CHAPTER 3: PLAN FRAMEWORK

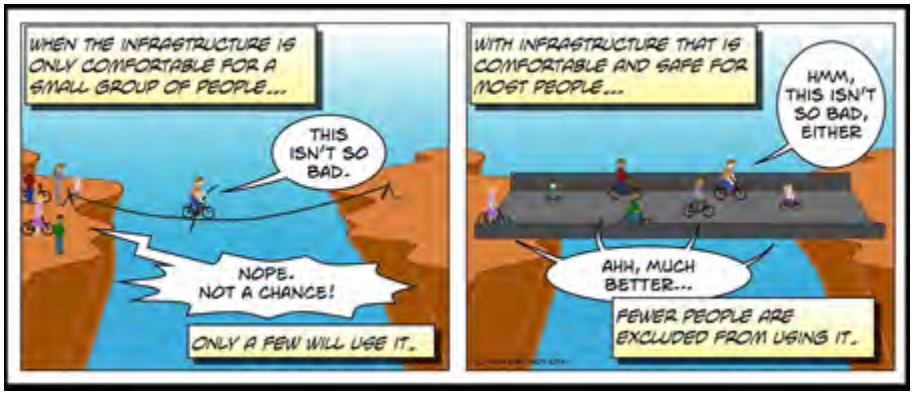
Guiding Principles for Bicycle Facility Planning and Design

The fundamental goal of this plan is to create an environment where anyone able to bike can safely and comfortably bicycle as part of their everyday routines, regardless of their age or their skill level at riding a bicycle. The majority of people will not bicycle if they view a route as unsafe, uncomfortable or out of their way. As such, jurisdictions developing new bikeways should strive to design "all ages and abilities" infrastructure.

This chapter first describes this and other guiding principles used to create the bike network routes shown in Chapter 4 and on the Bike Plan Map. The second part of this chapter provides information pertaining to selection and design of various facility types (separated path, bike lane, bike boulevard, etc.).

This plan builds on previous planning efforts both completed by the MIC as well as surrounding jurisdictions and partner agencies and organizations. The level of detail into which each of these plans gives recommendations regarding the bicycle network varies greatly. In addition, a number of other bikeway planning efforts have informed this plan, including the Connecting Duluth Report, the Downtown Duluth Bikeways Audit & Survey and the Michigan Street Protected Bikeway Demonstration Project.

Innovation in design of urban bicycle infrastructure is transforming urban streets and rapidly expanding bikeway infrastructure in cities across the United States. As new designs are being tried, new resources for urban bikeway design are also becoming widely available, particularly the NACTO guides, MnDOT's Bicycle Facility Design Manual and supportive approaches and recommendations in the Vision Zero and Safe Systems approach.



Design matters when building a bicycle network for people of all ages & abilities.

Bicycle Network Planning Principles

All Ages & Abilities

A central component of this Plan is the focus on "all ages and abilities." What does this mean?

In the past, bike planning and in turn infrastructure focused on the existing cyclists on the roads, riding with traffic, usually an adult who is in great physical shape and in good health and is riding for commute to work purposes and/or long-distance recreational trips. This plan instead is focused on people of all ages and all abilities and their numerous transportation trips made as part of their everyday routines.

NACTO has provided a clear and concise definition for "All Ages & Abilities" that this Plan is using as its definition (see images).

Further, In the Duluth-Superior metropolitan area, e-bikes have expanded accessibility for some populations where physical limitations previously existed, due to the hilly terrain or other reasons. This expansion means that there are more people who can use a bicycle as transportation.

Source: NACTO Designing for All Ages & Abilities – December 2017

DESIGNING FOR ALL AGES & ABILITIES

Bikeway design must meet the needs of a diverse array of potential bike riders.[8] Across North America, however, many existing bike facility designs provide enough comfort for only the boldest people biking and exclude many who might otherwise ride.

An **All Ages & Abilities** (AA&A) bikeway is one that feels comfortable and provides safety for all current and potential users. AA&A is inclusive of age, ability, type of bike or mobility device, socioeconomic status, race, gender, or any other identity and experience a person may hold. For many people, feeling safe and comfortable goes beyond just physical protection from motor vehicles. High-quality AA&A bikeways can create a sense of safety by helping people feel as though they belong, are safe from potentially dangerous interactions with police officers, and are welcome to use a variety of adaptive bikes and mobility devices.

