RAMSEY COUNTY-WIDE

Pedestrian & Bicycle Plan

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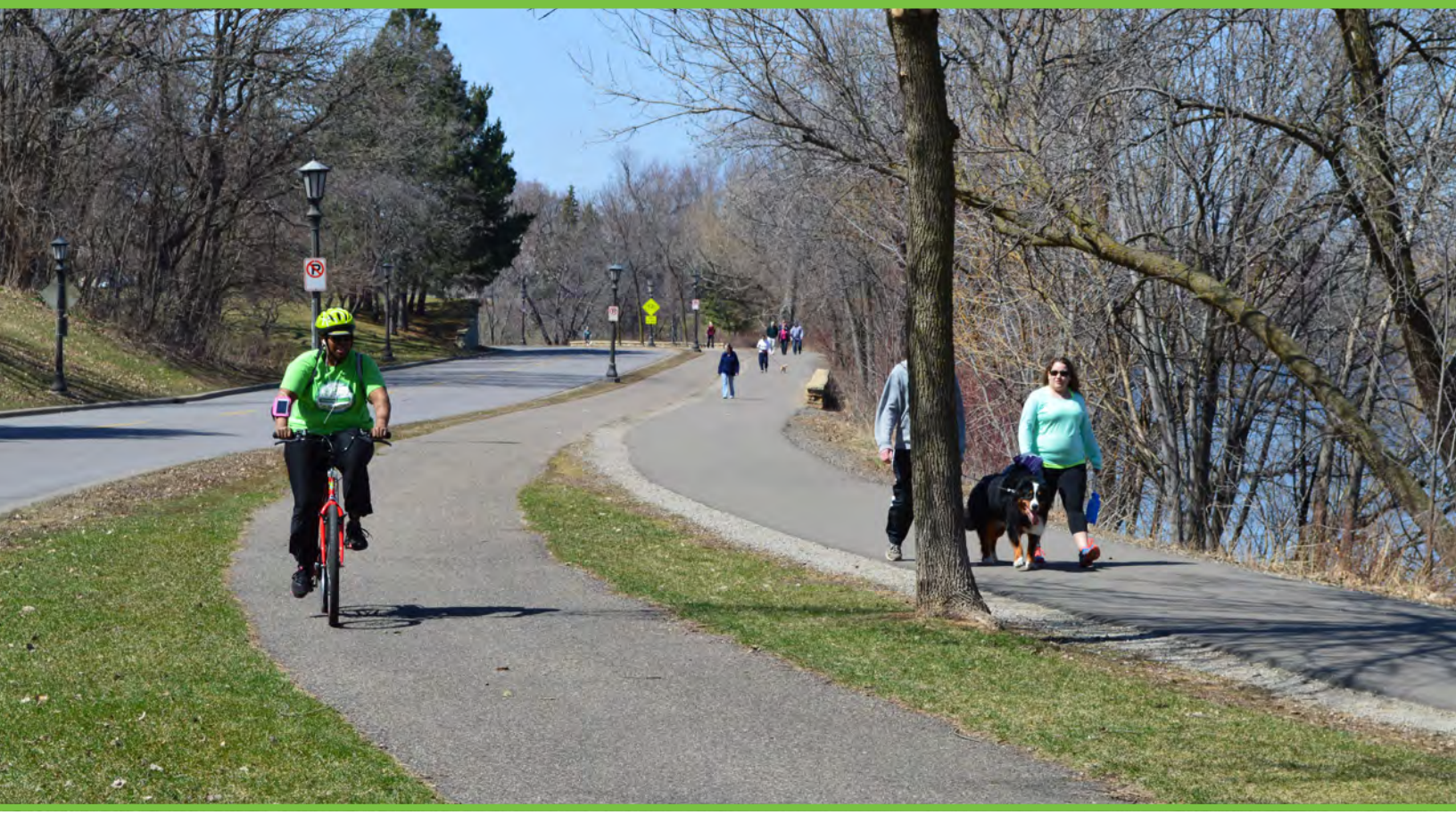
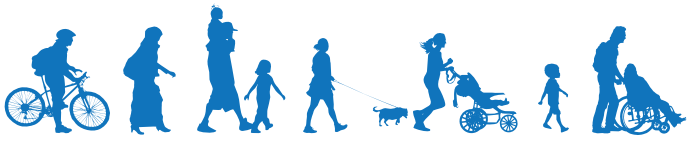


PRIMER: INFRASTRUCTURE DESIGN

Walking and Biking for All



Active Living Ramsey Communities

A Program of RAMSEY COUNTY

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Walking and Biking for All

THE RAMSEY COUNTY WAY

There is a movement to build a future where walking and biking are common and preferred ways of travel and recreation and where communities transform their infrastructure, policies and programs related to transportation.

For many years, the approach to transportation planning and design prioritized automobile travel, influencing overall travel behavior. Planning for all transportation options is making it easier for people to choose active modes like walking and biking. Bike and pedestrian facilities can serve both transportation and recreation needs when planned well. Coordination between parks and transportation agencies makes this possible.

Pedestrians are the foundation of the transportation system, playing a role in every trip. Adding biking and transit extends more opportunities for physical activity in daily routines. A rich variety of safe and convenient transportation choices helps to maximize the health of individuals, the environment and the economy for everyone.

This primer discusses the infrastructure needed to support a walkable and bikeable community. The design concepts presented here identify the critical dimensions, usage patterns and subtle details necessary to create a place where everyone is comfortable walking or biking. Because research, best practices and laws are constantly changing, it is necessary to check recent developments for the most up-to-date guidance.

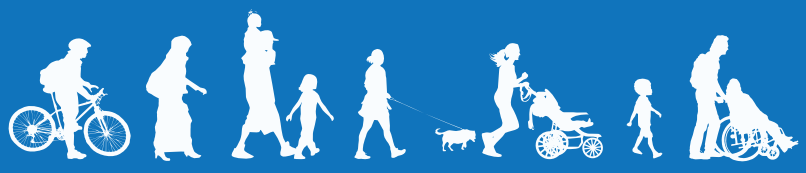
A walkable and bikable community is one that people of all **ages and abilities** *are able to enjoy.*

All ages *means that children as young as 8 can walk and bike independently from their parents. It means that the elderly can get around comfortably without a car. Facility needs vary by age and there is no "one size fits all" solution.*

All abilities *means that those using mobility devices or those with vision impairments are not faced with barriers. Crossings, intersections and facilities must be designed with users of all abilities in mind.*

ALL AGES AND ABILITIES

Walking for Everyone



WALKING THE WALK

Everyone is a Pedestrian

Pedestrians are the foundation of transportation systems. Every trip starts and ends as a pedestrian trip.

In this plan the term "pedestrian" includes people on foot, using mobility devices such as wheelchairs, walkers or canes, pushing strollers, rolling on skates or on a skateboard.

Even bicyclists in some conditions are considered legal pedestrians. Operating at a walking speed on sidewalks, shared use paths and through crosswalks, people on bikes have the same legal protections and responsibilities as pedestrians.

Walking is the oldest and most basic mode of travel and is a fundamental part of the United States transportation system.

-American Association of State Highway Officials[1]

1 AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities.* 2004.

Benefits of Walking

Safety Benefits: Walkable neighborhoods have much lower rates of traffic fatalities – for both pedestrians and motorists – compared with automobile-oriented areas.[1]

Health Benefits: Fewer than 50% of Americans meet the minimum guidelines for moderate physical activity – walking is the easiest and most affordable way to incorporate physical activity into everyday life.[2]

Social Equity Benefits: Low-income families are more reliant on walking for essential journeys, and yet these families often locate in the most car-dependent places.[3]

Environmental Benefits: Transportation is responsible for one third of all U.S. greenhouse gas emissions – converting short driving trips to walking reduces this impact significantly.[4]

Transportation Benefits: One quarter of all trips in the U.S. are one mile or less, and yet most of these trips are taken by car. Increasing walking reduces traffic congestion and the cost of street maintenance.[5]

Economic Benefits: Transportation is the second largest household expense in the United States. The average household cost to own and operate one car in the U.S. is $9,000 per year – walkable neighborhoods allow families to own fewer cars and save money.[6]

Support Infrastructure

General considerations that apply across all pedestrian and bicycle facilities are:

- Street lighting
- Wayfinding
- Stormwater storage and treatment
- Facilities such as benches and water fountains
- Snow and ice removal/ storage during winter months

1 Littman, T. et Al. *Safe Travels: Evaluating Mobility Management Traffic Safety Impacts*. VTPI. 2003.

2 American Psychological Association. *Sedentary Lives Can be Deadly: Physical Inactivity Poses Greatest Health Risk*. 2009.

3 Dombroski, M., *Securing Access to Transportation for the Urban Poor*. Columbia Law Review. 2005.

4 EPA. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013*

5 FHWA. 2006-2009 National Household Travel Survey.

6 AAA. Your Driving Costs. 2012.

A General Theory of Walkability

In *Walkable City,* the author describes the four pillars of walkability.[1] A walk must be **useful, safe, comfortable** and **interesting**. All of these are required to make walking viable, and one alone is insufficient.

A **safe** walk is free of violence and the fear of crime and includes both personal safety and traffic safety.

A **useful** walk is possible when places and people are in close proximity. The trip to the park, school, the store or a friend's house must be close enough for walking to even be considered.

A **comfortable** walk must consider the natural and built environment. Protection from sun, rain, wind and snow is important to encourage walking in all seasons. Facilities must be of ample width and safely set-back from fast moving traffic.

An **interesting** walk keeps pedestrians intrigued and entertained. Architecture with small scale details, large tree canopies and well-proportioned streets create a desirable place to be.

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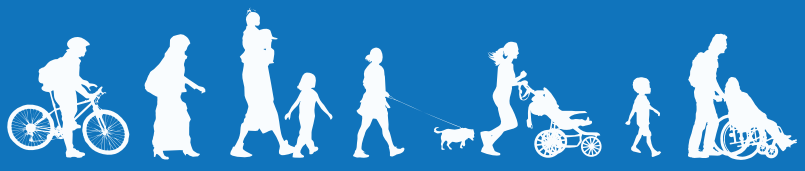
1 Jeff Speck. *Walkable City.* Farrar, Straus and Giroux. 2012.

Walking Facilities



WALKING ON SHARED SPACE STREETS

Many residential streets in Ramsey County were built with an elegant simplicity. Tree lined streets defined by curbs and asphalt are a shared resource where cars are parked, where children play and where neighbors drive a few blocks to reach their home. These streets work best when they are designed to encourage very slow speeds and attentive drivers and limit volumes to local traffic only.

Calm local residential streets can serve all users in a shared space.

Understanding when shared spaces are appropriate and when they are not is an important part of identifying where facilities need to be provided.

Design Details

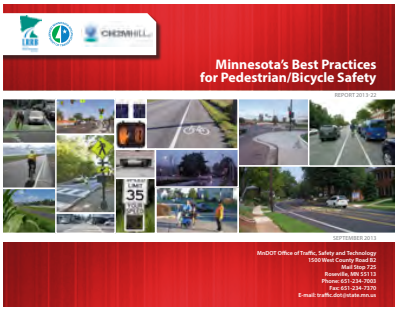
- This design is appropriate for **local residential streets,** as well as streets with **low speeds and volumes.**
- For walking in the street to be considered comfortable, cars must be traveling the **same speeds as people walking** (no more than **5-10 miles per hour.)** Traffic calming techniques work to manage traffic speed. **(MnDOT 2013)**
- Traffic on these streets should be limited to immediate residents, and will not be used as through-routes for long distances. The preferred traffic volume is under **400 cars per day,** but shared space will function up to 750 cars per day. Access management techniques should be used to manage traffic volumes. **(AASHTO 2011)**
- Many studies have shown that narrowing the motor vehicle travel area (to 10-12 ft) encourages slow speeds where all people can share the space safely.
- Existing streets can be retrofit as shared streets by using traffic calming devices such as chicanes, diverters and traffic circles. Trees, parking and other physical obstructions calm traffic by creating a horizontal deflection in the path of vehicles.

