Farms Neighborhood (Columbus, OH)

The Strawberry Farms neighborhood in the City of Columbus was the focus of a Traffic Management Plan. This plan was motivated by resident concerns about speeding and cut-through traffic (City of Columbus, 2011b). Some of the proposed treatments include:

- Intersection medians
- Speed tables
- Chokers
- Roundabouts
- Neighborhood traffic circles

For more information, consult the Traffic Calming plan at www.bit.ly/r9QLAm.

Conceptual plan for traffic calming features in Strawberry Farms. Source: Strawberry Farms Traffic Calming Master Plan. Columbus, OH.

Ninth Street (Ferndale, MI)

The National Trust for Historic Preservation recognized downtown Ferndale in 2010 with its highest honor - the Great American Main Street Award. Ferndale is a vibrant and healthy community, in part because of the design of its major thoroughfare, Ninth Street. A road diet was completed on Ninth Street, reducing the street from four travel lanes to two travel lanes. Ferndale Mayor Dave Coulter explains (Hughes, 2011): "It was a controversial issue at the time to slow traffic down and make it two lanes, but that was really the beginning in bringing people and foot traffic back to downtown Ferndale. We have to get past this mentality that the roads that go through communities like Ferndale are mini-expressways to get you some place quickly. Instead we have to realize these roadways really are a fabric of the community and that they can be a source of recreation and community."

The downtown was transformed into a comfortable, walkable area with businesses that spilled out into the sidewalk. Source: blog.preservationnation.org. Ferndale, MI.

4.8 Safe Routes to School Infrastructure

The Safe Routes to School (SRTS) program gives community leaders, schools, and parents the opportunity to improve safety around schools and encourage more children, including those with disabilities, to walk and bike to school safely. By increasing the number of students walking and biking to school, the program helps to reduce traffic congestion around schools and improve health and the environment. In return, communities become more livable for everyone (NCSRTS, 2011a).

There are five areas covered by a successful Safe Routes to School program. These are known as the five E's and include: Engineering, Education, Enforcement, Encouragement, and Evaluation. This section will focus on engineering.

4.8.1 Engineering for Safe Routes to School

The SRTS engineering strategy focuses on providing facilities so that kids can walk and bicycle to school safely. Children with disabilities should always be considered during SRTS planning. Within the SRTS concept, engineering refers to operational and physical improvements to the infrastructure surrounding schools to lower speeds, reduce potential conflicts with traffic, and establish safer and fully accessible walkways, trails, crossings, and bikeways. Thus, engineering creates safer settings for walking and biking and can influence the way people behave.

Several principles guide the engineering solutions as well as the design of the environment that provides a safe route to school for kids. The principles listed below should help SRTS committees (which are made up of teachers, parents, and community leaders) to make good decisions about providing a safe environment where most needed for children to walk and bike to school.

SRTS Engineering Principles

- Appropriate solutions should be provided to match the type of problems that have been identified by the community for improvements (e.g., if speeding is a problem, implement speed tables and signage).
- The physical environment often determines whether kids walk or bike to school. Kids need well-designed, well-built, well-maintained, and accessible facilities in order to walk or bike to school safely (e.g., wide and well-lit sidewalks or trails with safe crossings).
- A key purpose in SRTS is to enable and encourage kids, including those with disabilities, to walk and bike to school. An important aspect of this is to provide accessible infrastructure for those with disabilities (e.g., ADA-compliant sidewalks).

- The proximity of school buildings to sidewalks and crosswalks can determine the level of comfort a pedestrian or bicyclist feels. Getting the proximity right is key (e.g., school building next to the road and sidewalk with parking in the back, provides accessibility to the building by non-motorists).
- Improvements do not always require a large amount of money (e.g., signs or striping in part can make a huge difference and are relatively inexpensive). Building new sidewalks and crosswalks or the reconstruction of new streets can be costly and should be identified early in the stages of any transportation plan.

Engineering has the ability to accomplish the following goals related to Complete Streets and Safe Routes to School:

- Create safer settings for walking and biking.
- Improve the overall aesthetics of the urban landscape.
- Increase connectivity between neighborhoods and schools.
- Influence the way people behave.

Woodland Elementary School before (left) and after (right) an SRTS Infrastructure project was implemented. The main road to the school was lacking sidewalks and crosswalks prior to the implementation of the project. The number of children walking to school doubled after the improvements were installed. Source: ODOT. Liberty Township, OH.

4.9 Pavement Types

Communities have a variety of options when it comes to pavement. In addition to traditional pavement types, such as asphalt, brick, or concrete, there are also environmentally friendly forms of pavement that are more commonly used on low-volume roadways and walkways.

Asphalt road with a crosswalk and sharrow markings. Source: MORPC. Columbus, OH.

For the purposes of this section, pavement is defined as a hard surface that sustains vehicular or foot traffic. In general, when choosing the pavement type for an individual project, factors such as durability, safety, and sustainability should be considered. As with other aspects of Complete Streets, the pavement type chosen for a particular project should also take into consideration the context and function of the street or other facility in question. Several different types of pavement are discussed below and in "4.10. Innovative Practices," on page 4-57.

4.9.1 Traditional Pavement Types

Asphalt

Asphalt is a sticky, black and highly viscous liquid or semi-solid that is present in most crude petroleum and in some natural deposits. Asphalt is used as a durable surface for roads, airport runways, playgrounds, and parking lots, and as a sealant for rooftops. Below are some advantages and disadvantages to using asphalt as a street pavement (Asphalt Pavement Institute, 2011 and The Civil Engineer Group, 2010).

Table 7. Advantages and Disadvantages of Asphalt

ADVANTAGES	DISADVANTAGES
Good for bicycling, walking, and jogging due to its smooth surface.	Dark pavement increases heat radiating from the surface on sunny days; this can make it uncomfortable for pedestrians to walk without proper shading.
Cost effective, as asphalt is quick to implement and dries fast, reducing the time to complete construction.	Causes weather pollution since melting asphalt produces greenhouse gases.
Recyclable material, as asphalt can be used over and over again.	Less durable than concrete. Extreme wear leads to rutting and potholes.
Easy snow removal and reduced noise level due to smooth surface.	Not suitable for bus stops because of the heavy weight of the vehicle.
New design strategies and improved materials and construction techniques may allow asphalt to last over 40 years.	Temperature-sensitive and can therefore only be applied at certain times of the year depending on the location.
	At high temperatures, asphalt can cause flat tires.

Rubberized asphalt installation. Source: Franklin County Engineer's Office. Franklin County, OH.

Rubberized Asphalt

Rubberized asphalt is a pavement material that consists of regular asphalt concrete mixed with crumb rubber (ground, used tires that might otherwise be discarded). Rubberized asphalt is similar to conventional asphalt in many ways. A few additional benefits are noted below (Arizona DOT, 2011; Clemson University, 2011).

Benefits of Rubberized Asphalt:

- Improved resistance to cracking in pavement.
- Decreased noise levels because the rolling pressure of the tires reduces the frequency range that is heard.
- Environmentally friendly, as it keeps tires out of landfill.
- Good pavement type for trails because of the smooth surface.

Small trees along the concrete sidewalk ensure shade for pedestrians, but will not crack the sidewalk. Source: MORPC. Columbus, OH.

Concrete

Concrete is a composite construction material composed of cement and other materials, such as fly ash, slag cement, aggregate, water, and chemical admixtures. Concrete is used to make pavements for roads, sidewalks, bridges/overpasses, parking structures, walls, and other architectural structures and foundations. Below are some advantages and disadvantages to using concrete for street pavements (The Civil Engineer Group, 2010).

Table 8. Advantages and Disadvantages of Concrete

ADVANTAGES	DISADVANTAGES
High durability and long service life.	Higher initial cost compared to asphalt.
Concrete production is less polluting compared to asphalt.	High maintenance cost due to ease of cracking.
Does not give off heat on warm sunny days.	Sidewalks subject to cracking and heaving from tree roots.
Ideal surface for bus pads due to durability.	

4.9.2 Low-Volume Pavement Types

Chip Seal

Chip seal combines asphalt with a layer of aggregate to create a pavement. Chip seals are used as a pavement maintenance practice and on rural roads that carry low traffic volume. Chip seal is cheaper than asphalt, although it has a shorter lifespan. In hot weather, chip seals re-seal cracks by flowing back together.

The rough surface of a chip seal road creates more roadway noise than asphalt and concrete. Additionally, the uneven surface results in a reduced ride quality for bicyclists as well as motorists. As chip seal roads wear out over time, they can produce flying chips that can result in a broken windshield or harm a bicyclist (Galehouse & Wood, 2011).

Chip Seal Road. Source: Delaware County Engineer's Office. Delaware County, OH.

Brick

A brick is a block of ceramic material used in masonry construction, usually laid using various kinds of mortar. Brick pavement is incapable of withstanding heavy traffic, but is coming back into use as a method of traffic calming or as decorative surfaces in pedestrian precincts. Below are some advantages and disadvantages to using brick as a road surface (Fehr & Peers, 2008).

New brick streets and sidewalks provide traffic calming and a nice design element. Source: MORPC. New Albany, OH.

Table 9. Advantages and Disadvantages of Brick

ADVANTAGES	DISADVANTAGES
Longer lifespan than asphalt.	Cannot withstand heavy traffic.
Can be used as a traffic calming element in low-speed environments.	Individual bricks become loose and uneven over time and need to be replaced.
Provides a nice design element in neighborhoods and historic areas.	Tree roots can uplift bricks, which create an obstacle for pedestrians and wheelchair users.
	Brick streets and sidewalks are less comfortable for bicyclists and wheelchair users.

Gravel Roads

A gravel road is a type of unpaved road surface with gravel that has been brought to the site from a quarry or stream bed. Gravel roads are common in areas with low development, where they help to preserve the natural and historic character of the rural environment.

Gravel roads are less costly to construct than paved roads due to lower material costs. They are also easier to maintain as they require less equipment and surface damage is less expansive and easier to correct. They may, however, require more frequent maintenance in some cases as the gravel becomes loose over time.

Among the downsides of gravel roads are that they generate dust, they can become impassable with frequent snow or rain, they create greater wear and tear on vehicles than paved roads, and they're neither comfortable nor safe for bicyclists, as the gravel can cause them to fall. Gravel roads are also not ADA compliant, therefore making it difficult for individuals with disabilities to use the roads in wheelchairs or as pedestrians.

Gravel roads help to preserve rural character. Source: Delaware County Engineer's Office. Delaware County, OH.

4.10 Innovative Practices

When considering building complete streets, innovative practices should be explored where possible. Using innovative practices and applying existing standards more flexibly may require decision makers to make decisions that are outside of the traditional ways of building streets. However, using innovative practices could result in benefits such as reduced costs and improved environmental performance. Examples of innovative practices related to road pavement and stormwater management are discussed below.

4.10.1 Sustainable Pavement Practices

There are several technologies and strategies available to improve the environmental performance of newly constructed and rehabilitated roadways compared to conventional practices. In general, more sustainable pavement practices improve over their conventional counterparts in terms of stormwater management, materials, and construction practices.

Greenroads

Greenroads is a rating system that gives credits to projects where sustainable pavement practices are applied to new, reconstructed, or rehabilitated roads. The certification is based on a total point value similar to the LEED certification. A Greenroad is defined as "a roadway project that has been designed and constructed to a level of sustainability that is substantially higher than current common practice" (University of Washington, 2010).

Greenvale Road during and after the Greenroads construction process. Source: Upper Arlington, OH.

Best practices for Greenroads are divided into two types: required and voluntary. A project can become Greenroads-certified based on the total points achieved from the required and voluntary best practices. There are four certification levels:

- **Certified:** All Project Requirements + 32-42 Voluntary Credit points (30 to 40 percent of total)
- **Silver:** All Project Requirements + 43-53 Voluntary Credit points (40 to 50 percent of total)
- **Gold:** All Project Requirements + 54-63 Voluntary Credit points (50 to 60 percent of total)
- **Evergreen:** All Project Requirements + 64 Voluntary Credit points (>60 percent of total)

Greenroads is a project-based system and is applicable to the design of the project. The system boundaries apply distinctively to the design process and construction activities within the work zone, as well as the hauling of material and production of concrete and asphalt.

Compared to conventional road construction practices, roads built under the Greenroads process may result in lower construction costs, as existing asphalt can be recycled and reused on-site. In addition to the environmental benefit associated with recycling, reusing materials on-site reduces the transportation of road materials. Greenroads may also result in a shorter timeframe for completion of construction since most work is done on-site.

Five roads were included as part of a Greenroads pilot program in Upper Arlington, Ohio: Edgevale Road, Glenmere Road, Sunset Drive, Inverness Way, and Eastcleft Drive.

Replay is being applied to a county road. Source: Ohio Pavement Systems. Licking County, OH.

Green Asphalt Repair Treatment: RePlay

RePlay is a bio-based green product made from recyclables that is used as a preservation agent to seal and renew asphalt while adding new polymers to the pavement. By reversing oxidation and moisture penetration, which are major sources of road deterioration and pothole formation, it reduces the need to repair or patch roads and extends the useful life of the pavement (Ohio Pavement Systems, 2007).

Replay is 75 percent agricultural-based, with over 30 percent made from soybean oil. By reducing water permeability by over 95 percent, RePlay increases the useful life of a treated road surface by 2-3 times its normal life span. It has a fast cure time of 15-30 minutes, reducing the amount of time a road has to be closed along with the costs associated with road closure.

Pervious Pavement used as part of a parking lot. Source: Grange Insurance Audubon Center. Columbus, OH.

Permeable Pavement

Permeable pavement refers to a range of materials and techniques for paving roads, bike paths, parking lots, and pavements that allow the movement of water and air around the paving materials. Types of permeable pavement include: pervious concrete, porous asphalt, single-sized aggregate, porous turf, open-jointed blocks, resin bound, and bound recycled glass porous pavement.

Permeable pavement reduces the need for retention ponds, swales, and other stormwater management devices and is thus more sustainable and cost effective. The use of permeable pervious pavement is among the Best Management Practices recommended by the Environmental Protection Agency.

Table 10. Advantages and Disadvantages of Permeable Pavement

ADVANTAGES	DISADVANTAGES
Reduces rate and quantity of stormwater runoff.	Relatively high initial project cost.
Reduces stress on storm sewer systems.	Not a good source of pavement for high-traffic roads.
Recharges groundwater to maintain aquifer levels.	Requires frequent maintenance because grit or gravel can block the open spaces that allow water filtration.
Channels more water to tree roots and landscaping, which reduces the need for irrigation.	Snow plow blades could damage the surface.
	Chlorides from road salt could migrate through the porous pavement into groundwater.

4.10.2 Stormwater Management

Stormwater runoff occurs when precipitation flows over the land surface. Surfaces that prevent water from soaking into the ground, such as roads, driveways, and rooftops, increase the runoff volume during storms. The runoff is then quickly carried to local streams, lakes, wetlands, and rivers and can cause flooding and erosion. Stormwater runoff carries with it different pollutants that are found on paved surfaces, and thus, stormwater runoff is the number one reason of stream impairment in urban areas.

The Clean Water Act was expanded by the U.S. Environmental Protection Agency (USEPA) to reduce the impacts of runoff on urban streams. In 1987 the Clean Water Act was amended to require the USEPA to develop a program to address stormwater discharges. The USEPA requires municipalities to obtain permits for discharges of stormwater runoff (Clean Water Act).

There are many options that can be used for stormwater management, some of which are discussed below. In general, innovative stormwater management practices seek to reduce the volume and speed of runoff through a variety of on-site treatments. As with other elements of Complete Streets, context is very important. In particular, constrained rights-of-way may present an obstacle to the implementation of innovative practices in some areas.

Curb and Gutter

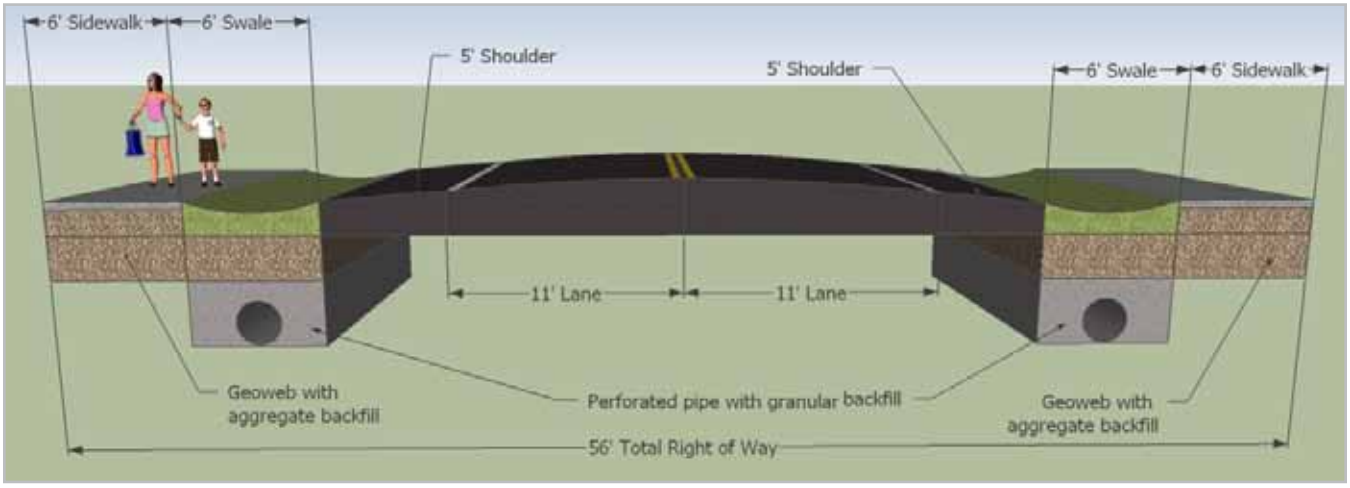
Curb and gutter is the traditional model for stormwater management in urban areas. It is intended to prevent flooding in developed areas. In curb and gutter systems, water is transported as quickly as possible to a stormwater drain without allowing for the removal of pollution or infiltration. There are a number of downsides to curb and gutter, such as a high peak-flow rate immediately after a rain event, which contributes to erosion. Pollutants are often not filtered when using curb and gutter. Additionally, curb and gutter systems often account for a substantial portion of the cost of a transportation project.

Road cross-section with 1'6" curb and gutter. Source: MORPC.

Swale

A swale is a "graded and engineered landscape feature appearing as a linear, shallow, open channel with trapezoidal or parabolic shape. The swale is vegetated with flood-tolerant, erosion-resistant plants" (Lake Superior Streams, 2011). The swale encourages stormwater to pass through at a slower controlled rate and acts as a filter for removing pollutants.

Swales allow for stormwater infiltration and eliminate the need for curb and gutter. They are a significant improvement over traditional draining in both slowing and cleaning the water. Swales are particularly useful in rural and suburban areas with sufficient right-of-way. Swales can serve as a buffer between sidewalks and trails and the roadway.



Road cross-section with 6' swale. Source: MORPC.

Rain Garden

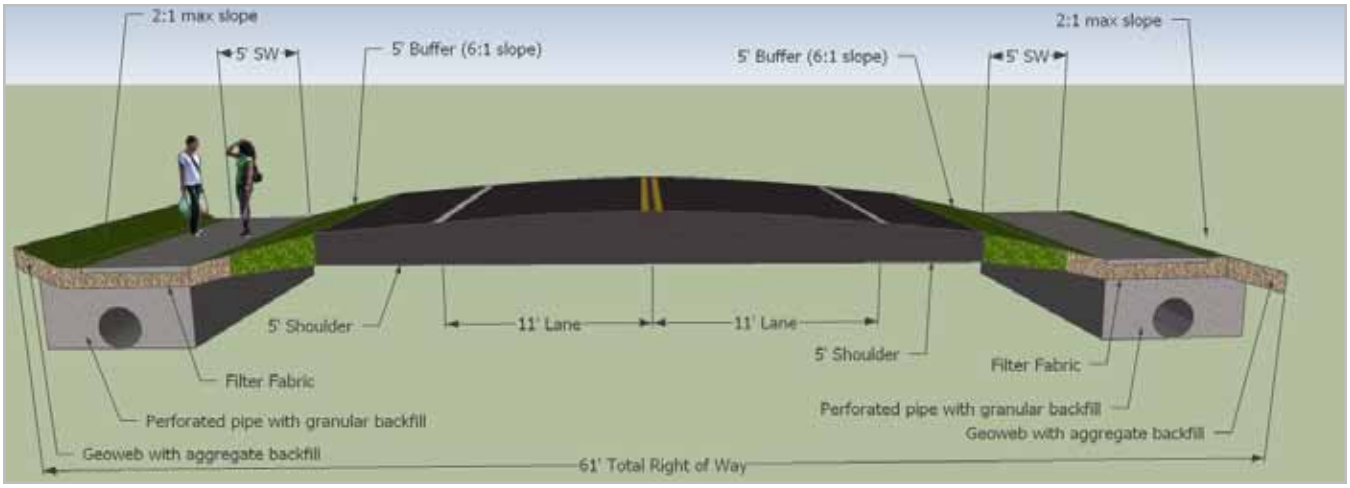
Rain gardens are a natural way to use rain water as a resource instead of as a waste product. Every time it rains or snow melts, large amounts of water from our rooftops, roads, sidewalks, and parking lots are carried through our stormwater system and drain directly into our creeks and streams. Pollutants are collected through the stormwater and create flooding that is harmful to property owners, stream life, and drinking water.

Rain gardens are an easy, cost-efficient way to slow and decrease the amount of stormwater runoff that ends up in the waterways. Rain gardens also enhance the streetscape and can eliminate the need for underground piping. Rain gardens are useful along narrow urban roads with slow speed and a high concentration of residential housing (Central Ohio Rain Garden Initiative, 2011).

Road cross-section with a 12' rain garden. In this example, the rain garden also serves as a buffer between cars and pedestrians. Source: MORPC.

Reduced Drainage Option

Permeable pavement is used as an alternative to asphalt or concrete surfaces. It allows stormwater to drain through the porous surface to a stone reservoir underneath. The stone reservoir temporarily stores surface runoff before it filters into the subsoil. "The appearance of the alternative surface is often similar to asphalt or concrete, but it is manufactured without fine materials and instead incorporates void spaces that allow for storage and infiltration" (USEPA, 2011b). By providing permeable pavement, the pipe size can be smaller and much less costly.



Example of road cross-section with a reduced drainage solution. Source: MORPC.

Integrating Stormwater Management with Complete Streets

In many cases, innovative approaches to stormwater management are complementary to complete streets concepts. A rain garden, for example, can be used as a corner extension to reduce the pedestrian crossing distance at an intersection and to slow vehicular traffic. Similarly, vegetated swales offer a buffer between pedestrians and vehicles that allows for more comfortable pedestrian travel. Portland, OR has a "green streets" program, which serves as a model for the incorporation of innovative stormwater management with multimodal transportation options. For more information, see: www.portlandonline.com/bes/index.cfm?c=44407 (City of Portland, 2011a).

4.11 The Sidewalk Corridor

The pavement area in the road, from curb-to-curb in urban areas, is often considered carefully when trying to build or retrofit a complete street, but the area between the road and the property line also needs to be taken into account. Every person is a pedestrian at some point in their journey, and street furniture can play an important role in making pedestrians safer and more comfortable.

In an urban area there may be a lawn or tree buffer, a sidewalk, and even outdoor seating for a restaurant. "Street furniture" includes bike parking, benches, light poles, transit shelters, parking meters, and garbage containers, among others. As with all components of Complete Streets, context-sensitivity is paramount. Bike racks, water fountains, benches, and garbage containers may not be appropriate alongside a rural or suburban street that only has a few people walking on it. The frequency of street furniture should be adjusted, with denser areas having a higher frequency of street furniture.

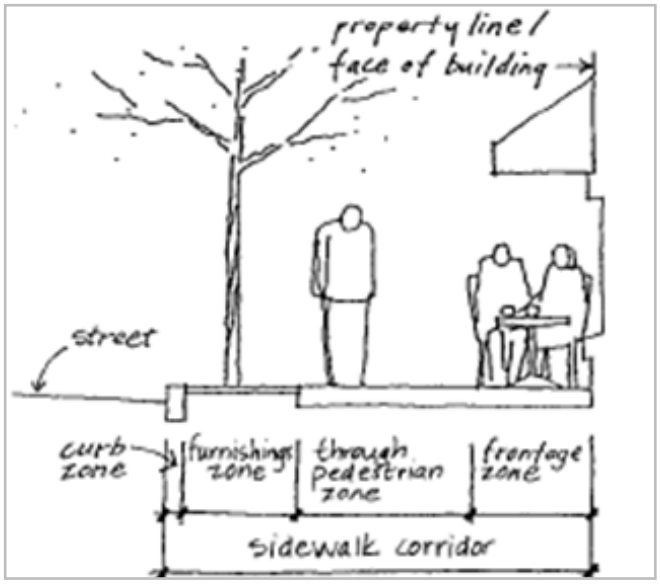
While basic, this sidewalk corridor includes all four zones of the sidewalk corridor. Source: MORPC. Columbus, OH.

The space between buildings (property line) and the road (pavement) is referred to as the "sidewalk corridor." It is helpful to think of the "sidewalk corridor" in terms of four zones. Moving from the road to the building, they are: (1) the Curb Zone, (2) the Landscape or Furniture Zone, (3) the Pedestrian Zone, and (4) the Frontage Zone (City of Portland, 1998).

4.11.1 Curb Zone

The curb zone is defined by the curb itself. It is the closest zone to the street. The curb zone creates a border between the paved roadway and the sidewalk corridor. Curbs make routine maintenance (such as street sweeping) of roads easier as they provide the operators with a solid edge. They also discourage motor vehicles from driving into the pedestrian area and can be helpful for pedestrians navigating with a cane.

The recommended minimum width of the curb zone is six inches. Additional width beyond six inches may be required if the curb zone includes curb extensions, curb ramps, and on-street vehicle parking (City of Seattle, 2011).



Sidewalk corridor zones in a commercial area. Source: Portland Pedestrian Design Guide, 1998.

Even though a large number of boxes are temporarily stacked in the furniture zone, the sidewalk corridor is wide enough to provide adequate space for pedestrians. Source: MORPC. Brooklyn, NY.

4.11.2 Furniture Zone

The furniture zone is located between the curb zone and the pedestrian zone. This zone provides space for obstacles, which keeps them out of the way of pedestrians traveling in the pedestrian zone (City of Portland, 1998; FHWA, 2001a).

The recommended minimum width of the furniture zone is two feet. If the street has on-street parking, the minimum width is three feet, so that car doors can open without blocking the pedestrian zone. The areas adjacent to opening car doors should be free of obstacles as well. Transit stops and transit shelters require a minimum width of 4 to 8 feet. In areas with large snow accumulations during winter, the furniture zone should have a minimum width of 6 feet.

Street furniture can include bike parking, benches, water fountains, signage, utility poles or boxes, news kiosks, light poles, transit shelters, fire hydrants, grates and hatch covers, parking meters, public telephones, mailboxes, and garbage containers. Movable objects should be secured so they are not moved into the pedestrian zone.

Furniture zones can either be paved or planted. In a commercial area the furniture zone may be paved, but should include trees, flowers, and shrubs to improve the quality of the pedestrian environment. In other areas, the furniture zone may consist of grass, but should be paved for access walkways, such as at bus stops. Street trees, shrubs, and ground cover may also be appropriate.

The furniture zone shown here includes benches, shrubs, and light poles. Source: MORPC. Hilliard, OH.

The furniture zone can also be behind the pedestrian zone, as in this example. Source: MORPC. Columbus, OH.

Natural drainage systems can be installed in the furniture zone to improve stormwater runoff management (City of Seattle, 2011). For more information on stormwater management, see "4.10. Innovative Practices," on page 4-57.

If street trees are planted rather than shrubs, grass, flowers, or ground cover, additional space may be needed in the furniture zone to accommodate the tree roots properly. For more information on Street Trees, see "4.12. Street Trees," on page 4-68.

The New York City Street Design Manual (www.nyc.gov) is a good resource for information relating to street furniture. It also includes information on different materials for use in crosswalks and sidewalks, lighting, and traffic signal poles.

This pedestrian zone is blocked by a fire hydrant and a stop sign pole. Source: MORPC. Columbus, OH.

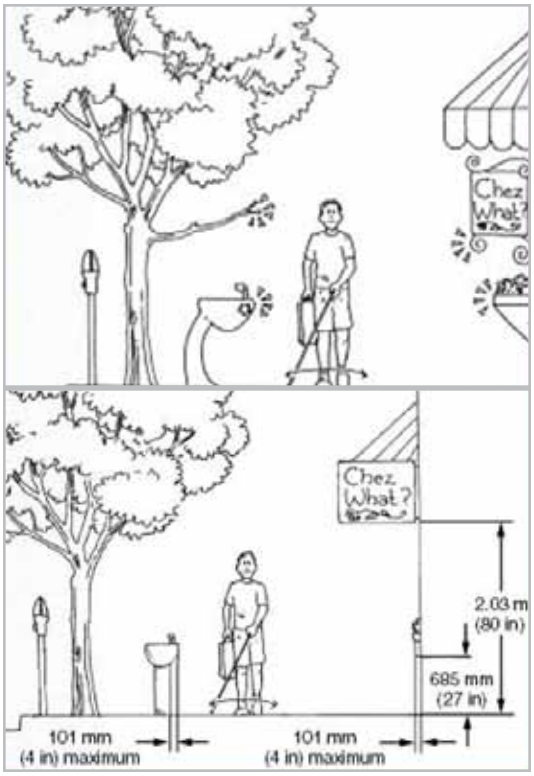
4.11.3 Pedestrian Zone

The pedestrian zone is the clear space for pedestrians located between the furniture zone and the frontage zone. It is important to keep this area free of protruding objects and vertical obstructions. Individuals with visual impairments can be particularly at risk from such objects.

The minimum width of the pedestrian zone is five feet. This allows a wheelchair user to travel comfortably, and also allows two pedestrians to walk side by side. People traveling with a sighted guide or guide animal are also best accommodated by at least five feet of pedestrian zone.

The pedestrian zone includes the corner of a dumpster, which is hazardous to blind pedestrians. Source: MORPC. Cleveland, OH.

An effort has been made to keep obstacles out of the pedestrian zone, but it remains less than the recommended 5 feet. Source: MORPC. Columbus, OH.



In the top illustration, several objects impede travel for blind pedestrians. These barriers have been eliminated in the lower illustration without sacrificing functionality. Source: FHWA, 2001a

The pedestrian zone should be expanded based on the anticipated volume of pedestrians. Larger widths are generally needed in denser areas. Local communities may have recommendations based on the type of roadway or neighborhood zone. If the pedestrian zone is narrower than recommended, providing passing spaces at least every 200 feet will help accommodate a wider variety of users.

4.11.4 Frontage Zone

The frontage zone is the space between the property line (typically a building in dense urban areas) and the pedestrian zone. The frontage zone is a shy zone, as pedestrians tend to avoid walking directly next to buildings and walls. By giving appropriate space for the frontage zone, pedestrians can avoid getting hit by doors opening into the sidewalk.

The recommended minimum width of the frontage zone is 12 inches. Sidewalk entertainment, street cafes, and street vendors may be located in the frontage zone, which should be widened in these instances. Signage for businesses may also be located in the frontage zone.

People with vision and/or auditory impairments may travel in the frontage zone to stay oriented. They tend to travel between 1 foot and 4 feet away from the building and are particularly at risk of running into obstacles in the frontage zone. It is important to keep this area free of protruding objects and vertical obstructions. Any items in the frontage zone should be detectable by a vision-impaired individual through the use of a white cane.

In residential areas the frontage zone may be eliminated, because buildings are set back from the property line. For example, there may be landscaped front yards.

4.11.5 Extending the Sidewalk Corridor

It is possible to extend the sidewalk corridor without rebuilding the curb. This involves taking roadway space and converting it to another use. This can provide a buffer between pedestrians on the sidewalk and the vehicles in the roadway.

This type of project is also known as a "pop-up café" or "parklet." The most typical use for this extension is outdoor restaurant seating. This is especially appropriate in areas where the sidewalk corridor is too narrow for the volume of pedestrians. Low vehicle speeds are also more conducive to this type of project. Such innovative use of public space has been piloted in San Francisco, New York City, and San Juan, Puerto Rico. A well-designed sidewalk extension should not impede proper drainage.

These sidewalk extensions provide a buffer for pedestrians, while also creating an outdoor seating environment. Source: MORPC. San Juan, Puerto Rico

Table 11. Sidewalk Zone Characteristics

SIDEWALK ZONE	KEY ELEMENTS	FUNCTION	MIN. WIDTH	NOTES
Curb Zone	Curb, curb ramps, curb extensions, on-street parking	Physical separation of pedestrians and motor vehicles, ease of maintenance, drainage	6”	
Furniture Zone	Street trees and other landscaping, natural drainage features, benches, transit shelters, bike racks, utility poles, signal poles, parking meters, kiosks, newspaper racks, trash cans, signage	Pedestrian and transit user amenities, utilities, buffer between pedestrians and motor vehicles, shade, aesthetics	2’	Breaks in furniture zone should be provided to allow access to on-street parking, especially in areas adjacent to opening car doors.
Pedestrian Zone	Sidewalk	Clear, unobstructed path for pedestrians and wheelchair users	5’	Larger sidewalks are needed in areas with higher pedestrian volumes.
Frontage Zone	Street cafe, street vendors	Shy zone for pedestrians, especially those who are vision-impaired	12”	Wider frontage zone is needed where outdoor seating or other potential obstacles are installed.

4.12 Street Trees

The term "street tree" refers to any tree located along the edge of the roadway, along a sidewalk, or in the median of a road (Nelson/Nygaard Consulting Associates, 2010). Street trees and landscaping are of great value to people in urban places. They provide many benefits and should always be considered as part of the planning and design process for any roadway project. Street trees remove air pollution, reduce stormwater runoff, and help to save energy. It is important that their placement allows for adequate sight distances at intersections and driveways. They should also allow light from street lamps to illuminate the street and should not impact overhead or underground utility lines. Street trees need to be trimmed regularly to ensure access to sidewalks for pedestrians. Additionally, the tree should be the appropriate size for planting next to a sidewalk, such that sidewalks are not destroyed due to root growth (see "Table 12. Suitable Trees for Ohio," on page 4-69 for more details).

4.12.1 Benefits of Street Trees

Street trees provide several benefits to pedestrians, residents, and business owners. A few examples are listed below:

- Reduced urban traffic speeds. Street trees create a vertical wall that frames the street and defines an edge for motorists, helping to guide the movement of the vehicle, which leads to a decrease in speed.
- Safer walking environments and better aesthetics. Street trees frame a wall between the motorist and pedestrian.
- Increased commercial activity.
- Protection from rain, sun, and heat.
- Conversion of harmful gases into oxygen and other natural gases. Due to proximity to pollution from vehicles, street trees convert carbon gases to oxygen at a greater rate than trees that are planted at a distance from the roadway.
- Lower urban air temperatures.
- Added value to adjacent homes, businesses, and tax base.
- Longer pavement life. The shade of street trees can increase the pavement life by 40 to 60 percent.
- Protection of urban habitat and wildlife.

Additional benefits can be found in Dan Burden's article "22 Benefits of Urban Street Trees" (Burden, 2006).

Well-maintained street trees provide a buffer and shade for pedestrians. Source: MORPC. New Albany, OH.

This tree blocks the sidewalk and has caused the sidewalk to heave. Source: MORPC. Columbus, OH.

4.12.2 Street Tree Evaluation

When designing a roadway, it is important to consider which type of landscape features are most appropriate for the setting. The Ohio Department of Natural Resources conducted a Street Tree Evaluation Project from 1971 to 1997 that examined 53 tree species in five Ohio cities. The trees listed in "Table 12. Suitable Trees for Ohio," on page 4-69 were found to be the best types of trees to grow in Ohio, based on the size of lawn available for each tree (Sydnor, et al., 2010).

In urban areas, smaller trees are appropriate, leaving more room for pedestrians. Source: MORPC. Columbus, OH.