AA&A bikeways are safe and comfortable for people:

Of all ages, sizes, and physical abilities. On an AA&A bikeway, grandparents and grandkids can ride bikes together. These designs support children and older adults, who sometimes have lower visual acuity and slower riding speeds, and people with disabilities who might use lower-profile or wider three-wheel adaptive bikes. Those with disabilities who are not using bikes or micromobility devices but need to cross or navigate around bikeways are also taken into account.

Of all races and ethnicities. Black and Latine people on bikes are more than four times as likely to be killed in a traffic crash than white people on bikes. Additionally, law enforcement officers issue a disproportionate number of traffic tickets to Black and Latine people on bikes for actions such as biking on the sidewalk. High-quality bike infrastructure makes streets safer and reduces police interactions. Research from Chicago found that major streets with bike lanes had half the number of tickets compared to similar streets without bike lanes.

Of all incomes. Low-income bicyclists make up half of all Census-reported commuter bicyclists, relying extensively on bicycles for basic transportation needs such as getting to work. Research shows that unhoused people are given a disproportionate number of bike tickets in some jurisdictions, including for minor issues such as riding helmetless. Basic infrastructure is often deficient in low-income neighborhoods, creating real safety issues for those who bike there.

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2.1 | IMAGINING A FUTURE BIKE NETW

Of all experience levels and despite past experiences. Bikeways need to be welcoming to people who have little experience biking on urban streets and those who have had previous negative experiences while riding a bike or other micromobility device. AA&A bikeways enable people to feel confident biking–and learn to feel comfortable biking on a wider variety of urban streets.

Of all gender identities and sexual orientations. In most North American cities, people who bike are predominantly male. Surveys reveal that women in particular cite safety and lack of bike infrastructure as core reasons why they choose not to bike. Women and LBGTQ+ people also report regular harassment while biking. High-quality facilities on urban streets create a sense of safety by being well-lit and highly visible to passersby. AA&A bikeways feel safe and welcoming for people of a diversity of gender expressions and experiences.

Working in a variety of industries. Often paid per delivery, workers who deliver on bikes need bike lanes that accommodate faster speeds and a wider range of devices, including e-bikes and cargo bikes. AA&A bikeways are suitably wide and feature intersection designs that enable these workers to get around at pace. People who work using bikes also benefit from infrastructure that limits interactions with police, as every interaction risks time and money lost from a day's work.

Using all types of bikes and micromobility devices. AA&A bikeways are designed for people moving goods or cargo, whose bikes are often wider and longer; caregivers with children on their bikes, who are extra concerned with safety and may require frequent stops; people riding electric scooters or electric bikes, who move faster than many other people on bikes; and people riding adaptive bikes and adult tricycles, whose bikes are larger and slower than other bike facility users.

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Source: NACTO Urban Bikeway Design Guide, third ed, pages 20-21

Everyday Routine

People traveling for their everyday routine activities—daily trips including commute to work, school, grocery store, shopping, visiting family or friends, etc.

Shorter Distances

People traveling shorter distances—focus on trips less than 3 miles. The distance that most people will shift modes from a bicycle to a motor vehicle is for distances greater than 3 miles. In addition, the majority of all trips people make, regardless of mode, is less than 3 miles in distance each way.

Plan Framework – Focus on 3 Principles

All Ages & Abilities

Everyday Routine

Short Trips

Bikeways Route Planning

Route selection is critical. Bikeways will under-perform or not serve the latent demand for bicycling at all when routing is illogical, requires frequent or unnecessary stopping, or requires shared lane usage on roadways with high traffic speeds and volumes without physical separation which makes the more vulnerable road user (the bicyclist) feel uncomfortable and/or unsafe.

Decision-Making Criteria

As part of designating a system of preferred routes, new projects should consider the following criteria:

1. Low-stress bikeway network facilities – continuous and direct route.
2. Designed with the end user in mind, i.e., people who ride bicycles from Point A to Point B for transportation, not just for recreation.
3. Trips – design for people making a variety of trips including short-trips (*see: Short Trips Generators Map(s)*) while also providing connectivity between for cyclists making longer trips.