When Shared Space is Not Enough

Shared space streets break down when they become a place for traffic more than anything else. Fast cars easily crowd out the feeling of safety, discouraging walking.

As motor vehicle speeds and volumes increase, providing a sidewalk on one or both sides of the street becomes necessary to preserve walking comfort. **(AASHTO 2004)**

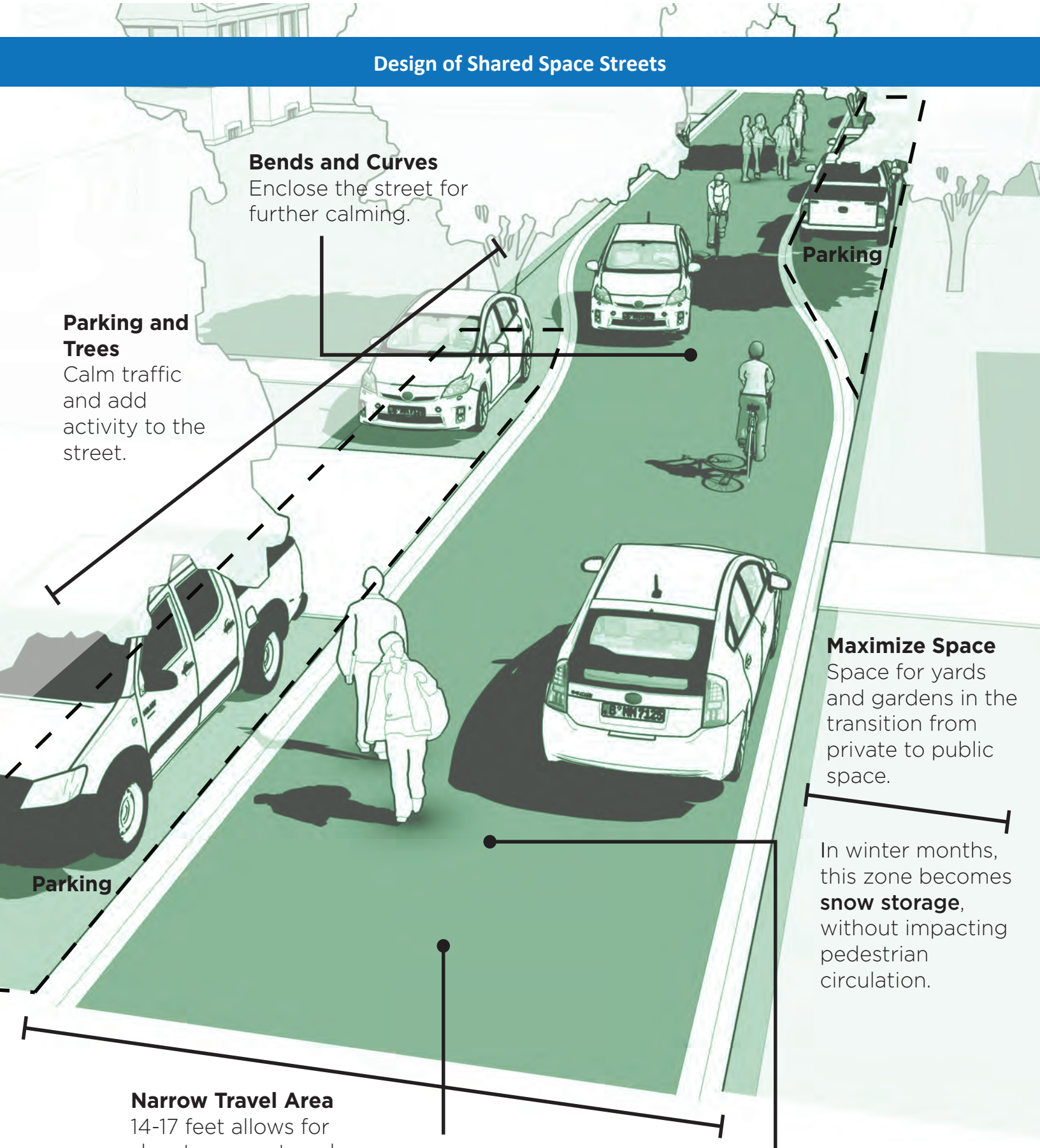
Key References



More information on chicanes, diverters and traffic circles can be found here:

http://nacto.org/publication/urban-street-design-guide/street-design-elements/

Design of Shared Space Streets



WALKING ON SIDEWALKS

In many residential areas, sidewalks are nonexistent. This may be fine on calm ***Shared Space Streets***, but is a major impediment to walking when sidewalks are missing from streets with heavier traffic.

On many streets, particularly those that connect to important destinations, a sidewalk is a required part of the street. Without a separate, secure, comfortable space to walk, people would rather not.

Design Details

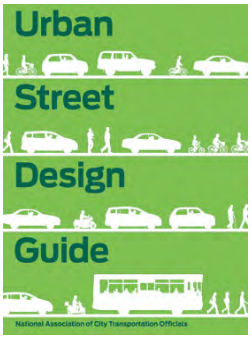
- This design is appropriate for **local, collector and arterial streets.**
- The sidewalk must meet the requirements of the Americans with Disabilities Act. This requires adequate width and enough room to allow for the periodic passing of two people using wheelchairs. **(USDOJ 2012)** Many older sidewalks are not ADA compliant, with insufficient width and lack of curb ramps.
- A planted buffer area between the sidewalk and the street is preferred. This becomes a place for landscaping such as shrubs and trees, as well as a place for street lights, telephone poles, and open doors of cars. **(AASHTO 2004)** This area is also used for snow storage in the winter.
- Driveways shouldn't interfere with the sidewalk. The sidewalk should be maintained with a straight level path, and the driveway apron should transition within the landscaped area.
- In general, if a street is busy enough to need sidewalks, then sidewalks should be provided on both sides. It may be adequate to provide a sidewalk on only one side of the street if traffic volumes are low enough to allow for easy, stress-free street crossings at every corner. **(ITE 1998)**

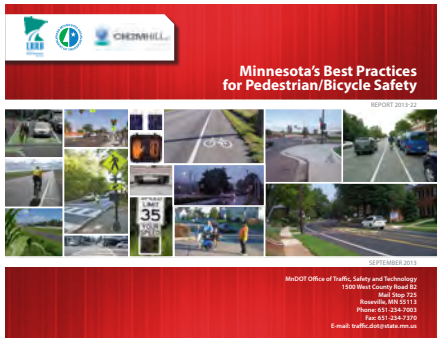
What about Bicycles on Sidewalks?

Standard sidewalks are designed for pedestrians only. If there is demand for bicycling on the sidewalk, then the proper facility is likely a ***multi-use path*** or a ***physically separated bike lane.*** **(FHWA 2015)**

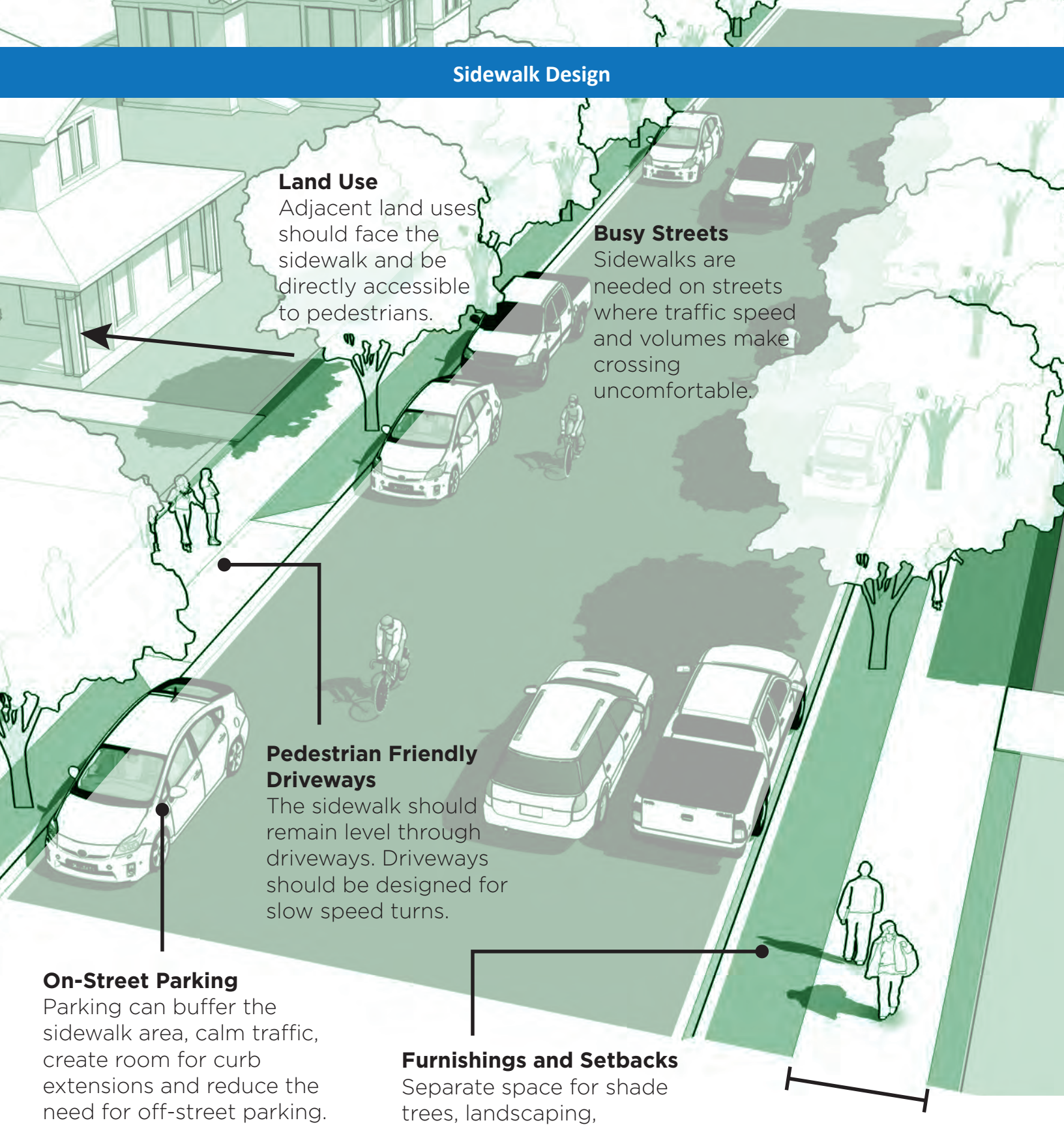
Minnesota statute prohibits biking on sidewalks in business districts.

Key References





Sidewalk Design



Land Use
Adjacent land uses should face the sidewalk and be directly accessible to pedestrians.

Busy Streets
Sidewalks are needed on streets where traffic speed and volumes make crossing uncomfortable.