Table 12. Suitable Trees for Ohio

2-4 FOOT LAWN BUFFER		
Armstrong Red Maple	Bowhall Red Maple	Washington Hawthorn
5-8 FOOT LAWN BUFFER		
Norway Maple	Swedler Norway Maple	White English Hawthorn
Red Maple	Crimean Linden	Sweetgum
Amur Corktree	Japanese Scholar Tree	Ruby Red Horsechestnut
Cleveland Norway Maple	Fassens Black Norway Maple	Shademaster Honeylocust
Callery Pear	Hardy Rubbertree	Crimson King Norway Maple
Littleleaf Linden	Skyline Honeylocust	Sunburst Honeylocust
American Hophornbeam	Kwanzan Japanese Cherry	
10-16 FOOT LAWN BUFFER		
Trident Maple	Upright Norway Maple	Greenspire Littleleaf Linden
Amur Corktree	Modesto Velvet Ash	Japanese Scholartree
Japanese Tree Lilac	Japanese Zelkova	Sycamore Maple
Littlelead Linden	Callery Pear	Christine Buisman Smoothleaf Elm
Rosebloom Crabapple	London Planetree	Marshall's Seedless Green Ash
Sweetgum	Thornless Honeylocust	Moraine Honeylocust
Cleveland Norway Maple		
RESIDENTIAL LAWN & 29-FOOT BUFFER		
Norway Maple	Sugar Maple	Upright Norway Maple
Red Oak	Littlelead Linden	

This sidewalk planter serves as a median, which has a traffic calming effect. Source: MORPC. Columbus, OH.

4.12.3 Sidewalk Planters

Sidewalk planters are an easy way to add green space to a wide sidewalk or other area where pavement can be replaced with landscaping. Sidewalk planters can be found on the side of a road, next to a wide sidewalk, or in the median of a street. Their main purpose is to improve the aesthetics of a neighborhood, but they can also buffer pedestrians from vehicles while filtering and detaining stormwater.

Long-term maintenance should be considered before installing sidewalk planters. For example, shrubs, bushes, and small trees require less maintenance than most flowers. Also, trees that have green foliage all year round ensure shade during all months of the year (Nelson/Nygaard Consulting Associates, 2010).

The benefits of sidewalk planters include the following:

- Improved aesthetics.
- Low maintenance.
- Easy to design and build.
- Stormwater infiltration.

4.13 Construction Access

During construction and maintenance of roads and buildings, the mobility needs of all users should be accommodated. In the same way that closing a roadway requires a plan for how to detour motor vehicle traffic, there should be a plan for how to maintain access for other users, particularly pedestrians.

Note that while maintaining access for pedestrians during construction is a recommended component of a Complete Streets policy, it is also required for ADA compliance. In addition, the Ohio MUTCD contains similar requirements in Part 6, Temporary Traffic Control (ODOT, 2005c). Another important consideration of the Ohio MUTCD is protecting the safety of construction/roadway workers.

4.13.1 Motor Vehicles and Trucks

Motor vehicles and commercial vehicles are likely to be affected by construction. Several considerations related to construction access for vehicles and trucks in Temporary Traffic Control (TTC) zones are listed below:

- Drivers tend to reduce their speed only when they clearly perceive a need to do so.
- Frequent and abrupt changes in geometrics, such as lane narrowing, dropped lanes, or main roadway transitions that require rapid maneuvers, should be avoided.
- Road users should be encouraged to use alternative routes that do not include TTC zones.
- Roadway occupancy should be scheduled during off-peak hours and, if necessary, night work should be considered.
- Commercial vehicles and vehicles carrying hazardous materials might need to follow a different route from passenger vehicles because of bridge, weight, clearance, or geometric restrictions.

For more information, please consult the Ohio MUTCD (ODOT, 2005c).

4.13.2 Transit Vehicles and Riders

In many cases, road construction also affects routes used by transit vehicles. Fixed-route transit service providers (e.g., COTA and DATA) should be contacted when a bus stop or bus route is on the affected roadway. It may be necessary to close a bus stop for the duration of the construction project. Detouring the bus may also be necessary. Furthermore, the transit agency should be able to determine the best detour based on available pedestrian facilities, such as sidewalks or crossings.

4.13.3 Motorcycles and Scooters

Conditions that can be a minor annoyance to a 4-wheel vehicle may warrant extra caution for motorcyclists. Roadway conditions that are particularly difficult for motorcyclists to navigate include: bumps, dips, pavement ends, loose gravel, rough roads, uneven lanes, and other locations that become slippery when wet. Metal plates, usually labeled as "steel plates," are often used to cover large holes created during construction or repair of a road. These can be hazardous to motorcyclists and bicyclists, especially when the metal plate is wet. Warning signs providing advance notice to motorcyclists are helpful in these situations, even if only caused by short-term construction.

A sample of roadway condition signs that are especially pertinent to motorcyclists. Source: FHWA, 2003.

4.13.4 Bicyclists

Many of the considerations for motor vehicles are the same or similar for bicyclists. In addition to being affected by TTC projects on roads, bicyclists are also affected by projects on multi-use paths. The following are some key considerations related to bicyclists and the TTC zone (ODOT, 2005c).

- Bicyclists should be provided with access and safe passage through the TTC zone, whether they are traveling in a shared lane or bike lane.
- Projects that affect multi-use paths should provide alternative access for bicyclists and pedestrians who normally use the path.

For more information please consult the Ohio MUTCD.

4.13.5 Pedestrians

Pedestrians need a clearly delineated and usable travel path through or around construction areas. A wide range of pedestrians may be affected, including the young, elderly, and people with disabilities. The pedestrian path should follow PAR (pedestrian accessible route) standards. (ODOT, 2005c).

The following factors should be considered with regard to pedestrian access during construction:

- Pedestrians should not be led into conflicts with work site vehicles, equipment, and operations, nor with vehicles moving through or around the work site.
- Pedestrians should be provided with a reasonably safe, convenient, and accessible path that replicates as nearly as practical the most desirable characteristics of the existing sidewalk(s) or footpath(s).
- The width of the existing pedestrian facility should be provided for the temporary facility if practical. Traffic control devices and other construction materials and features should not intrude into the usable width of the sidewalk, temporary pathway, or other pedestrian facility.
- Closed sidewalks should include a barrier that is detectable by a person with a visual disability through the use of a long cane. The barrier should extend across the full width of the closed sidewalk.
- Barriers and channelizing devices should be detectable to pedestrians who have visual disabilities. Tape, rope, or plastic chain strung between devices are not detectable and do not comply with the design standards in the "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)" (USAB, 2005). They should not be used as a control for pedestrian movements.
- Abrupt changes in grade or terrain should be avoided, as these may cause a tripping hazard or block passage for wheelchair users.
- When work is conducted by private contractors, advance notification should be provided to the maintaining agency.
- Pedestrians are reluctant to retrace their steps to a prior intersection for a crossing or to travel far out-of-the-way to reach their destinations. As a result, reasonable detours with appropriate signage are needed to ensure pedestrian safety during construction.
- A canopied walkway may be used to protect pedestrians from falling debris, and to provide a covered passage for pedestrians.

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5. EDUCATION & ENCOURAGEMENT

5.1 Introduction

Education and encouragement are separate but related activities that help the public understand and utilize a wider range of transportation options. Education programs typically involve the transfer of information, whereas encouragement programs are motivational in nature, often relying on incentives or other means to nudge people to make positive changes in their transportation habits.

In this chapter, a wide variety of education messages and encouragement programs are discussed. These programs will give the reader ideas that can be tailored to their own community. The chapter is divided into sections according to the mode of transportation.

5.2 Pedestrian Education & Encouragement

Every trip - whether by car, rail, bicycle, bus, or air - involves some walking. This means that everyone taking a trip is a pedestrian at some point in their journey. Pedestrian education involves informing pedestrians of their rights and responsibilities, as well as adressing safety concerns specific to pedestrians. Pedestrian encouragement programs are designed to motivate people to walk for transportation and recreation, through incentives and information that conveys the benefits of walking.

5.2.1 Pedestrian Education

Education of pedestrians is critical to ensure road safety, and is therefore integral to the concept of Complete Streets. This section covers messages and methods to educate pedestrians about how to walk safely. The same or similar topics can also be used when educating motorists.

Proper signage warns drivers that pedestrians may be crossing. Source: MORPC. Columbus, OH.

Crosswalks

Crosswalks are an important area of concern for pedestrians. Unfortunately, pedestrians and motorists often do not understand how to interact safely at crosswalks.

At unsignalized crosswalks, pedestrians have the right-of-way. However, they should always cross with caution and should not enter the crosswalk if motorists do not have sufficient time to stop. It is important for pedestrians to use the crosswalk when provided, since crossing outside the crosswalk is typically illegal.

At signalized crosswalks, pedestrians should wait for a "walk" signal, or if there is not a pedestrian signal, they should wait for a green light in their direction. Crossing during a "don't walk" signal or red light is illegal.

Per Ohio law, pedestrians also have the right-of-way to cross at unmarked crosswalks (i.e., any intersection where pedestrian crossing is not prohibited by a "don't walk" sign or red light). However, many motorists are unaware of this law, so pedestrians should exercise special caution when crossing at unmarked crossings.

Pedestrians should be aware that drivers may not see them at crosswalks. One scenario where this is especially likely occurs on multi-lane roads when one vehicle stops for a pedestrian, but a driver in an adjacent lane does not see the pedestrian and fails to yield. This problem may be alleviated by measures that encourage motorists to stop at a greater distance before the crosswalk, as doing so creates a greater sight triangle. Advance stop or yield bars are recommended at crosswalks on multi-lane roads for this reason.

Pedestrians exiting buses should take extra caution, whether crossing behind or in front of the bus. The bus can visually obscure the pedestrian from other drivers, even if the pedestrian is in a crosswalk and has the legal right to cross. If crossing in front of a bus, pedestrians should also make sure the bus driver sees them.

Pedestrians always need to be aware of their surroundings. Part of being aware is not being distracted by text messages, music (ear buds), cell phones, or other technology. Some electric cars can be particularly quiet and hard to hear over music coming from headphones. These distractions are especially problematic when crossing the street.

Railroad Crossings

Walking on railroad tracks is considered as trespassing on railroad property; this is not only illegal, but extremely dangerous. Furthermore, trains are a lot quieter than they used to be and overhang on each side by at least 3 feet, and up to 12 feet. Pedestrians should cross railroad tracks only at designated crossings.

Pedestrian crossing at a railroad with gate and lights. Source: FHWA.

Roads without Sidewalks

Walking on roads without sidewalks is a concern in rural areas and roads without a wide paved shoulder, but also on urban and suburban streets without sidewalks, or streets with sidewalks that are temporarily impassable due to snow, ice, or construction. In such circumstances, pedestrians should walk facing traffic so that they can see and take evasive action from any vehicle that may pose a danger to them.

Dark clothing increases the hazard of being struck by a motorist, especially on a high-speed road without street lights. When walking at night, in addition to walking facing traffic, pedestrians should wear reflective clothing and consider wearing lights (e.g., LED armbands or headlamps).

A pedestrian correctly walking facing traffic on an urban street without a passable sidewalk . Source: MORPC. Columbus, OH.

Pedestrian Laws

The definition of a "crosswalk" is provided in the Ohio Revised Code (ORC) as follows (§4511.01 LL):

1. That part of a roadway at intersections ordinarily included within the real or projected prolongation of property lines and curb lines or, in the absence of curbs, the edges of the traversable roadway.
2. Any portion of a roadway at an intersection or elsewhere, distinctly indicated for pedestrian crossing by lines or other markings on the surface.
3. Notwithstanding divisions (LL)(1) and (2) of this section, there shall not be a crosswalk where local authorities have placed signs indicating no crossing.

Per item (1), there is legally a crosswalk at an intersection where no crossing is striped or marked. ORC§4511.48 states that pedestrians who are crossing a roadway must yield the right-of-way to all vehicles, except when crossing at a (marked or unmarked) crosswalk.

Pedestrians have the right-of-way at this mid-block unsignalized crosswalk. Source: MORPC. Columbus, OH.

5.2.2 Pedestrian Encouragement

Encouragement for pedestrians refers to a variety of programs and activities that support and promote walking. It is important to note that any encouragement effort should be accompanied by education. Examples of encouragement programs are listed below.

Kids participate in Walk to School Day, 2009. Source: MORPC. New Albany, OH.

Walk to School Events

Walk to School events are special events during which children who live within a walkable distance from their schools are encouraged to walk instead of riding buses or being driven by their parents. Parents, teachers, law enforcement officers, and community leaders often participate. Walk to school events can be valuable opportunities for educating children about pedestrian safety. For more information, visit MORPC's website at www.morpc.org/walktoschool.

Columbus Neighborhood Walking Maps

Walking maps have been created for several neighborhoods within the City of Columbus by the Columbus Public Health program, "Healthy Places." The neighborhood walking maps include routes that connect destinations, such as grocery stores, recreation centers, multi-use paths, libraries, parks, and commercial districts. Residents may suggest routes for the maps and assist with safety-related information (e.g., no street lights, abandoned homes, unchained dogs, etc.). For more information, visit the Healthy Places website: www.bit.ly/ncYmJz.

Smart Trips Program

Smart Trips is an individualized marketing program with information about many different modes of travel, including walking. This program originated in Australia and Europe, but has been used successfully in many communities in the U.S. over the past decade.

The goals of Smart Trips include: reducing drive-alone trips, increasing walking, biking, transit, carpooling and car-sharing trips, and increasing neighborhood mobility and livability. A small geographic area of the city is chosen for the program each year; residents within this area receive individualized marketing on other modes of transportation besides driving alone.

Some of the walking-related elements of Smart Trips include (PBIC, 2011b):

- Calendar of walks and walking tours in the residents' areas
- Area walking maps
- A Walk to Wellness brochure focusing on health
- A crosswalk laws brochure
- A free pedometer and a walking log to keep count of daily steps

For more information, see "5.7.3. Smart Trips Program," on page 5-34.

Senior Strolls Walk Event

The Senior Strolls events are part of the Smart Trips program in Portland, OR (City of Portland, 2011b). However, such a series of walks targeted at seniors could be held apart from the full Smart Trips program.

Strolls typically range from 1 to 2 or more miles in length, offering seniors an easy, pleasant, social walking experience that gives them the confidence to consider walking as a transportation option. Walking with other senior strollers provides the added benefits of a valuable support network and new friendships.

Participants enjoy a senior stroll event. Source: Transportation Options. Portland, OR.

Walk Wise, Drive Smart

Walk Wise, Drive Smart is a community-based pedestrian safety program working to build community support for and awareness of senior-pedestrian safety issues. Funded by the National Highway Traffic Safety Administration (NHTSA), this program in Hendersonville, North Carolina has several components:

- Educational workshops and walking audits in different neighborhoods
- Community feedback through surveys and interviews
- Identification elements for a pedestrian safety plan

For more information, visit the Walk Wise, Drive Smart website: www.walk-wise.org.

5.3 Bicycle Education & Encouragement

As with other modes of travel, education is an important part of safe bicycling. Encouragement may also be helpful for people who are interested in bicycling, but who need motivation or have questions about how to get started. There are a number of bicycle programs focused on education and encouragement throughout the United States. Education programs work to ensure that bicyclists understand how to safely operate a bicycle under a variety of conditions. Meanwhile, encouragement programs help to increase the number of bicyclists on the road.

5.3.1 Bicycle Education

Bicycle training courses are an excellent way for new cyclists to develop the knowledge and skills necessary to safely ride a bicycle. They are also good for people who rode a bike earlier in life, but need a skills refresher to develop the confidence to begin riding on a regular basis. There are several different training programs available, ranging from absolute beginner-level classes to those teaching advanced technical skills. Similarly, there are classes suitable for nearly every age.

League of American Bicyclists Courses

The League of American Bicyclists (LAB) is a national organization with standardized training courses. This reduces the need for local training courses to be built from scratch. The LAB courses are structured in a progressive way, so that a student can go from beginning to advanced level, and even go on to become a League-Certified Instructor (LCI). However, LAB classes are not focused on learning how to ride a bicycle (how to balance, how to pedal, etc.), but rather are focused on how to ride safely in a variety of environments, including on-road.

LCIs teach classes designed by the League, and may also develop specialized classes for individual circumstances or groups. In addition to the training provided by the League, classes taught by LCIs are automatically covered through the LAB's insurance policy. Up-to-date rosters of LCIs are available online at the LAB website: www.bikeleague.org/programs/education/course_schedule.php.

Some LCIs prefer to work with certain audiences, such as school-aged children, college students, corporate office commuters, or night-shift workers. Classes can also be customized to a particular audience.

Education in the Nonmotorized Transportation Pilot Program

Education is a key component of the Nonmotorized Transportation Pilot Program (NTPP). Under this program, four U.S. communities (Marin County, CA; Minneapolis, MN; Sheboygan, WI; and Columbia, MO) each received $25M to demonstrate how improved walking and bicycling networks can increase rates of walking and bicycling (FHWA, 2011b). Each of the NTPP communities has a LAB class component as part of their education efforts. For more information about the NTPP, please see the FHWA website: www.fhwa.dot.gov/environment/bikeped/ntpp.htm.

The following classes are taught by LCIs:

- Traffic Skills 101
- Traffic Skills 201
- Group Riding
- Commuting
- Share the Road (for motorists)
- Cycling Skills for Parents
- Cycling Skills for Kids
- Safe Routes to School

Traffic Skills 101 is the most common LAB course offered. It includes classroom instruction, on-road riding, and emergency maneuver drills. More information on the classes and how to become an LCI is available on the LAB website: www.bikeleague.org/programs/education.

Traffic Skills 101 parking lot drills. Source: Granite State Wheelmen. New Hampshire.

Other Types of Bicycle Education

There are bicycle classes for a wide variety of topics beyond those discussed above. Some examples include:

- **Learning how to ride a bicycle for children and adults**. Note that adult learners may not want to take a class with children, or they may not want to take a class with other students.
- **Bicycle repair and maintenance**. Basic repair techniques are taught as part of LAB's Traffic Skills 101 class. However, a class devoted to bicycle repair can be more useful for some students and can also cover more advanced repairs. Potential local resources include various bike shops as well as two bicycle co-ops.

Parking lot drills during a "Confident Cycling for Families" class. Source: Eugene SRTS. Eugene, OR.

- **Bike Club Training**. Bicycle clubs tend to hold regular rides, some of which have a training focus. LAB offers separate leadership training for Bicycle Club Leaders. More information can be found online: www.bikeleague.org/members/club/leadershiptraining.php.

Since LAB courses are standardized, it is strongly recommended that LCIs be used for training courses focused on safe riding on roads. One exception is the International Police Mountain Bike Association (IPMBA), which offers classes for law enforcement and Emergency Medical Service (EMS) personnel (see below for more discussion).

Bicycle patrol officers enrolled in IPMBA training. Source: IPMBA.

Bicycle Patrol Unit Education

In the City of Columbus, each bicycle patrol unit consists of two police officers. The Bicycle Patrol Unit can also function as an educational tool. Law enforcement officers can provide bicycle education, not only by enforcing existing laws and speaking with residents, but by providing an example of good bicyclist behavior.

Many bicycle patrol officers take a training course offered by the IPMBA. Officers learn "skill development, riding in diverse traffic situations and practicing patrol tactics or EMS-specific techniques. They learn to ascend curbs, descend stairs and perform emergency maneuvers designed to avoid crashes" (IPMBA, 2011).

5.3.2 Bicycle Encouragement

As opposed to formal education classes, encouragement programs work by creating incentives and support for bicycling. Education may be incorporated into these programs, but the primary goal remains to encourage bicycling. As such, these programs often target people who do not currently bike, or who could bike more often. Some example programs are discussed below.

Pedal Instead bike parking. Source: MORPC. Columbus, OH.

Pedal Instead

Pedal Instead is a free bike valet program for special events such as festivals and OSU football games. This program can encourage people to travel by bike to special events, especially if motor vehicle parking is expensive or roads are congested. In 2009, Pedal Instead parked 5,436 bikes, which was an increase of almost 30 percent over 2008. People who used Pedal Instead to park their bike traveled over 43,000 miles (Pedal Instead, 2011).

Pedal Instead is staffed by local volunteers. In addition to parking the bikes, volunteers use the opportunity to discuss bicycle-related topics with users or passersby. The bikes are stored in a monitored fenced-off area. Items on the bikes (such as bags and baskets) can be left on the bike and locks are not required. In the drop-off area, there is typically a table with materials, such as bicycle group brochures, maps, and educational brochures. More information can be found on the Pedal Instead website: www.pedalinstead.org.

Free Lights

Many cities in the U.S. have a program that provides reduced cost or free bicycle lights to make cyclists more visible at night. The Columbus Bicentennial Bikeways Plan (BBP) recommended a "Lights on Safety" Campaign. It would include advertising and "a way to provide reduced cost or free bicycle lights to bicyclists." (City of Columbus, OH & Alta Planning, 2008).

Ciudad de Luces

The 2011 Alliance for Biking and Walking Best Practices Award was given to the Los Angeles County Bicycle Coalition City of Lights program. Also known as "Ciudad de Luces" the program's goal is "to increase working-class Latino immigrant bicyclists' safety and empower them to educate and spread bicycle safety information and advocacy to their communities." They have given out both bike lights and safety vests. More information can be found on their webpage: www.ciudaddeluces.wordpress.com.

Bike Share Programs

Bike share programs can encourage tourists and others to consider biking for their transportation needs. For more information, please see "5.7.5. Bicycle Share Programs," on page 5-38.

Bicycle share station by B-Cycle. Source: MORPC. Denver, CO.

Bike Ambassadors

Bike Ambassador programs provide hands-on demonstrations and presentations at various events on bicycle safety. The program goals are to reduce bicycle crashes and help all road users learn how to share the road.

Below is a partial list of cities with ambassador programs:

- Chicago, IL: Mayor Daley's Bike Ambassadors
- Boulder, Colorado: GO Ambassadors
- Minneapolis, Minnesota: Bike Walk Ambassadors
- Washington, DC: DC Bike Ambassadors
- Philadelphia, Pennsylvania: Bicycle Ambassadors

One of the oldest and largest bike ambassador programs is the Chicago program, which is described in more detail in the box below and at www.bicyclingambassadors.org. There are currently no bike ambassador programs in the State of Ohio.

Chicago's Bike Ambassadors

Mayor Daley created Chicago's Bike Ambassador program in 2001. The three main goals of the program are:

- *To increase the number of trips made by bicycle*
- *To reduce the number of bicycling-related injuries and fatalities*
- *To help cyclists, motorists, and pedestrians better share the roads and off-street trails*

Ambassadors attend musical festivals, neighborhood health fairs, block parties, and famers markets to encourage and educate residents about bicycling. They also give demonstrations at day camps, libraries, schools, and area businesses. In 2010, the Ambassadors attended 359 events and had face-to-face contact with more than 60,000 people, up more than 600 percent since 2001. Their peak season is between May and September.

The Ambassadors work with a diverse audience, including people of all ages and cultures. They have handouts available in many different languages, including English, Spanish, Chinese, Korean, and Polish.

High school students can work with Bicycling Ambassadors to target their peers. They become Junior Ambassadors after completing a 10-week after-school bicycle safety and repair class (City of Chicago, 2011).

Bicycle Ambassadors help kids properly adjust their helmets. Source: City of Chicago's Bicycle Ambassadors (2011). Chicago, IL.

5.3.3 Brochures and Other Educational Materials

A wide variety of bicycle education and encouragement brochures and other materials are available online. Some of these are presented in "Table 13. Bicycle Education and Encouragement Publications" below.

Table 13. Bicycle Education and Encouragement Publications

PUBLICATION	SOURCE	TARGET AUDIENCE	LINK	NOTES
Bicycling Street Smarts: Riding Confidently, Legally and Safely	Ohio Department of Transportation	All bicyclists, especially adults	www.bit.ly/tCZxxs	
Do You Make These Eight Common Cycling Mistakes?	Ohio Department of Public Safety	All bicyclists, especially adults	http://1.usa.gov/nZkHMk	
Bicycle Safety Coloring Book	Ohio Department of Public Safety	Children	http://1.usa.gov/po1ckv	
Bicycle Safety: What Every Parent Should Know	Ohio Department of Public Safety	Parents	http://1.usa.gov/ngxJ32	
Bike Commuting 101	Bike Pittsburgh	New bike Commuters	www.bit.ly/oES4Kv	Comic book format
Columbus Metro Bike User Map	MORPC	Central Ohio bike commuters	www.morpc.org/bikemaps	Includes safety tips and information on shared-lane markings

5.3.4 Local Plans that Support Bicycle Education

Transportation and city plans tend to focus on infrastructure planning and design. However, support can be found in these plans for bicycle education and encouragement efforts, whether through policy goals or program funding.

The Columbus Bicentennial Bikeways Plan

The Bicentennial Bikeways Plan (BBP) was released in May 2008 (City of Columbus & Alta Planning, 2008). This plan was developed for the City of Columbus, but has regional implications, as Columbus is the largest city in the MORPC region, based on both population and land area.

Two of the nine bicycle elements identified in the Columbus BBP include education: *(6) Promote bicycle safety issues* and *(9) Champion the education of motorists and bicyclists concerning the shared use of roadways.*

To address *(6) Promote bicycle safety issues*, the plan recommends the following strategies: education and enforcement programs, including incorporating bicycle safety education into public schools' curriculum and driver point reduction classes; a campaign to increase the use of bicycle helmets and bike lights; and target enforcement to encourage bicyclists and motorists to follow traffic laws.

To address *(9) Champion the education of motorists and bicyclists concerning the shared use of roadways*, the plan recommends implementation of a citywide 'Share the Road' education and enforcement campaign, with the High Street corridor as a demonstration area.

For more information view the entire Columbus BBP online: www.altaprojects.net/columbus.

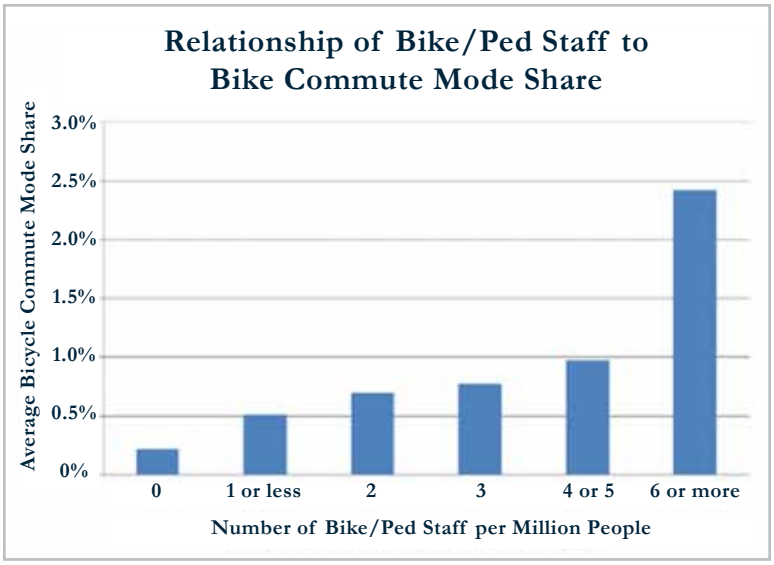
Regional Bikeways Plan

MORPC promotes "multi-modal transportation choices including travel by highways, transit, passenger rail, bicycling, and walking; reducing the demand for driving alone" (MORPC, 2006). Every four years, MORPC updates its regional bikeways plan. This Plan is in the process of being updated for the 2012 Regional Plan. The latest Regional Bikeways Plan can be found online: www.morpc.org/trans/BikePedRegionalBicycleTransportationFacilitiesPlan.pdf.

In addition, MORPC is creating a methodology for the regional bikeway system to identify which routes have the highest need for a bike facility based on a variety of criteria, such as origins and destinations, safety, and barriers.

5.3.5 Staffing Support

Many cities find it beneficial to have a staff person dedicated to bicycle programming. The individual in this position is often referred to as the Bikeways Coordinator. In addition to educational programming, the Bikeways Coordinator can work on the planning, facility construction, and maintenance of the bikeways. This person can also work with the Advisory Committee, which is usually made up of a broad cross-section of local residents.



Cities with higher bicycle and pedestrian staffing levels tend to have a higher bicycle commuter mode share. Source: LAB, 2010.

The League of American Bicyclists (LAB) released a report in April 2010 on different levels of staffing support for bicycling. The results showed that cities with higher bicycle and pedestrian staffing levels tend to have a higher commuter mode share. This document may also provide some helpful information on the benefits of staffing support (LAB, 2010).

Bikeways Advisory Committee

An advisory group made up of residents can help to advise the city on bike projects and programs on an ongoing basis. While this should not replace general public involvement, the meetings should be open to the public and well publicized to increase transparency. Additional public involvement meetings should be held, especially for larger projects.

On a regional level, MORPC has been convening its Pedestrian & Bicycle Staff from Local Jurisdictions (PBJ) group since summer 2010. The quarterly meetings are designed to provide engineers, planners, parks and recreation staff, health departments, and transit agencies the opportunity to exchange projects and ideas, learn about best practices, and participate on regional pedestrian and bike issues.

A good example of a local advisory group is the Dublin Bicycle Advisory Task Force, which was most active from late 2009 to early 2011. Local residents applied and were selected by City Council to participate. For more information, please visit: www.dublin.oh.us/bdscomm/bike/index.php.

Another local example is OSU's bicycle advisory committee which meets on a regular basis to discuss how to make the universtiy campus area more bicycle friendly. OSU staff shares information with the group about projects that other agencies are working on and have an impact on the area.

Professional Training for Engineers and Planners

There are a number of training opportunities for engineers and planners that will help them include bicyclists in their work. Some options include:

- The National Highway Institute (NHI) is a division of the Federal Highway Administration (FHWA). They hold training classes with continuing education credits. These include Pedestrian Facility Design (FHWA-NHI-142045) and Bicycle Facility Design (FHWA-NHI-142046). Visit their website for more information: www.nhi.fhwa.dot.gov.
- FHWA has also created a university course on Bicycle and Pedestrian Transportation. Twenty-four lessons cover a range of planning and design issues. For more information see the FHWA webpage: www.fhwa.dot.gov/publications/research/safety/pedbike/05085.
- There are a wide variety of conferences that offer continuing education credits. The Pro Walk Pro Bike conference is held every two years and usually offers continuing education credits. For more information visit: www.bikewalk.org/conference.php.
- The Association of Pedestrian and Bicycle Professionals (APBP) holds monthly webinars on non-motorized transportation topics. For more information check their website: www.apbp.org/?page=Webinars. Locally, MORPC hosts these webinars for free to members and the general public. Contact MORPC for more information on the webinars held at MORPC. Most presentations offer credit for professional certification.

5.4 Transit Education & Encouragement

Education of both transit riders and transit drivers is a critical component of the successful operation of a mass transit system. For example, transit riders need to know where transit routes go, how often the routes run, how much fares cost, how fares can be paid, and how to stay safe when using the system.

Transit drivers need to know how to operate transit vehicles safely when interacting with a variety of other users, such as pedestrians of all ages, bicyclists, wheelchair users, private cars, and other larger vehicles. Transit drivers should also recognize that there is an element of customer service to their work, and that professional behavior is crucial to the operation of a successful transit system.

Education of transit users will improve road safety, and is therefore integral to the concept of Complete Streets. This section covers messages and methods to educate transit users. Some example encouragement programs have also been included.

5.4.1 Transit User Education

The topics discussed below should be addressed in educational messages for transit riders. These messages can be conveyed through a variety of media, such as signs, brochures, and presentations.

Safety

Some bus stops are located in areas without sidewalks. Others are located without a convenient crosswalk to cross a busy road. Although these are engineering problems, transit riders should be educated to use caution at such locations.

Convenience

Transit systems should be marketed as convenient (and in some cases, faster) alternatives to driving. Amenities offered by transit systems, such as bike racks on buses, Wi-Fi on buses, and special service to large events, should be specifically marketed to raise awareness. Buses that lower to the curb and lifts for wheelchairs and other devices can be helpful for all riders, especially those with disabilities.

How To Ride

The practices listed below will help transit users to become more familiar and comfortable with the transit system. Ultimately, this may increase user satisfaction and ridership levels.

- Maps and schedules for individual bus routes should be posted at bus stops wherever possible.
- Maps of the entire bus system should be available and should be posted inside bus shelters.
- Printed bus schedules for the appropriate routes should be available inside buses.
- Consider providing schedules and other information in a variety of formats. For example, audiotape, large print, Braille, and languages such as Spanish and Somali.
- Encouraging passengers to exit through the rear door of a bus can improve transit system efficiency because it avoids congestion caused by passengers boarding and exiting through the same door. This can reduce the amount of time the bus spends at a stop. However, some bus systems (for example, Ohio State University's free CABS system) allow riders to board at the rear as well as the front, since no fares are collected.
- Brochures that explain "how to ride" may also be helpful, especially for those with no prior experience using transit. This can make the process seem more familiar. An example of such a brochure is COTA's "How to Ride Guide." It can be found online at www.cota.com/assets/Riding-Cota/How_to_Ride_BrochureWEBopt.pdf.

Bus schedule and map posted inside a COTA shelter. Source: MORPC. Columbus, OH.

Electronic Rider Information

Over the last several years, there have been many innovations in the realm of electronic dissemination of transit information. This is an important development as it allows users to access information in the format that they are most likely to use. The list below includes some ways that this information may be made available.

- Route maps and schedules should be available on the transit agency website in an easily printable format, such as PDF.
- System maps should also be available on the transit agency website. They may show different levels of detail for areas in which transit routes are more or less dense. For example, COTA has three system maps available at: www.cota.com/maps.aspx.
- Many transit agencies have an interactive online system map. Online trip planners are useful tools for many transit riders as they help customize the information to the individual trip. They allow the user to enter an origin, destination, and desired time of arrival. A local example is the COTA online trip planner: www.infoweb.cota.com/hiwire.
- Google Maps (www.maps.google.com) also has information on transit routes and schedules. It offers an option to select "public transit" as the travel mode when getting directions. It is possible to customize your route by choosing "fewer transfers" or "least walking." For most urban areas, bus stops are marked on the map, and information on arriving buses can be obtained by clicking on the bus stop icon. Google Maps data are provided by the transit agencies; however, they may not include temporary route or schedule changes.
- Bus route and schedule information can also be made available on demand through relatively simple mobile phone tools. For example, COTA has an automated phone line that allows users to enter the ID of the bus stop where they are waiting to receive bus schedule information over the phone. COTA's "TXT 4 NXT Bus" pilot program allows users to send a bus stop ID via text message and receive a text message in reply giving the times of upcoming buses: www.cota.com/TXT4NXTBUS.aspx.
- Bus route and schedule information can also be made available through more sophisticated methods such as smartphone applications. An example is the Chicago L Rapid Transit iPhone and iPod Touch Application, which allows users to find nearby transit stops, plan trips, and find points of interest: www.presselite.com/iphone/chicagorapidtransit.
- Automatic vehicle locator (AVL) systems show the real-time status of a given transit vehicle through the use of GPS and web-based technologies. The information may be conveyed through a map interface or an electronic messageboard. This can be useful for passengers, as it provides real-time information about whether a bus is going to arrive on time at a specific stop.

Response from COTA's "TXT 4 NXT Bus" message system. Source: MORPC.

Open Transit Data

Advances in technology have created new opportunities for transit agencies to disseminate transit schedules in a more convenient format for their customers. Open data provided by transit agencies facilitates the development of electronic trip planning tools by private developers. This can increase transit ridership by making transit use more convenient.

The film, "A Case for Open Data in Transit," gives a good overview of the benefits of open transit data. Additionally, a "public transit openness index" has been developed and applied to a selection of U.S. transit agencies. It can be viewed at: www.bit.ly/ucKLrc. COTA has provided its data in Google Transit Feed Spec format on the following webpage: www.cota.com/data.asp. These data are used by Google Maps to provide transit directions.

5.4.2 Transit Driver Education

In addition to Commercial Driver License (CDL) training, bus drivers should be specifically trained on a number of issues relating to operating a large vehicle in an urban environment. Specifically, transit drivers should be trained to:

- Yield to pedestrians at crosswalks.
- Be alert for pedestrians who may cross improperly or suddenly in front of transit vehicles.
- Observe all traffic laws with regard to bicyclists, and understand that bicycles are considered vehicles under Ohio law.
- Pass bicyclists at a safe lateral distance of at least 3 feet.
- Assist bicycle riders with the usage of the bike racks.
- Understand that bicyclists belong in the road and should generally not ride on sidewalks.
- If applicable, ensure that the bus stop announcement system is working and report any damage of the in-vehicle electronic signs that display the next bus stop. This is especially important to make transit user-friendly to people with disabilities. If the announcement system needs repair, the bus driver should personally call out the stops.
- Remind passengers to use the rear door to exit, as this can speed up the time the bus spends at a stop. Delays at stops can reduce the ability for transit to stay on schedule.

