Appendix D



Design Guidelines

The Ecusta Rail Trail will accommodate a wide range of users, including pedestrians, bicyclists, equestrians, and persons with mobility impairments, and it will pass through a number of different landscapes in Henderson County and Transylvania County. Trail character will vary in response to the landscape or built environment in which it is located.

There are a number of federal, state and local guidelines that apply to pedestrian and bicycle facilities. While these documents are not absolute standards, public agencies may require projects to meet the guidelines as a minimum condition for key dimensions, including slope, horizontal and vertical clearances, surface conditions, signage, and pavement markings.

This section presents trail design guidelines for typical facilities that may occur along the Ecusta Rail Trail, including:

- Paved Multi-use Trails and Bikeways
- Unique Trail Applications
- Accessible Trails
- Trails and Roadway Crossings
- Signs and Wayfinding
- Trail Amenities
- Drainage and Erosion Control

These design guidelines are based on applicable mandatory or advisory state and federal standards and are not engineering specifications. Design engineering should be conducted by licensed professionals and should meet all local design and construction standards.

Reference Materials

Reference materials used to support the design guideline recommendations include:

AASHTO Guidelines for the Development of Bicycle Facilities, 1999

This guide lists the bicycle design standards and protocols from State Highway Departments from all 50 states. The Guidelines address in further detail the varying types of bicyclists, space requirements for bicycles, and bicycle facilities. The AASHTO Guidelines (or "Green Book", as it is frequently called) is helpful source material for sample road configurations that accommodate on-street bike facilities. The AASHTO Guidelines for the Development of Bicycle Facilities is presently in the process of being updated, with a draft version currently available. The AASHTO Guide is available online at: safety.fhwa.dot.gov/ped_bike/docs/b_aashtobik.pdf.

Contents:

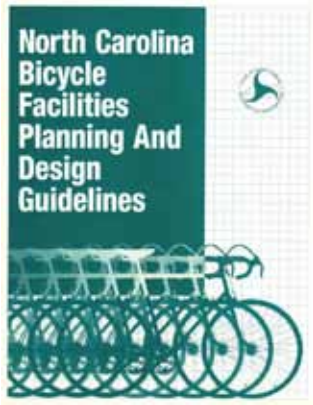
Manual of Uniform Traffic Control Devices (MUTCD), 2009

The MUTCD is a compilation of design guidelines and standards for traffic control devices, administered and overseen by the Federal Highway Administration of the United States Department of Transportation. The MUTCD is a compilation of national standards for all public roads, streets, and bikeways. Part 9 (Traffic Control for Bicycle Facilities) addresses some of the most fundamental components of a bicycle infrastructure network, including guidance on signage, shared lane markings ("sharrows"), bike lanes, shared-use paths, and detection devices. Part 9 is available online at: mutcd.fhwa.dot.gov/pdfs/2009/part9.pdf.

National Association of City Transportation Officials (NACTO) Cities for Cycling Urban Bikeway Design Guide, 2011

The purpose of the NACTO Urban Bikeway Design Guide (part of the Cities for Cycling initiative) is to provide cities with state-of-the-practice solutions that can help create complete streets that are safe and enjoyable for bicyclists. The NACTO Urban Bikeway Design Guide is based on the experience of the best cycling cities in the world. The designs in this document were developed by cities for cities, since unique urban streets require innovative solutions. Most of these treatments are not directly referenced in the current versions of the AASHTO Guidelines or the Manual of Uniform Traffic Control Devices (MUTCD), although many of the elements are found within these documents. The Federal Highway Administration has recently posted information regarding approval status of various bicycle-related treatments not covered in the MUTCD, including many of the treatments provided in the NACTO Urban Bikeway Design Guide. All of the NACTO Urban Bikeway Design Guide treatments are in use internationally and in many cities around the US. The NACTO Urban Bikeway Design Guide is available online at: http://nacto.org/cities-for-cycling/design-guide/