Pedestrian Friendly Driveways
The sidewalk should remain level through driveways. Driveways should be designed for slow speed turns.

On-Street Parking
Parking can buffer the sidewalk area, calm traffic, create room for curb extensions and reduce the need for off-street parking.

Furnishings and Setbacks
Separate space for shade trees, landscaping, streetlights and utilities preserve and protect the pedestrian zone.

Snow Storage
The furnishing zone is where snow is stored in winter months. Snow should not be stored on the sidewalk.

Accessible Widths
The pedestrian travel area should be wide enough for two people in mobility devices to pass (6 ft).

WALKING ON A TRAIL

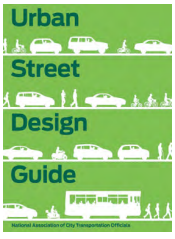
Trails or paths bring the community together for recreation and transportation, walking, rolling, jogging, bicycling and more.

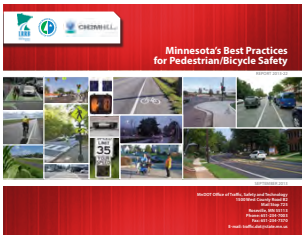
Paths are many people's favorite way to get around as pedestrians or bicyclists, as they are separated from traffic.

Design Details

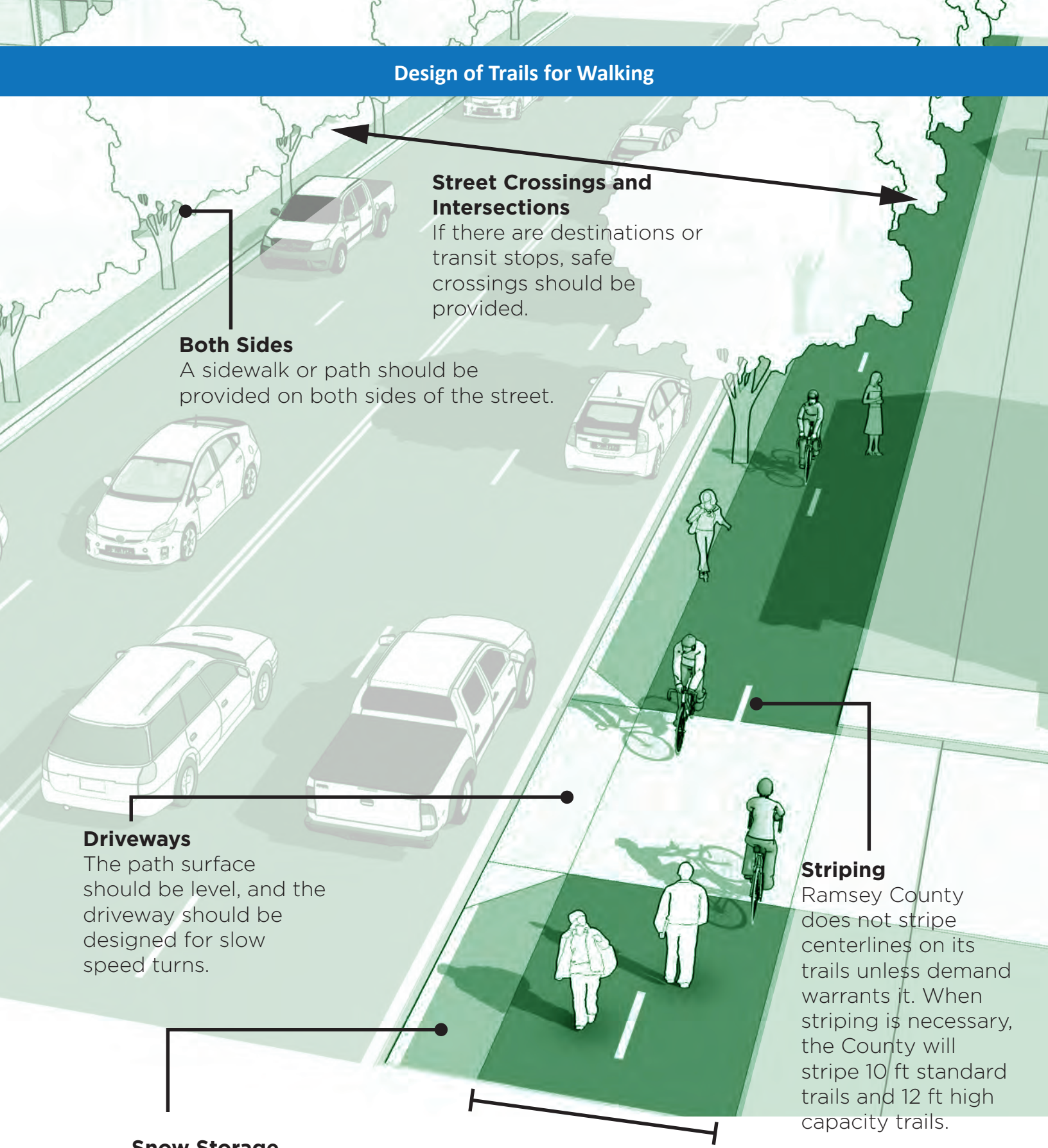
- This design is appropriate for **multi-lane collector and arterial streets.**
- Don't build an undersized path. Even if demand is low today, it will likely be higher in the future. The standard width of a path is 12 ft, and 10 ft should be considered the minimum size, with 8 ft in constrained conditions, but only for short distances (< 200 ft). **(AASHTO 2013)**
- Ramsey County's standard practice is to build paths that are 10 ft wide, 12 ft where demand supports it and 8 ft in constrained conditions with 2 ft buffers on each side for all paths.
- MnDOT specifies a path width of 14 ft or greater width for two-way travel with heavy bicycle and pedestrian activity. **(MnDOT 2007)** Where possible, the path should delineate separate bicycle and pedestrian areas with markings or construction materials.
- Pay special attention to the design of driveways and intersections. At driveways the path should maintain a straight, level alignment, and the driveway should transition over the path.
- At intersections and street crossings, a high quality, safe crossing is important to maximize use of the path. Signals, beacons, and safety islands can reduce exposure and mitigate risk. **(Mineta 2011)**

Key References





Design of Trails for Walking



Street Crossings and Intersections
If there are destinations or transit stops, safe crossings should be provided.

Both Sides
A sidewalk or path should be provided on both sides of the street.

Driveways
The path surface should be level, and the driveway should be designed for slow speed turns.

Striping
Ramsey County does not stripe centerlines on its trails unless demand warrants it. When striping is necessary, the County will stripe 10 ft standard trails and 12 ft high capacity trails.

Snow Storage
Snow should be stored in the furnishing zone when possible. Snow removal plans are necessary to ensure clear facilities.

Width Matters
12 ft is the standard width for shared use paths, with additional width for shoulder/buffer. Extra width is important when volumes are high or mixing with bicyclists is expected.

WALKING THROUGH INTERSECTIONS

Crossing the street is one of the most important details to get right when designing for walkability.

It doesn't matter how nice the path or sidewalk is if you can't cross the street to reach your destination.

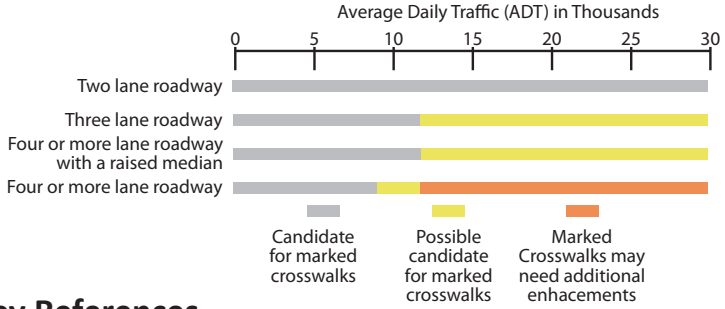
Design Details

Crosswalk markings alone do not improve safety. Crossings should be enhanced as necessary to create safe, comfortable crossing conditions. **(MnDOT 2013)** Common treatments include:

- Curb Extensions
- Median Safety Islands
- Active Warning Beacons
- Pedestrian Hybrid Beacons
- Pedestrian Half Signals
- Leading Pedestrian Intervals & Pedestrian Signal Phases

In general, as the number of lanes increases (and along with it, the intensity of traffic) the more robust crossing treatments will be required. The chart below indicates where crosswalk markings may be installed with confidence. At locations where "marked crosswalks alone are insufficient," crosswalks should be enhanced. **(NCHRP 2006)**

Crosswalk Installation Criteria



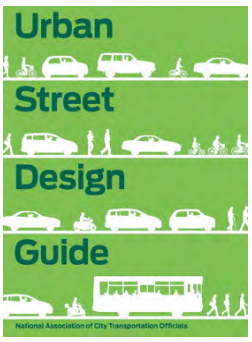
Pedestrian Overpasses

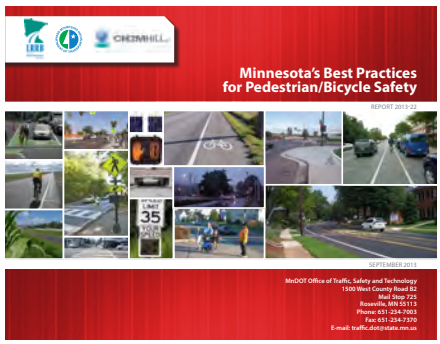
Pedestrian overpasses are inappropriate design solutions for most streets. Only in very high traffic cases, such as limited access highways or arterial streets that function as freeways, should a pedestrian overpass be considered. **(AASHTO 2004)**

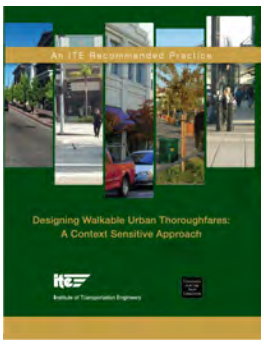
Channelized Turn Lanes

Channelized turn lanes (also called slip-lanes or free-right turns) create stressful conditions that discourage pedestrian activity. If used, the channelized turn lane should include a raised crossing to increase yielding rates. This design is different from free right turns or slip lanes. Existing installations of those designs should be evaluated for re-engineering as a pedestrian-friendly channelized turn lane.