4. Slope – avoid steep grades
    a. Any roadway or path with a grade greater than 8% must be avoided (not reasonable).
    b. Any roadway or path with a grade between 5-8% can be a bikeway for only 1 consecutive block if no other option is available.

5. Public Health - designed for people to conduct their activities via bicycle as part of their everyday routine.

6. All ages and all abilities network – building a system that the largest number of people can use, not just the confident road cyclists. This will also unlock "latent demand."

7. Direct access to destinations --
    a. Public schools.
    b. Public transit centers and stations.
    c. Civic & Community Institution (town hall, city hall, county courthouse)– places where public decisions are made i.e. places where public meetings are held.
    d. Food Distribution– places where people purchase or pick up food.
    e. Commercial destination centers
    f. Medical Facilities – hospitals, doctor's office, pharmacy.
    g. Recreational places – parks and trails.
    h. Desire line for bicyclists – closely follow a desire line for bicycle travel.

8. An understanding of which agency or municipality is responsible for maintenance and snow-clearing for any proposed bike facility. Ensure clear expectations for facility maintenance. That said, jurisdictions should guard against lack of current winter maintenance funding or equipment being the only factor that limits the ability to construct new bicycle facilities.

Following these criteria will help create a network that increases ridership. To do so, jurisdictions may find that they need to overcome the most frequent criticism about bicycle infrastructure.

Arguably, the most frequent criticism heard about bicycle infrastructure, regardless of location, is that "no one uses it". This concern over bicycle infrastructure, including installing facilities on the street as well as practical and usable bike parking, may be a factor in limiting the infrastructure projects that are put into place.

Even if the infrastructure is put into place, the question arises whether or not this infrastructure really only serves a small number of people; and is that benefit worth the costs?

Of course, other value judgments are made here as well, maintaining the paradigm of car ownership as a primary means of transportation, and its corollary, that the built environment should continue to focus on making it easier and more convenient to drive a car, at the expense of the other modes.

Additionally, this area's climate and hilly terrain further push bicycling to the margins of the area's transportation system.

Despite these challenges, bicycling can be a viable transportation mode in the Twin Ports, as long as the bike routes center **all ages and abilities**, **everyday routine**, and **short trips**, following the criteria listed above.

Bikeway Facility Types

This section provides an overview of bikeway facility options. See MnDOT's Bicycle Facility Design Manual, Chapter 5 Bicycle Facilities, for more detailed facility descriptions and guidance.

Bike Lanes

Conventional Bike Lanes

The bike lane is located adjacent to motor vehicle travel lanes and flows in the same direction as motor vehicle traffic. Bike lanes are typically on the right side of the street, between the adjacent travel lane and curb, road edge, or parking lane. This facility type may be located on the left side when installed on one-way streets, or may be buffered if space permits. An example of this is 4th St in Duluth, east of 6th Ave East.

Buffered Bike Lanes

Buffered bike lanes are conventional bicycle lanes paired with a designated buffer space separating the bicycle lane from the adjacent motor vehicle travel lane and/or parking lane. An example of this is E 3rd St in Duluth.

Contra-Flow Bike Lanes

Contra-flow bicycle lanes are bicycle lanes designed to allow bicyclists to ride in the opposite direction of motor

vehicle traffic. They convert a one-way traffic street into a two-way street: one direction for motor vehicles and bikes, and the other for bikes only. Contra-flow lanes are separated with yellow center lane striping at minimum, but should be physically separated. Combining both directions of bicycle travel on one side of the street to accommodate contra-flow movement results in a two-way cycle track.

Left-Side Bike Lanes

Left-side bike lanes are conventional bike lanes placed on the left side of one-way streets or two-way median divided streets.

Paved Shoulders

Paved shoulders used as bike lanes are wide enough for bikes to use, however because their primary purpose is not a bicycle lane, they may be blocked at times. This is not an ideal bike facility, due to the fact that it is not consistently reliable. 6th Avenue East will have a wide paved shoulder, following its resurfacing in the summer of 2025.