5.4.3 Transit User Encouragement

Encouragement programs are designed to increase the number of people using transit. Encouragement programs should always be accompanied by educational messages to ensure people are using the system safely and are having a pleasant experience. Targeted encouragement aimed at specific populations can be especially effective. Examples of transit-related encouragement tips and programs are discussed below.

Transit Encouragement for Children

Children should be encouraged to ride transit as appropriate. They may use public transit to travel to school or other destinations. This can reduce traffic congestion around schools, thus increasing safety for all students. Columbus City School students can already ride COTA for free with a valid student ID card.

Children should be accompanied a few times before they ride on their own. If they are not sure where to get off the bus, they should ask the driver. Sitting near the driver may also be a good idea. As for other passengers, children should wait until the bus has come to a full stop before standing up.

More tips can be found on Vancouver's Smart Trips program website, called "Travel Smart": www.travelsmart.ca/en/School/Getting-there.aspx.

Transit Encouragement for College Students

College campuses tend to have a high demand for parking spaces. As a result, parking is often expensive on and around college campuses. Expensive parking encourages the use of transit, which can be an effective part of a comprehensive Travel Demand Management (TDM) program.

Agreements have been reached between COTA and two local colleges, The Ohio State University (OSU) and Columbus College of Art & Design (CCAD), so that students may ride without paying bus fares when they board. Students pay a small fee as part of their tuition: www.cota.com/Students.aspx. CCAD and OSU students may ride COTA for free by showing their student ID. The fee for this service is only $9/quarter for students. For more information, please see: www.tp.osu.edu/students/alternate.shtml.

A COTA service website aimed at OSU students can be found at COTA Go Bus: www.cotagobus.com. Additionally, OSU has its own transit service called the Campus Area Bus System (CABS). Students as well as the public at large can ride CABS for free. For more information, visit: www.tp.osu.edu/cabs/index.shtml.

Transit Encouragement for Seniors

Public transit can provide seniors with independence. There are several useful resources available to help and encourage seniors to use transit. The American Association of Retired Persons (AARP) outlines the steps to take when riding public transit for the first time on its website: www.aarp.org. AARP has also produced a "Getting Around Guide" for seniors, which includes information on using transit. English and Spanish versions are both available at their website (AARP, 2011).

COTA users who are 65 and older are eligible for a Senior ID card. This provides significant discounts (50 percent) on COTA monthly passes. COTA also provides free travel training to senior organizations. For more information, contact COTA at 614-275-5828.

Additionally, there are service providers that work with the senior population. Please see the Franklin County Coordinated Plan for more information (MORPC, 2008). This program is reviewed tri-annually.

A wheelchair user boarding a COTA bus. Source: COTA. Columbus, OH.

Transit Training for Disabled Populations

Transit service is often complemented by paratransit service. This service is provided for those who are unable to use fixed-route service due to their disability. It is a demand-response shared-ride service called "Mainstream." For more information on this program, call 614-275-5828 or review the Mainstream brochure on COTA's website: www.cota.com. Riders with disabilities also receive a 50 percent discount on bus fares on regular fixed-route COTA service.

Local Incentives

Columbus-area businesses may offer discounted monthly COTA passes to their employees. Seven-day COTA passes are also available for purchase. For more information, check COTA's website: www.cota.com/Employer-Bus-Passes.aspx.

MORPC RideSolutions offers a free guaranteed ride home (GRH) program, whereby registered transit users receive reimbursement for emergency taxi service home from work, up to 4 times a year. For details, visit the RideSolutions website: www.morpc.org/ridesolutions.

Smart Trips

As discussed earlier, Smart Trips is an individualized marketing program with information about many different modes of travel, including transit. Some of the transit-related items include: provision of relevant transit maps and schedules, ride guides for seniors and the disabled, and a list of bus stop IDs for stops closest to the resident's home, which makes calling the transit agency for real-time bus information easier. For more information, see "5.7.3. Smart Trips Program," on page 5-34.

Additional Public Meetings Related to Transit Programs

There are various public meetings related to transit programs. These can especially be of interest to the senior and disabled populations. For more information about COTA's Mobility Advisory Board, please call (614) 866-6900.

An advisory group called "Accessible Transportation Advisory Council (ATAC)" is chaired by COTA staff and meets regularly. Please visit their forum for more information: www.health.groups.yahoo.com/group/mailatac.

The City of Columbus holds a meeting of the Advisory Committee on Disability Issues. For more information, please contact the Columbus ADA Coordinator, at (614) 645-7671. You may also visit the ADA Coordinator webpage at: www.bit.ly/A9XsuK.

A COTA 2010 short-range plan meeting with local stakeholders. Source: MORPC. Columbus, OH.

5.5 Motorist Education

Throughout the United States, and including central Ohio, the vast majority of trips - whether for work, school, shopping, recreation, or other purposes - are taken via private vehicle. This means that motorists are the most common type of road user. Therefore, education of motorists is a crucial component of any Complete Streets effort. Motorists can be educated through a variety of programs, and examples of these are outlined in this section. Since most trips are taken by private vehicles, further encouragement is not needed.

The term "motorist" generally refers to drivers of automobiles, but also includes drivers of any motorized vehicle, such as a scooter or motorcycle. Relevant educational messages for these specific types of motorists have been noted throughout this section. Another related term is "vulnerable road user," which refers to pedestrians, bicyclists, moped users, scooter users, motorcyclists, farm vehicle drivers, and Amish carriages. For more information on vulnerable road users, including laws passed to help protect them, refer to the other sections in this chapter.

5.5.1 Motorist Education Messages

The topics discussed below address some of the most important messages relating to motorist education and Complete Streets.

A driver fails to yield to a student crossing legally at a crosswalk. Source: MORPC. Columbus, OH.

Motorist Interaction with Pedestrians

Ohio state law requires motorists to yield to pedestrians at all marked and unmarked crosswalks. Yielding is also required at WALK signals. Motorists should use special caution when driving through residential areas, school zones, or other places where the volume of pedestrians and children playing is high. Initiatives such as a pedestrian crosswalk sting can increase awareness and understanding. For more information, see "6.5. Motorist-Related Enforcement," on page 6-10.

Motorist Interaction with Bicyclists

The Pedestrian and Bicycle Information Center (PBIC) gives the following advice regarding motorist education (PBIC, 2010a):

- When educating motorists, one should always emphasize the benefits of sharing the road, such as safer, more inviting streets with reduced crime, increased property value, a better environment, and an overall enhanced quality of life.
- Instructors in motorist education should underscore the notion that a bicycle is not a toy but a viable means of transportation, often the only means of transportation for many people.
- Those educating motorists should stress that they are not trying to force motorists off the roads or take away their rights, but illustrate that cyclists have an equal right to the road. The more motorists know about cycling safety, the safer streets will be for everyone on them.

Motorist Interaction with Scooters and Motorcyclists

Scooter and motorcycle riders generally have the same rights and responsibilities as automobile drivers. However, due to their smaller size and lack of physical protection, they are more vulnerable than car drivers. They are easily hidden in a car's blind spot and it can be more difficult to judge their speed. Additionally, scooters and motorcycles are more severely affected by debris and adverse road conditions. For more information, please see: www.forcardrivers.com/index.html.

Safe Driving Concerns with Targeted Age Groups

Teenage drivers (15 to 20 years old) are involved in three times as many fatal crashes as are all other drivers (NHTSA, 2011c). In 2008, older people (65 years and older) accounted for 15 percent of all traffic fatalities (NHTSA, 2011b).

Both teens and seniors may suffer from poor driving skills. Teen drivers have less experience driving and may be overconfident, while senior drivers often have declining vision, hearing, and reaction time. In addition to impaired faculties, senior drivers can encounter issues with multiple medication use or drug interactions. These issues should be openly discussed and alternatives to driving should be offered.

A teenager texting while driving. Source: NHTSA.

Unsafe Driving Behavior

Several unsafe driving behaviors have been identified by the National Highway Traffic Safety Administration (NHTSA) including distracted driving, impaired driving (alcohol and other drugs), aggressive driving, and unrestrained driving.

Distracted driving activities include: using a cell phone, eating and drinking, reading, and watching a video, among others. MORPC adopted a resolution in 2010 to support distracted driving legislation and frequently testifies in support of such bills (MORPC, 2011e). For more information, please see: www.distraction.gov.

Impaired driving mainly refers to driving under the influence of alcohol and drugs. For more information, see: www.nhtsa.gov/Impaired.

Aggressive driving refers to a person committing a combination of moving traffic offenses so as to endanger other persons or property. This includes speeding, following too closely, or running red lights. For more information, see: www.nhtsa.gov/Aggressive.

Unrestrained driving means that the driver or passengers in a car are not belted. Ohio has a secondary seatbelt law, which allows officers to issue a citation only after the officer stops the vehicle or cites the driver for another offense. MORPC and many other central Ohio agencies and individuals support the adoption of a primary seatbelt law since it can save lives, reduce injuries, and decrease costs. MORPC, together with many other agencies and individuals, advocated for a statewide primary seatbelt law in 2009, but the proposed house bill was turned down by the Senate. For more information on unsafe driving behavior, see: www.nhtsa.gov/Driving+Safety/Occupant+Protection.

Innovative Designs

When a new roadway design, such as a roundabout, is introduced to a community, it is important to provide educational outreach on use and benefits. For example, a regional outreach effort was conducted in 2007 to better explain the use of roundabouts to drivers since many were still unfamiliar with them. Brochures and a video were produced, based on existing federal roundabout education information.

For more information about roundabouts, please see:
www.morpc.org/roundabout.

5.5.2 Motorist Education Programs

There is a variety of ways to educate motorists on the topics mentioned above. Some examples are discussed in this section.

Driver Education through Licensing

Driver's licensing agencies can require motorists to demonstrate knowledge of how to drive safely and courteously in the presence of other motorists, bicyclists, pedestrians, and other vulnerable road users. For example, Ohio's Graduated Driver Licensing law was made stricter for teen drivers in 2007 by limiting the number of non-related occupants that can be in a car, and by increasing night driving rules (ODPS, 2010b). For more information, see: www.bmv.ohio.gov/graduated_dl_teen_laws.stm.

The Ohio driver's manual is very limited in its coverage of laws with regard to pedestrians, bicyclists, and other vulnerable roadway users. Some states, such as Oregon and Tennessee, have bicycle- and pedestrian-related questions in the driving exam:

- As part of Tennessee's strategic highway safety planning efforts, a section on non-motorized travel was added to the 2010 Tennessee Driver's License Manual, and test questions will be added to the driver's license exam addressing bicycle and pedestrian laws (Meehan, 2010).
- The Oregon driver's manual has sections on pedestrians and bicyclists (Oregon DOT, 2010, pp. 77-83).

Public Service Announcements

Public service announcements (PSAs) broadcast on radio, television, and other venues can be an effective way to reach a large and widespread audience. A good example is the Tennessee Department of Motor Vehicles, which runs public service announcements about the state's three feet Passing Law (requiring motorists to allow at least three feet of lateral distance when passing bicyclists) at all testing centers, and also showcases the three-feet law on wall posters (Meehan, 2010).

Driver Diversion Programs

A driver diversion program is an educational program intended for drivers who have violated road laws (usually first-time offenders). Completion of the program can allow an offender to avoid penalties such as paying a fine or losing driving privileges. For example, Multnomah County, Oregon offers a "Share the Road Safety Class" for all road users. The class covers state laws that apply to motorists, pedestrians, bicyclists, and other road users. Eligible first-time offenders can take the class as an alternative to a conviction or a fine (Larsen, 2008).

Educational Websites

Websites providing easily accessible educational information on Rules of the Road, including videos, can be very useful in increasing awareness and understanding. A few examples are listed below:

- MORPC's "Rules of the Road" webpages focus on pedestrian, bicycle, and roundabout safety (www.morpc.org/transportation/Rules_Of_The_Road/RulesoftheRoad.asp). These pages can be expanded as new educational needs arise.
- MassBike provides the "Same Roads Same Rules" educational website, with tips for motorists and bicyclists (www.massbike.org/srsr/).

League of American Bicyclists Motorist Education Classes

The League of American Bicyclists (LAB) offers a Motorist Education class that can be added to driver's education programs. The three-hour class is suitable for a variety of class settings including general driver's education, diversion training, and bus driver training. Topics such as bicyclist roadway positioning, hand signals, turning, and principles of right-of-way are covered (LAB, 2011b).

Senior Driver Education Programs

Education programs for senior drivers can help people better understand current vehicle technology as well as their own driving limitations. Lower insurance rates may be used as an incentive to encourage seniors to take the course, where applicable. The following programs are targeted toward seniors:

- AARP's Driver Safety Program, which includes courses, checklists, and various publications on related topics (www.aarp.us/vZnu59).
- AAA's website for senior drivers, including general information and various online tools and programs (www.seniordrivers.org/home).
- CarFit, a program designed to help older drivers find out how well they currently fit their personal vehicles, to highlight actions they can take to improve their fit, and to promote conversations about driver safety and community mobility (www.car-fit.org).

Motorist Education Through High Schools

Schools can be an excellent venue for educating motorists about safe driving around vulnerable road users. Both teen drivers and parents can be educated through school programs.

Many schools encourage student drivers and parents to take safe driving pledges via school websites and other venues. A local example is the Olentangy Local School District, which has offered various incentives for parents and students to take a safety pledge. The pledge is available online at: www.olentangy.k12.oh.us/buildings/olhs/docs/2010safedriverpledge.pdf.

Another example is the Rye, NY Safe Routes to School program, which developed separate pledges for both parents and students. The Parents' Safe Driving Pledge includes points about safe driving around pedestrians and bicyclists, and may be viewed at: www.ryeymca.org/pdf/SRTS%20webinar_2009.pdf.

Parents' Safe Driving Pledge

I promise to:

- *Never speed through residential streets and school zones*
- *Never talk or text on a hand-held phone while driving*
- *Always wear a seat belt and make sure passengers also buckle up*
- *Stop for pedestrians and bikers in crosswalks*
- *Never pass a vehicle stopped for a crossing pedestrian*
- *Never run stop signs or red lights*
- *Never pass a stopped school bus with flashing red lights*
- *Never park in or block a crosswalk*
- *Always drop children at curbside, never from a double-parked car*
- *Never leave the car idling for more than 3 minutes (state law)*

Source: Rye, NY YMCA, 2011.

Students' Safety Pledge

I promise to:

- *Always follow traffic signals or the directions of a crossing guard*
- *Always cross the street in a crosswalk; make sure the driver can see you, has time to stop*
- *Always look left, right, and left again before crossing the street*
- *Never dart out between parked cars*
- *Always wear my seat belt when riding in a car*
- *Always exit the car from the curb side*
- *Always wear a bike helmet when riding my bike*
- *Always ride my bike in the same direction as the car traffic*
- *Always use hand signals when turning on my bike*
- *Never cross a street while on the phone, texting, or wearing headphones*

Scooter and Motorcycle Education Programs

The Motorcycle Safety Foundation is a national non-profit organization that provides programs in rider training, operator licensing, and public information. They offer a variety of rider courses, including the Basic Rider Course (BRC), Experienced Rider Course, and Scooter Basic Rider Course. Some benefits of taking such courses include greater confidence, improved skills, licensing-test waivers, and insurance discounts. In Ohio, participation in the BRC requires at least a temporary motorcycle learner's permit. Those who pass the BRC receive the motorcycle endorsement. For more information, please see: www.motorcycle.ohio.gov.

Crosswalk Stings

Crosswalk stings are events aimed at improving motorist behavior, in which police officers target a particular crosswalk (usually unsignalized) during a specific time period, and issue warnings or citations to motorists who fail to yield to pedestrians. Studies have shown these operations can result in a long-term improvement in motorists' yielding behavior at the locations where they take place. One example is Miami Beach, FL, where yield rates at one location increased from 3.3 percent to 27.8 percent (Van Houten and Malenfant, 2004).

MORPC organized crosswalk stings in central Ohio in September 2010, with five communities participating.

A Police officer conducts a crosswalk sting. Source: MORPC. Columbus, OH.

5.6 Safe Routes to School

A Safe Routes to School (SRTS) program gives community leaders, schools, and parents the opportunity to improve safety around schools and encourages more children, including those with disabilities, to walk and bike to school safely. By increasing the number of students walking and biking to school, the program helps to reduce traffic congestion around schools and to improve health and the environment; in return communities become more livable for everyone (NCSRTS, 2011b).

A successful Safe Routes to School program must address 5 interrelated topic areas known as "the 5 E's." The 5 E's include: Engineering, Education, Enforcement, Encouragement, and Evaluation. This section focuses on education and encouragement.

5.6.1 SRTS Education

Education is an important element to raise awareness of the benefits and goals of the SRTS program. Education activities are closely linked to encouragement strategies (see below). The main goal of an SRTS education component is to teach pedestrian and bicyclist traffic safety skills.

Education programs can have long-lasting effects on the community as they not only teach children how to walk and bike safely but also inform parents and other drivers how to drive more safely around pedestrians and bicyclists. In order to come up with the right educational strategy, it is important to utilize an SRTS committee made up of teachers, parents, and community leaders. This committee can determine who needs to be educated, when the education should start and what information needs to be shared and how to share it.

SRTS education strategies typically focus on traffic safety skills, safety awareness, creation of life-long safety habits, and inclusion of parents, neighbors, and other drivers.

Examples of education programs include bike rodeos, bike education classes, walk-a-thons, safety stations set up at schools, or bike rodeos that focus on topics such as pedestrian safety, bike safety, 911 emergency, or railroad safety.

Elementary school kids learn the rules of the road and how to ride a bike safely at bike rodeos in Pickerington, OH (left) and Gahanna, OH (right). Source: MORPC.

5.6.2 SRTS Encouragement

As part of the SRTS program, encouragement strategies focus on the benefits of walking and biking to school. Encouragement strategies are necessary in order to create excitement and interest in walking and biking. Encouragement can include special events, walking and biking clubs, poster contests, or activities that show parents and kids that walking and biking are a lot of fun.

Encouragement and education are closely related. While parents and kids are encouraged to walk and bike, they can also be educated on the safety and benefits of walking and biking. Encouragement builds interest in the SRTS program and the excitement will create the support that is needed for long-term projects, such as construction of a new sidewalk.

Encouragement activities should be chosen based on the number of kids that are able to walk and bike from home to school. However, children who live too far or have unsafe routes to school should also be considered.

Encouragement activities are easy to start and often require little or no funding. Anyone in the community can organize an event and all children should be involved, including children with disabilities. When planning an activity, it should show quick success and generate excitement for other strategies that may require more resources. Examples of encouragement incentives and activities include incentives, such as a golden shoe, little feet pendants, or stickers; offering a walking school bus; or using the MORPC Walk to School Toolkit.

MORPC promotes and coordinates Walk to School efforts throughout cental Ohio. MORPC partners with agencies, including schools, health departments, service departments, police agencies, and parent associations, among others, to provide tools and resources to communities to help with their walk to school initiatives. The goal is to bring communities together, to build partnerships among different agencies, and to work toward a safer and more livable region. More information about MORPC's efforts can be found on its website at www.morpc.org/walktoschool.

This Golden Shoe was awarded to the class with the most walkers and bikers. Source: Par Excellence SRTS Committee. Newark, OH.

Children in Worthington display signs as they walk or bike to school in a "Walking School Bus." Source: Jeff Stephens. Worthington, OH.

Kids walk and ride their bikes along a trail leading to their school on International Walk to School Day. Source: MORPC. Gahanna, OH.

5.7 Transportation Demand Management

Transportation Demand Management (TDM) can be defined as "various strategies that change travel behavior (how, when, and where people travel) in order to increase transport system efficiency and achieve specific planning objectives" (VTPI, 2011b).

MORPC has its own TDM program with the vision to "guide people toward healthy travel options that support environmentally sustainable, economically thriving, and equitable communities." MORPC's TDM program includes its ridematching program, RideSolutions; its bicycle and pedestrian programs; its Safe Routes to School program; its Complete Streets policy; and its encouragement of people to use transit.

In 2010, MORPC worked with Cambridge Systematics to create a TDM Strategic Plan, which establishes a five-year vision for TDM programs in MORPC's region. The Plan "was developed through a strategic planning process that included MORPC and its mobility partners. The process included outreach to the region's residents and businesses, through surveys and interviews, to determine their needs for transportation services" (MORPC, 2011h).

The plan outlines key goals and objectives for regional TDM, and lists actions to take to reach these goals in six different areas: the structure and management of the program; outreach and marketing; employer/worksite programs and services; neighborhood/community programs and services; regional programs and services; and research and evaluation. MORPC staff is currently working on implementing the plan.

Several examples of local, regional, and national TDM programs or measures are discussed below.

MORPC's TDM Partners

- *Central Ohio Transit Authority (COTA):* www.cota.com
- *Delaware County Transit Authority (DATA):* www.ridedata.com
- *Lancaster Public Transit:* www.ci.lancaster.oh.us/dept/transit
- *Licking Country Transit:* www.lcounty.com/lctb
- *Ohio State University Transportation and Parking:* www.tp.ohio-state.edu
- *Consider Biking:* www.considerbiking.org
- *Yay Bikes!:* www.yaybikes.com

5.7.1 Increase Employee Commute Options

The U.S. Department of Transportation (USDOT) and the U.S. Environmental Protection Agency (USEPA) developed the Commuter Choice Initiative to expand the availability of commute options. "Commuter Choice is a nationwide initiative encouraging employers to offer a broad range of commuting options to their employees. This means expanding the choices available for employees to get to and accomplish their work." This includes … "transportation options such as public transportation, bicycles, carpools, modified work schedules, or technology options such as telecommuting that change how work is done" (USDOT, 2003).

For more information on how employers can develop effective programs, please see the Commuter Choice primer: http://1.usa.gov/qyy55v.

5.7.2 RideSolutions

MORPC's RideSolutions program promotes alternatives to driving alone, including vanpools, carpools, public transit, walking, and bicycling. RideSolutions' goals are to reduce congestion in central Ohio, reduce fuel costs for commuters, and improve the environment. The program is principally concerned with promoting alternative ways for people to get to their workplaces (as opposed to other destinations). The main RideSolutions web page is at the following link: www.morpc.org/ridesolutions. RideSolutions offers the following services:

- **Guaranteed Ride Home.** Under this program, commuters who carpool, vanpool, ride public transportation, bike, or walk may be reimbursed for 90 percent of cab fare if they are stranded at work due to an emergency or unexpected overtime. Commuters can sign up for the program by calling 1-888-742-RIDE or visiting: www.morpc.org/transportation/ridesolutions/grh.asp.
- **Compute your Commute.** This is an online tool with which users can easily calculate what it costs to drive to work, including the costs of fuel, insurance, vehicle depreciation, taxes, and parking: www.morpc.org/transportation/ridesolutions/CommunityCompute.asp.
- **Carpool Matchlists.** The carpool matchlist program enables commuters who sign up and provide information about their regular working hours and origin and destination of travel to receive contact information about other commuters with similar characteristics. This service is free and allows commuters to find partners for carpooling.

- **Vanpool Assistance.** MORPC staff work with companies and commuters to form groups of 7 to 15 people to share the ride to work in a van. Specific assistance provided by MORPC includes:
  - Determination of the basic route, schedule, and estimated passenger cost
  - Advertisement of the route and signing up riders
  - Facilitating group meetings to determine roles of each rider and other details
  - Arranging for the delivery of the van
  - Enrolling vanpoolers in the Guaranteed Ride Home program (GRH)

Ridesolutions Vanpool Van.Source: MORPC. Columbus, OH.

- **School Pool Program.** Similar to carpool matchlists, this is a voluntary program that works with schools and school districts to create matchlists for parents and students. It helps parents to find carpooling partners and students to find a bike or walk companion for a safer commute to school.
- **Community Program.** MORPC staff works with specific communities to establish a TDM program for its residents who commute to work to places outside of their community. Program elements can include identifying Park & Ride lots or giving out information on transit schedules and bike routes.
- **Employer Services.** Ridesolutions staff work with employers to develop and encourage TDM programs that cater to the specific needs of their employees. Example activities include:
  - Surveys to identify employee transportation needs
  - Presentations to employers and employees
  - On-site events and promotions for employees
  - Outreach materials, including fliers, posters, brochures, and email marketing
  - Assistance with employee relocation
  - Promotion and assistance with commuter programs, including carpool, vanpool, transit biking, and walking

5.7.3 Smart Trips Program

Smart Trips is an individualized marketing program that actively promotes alternative modes of transportation to residents of a selected geographic area or employees of targeted businesses. Its main goals are to increase walking, biking, transit, carpooling, and carsharing trips, and to increase neighborhood mobility and livability in general. As part of the effort, a variety of newsletters, special events, and free activities are made available to the area residents. This program originated in Australia and Europe, under the name TravelSmart, but has been used successfully in many communities in the U.S. over the past decade. Smart Trips can be a component of a larger Transportation Demand Management campaign.

Success of the Smart Trips Program

Community-based SmartTrips projects have yielded a reduction of 9 to 13 percent in drive-alone car trips by all area residents with a corresponding increase in walking, bicycling, and transit mode shares in the areas (City of Portland, 2009).

In the Portland project, all SmartTrips area residents received SmartTrips messages at least 7 times during the first year. These messages came through mailers, media coverage, and outreach events. In following years, approximately 30 percent of all area residents either ordered materials or participated in a SmartTrips event or activity. Twenty percent of all households ordered materials. For more detailed information about the results methodology, check the SmartTrips final reports online, listed by yearly program: www.gettingaroundportland.org.

Employer-based Smart Trips programs showed that (City of Portland, 2009):

- Participants who pledged to reduce trips demonstrated a 24 percent relative reduction in drive-alone commute trips.
- Participants reported a 15 percent relative reduction in drive-alone trips 1 year after ordering materials.
- Approximately 1 out of every 4 participants shifted at least 1 drive-alone commute trip a week to an environmentally friendly mode.

Cost of Smart Trips

The Smart Trips program costs roughly $10 per person in the SmartTrips area. A typical 20,000-household program costs $570,000. This cost includes 4.35 full-time staff, along with most materials and services. (Staff overhead is included in this number, but general overhead, and printing of bicycle maps and transit schedules are not included).

Information Provided through Smart Trips

A variety of materials and information can be distributed based on the promotion of a specific mode. Several examples are listed below:

- **Walking-related information:**
  - Calendar of walks and walking tours in the residents' area
  - Area walking maps
  - A Walk to Wellness brochure focusing on health
  - A crosswalk laws brochure
  - A free pedometer and a walking log to keep count of daily steps
- **Bicycling-related information:**
  - Citywide and neighborhood bicycle maps
  - Bicycle Guide with tips and rules of the road
  - Rides and workshop schedules
  - Bikes on Transit Guide
  - Pant leg strap
- **Transit-related information:**
  - Bus and light-rail schedules
  - Transit guide for seniors and the disabled
  - Information on the four bus stops closest to the resident's home
- **Driving-related information:**
  - Information on local carshare options
  - Information on carpooling
  - Information specific to older drivers

For key resources, visit Portland's Smart Trips program website: www.gettingaroundportland.org.

Portland's Smart Trips logo.
Source: www.gettingaroundportland.org.

5.7.4 Bike Month Activities and Programs

The month of May is National Bike Month in the U.S. During this time, cities across the nation provide a variety of events and programs to celebrate and promote biking. Many of these events are focused around Bike to Work Week and Bike to Work Day, the dates of which are established by the League of American Bicyclists.

Some common Bike Month events are described below:

- **Commuter Energizer/Breakfast Stations.** Stations are usually set up along major bike routes and offer coffee, food, and other giveaways, such as safety equipment and coupons.

Columbus Mayor Micheal Coleman leads a kick-off ride in 2010. Source: ODOT. Columbus, OH.

- **Commuter Convoy.** In a convoy, more experienced riders can lead group rides to local employment centers, providing guidance for novice bicycle commuters. Commuter convoys provide an introduction to bicycle commuting, which can help new riders gain confidence in their ability.
- **Community Ride.** A community ride reinforces the legitimacy of bicyclists on the road and in the community and fosters a sense of identity around bicycling. Most community rides are relatively short and relaxed, with the intention of creating an inclusive atmosphere for bicyclists of all skill levels.
- **Bike Workshops.** Bike workshops link qualified bicycle mechanics with bicycle commuters on the way to work. Commuters can get a free tune-up and safety inspection as well as resources regarding local bike shops.
- **Bike to School Ride.** Parents can organize a bike pool or bike alone with their children. This reinforces good safety habits and demonstrates that biking is an activity for all ages. Biking to School is supported by Safe Routes to School programs.
- **Company Commuter Challenge.** Companies are challenged to encourage bicycle commuting to work with the goal of achieving the highest percentage of bike commuters. This is an excellent way of getting employees together in a friendly competition against other regional companies, building company morale, and creating a culture of bicycle commuting at a workplace.

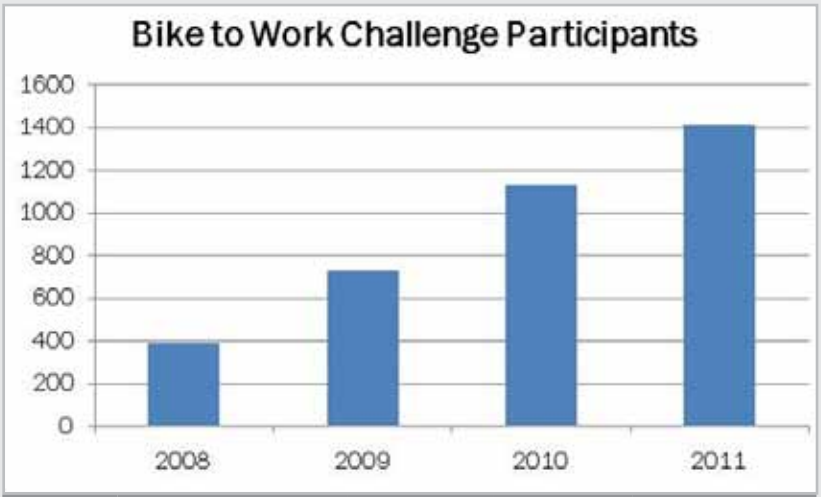
YayBikes! Bike to Work Challenge

A Bike to Work Challenge encourages teams within organizations to achieve the highest bicycle mode share within a selected period of time. Mode share is defined as the percentage of total trips made by a particular mode of transportation, including bike to transit or bike from Park & Ride lots.

Since 2008, when 393 individual cyclists from 29 teams rode more than 10,000 miles on 1,738 trips, Columbus' Bike to Work Challenge has grown substantially - in large part because the switch to a web-based tracking and sign-up system facilitated an easier process for both organizers and participants.

In 2010, 634 of the 1,129 registered cyclists on 114 teams rode more than 30,000 miles on 5,209 trips (YayBikes! 2010).

For more information about the YayBikes! Bike to Work Challenge visit the website: www.biketoworkchallenge.com.



Year	Participants	Teams	Trips	Days
2008	393	29	1,738	4
2009	734	110	5,817	11
2010	1,129	114	5,209	11
2011	1,411	158	3,857	31

Participation in YayBikes! Bike to Work Challenge has increased annually since 2008.

Consider Biking's 2 by 2012 Challenge

Consider Biking encourages central Ohio residents to bicycle to work, school, or any other place at least two days per month by the Columbus Bicentennial in 2012. The advocacy group assists companies in designing customized bike to work programs through consultation and ongoing support.

For more information about the challenge, visit: http://www.considerbiking.org/activities/2-by-2012/.

5.7.5 Bicycle Share Programs

Bicycle share programs provide convenient rental bicycles for short utilitarian trips, similar to carsharing. They encourage bicycle use and are a good way to improve bicycle transportation. Other names for these types of programs include Public Bike Systems and Community Bike programs (VTPI, 2011b).

Bike share programs are becoming more popular since advances in technology allow for payment at the stations and GPS tracking of the bikes helps prevent theft. These newer bike share programs started in Europe, but have since appeared in the United States.

The following elements are part of a typical bike share program:

- A fleet of bicycles
- A network of automated stations where bikes are stored
- Bike redistribution and maintenance programs

As with carsharing, bike share systems are most efficient when bikes are shared by many users each day; some systems average as many as twelve daily users per bike. Bikes may be rented at one station and returned to another, either for free or a small fee.

Successful systems have resulted in a mode shift from automobile to bicycle of 5 to 8 percent. However, use typically declines during cold or wet weather.

In order to maximize effectiveness and benefits, a Public Bike System should have the following attributes (VTPI, 2011b):

- High number of easy-to-use docking systems around the city and near public transit stations
- Encouragement programs for new and inexperienced riders
- Easy payment system with fees structured to encourage use for short trips (free or very inexpensive for the first 30 minutes)
- Well-maintained stations and bikes
- Well-designed bike redistribution system to avoid areas that accumulate excess bikes and those that have too few bikes

Capital Bikeshare station. Source: Mario Roberto Duran Ortiz. Washington, DC.

Well-known bike share programs in the U.S. are located in Louisville, KY (Humana, B-cycle), Chicago (B-cycle), and Washington, D.C. (Capital BikeShare). These bike share programs have a variety of locations and standardized bicycles for short-term use. While there are some local examples of bike sharing, they do not have the density of stations and number of bikes to promote widespread use. For example, the Velib system in Paris, has over 20,000 bicycles at almost 1,500 stations compared to fewer than 50 bikes for local examples.

Local University Bike Sharing Programs

A few local universities initiated bike share programs in 2008 and 2009. The programs were often organized by students, rather than being a formal program of the university administration. Some of the programs allow students to keep the bikes for use over a quarter or year, rather than the short time period more common among other bike share programs. Local university bike share programs are discussed below:

- **Buckeye Bikes** is a bike share program at The Ohio State University (OSU), started in 2008. Twenty Schwinn bikes are available for rent at the RPAC Sports Shop. All Ohio State Recreational Sports members (students, faculty, and staff) can check bikes out for 48 hours. Users must fill out a release, waiver, and assumption of risk agreement upon first use of the service. After the initial use, a valid BuckID allows a bike to be checked out (Gottesman, 2009). For more information, please view the video at: www.youtube.com/watch?v=wil19b5QXcY.
- **Otterbikes** is a bike share program at the Otterbein University campus in Westerville, started in 2009. Check-out at the Library front desk requires a signed liability waiver and a $10 one-time fee. Bikes may be rented for 3 days. When returning a bike, one must use a specified rack. For more information, please see: www.otterbein.edu.
- **The Bike Movement** is a bike share program at the Ohio Wesleyan University campus in Delaware, started in 2009. Enrollment requires an annual $5 fee. Bright yellow bikes are locked in different locations around the campus (Ohio Wesleyan University, 2011).

Local Bike Sharing: EveryoneBikes

The only local example of a non-university bike share program is the EveryoneBikes program. The program started in 2009 with 10 bikes. In the summer of 2010, the program had 14 locations in the Short North neighborhood of Columbus with a total of 20 bikes. Businesses participate by keeping a bike at their locations. The bikes are available for borrowing during the business hours of that location. One downtown hotel also uses the program as an internal bike-borrowing system. Use of the bikes is free and open to anyone, but a credit card and driver's license (or state ID) are required. Bikes must be returned to the same location where they were booked (Bushong, 2009). For more information, see: www.everyonebikes.org.

Bikes from the EveryoneBikes program. The sponsoring business and checkout location are displayed on the front basket. Source: EveryoneBikes Blog. Columbus, OH.

5.7.6 Commuter Tax Credit

Commuter tax credits refer to a variety of financial incentives for commuters, such as parking cash-out, rideshare benefits, and travel reimbursement (VTPI, 2011b). One notable incentive is the transit benefit, which is part of IRS regulation 132.