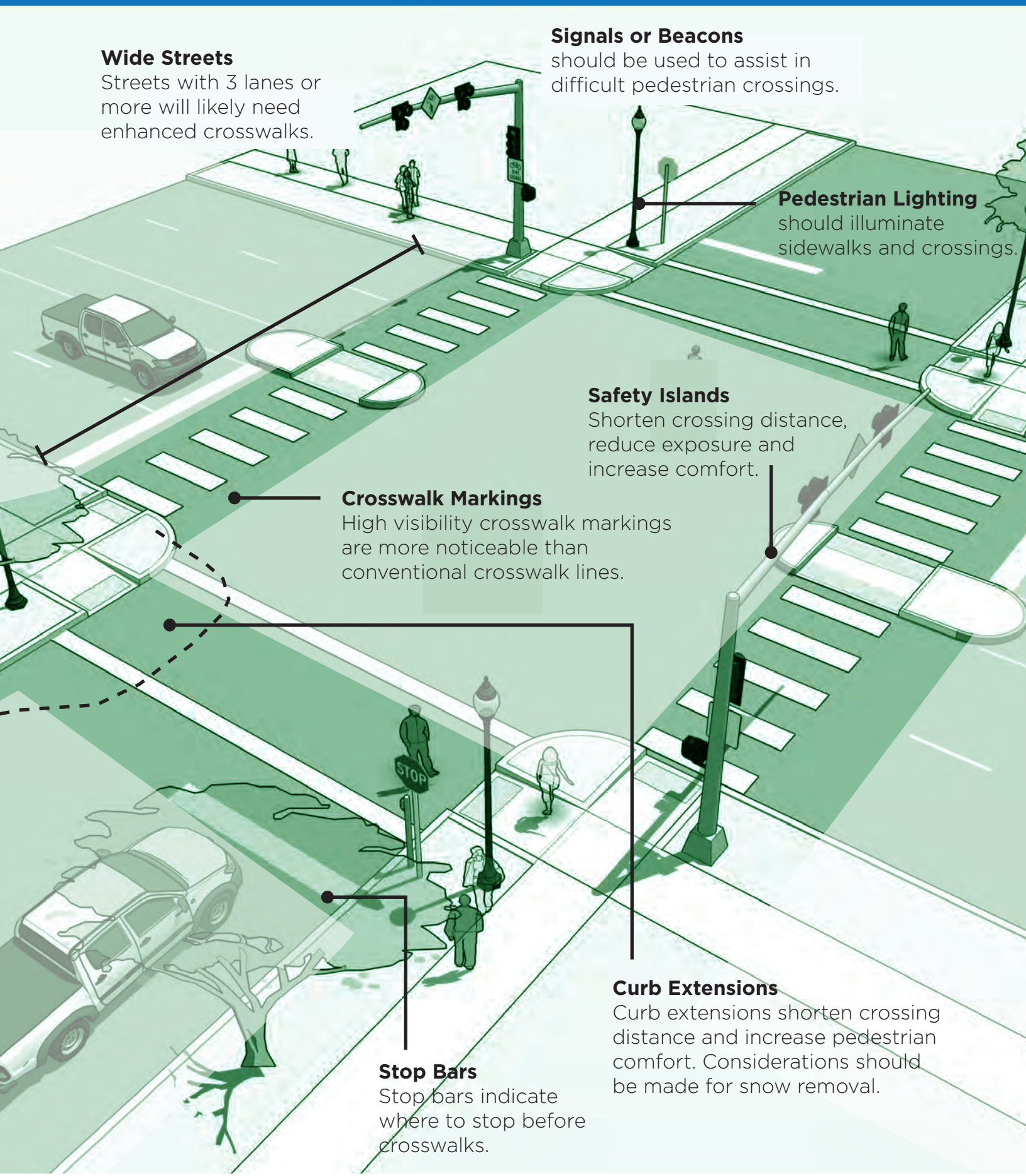
Key References







Intersection Design for Pedestrians



Wide Streets
Streets with 3 lanes or more will likely need enhanced crosswalks.

Signals or Beacons
should be used to assist in difficult pedestrian crossings.

Pedestrian Lighting
should illuminate sidewalks and crossings.

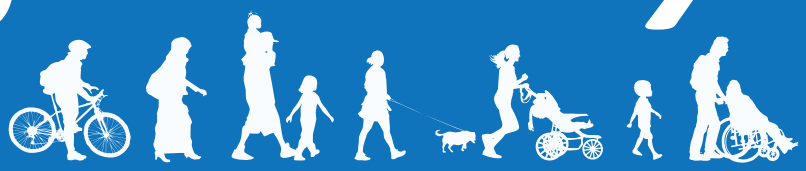
Safety Islands
Shorten crossing distance, reduce exposure and increase comfort.

Crosswalk Markings
High visibility crosswalk markings are more noticeable than conventional crosswalk lines.

Curb Extensions
Curb extensions shorten crossing distance and increase pedestrian comfort. Considerations should be made for snow removal.

Stop Bars
Stop bars indicate where to stop before crosswalks.

Bicycling for Everyone



HOW TO MAKE BICYCLING APPEALING

The United States has officially recognized **the importance of cycling as a practical mode of transportation.**[1]

Cycling Needs to be Safe and Low Stress

The most important reason for the higher levels of cycling in some countries, especially among women, children and the elderly, **is that cycling is much safer than in the US**. Increased safety is a prerequisite to increasing the rate of cycling in the United States.[2] In addition to safety, people are also interested in comfort. Stressful situations, even if they are safe, are a deterrent to increased bicycling.

The Types of Bicyclists

One framework for understanding people's interest in bicycling for transportation is described below. Bicycle facilities should be planned to provide continuity and consistency for all types of bicyclists.[3]

Strong and Fearless (approximately 1% of population) – This group consists of bicyclists that will typically ride anywhere regardless of street conditions or weather.

Enthused and Confident (5-10% of population) - This user group encompasses bicyclists who are fairly comfortable riding on all types of bikeways but usually choose low traffic streets or shared-use paths when available.

Interested but Concerned (approximately 60% of population) – This user type comprises the **bulk of the cycling population** and represents bicyclists who typically only ride a bicycle on low traffic streets or shared-use paths under favorable weather conditions. These bicyclists perceive significant barriers to their increased use of cycling, specifically traffic and other safety issues.

No Way, No How (approximately 30% of population) – Persons in this category are not bicyclists, and are not interested in bicycling for transportation at all.

1 U.S. Department of Transportation (2004) National Bicycling and Walking Study: Ten Year Status Report (Washington, DC: Federal Highway Administration).

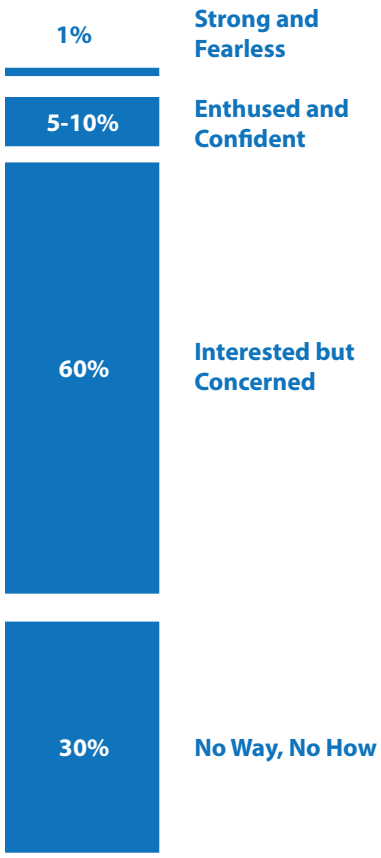
2 Rietveld, P. and Daniel, V. (2004) Determinants of bicycle use: do municipal policies matter?, Transportation Research A, 38, pp. 531–550.

3 Roger Geller, City of Portland Bureau of Transportation. Four Types of Cyclists. 2009.; Dill, J., McNeil, N. Four Types of Cyclists? Testing a Typology to Better Understand Bicycling Behavior and Potential. 2012.

Many developed countries in the world have managed to make cycling a mainstream mode of transport. Cycling is for everyone; it doesn't require expensive equipment, special training or a high degree of physical fitness.[1]

1 Pucher, J., Buehler, R., Making Cycling Irresistible: Lessons from the Netherlands, Denmark and Germany. 2008.

Typical Distribution of Bicyclist Types



Level of Traffic Stress

One way to understand how to serve different types of users is to understand what influences the level of stress of a bicycling facility. In a Level of Traffic Stress (LTS) analysis, street segments are classified into one of four levels of traffic stress based on the anticipated user comfort as shown in Table 3-1. MnDOT has created a reference for bicycle and pedestrian safety strategies that can be found that the following link: http://www.dot.state.mn.us/stateaid/trafficsafety/reference/ped-bike-handbook-09.18.2013-v1.pdf

More cycling supports safer cycling. The "Safety in Numbers" phenomenon is real.[1]

1 Jacobsen, P. (2003) Safety in numbers: more walkers and bicyclists, safer walking and bicycling, Injury Prevention, 9, pp. 205–209.

TABLE 3-1 - Levels of Traffic Stress (Mineta 2011)

LTS	Description	Suitability	Traffic Speed	Intersections	Typical Locations
1	Little traffic stress and requires less attention	All bicyclists (age 10 or higher)	Low	Easy to cross by children and adults	Residential local streets and separated bike paths/cycle tracks.
2	Little traffic stress but requires more attention than young children can handle	Teen and adult bicyclists with adequate bike handling skills	Low	Not difficult to cross for most teenagers and adults	Collector-level streets with bike lanes or a central business district
3	Moderate stress	Most observant adult bicyclists	Moderate	Perceived to be safe by most adults	Low-speed arterials with bike lanes or moderate speed non-multi-lane streets
4	High stress	Experienced and skilled bicyclists	Moderate to high	Complex, wide and/or high volume/speed that can be perceived as unsafe by adults and are difficult to cross	High-speed or multi-lane streets with narrow or no bike lanes

Other Policies and Measures

Researchers have done extensive review of the policies and regulatory measures that support an all ages and abilities cycling network in other countries. The report ***Making Cycling Irresistible: Lessons from The Netherlands, Denmark and Germany*** examines three countries where cycling rates are the highest in the world. The analysis includes national data as well as case studies of large and small cities in each country. The strategies on the following page include those that successful cycling communities have implemented and includes both infrastructure and policy measures.

Key Policies and Measures used in successful cycling communities to promote safe and convenient cycling (Pucher, Buehler, 2008)

The world's best bicycling cities use the following policies and regulatory measures. Not all of these policies can be applied in Minnesota due to regulatory constraints, and some may not be compatible with current engineering practices.

Intersection modifications and priority traffic signals

- Advance green lights for bicyclists at most intersections
- Advanced cyclist waiting positions (ahead of cars) fed by special bike lanes facilitate safer and quicker crossings and turns
- Cyclist short-cuts to make right-hand turns before intersections and exemption from red traffic signals at T-intersections, thus increasing cyclist speed and safety
- Bike paths turn into brightly colored bike lanes when crossing intersections
- Traffic signals are synchronized at cyclist speeds assuring consecutive green lights for bicyclists (green wave)
- Bollards with flashing lights along bike routes signal bicyclists the right speed to reach the next intersection at a green light

Bike parking

- Large supply of good bike parking throughout the city
- Improved lighting and security of bike parking facilities often featuring guards, video-surveillance and priority parking for women

Extensive systems of separate cycling facilities

- Well-maintained, fully integrated paths, lanes and special bicycle streets in cities and surrounding regions
- Fully coordinated system of color-coded directional signs for bicyclists
- Off-street short-cuts, such as mid-block connections and passages that create dead-end streets for motor vehicles.