Protected Bike Lanes (also called Separated Bike Lanes or Cycle Tracks)

One-Way Protected Bike Lane

One-way protected cycle tracks are bikeways that are at street level and use a variety of methods for physical protection from passing traffic. A one-way protected cycle track may be combined with a parking lane or other barrier between the cycle track and the motor vehicle travel lane.

Raised Protected Bike Lane

Raised cycle tracks are bicycle facilities that are vertically separated from motor vehicle traffic. Many are paired with a furnishing zone between the cycle track and motor vehicle travel lane and/or pedestrian area. A raised cycle track may allow for one-way or two-way travel by bicyclists. The new design of W. Superior St will have a raised, protected bike lane.

Two-Way Protected Bike Lane

Two-way cycle tracks (also known as protected bike lanes, separated bikeways, and on-street bike paths) are physically separated cycle tracks that allow bicycle movement in both directions on one side of the road. Two-way cycle tracks share some of the same design

characteristics as one-way tracks, but may require additional considerations at driveway and side-street crossings. An example of this is the bike lane that was on W. Superior St.

Which facilities make riders feel safer?

Shared-Use Path/Side Path, Separated Lane: 51-56%

Buffered Bike Lane/Bike Lane: 5-9%

Shoulder/Shared Lane: 4-7%

NHSTA/USDOT

Public input on this plan and specific road improvement projects in the MIC area also indicates a preference for separated bike facilities, with many residents saying "I am not comfortable biking on a busy road" or "I am not comfortable letting my kids bike on a busy road."

Bicycle Boulevards (also called Neighborhood Greenways)

These are facilities that are to be implemented on low-volume, low-speed streets (typically residential streets), that are parallel to higher-volume roadways. The main objective of bike boulevards is traffic calming through design and an easy flow-through for cyclists. These would include implements such as bike sharrow on-street markings, wayfinding signage, and volume control (e.g., right-turn diverters at intersections for motor vehicles, which still permit through-travel for smaller vehicles such as bicycles, such as removable planters or other landscape implements).

Route Selection

Route selection for all bicycle facilities is critical. Specifically, Bicycle Boulevards will not work if they are routed in illogical ways, if they require frequent or unnecessary stopping, or if they follow higher traffic speed and volume roadways. Bicycle Boulevards/Neighborhood Greenways have the potential to play a key role in a low-stress bikeway network, as they can complement and provide strategic connections between off-street paths and conventional bike lanes.

Support Facilities for Bike Boulevards

- **Signs and Pavement Markings**
  Signs and pavement markings create the basic elements of a bicycle boulevard, and are easy to find and to follow. They indicate that a roadway is intended as a shared, slow street, and reinforce the intention of priority for bicyclists along a given route. Signs and pavement markings alone do not create a safe and effective bicycle boulevard, but act as reinforcements to other traffic calming and operational changes made to the roadway.

  Paint: Inexpensive, effective, can be used as a less-than-permanent solution and precursor to more permanent changes in road design and layout, should it be successful.

  Conflict Zones/Shared Space: Green paint to identify a conflict zone or shared use space.

- **Speed Management**
  Speed Management measures for bicycle boulevards slow motor vehicle speeds, bringing motor vehicle speeds closer to those of bicyclists. Reducing speeds along the bicycle boulevard improves the bicycling environment by reducing overtaking events, enhancing drivers' ability to see and react, and diminishing the severity of crashes if they occur. Speed management is critical to creating a comfortable and effective bicycle boulevard.

- **Volume Management**
  Volume Management measures reduce or discourage through traffic on designated bicycle boulevard corridors by physically or operationally reconfiguring select corridors and intersections along the route. The effect is to lower or reduce motor vehicle volumes. On roadways with shared travel lanes such as bicycle boulevards, motor vehicle traffic volumes significantly impact bicyclist comfort. Higher vehicle volumes decrease comfort and may lead to a greater potential for conflicts, as well as a loss of perceived safety.

- **Minor Street Crossings**
  Minor Street Crossings for bicycle boulevards are intended to minimize bicyclist delay and typically involve the intersection of two residential or local streets with low motor vehicle volumes and speeds. At intersections with local streets and minor collectors, bicycle boulevards should have right-of-way priority and reduce or minimize delay by limiting the number of stop signs along the route. Stretches of at least a half mile or more of continuous travel without stop sign control are desirable.