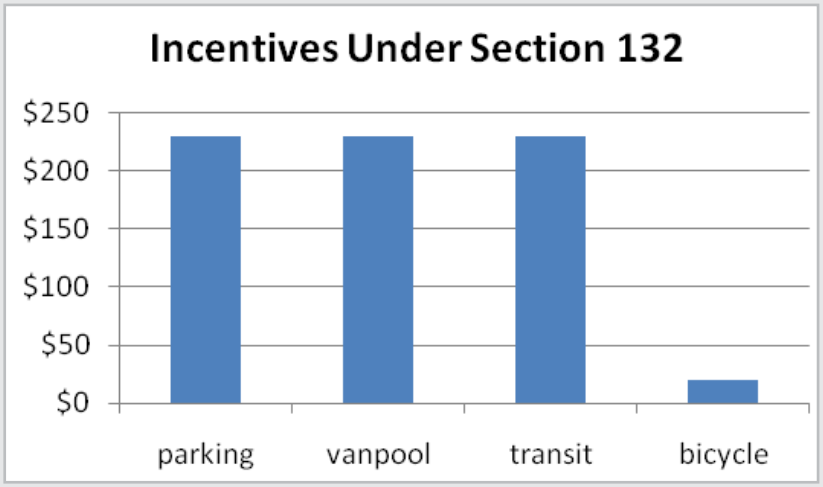
Section 132 Pre-Tax Benefit

IRS Regulation 132 (section 132 (f) of the Internal Revenue Code) is the Qualified Transportation Fringe Benefit. This is commonly known as the "Commuter Tax Benefit" (National Center for Transit Research, 2011). Savings are generated from the federal and state taxes that are not assessed on transit costs when paid by employees on a pre-tax basis. The IRS establishes employers as the gatekeeper sfor this federally approved program, and their responsibility is to deduct the cost of the pass each month from the employee's paycheck. This benefit allows employers to save on payroll-related taxes and allows employees to save on federal income taxes.

More details can be found in the IRS document:
www.nctr.usf.edu/wp-content/uploads/2011/04/irs_finalrule_01-11-01.pdf.

Section 132 Incentives for Employees

Employers may provide workers with up to $230 per month in tax-free transit, vanpool, or parking expenses. Alternatively, employers may provide workers with up to $20 per month in reimbursement for qualified bicycle expenses, including the purchase of a bicycle, bicycle improvements, bicycle repair, and bicycle storage. Note that an employee cannot receive the bicycle reimbursement for a month in which they received a transit, vanpool, or parking benefit. On the other hand, they can receive the transit and parking benefits (total of $460 per month) in the same month. This curtails the usefulness of the incentive for employees who would like to bicycle. It also ignores the multi-modal nature of bicycle trips, such as riding a bicycle in the beginning of your trip, and then using transit to complete your trip.



The incentive for bicycling is much lower than the incentives for other modes. Source: King County, 2011.

5.7.7 Carsharing

Carsharing is an alternative program of car ownership, access, and use. Carsharing differs from traditional car rental, as it is intended to substitute private vehicle ownership. Carsharing is intended to be used by people for short periods of time. The cars are self-service and spread out throughout a metropolitan area, instead of at one rental location. Members of carsharing programs only pay for the time the car is used, as the gas, insurance, and maintenance are included in the membership price.

Carsharing is meant to act as an extension of the public transportation network, to enhance mobility options, and to decrease the necessity of car ownership. According to the TDM Encyclopedia, carsharing "makes occasional use of a vehicle affordable, even for low-income households, while providing an incentive to minimize driving and rely on alternative travel options as much as possible" (VTPI, 2011b). Carsharing programs need to be accessible, affordable, convenient, and reliable.

How Does Carsharing Work?

Most carsharing programs enable users to sign up for a membership online. An annual fee is typically required. Upon becoming a member, users can reserve cars via the website or through smart phone applications. The real-time location of vehicles is available to users so they are able to find the nearest car. Upon reserving the car, the membership card allows members to gain access to the vehicle at the appropriate time and location. When done with the car, it can be returned to any designated location.

Accessing the car via a magnetic key card. Source: MORPC. Columbus, OH.

Benefits of Carsharing

The benefits of carsharing include (VTPI, 2011b):

- Increased travel options and financial savings
- Increased affordability for lower-income drivers who occasionally need a vehicle
- Reduced per capita annual mileage, resulting in reduced congestion, road and parking facility costs, crashes, pollution, and energy use
- Reduced residential parking requirements and support for higher density residential development

Carsharing in Columbus

Currently, the only carsharing service in central Ohio is through OSU. However, there are discussions on a regional and local level to increase carsharing stations for both business and public use.

OSU Transportation and Parking has partnered with Hertz Connect to provide a carsharing program on campus. There are 15 vehicles at 6 locations on campus. The fleet consists of Toyota Camrys, Ford Escapes, Toyota Prius Hybrids, a Mini Cooper, and a Ford Ranger pickup truck (OSU, 2011a). Features in the cars include GPS navigation, interactive screen pad, iPod adapter, and Bluetooth technology. The vehicles come with 24-hour roadside assistance as well as gas and insurance.

5.7.8 Improved Payment Options for Transit Systems

There is a variety of payment systems associated with transit service, including tokens, cash (coins or bills), paper tickets, and magnetic stripe cards. With advances in technology, a relatively new option is the "Smart Card."

Payment options such as magnetic stripe cards and "smart cards" can increase customers' flexibility, convenience, and ease of use, resulting in greater utilization of the transit system (Schaller, 1998). Smart card systems have been a factor in increased ridership trends in New York City, Chicago, and Washington, D.C. (VTPI, 2011b).

Magnetic Stripe Cards

Magnetic Stripe Cards function like a credit card and are read by physical contact and swiping past a magnetic reading head. COTA's monthly passes utilize this technology, which improves boarding times, compared to paying in cash. However, physical swiping is required.

Smart Cards

Smart Cards are pocket-sized cards with embedded integrated circuits. Most smart cards used in transit systems are actually contactless and use radio to transmit the data. In some cases, smart cards may be connected to a bank account.

Many smart cards used in transit do not need to be removed from a wallet or purse. Usually, smart cards function as "tap and go," which is much faster than swiping, thus reducing boarding times. Smart cards can be designed to be used over a variety of transit systems, which benefits users in regions with multiple transit agencies. They can also be used for other payments, such as vehicle parking, bicycle or car share systems, or general retail purchases.

6. ENFORCEMENT

6.1 Introduction

Enforcement is one of the 5 E's of Complete Streets. This chapter describes Ohio laws and common sense rules for pedestrians, bicyclists, transit users, and motorists. Following these rules ensures that transportation-related fatalities and injuries are minimized. Additionally, a safer and more orderly transportation system encourages walking and bicycling.

6.2 Pedestrian-Related Enforcement

There are many laws related to walking and the walking environment. In general, these laws are intended to protect pedestrians from harm that would result from crashes with motor vehicles. As a result, many pedestrian-related laws actually regulate the actions of motorists. Nonetheless, pedestrians themselves also have certain responsibilities to maintain their own safety. As in other areas of the law, common sense should also be applied.

Mid-block crosswalk near Ohio State University's campus. Source: MORPC. Columbus OH.

6.2.1 Crosswalks and Sidewalks

According to the Ohio Revised Code §4511.46, the right-of-way for pedestrians in crosswalks is upheld in the following ways:

- Marked mid-block crosswalks give pedestrians the legal right-of-way.
- Intersections have unmarked crosswalks but motorists are still required to yield.
- Drivers turning right across a crosswalk must yield, even if they have a green light, per Ohio Revised Code §4511.13. However, drivers have the right-of-way if the green light is a green turning arrow.
- Drivers must yield at WALK signals per Ohio Revised Code §4511.14.

Pedestrians have to follow these rules:

- If the "Don't Walk" signal is flashing, pedestrians should not start crossing, but should continue across once started.
- Pedestrians should not walk in prohibited areas, such as limited-access highways and railroad tracks.
- If there is no sidewalk, pedestrians are allowed to walk on the side of the road, facing traffic.
- If a sidewalk is available, pedestrians must use the sidewalk and not the roadway.
- Pedestrians are allowed to travel in both directions on sidewalks.

Sullivant Trace Trail/MUP. Source: Columbus Parks and Recreation. Columbus, OH.

6.2.2 Multi-Use Paths

Multi-Use Paths (a.k.a. MUPs, trails, or bike paths) are open to both bicyclists and pedestrians. Many MUPs in central Ohio are next to rivers and therefore are typically considered recreational in nature. Regardless of their location, people use MUPs for recreation, commuting, and other transportation purposes.

The following rules apply to MUPs in Columbus and most other locations:

- Motorized vehicles, including motorcycles and scooters, are not permitted. Pets are not permitted on Greenway Trails.
- Bicyclists and skaters must yield to pedestrians.
- All users should keep to the right side of the trail, listen for audible signals, and allow faster trail users (runners and bicyclists) to pass safely.
- Always pass on the left, and give an audible warning when passing other trail users.
- Maintain single file when others are within 100 feet. Slow down and form a single file in congested conditions, reduced visibility, and other hazardous conditions.

6.2.3 Bike and Equestrian Paths

The majority of paths in central Ohio are multi-use paths; however, some paths provide for exclusive or preferential bicycle or equestrian use. Generally, these paths are not paved and wheelchair users may find it difficult or impossible to travel on these paths. Pedestrians should use caution when using such paths, and should always yield to horses.

Bikes stop for a horse and rider. Source: www.horseandman.com

6.2.4 Railroad Crossings

Pedestrians should exercise extra caution at railroad crossings as trains always have the right-of-way over pedestrians as well as emergency vehicles, cars, law enforcement, bicyclists, and other road users. The following safety tips apply to pedestrians at railroad crossings (Operation Lifesaver Inc., 2011):

- Stay alert and avoid distractions, such as texting and using headphones.
- Look both ways before crossing railroad tracks.
- Always yield to flashing lights, whistles, closing gates, crossbucks, or stop signs at railroad crossing.
- Pedestrians are forbidden from walking on railroad tracks, except when crossing at designated locations. Never try to outrun a train.
- Crossing is forbidden after the lights begin to flash and the gates begin to drop.

Gates are closing at a railroad crossing. Source: Korve, et al. Unknown location.

6.3 Bicycle-Related Enforcement

According to the Ohio Bicycle Federation's Digest of Ohio Bicycle Traffic Laws, people that follow the rules of the road and recommended techniques can reduce their crash risk by 80 percent. Ohio State law states that a bicycle is considered a "vehicle" and therefore must follow the same laws that apply to cars and trucks, which especially means not to ride against traffic and to ride predicably (Ohio Revised Code §4501.01).

Children riding on the sidewalk. Source: Dan Burden. Carbondale, CO.

6.3.1 Bicyclists on Sidewalks

Bicyclists are generally prohibited from riding in crosswalks and sidewalks. However, exceptions are often made for child bicyclists. This is due to their slower speed, which is usually more similar to a person walking.

While municipalities may allow (or prohibit) bicycles to use the sidewalk, they cannot require bicyclists to use the sidewalk (Ohio Revised Code §4511.711). Riding a bicycle on the sidewalk reduces the cyclist's visibility to motor vehicles and increases their risk of getting in a crash in some situations. When bicyclists ride on the sidewalk (or MUPs), extra caution at driveways and intersections should be exercised.

6.3.2 Multi-Use Paths

As discussed above, multi-use paths are open to both bicyclists and pedestrians, as well as skaters, roller bladers, and other non-motorized users. For more information on multi-use paths, please see "4.4.10. Multi-Use Paths," on page 4-16.

Bike Trail that is not a Multi-Use Path. Source: MTBikeTrail.com. Alum Creek State Park, OH.

6.3.3 Unpaved Bike Trails

The majority of paths in central Ohio are paved multi-use paths. However, mountain bike trails or other unpaved surfaces may be encountered. Some bicycle users (such as recumbent or road bikes) may find it difficult or impossible to travel on unpaved paths. Bike paths that are "off-road" are recreational in nature and are not typically intended for use by non-bicyclists, though hikers may use them in some situations. Where bicyclists encounter horses on trails, they should yield the right-of-way to the horse, giving it a wide berth.

6.3.4 Passing Large Vehicles

When passing any vehicle, a bicyclist should pass on the left and return after safely clearing the other vehicle (Ohio Revised Code §4511.27). This is especially important when passing a vehicle stopped in the road or in the bike lane. This can include delivery trucks or transit vehicles. All roadway users should provide three feet of clearance when passing and avoid passing on the right, as doing so is very dangerous.

A COTA bus stops to pick up passengers and a bicyclist prepares to pass the bus on the left. Source: MORPC. Columbus, OH.

6.3.5 Riding in Roundabouts

A roundabout is a one-way, circular intersection in which traffic flows around a center island. Bicyclists have two options when encountering a roundabout:

1. **Dismount and walk the bike**. If a bicyclist is uncomfortable riding through the roundabout, or any intersection, they should get off the bike and travel through the roundabout as a pedestrian, using the marked crosswalks to cross each leg of the roundabout.
2. **Ride through the roundabut**. When riding on the road through the roundabout, it is important to ride in the middle of the lane and turn when exiting the roundabout. The roundabout should be treated the same by bicyclists as by drivers of motor vehicles. As with any intersection, bicyclists (like motor vehicle drivers) must yield to pedestrians in the crosswalks.

How to use a roundabout as a pedestrian or bicyclist. Source: FHWA, 2011a.

6.3.6 Railroad Crossings

Bicyclists should exercise extra caution at railroad crossings. It is particularly important to stay alert and avoid distractions, such as texting and using headphones. The following considerations are important for bicyclists at railroad crossings (Operation Lifesaver Inc., 2011):

- Bicyclists must look both ways before crossing railroad tracks.
- An additional hazard for bicyclists at railroad crossings is from the tracks themselves. As such, it is critical for the bicyclist to cross the tracks at a 90-degree angle to avoid having the bicycle tires stuck in the tracks.
- Trains always have the right-of-way over bicyclists, as well as emergency and law enforcement vehicles, cars, and pedestrians.

- Bicyclists must always yield to flashing lights, whistles, closing gates, crossbucks, or stop signs at a railroad crossing.
- Crossing is forbidden after the lights begin to flash and the gates begin to drop.

6.3.7 Required and Recommended Equipment

Bicycles are required to have certain equipment to ensure a basic level of safety and operability. These equipment requirements are established by Ohio state law and include the following (Ohio Revised Code §4511.56):

- **Red rear reflectors and colorless front reflector**, capable of being seen by the headlamps of a motor vehicle. Additionally, a **red rear light** is required. It may be steady or flashing. The red rear reflector is not required if the light can be seen as well as the reflector.
- For nighttime riding, a **front white lamp**, either steady or flashing, must be mounted to the bicycle or the helmet and used in dark conditions. In addition to required equipment, the following equipment is strongly recommended (Allen, 2001):
- **Bell or Horn.** In the absence of a sound-producing device, a bicyclist can use their voice to signal passing or otherwise alert others to their presence.
- **Helmet.** Helmets reduce the risk of serious head injury by 85 percent. The helmet should be snug and level, and cover the forehead.
- **Rear-view mirror.** A rear-view mirror helps bicyclists to see cars behind them without turning around. A helmet-mounted mirror is useful for shock-proof visibility, though it can be difficult to use at first. A handlebar mirror could be a more convenient option.
- **Bicycling gloves.** Gloves reduce shock from the handlebars and protect the hands in the case of a fall.
- **Tools.** A small tool kit with tire patch, tire pump, and the knowledge to use them.
- **Baggage.** A mounted water bottle and small bag for tools and extra clothes is helpful as it eliminates the need for a backpack, resulting in a lighter ride.
- **Locks.** Locks help to secure the bike and easily removed parts.
- **Fenders and rain cape.** This will help the bicyclists to stay dry when riding in wet conditions.

Bicyclist shown at night with helmet, rear red light, and front white light. Source: Bay Area 511 Bicycle Safety.

6.3.8 Other Considerations for Bicyclists

The following considerations are important for bicyclists to ensure their safety as well as that of other roadway users.

- A person guilty of operating their bicycle while under the influence of alcohol can be assessed points to their driver's license (ORC §4511.52).
- Bicyclists must signal their turns appropriately unless their hand is necessary to maintain control of their bike (ORC §4511.39). Turn signals for a bicyclist are as follows (ORC §4511.40):

Examples of how to make turn signals as a bicyclist. Source: MORPC Bike User Map

  - Left turn: left hand and arm extended horizontally
  - Right turn: right hand and arm horizontally and to the right side of the bicycle
  - Stop or decrease speed: left hand and arm extended downward
  - Cyclists who are riding together must not travel more than two abreast per lane (ORC §4511.55).
- Bicyclists should avoid riding on metal surfaces, oil slicks, painted roadway markings, or steel-gridded bridge decks as they will be especially slippery.
- Cyclists should avoid the door zone next to parked cars and allow three to five feet of empty space between the bicycle and the parked car (with door unopened).
- Bicyclists should not weave between parked cars to allow motorists to pass them. It is safer to continue in a straight line where motorists can more easily see the cyclists and predict their actions.

6.3.9 Recommended Print Resources

A guide entitled *Ohio Bicycling Street Smarts* by John Allen, issued by the Ohio Department of Public Safety, acts as an operator's manual for cyclists. While laws state whether bicyclists are permitted to undertake a specific action, they do not necessarily tell them how to ride safely.

The Ohio Bicycling Street Smarts guide is meant to act as a manual specifically for the purpose of encouraging good riding habits for cyclists. You can view the Street Smarts booklet online at: www.bit.ly/tCZxxs. Hard copies may be available through ODOT.

6.4 Transit-Related Enforcement

It is important that transit operators respect the rights of all users of the road, especially pedestrians and bicyclists, as they are particularly vulnerable if they are in a crash with a motorized vehicle. Similarly, other roadway users should understand and respect the limitations and requirements of transit vehicles. For example, they have slower acceleration, longer braking distances, and wider turning radii compared to ordinary vehicles. Education of transit drivers and the public is needed to improve the interaction of transit and other modes. For more information on transit-related education, please see "5.4. Transit Education & Encouragement," on page 5-15.

6.4.1 Bus-Only Lanes

Where a transit vehicle does not have dedicated, physically separated lanes, there will be interactions between the transit vehicle and other users, predominantly motorists. COTA buses benefit from signed bus-only lanes on High Street in Columbus, but they are not separated in the way that a light-rail vehicle may have its own tracks.

Bus-only lanes can improve the transportation system by making bus travel more efficient and less subject to traffic delays. This has the additional benefit of increasing transit mode share and reducing congestion. Some degree of enforcement is needed for bus-only lanes in order to prevent other motorists from disregarding the regulation. Photo enforcement may help to solve this problem.

Some bus-only lanes are only restricted during peak hours. For example, High Street in downtown Columbus, OH restricts one lane in each direction to buses and taxis from 7 - 9 a.m. and 4 - 6 p.m. on weekdays. In some circumstances, it may be practicable for other users, such as bicyclists and taxicabs, to be permitted in bus-only lanes.

6.4.2 Transit Operator Behavior

There are a variety of poor driving behaviors that transit operators should avoid. These include distracted driving, using cell phones, and running red lights. For more information, please see "6.5. Motorist-Related Enforcement," on page 6-10.

Distracted Driving

A distracted driver is any driver whose attention is not fully focused on the task of driving. This can contribute to the likelihood of a crash. Distraction may be caused by a wide range of activities, such as eating, drinking, talking to passengers,

reading maps, and applying makeup or engaging in other grooming activities. In 2009, an estimated 5,474 people died and 448,000 were injured in crashes in the United States in which at least one form of driver distraction was recorded (USDOT, 2010b).

Many states currently do not collect data on cell phone/electronic equipment distraction in police crash reports, which means that the true numbers are likely higher than those cited above (GHSA, 2011). Beginning in 2012, Ohio's crash reports will have a section where cell phone use can be recorded.

Red-Light Running

Red-light running is a common motorist behavior. A study conducted at five busy intersections during several months in Fairfax, Virginia (prior to red light camera installation) found that on average, a motorist ran a red light every 20 minutes at each intersection (IIHS, 2009). Red-light running is risky behavior, as it combines the conflict point of the intersection with high-speed driving, precisely when other road users may start their own movement.

According to the Insurance Institute for Highway Safety, 676 people were killed and an estimated 113,000 were injured in the U.S. in 2009 from crashes that involved red-light running.

Railroad Crossings

Motorists, including transit operators, should exercise extra caution at railroad crossings. Due to the speed and mass of a train, all roadway users are extremely vulnerable if they are involved in a crash with a train. Additional rules for motorists and transit operators at railroad crossings are listed below (Operation Lifesaver Inc., 2011):

- Motorists always need to yield to flashing lights, whistles, closing gates, crossbucks, or stop signs at a railroad crossing. Motorists are not allowed to try to "beat" a train.
- Motorists are not allowed to pass another vehicle within 100 feet of a railroad crossing.
- Some vehicles must stop at all railroad crossings, such as school buses. Use caution when travelling behind these vehicles, since they will stop even if no train can be detected.
- If a motorist is crossing the railroad tracks and the gate comes down behind them, they need to keep driving. They are allowed to break the gate in front of them if necessary.
- Trains always have the right-of-way over emergency vehicles, cars, law enforcement, bicyclists, and pedestrians.

6.5 Motorist-Related Enforcement

Enforcement efforts to promote complete streets should include substantial efforts directed toward motorists. This is important for several reasons. In almost all areas, motorists comprise the majority of road users, and the vast majority of trips in central Ohio are currently taken by motor vehicle. Motorists are less vulnerable to injury and death in crashes than non-motorized users, such as pedestrians and bicyclists. Therefore, safe driving behavior on the part of motorists is essential in order to reduce the number of vehicle-related injuries and deaths.

From 2007 to 2009, in MORPC's transportation planning area, 86 percent of pedestrian-related crashes resulted in injuries, and 80 percent of bicycle-related crashes resulted in injuries. By contrast, only 26 percent of crashes overall resulted in injuries.

The test required to obtain a driver's license in Ohio normally does not include any questions related to how motorists should behave with regard to pedestrians, bicyclists, and other more vulnerable road users (ODPS, 2010c). Therefore, it is important for local jurisdictions to implement their own education and enforcement efforts.

6.5.1 Enforcement Strategies

In this section, some programs and messages that target specific issues known to increase the likelihood of crashes are discussed. These include failing to yield to pedestrians in crosswalks, disregard for bicyclists using roadways legally, distracted driving, or red-light running.

A police officer at a crosswalk sting event. Source: MORPC. Columbus, OH.

6.5.2 Crosswalk Stings

Pedestrian safety "stings" are events in which police officers target a particular crosswalk (usually an unsignalized crosswalk) during a specific time period, and issue warnings or citations to motorists who fail to yield to pedestrians.

In various studies, crosswalk stings have been shown to result in a lasting improvement in motorists' yielding behavior at the locations where they take place. For example, a crosswalk sting project in Miami Beach, FL resulted in an increase in yield rates from 3.3 to 27.8 percent. The improvement in yielding was maintained up to a year after the periods of high-level enforcement (Van Houten and Malenfant, 2004).

Crosswalk sting events require coordination between local government and police departments. Media exposure is also very important, since raising public awareness is a key part of such endeavors. Locations and times should be carefully chosen in order to have the maximum impact in terms of changing motorist behavior.

Data on motorists' yielding rates should be collected directly before and after sting events in order to gauge their effectiveness. Ideally, data on yielding rates should be collected again several months after the event in order to gauge the long-term impact. A sample data collection form is available online: www.morpc.org/trans/MORPC_CrosswalkYieldRate_DataForm.pdf.

In September 2010, several local police agencies participated in crosswalk stings for their communities. Over a two-week period, these stings received a lot of media attention and positive feedback by residents.

6.5.3 Bicycle Safety

Similar to pedestrians, bicyclists are particularly vulnerable if they are in a crash with a motorized vehicle. Bicycles are particularly prone to crashes at intersections, just as motor vehicles are more likely to crash into other motor vehicles at intersections.

Bicyclists are allowed to use the full lane on most roadways. It is important to ensure that motorists respect bicyclists on the road with them. Many states have passed a law that a motorist must give 3 feet to a bicyclist when passing; however, that law has not yet been adopted in Ohio.

Actions and sentiments that amount to harrasment of bicyclists should be strongly discouraged. Unfortunately, Ohio has no specific laws restricting motorists from harassing and threatening bicyclists. Therefore, local governments should pass their own anti-harassment laws. Several municipalities outside Ohio have passed such laws, including Boise, Idaho. Boise's law states that (City of Boise, ID; 2009):

- It shall be a misdemeanor for any person, maliciously and with the specific intent to intimidate or harass or cause another person to crash, stumble, or fall because that other person is walking along the roadway or operating a bicycle along the roadway, to:
    - Threaten, by word or act, to cause physical injury to the pedestrian or bicyclist
    - Throw or otherwise expel any object at or in the direction of the pedestrian or bicyclist

Professional drivers, such as transit vehicle operators and commercial drivers should be educated with regard to bicyclists' rights and discouraged from harassing bicyclists. Law enforcement officers should also be familiar with bicyclists' rights and educate other roadway users.

A driver distracted by using the keypad of a handheld phone. Source: Flickr/ Kordite. Pittsburgh, PA.

6.5.4 Distracted Driving

A distracted driver is any driver whose attention is not fully focused on the task of driving. This can increase the likelihood of a crash. Distraction may be caused by a wide range of activities, such as eating, drinking, talking to passengers, reading maps, adjusting a car radio, using handheld electronic devices, and applying makeup or engaging in other grooming activities.

According to the U.S. Department of Transportation, there are three main types of distraction:

- Visual (when driver is not watching the road).
- Manual (when driver's hands are not on the wheel).
- Cognitive (when driver's mind is not involved in task of driving).

Increase in Crash Risk From Cell Phone Use

A study from the Virginia Tech Transportation Institute estimated the increase in crash risk caused by various types of cell phone use while driving. Text messaging is particularly dangerous. For heavy vehicles and trucks, dialing a cell phone results in a crash risk 5.9 times higher than non-distracted driving. For heavy vehicles and trucks, text messaging results in a crash risk 23.2 times higher than non-distracted driving.

Table 14. Risk of Using Handheld Devices while Driving (VTTI, 2009)

CELL PHONE TASK	RISK OF CRASH OR NEAR CRASH EVENT
Light Vehicle/Cars	
Dialing Cell Phone	2.8 times as high as non-distracted driving
Talking/Listening to Cell Phone	1.3 times as high as non-distracted driving
Reaching for object (i.e., electronic device or other object)	1.3 times as high as non-distracted driving
Heavy Vehicles/Trucks	
Dialing Cell Phone	5.9 times as high as non-distracted driving
Talking/Listening to Cell Phone	1.0 times as high as non-distracted driving
Reaching for object (i.e., electronic device or other object)	6.7 times as high as non-distracted driving
Text Messaging	23.2 times as high as non-distracted driving

In 2009, an estimated 5,474 people died and 448,000 were injured in crashes in the United States in which at least one form of driver distraction was recorded (USDOT, 2010b). Many states currently

do not collect data on cell phone/electronic distraction in crash reports, which suggests that the true numbers are likely higher than those cited above (GHSA, 2011). Beginning in 2012, Ohio's crash reports will include a section to record cell phone use.

The use of various electronic devices is becoming increasingly widespread and represents one of the most significant sources of distraction while driving. Examples include cellular phones, GPS navigation systems, MP3 players, and laptops. Drivers can be distracted by many different electronics-related activities, such as talking on phones, initiating phone calls, composing e-mails or text messages, viewing web pages, finding directions via GPS, or watching videos.

Although Ohio does not currently have state laws against the use of electronics while driving, several local governments in central Ohio have passed legislation to prohibit text messaging while driving. When developing such laws, it is important to make their enforcement primary as opposed to secondary.

6.5.5 Red-Light Cameras

Red-light cameras are automated cameras that take photographs when drivers disobey stop lights. Red-light cameras are more efficient than conventional police enforcement, since they do not require a police vehicle to follow the violating motorist.

The red-light camera system continuously monitors the traffic signal; the camera is triggered by any vehicle entering the intersection above a preset minimum speed and following a specified time after the signal has turned red.

When their presence is indicated by signs, red-light cameras can be an effective deterrent to red-light violation, since motorists are made aware that they will be ticketed. Photographs provide evidence of the violation and the citation is typically mailed to the offending motorist.

Red light camera with sign. Source: MORPC. Columbus, OH.

In Columbus, the cost of a ticket is $95. Since red-light cameras were installed in 2006, there has been an 83 percent decrease in right-angle crashes at camera-monitored intersections. Less-severe rear-end crashes have also decreased (Vitale, 2011).

Where red-light cameras are implemented the following recommendations should be followed:

- A publicity campaign should inform motorists that the cameras will be in use and that their purpose is to improve safety, not to generate revenue.
- Signs should be installed at all camera-monitored intersections advising motorists of the photo enforcement.
- Cameras should be set so that only vehicles that enter an intersection after the light has turned red are photographed. Vehicles that enter on yellow and are still in an intersection when the light changes to red should not be photographed or ticketed (IIHS, 2009).
- Police officers should review every photo and make sure the vehicle is in violation.

Police officers volunteer to help with International Walk to School Day 2009. Source: ODOT. Columbus, OH.

School officials help with directing traffic so kids can cross the street. Source: City of Delaware. Delaware, OH.

6.6 SRTS Enforcement

Enforcement strategies related to school transportation are important to ensure that all roadway users obey traffic laws, behave safely, and share the road with one another. By providing effective enforcement around schools, the safety of parents and children walking and biking to school is increased.

Enforcement strategies of the Safe Routes to School program are often focused on speeding, non-yielding behaviors, or distracted driving and walking. However, it is important to note that in order to be successful, the other E's (Engineering, Education, Encouragement, and Evaluation) must also be included as part of an effective campaign. As such, safety awareness education is a key component of enforcement. Enforcement therefore doesn't stop with the police officers, but includes students, parents, adult school crossing guards, school personnel, and community watch programs who all work with local and state law enforcement agencies.

Some benefits of school zone enforcement include the following:

- Increased awareness of pedestrians and bicyclists
- Improved driver behavior
- Improved compliance with traffic rules among children.
- Decreased parent perceptions of danger.

Examples of good SRTS enforcement programs include:

- AAA Crossing Guard Program
- City of Columbus school zone enforcement
- Police liaisons, such as school resource officers
- No-idling policies

7. EVALUATION

7.1 Introduction

Data are, in many ways, reflections of society's priorities. We collect data about things that we think are important. Data help us to focus our attention on meeting goals and objectives, and inform us of whether or not we are making progress. By extension, data help us to prioritize our efforts and resources in areas or on projects that are the highest priorities. It follows that those goals for which we have little data are less likely to be achieved.

In the world of transportation funding, it is often noted that "what gets measured, gets done." This simple statement describes an important obstacle to the advancement of non-motorized transportation projects. Projects and programs that can demonstrate a positive benefit to society are more likely to be funded than those for which evidence is lacking or unclear; and in order to demonstrate a benefit, it is necessary to measure outcomes.

Vehicular traffic trends have been measured for many years. By comparison, bicycling and walking have only recently begun to be measured on a consistent basis. As a result, transportation decision makers have a better understanding of vehicular traffic trends and are more easily able to formulate projects that will result in measurable improvements for vehicular travel. Since bicycling and walking have not received such attention in the past, planners and elected officials have less understanding about how to influence trends related to these modes.

Over the past few years, interest in bicycle and pedestrian data collection has increased greatly. This is reflected in the U.S. Department of Transportation's Policy Statement on Bicycle and Pedestrian Accommodation (USDOT, 2010a):

> *"The best way to improve transportation networks for any mode is to collect and analyze trip data to optimize investments. Walking and bicycling trip data for many communities are lacking. This data gap can be overcome by establishing routine collection of nonmotorized trip information. Communities that routinely collect walking and bicycling data are able to track trends and prioritize investments to ensure the success of new facilities. These data are also valuable in linking walking and bicycling with transit."*

There are several types of non-motorized data, including volume data, crash data, behavioral and demographic factors, and trip behavior. In general, the most commonly collected pedestrian and bicycle data fall into the volume and safety categories. More complex trip behavior data can be collected as part of a broader travel survey, such as the household surveys that are conducted during long-range transportation planning processes.

Each type of data has strengths and weaknesses related to cost, accuracy, and use. Additionally, there is often more than one method of obtaining non-motorized data for a given purpose. For example, volume data can be collected through human observation or through one of several automatic counting technologies, such as infrared detection. Manual counts are superior to automatic counters in terms of accuracy, but automatic counters are useful for longer periods of time, and can be deployed at relatively little expense. Both methods can be worthwhile, depending on the goal.

7.2 National Bicycle and Pedestrian Documentation Project

In order to address the lack of hard data for the bicycle and pedestrian modes, Alta Planning & Design and the Institute of Transportation Engineers Pedestrian & Bicycle Council developed the National Bicycle and Pedestrian Documentation Project (NBPDP) in 2003 (Alta Planning & Design, 2011). Since then, the counting protocols have been used in many cities and regions around the U.S., including the mid-Ohio region.

The NBPDP specifies dates and times to conduct counts which, upon completion, are submitted to Alta for entry into a national database. This allows for comparison across locations in different cities. Since the same locations are generally used for each count, long-term trends can also be analyzed.

In addition to pedestrian and bicycle counts, the NBPDP has developed a standardized survey which allows agencies to better understand the behaviors of bicyclists and pedestrians. The Caltrans Seamless Travel Study provides an excellent example of how the survey results can be used to get a better understanding of non-motorized travel trends (UC Berkeley Safe Transportation Research & Education Center, 2010).

MORPC has used the NBPDP methodology since 2005 to conduct counts at various locations throughout Franklin County. Additionally, some member agencies, such as Dublin, Pickerington, and Westerville, have used the methodology in their own counts. MORPC encourages any interested member agencies to participate in the NBPDP to improve local knowledge of bicycle and pedestrian transportation trends. MORPC also makes the local count data and trends available on its website and through annual reports. For more information, please see: www.morpc.org/transportation/bicycle_pedestrian/project.asp.

7.3 Trip Purpose

Just as with other modes of transportation, bicycle and pedestrian trips may be made for a variety of purposes. The most important distinction is between recreation and utilitarian trips. Breaking down utilitarian trips further, there are work trips, errands, and family or other social trips. Bicycling and walking are encouraged for all trip types; however, the different types of trips have differing implications for the transportation system, and different strategies are needed to encourage each type.

Non-motorized utilitarian trips are more likely than recreational trips to replace automobile trips, which is very important in terms of reducing congestion, emissions, and transportation costs. The benefits of recreational trips are also important, but they are likely to be limited to health and quality-of-life benefits. Since utilitarian trips also offer health benefits, non-motorized utilitarian trips offer a greater benefit to society compared to recreational trips.

Just as the benefits of non-motorized transportation depend on the type of trip, the strategy to encourage such trips also depends on the type of trip. For instance, encouragement of recreation trips may rely on health and quality-of-life messages while utilitarian trips may be better served with messages relating to reduced expenses and environmental benefits, in addition to health messages.

Trip purpose also relates to the types of facilities needed to encourage non-motorized modes. Recreational trips are best served with scenic and relaxing facilities such as off-street trails in river corridors. These facilities may also serve a transportation-related purpose, but other facilities such as sidewalks, traffic-calmed streets, and bike lanes are equally necessary to provide access to destinations. One important consideration is that individuals making utilitarian trips typically prefer a fast and direct route from origin to destination, whereas people are more tolerant of indirect paths and other diversions during recreational activities.

7.4 Safety

The concept of Complete Streets is closely related to safety. Where walking and bicycling feel unsafe, people will be unlikely to use those modes. As a result, evaluating the safety of a street is a good step in determining whether it serves the needs of its users.

Crash data are one important means by which to evaluate the transportation system. Crash data often point to specific problems, such as dangerous intersections, maintenance needs, and opportunities for facility improvements; but whereas motor vehicle crashes have been subject to rigorous study over the past several decades, bicycle and pedestrian crashes have received considerably less attention. Nonetheless, crash data analysis remains a fundamental aspect of safety evaluation for all modes.

Top 10 Regional Ped/Bike Crash Corridors in Central Ohio for 2006-2010. Source: MORPC

MORPC dedicates a considerable amount of resources and effort to crash data analysis. Along with high-crash location lists for each of its member jurisdictions, MORPC analyzes the most dangerous intersections and corridors for bicyclists and pedestrians. This analysis provides a good starting point in terms of reducing pedestrian and bicycle crashes, and specifically injuries and fatalities that result from these crashes.