Traffic calming

- Traffic calming of all residential neighborhoods via speed limit (20 mph) and physical infrastructure deterrents for cars
- Bicycle streets, narrow roads where bikes have absolute priority over cars
- 'Home Zones' with 7 km/hr speed limit, where cars must yield to pedestrians and bicyclists using the street

Traffic laws

- Special legal protection for children and elderly bicyclists
- Motorists assumed by law to be responsible for almost all crashes with bicyclists
- Strict enforcement of cyclist rights by police and courts

Coordination with public transport

- Extensive bike parking at all metro, suburban and regional
- 'Call a Bike' programs: bikes can be rented by cell phone at transit stops, paid for by the minute and left at any busy intersection in the city
- Bike rentals at most train stations
- Deluxe bike parking garages at some train stations, with video-surveillance, special lighting, music, repair services and bike rentals

Traffic education and training

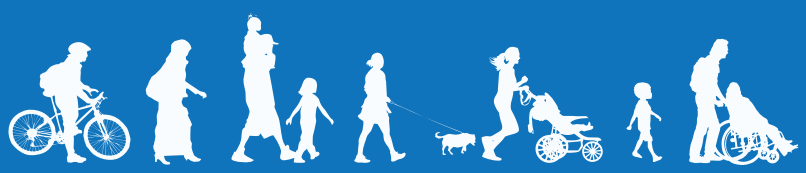
- Comprehensive cycling training courses for virtually all school children with test by traffic police
- Special cycling training test tracks for children
- Stringent training of motorists to respect pedestrians and bicyclists and avoid hitting them

Photo: Bike Texas via Flickr (CC BY 2.0)

CASE STUDY

Major change can happen quickly. For example, in Seville, Spain a steep increase in bicycle ***mode share from 0.6% to 6.6% in three years*** *has been credited in large part to the installation of 120 km of physically separated bike lanes.*

Bicycling Facilities



BICYCLING IN MIXED TRAFFIC

When designed to a high level of quality, bicycle boulevards can provide a trail-like experience on a street without prohibiting access by motor vehicles. Like a pedestrian oriented shared-space street, a bicycle boulevard actively manages motor vehicle speeds and volumes to prioritize other users. **(NACTO 2012)**

Sharing streets with motor vehicles can be a safe, comfortable experience. At its best, it can be more welcoming than even a separated path on the side of a street. To do this right requires intentional design and engineering.

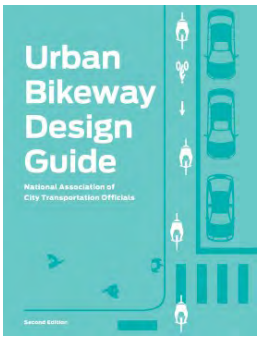
Design Details for Low Traffic Stress[1]

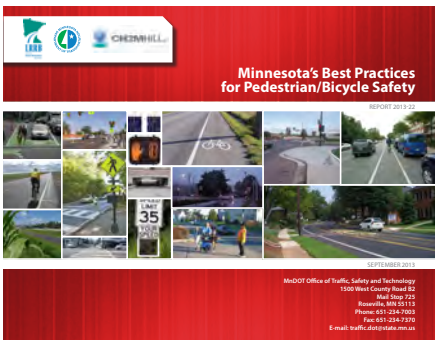
- This design is appropriate for **local residential streets.**
- 20 mph (85th percentile speeds)
- 1,000 ADT Preferred (2,000 maximum)
- 100 "Gaps" per peak hour when crossing major streets (60 minimum). This is a gap in traffic that allows bicyclists to cross.
- No centerline marked
- Narrow lane width preferred
- Parking lanes (if present) should be occupied with parked cars or curb extensions to limit the appearance of a wide-open street.

Signs may be used to indicate the bicycle priority nature of the street. This sign from the Netherlands says "Bicycle Street" - "Cars are Guests."

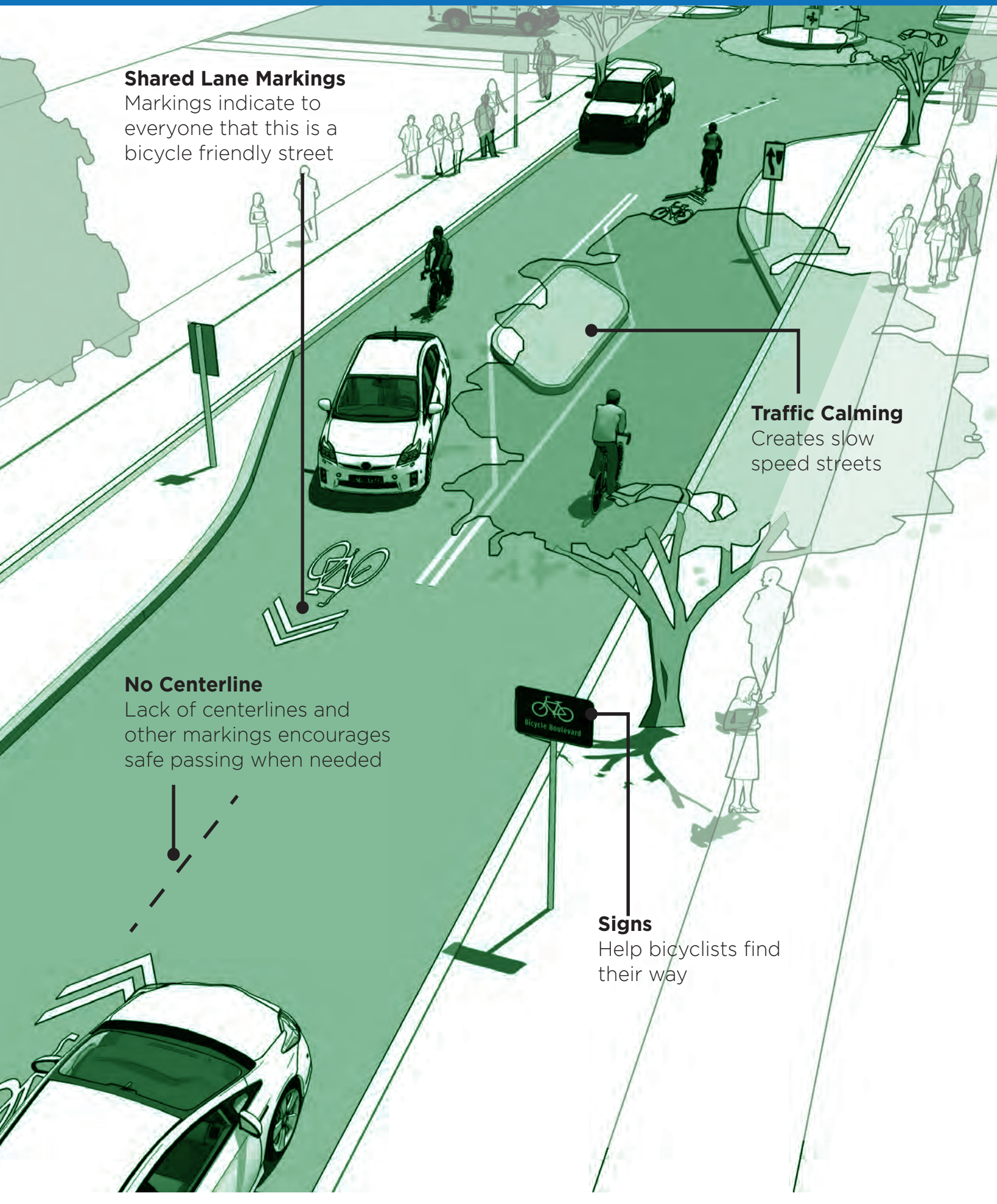
1 Design details below based on City of Portland preferred operations thresholds. (Bicycle boulevard report. 2015)

Key References





Design of Mixed Traffic Streets



BICYCLING IN BIKE LANES

Streets with moderate speeds and volumes are too busy to function as bicycle boulevards, but may be good candidates for bike lanes. (Mineta 2011)

Design Details for Low Stress Bike Lanes

- This design is appropriate for **collector or arterial streets** with one lane in each direction.
- Bicycle lanes are typically 6 – 7ft (minimum 3ft) wide to keep people riding outside of door zones and allow for side-by-side operation.
- These are appropriate on streets with one travel lane in each direction. Multi-lane streets increase stress and require more robust bikeway designs.
- The adjacent street should be 30 mph or slower (25 mph preferred). Minnesota state speed limit minimum is 30 mph with allowed exception to 25 mph on streets with bike lanes.

If speeds and volumes exceed these thresholds, a physically separated bike lane or path is a more appropriate facility. **(FHWA 2015)**

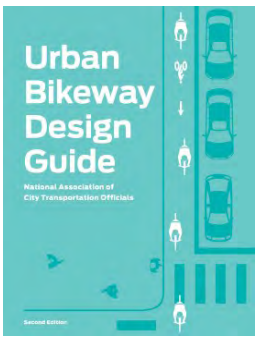
When speeds and volumes increase, bicyclists need their own ample space to feel comfortable. A simple bike lane, marked with only a line of paint, can be a safe, comfortable place to ride, in the right context.

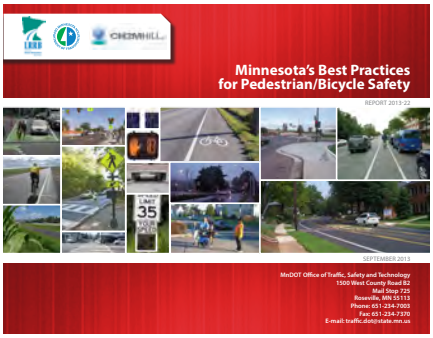
Street Diets

One popular way to create space for bicycle lanes is to convert a 4-lane undivided street into a 3-lane street. This practice is supported by FHWA on most streets with fewer than 20,000 average daily traffic, with 20,000 as the cut off for road diet candidate streets.

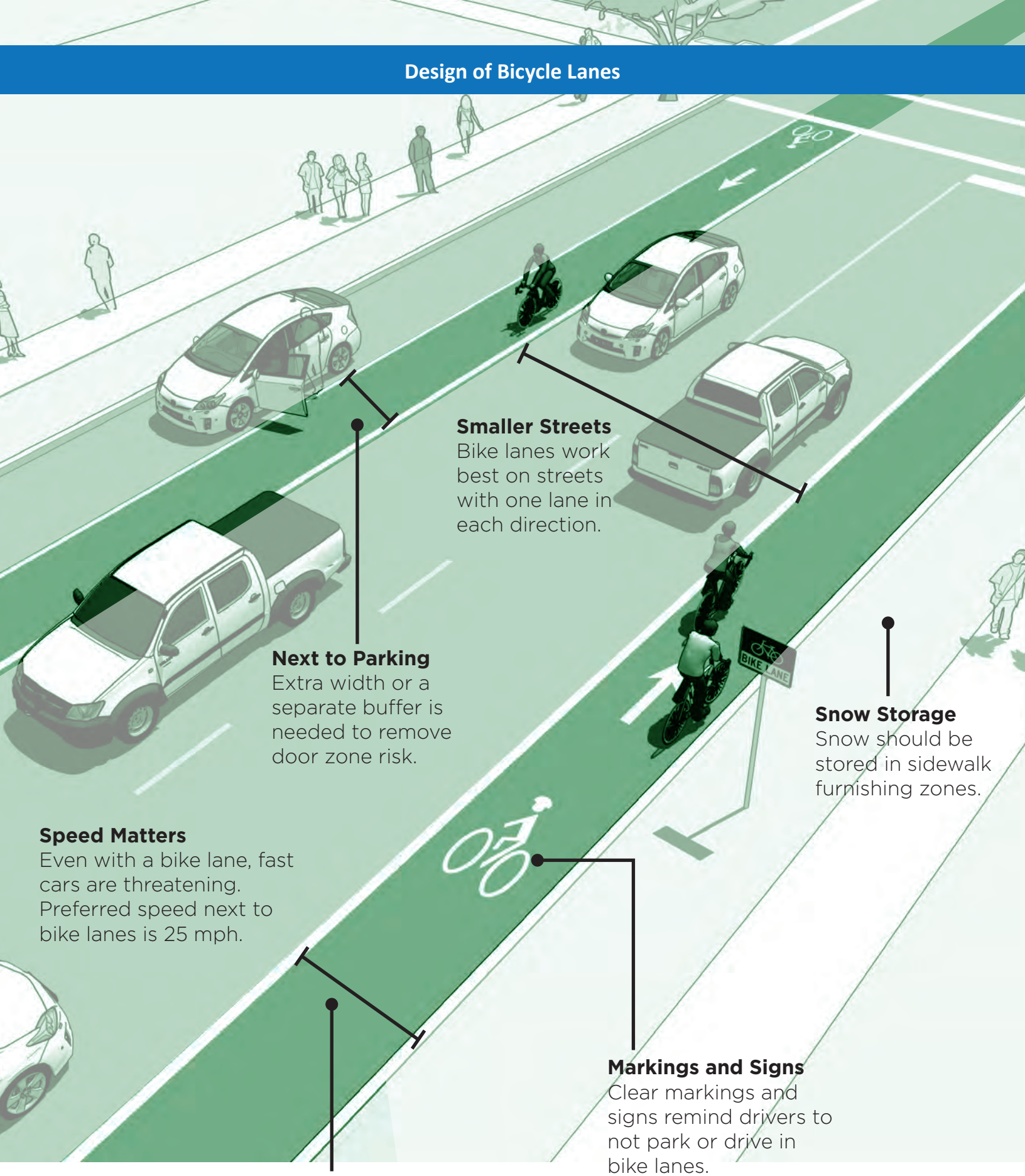
See the Road Diet Informational Guide released in 2014 for more information, available here: http://safety.fhwa.dot.gov/road_diets/info_guide/

Key References





Design of Bicycle Lanes



Smaller Streets
Bike lanes work best on streets with one lane in each direction.