- **Major Street Crossings**
  Major street crossings may pose a significant barrier to the effectiveness and quality of a bicycle boulevard. Safe and convenient crossing treatments of high quality should be selected to mitigate these barriers.

- **Offset Intersections**
  Offset Intersections are junctions at which two streets in a designated bicycle boulevard corridor align asymmetrically with an intersecting roadway. They are intended to provide clear and safe navigation through the intersection. Since bicycle boulevards typically utilize local streets, bicyclists are likely to encounter discontinuities in the street grid that require them to turn briefly onto another street before resuming their original direction. Offset intersection treatments are categorized into treatments for major street crossings and treatments for minor street crossings.

- **Green Infrastructure**
  Making the inclusion of trees and native plantings part of roadway projects that include bike infrastructure enhance the environment and are helpful to bicyclists and the neighborhoods and streets that they bike through, writ large.

  Incorporating green infrastructure into transit street design can improve water quality, detain stormwater flows, reduce the volume of stormwater runoff, and relieve burden on municipal water treatment systems.

Other Bicycle Facilities

Separated Path

A separated path is a two-way paved micromobility facilities that are separated, both in terms of grade and lateral physical separation, from their parallel roadways to ensure safety for *All ages and Abilities*, that are also ADA accessible, meaning that there is clear space for mobility devices to pass each other, either traveling in the same direction, or in opposite directions. The width of the facility may need to increase based on projected volumes and types of non-motorized traffic.

Recreational Trail

While not all ages and abilities bike connections are officially part of the bicycle map, it is important to acknowledge that individuals may choose to use the area's recreational bike trails for transportation. Those who are capable of biking these trails to get to their destinations should be encouraged to do so and these trails should have clear way-finding and safe crossings with streets to facilitate safe integration of

these recreational trails with the bike network. The Duluth-Superior metropolitan area has plenty of recreation folks, both locals and tourists, who use bicycling as a form of recreation, and acknowledging that our green trails are natural transportation corridors is crucial to increasing bicycling among this major group.

Intersections

Bike Boxes

A bike box is a designated area at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get ahead of queuing traffic during the red signal phase.

Intersection Crossing Markings

Intersection crossing markings indicate the intended path of bicyclists. They guide bicyclists on a safe and direct path through intersections, including driveways and ramps. They provide a clear boundary between the paths of through bicyclists and either through or crossing motor vehicles in the adjacent lane.

Two-Stage Turn Queue Boxes

Two-stage turn queue boxes offer bicyclists a safe way to make left turns at multi-lane signalized intersections from a right-side cycle track or bike lane, or right turns from a left side cycle track or bike lane. Two-stage turn queue boxes may also be used at unsignalized intersections to simplify turns from a bicycle lane or cycle track, as for example, onto a bicycle boulevard. At midblock crossing locations, a two-stage turn queue box may be used to orient bicyclists properly for safe crossings. Multiple positions are available for queuing boxes, depending on intersection configuration.

Median Refuge Island

Median refuge islands are protected spaces placed in the center of the street to facilitate bicycle and pedestrian crossings. Crossings of two-way streets are facilitated by allowing bicyclists and pedestrians to navigate only one direction of traffic at a time. Medians configured to protect cycle tracks can both facilitate crossings and also function as two-stage turn queue boxes.

Through Bike Lanes

For bicyclists traveling in a conventional bike lane or from a truncated cycle track, the approach to an intersection with vehicular turn lanes can present a significant challenge. For this reason, it is vital that bicyclists are provided with an opportunity to correctly position themselves to avoid conflicts with turning vehicles.

Combined Bike Lane/Turn Lane

A combined bike lane/turn lane places a suggested bike lane within the inside portion of a dedicated motor vehicle turn lane. Shared lane markings or conventional bicycle stencils with a dashed line can delineate the space for bicyclists and motorists within the shared lane or indicate the intended path for through bicyclists.

Cycle Track Intersection Approach

The approach to an intersection from a cycle track should be designed to reduce turn conflicts for bicyclists and/or to provide connections to intersecting bicycle facility types. This is typically achieved by removing the protected cycle track barrier or parking lane (or lowering a raised cycle track to street level) and shifting the bicycle lane to be closer to or shared with the adjacent motor vehicle lane.