It is not always possible to rely on crash data to proactively find dangerous locations, however, since pedestrian and bicycle crashes tend to be infrequent even in the most problematic spots. For this reason, methods to address pervasive safety concerns on a system-wide basis are another important way to reduce pedestrian and bicycle crashes.Furthermore, the lack of safe infrastructure in certain areas can create an unsafe environment and deter pedestrians from walking in those areas. As such, the simple fact that there are no crashes is not necessarily an indication that the place is safe.

In recent years, attention to bicycle and pedestrian crashes has increased, due to the increasing popularity and interest in these modes. Along with this, several evaluation methodologies and resources have been developed to help practitioners better understand and prevent bicycle and pedestrian crashes. A few examples of pedestrian and bicycle safety evaluation methodologies and resources are listed here:

- PedSafe: Pedestrian Safety Guide and Countermeasure Selection System (FHWA, 2004). www.walkinginfo.org/pedsafe
- BikeSafe: Bicycle Countermeasure Selection System (FHWA, 2006a). www.bicyclinginfo.org/bikesafe
- Pedestrian and Bicyclist Intersection Safety Indices (FHWA, 2006c). www.bicyclinginfo.org/library
- How to Develop a Pedestrian Safety Action Plan. www.walkinginfo.org/library

Although not strictly oriented toward safety, there have been a variety of level-of-service models developed that attempt to capture how well a street serves pedestrians or bicyclists. These LOS models tend to focus on how a street is perceived by its users, but they can also reveal safety problems, since user satisfaction is very closely related to safety for bicyclists and pedestrians. Some examples include:

- Modeling the Roadside Walking Environment: A Pedestrian Level of Service (Landis, et al., 2001). www.bit.ly/zrY54R.
- Bicycle Level of Service: Applied Model (Sprinkle Consulting, 2007). www.bit.ly/zltlsi.

7.5 Economic Impacts

Another aspect of Complete Streets evaluation relates to the economic impacts they may bring. Although it is difficult to directly relate economic development to the implementation of Complete Streets, some studies suggest that streets designed for bicycling and walking bring about economic benefits, such as increased spending at local businesses and increased tourism.

One study that looked at the potential impact of bike lane installation in Toronto concluded that, contrary to some popular perceptions, replacing on-street parking with bike lanes would increase economic activity. The authors found that bicyclists and pedestrians were among the more frequent patrons of adjacent business, with higher than average spending on a monthly basis, compared to patrons arriving in vehicles (Clean Air Partnership, 2009).

Another study found that housing values are considerably higher in walkable neighborhoods compared to those that are less walkable (Cortright, 2009). In this case, "walkability" was defined as having access to a variety of land uses, as measured by Walk Score (www.walkscore.com).

For more information on the impacts of Complete Streets, please see www.completestreets.org.

7.6 Safe Routes to School

The Safe Routes to School (SRTS) program gives community leaders, schools, and parents the opportunity to improve safety around schools and encourage more children, including those with disabilities, to walk and bike to school safely. By increasing the number of students walking and biking to school, the program helps to reduce traffic congestion around schools and improve health and the environment; in return communities become more livable for everyone (NCSRTS, 2011b).

As with any type of program, it is important to measure the success of the implemented strategies to ensure that resources are spent toward efforts that show the greatest likelihood of success and to better assess how the program is making a difference. Evaluation should begin when the program is launched and continue through implementation.

This SRTS walking map shows good and bad streets and intersections for walking. Source: City of Columbus Public Health Dept.

Evaluation involves collecting data to determine baseline conditions. Data collection methods in SRTS programs often include student travel tallies, parent surveys, or sidewalk and bikeway inventories. These data can help evaluate the impact of the activities by understanding if changes in travel mode and safety have occurred. As such, every SRTS program can benefit from evaluation. Evaluation allows for:

- Making sure that the underlying problem is identified so that proper strategies to address the problem are selected
- Setting reasonable expectations about what the program can do
- Identifying changes that will improve the program
- Determining if the program is achieving the intended results

Benefits of the evaluation strategy go beyond local programs. The data collected during this process can be used to influence future funding at the local, state, and national levels for the SRTS program.

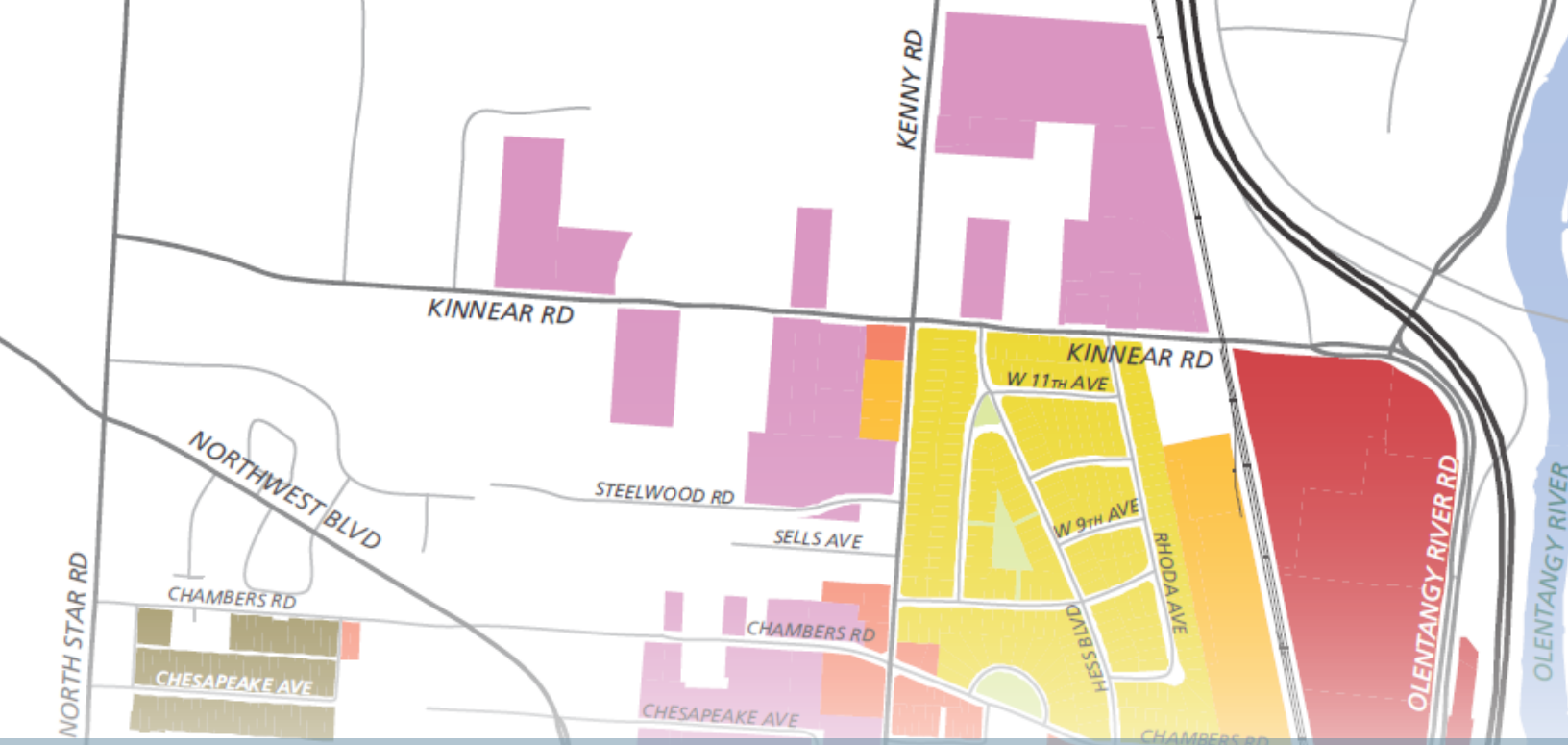
Evaluation is typically done before and after the program. Basic evaluation includes collecting baseline information using tools such as a student travel tally and parent survey. As part of the SRTS program, there are 2 main evaluation goals:

- To create a change in mode choice; i.e., increasing the number of children walking and biking to school.
- To decrease the amount of crashes by improving the infrastructure and providing increased enforcement and evaluation.

The steps shown in the table below should be followed when evaluating an SRTS program.

Table 15. Six-Step Process for SRTS Program Evaluation

PROJECT STAGE	EVALUATION STEP
Before	Plan the program/Collect information
	Write objectives
	Decide what, how, and when to measure
During	Conduct the program and monitor progress
After	Collect information and interpret findings
	Use results



8. LAND USE & URBAN FORM

8.1 Introduction

The term 'land use' refers to the built environment and its various functions, such as agricultural, residential, office, commercial, industrial, etc. Land use patterns are typically regulated through zoning laws, which determine how close different land uses are to each other.

Some zoning laws maintain strict separation of land uses, increasing the distance between residential and commercial or industrial areas. Others allow for a mix of uses, resulting in more integrated land use patterns and less distance between uses. According to Frumkin, et al. (2004), "the density and variety of uses in a neighborhood, community, or city district largely determine the functional distances that separate the places in which we live, work, and play." Land use patterns have implications for density, walkability, public health, the environment, and more.

Connectivity deals with the linkages between places, taking into account both distance and ease of travel. Proximity is important, but if there are poor connections between close destinations, it can seem that they are functionally disconnected.

8.2 Street Patterns

Both the street form and the physical aspects of streets can foster more complete streets. Street form refers to the organization or layout of streets. A grid pattern is often thought of as having the highest amount of connectivity, with short blocks and many intersections. The intersections allow for many different paths through an area, making it more permeable to traffic. Marshall (2005) distinguishes "connectivity" from "permeability" with "connectivity" dealing with the actual number of connections, and "permeability" as the capacity of those connections. As noted by Sucher (2003), "more intersections mean more places where the cars must stop, thus lowering average auto speed. Short blocks also create more opportunities for walkers to cross the street. The short block is more interesting for walkers. A journey seems quicker, livelier, and more eventful punctuated by crossing streets."

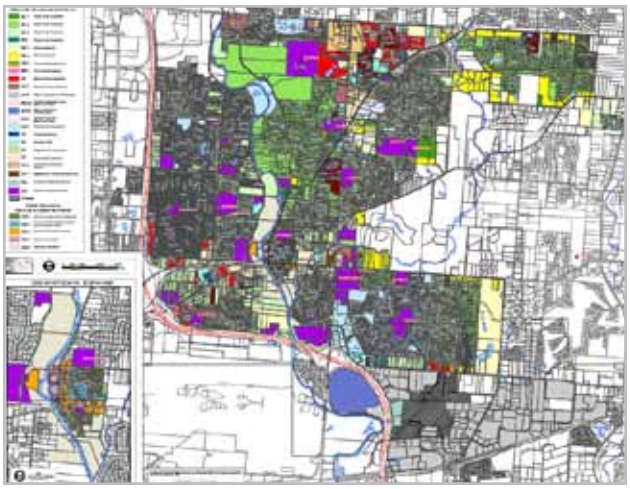
Another type of street pattern is a hierarchical system, where streets are arranged based on their capacity (highways, arterials, collectors, residential streets, etc.). This type of street network often restricts or eliminates connections between differing levels of roads (for instance not connecting residential streets with arterials). The lowest level of the hierarchy is cul-de-sacs, which have only one entrance and exit.

Hierarchical systems have been the dominant transportation configuration in the United States since the 1960s, reflecting automobile dependence. In relation to hierarchical systems, Tachieva (2010) notes, "transportation constraints include the lack of connectivity and permeability in existing suburban thoroughfare patterns. There is rarely a continuous network to allow for multiple choices of movement, only a sparse arrangement of highways, collectors, and cul-de-sacs confining the traffic stream to limited channels of high speed and congestion."

These street patterns show decreasing levels of connectivity and permeability (left to right). Source: Google Maps.

8.3 Zoning

Zoning regulations are used by local municipalities to designate uses to areas. According to Cullingworth (1993), "zoning is an exercise of the police power: the inherent power of a sovereign government to legislate for health, welfare, and the safety of the community." Originally, zoning regulations were used in Germany in the late 19th century to keep slaughterhouses out of residential areas. In the United States in the early 20th century, the first zoning regulations were used to keep industrial uses out of residential areas (Frumkin et al, 2004).



Official zoning map of the City of Gahanna, OH.

The idea behind zoning is that cities should be able to keep land uses that were incompatible away from each other, or to prevent nuisances from occurring. Zoning has been described in the following way (Institute for Local Government, 2010):

> *"Zoning implements the general plan; it separates a community into districts, or 'zones,' that regulate land uses and the intensity of development. A zoning designation is assigned to every legally defined parcel within a zone in the community. A zoning map shows officials and the public the location of the various zones, and the zoning code specifies which uses are permitted in those zones and the standards that apply to each use."*

8.3.1 Types of Zoning

There are several types of zoning codes, including euclidean, form-based, incentive-based, and performance-based. Each approach has strengths and weaknesses and is best applied under a particular set of circumstances or with a particular goal in mind. Furthermore, the elements of each type of code may be combined into a hybrid code to develop a suitable code for a given area (Zoning Matters, 2011).

Euclidean Code

Euclidean code is the most common type of zoning code. Euclidean zoning uses pre-determined dimensions to classify land into categories such as single-family residential, multi-family residential, commercial, institutional, industrial and recreational. As such, this type of zoning code separates uses and generally does not support mixed uses. It may also be associated with increased car travel due to greater distances between land uses (Tachieva, 2010).

While it is possible to create mixed-use spaces through retrofitting (altering zoning codes to add more mixed-use spaces), it is important to avoid a fragmented approach. Planned Urban Development or Urban Overlay Districts, which allow for mixed uses only within designated zones, create a piecemeal land use system rather than overhauling the entire zoning code. A more comprehensive approach utilizes form-based code.

Form-based code examples illustrating setback requirements (top), and requirements for a lot fronting a primary and a non-primary street (bottom). Source: Franklin County, OH Economic Development & Planning.

Form-Based Code

Form-based code (FBC) does not focus on segregating land use. Instead, FBC regulates the visual characteristics of a community by stipulating building scales, building facades, and the public realm. Where euclidean zoning deals with the uses of land, form-based code deals with the structure of what is on the land.

The Form-Based Codes Institute uses this definition: "Form-based codes use physical form, rather than separation of land uses, as their organizing principle. They foster predictable results in the built environment and a high quality public realm." They also deal with the relationships of buildings within an area, so that a building's context is taken into consideration, as well as its placement, mass, etc.

Because form-based codes deal with form and not only function of space, they can be used to create zoning codes that encourage Complete Streets, such as reducing setbacks so that buildings address the street and locate the parking behind the building, to increase walkability.

Common Elements of a Form-Based Code include (Form-Based Code Institute, 2011):

- **Regulating Plan.** A plan or map of the regulated area designating the locations where different building form standards apply, based on clear community intentions regarding the physical character of the area being coded.
- **Public Space Standards.** Specifications for the elements within the public realm (e.g., sidewalks, travel lanes, on-street parking, street trees, street furniture, etc.).
- **Building Form Standards.** Regulations controlling the configuration, features, and functions of buildings that define and shape the public realm.
- **Administration.** A clearly defined application and project review process.
- **Definitions.** A glossary to ensure the precise use of technical terms.

Form-based codes may also include:

- **Architectural Standards.** Regulations controlling external architectural materials and quality.
- **Landscaping Standards.** Regulations controlling landscape design and plant materials on private property as they impact public spaces (e.g., regulations about parking lot screening and shading, maintaining sight lines, ensuring unobstructed pedestrian movement, etc.).
- **Signage Standards.** Regulations controlling allowable signage sizes, materials, illumination, and placement.
- **Environmental Resource Standards.** Regulations controlling issues such as storm water drainage and infiltration, development on slopes, tree protection, solar access, etc.
- **Annotation.** Text and illustrations explaining the intentions of specific code provisions.

New Albany, OH's Form-Based Code

The City of New Albany has used a form-based code, called Urban Center Code, to create and maintain a traditional town center form for its Village Center. The code evolved out of the 2005 Village Center Strategic Plan and "standardizes the community design elements (design of buildings, streets, and public spaces) to create a vibrant and mixed-use district" (City of New Albany, 2011b).

Urban Center Zoning District (UCD) Key Components:

- *UCD is more picture-oriented and establishes expectations for where development should go rather than where it shouldn't.*
- *UCD describes the form that buildings should take and where they are situated on the site, with less focus on the use of the building.*
- *UCD encourages mixed-use development and integrated land uses.*
- *UCD revises the parking requirements in the new urban center zoning code or in an overlay district to provide adequate, but not unnecessary parking.*
- *UCD establishes street standards that create the 'town center' development pattern and form.*

Example of commercial buildings under form-based code in New Albany, OH. Source: MORPC.

Incentive-Based Code

Incentive-based code allows building designs that do not fit within the existing zoning regulations in exchange for a design that benefits the community. Common design factors include open space, plazas, art, or affordable housing. It is often used to get developers to include affordable housing aspects of projects, usually by increasing the allowed density. Incentive-based code is flexible, but can be complex to administer.

Performance-Based Code

Performance-based code regulates the impact that the activities associated with a building or business can have on the surrounding community and environment. Regulations commonly include noise pollution, air pollution, light pollution, and traffic flow. Like incentive-based code, performance-based code is flexible, but can be complex to administer.

Parking Requirements

Zoning regulations also typically include parking requirements, which usually stipulate a minimum number of required spaces for each building. Parking minimums are traditionally calculated from the building's use and square footage and have led to excessive parking availability.

Tachieva (2010) notes that "excessive requirements for on-site parking reduce the potential for increasing density and varying building types. Most conventional zoning codes require on-site parking and do not allow shared parking ratios, thus limiting development to low structures with parking lots or high-rises with parking decks. There is no incentive for mid-size buildings with lower parking ratios that will more evenly distribute construction through the suburban fabric."

8.4 LEED-ND

There are many different types of green building certifications available to builders. One of the most well-known is the Leadership in Energy and Environmental Design (LEED), which was established by the U.S. Green Building Council (USGBC) in 1998. More recently, the USGBC partnered with the Congress for New Urbanism (CNU) and the Natural Resources Defense Council (NRDC) to create the LEED for Neighborhood Development (LEED-ND) rating system, which integrates the principles of smart growth, urbanism, and green building.

LEED-ND is a certification that verifies a development project's location and design meet high levels of environmentally responsible, sustainable development (USGBC, 2011). The certification is "a finely-tuned mix of USGBC's materials and land use considerations, CNU's urban design guidelines, and NRDC's

The LEED-ND Process

Obtaining LEED-ND certification is a three step process. In stage one, conditional approval for the project is awarded. As development continues pre-certification is granted in stage two. Lastly, in stage three the project can earn certification qualifying it as an LEED-ND certified project. The certification is determined by the number of criteria met in the following categories:

- *Smart Location and Linkage*
- *Neighborhood Pattern and Design*
- *Green Infrastructure and Buildings*
- *Innovation and Design Process*
- *Regional Priority*

Various resources related to LEED-ND are available at: www.usgbc.org.

environmental and smart growth concerns. This three-layered lens evaluates projects by a number of criteria, including location, density, conservation of wetlands and agricultural lands, reduced automobile dependence, proximity to housing and jobs, walkability, energy efficiency, and a host of other measures" (Berg, 2007).

The three prerequisites in the Neighborhood Pattern and Design section of the scoring section are walkable streets, compact development, and connected and open community, all of which support Complete Streets tenets.

LEED-ND embraces the practice of retrofitting neighborhoods to create pedestrian-friendly communities with mixed land use, green design, and green infrastructure. Green design/infrastructure incorporate provisions that reduce environmental harm and promote community wellbeing. Some specific provisions include:

- Using sustainable design practices for buildings.
- Avoiding the disturbance of natural habitats such as wetlands and floodplains.
- Minimizing pollutants (air, water, light, and noise).
- Maximizing energy efficiency.

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9. TRANSIT-ORIENTED DEVELOPMENT

9.1 Introduction

High quality transit is an important component of a vibrant, sustainable community. Reliable and efficient transit systems allow people to drive less, resulting in lower per-capita emissions, increased walking and bicycling, and higher disposable income.

One of the key factors of success for any transit system is high ridership, which allows for more comprehensive coverage and frequent service. Perhaps the best way to achieve high ridership is by linking transit service to residential and commercial development. Transit-Oriented Development (TOD) is a development strategy that takes advantage of the relationship between transit and density to create a better transit system and a more vibrant community.

Transit-Oriented Development has generated a lot of interest over the past few years, but the concept is not new. In fact, TOD was a common development pattern prior to the rise of the automobile. In the late 19th and early 20th centuries, many North American communities developed densely along streetcar lines. During the mid-to late 20th century, the proliferation of the automobile and expansion of the highway system allowed development to become more dispersed, ultimately leading to a more uniform pattern of lower density development. While it is possible to provide transit service to a dispersed population, the cost of doing so is very high and the quality of service tends to be poor (e.g., infrequent, slow, etc.). Conversely, TOD is a cost-effective way to provide high quality transit service.

Planning for TOD is an ongoing process. While areas with existing transit service and high densities offer the best possibilities, the principles of TOD can also be applied to planned future development, even where transit service does not currently exist. In this case, planning for future transit can eliminate the need for costly retrofits and create a more sustainable land use pattern.

9.2 Benefits

Recent demographic trends and shifting socio-cultural values point to an increased demand for transit in the United States, and urban areas in particular. As the ability of baby boomers to provide for their own transportation is diminished, they will increasingly rely on public transit for mobility. At the same time, younger generations have become more concerned with the consequences of automobile-oriented transportation, and look to transit as a desirable alternative. This pattern is reflected in the ongoing revitalization of cities across the country, and in central Ohio specifically. One of the most important benefits of TOD is that it can simultaneously address these two important societal trends.

In addition to these quality-of-life benefits, researchers have documented several more specific outcomes attributable to TOD. While these may vary across individual developments, the following patterns are likely in successful TODs (Lund et al. 2004; TCRP, 2004; TCRP, 2008; VTPI, 2011a):

- Increased transit ridership: residents living near transit stations are about 5 times more likely to commute by transit as the average resident of the same city.
- Increased bicycling and walking and associated health benefits.
- Reduced fuel consumption and associated pollution.
- Reduced traffic congestion and vehicle miles traveled.
- Higher transit revenues.
- Reduced automobile ownership: car ownership among people who live in TODs is roughly half compared to similar households not living in TODs.
- Reduced overall personal transportation costs.
- Revitalized neighborhoods and economic development.
- Increased land values and rents.
- Increased property and sales tax revenues.

9.3 Implementation Strategies

There is a number of tools and strategies that communities can employ to encourage transit-oriented development. These range from broad policies to site-specific implementation measures. Typically, the idea behind these strategies is to create conditions that will allow the private sector to be profitable in creating TODs. Additionally, certain strategies are intended to benefit transit agencies. Some or all of the following strategies can be used to encourage TOD.

9.3.1 Zoning

Land use controls implemented through changes in zoning designations or TOD overlay zones can encourage transit-friendly development. In many cases, TOD zoning can be implemented proactively, before a station and/or development is in place. The provisions of TOD zoning may include (TCRP, 2004):

- High-density near transit stations, gradually declining farther away. Residential densities ranging from 7 to 30 units per acre are suggested, based on the intensity of transit (Ewing, 1997).
- Mixed land uses near transit stations.
- Reduced parking requirements, or parking maximums near transit stations.
- Increased requirements for bicycle and pedestrian access. Examples include sidewalk connections to transit stops, schools, and trails, and bicycle parking requirements at buildings and transit stops.
- Increased floor-to-area ratio (FAR). Floor-to-area ratio is calculated by dividing the total square footage of a building by the square footage of the parcel. The resulting measure reflects the intensity of the use of land. A minimum FAR of 0.35 is suggested for nonresidential areas.

For more information on Zoning, please see "8. Land Use & Urban Form," on page 8-1.

9.3.2 Value Capture

TOD projects can be funded through any of several "value capture" strategies, such as special assessments, tax increment financing, joint development, or developer/impact fees (CTOD, 2008).

9.3.3 Coordinated Public Infrastructure Investment.

Public spending can impact land use patterns and make transit more or less likely to succeed. For example, infill sites may need upgraded sewers and water lines, streetscape improvements, bike and pedestrian access improvements, etc.

9.3.4 Tax Incentives

Local governments may reduce tax obligations for commercial developments near transit stations. Similarly, federal income tax credits could be used to encourage TOD, as proposed by Sen. Robert Menendez (NJ) in 2010.

9.3.5 Land-banking

Recognizing the potential for transit-oriented development, redevelopment agencies, transit agencies, or other governmental or non-profit agencies may purchase land to be developed at such time as it becomes feasible to implement TOD.

9.3.6 Carsharing

Residents and employees of TODs benefit from carsharing, which allows individuals to rent a car or truck for short trips, such as grocery shopping or emergencies. While it is generally expected that these individuals will rely on transit, walking, or biking for most trips, access to a vehicle is important to fulfill a person's full range of mobility needs. Carsharing allows people to live without owning a car, which in turn results in a host of benefits.

9.3.7 Reduced Trip Generation Rates

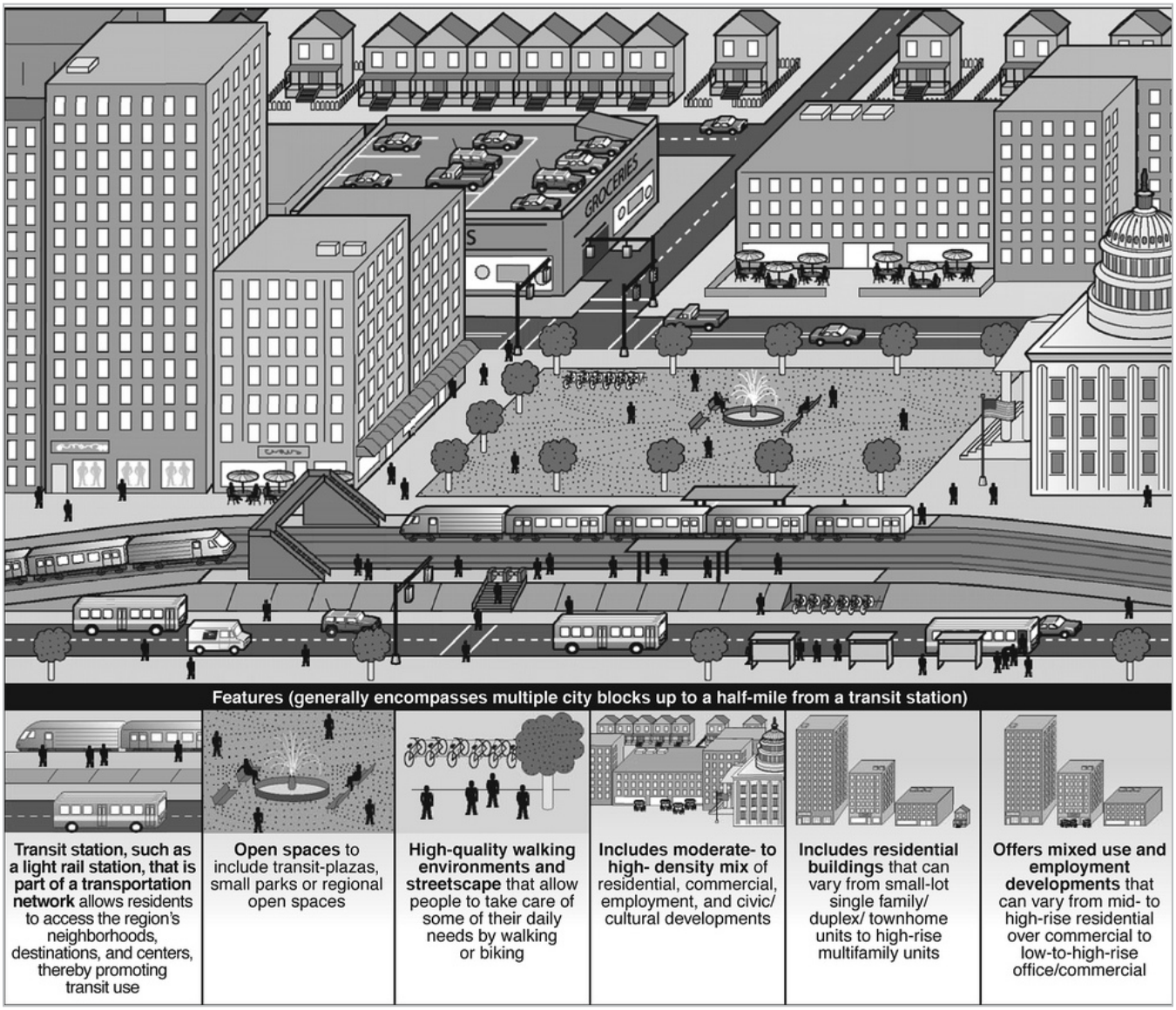
The development process typically requires that traffic resulting from new development does not overburden the current transportation system. To this end, planners use trip generation rates to determine whether existing road capacity needs to be expanded as a result of new development. However, conventional trip generation rates are not representative of likely mode shares in TODs. As a result, trip rates should be reduced when evaluating TODs.

9.4 Additional Considerations

TOD is best thought of as a set of development concepts rather than an end product. A development may incorporate some features of TOD, while omitting others, depending on the situation. The list below includes some of the special considerations related to TOD:

- Although TOD is often associated with rail, TOD does not prescribe a particular transit technology. For instance, TOD can be based around fixed-route bus service, bus rapid transit, light rail, streetcars, commuter rail, or other transit technologies.
- One of the primary factors that individuals consider when deciding whether to use transit is travel time. Improved transit travel times result in greater transit mode share.
- Reduced automobile ownership is a cornerstone of TOD success. A mix of land uses is important to achieve that goal.
- The conversion of excess surface parking to TOD is an especially beneficial strategy that can also meet the goals of infill development.

- The structure of the current real estate finance system unduly limits the financial viability of proposed TODs. An improved system would allow lenders to consider transportation costs in their decision of whether to fund a mortgage. A mortgage based on this concept is referred to as a "location-efficient mortgage" (VTPI, 2011b). Since transportation costs are typically not considered in a lender's decision, the borrowing power of potential TOD residents may be less than their actual ability to pay, based on their lower transportation costs. Conversely, mortgages provided to residents where driving is the only viable option are likely to overestimate the borrower's ability to pay. To address this problem, the Center for Neighborhood Technology has developed the Housing & Transportation Affordability Index, which includes an interactive map of transportation and housing costs for the Columbus, OH region. The map can be viewed at: www.htaindex.cnt.org.



Representation showing various elements of a TOD. Source: GAO, 2009.

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10. PARKING MANAGEMENT

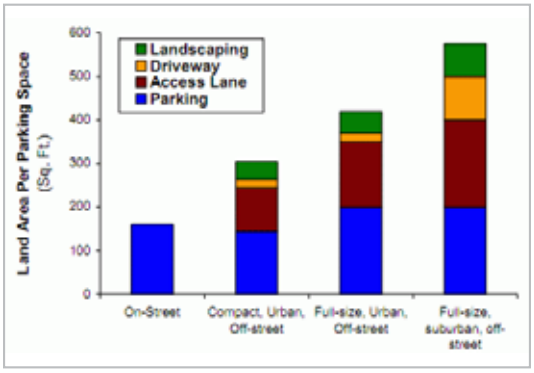
10.1 Introduction

In the United States, parking is often considered a key amenity for commuters, residents, and visitors. When designing neighborhoods and cities with Complete Streets in mind, there are several things that should be considered related to parking.

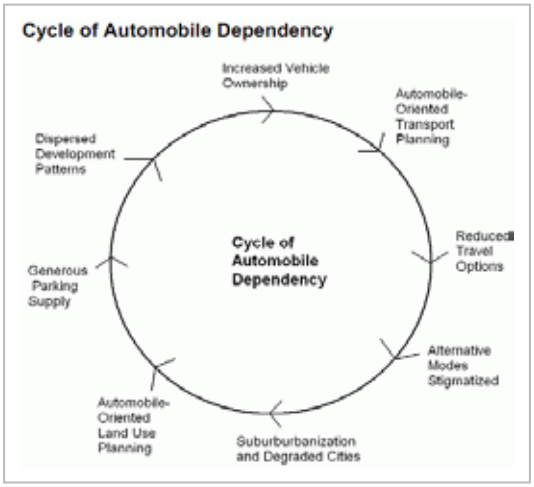
On-street parking can contribute to the quality of a complete street. It can offer an amenity for drivers while serving as a buffer between traffic lanes and sidewalks. However, in many contexts, parking is provided outside the street right-of-way. Even these surface parking lots deserve attention, as they can serve as a barrier between the street and the building entrance. Effectively mitigating the impact of the gap between the street and the building entrance can improve accessibility for all modes of transportation.

In the United States, 99 percent of all automobile trips include free parking (Shoup, 1999). When something is offered free of charge, its perceived demand can seem almost infinite. Accommodating parking in a context-sensitive matter may require one or more of the approaches below depending on the scale (site, corridor, district and municipal) and local conditions (capacity for implementation, monitoring, and enforcement).

This retail parking lot remains unused throughout much of the year. Source: MORPC.



Land area required for typical parking facilities. Source: VTPI, 2010.



Generous levels of parking contribute to automobile dependency. Source: VTPI, 2010.

10.2 Parking Supply

If the environment indicates that more parking spaces are necessary to accommodate residents and visitors, it is important to clearly define parking demand as well as strategies that could reduce the demand. Parking requirements are a standard part of most zoning codes, but research shows that many codes actually require too much parking (Shoup, 1999; Shoup, 2006). The standards referenced in such codes are often based on studies from suburban locations at peak periods.

These same parking requirements often only allow parking that is "on-site" (see definition below) to count against this parking demand. Solutions that capture some or all of this demand off-site may be overlooked.

The urban form that results from this approach is characterized by buildings surrounded by parking. These buildings are isolated from the street and from each other, defeating the accessibility gains of streets that are otherwise complete. Accurately measuring and mitigating parking demand can help to mitigate this problem. Shoup (2005) has compiled a lengthy reference on parking and zoning that fully describes this phenomenon as *The High Cost of Free Parking*.

10.2.1 On-site Parking

On-site parking refers to the parking available on the same piece of property as the building or use. Excessive on-site parking requirements tend to result in buildings being separated by large parking lots, thus increasing automobile dependence that induces further demand (VTPI, 2010 and Shoup, 2005). It is therefore recommended to apply other strategies to break this cycle. Litman (2006) details these strategies, and a summary of the strategies is available through the Victoria Transport Policy Institute (VTPI, 2010).

Structured parking refers to multi-level above or below ground structures that allow more vehicle parking on-site than would be possible at the surface. The structures may or may not be incorporated into a building.

While such structures are often cost-prohibitive, they allow for the integration of parking into a more compact land use pattern that supports a mix of residential and business units.

In locations with high land acquisition cost and higher density (existing or under construction), it is possible to support the construction, operation, and maintenance of a parking structure.

Of the different structured parking types available, underground structures are more expensive due to the ventilation and structural requirements (Balboni, 2007; VTPI, 2009).

This structured parking lot blends in with the historic district and offers street-level interest by including retail space. Source: Andy Taylor. Lincoln, NE.

10.2.2 Peripheral/Remote Parking

Peripheral or remote parking refers to parking lots outside the business area. Remote lots can serve employees or fulfill other long-term parking needs. Access to the destination can be provided by shuttle or transit service. Such lots can offset the need to design parking lots to meet high peak-period demand, which allows for smaller surface parking lots and a more compact land use pattern. This strategy is described in more detail by Litman (2006) and the Congress for the New Urbanism (2001).

Remote parking is a good strategy where compact, mixed-use land patterns are desired, but the high capital cost of building structured parking is not feasible. However, ongoing operation of a shuttle service should be weighed against the cost of adding more parking. This strategy also works well for special events in historic town centers, which were not designed around the car.

The sidewalk (top) allows pedestrians to avoid walking through access aisles. Striping is another method to highlight pedestrian travel through parking lots (bottom). Sources: NNECAPA. Lexington, MA (top); MORPC. Columbus, OH (bottom).