Next to Parking
Extra width or a separate buffer is needed to remove door zone risk.

Snow Storage
Snow should be stored in sidewalk furnishing zones.

Speed Matters
Even with a bike lane, fast cars are threatening. Preferred speed next to bike lanes is 25 mph.

Markings and Signs
Clear markings and signs remind drivers to not park or drive in bike lanes.

Lane Width
Bike lanes should be 6-7 ft wide (3 ft minimum).

BICYCLING ON SHOULDERS

Many streets today provide shoulders that function as a type of bicycle facility. The design enhancements listed below can improve the safety and utility of bicyclists that are comfortable using these facilities.

Paved shoulders can provide a minimum level of access to bicyclists in areas of low demand and has been a strategy used by Ramsey County Public Works.

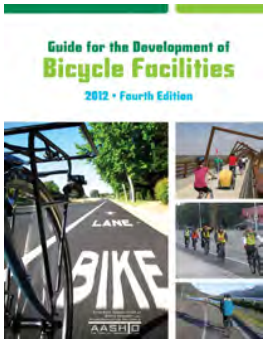
Design Details for Enhancing Shoulders

- This design is appropriate for **rural streets.**
- At least 6 ft preferred bicycle travel area width (4 ft minimum to be considered bicycle accessible). **(AASHTO 2013)**
- Provide rumble strips outside of the bicycle travel area **(MnDOT 2013).** Rumble strips should be overlapped with the edge line, rather than placed within the shoulder space. Rumble strips do not count toward the width of the bikeable shoulder.
- Where space is available, provide a wide 3-4 ft buffer area, in addition to the bicycle travel area. This space should be marked with chevron markings. **(NACTO 2012)**
- Provide gaps in the rumble strip to allow bicyclists to exit the shoulder at intersections or driveways, and at periodic intervals along the corridor. 12 ft gaps every 40-60 ft should be provided to allow access as needed. **(MnDOT 2013)**

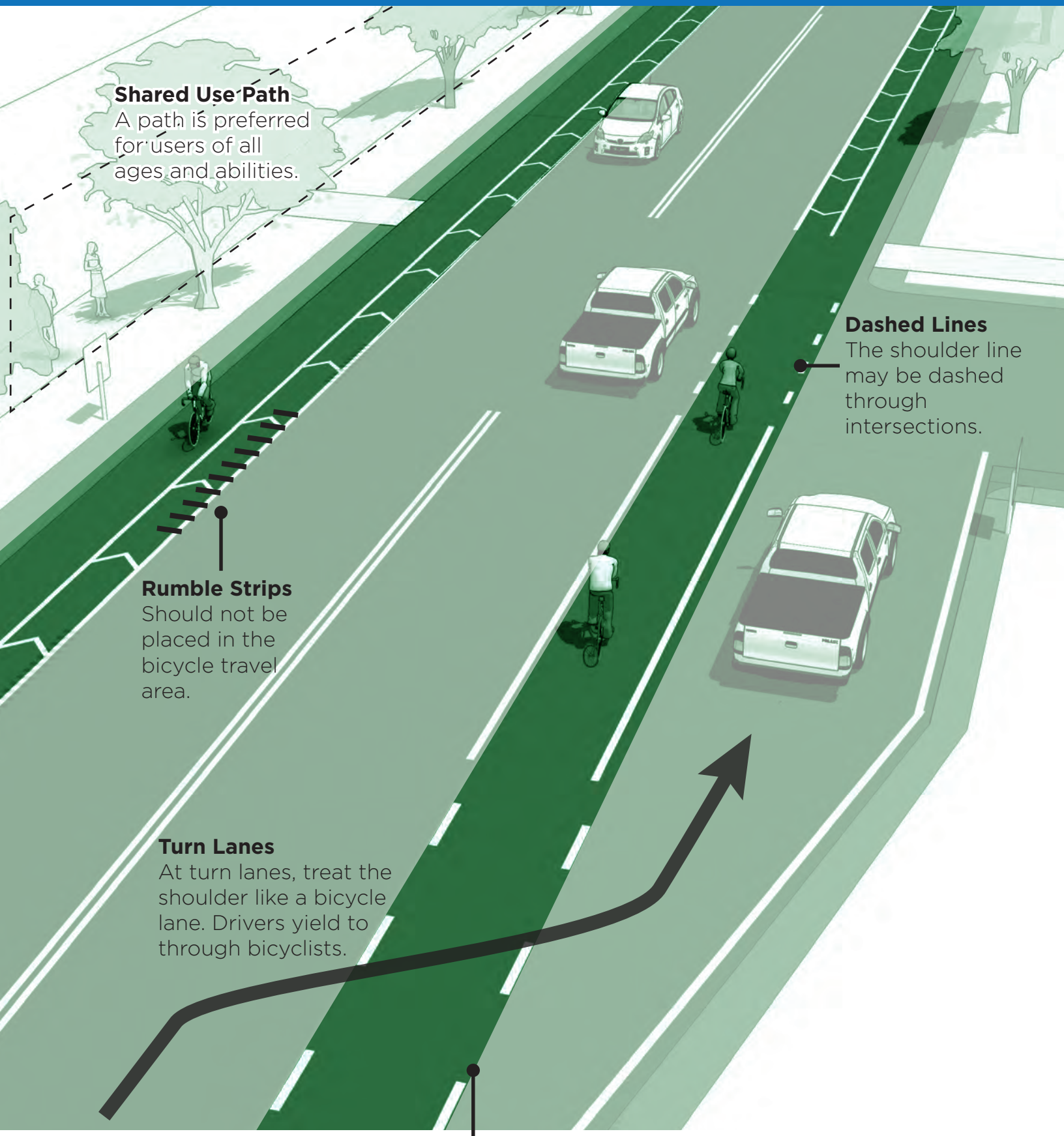
Alternative Designs

On less urban streets, the preferred bikeway design is a shared use path separated from the street. Only a separated facility can provide the comfortable low-stress experience needed to appeal to all users.

Key References



Design of Shoulders to Accommodate Bicyclists



BICYCLING ON TRAILS

On busier streets, a trail or path adjacent to the street can serve users of all ages and abilities when an on-street bike lane or shoulder would not be comfortable enough. (Mineta 2011)

A trail allows for two-way, off-street bicycle use and also may be used by pedestrians, including skaters, people using wheelchairs and other non-motorized users. These facilities are frequently found in parks, along rivers and beaches and in utility corridors where there are few conflicts with motorized vehicles.

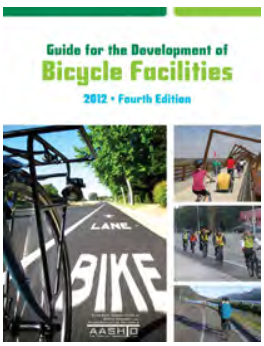
Design for Low Stress Shared Use Paths

- This design is appropriate for **multi-lane collector or arterial streets.** Trails can be built outside of street right-of-way, for example through a park or open space.
- On very wide streets (4 lanes or wider) with destinations on both sides of the street, consider providing a trail on both sides of the street. This will minimize out of direction travel and help bicyclists reach their destination in a more direct and convenient route.
- Trails work best for bicycling where there is a limited number of at-grade crossings with streets or driveways. **(AASHTO 2013)**
- Where possible, the path should delineate a separate bicycle and pedestrian area with markings or construction materials. This is particularly important at areas where heavy use is expected.
- It is important to provide adequate room for bicyclists waiting to turn off of the path at midblock and intersection locations.

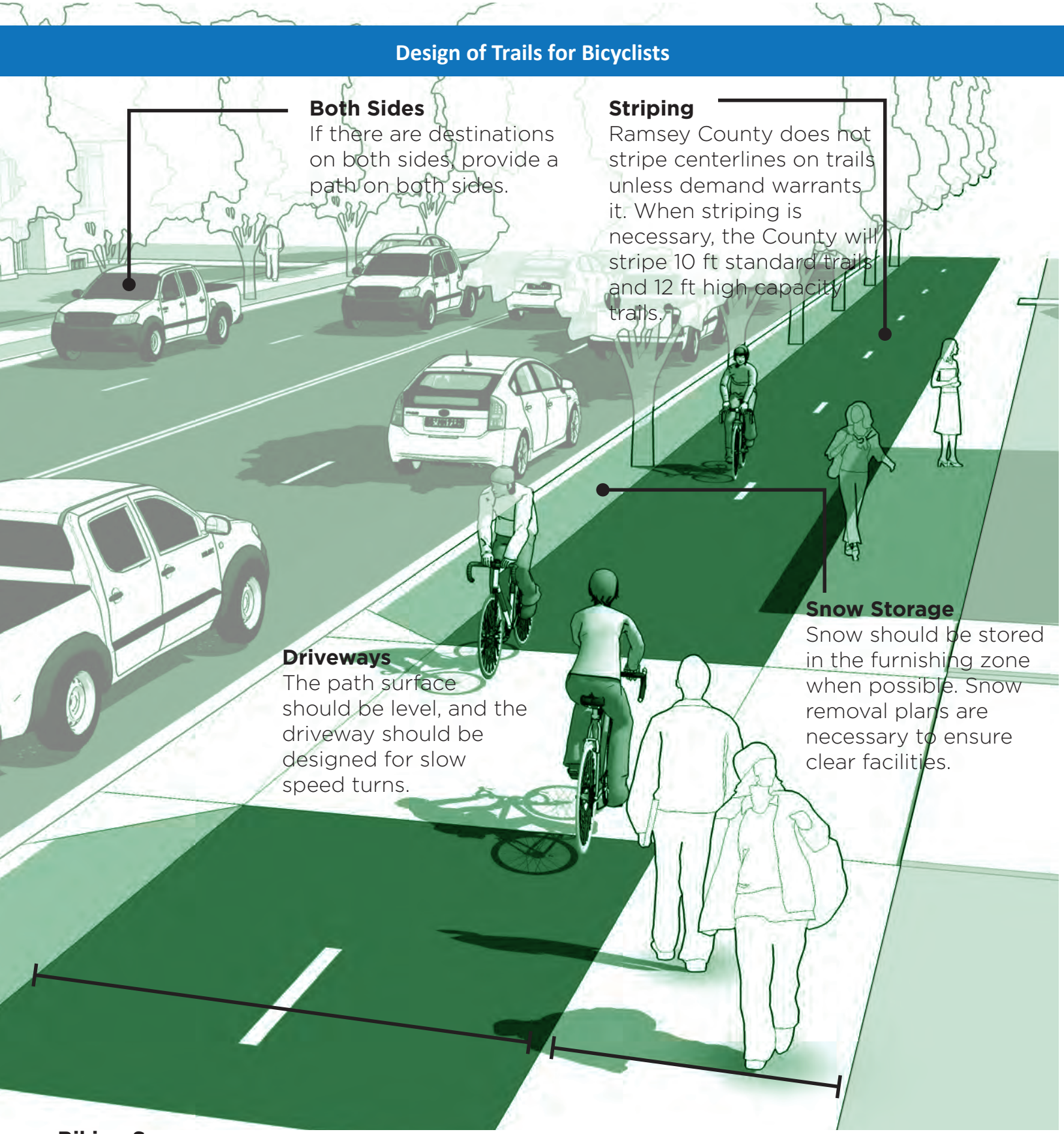
AT INTERSECTIONS

At intersections and crossing of streets, a high quality safe crossing is important to maximize use of the path. Signals, beacons and safety islands should be used to reduce exposure and mitigate risk. **(Mineta 2011)**

Key References



Design of Trails for Bicyclists



Both Sides
If there are destinations on both sides, provide a path on both sides.