Signals

Bicycle Signal Heads

A bicycle signal is an electrically powered traffic control device that should only be used in combination with an existing conventional traffic signal or hybrid beacon.

Signal Detection and Actuation

Bicycle detection is used at actuated signals to alert the signal controller of bicycle crossing demand on a particular approach. Bicycle detection occurs either through the use of push-buttons or by automated means (e.g., in-pavement loops, video, microwave, etc).

Active Warning Beacon for Bike Route at Unsignalized intersection

Active warning beacons are user-actuated amber flashing lights that supplement warning signs at unsignalized intersections or mid-block crosswalks. Beacons can be actuated either manually by a push-button or passively through detection.

Hybrid Beacon for Bike Route Crossing of Major Street

A Pedestrian Hybrid Beacon, also known as a High-intensity Activated Crosswalk (HAWK), consists of a signal-head with two red lenses over a single yellow lens on the major street, and pedestrian and/or bicycle signal heads for the minor street.

Signing and Marking

Colored Pavement

Colored pavement within a bicycle lane increases the visibility of the facility, identifies potential areas of conflict, and reinforces priority to bicyclists in conflict areas and in areas with pressure for illegal parking.

Shared Lane Markings

Shared Lane Markings (SLMs), or "sharrows," are road markings used to indicate a shared lane environment for bicycles and automobiles.

Bike Route Wayfinding

A bicycle wayfinding system consists of comprehensive signing and/or pavement markings to guide bicyclists to their destinations along preferred bicycle routes. This is especially important for populations without access to smartphones (including children), and for people not familiar with the areas of our region. Signs are typically placed at decision points along bicycle routes – typically at the intersection of two or more bikeways and at other key locations leading to and along bicycle routes. This could include but is not limited to destination signs with distance and/or time indicated, or routes and turns that are indicated either with signs or on-street markings (per MUTCD (Manual on Uniform Traffic Control Devices) and/or NACTO guidance).

Additional Features

Lighting

Pedestrian scale lighting for bikeways makes bikers more visible, enables bikers to notice surfaces irregularities, is key in areas with traffic or limited visibly, and increases the safety and comfort of bikers. The MnDOT Roadway Lighting Design Manual contains guidance on lighting.

Facility Transitions

Showers and bike rooms at work make bike commuting more feasible and comfortable.

Drainage

Grates in bike lanes should be bicycle compatible or have covers, to prevent those on bikes from catching their wheels in the gaps.

Maintenance

Year-round maintenance of the bicycle facility -including winter maintenance- is essential to maintaining the accessibility and safety of the bike route. During construction projects, bike detours should be planned in addition to motor vehicle detours.

Bike Parking

Bike parking that meets recommended standards is necessary along the bike routes and at key destinations. More information on ideal bike parking can be found in the Association of Pedestrian and Bicycle Professionals guide titled "Essentials of Bike Parking: Selecting and Installing Bike Parking that Works (2015)".

Bike Repair Stations

Bicycle repair stations, with pumps and possibly other elements, are key along bike routes. These can be done in partnership with local bike shops or community organizations, or simply available adjacent to bicycle parking.

Design Resources

MnDOT Bicycle Facility Design Manual (October 2024)

Contains applicable guidance that will be of extra value to the Duluth-Superior MIC in cementing its bicycle network.
www.dot.state.mn.us/bike/bicycle-facility-design-manual.html

NACTO Broad Urban Street Design Guide

Street Design Principles

Streets are public spaces and in an urban context, street design must meet the needs of people walking, driving, cycling, and taking transit, all in a constrained space. The best street design also adds to the value of businesses, offices, and schools located along the roadway.
https://nacto.org/publication/urban-street-design-guide/streets/street-design-principles/

Residential Shared Street

Low-volume residential streets, especially in older cities, often have narrow or crumbling sidewalks. Many of these streets operate as de facto shared spaces in which children play and people walk, sharing the roadway with drivers. Depending on their volume and role in the traffic network, these streets have the potential to be redesigned and enhanced as shared streets.
https://nacto.org/publication/urban-street-design-guide/streets/residential-shared-street/