10.2.3 Parking Lot Design

Taking driveway entries, aisle access, landscaping, and the parking space itself, each space in a parking lot requires 300-400 square feet. Small parking lots tend to be less efficient in terms of square feet per space because fewer spaces share set entry and access square footage.

Municipalities can suggest landscaping and stormwater facilities that require less space for the same effect, depending on the context. Landscaping can also be combined with pedestrian and bike access in and through parking lots, which is especially important for lots with high turnover rates.

Depending on the dimensions of the land available for parking and the access points, angled parking can be more efficient space than perpendicular parking because access aisles only allow one-way traffic. However, perpendicular parking with two-way access aisles is easier to navigate, especially for visitors.

Some city codes specify one set of dimensions for all parking spaces. However, a more flexible coding system is preferred, as different users require different levels of service. For example, a 9' wide space may consume too much of the limited land available for parking. High-turnover spaces, as can be found in a retail parking lot, should only require 8'6" wide spaces. Spaces 8' wide should suffice for low-turnover spaces, such as those used once a day by office employees.

More information on parking space dimensions can be found in the Planning and Urban Design Standards (APA, 2006) and The Dimensions of Parking (ULI, 2009).

10.2.4 On-Street Parking

On-street parking refers to the space for parked vehicles that is permitted as a part of the public right-of-way at curb. If a roadway has sufficient right-of-way on each side, angled curb parking can add to the parking supply by as much as 50 percent compared to parallel parking (Robertson, 2007). Back-in angled parking is another option which requires additional navigation for those parking, but removes the blind spot during departure, and thus reduces potential conflicts with bikes.

Parallel parking can be accommodated on roadways without space for angled parking. Careful tradeoffs must be made between traffic lanes, bike lanes (door zone issue), and on-street parking. Traffic speed must also be considered because the maneuver to park requires backing in. Striping parallel parking spots can make them more inviting to the short-term user, but will take away from the total supply (i.e., the typical car is 16'6" long, while a striped parallel space requires 22').

On-street parking near Ohio State University. Source: MORPC. Columbus, OH.

10.3 Parking Supply Management

Adding to the overall parking supply may be a worthy goal. However, as noted above, it is not without negative impacts to compact and walkable urban form. Additionally, it may not be practical for all sites, in terms of layout or cost.

In cases where adding to the overall parking supply is desired, but not possible or practical, strategies to better manage the existing parking supply should be used to meet goals of improved vehicle accessibility. It can also facilitate property reuse and infill by accommodating more users on a site that would otherwise require a parking variance.

10.3.1 Flexible Parking Requirements

Most zoning codes require a certain number of parking spots for a building based on size and use. However, other factors impact the amount of parking a destination should supply. For example, if a location is well served by transit, it should merit a reduction. The strategies discussed below may also merit a reduction (Litman, 2006; VTPI, 2010).

10.3.2 Shared Parking

Parking demand for different land uses peaks during different periods of the day. This can allow neighboring uses to pool their parking supply, requiring less than the sum of the others in isolation.

Smith (2005) provides a detailed process to determine the appropriate amount of shared parking. Others offer an abbreviated version of this process (APA, 2006; Center for Applied Transect Studies, 2009).

Shared lots have other efficiencies in terms of size and layout. Small lots for a single use or building may each require their own driveway access and landscaping that could otherwise be shared among more spaces in a larger lot.

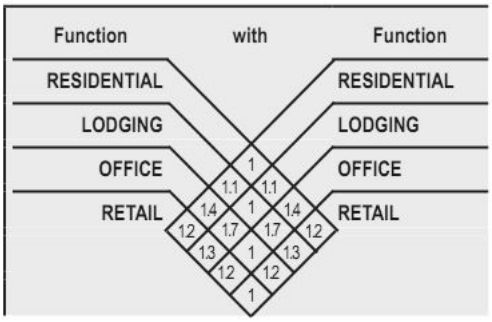
In contexts where parking supply is limited, shared parking might be most effective in the form of public, off-street parking lots (Robertson, 2007). Where parking is not immediately adjacent to the destination, clear signage is important to ease wayfinding. Maps and online information can also prepare area visitors for their parking options.

TABLE 11: Parking Calculations. The Shared Parking Factor for two Functions, when divided into the sum of the two amounts as listed on the Required Parking table below, produces the Effective Parking needed for each site involved in sharing. Conversely, if the Sharing Factor is used as a multiplier, it indicates the amount of building allowed on each site given the parking available.

REQUIRED PARKING (See Table 10)

	T2 T3	T4	T5 T6
RESIDENTIAL	2.0 / dwelling	1.5 / dwelling	1.0 / dwelling
LODGING	1.0 / bedroom	1.0 / bedroom	1.0 / bedroom
OFFICE	3.0 / 1000 sq. ft.	3.0 / 1000 sq. ft.	2.0 / 1000 sq. ft.
RETAIL	4.0 / 1000 sq. ft.	4.0 / 1000 sq. ft.	3.0 / 1000 sq. ft.
CIVIC	To be determined by Warrant		
OTHER	To be determined by Warrant		

SHARED PARKING FACTOR



Shared Parking Factor included in the Center for Applied Transect Studies' Smart Code. Source: Center for Applied Transect Studies, 2009.

10.3.3 Regulations/Restrictions

Time-based restrictions are common in many districts with limited parking supply, but official enforcement requires staff resources from public safety departments. Some business districts issue unofficial warnings to frequent offenders (Congress for the New Urbanism, 2001).

Permit parking is common in many districts with limited parking supply and a high proportion of residential properties. Permit parking lots privilege the needs of residents (and sometimes employees) over area visitors who are important for many businesses. Creating permit areas can artificially decrease the parking supply in mixed-use districts (Congress for the New Urbanism, 2001). Careful consideration should be given to the business mix (i.e., retail, restaurants, and office) and the expectations of the residents (i.e., rates of car ownership, availability of off-street parking). Metering can be a good alternative to keep turnover rates high.

Parking regulations are clearly marked by appropriate signs. Source: Andy Taylor. Grove City, OH.

10.3.4 Preferential Parking

Preferential parking refers to the spaces reserved nearest the associated destination for a specific set of users. Offering this type of prime parking to carpools or vanpools encourages efficient use of the parking supply by adding another incentive to share a ride - and a parking spot.

Preferential parking can be reserved for carpools and energy-efficient vehicles, among others. Source: Andy Taylor. Columbus, OH.

10.3.5 Parking for Other Users

Bicycle parking can be encouraged or required by local parking code. If on-street bicycle parking is used, several bicycles will fit in the space occupied by one automobile. If off-street bicycle parking is provided, care must be taken to ensure the parking area does not encroach on pedestrian access. A good resource to consult is the Bicycle Parking Guidelines, published by the Association of Pedestrian and Bicycle Professionals. It can be found online at: www.apbp.org/?page=Publications.

Motorized two-wheel vehicles, such as scooters and motorcycles, can also have dedicated parking spaces. Downtown Columbus has several such areas.

On-street scooter and motorcycle parking. Source: MORPC. Columbus, OH.

10.4 Parking Demand

Reducing demand for parking can have the same benefits as better managing the physical supply, such as retaining compact and walkable urban form or encouraging property reuse where parking supply may be physically restrained.

The goal of the following strategies is to reduce the demand for parking without reducing the number of users reaching their destination. This can be accomplished when, for example, vehicles bring more users or visit for shorter periods of time.

Modern parking meters accept credit cards. Source: MORPC. Columbus, OH

10.4.1 Metering

Metering on-street spaces encourages turnover in the most convenient and visible locations. It is easier to enforce than posted time-based restrictions.

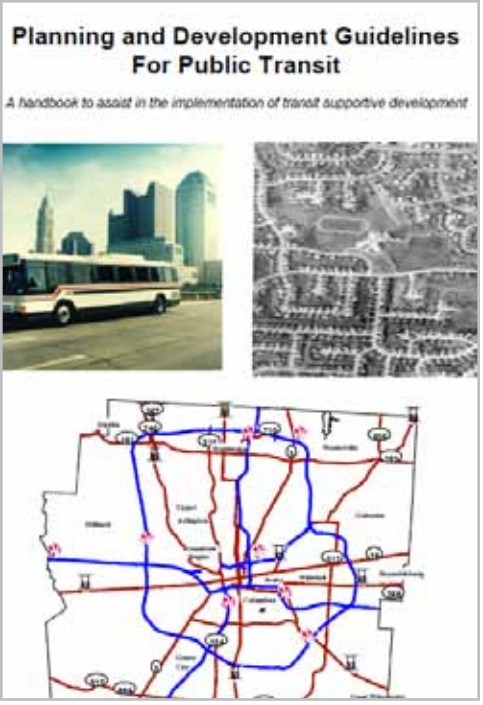
The most effective way to reduce demand for parking is to charge users based on time parked. This can be a contentious issue for businesses and residents who may expect parking to be free. Robertson (2007) observes that users fail to understand that the cost of supplying parking is factored into their destination's overhead, similar to rent or utilities. When that destination is designed around the car and not hemmed in by other properties, this cost may be marginal. The cost is far from marginal when that destination is in a location where property is scarce or expensive.

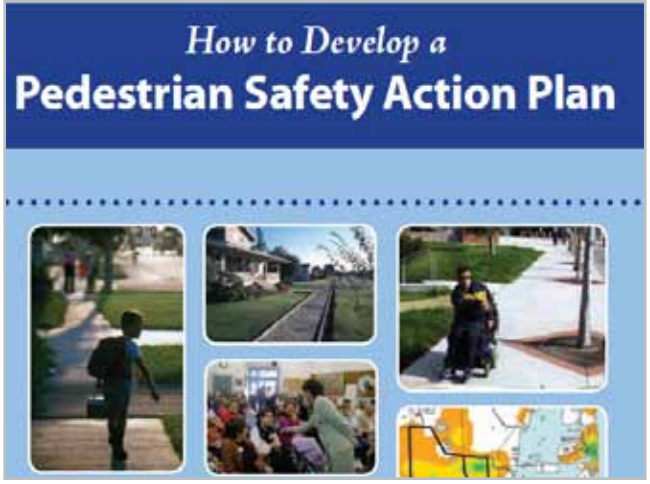
"Parking benefit districts" can increase the acceptance of parking fees. In these districts, revenues collected from the meters pay for public improvements in the district, such as sidewalk repair. Common opponents of metered pricing, such as businesses and residents, can now see the direct local benefit of these fees (Shoup, 2006).

10.4.2 Cash Out Employer Paid Parking

Even in contexts where parking is priced, employers often subsidize the cost, making parking free or at least cheaper for their employees. A "cash out" program offers employees a portion of that subsidy as cash in lieu of free parking.

As an example, if a space costs an employer $75 per month, the employee is offered $50 per month. The employee who accepts the $50 no longer has free parking at the workplace. The employee who does not accept the $50 continues to have free parking. Under such a program, an employee has an incentive to find an alternate mode of travel and the employer saves a portion of what they would otherwise be spending on parking every month.





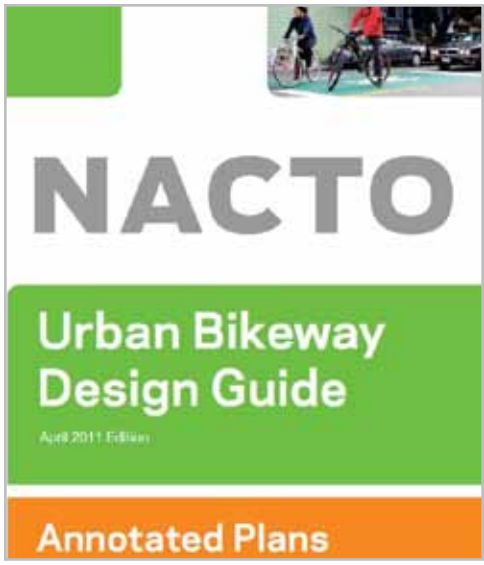


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Table 16. Key Resources

SOURCE	TITLE	YEAR	LINK
AARP	Getting Around Guide	2010	www.aarp.us/pZ1RO4
AASHTO	A Policy on Geometric Design of Highways and Streets	2004	
AASHTO	Guide for the Development of Bicycle Facilities	1999	
AASHTO	Guide for the Planning, Design, and Operation of Pedestrian Facilities	2004	
Allen, J.S. (ODPS)	Ohio Bicycling Street Smarts	2001	www.bit.ly/tCZxxs
ALTA Planning & Design	Bicycle Interactions and Streetcars	2008	www.bit.ly/pKXZFu
ALTA Planning & Design	Columbus Bicentennial Bikeways Plan	2008	www.bit.ly/qzzsjb
APA	Planning and Urban Design Standards	2006	
APBP	Bicycle Parking Guidelines	2010	www.bit.ly/kbWrIY
APHA	Transportation and Health Toolkit	2011	www.bit.ly/pcd9yR
Bike Pittsburgh	Bike Commuting 101	n.d.	www.bit.ly/oES4Kv
Burden, Dan	22 Benefits of Urban Street Trees	2006	www.bit.ly/o4ZPB4
CalTrans	Temporary Pedestrian Facilities Handbook	2011	http://1.usa.gov/qgiiw1
Chicago, IL Bicycle program	Video: "Share the Road - Buses and Bicycles"	2010	www.bit.ly/pugPe4
City of Seattle, WA	Pedestrian Toolbox	2011	http://1.usa.gov/pOhE5x
Columbus LCIs	Columbus League Cycling Instructors website	n.d.	www.bit.ly/pwRyUL
COTA	Long Range Transit Plan 2006 to 2030	2006	www.bit.ly/pNiY0A
COTA	Planning and Development Guidelines for Public Transit	1999	www.bit.ly/l43sun
CPH	Creating a Walking School Map	n.d.	www.bit.ly/qt6ZJO
Ewing, R. & Brown, S.	U.S. Traffic Calming Manual	2009	www.bit.ly/iWMHOU
FHWA	BikeSafe	2006	www.bit.ly/yMgtDU
FHWA	Designing Sidewalks and Trails for Access	2001	http://1.usa.gov/r5W6vV
FHWA	Good Practices Guide for Bicycle Safety Education	2002	www.bit.ly/qVCpKZ
FHWA	How to Develop a Pedestrian Safety Action Plan	2009	www.bit.ly/wTsp9r
FHWA	Manual on Uniform Traffic Control Devices for Streets and Highways	2009	http://1.usa.gov/rhVT7t

SOURCE	TITLE	YEAR	LINK
FHWA	Pedestrian Safety Guide for Transit Agencies	2008	www.bit.ly/pXv65Y
FHWA	PedSafe	2004	www.bit.ly/yGIqBU
FHWA	University Course on Bicycle and Pedestrian Transportation	2006	http://1.usa.gov/nMTbAT
Goodell, S. and C.H. Williams	The Built Environment and Physical Activity: What is the relationship? (Policy Brief No. 11)	2007	www.bit.ly/qlladP
IBPI	Fundamentals of Bicycle Boulevard Planning and Design	2009	www.bit.ly/k520Ck
ITDP	Bus Rapid Transit Planning Guide	2007	www.bit.ly/pQzGW5
ITE	Designing Walkable Urban Thoroughfares	2009	www.bit.ly/pXVceD
ITE	Traffic Calming Library	2011	www.ite.org/traffic/
LAB	Bicycle Education Programs website	n.d.	www.bit.ly/qe18H9
MORPC	Bike User Map	2010	www.morpc.org/bikemaps/
MORPC	Franklin County Coordinated Plan	2008	www.bit.ly/oayQ3w
MORPC	Regional Bicycle Transportation Facilities Plan	2006	www.bit.ly/pa3EMs
NACCHO	NACCHO's Toolbox	2011	www.bit.ly/pB3zBN
NACTO	Urban Bikeway Design Guide	2011	www.bit.ly/yhcGGf
NCSRTS	SRTS Guide	2011	www.bit.ly/neBMJl
Nelson/Nygaard Consulting Associates	Streets for Living: Planning and Best Practices in Street Design	2010	www.bit.ly/nJvbif
New York City DOT	Street Design Manual	2009	www.on.nyc.gov/nidvxr
NHI	Bicycle Facility Design	n.d.	http://1.usa.gov/qgRG5O
NHI	Pedestrian Facility Design	n.d.	http://1.usa.gov/qGqa69
ODOT	Location & Design (L&D) Manuals	2010	www.bit.ly/zWaJc9
ODOT	Ohio Manual on Uniform Traffic Control Devices	2010	www.bit.ly/qVRJDS
ODPS	Digest of Ohio Motor Vehicle Laws	2009	http://1.usa.gov/ppK4ku
ODPS	Do You Make These Eight Common Bicycling Mistakes?	n.d.	http://1.usa.gov/nZkHMk
PBIC and NCSRTS	Evaluation Guide for Community Safe Routes to School Programs	2008	www.bit.ly/n6fzfF
PolicyLink	Equitable Development Toolkit	2011	www.bit.ly/nKex5A
Prevention Institute	Health Equity and Prevention Primer	2010	www.bit.ly/orW6B3

SOURCE	TITLE	YEAR	LINK
Rosales, J.	Road Diet Handbook: Setting Trends for Livable Streets, 2nd ed	2009	
TCRP	Integration of Bicycles and Transit	2004	www.bit.ly/qvF6aL
USAB	ADA Accessibility Guidelines for Facilities and Buildings	2005	http://1.usa.gov/pRkJf5
USDOJ	2010 ADA Standards for Accessible Design	2010	http://1.usa.gov/pdVqbh
USDOJ	ADA Best Practices Tool Kit for State and Local Governments	2007	http://1.usa.gov/nL7Yer
USDOT	Commuter Choice Primer: An Employer's Guide to Implementing Effective Commuter Choice Programs	2003	http://1.usa.gov/qyy55v
USDOT	Statistics and Facts About Distracted Driving	2010	www.bit.ly/n5eclC
USEPA	Stormwater Management Best Practices	2011	http://1.usa.gov/rt4F6Y
VTPI	Transportation Demand Management Encyclopedia	2011	www.vtpi.org/tdm/

APPENDIX

Appendix 1: MORPC Complete Streets Policy
Appendix 2: MORPC Complete Streets Checklist
Appendix 3: Complete Streets Toolkit Library
Appendix 4: Funding Sources

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MORPC Complete Streets Policy

1. Background

MORPC has long been a proponent of creating a multimodal, safe and efficient transportation system that ensures accessibility to all roadway users. In order to increase the number of projects that provide bicycle and pedestrian facilities in central Ohio, MORPC adopted a Routine Accommodation policy in 2004. This policy recognized the importance of and encouraged the construction of non-motorist facilities by putting a mechanism in place that required all project sponsors receiving MORPC-attributable federal funding to provide bicycle and pedestrian facilities in their design and construction phases as appropriate.

Since 2004, MORPC has engaged in intensive research to better understand how it can help make the region as attractive, livable, and prosperous as possible. The foundation of this research was a multifaceted growth strategy called *Regional Connections*. The objectives of Regional Connections were to create an understanding of central Ohio's anticipated growth over the next 20 to 30 years, and to formulate a strategy to address this growth in a way that would enhance the region aesthetically and economically. In 2007, MORPC adopted the recommendations of Regional Connections as "a significant guiding framework for Commission policy decisions."

This Complete Streets policy builds upon these efforts and promotes a multimodal transportation system that is integrated with sustainable land use developments. Its main objective is to design and build roads that safely and comfortably accommodate all users of roadways, including motorists, cyclists, pedestrians, transit and school bus riders, delivery and service personnel, freight haulers, and emergency responders. It includes people of all ages and abilities.

Building complete streets provides many benefits to residents, business owners, developers, and the community as a whole. First and foremost, embracing the complete streets concept will create balanced transportation systems by providing accessible, safe, and efficient connections between destinations. It will bolster economic growth and stability while increasing property values. It will ensure job growth, reduce crashes through safety improvements, improve public health and fitness, reduce harmful emissions, and reduce the overall demand on our roadways by allowing people to replace motor vehicle trips with active transportation options. Secondly, integrating sidewalks, bike facilities, transit amenities, or safe crossings into the initial design of a project spares the expense and complications of retrofits later.

2. Definition

Complete Streets are roadways designed to safely and comfortably accommodate all users, including, but not limited to motorists, cyclists, pedestrians, transit and school bus riders, delivery and service personnel, freight haulers, and emergency responders. "All users" includes people of all ages and abilities.

3. Vision/Purpose

To create an equitable, balanced, and effective transportation system where every roadway user can travel safely and comfortably and where sustainable transportation options are available to everyone.

The **goals** of this Complete Streets Policy are:

1) To create a comprehensive, integrated, and connected transportation network that supports compact, sustainable development and provides livable communities.

2) To ensure safety, ease of use, and ease of transfer between modes for all users of the transportation system.

3) To provide flexibility for different types of streets, areas, and users.

4. Policy

Policy Statement

1. MORPC will promote the Complete Streets concept throughout the region and, therefore, recommends that all local jurisdictions and the state adopt comprehensive Complete Streets policies, consistent with the Regional Policy. MORPC will seek incorporation of the Complete Streets concept and policy into the development of all transportation infrastructures within the region at all phases of their development, including planning and land use control, scoping, design approvals, implementation, and performance monitoring.
2. MORPC requires that all projects receiving MORPC-attributable federal funding adhere to this policy. MORPC members receiving MORPC-attributable federal funding shall fill out the checklist accompanying this policy. More information on the review and appeals process is available in the Applicability section. Projects utilizing any other funding sources are also encouraged to adhere to this policy.

Applicability

This Complete Streets Policy applies to all projects, including the new construction, reconstruction, rehabilitation, repair, maintenance, or planning of roadways, trails and other transportation facilities that will use federal funds allocated through MORPC.

Review process – The following three steps will be part of the general review process of MORPC-funded projects. A MORPC checklist accompanying the policy was developed to guide project sponsors through the project definition, scoping, funding application, and project design stages.

Step 1: As described in MORPC's funding application process, MORPC staff will perform an initial screening of new requests and discuss with the applicants the competitiveness of their requests in comparison to other projects and available funding. MORPC staff will also be available to discuss the different ways of adhering to the Complete Streets policy and provide technical assistance.

Step 2: Projects sponsors applying for MORPC-attributable federal funding will be asked to provide a statement that their project will comply with the Complete Streets policy by accommodating all users as reasonably as possible. Questions as shown in the Complete Streets checklist *Section A* are only informational. Applicants will respond to these questions as part of completing the funding application itself.

Step 3: After MORPC has committed funding to a project, MORPC staff will review the project throughout the design phase to ensure that the requirements are met and to provide assistance where needed. The completion of the answers in *Section B* of the Complete Streets checklist will assist with this process. Because of the flexibility of the policy and the variety of approaches that a sponsor may take to complete a street, MORPC staff, as stewards of the Complete Streets policy, will work with the project sponsor throughout the project development to find an acceptable solution for both parties. MORPC staff will maintain publically available information describing the nature and extent of the compliance with the Complete Streets policy. The appeals process described below would be used in those instances where sponsors and staff cannot reach an agreement.

Appeal process – Project sponsors may request an exemption or re-review of their projects by the Appeals committee if they cannot reach an agreement with MORPC staff.

The Appeals committee is made up of a total of six (6) people who are appointed by the Policy Committee Chair for two years terms. Members may be reappointed for successive terms. The voting membership consists of three (3) representatives of local communities and two (2) public members who are all knowledgeable about transportation design. This committee is supported by one (1) non-voting MORPC staff. The Appeals committee will meet on an "as needed" basis. MORPC staff will review the requests initially and provide a report with recommendations to the committee in advance of each meeting. The applicant will have the opportunity to review the report and add comments to it prior to its submittal to the committee. During each meeting the committee shall discuss and evaluate the request(s) and vote on a recommendation. The committee may invite the applicant to attend the meeting(s).

A quorum will consist of at least three (3) voting members, and a majority of the voting members of the full appeals committee is needed to act. Members with conflicts of interest on a particular project before the committee must recuse themselves from deliberation on that project. In the event that the sponsor disagrees with the action of the Appeals committee, the sponsor may appeal to the MORPC Policy Committee officers who may or may not elect to hear the appeal request.

Instead of an exemption, the Appeals committee may also suggest a lesser level of accommodation. All exemptions will be kept on record and made publicly available. Over the next year, MORPC staff will prepare an exemption document that will help streamline the appeals process. Exceptions would account for issues of prohibitive costs, highways or other roads where pedestrians are not allowed, and other justifiable reasons that arise during development of projects with allocated MORPC funds.

Requirements

- Each project shall use the most appropriate design standards and procedures. For projects using MORPC attributable federal funding, it will be necessary to meet or exceed standards and procedures acceptable to the Ohio and U.S. Departments of Transportation, such as the Ohio Department of Transportation's Project Development Process and Location & Design Manual.
- Project sponsors shall fill out Section B of the checklist accompanying this policy and provide completed form to MORPC.
- Designs shall include accommodation of all users and be sensitive to the context of the project setting. It is important to note that Complete Streets may look different for every project and road type. For example, wide lanes or paved shoulders may be sufficient in a rural area, whereas sidewalks and/or bike lanes are needed in an urban setting. Also, when re-striping projects are considered, where the right-of-way will not change, options such as bike lanes, sharrows, and pedestrian crosswalks could still be implemented. More information and examples will be provided as part of the checklist and toolkit.
- A systems approach shall be used in developing roadway projects, especially to ensure coordination with nearby jurisdictions, projects, and plans irrespective of the project sponsor.
- If there is another project planned or in development near this project the two should be coordinated to ensure consistency in the facilities serving the corridor.
- Logical termini should be chosen to include connections through "pinch points," such as overpasses, railroad crossings, and bridges. Logical termini should not be chosen so that the project ends before such a "pinch point" unless there is a compelling reason to do so.

- If the project serves a destination point, such as a school, recreational facility, shopping center, hospital, or office complex, the project shall provide the opportunity for the destination to have access to the project's pedestrian and bicycle facilities.
- Every project shall involve the local transit agency in the design process to ensure that sufficient accommodation of transit vehicles and access to transit facilities is provided. The project sponsor shall provide the local transit agency during Step 1 of the Project Development Process the opportunity to participate throughout the entire process.
- Public transit facilities shall be designed with the goals of Complete Streets in mind, by including sidewalks, bicycle connections, or secure bicycle parking, among others.
- Every project shall provide the opportunity for utility/telecommunications infrastructure to be appropriately accommodated to allow for existing and future growth. Efficient use of right-of-way during construction and maintenance should be considered to improve access to utility systems, including future broadband networks. This policy is not intended to create new rights for utilities outside those provided by existing law and contract.
- Every project shall ensure that the provision of accommodations for one mode does not prevent safe use by another mode (e.g., a bus shelter should not block the clear walking zone on the sidewalk).

5. Recommendations

- All users should be considered during the entire life cycle of a project, including planning, design, construction, operations, and maintenance.
- Street furniture, such as bike racks or benches, should be considered as part of all projects as long as they do not impede any user.
- When designing a facility that includes or crosses an existing or future transit route, ensure that the appropriate pedestrian and wheelchair access is provided to and from the transit stops.
- Traffic-calming elements including, but not limited to, landscaping, street trees, and narrowing of lanes, should be considered where safe and appropriate.
- Project sponsors should consider including street trees and landscape components, with careful analysis of tree, site, and design considerations.
- Special consideration should be given to future planned facilities or services.
- Each project design should be coordinated with appropriate access management strategies. Access management strategies should consider the placement of sidewalks and ramps to eliminate sight distance issues.
- Although this policy focuses on engineering projects, the project sponsor should provide education, encouragement, and enforcement strategies during or after the project. The education component should include government officials, developers, and the public. A toolkit designed by MORPC staff will provide best practices, ideas, and resources to help with these efforts (see Implementation section).
- While this policy focuses on transportation, local governments should review their land use and zoning policies to provide for mixed land use developments and projects that provide direct non-vehicular connections within a given development.
- Each local community should regularly update its project design standards and procedures and train its staff to adhere to them.

- Local governments are encouraged to adopt their own Complete Streets policies, consistent with this regional policy and federal and state design standards. State governments should work with the local Metropolitan Planning Organizations to ensure consistency in polices at the state, regional and local level.

6. Implementation

Upon approval and adoption of this Complete Streets policy, it will become part of MORPC's planning process and project selection for MORPC-attributable funding. The principles of this policy will also guide MORPC staff in the preparation of the Regional Transportation Plan and other plans it prepares or to which it contributes.

A toolkit will be developed and provided to each community in modules as they become available. The objective of this toolkit is to assist project sponsors in developing Complete Streets projects. This toolkit will contain model policies, sample design standards, examples for land use and zoning practices, educational and enforcement strategies, and information on other resources.

7. Evaluation

MORPC shall, at a minimum, evaluate this policy and the documents associated with it on an annual basis. This evaluation may include recommendations for amendments to the Complete Streets Policy, including the development of exemption guidance, and subsequently be considered for adoption by the Policy Committee of MORPC utilizing its then current public and member involvement procedures.

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MORPC Complete Streets Checklist for Project Sponsors

This checklist accompanies the Regional Complete Streets policy and is developed to assist project sponsors in defining and designing their projects in adherence to the policy. A Complete Streets toolkit will be developed over the next year to provide more detailed information on engineering, design, educational, and enforcement strategies. More specifically, the toolkit will elaborate on many of the items discussed in the checklist and Appendix 1.

- The questions shown in Section A are only informational and are included in the MORPC funding application. You will NOT need to fill them out here but within the funding application itself.
- Project sponsors who have received MORPC funding will be asked to fill out Section B during Step 1 of the Project Development Process. Answers to these questions will help MORPC staff in reviewing the project and providing assistance where needed.
- Sections C through H are informational only and provide recommendations for certain stages and aspects of the project.

Being in compliance with the policy means that project sponsors plan for, design, and construct all transportation projects to provide appropriate accommodation for all users of roadways, including motorists, cyclists, pedestrians, transit and school bus riders, delivery and service personnel, freight haulers, and emergency responders. It includes people of all ages and abilities.

The Complete Streets policy promotes a multimodal transportation system that is integrated with sustainable land use developments.

The **goals** of this Complete Streets Policy are:

1) To create a comprehensive, integrated, and connected transportation network that supports compact, sustainable development and provides livable communities.
2) To ensure safety, ease of use, and ease of transfer between modes for all users of the transportation system.
3) To provide flexibility for different types of streets, areas, and users.

"Complete streets policies are a reminder that providing for safe travel by users of all modes is the primary function of the corridor. Under complete streets, basic facilities for bicyclists, pedestrians, transit users, and disabled travelers are necessities, rather than optional items. Their needs must be included regardless of their presence or lack thereof at stakeholder meetings." (National Complete Streets Coalition)

It is important to note that Complete Streets may be achieved incrementally through a series of smaller improvements or maintenance activities over time.

The checklist contains the following sections:

Section A: Project Description & Scope

The purpose of Section A is to determine the scope and character of your project, including the rationale behind the project and the ways it will affect the surrounding areas. **Please note that the questions shown in this Section A are only informational and are included in the MORPC funding application. You will NOT need to fill them out here but within the funding application itself.** The questions in this section will give you a better understanding of what MORPC staff is considering when determining if a project is addressing all users.

LPA Project Manager:

Project Title:

Describe Project's Purpose & Need:

Project Limits (Include County, Route and Section) & Project Length:

Existing conditions

A. Explain how the project area currently accommodates pedestrians (including ADA compliance), bicyclists, and transit users.

Explain how the proposed project will accommodate them once completed.

B. What is the current and projected Level of Service (LOS)? Please provide existing Average Daily Traffic (ADT) counts for all modes for which counts are available. (Vehicular traffic counts are available in MORPC's online traffic count database. Pedestrian and bicycle traffic counts for selected locations are also available on the MORPC website.)

☐ Counts attached

C. Please provide the percentage of truck traffic (ODOT Type B and C Commercial). MORPC can evaluate the project using ODOT Traffic Survey Reports (if available). Alternatively, you may provide classification counts.

D. Please describe the existing character of the project area, including land use, estimated pedestrian and bicycle traffic, any unofficial walking paths, density of development, street furniture/lighting, emergency call boxes, perceived safety issues, transit routes and stops.

E. Please attach a map of the project area, showing land use and existing and future trip generators. Existing and future trip generators are places that attract customers, employees, students, visitors, and others. The following are some examples:

- *Employment centers*
- *Schools/Colleges*
- *Libraries*
- *Residential areas*
- *Recreational facilities (parks, etc.)*
- *Tourist destinations*
- *Community gathering places (churches, etc.)*
- *Entertainment*
- *Shopping*
- *Logistic centers*

F. To what extent does the project serve Environmental Justice target populations (includes minorities, people living in poverty, elderly, transportation handicapped, and 0-car households)? This information can be found from the 2000 Census or by contacting MORPC for assistance.

G. Please fill out the following:

Existing ROW Width:			Proposed ROW Width:		
Existing Pavement Width:			Proposed Pavement Width:		
Existing Number of Lanes:	NB/EB	SB/WB	Proposed Number of Lanes:	NB/EB	SB/WB
Is there an existing 2-way center turn lane?	Yes	No	Is there a proposed 2-way center turn lane?	Yes	No
Existing Shoulder Widths:	NB/EB	SB/WB	Proposed Shoulder Widths:	NB/EB	SB/WB
Existing Sidewalk Widths:	N/E	S/W	Proposed Sidewalk Widths:	N/E	S/W
Existing Bike Lane Widths:	NB/EB	SB/WB	Proposed Bike Lane Widths:	NB/EB	SB/WB
Existing MUP Width:			Proposed MUP Width:		
Existing Speed Limit	MPH		Proposed Speed Limit	MPH	

Number of railroad facilities within the project limits: _____

H. What are the functional classifications of the roads covered by this project? Check all that apply.

Functional Classification	☐ Urban Interstate Highway	☐ Urban Other Expressway	☐ Urban Principal Arterial
	☐ Urban Minor Arterial	☐ Urban Collector	
	☐ Rural Interstate Highway	☐ Rural Principal Arterial	☐ Rural Minor Arterial
	☐ Rural Major Collector	☐ Rural Minor Collector	☐ Local Road*
	☐ Other – Please specify:		

* Local Roads have limited eligibility for MORPC funding.

I. Briefly explain how the project will improve safety. MORPC can evaluate the project using its cleaned crash data of the last 3 years. Alternatively, you may submit your own crash data and methodology used. MORPC strongly encourages sponsors of intersection safety projects to conduct a crash study and provide results. Your crash information also needs to include the number of pedestrian and bicycle crashes by severity, as well as if the project area includes any locations (corridors or intersections) that are on MORPC's and/or ODOT's high-crash lists.

J. Project limits should be selected so that they can accommodate existing and future connections. In this regard, were logical termini chosen to include connections through "pinch points" such as overpasses, railroad crossings, and bridges? If the project touches another jurisdiction, was a systems approach taken? Were cross-jurisdictional connections considered? Please explain:

K. Does your project area include recommendations that are contained in any of the following plans? Please check all that apply.

- ☐ Pedestrian plans or sidewalk inventories
- ☐ Bikeway plans
- ☐ Freight plans
- ☐ Thoroughfare plans
- ☐ Greenways plans
- ☐ Active Transportation/Open Space plans
- ☐ Short-range and/or Long-range transit plans
- ☐ CapitalWays Transportation Plan
- ☐ ODOT plans
- ☐ Safe Routes to School travel plans
- ☐ ADA Transition plans
- ☐ Any neighborhood or mobility plans
- ☐ Any other plans, e.g., comprehensive plans

If yes, how does your project fulfill any of these plans? Please specify the plan name(s).

L. Is there additional information you would like to provide about the project?

Section B: Project Design to meet Complete Streets standards

After your project has received a funding commitment, you will be asked to fill out this section during Step 1 of the Project Development Process (PDP) to better help us review your project through the design process and provide assistance where needed. If you are receiving funds through other means, this section may be helpful to you during Step 1 of the PDP. **As each complete street is unique, there will not be one right answer.**

The purpose of this section is to ensure you have considered all users in your project, to ask more detailed questions, and to ensure your project meets appropriate design standards. For projects using MORPC attributable federal funding, it will be necessary to meet or exceed standards and procedures acceptable to the Ohio and U.S. Departments of Transportation, such as the Ohio Department of Transportation's Project Development Process and Location & Design Manual. Information on various guidelines and standards is listed on the MORPC Complete Streets website.