Striping
Ramsey County does not stripe centerlines on trails unless demand warrants it. When striping is necessary, the County will stripe 10 ft standard trails and 12 ft high capacity trails.

Snow Storage
Snow should be stored in the furnishing zone when possible. Snow removal plans are necessary to ensure clear facilities.

Driveways
The path surface should be level, and the driveway should be designed for slow speed turns.

Biking Space
Where demand is high, separate space for bicyclists and pedestrians provides the most comfort. A two-way path should be 10-12 ft wide (minimum), with an additional 2 ft buffer on each side. (MnDOT)

Walking Space
A painted line may separate a walking space, but differing materials work best, if high volumes are present.

BICYCLING IN PHYSICALLY SEPARATED BIKE LANES

On busy streets dominated by motor vehicles, a regular bike lane is not enough to provide a comfortable experience for users of all ages and abilities. Physically separated bike lanes provide a space dedicated for bicyclists, separated from motor vehicles by a vertical element and not shared with pedestrians.

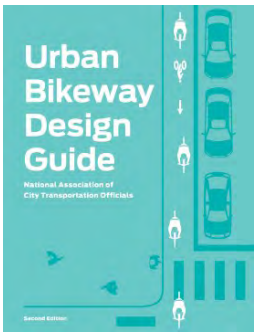
Common separating elements include curbs, flexible posts, bollards, planters or parked cars.

On truly busy streets with multiple lanes of traffic, only physical separation can create an experience desired by the everyday casual bicyclist.

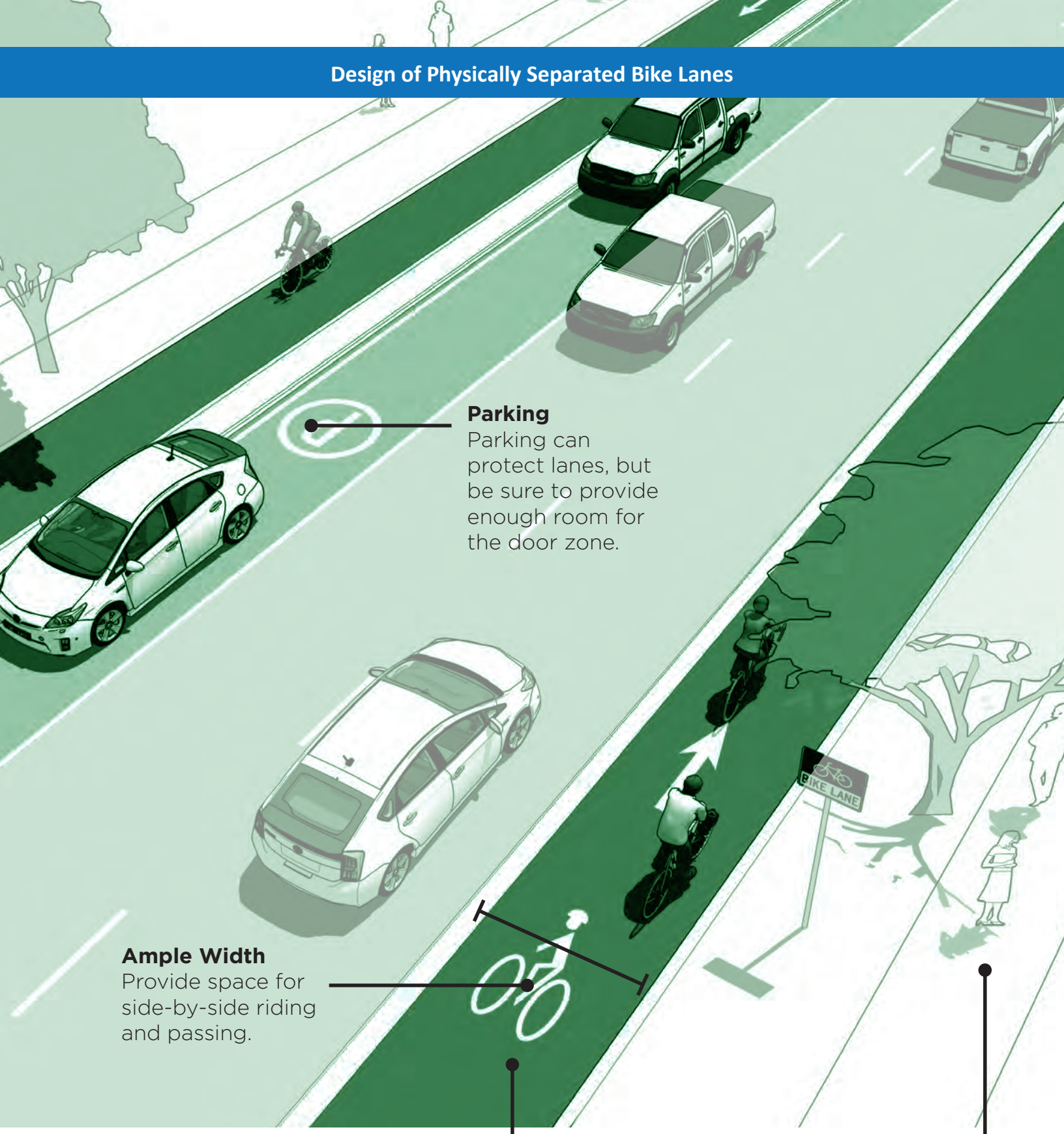
Design for Low Stress Separated Bike Lanes

- Appropriate on streets with multiple travel lanes in each direction. **(Mineta 2011)** This design is appropriate for **multi-lane collector or arterial streets.**
- A one-way physically separated bike lane should be 7 ft wide (exclusive of the physical separation) to allow for bicyclists to ride side-by-side and pass slower bicyclists. **(FHWA 2015)**
- Two-way physically separated bike lanes should be at least 10 ft wide. **(NACTO 2012)**
- A variety of buffer methods and materials exist to separate bicyclists from adjacent traffic, including bollards, planters and parked cars. Separation can be as narrow as 1.5 ft wide or 3 ft when adjacent to parked cars. **(NACTO 2012)**

Key References



Design of Physically Separated Bike Lanes



Parking
Parking can protect lanes, but be sure to provide enough room for the door zone.

Ample Width
Provide space for side-by-side riding and passing.

Snow Storage
Consider the needs of snow removal vehicles when designing separated bike lanes. Adequate width and access points are necessary for easy snow removal.

Separate Pedestrian Space
This is not a shared use space.

BICYCLING THROUGH INTERSECTIONS

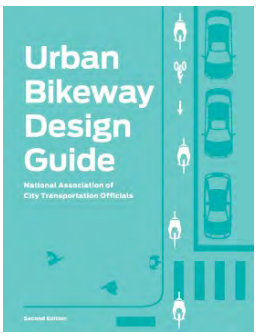
The configuration of a safe intersection for bicyclists may include elements such as color, signage, medians, signal detection and pavement markings. Intersection design should take into consideration existing and anticipated bicyclist, pedestrian and motorist movements.

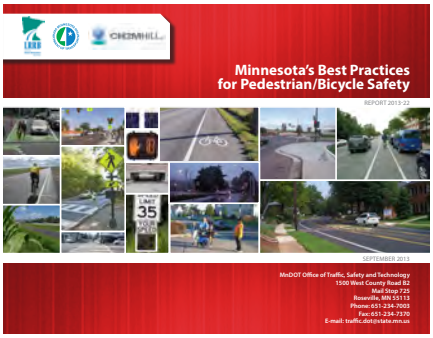
Designs for intersections with bicycle facilities should reduce conflict between bicyclists (and other vulnerable street users) and vehicles by heightening the level of visibility, denoting clear right-of-way and facilitating eye contact and awareness with other users.