One of the goals of MORPC's Complete Streets Policy is to provide flexibility for different types of streets, areas, and users. This means that a Complete Street in a rural area may look very different from a Complete Street in an urban area. *Please also see example street cross-sections in Appendix 1.*

A. Please cite the specific design guidance or resources which relate to Complete Streets that you have used in developing the scope of your project. Examples may include appropriate sections of the American Association of State Highway and Transportation Officials (AASHTO) Green Book, the Manual of Uniform Traffic Control Devices (MUTCD), etc. Links to these documents are available on the MORPC website.

B. Transit accommodations to the extent needed should be handled in consultation with the local transit authority. Have you consulted your local transit agency to ensure that transit vehicles will be accommodated and access to transit facilities will be provided? Please explain:

C. Has a speed study been conducted for the street/corridor? Please consider project conditions and context to determine if a speed study is necessary.

- ○ Yes
- ○ No

D. Has a parking study been conducted for both on-street and off-street parking? Please consider project conditions and context to determine if a parking study is necessary.

- ○ Yes
- ○ No

E. How will the project consider future utility/telecommunications needs?

F. Which, if any, of the following items will be incorporated in your project? Please check all that will apply.

- [ ] Lighting
- [ ] 911 Call Boxes

- [ ] Bicycle Facilities
    - [ ] Bike Lanes
    - [ ] Shared-Lane Markings / Sharrows
    - [ ] Shared Bike-Bus Lane
    - [ ] Bicycle Signage (e.g., designated bike route)
    - [ ] Secure Bicycle Parking
    - [ ] Bicycle Detectors
    - [ ] Multi-Use Path
- [ ] Pedestrian Facilities
    - [ ] Sidewalk with ADA compliant curb ramps
    - [ ] Signalized Crosswalk
    - [ ] Marked Crosswalk with signage, including Mid-Block Crossing
    - [ ] Pedestrian Detectors
    - [ ] Audible Signals
    - [ ] Multi-Use Path
- [ ] Transit Facilities
    - [ ] Secure Bicycle Parking
    - [ ] Shared Bike-Bus Lane
    - [ ] Priority Bus Lane
    - [ ] Bus Stop, including Paved Passenger Waiting Area
    - [ ] Bus Passenger Shelter
    - [ ] Real-Time Bus Arrival Information Signs
    - [ ] Bus Pads
- [ ] Traffic Calming Elements
    - [ ] Landscaping, including Street Trees
    - [ ] Narrower Traffic Lanes
    - [ ] On-Street Car Parking
    - [ ] Other Physical Changes (e.g., Chicanes, Curb Extensions)
    - [ ] Reduction in Speed Limit
- [ ] Other(s) (please explain)

If you are not providing any pedestrian, bicycle, or transit facilities, please explain why.

G. Are there any Intelligent Transportation Systems (ITS)-related recommendations within the project area, such as emergency or transit vehicle signal pre-emption systems, dynamic message signs, or signal coordination? (Note: If yes, then the project must be part of the regional ITS architecture. The database and document can be found here: http://www.morpc.org/transportation/highway/Architecture.asp.

- ○ Yes
- ○ No

Please explain:

H. Please list the stakeholders who are involved during the early stages of the planning process.

I. Is there additional information you would like to provide about the project that is unique or wasn't captured previously with regard to the Complete Streets policy?

Please note: While we are not asking for estimated future counts for each mode, we encourage project sponsors to conduct pre- and post-counts of all users in the project area. Having this data available region-wide will help us create a reliable forecasting methodology for pedestrian and bicycle counts.

Section C: Construction

The purpose of this section is to ensure that project sponsors are maintaining adequate access for all users during the construction of their project, which may be done via keeping some facilities open for traffic or via providing clear detour routes.

A. During construction, will safe access be maintained for all users, including pedestrians, bicyclists, transit users, and delivery vehicles?

- ○ Yes
- ○ No

B. Will detour routes for all users on site or nearby be provided and clearly marked, including advanced warning signs?

- ○ Yes
- ○ No

C. Is there additional information you would like to provide about the project?

Section D: Maintenance & Operation

The purpose of this section is to encourage that project sponsors are operating and maintaining their facilities while keeping all users in mind. This section is for informational purpose only and can be used as a self-evaluation tool by the project sponsor. Detailed information on maintenance issues will be discussed as part of the Complete Streets toolkit.

A. What agency will be responsible for ongoing maintenance of the facility and how will this be budgeted? If the project sponsor is not responsible for maintenance after the project ends, please indicate responsible agency name. Please attach the maintenance agreement as well.

Please explain:

☐ Maintenance agreement attached

B. Describe the signal timing. Include information on the wait time for cars, pedestrians and cyclists, crossing time for pedestrians, cycle length, delay, level of service, and time of day being evaluated.

C. Have you coordinated the signal timing within and beyond the project limits and irrespective of jurisdiction to allow traffic flow and discourage speeding?

○ Yes

○ No

D. Is there additional information you would like to provide about the project?

Section E: General Recommendations

The following are recommendations by MORPC as included in the Complete Streets policy.

- All users should be considered during the entire life cycle of a project, including planning, design, construction, operations, and maintenance.
- Street furniture, such as bike racks or benches, should be considered as part of all projects as long as they do not impede any user.
- When designing a facility that includes or crosses an existing or future transit route, ensure that the appropriate pedestrian and wheelchair access is provided to and from the transit stops.
- Traffic-calming elements including, but not limited to, landscaping, street trees, and narrowing of lanes, should be considered where safe and appropriate.
- Project sponsors should consider including street trees and landscape components, with careful analysis of tree, site, and design considerations.
- Special consideration should be given to future planned facilities or services.
- Each project design should be coordinated with appropriate access management strategies. Access management strategies should consider the placement of sidewalks and ramps to eliminate sight distance issues.
- Although this policy focuses on engineering projects, the project sponsor should provide education, encouragement, and enforcement strategies during or after the project. The education component should include government officials, developers, and the public. A toolkit designed by MORPC staff will provide best practices, ideas, and resources to help with these efforts (see Implementation section).
- While this policy focuses on transportation, local governments should review their land use and zoning policies to provide for mixed land use developments and projects that provide direct non-vehicular connections within a given development.
- Each local community should regularly update its project design standards and procedures and train its staff to adhere to them.
- Local governments are encouraged to adopt their own Complete Streets policies, consistent with this regional policy and federal and state design standards. State governments should work with the local Metropolitan Planning Organizations to ensure consistency in polices at the state, regional and local level.

Section F: Recommended Public Input Practice

The public input process should be commensurate with the scope and complexity of the project and should meet National Environmental Policy Act (NEPA) requirements (when the project is developed through the ODOT Project Development Process). This may include public meetings, stakeholder meetings, direct mailing, a project website, or other suitable methods.

- A copy of public involvement plan and link to project website should be provided to MORPC, if available.
- Coordination with applicable agencies (Ohio Department of Transportation, Ohio Department of Natural Resources, etc.) should be done to ensure National Environmental Policy Act (NEPA) compliance.
- The public input periods and stakeholder meetings should be consistent with the Project Development Process. Determination of the number of public meetings should be made with regard to the number of affected persons, the type of project, and the desired outcome of the public input process.
- Meetings should be held at appropriate times to allow a high number of people to attend. When choosing the meeting place, accessibility for pedestrians, bicyclists, and transit riders should be considered.
- Sufficient drawings and description of the project should be made accessible to the public via the project website or other means, in order to allow the public to truly understand the project design and process.
  - Including, but not limited to: meeting notices, agendas, meeting notes, and comments.
- Comments should be allowed via email, fax, and regular mail. If appropriate, it is encouraged to get public input via other means, such as porch chats.
- Opportunities to comment and attend meetings should be well publicized.
- The project sponsor should clearly address each comment and explain why or why not it is being accepted.
  - Public comments and responses to comments should be made available via website or other means.

Section G: Stakeholders

Stakeholders should be involved during the early stages of the planning process and be made aware of all details so they can be a part of deciding key elements of the project. The following are examples of potential stakeholders:

- Law enforcement
- Advocates (bicycle, pedestrian, transit, individuals with disabilities)
- Transit Authorities
- Schools and libraries, if in vicinity to one
- Local business associations
- Area commissions and civic associations
- Park representatives
- Public Health
- Representatives from major generators adjacent to or near project
- Safe Routes to School committees

Section H: Other Resources

Below are some sample resources. More resources are available online and as part of the MORPC toolkit.

Policy Guidance

- US DOT Policy Statement: "Design Guidance Accommodating Bicycle and Pedestrian Travel: A Recommended Approach" (http://www.fhwa.dot.gov/environment/bikeped/design.htm)
- AASHTO Design Publications (listed at http://design.transportation.org/?siteid=59&pageid=848)
- National Complete Streets Coalition (http://www.completestreets.org)
- Road Diet Handbook: Setting Trends for Livable Streets (available in MORPC's library)
- ITE Recommended Practice (RP-036A): "Designing Walkable Urban Thoroughfares: A Context Sensitive Approach" 2010 (http://www.ite.org/emodules/scriptcontent/Orders/ProductDetail.cfm?pc=RP-036A-E)

Pedestrian and Bike Information

- The Pedestrian and Bicycle Information Center (PBIC) (http://www.walkinginfo.org)
- Ohio Department of Transportation Bike and Pedestrian Plan (http://www.dot.state.oh.us/Divisions/TransSysDev/MultiModalPlanning/bicycle/Pages/Default.aspx)

Safe Routes to School

- National Center for Safe Routes to School (http://www.saferoutesinfo.org/

Appendix 1: Selected CS Design Information & Sample Cross-Sections

The following are sample Complete Streets cross-sections for rural, suburban, and urban roads. These are only examples and are not meant to be the only allowable Complete Streets you can build. These examples are offered to get you thinking and are not meant as prescriptions. More information will be provided in MORPC's Complete Streets toolkit, including crosswalks, turn lanes, transit shelters, and roundabouts. Design guidelines should always be followed during detailed engineering design of your roadway cross-section.

Also note that education, enforcement, and encouragement play an important part in making these projects successful and should be included as part of any infrastructure project. Possible strategies and resources will be part of the toolkit.

Notes explaining the development of these cross-sections

- Every attempt was made to ensure the following example cross-sections **conformed to national and state standards**. For more notes on this, please see "*Notes on Sources for Design Standards*" for specific citations we used as we developed our examples.

  Cross-section Examples in this document:

  1 Rural 4-lane Road
  2 Rural 2-lane Road
  3 Suburban 5-lane Road (Without Parking)
  4 Suburban 5-lane Road (With Parking)
  5 Suburban 3-lane Road (Without Parking)
  6 Urban 4-lane Road (Without Parking)
  7 Urban 4-lane Road (With Parking)
  8 Urban 2-lane Road (Without Parking)
  9 Urban 2-lane Road (With Parking)

- There is a wide range of acceptable values to consider. Some of the different factors you would consider include design speed, truck traffic volumes, turning lane needs, drainage, maintenance, and type of landscaping and street tree canopy desired.
- To determine the need for increased accommodations for bicyclists and pedestrians for your project, local or regional plans should be consulted. Particular attention should be paid to bicycle master plans and pedestrian master plans.
- **ADA** compliance and accommodations are critical elements of designing Complete Streets. There are a wide variety of mobility types to consider, including ambulatory impairments, wheelchair and scooter users, walking-aid users, prosthesis users, hearing impairments, vision impairments, white cane users, dog guide users, and cognitive impairments. Please reference guides such as the AASHTO Pedestrian Guide[1], the MUTCD, the ADA Accessibility Guidelines for Buildings and Facilities (ADAAG), and the Public Rights-of-Way Accessibility Guidelines (PROWAG) to ensure you properly accommodate these users.
- Although **public transportation** accommodation is not specifically mentioned within most cross-section examples, we provided these examples with transit in mind. Also see "*Notes on Sources for Design Standards*". Be sure to consult your local transit agency for local design standards.
- A **traffic operations and capacity analysis** should be conducted to investigate the possibility of a road diet. A parking study should be conducted to investigate the need for 24-hour on-street parking. For more notes see "*Notes on Sources for Design Standards*".
- Bicyclists are legally allowed to use all roads, except for freeway interstates or highways where they are explicitly prohibited. The absence of bicycle facilities on a road does not mean that bicyclists will not use that road. In the following cross-sections, bicyclists may use any lane marked "Lane" (including center turn lanes), in addition to using Paved Shoulders, Multi-Use paths (MUPs), and Bike Lanes. For more on bicycle facilities, see "*Notes on Sources for Design Standards*".

[1] AASTHO Guide for the Planning, Design, and Operation of Pedestrian Facilities. July 2004.

Notes related to Transit, Sidewalk, and Other Items

There are many factors to consider when designing or retrofitting your Complete Street.

- Safety for all users should be kept at the forefront when designing Complete Streets.
- The minimum sidewalk width in the following cross-sections is at least 5 feet. We have chosen this because sidewalks narrower than 5 feet cannot accommodate two pedestrians walking side-by-side. Sidewalks that are 5 feet wide can accommodate pedestrians with large strollers as well as two wheelchair users side-by-side. AASTHO (p. 58) says the absolute minimum is 4 feet, but recommends a minimum of 5 feet.[1]
- Lighting, signs, poles, benches, and other utilities and street furniture should always be placed outside of the clear width of the sidewalk or bikeway. The clear width of a sidewalk is at least 5 feet, which doesn't mean that you can't build wider sidewalks. Wider sidewalks or lawn areas are always preferred.
- Curb and gutter sections may vary in width from the sample cross-sections. The suburban and urban samples used in this document always show a 2-foot curb and gutter section when there is no on-street parking.
- Larger-size passenger vehicles (such as SUVs), trucks, and transit buses (such as COTA buses) can use any lane that is at least 10 feet wide (see "*Notes on Sources for Design Standards*"). Turning radii, sight distance, and other design considerations will have to be considered during the detailed engineering phase of your roadway. Roads with intense transit use may require design consideration of wider outside lanes. High tractor-trailer traffic may also require design consideration of wider outside lanes.
- The rural cross-sections are intended to provide examples for roads in areas that will remain rural for the next 20-30 years. If the character of an area is predicted to become more suburban or urban within that timeframe (due to increased residential density or new commercial development, for example), then suburban or urban cross-section examples should be used for guidance instead. Consult regional or local planning documents to determine the predicted character of the area in 20-30 years.
- Whenever possible (after thorough traffic operation and capacity analysis), road diet techniques should be considered when retrofitting streets. Some streets may be safer and more US comfortable for all users when a road diet is put in place. Road diet techniques include converting some travel lanes to on-street parking and/or reducing the total number of travel lanes. Existing space is reallocated but the overall area remains the same. In some cases this may reduce the vehicular capacity. Note that FHWA has found that "under most ADT conditions tested, road diets have minimal effects on vehicle capacity, because left-turning vehicles are moved into a common two-way left-turn lane."[2] (Source: FHWA Report) When considering a road diet, a parking study may also be required.
- Design speeds need to be considered when designing the roadway. Lowering the design speed to match the posted speed should be considered where appropriate. A traffic operations and capacity analysis should be conducted to investigate the possibility of lowering the posted speed limit and/or the design speed. Reductions in speed limits must be based on the Ohio Revised Code or a speed study approved by the State.
- Narrowing lane widths should be considered where deemed appropriate by a traffic safety investigation, on low speed and/or lower traffic volume streets. Lanes that are overly wide encourage higher speeds by motor vehicles.
- Landscape features such as street trees should be considered where appropriate. Studies have found that this can visually narrow the roadway, which helps to discourage excessive speeds by motor vehicles. When planting trees in urban or suburban settings, ensure the lawn width is at least 7 feet to minimize damage to sidewalk/pavement by tree roots. Trees should not be placed within the clear zone on higher speed streets or highways.
- When considering street trees, take note of the following factors: site design details, root volume requirements, overhead spatial needs, tree selection, and tree planting. These critical factors will affect tree health and safety, surrounding infrastructure, and motorists, cyclists, and pedestrians. Some special types of trees may not require a 7 feet lawn width.
- National Highway System (NHS) connectors were established in 1982. These roadways are required to have at least one 12-foot lane in each direction in order to accommodate trucks. Example roads include US 40, US 23, or US 33. The following cross-sections assume that the roadways are not part of the NHS. Additional consideration will have to be made if the road is a NHS connector or if tractor-trailers will be regularly using the road.

[2] FHWA-HRT-04-082. "Summary Report: Evaluation of Lane Reduction "Road Diet" Measures and Their Effects on Crashes and Injuries.": http://www.tfhrc.gov/safety/hsis/pubs/04082/

Notes related to Bicycle Facilities

No one type of bicycle facility suits every bicyclist and no designated bicycle facility can overcome a lack of bicycle operator skill.

- It is generally assumed that bicyclists will not be riding on sidewalks, except for young children. Many communities, including the City of Columbus, prohibit bicycling on sidewalks because of safety concern. Bicyclists are legally allowed to ride in vehicular travel lanes, and motorists must share the road with them. Bicyclists can also ride on paved shoulders and shared-use paths.
- 2009 Federal MUTCD guidance states that SLMs (sharrows) should not be placed on roads with speed limits above 35 mph. There are no speed limit restrictions for providing bicycle lanes.
- When a bicycle lane is built on a street with curb and gutter, debris and water tend to accumulate in the gutter pan. Drain inlets may also be located in the gutter pan and may be hazardous to bicyclists. The cross-sections assume that the gutter pan is not included as part of the bicycle lane width.
- 2009 Federal MUTCD (http://mutcd.fhwa.dot.gov/pdfs/2009/pdf_index.htm) includes a "Bikes May Use Full Lane" sign as a regulatory sign for bicycle facilities. The section on "Bicycles May Use Full Lane" signage is on p. 794 and the sign is illustrated on p.793 in Figure 9B-2. The sign is already in use in some locations in Ohio (for example, in the village of Yellow Springs). Furthermore, this sign is not in conflict with Ohio Revised Code 4511.55. The Code states that bicyclists should "ride as near to the right side of the roadway as practicable." It also states that it "does not require a person operating a bicycle to ride at the edge of the roadway when it is unreasonable or unsafe to do so." The "Share the Road" sign is included as a warning sign for bike facilities. Note that the Ohio MUTCD will be updated over the next few years to match the MUTCD, but it does not currently include the "Bikes May Use Full Lane" sign.
- There should be a minimum 4 feet of space between the outer edge of the rumble strip and the outside edge of the paved shoulder. This gives the bicyclists a minimum of 4 feet of space. Gaps should be provided in the rumble strip pattern ahead of intersections to permit bicyclists to merge with traffic and to make left turns.
- At bus stop locations, the bike lane should be marked with a broken line. Bike lane markings (such as at intersections) should follow the recommendations of the AASHTO Bicycle Guide.
- Use care when designing bike lanes in areas with frequent curb cuts and driveways. The same is true for Multi-Use Paths (MUPs). What constitutes "frequent curb cuts" is left to engineering judgment and decisions should be made based on the context of the project area. When designing MUPs and bicycle lanes, special care must be taken at intersections. For more information, see "*Notes on Sources for Design Standards*".
- FHWA uses three general categories for bicycle users. B for "Basic or less confident adult riders [who] prefer to avoid roads with fast and busy motor vehicle traffic unless there is ample roadway width to allow easy overtaking by faster motor vehicles. Thus, basic riders are comfortable riding on neighborhood streets and shared use paths and prefer designated facilities such as bike lanes or wide shoulder lanes on busier streets."[3] (Source: AASHTO Bicycle Guide.) However, note that "Bike lanes can create a false sense of security for inexperienced bicyclists, causing them to give lessened attention to the constantly changing traffic around them."[4] (Source: ODOT Roadway Based Bicycle Facilities Guide)
- Providing a bike lane does not preclude the use of signage such as "Bikes May Use Full Lane." Bicycles may use any lane, even if a bike lane is provided. Even those users who feel most comfortable in a bike lane may have to leave the bike lane to reach their destination.
- "Bikes May Use Full Lane" signage is not only instructional to bicyclists, but can help to educate motorists. However, this is not the only education that should be undertaken as part of a Complete Street. More information on education for motorists and bicyclists will be included in the MORPC Complete Streets toolkit.
- The typical bicycle operating space is 40 inches of width. This means that the pavement markings for bicycle wheels should be 20 inches away from the furthest handlebar edge.
- There are "non-typical" bicyclists that may have different considerations. These include recumbent bicycles, tandem bicycles, bicycles carrying trailers, adult tricycles, and long-tail bicycles (such as Xtracycle). The operating space for these bicycles may not match that of the typical bicycle.

[3] Page 6 of the AASHTO Bicycle Guide. "Guide for the Development of Bicycle Facilities." Chapter 1, Planning. 1999.
[4] ODOT Independent Bicycle Facilities Guide. "ODOT Design Guidance for Independent Bicycle Facilities." Section V. Frequently Asked Questions. October 2005.

On-street Parking Considerations

- The sample cross-sections assume that the parking lane is a 24-hour parking lane and will not be used for through-travel.
- The sample cross-sections use a standard 8-foot parking lane, which includes the gutter pan but does not include a 0.5-foot curb width.
- When providing on-street parking, the parking lanes should be marked. This encourages motorists to park closer to the curb and discourages motorists from using the parking lane as a travel lane. Additionally, signage can be used to inform motorists.
- The area next to parked cars can be hazardous to bicyclists. There are two injuries possible: they can collide with an opening car door or they can move unexpectedly into the next lane, colliding with a moving vehicle. (The word “move” includes the following: the bicyclist may be pushed by the door, they may fall after the collision, or they may instinctively swerve to avoid the open door.) Bicycle lanes next to parked cars should not be marked in the door zone.
- Based on preliminary research (see footnote 26), it is recommended that a 5-foot door zone buffer be provided. Given a 5-foot door zone buffer next to an 8-foot parking lane, the recommended distance between the outside edge of a bicycle and the curb is a minimum of 13 feet. This is true whether a bike lane is provided or not.
- If there is no bike lane next to parked cars, shared lane markings should be used to indicate where bicyclists can travel safely outside of the door zone. Depending on the width of the travel lane, the sharrow may be placed in the center of the travel lane. This is an acceptable placement for sharrows.
- When sharrows are used next to parked cars, use the following guideline: The middle of the sharrow indicates where the bicycle wheel should travel. The bicycle’s outside edge (handlebars) should be at least 13 feet from the curb, then the sharrows need to be placed at least 14 feet 8 inches from the curb (13 feet + 20 inches = 14 feet 8 inches). This ensures that the handlebars of the bicycle will clear the opening car door safely while traveling in a straight line. Depending on the width of the travel lane, the sharrow may be placed in the center of the travel lane. This is an acceptable placement for sharrows.

Notes on Sources for Design Standards

Every attempt was made to ensure that the following example cross-sections conformed to national and state standards, such as MUTCD, AASHTO, or ODOT's L&D Manual. Detailed engineering work is necessary when designing a roadway. Assumptions that were made when developing the cross-sections have been noted.

While AASHTO and other guidance provide minimum values that must be adhered to, it is possible to provide more accommodation than the minimum.

The following citations may help you further understand the sample cross-sections provided to you.

Urban and Suburban Lane Widths

- "Studies have increasingly validated the ability to safely use lanes narrower than 12 ft. lanes on roadways. As noted in a paper on suburban and urban arterials at the 2007 TRB conference, "There is no indication that the use of 10- or 11-ft. lanes rather than 12-ft. lanes for arterial midblock segments leads to increases in accident frequency." A similar conclusion was reached for lane widths at intersections."[5] (Source: Smart Transportation Guidebook)
- Urban lane widths vary from 10 feet to 12 feet. For arterial streets, 12-foot widths are required for roads with 50 mph or more. 11-foot widths are permitted (minimum) on roads less than 50 mph. For collector streets 11-foot widths are permitted (minimum) in commercial/industrial areas.[6] (Source: ODOT L&D Manual)

Rural Lane Widths

- Rural Lane Widths vary from 9 feet to 12 feet. For arterial roads 11 feet and 12 feet widths should be used, depending on the design speed and Design Year ADT.[7] (Source: ODOT L&D Manual)
- For a road with over 2,000 ADT, the required minimums are 12 feet and paved shoulders are 8 feet.[8] (Source: AASHTO Green Book)

Rural Rumble Strips

- "If rumble strips are installed, there should be a minimum 4 feet of space between the outer edge of the rumble strip and the outside edge of the paved shoulder, to accommodate cyclists."[9] (Source: AASHTO Bicycle Guide)
- "Rumble strips affect control of the bike, and are dangerous. The ODOT Policy on the Use of Rumble Strips on Shoulders (Policy Number 322-011(P)) states that "Rumble strips generally should not be used on the shoulders of roadways designated as bicycle routes or having substantial volumes of bicycle traffic, unless the shoulder is wide enough to accommodate rumble strips and still provide at least 3.25 ft. for bicyclists. Also, gaps should be provided in the rumble strip pattern ahead of intersections where bicyclists are likely to make left turns and to permit bicyclists to merge with traffic.""[10] (Source: ODOT Roadway Based Bicycle Facilities Guide)
- Based on the AASHTO Bicycle Guide, a minimum of 4 feet of space should be provided when rural rumble strips are installed.

Rural Paved Shoulders

- Based on AASHTO's and ODOT's L&D Manual, the width of paved shoulders can vary between 4 and 8 feet, depending on speed, traffic volume, and other characteristics.
- The width of rural paved shoulders should be considered when providing appropriate accommodations for pedestrians and bicyclists. A 4-foot paved shoulder is a suggested minimum.

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[5] Page 46 of the Smart Transportation Guidebook. Chapter 7, Roadway Guidelines. March 2008. http://www.smart-transportation.com/assets/download/Smart%20Transportation%20Guidebook.pdf Accessed Feb 2010.
[6] Page 27 of the ODOT L&D Manual. Vol. 1 Roadway Design. October 2009 revision.
[7] Page 24 of the ODOT L&D Manual. Vol. 1 Roadway Design. October 2009 revision.
[8] Page 448 of the AASHTO Green Book. Chapter 7, Rural and Urban Arterials. 2004.
[9] Page 24 of the AASHTO Bicycle Guide. "Guide for the Development of Bicycle Facilities." Chapter 2, Design. 1999.
[10] ODOT Roadway Based Bicycle Facilities Guide. "ODOT Design Guidance for Roadway-Based Bicycle Facilities." Section III. Accommodating Bicyclists on Roadways. October 2005.

Parallel Parking Lane Widths

- For urban arterials parallel parking lane widths vary. If the parking lane is not a through lane, then 8 feet may be acceptable.[11] (Source: AASHTO Green Book). For urban areas, the recommended parallel parking lane widths in commercial areas is 8 feet.[12] (Source: ITE RP-036A)

Multi-Use Paths / Shared Use Paths

- Shared use paths are facilities on exclusive right-of-way and with minimal cross flow by motor vehicles. Users are non-motorized and may include but are not limited to: bicyclists, in-line skaters, roller skaters, wheelchair users (both non-motorized and motorized) and pedestrians, including walkers, runners, people with baby strollers, people walking dogs, etc. These facilities are commonly designed for two-way travel.[13] (Source: AASHTO Bicycle Guide)
- A recommended width for a two-directional shared use path is 10 feet. The MUP has a 2-foot graded area on each side. "It may be necessary or desirable to increase the width of a shared use path to 12 feet or even 14 feet due to substantial use by bicyclists, joggers, skaters, and pedestrians."[14] (Source: AASHTO Bicycle Guide)
- "The standard width of an independent shared-use path in Ohio is 10 feet plus two-foot shoulders and three-foot clearance per side."[15] (Source: ODOT Independent Bicycle Facilities Guide)
- "It is unacceptable to build two 5-feet-wide paths (sidewalks, actually) on each side of the street, as each path will be used for two-way travel regardless of the intent. All paths are to be 10-feet-wide and designed for two-way-travel."[16] (Source: ODOT Independent Bicycle Facilities Guide)
- An MUP width of at least 10 feet, with a 2-foot graded area on each side, is a suggested minimum.

Bike Lane Widths

- The minimum recommended width of a bike lane is 5 feet, which should be located outside the door zone. The door zone […] is the area that is the width of the car door when the door is open.[17] (Source: MORPC Breaking Barriers to Bicycling Report)
- "The City of Chicago does not stripe a bike lane less than five feet in width. However, the AASHTO Guide and some agencies will stripe bike lanes as narrow as four feet wide in certain situations. If you propose to use a four foot bike lane, make sure that the four feet does not include a joint with the gutter pan, or that drainage gates take up some of the width."[18] (Source: The Chicago Bike Lane Design Guide)
- The recommended practice for walkable urban thoroughfares (with no on-street parking) is that a minimum width of 5 feet be used for bike lanes. The recommended width is 6 feet.[19] (Source: ITE RP-036A)
- "The recommended width of a bike lane is 5 feet from the face of a curb or guardrail to the bike lane stripe. This […] should be sufficient in cases where a 1-2 foot wide concrete gutter pan exists, given that a minimum of 3 feet of ridable surface is provided, and the longitudinal joint between the gutter pan and pavement surface is smooth. The width of the gutter pan should not be included in the measurement of the ridable or usable surface, with the possible exception of those communities that use an extra wide, smoothly paved gutter pan that is 4 feet wide as a bike lane. If the joint is not smooth, 4 feet of ridable surface should be provided."[20] (Source: AASHTO Bicycle Guide)

[11] Page 478 of the AASHTO Green Book. Chapter 7, Rural and Urban Arterials. 2004.
[12] Page 147 of the ITE Recommended Practice 036. Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities. Chapter 9. Traveled Way Design Guidelines. 2010.
[13] Page 33 of the AASHTO Bicycle Guide. "Guide for the Development of Bicycle Facilities." Chapter 2, Design. 1999.
[14] Page 35-36 of the AASHTO Bicycle Guide. "Guide for the Development of Bicycle Facilities." Chapter 2, Design. 1999.
[15] ODOT Independent Bicycle Facilities Guide. "ODOT Design Guidance for Independent Bicycle Facilities." Section IV. Supplemental Design Considerations. October 2005.
[16] ODOT Independent Bicycle Facilities Guide. "ODOT Design Guidance for Independent Bicycle Facilities." Section VII. Frequently Asked Questions. October 2005.
[17] Page 12 of MORPC Breaking Barriers to Bicycling: Bicycle Lanes Best Practices and Pilot Treatments. October 2005.
[18] Page 5 of The Chicago Bike Lane Design Guide. "Bike Lane Design Guide." October 2002 revision.
[19] Page 145 of the ITE Recommended Practice 036. Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities. Chapter 9. Traveled Way Design Guidelines. 2010.
[20] Page 23 of the AASHTO Bicycle Guide. "Guide for the Development of Bicycle Facilities." Chapter 2, Design. 1999.

Bike Lanes and MUPs in areas with Frequent Curb Cuts or Driveways

- "Shoulder bike lanes work best where intersections and turning traffic is infrequent."[21] (Source: ODOT Roadway Based Bicycle Facilities Guide). "Intersection placement and details require the most forethought when planning a new path. Crashes or close calls happen at intersections when the bicyclist on the path and the motorist on the roadway are thinking unconsciously that they don't have to worry about each other because they are on separate facilities."[22] (Source: ODOT Independent Bicycle Facilities Guide).
- "[Bike lane] marking discourages motorists from crossing into that portion of the road. Bike lanes can be ideal along stretches of roadway where there are few intersections and where speed differences between motorists and bicyclists are notable. [...] Bike lanes require a high level of attention in campus or shopping areas where there are frequent crossovers, turning movements, and/or complicated intersections."[23] (Source: ODOT Roadway Based Bicycle Facilities Guide)
- Most bicycle/auto crashes occur at intersections including driveways, parking lots, and alleys.[24] (Source: MORPC Breaking Barriers to Bicycling Report)
- Use care when designing bike lanes or MUPs where there are frequent curb cuts and driveways. What constitutes a "frequent curb cut" should be left to engineering judgment.

Buses and Lane Widths

- The maximum width of a COTA bus is 8.5 feet.[25] (Source: COTA Guidelines)
- The preferred lane width for a COTA bus is 12 feet.[25] (Source: COTA Guidelines). Current COTA bus routes regularly include roadways that are 10 feet wide.

Bike Lanes and the Door Zone

- Well designed bike lanes can enhance the comfort level of some bicyclists, and are a useful tool when building Complete Streets, but they need to be properly designed. The door zone is a well-recognized problem, but the definition of the width of the door zone has varied.
- A passenger vehicle properly parked with its door open occupies approximately 10 feet of space from the curb face. [26] (Source: AASHTO and Door Zone Bike Lanes report by Pein) This number may vary by model of car, since different models have different size doors. Not all passenger vehicles are properly parked flush to the curb. Additionally, extra clearance is needed, so that bicycles can safely and comfortably pass an open door without leaving the bike lane.
- "Typical bicycling education programs… have long instructed bicyclists to ride more than a door's width from parked cars. Bicyclists should be instructed and lead to track a minimum of 5 feet from the side of parked vehicles to provide minimal clearance from potentially opening doors; additional clearance is desirable, particularly as bicyclist speed increases."[26] (Source: AASHTO and Door Zone Bike Lanes report by Pein)
- "Bicycle [riders] should expect an obstacle-free travel way, as do motor vehicle operators. Bike Lanes that invite and constrain bicyclists to ride in the Door Zone create an unacceptable hazard with a potentially suddenly-appearing fixed object."[26] (Source: AASHTO and Door Zone Bike Lanes report by Pein)
- "Bicycle tires should track a minimum of 5 ft. from the parking line."[27] (Source: Bicycling and On-Street Parallel Parking report by Pein)

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[21] ODOT Roadway Based Bicycle Facilities Guide. "ODOT Design Guidance for Roadway-Based Bicycle Facilities." Section II. Types of Roadway-Based Bicycle Facilities. October 2005.
[22] ODOT Independent Bicycle Facilities Guide. "ODOT Design Guidance for Independent Bicycle Facilities." Section IV. Supplemental Design Considerations. October 2005.
[23] ODOT Roadway Based Bicycle Facilities Guide. "ODOT Design Guidance for Roadway-Based Bicycle Facilities." Section V. Frequently Asked Questions. October 2005.
[24] Page 6 of MORPC Breaking Barriers to Bicycling: Bicycle Lanes Best Practices and Pilot Treatments. October 2005.
[25] Page III-4 and IV-1 of COTA Guidelines. "Planning and Development Guidelines For Public Transit." February 1999.
[26] AASHTO and Door Zone Bike Lanes report. By Wayne Pein. May 2004 http://www.humantransport.org/bicycledriving/library/AASHTO_DZBL.pdf Accessed Feb 2010.
[27] Bicycling and On-Street Parallel Parking. By Wayne Pein. Revised December 2003. http://www.humantransport.org/bicycledriving/library/door_zone.pdf Accessed Feb 2010.

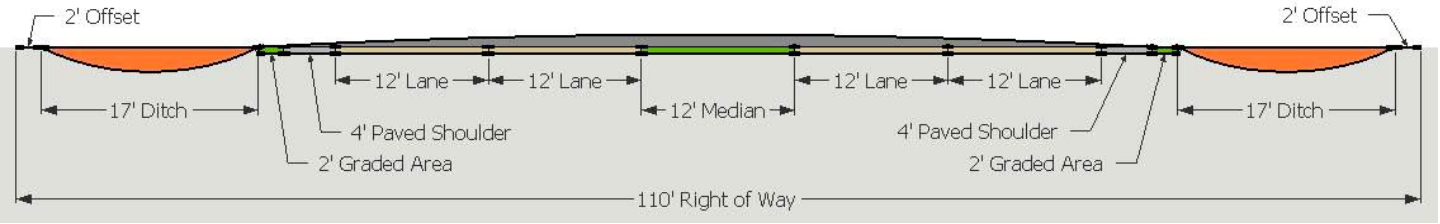
Selected Cross-Section Examples for Complete Streets

The examples below are not intended to be prescriptive or to preclude other types of design. They are merely examples and actual road design will vary depending on the individual context.

Example 1– Rural 4-Lane Road

Recommended Minimum Accommodation Example

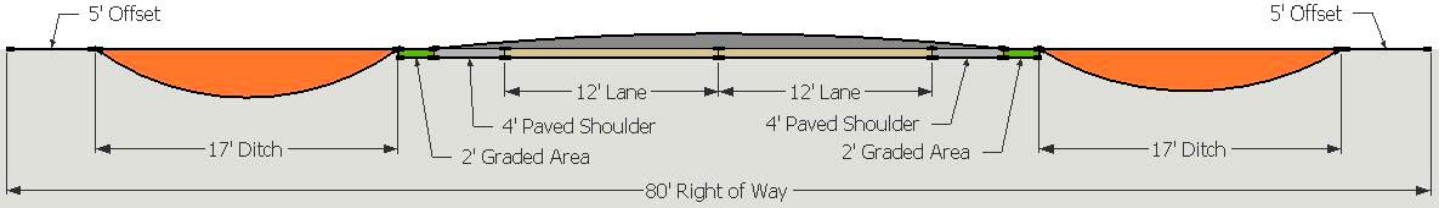
- Rural road designs should be used in areas that are expected to remain rural for the next 20-30 years.
- Shoulder width and general road configuration is dependent on the traffic volume of each road.
- A multi-use path may be built for additional accommodation (see Example 2)



Example 2 for Complete Streets – Rural 2-Lane Road

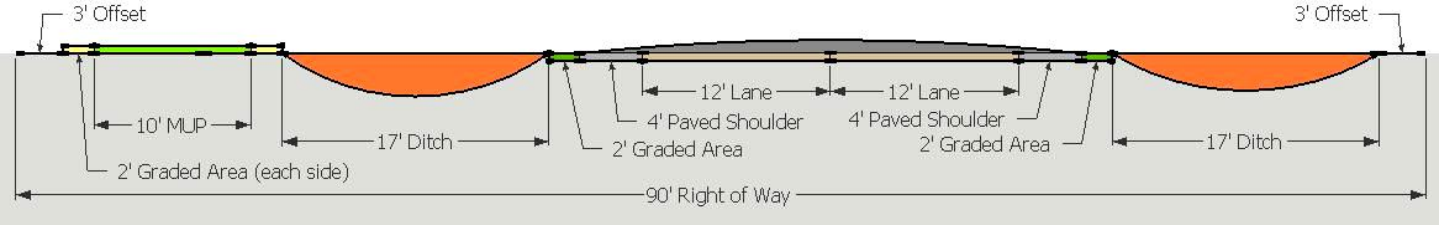
Recommended Minimum Accommodation Example

- Rural road designs should be used in areas that are expected to remain rural for the next 20-30 years.
- As per the ODOT L&D Manual (Table 301-3E), minimum shoulder width is 4 feet. Minimum shoulder width is 8 feet for roads with both > 1500 ADT and ≥ 50 mph design speed.
- As per the ODOT L&D Manual (Table 301-2E), lane width may be reduced to 11 feet for roads with both < 2000 ADT and design speed of ≤ 45 mph.
- Some roads with combinations of low design speed and low ADT may have lane widths further reduced to 10 feet or below (see ODOT L&D Manual Table 301-2E).



Multi-Use Path Option - Example

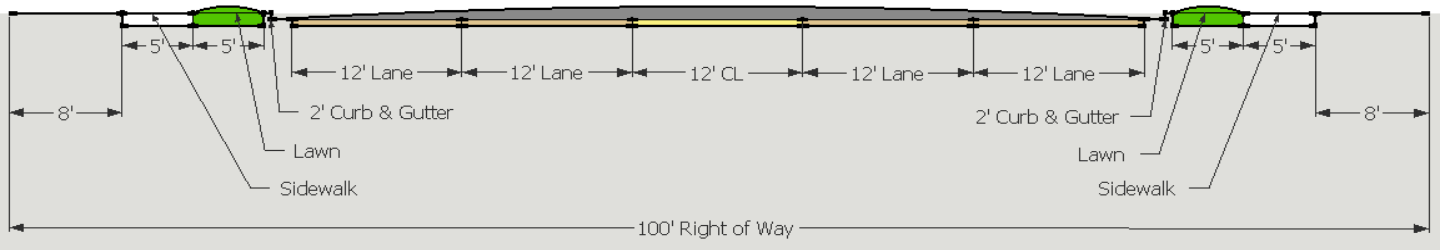
- The cross-section below shows a rural road with a parallel multi-use path to accommodate additional pedestrian and bicycle traffic. Pedestrians and bicyclists may still legally use the shoulder. Bicyclists may also use the travel lanes.
- A multi-use path (MUP) may be built parallel to the road to accommodate additional bicycle and pedestrian traffic. Bicyclists may also legally use the travel lanes. The recommended MUP width is 10 ft, plus 2 ft graded shoulders.



Example 3 for Complete Streets – Suburban 5-Lane Road (Without On-Street Parking)

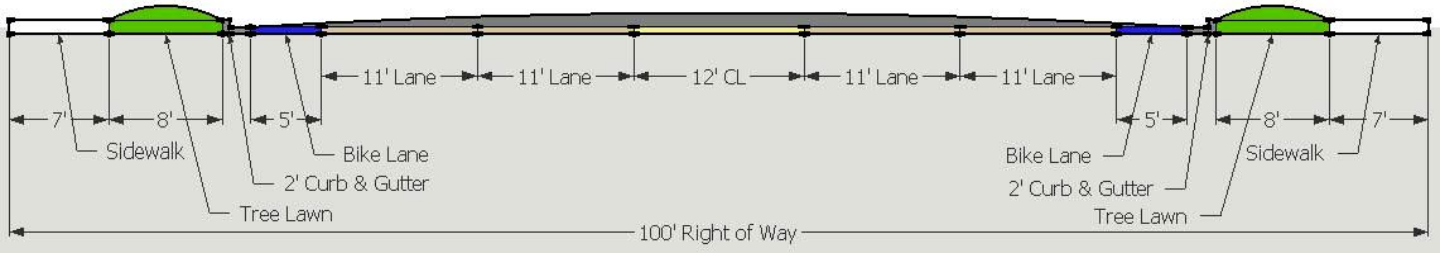
Recommended Minimum Accommodations

- As per the ODOT L&D Manual (Table 306-1E), sidewalks should be provided wherever there are 1 or more residences per acre.
- Bicyclists can use the travel lanes.
- Shared lane markings (sharrows) can be used if the design speed is 35 mph or less. At speeds above 35 mph, bicycle lanes are recommended.
- Drainage is provided by curb and gutter.



Example for providing additional accommodation

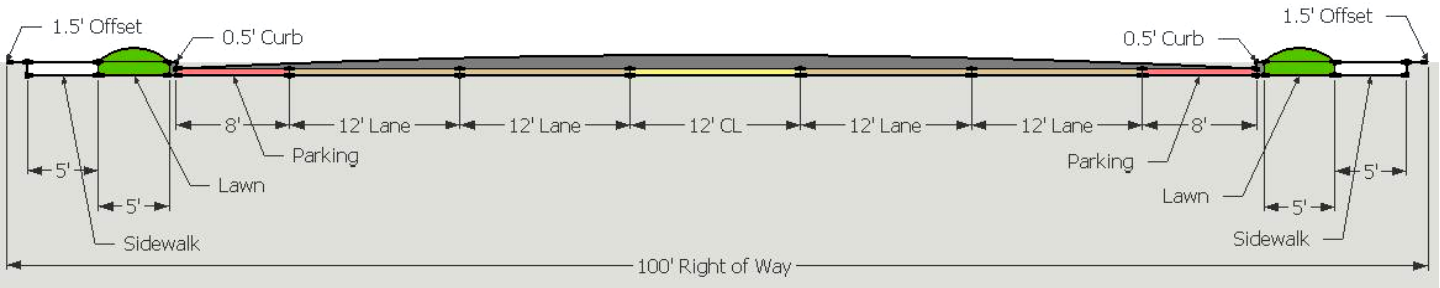
- In this example, lanes are narrowed to 11 feet (permitted for local, collector, and arterial streets with < 50 mph design speed, as per ODOT L&D Manual Table 301-4E) and bicycle lanes are added.



Example 4 for Complete Streets – Suburban 5-Lane Road (With On-Street Parking)

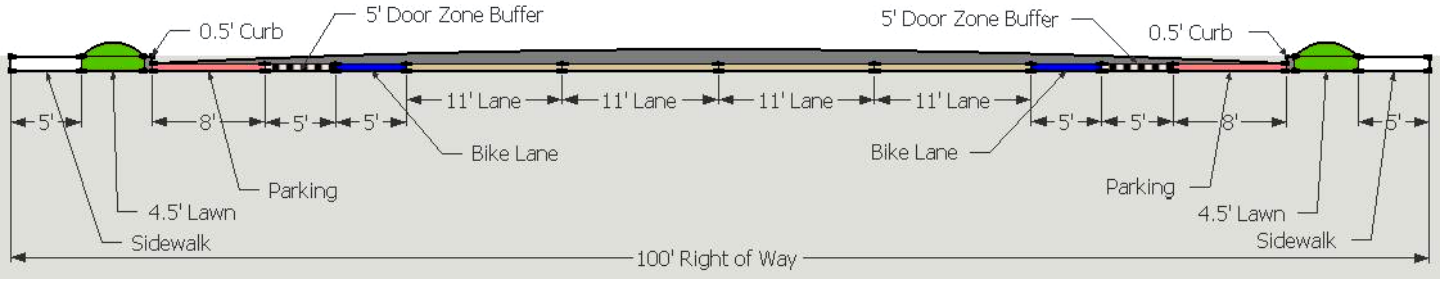
Recommended Minimum Accommodations

- As per the ODOT L&D Manual (Table 306-1E), sidewalks should be provided wherever there are 1 or more residences per acre.
- Bicyclists can use the travel lanes. Shared lane markings (sharrows) can be used if the design speed is 35 mph or less. At speeds above 35 mph, bicycle lanes are recommended. Bicycle lanes and sharrows should not be placed in the door zone.
- Drainage is provided by curb and gutter.



Road Diet - Example

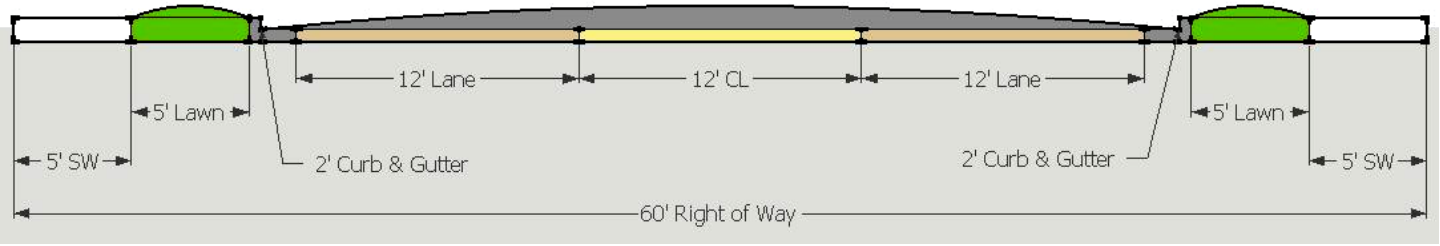
- In this example, the center turn lane has been removed and travel lanes have been narrowed to 11 feet (permitted for streets with lower design speed, as per ODOT L&D Manual Table 301-4E).
- This street design is appropriate for a suburban area with higher existing or expected volumes of pedestrian and bicycle traffic. A detailed traffic operation and capacity analysis has indicated that the center turn lane can be removed, and a parking study has shown that the existing on-street parking is still needed.
- Bicycle lanes should not be placed in the door zone. The door zone must be marked and signed so that motorists and bicyclists understand that it is not a travel lane.



Example 5 for Complete Streets – Suburban 3-Lane Road (Without On-Street Parking)

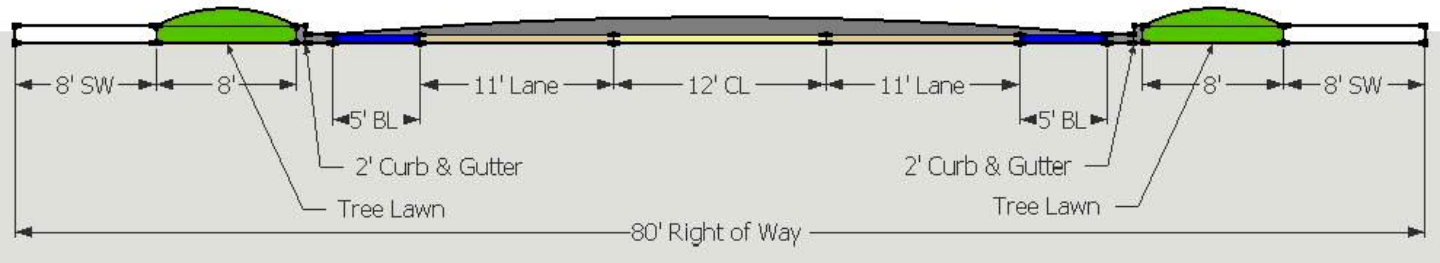
Recommended Minimum Accommodations

- As per the ODOT L&D Manual (Table 306-1E), sidewalks should be provided wherever there are 1 or more residences per acre.
- Bicyclists can use the travel lanes.
- Shared lane markings (sharrows) can be used if the design speed is 35 mph or less. At speeds above 35 mph, bicycle lanes are recommended.
- Drainage is provided by curb and gutter.



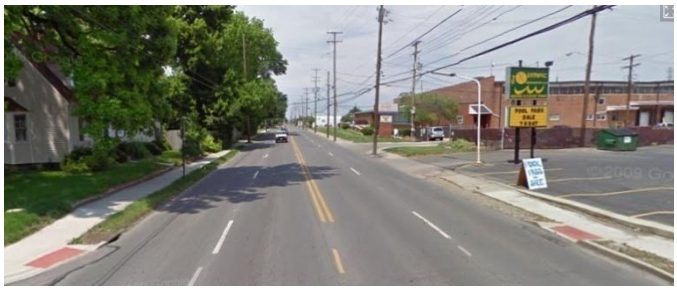
Example for providing additional accommodation

- In this example, sidewalks have been widened, bicycle lanes have been added, and travel lanes have been narrowed to 11 feet (permitted for streets with lower design speed, as per ODOT L&D Manual Table 301-4E).
- Lawns have been widened to 8 feet, allowing space for proper growth of street trees.

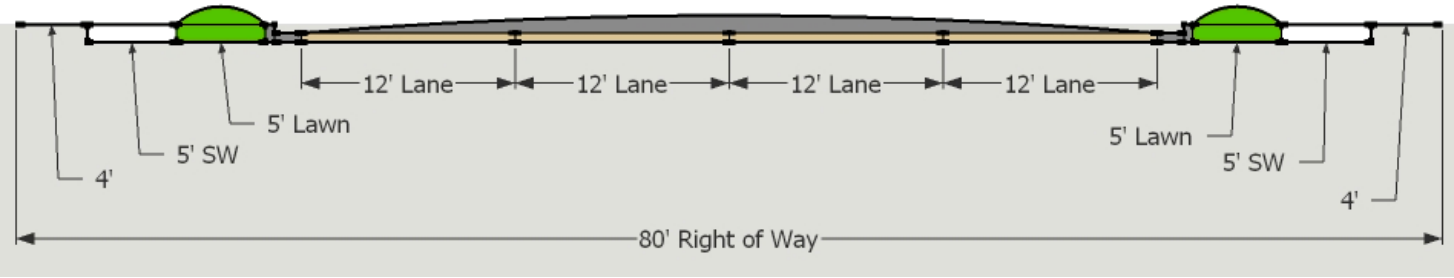


Example 6 for Complete Streets – Urban 4-Lane Road (Without On-Street Parking)

Recommended Minimum Accommodations

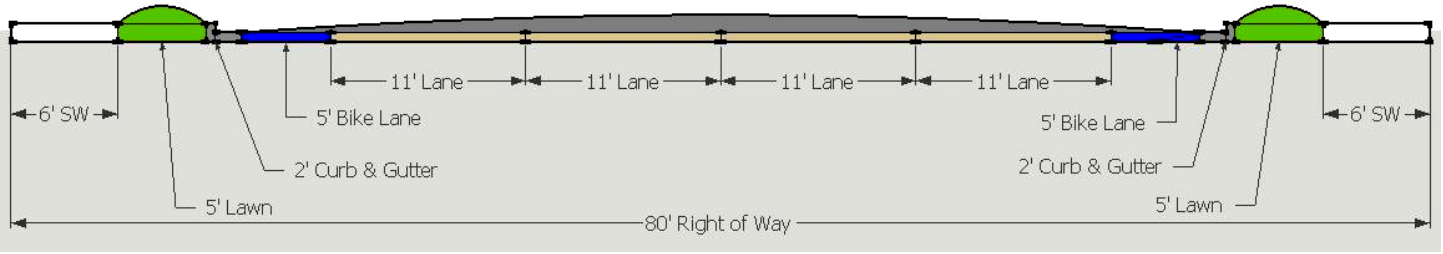


- As per the ODOT L&D Manual (Table 306-1E), sidewalks should be provided wherever there are 1 or more residences per acre.
- Bicyclists can use the travel lanes.
- Shared lane markings (sharrows) can be used if the design speed is 35 mph or less. At speeds above 35 mph, bicycle lanes are recommended.
- Drainage is provided by curb and gutter.



Example for providing additional accommodation

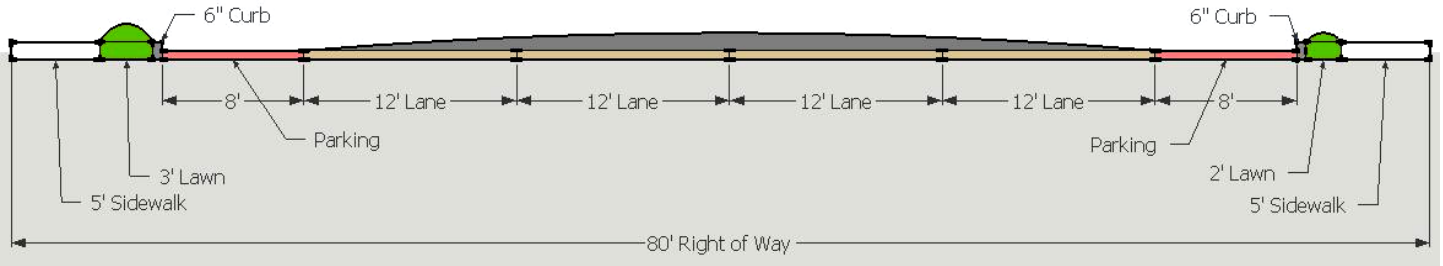
- In this example, bicycle lanes have been added and travel lanes have been narrowed to 11 feet (permitted for streets with lower design speed, as per ODOT L&D Manual Table 301-4E).



Example 7 for Complete Streets – Urban 4-Lane Road (With On-Street Parking)

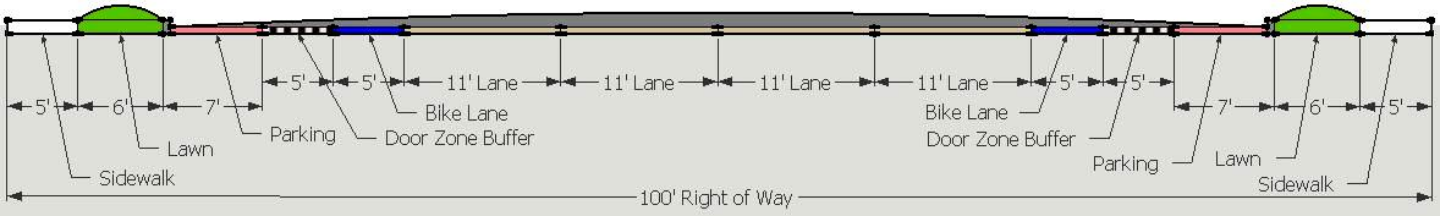
Recommended Minimum Accommodations

- As per the ODOT L&D Manual (Table 306-1E), sidewalks should be provided wherever there are 1 or more residences per acre.
- Bicyclists can use the travel lanes.
- Shared lane markings (sharrows) can be used if the design speed is 35 mph or less. At speeds above 35 mph, bicycle lanes are recommended.
- Drainage is provided by curb and gutter.



Example for providing additional accommodation

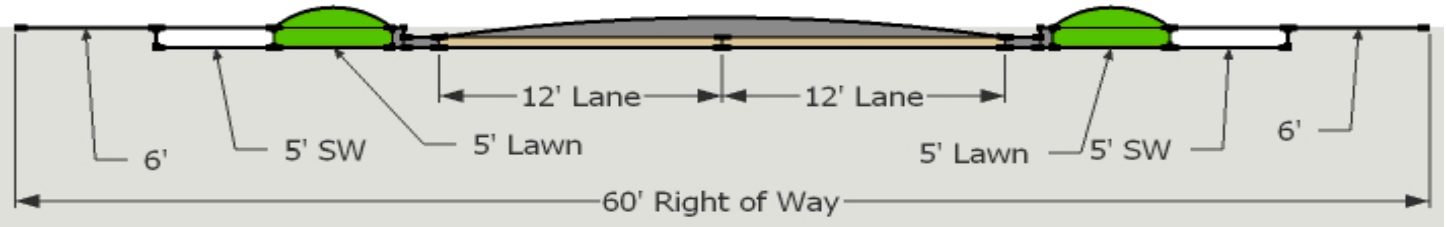
- The cross-section below shows a street design that is appropriate for an urban area with higher volumes of pedestrian and bicycle traffic (existing or expected). Bicycle lanes have been added. Travel lanes have been narrowed to 11 feet (permitted for streets with lower design speed, as per ODOT L&D Manual Table 301-4E).
- Bicycle lanes should not be placed in the door zone. The door zone must be marked and signed so that motorists and bicyclists understand that it is not a travel lane.



Example 8 for Complete Streets – Urban 2-Lane Road (Without Parking)

Recommended Minimum Accommodations

- As per the ODOT L&D Manual (Table 306-1E), sidewalks should be provided wherever there are 1 or more residences per acre.
- Bicyclists can use the travel lanes.
- Shared lane markings (sharrows) can be used if the design speed is 35 mph or less. At speeds above 35 mph, bicycle lanes are recommended.
- Drainage is provided by curb and gutter.



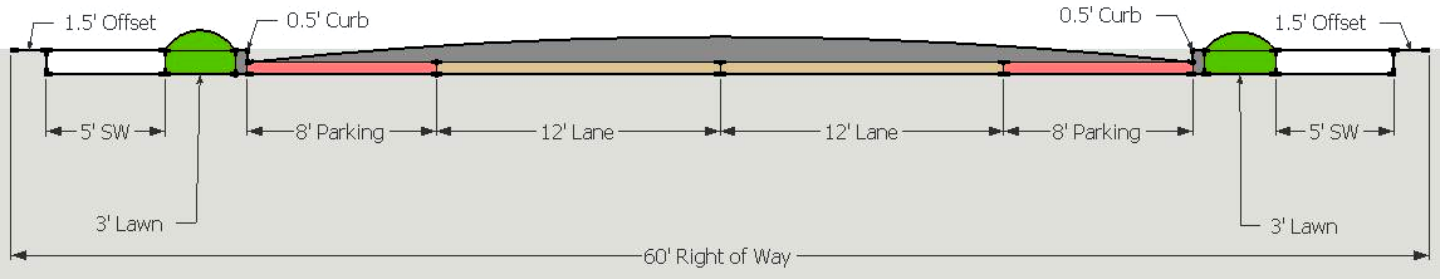
Example for providing additional accommodation

- In this example, sidewalks have been widened, lawns have been widened to allow space for street trees, and travel lanes have been narrowed to 11 feet (permitted for streets with lower design speed, as per ODOT L&D Manual Table 301-4E).
- Shared lane markings (sharrows) and/or “Bicycles May Use Full Lane” signage should be installed.

Example 9 for Complete Streets – Urban 2-Lane Road (With Parking)

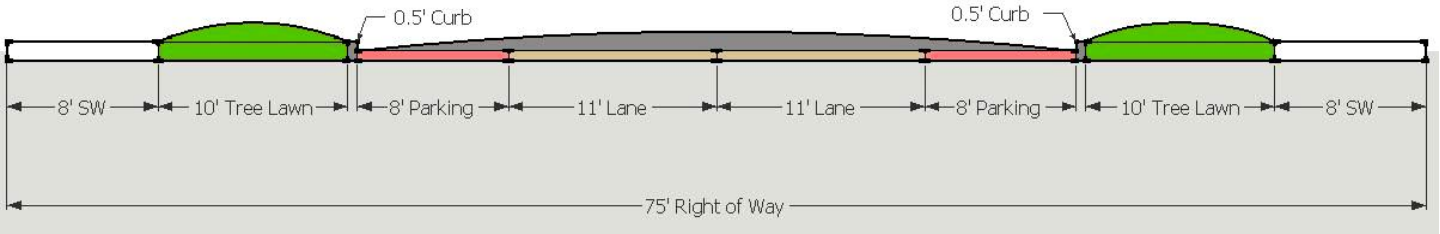
Recommended Minimum Accommodations

- As per the ODOT L&D Manual (Table 306-1E), sidewalks should be provided wherever there are 1 or more residences per acre.
- Bicyclists can use the travel lanes.
- Shared lane markings (sharrows) can be used if the design speed is 35 mph or less. At speeds above 35 mph, bicycle lanes are recommended.
- Drainage is provided by curb and gutter.



Example for providing additional accommodation

- In this example, sidewalks have been widened, lawns have been widened to allow space for street trees, and travel lanes have been narrowed to 11 feet (permitted for streets with lower design speed, as per ODOT L&D Manual Table 301-4E).
- Shared lane markings (sharrows) and/or “Bicycles May Use Full Lane” signage should be installed. Sharrows should be placed to guide bicyclists to ride outside the door zone.



Appendix 2: Glossary / Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ADAAG	ADA Accessibility Guidelines for Buildings and Facilities
ADT	Average Daily Traffic
BL	Bike Lane
CL	Center Lane, also known as a “Two Way Left Turn Lane” (TWLTL)
COTA	Central Ohio Transit Authority
CS	Complete Streets
FHWA	Federal Highway Administration
ITE	Institute of Transportation Engineers
L&D Manual	Location & Design Manual
LPA	Local Public Agency
MUP	Multi-Use Path (typically bicyclists and pedestrians)
MUTCD	Manual of Uniform Traffic Control Devices
NHS	National Highway System
ODOT	Ohio Department of Transportation
PROWAG	Public Rights-of-Way Accessibility Guidelines
PS	Paved Shoulder
ROW	Right of Way
SLM	Shared Lane Marking, also known as a “sharrow”
SW	Sidewalk

Appendix 3: Complete Streets Toolkit Library

Introduction

MORPC has created a tool library where member governments can borrow equipment that may be too expensive or too specialized for them to purchase. Using the equipment will allow communities to evaluate progress toward Complete Streets goals and to document trends and usage patterns as well as identify areas with excessive speeding.

Library Equipment Available

The following equipment is available, with necessary installation equipment. To use the equipment, agency representatives simply follow the check-out process described later in this chapter.

- (8) Trailmaster TM1550 Active Infrared Trail Monitors
- (2) Eco-Counter Selective Pneumatic Tubes
- (1) Radar gun
- (5) Measuring Wheels
- Several click counters

Trailmaster TM1550 infrared counter set. Source: MORPC.

Trailmaster TM1550 Counters

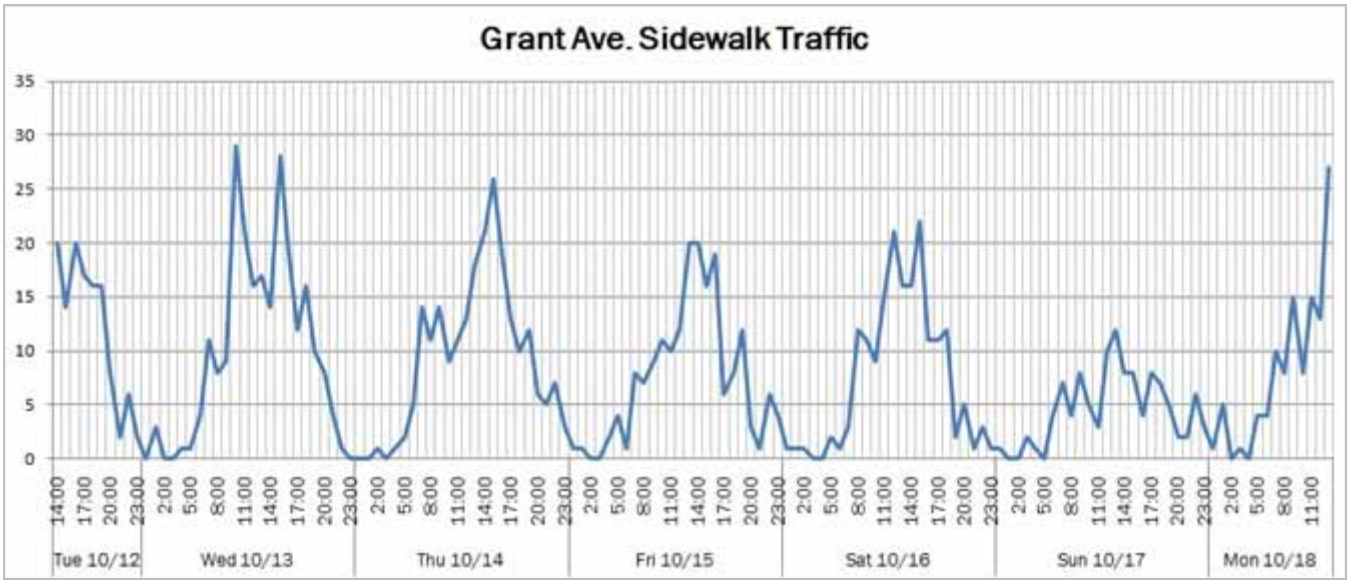
The Trailmaster TM1550 counters use infrared technology to detect pedestrians and bicyclists along trails or sidewalks. Unfortunately, the counters are not able to distinguish between the two. The Trailmaster counters are most suitable for off-street trails and sidewalks in secure locations. It is preferable that pedestrians and bicyclists are channeled at or near the counting location, to increase the likelihood that they will be counted. Ideal locations include bridges, trails with vegetation on both sides, and sidewalks with poles on either side.

In areas where they can be properly installed, the counters are effective in establishing trends and usage patterns. They are not 100 percent accurate, however, and it is ideal to conduct a corresponding one- to two-hour manual count to determine their accuracy for any given deployment. MORPC staff can explain this in greater detail during the checkout process.

Output from the Trailmaster is timestamped as shown in the table to the right. The raw data can then be aggregated by the hour or other time interval, as in the Grant Ave. Sidewalk Traffic chart below.

EVENT	DATE	TIME
145	9/21/10	16:02
146	9/21/10	16:03
147	9/21/10	16:04
148	9/21/10	16:04
149	9/21/10	16:05
150	9/21/10	16:05
151	9/21/10	16:05
152	9/21/10	16:05
153	9/21/10	16:06
154	9/21/10	16:07

Results from the Trailmaster TM1550 infrared counter. Source: MORPC.



Eco-Counter Selective Pneumatic Tubes. Source: MORPC.

Eco-Counter Selective Pneumatic Tubes

The selective pneumatic tube system by Eco-Counter allows bikes to be counted on trails or roads. The system operates similar to traditional tube counting systems used for vehicles, but with the ability to count bikes only. Coupled with the infrared counters described above, the tube counters could be used to better understand mode split on off-street trails.

Secure locations along trails are the best locations to install selective pneumatic tubes, but narrow and/or low-speed roads with relatively high bicycle traffic may also work well. In either case, the tubes should be located where they cannot be easily avoided by bicyclists.

Click counters. Source: MORPC.

Click Counters

Click counters are an intuitive way to conduct manual pedestrian or bicycle counts at high-volume locations. These compact counters allow the user to keep track of four separate groups. A good example of their use is at intersections, where each leg of the intersection can be counted separately. Similarly, attributes such as direction or helmet usage, could be separately tallied using click counters on off-street trails.

Radar Gun

Another tool that can help with problem identification is a radar gun. Although a radar gun will not provide the same level of detail as a formal traffic study, it can be used to gain an initial sense of whether a given stretch of road suffers from a speeding problem. Similar to the measuring wheels discussed above, the radar gun could be used for projects relating to Safe Routes to School, traffic calming, and other areas where speeding is a concern.

Radar gun. Source: MORPC.

Measuring Wheels

Measuring wheels are useful when conducting site visits related to Complete Streets. In particular, they are a quick and effective way to measure crossing distance, curb-to-curb width, and the widths of travel lanes, sidewalks, and grass buffers. These dimensions are useful for inventories relating to Safe Routes to School, road diets, and bike lane implementation, among other purposes.

Measuring wheel. Source: MORPC.

Library Checkout Process

MORPC member agencies are strongly encouraged to utilize the equipment from the toolkit library. The checkout process requires agency representatives to fill out the Complete Streets Toolkit Library Checkout Form, available here: www.morpc.org/trans/CSToolkit_CheckoutForm.pdf.

MORPC staff is available to instruct the borrower on the proper use of the equipment and to answer any questions relating to installation or other aspects of the equipment. Additionally, the equipment documentation will be made available to the user. After the equipment is returned, the borrower will be asked to fill out a feedback form that allows MORPC to improve the Toolkit Library. This form is available here: www.morpc.org/trans/CSToolkit_FeedbackForm.pdf.

Available Training

MORPC staff is available to train staff from member agencies on the use of the equipment in the Complete Streets toolkit library.

Please contact Joe Fish at (614) 233-4123 or jfish@morpc.org to arrange training.

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Appendix 4: Funding Sources

PROGRAM	AGENCY	ELIGIBLE PROJECTS	LINK
Surface Transportation Program (STP)	FHWA/ ODOT/ MORPC	Roads, bicycle and pedestrian facilities, bridges, transit facilities.	http://1.usa.gov/p7j37o
Recreational Trails Program (RTP)	FHWA/ ODNR	Trail construction, maintenance, improvements, and land acquisition.	http://1.usa.gov/n1ohLS
Transportation Enhancements (TE)	FHWA/ ODOT/ MORPC	Pedestrian, bicycle, beautification, cultural, or historical projects or programs.	http://1.usa.gov/qHCnnR
Safe Routes to School (SRTS)	FHWA/ ODOT	Sidewalks, curb ramps, crosswalks, traffic calming, signage, bike parking, education, encouragement, enforcement, and school travel planning.	http://1.usa.gov/noax4s
Congestion Mitigation and Air Quality (CMAQ)	FHWA/ ODOT/ MORPC	Bicycle and pedestrian projects, ridesharing, other projects with ability to reduce air pollution.	http://1.usa.gov/pmY5WR
Highway Safety Improvement Program (HSIP)	FHWA/ ODOT	Safety improvements, including bicycle and pedestrian projects. All projects must demonstrate ability to reduce fatal and injury crashes.	http://1.usa.gov/nYiWnH
Transportation, Community, and System Preservation (TCSP)	FHWA	Wide range of projects that improve the efficiency of the transportation system.	http://1.usa.gov/r2KuXA
Urbanized Area Transit Formula Grants (5307)	FTA/ODOT	Planning, engineering design and evaluation of transit projects; bus replacement, capital investments in new and existing fixed-guideway systems.	http://1.usa.gov/qm4gAS
New Starts/Small Starts (5309)	FTA/ODOT	New rail or bus projects, or an extension/ improvement to existing lines.	http://1.usa.gov/nLSLAE
Jobs Access Reverse Commute (5316)	FTA/ODOT	Capital, planning and operating expenses for projects that transport low-income individuals to and from jobs and activities related to employment.	http://1.usa.gov/p199l1
New Freedom (5317)	FTA/ODOT	Public transportation-related capital and operating expenses designed to assist individuals with disabilities, beyond those required by ADA.	http://1.usa.gov/rdeR03
Community Development Block Grant (CDBG)	HUD	Sidewalk construction, traffic calming, stormwater management. Note: only applicable in certain areas meeting low-income requirements.	http://1.usa.gov/q6Axzu
NatureWorks Grants	ODNR	Acquiring, developing, and rehabilitating recreational areas, including trails.	http://bit.ly/oW0xwQ
Clean Ohio	ODOD/ OEPA	Trail and green space conservation projects.	http://clean.ohio.gov/

See MORPC's funding opportunities database for an up-to-date listing of available funding sources and associated requirements and deadlines: www.morpc.org/info_center/grants/grants.asp.