Design for Low Stress Bicycle Intersections

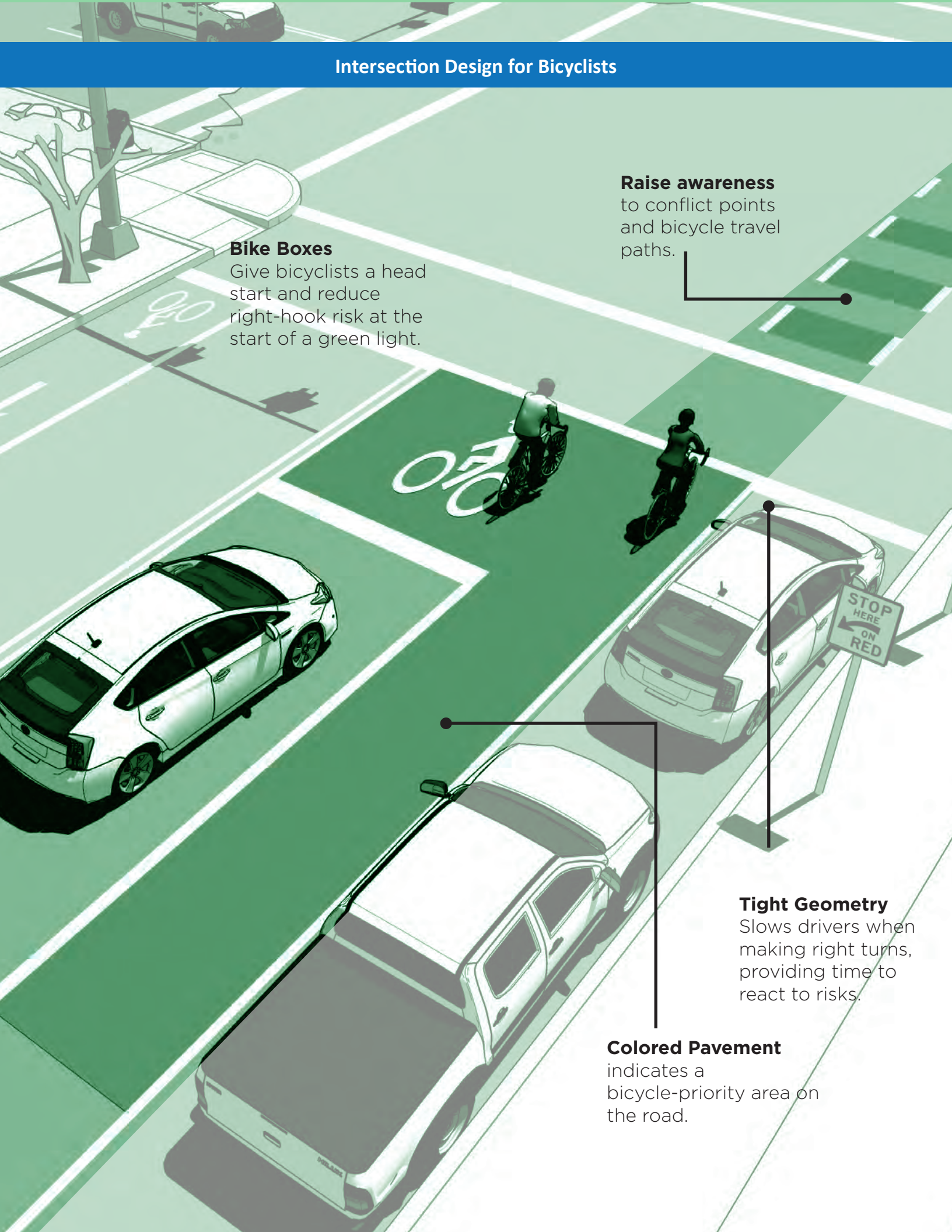
- In mixed traffic, crossings should respond to bicyclists needs for signal detection and activation. Crossings of major streets may be paired with access management to allow bicyclists to cross the street at locations where motor vehicle crossings are prohibited. **(NACTO 2012)**
- For on-street bicycle lanes, minimize the sharing or weaving of motor vehicles and bicyclists. This is particularly true on high-speed streets. **(Mineta 2011)**
- The design of physically separated bicycle lanes at intersections should minimize turning conflicts. Slow-speed geometric design should force slow speed turns, and/or bicycle signals and protected signal phasing should be used to prevent conflicts. **(Mineta 2011)**
- The application of bike boxes should be considered with extreme caution on high volume roads or on roads with a high percentage of truck traffic.

Key References





Intersection Design for Bicyclists



Bike Boxes
Give bicyclists a head start and reduce right-hook risk at the start of a green light.

Raise awareness
to conflict points and bicycle travel paths.

Tight Geometry
Slows drivers when making right turns, providing time to react to risks.

Colored Pavement
indicates a bicycle-priority area on the road.

BICYCLING THROUGH ROUNDABOUTS

Compact single lane roundabouts offer safety and comfort improvements for bicyclists and pedestrians. High-speed designs, or designs with multiple lanes, will degrade the experience over conventional intersection designs and will act as a barrier to walking and biking unless additional measures are used to mitigate the negative impacts.[1] Good design is particularly beneficial for pedestrians with vision disabilities.

Roundabouts may offer a safer, more efficient and more affordable alternative to a fully signalized intersection, but only if they are designed properly for bicyclists and pedestrians.

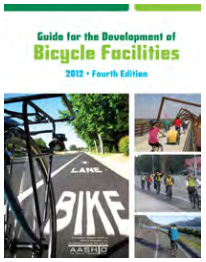
Design for Low Stress Bicycle Roundabouts

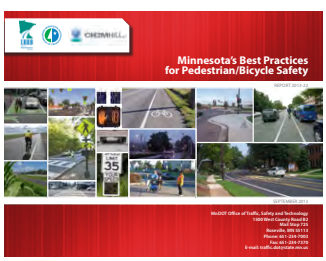
Roundabout designs should focus on reducing exposure and increasing yielding of motorists to bicyclists and pedestrians in the crosswalk.

- Only single-lane roundabouts can be designed in a pedestrian and bicycle friendly fashion.
- Multi-lane roundabouts should allow for bicycle accommodation and circulation following **AASHTO** standards, but will not be appropriate for use by bicyclists of all ages and abilities.
- Roundabouts should be designed for circulating at bicycle-compatible speeds of 15-20 mph.
- All roundabouts should offer an opportunity for bicyclists to exit the street and circulate on the sidewalk. In this situation, the sidewalk should be designed as a shared use path, wide enough to support multiple users and types.
- If a roundabout is operating at speeds 25 mph or higher, crossing enhancements such as raised crosswalks and Rectangular Rapid Flashing Beacons should be used to improve yielding compliance for pedestrians and bicyclists in the crosswalk. **(NCHRP 2011)**

1 NCHRP 674: Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities. TRB. 2011.

Key References





MULTI-LANE ROUNDABOUTS

National guidance on roundabouts stresses the importance of not overbuilding roundabouts:

"… it is important not to select a multi-lane roundabout over a single-lane roundabout in the short-term, even when long-term … traffic predictions suggest that a multi-lane roundabout may be desirable." **(NCHRP 2010)**

If a multi-lane roundabout is considered necessary, explore crossing enhancements, or grade separation in the form of a tunnel to provide safe navigation by bicyclists and pedestrians.

Roundabout Design

Enhanced Crossings
If yielding compliance is low, enhance the crosswalks with rapid flashing beacons or raised crossings.

Straight Crossings
Are easiest for pedestrians with vision disabiltiies.

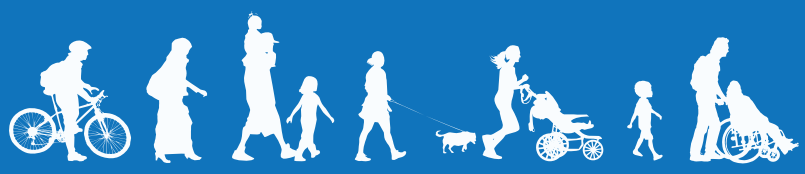
Single-Lane Roundabouts
Single-lane designs are best for pedestrians and bicyclists.

Slow Speed Geometry
Curves should enforce a slow speed limit of 15 mph.

Shared Use Path
Sidewalks should be wide enough for pedestrians and bicyclists.

Bike Lane Ends
A bike lane should not be continued through the roundabout. Bicyclists should be allowed to either ride in the travel lane, or mount onto a widened sidewalk.

Supporting Local Policies and Plans

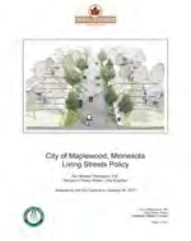


ACTIVE TRANSPORTATION PLANS IN RAMSEY COUNTY

Communities throughout Ramsey County are adopting Living Streets (or other context sensitive design) policies to govern how they construct, prioritize and retrofit their transportation network. These efforts are supported at the statewide level through the MnDOT Complete Streets Policy and Technical Memorandum, found here: http://www.dot.state.mn.us/planning/completestreets/policy.html

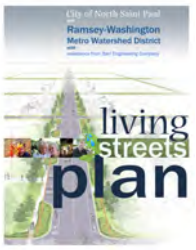
A common thread of these plans is that streets can work for users of all ages and abilities. This goal can be met by developing high-quality facilities for all transportation modes. The designs shown in the previous pages are compatible with a **vision of all ages and abilities mobility**. This vision is supported by the plans and policies noted below:

"[Living Streets] improve public health by offering easy opportunities for walking and bicycling; living streets encourage a healthy life-style **for people of all ages, especially the elderly.***"* - Maplewood Living Streets Plan



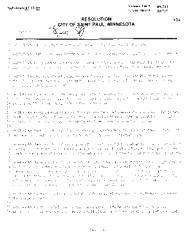
"Connect neighborhoods and daily destinations with a comfortable, safe walking and biking **network for people of all ages and abilities***."*

- A design principle for the North Saint Paul Living Streets Policy



"The public right of way must account for the safety and convenience of the **most vulnerable populations, including children, seniors, persons with disabilities,** *and those who cannot or do not drive a motor vehicle."*

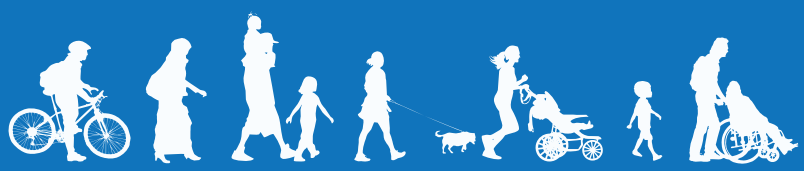
-Saint Paul Complete Streets City Council Resolution



"We are asking our streets to be safe and attractive places for **people of all ages to walk and bike***."* -Mayors Introduction to the Saint Paul Design Manual

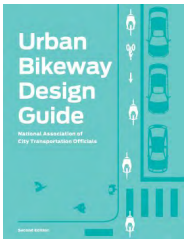
"A variety of transit and transportation options are accessible and safe for users of all abilities and incomes." - Ramsey County Critical Success Indicator

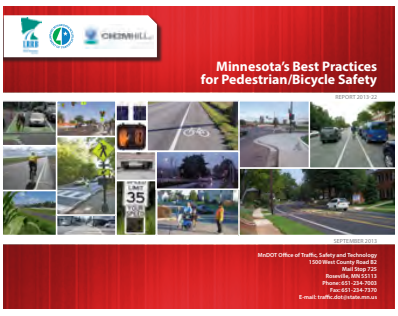
References, Research, and Design Resources



REFERENCES

The following guidelines contain more detailed guidance on implementing individual treatments. In all cases, engineering judgement is recommended to ensure that the application makes sense for the context of each treatment, given the many complexities of streets.





Primary Guidance

The American Association of State Highway and Transportation Officials **(AASHTO) A Policy on Geometric Design of Highways and Streets (2011)** commonly referred to as the "Green Book," contains the current design research and practices for highway and street geometric design.

Based on Federal guidance, Minnesota's **Manual on Uniform Traffic Control Devices (MUTCD) (2015)** defines the standards used by street managers to install and maintain traffic control devices on all public streets, highways, bikeways, and private streets open to public traffic.

The **AASHTO Guide for the Development of Bicycle Facilities (2013)**, provides guidance on dimensions, use and layout of conventional bicycle facilities. Contemporary bicycle facility design is presented in detail in the National Association of City Transportation Officials **(NACTO) Urban Bikeway Design Guide (2012),** and in the **FHWA Separated Bike Lane Planning and Design Guide (2015).**

Pedestrian design is covered in detail in the **AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities (2004)**, as well as the **ITE Designing Walkable Urban Thoroughfares and Context Sensitive Approach**, and is covered holistically in the **NACTO Urban Street Design Guide (2014)**.

Meeting the requirements of the Americans with Disabilities Act (ADA) is an important part of any bicycle and pedestrian facility project. The United States Access Board's proposed **Public Rights-of-Way Accessibility Guidelines (PROWAG)** and the **USDOJ 2010 ADA Standards for Accessible Design (2010 Standards)** contain standards and guidance for the construction of accessible facilities. This includes requirements for sidewalk curb ramps, slope requirements and pedestrian railings along stairs.

In Minnesota, MnDOT is responsible for the prevailing design guidelines in local jurisdictions. Their 2013 report, **Minnesota's Best Practice for Pedestrian/Bicycle Safety,** summarizes the state of the practice in MnDOT accepted safety treatments.

FULL REFERENCE LIST

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