North Carolina Bicycle Facilities Planning and Design Guidelines, 1994



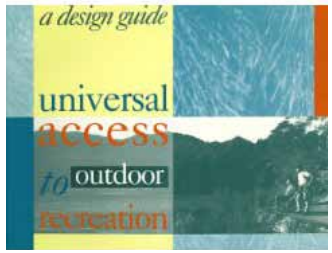
The North Carolina Department of Transportation, Division of Bicycle and Pedestrian Transportation provides guidelines regarding bicycle laws in North Carolina. The manual provides detailed planning and design considerations available for safe and effective bicycle facilities development, construction, and maintenance. It provides guidelines, contains information specific to North Carolina and includes many illustrations, photographs, engineering specifications and references to supplemental documentation. As a companion to the North Carolina Bicycle Facilities Planning and Design Guidelines, the Division of Bicycle and Pedestrian Transportation developed a 22-minute video in 1995 to explain critical aspects of well-designed bicycle accommodations. The viewer is able to see a number of operating characteristics of successful and unsuccessful facilities. The design guidelines and companion videocassette together provide an important technical resource for communities involved in the construction of bicycle facilities. Information regarding the manual and video can be found online at: http://www.ncdot.org/bikeped/projectdevelopment/design_guidelines/

Universal Design/ ADA Access

Good design for the Ecusta Rail Trail will ensure universal access for all. In addition, all greenway trails and other trails that receive funding from state or federal sources must conform to the Americans with Disabilities Act (ADA) guidelines. The Federal Highway Administration publishes a guidebook entitled *Designing Sidewalks and Trails for Access*. Chapter 5, (Trail Design for Access) is the most relevant portion of the report and is available online at: http://www.fhwa.dot.gov/environment/sidewalks/chap5a.htm

Another good resource is *Universal Access to Outdoor Recreation:A Design Guide*, which details the systems and elements needed to ensure universal access to recreation sites. The guide helps users determine the appropriate level of access for a range of outdoor sites.

Design Guideline Elements



These design guidelines address the following concepts relevant to the Ecusta Rail Trail:

Multi-use Trails

Paved, multi-use trails, for purposes of this study, include trails that meet or are proposed to meet the dimensional, geometric, and functional

standards set forth by NCDOT and AASHTO. It is anticipated that much of the Ecusta Rail Trail will be located within former railroad rights-of-way. These rails-to-trails projects take on design characteristics of multi-use trails.

Unique Trail Applications

This section will cover special trail design treatments that may be required to complete the trail connections, including trails in floodplains and along slopes.

Accessible Trail Design

Accessible trail design is important to both recreational and transportation trails, and the standards for accessibility are generally established by the United States Access Board, the U.S. Department of Transportation, and the Federal Highway Administration's Recreational Trails Program Guidance. The discussion included in this section introduces the basic concepts of accessible trail design, which provide for the needs of people with varied mobility requirements.

Crossings

The design of trail crossings of streets, roads, highways, and railroads must account for a variety of factors and always requires site specific traffic engineering and safety analysis. The framework presented here introduces the key variables that influence trail crossings.

Trail Signage

A comprehensive sign system increases user safety and comfort, and it helps make a trail system memorable. This section covers regulatory, etiquette, wayfinding and identity, informational and interpretive signage, and striping signs and markings.

Trailheads

Good access to a trail system is a key element for its success. Trailheads (formalized parking and access areas) serve the local and regional population arriving to the trail system by car, transit, bicycle, or other modes.

Trail Amenities

Trail support facilities - such as restrooms, seating, and lighting - should provide trail users with the accommodations they need and encourage use of the facilities.

Trail Safety and Security

Various design and programmatic measures can be taken to address safety issues on a multi-use trail.

Drainage and Erosion Control

Design of trails to maximize drainage, minimize erosion, and ensure long term sustainability is critically important to trail and resource managers. This section introduces basic drainage and erosion control concepts.

On-Road Bicycle and Pedestrian Facilities

When locating a trail within the railroad right-of-way is not feasible or desirable, a variety of on-road facilities can provide opportunities for bicycling and walking in the corridor and for providing connections to nearby destinations. Bicycle lanes, shared lane markings, bicycle boulevards, and striped shoulders serve a variety of commuter, utilitarian, and recreational trips.

Completed Rail-with-trail

Multi-use Trails

Multi-use trails (also referred to as "paths", "shared-use paths", or "greenways") are often viewed as recreational facilities, but they are also important corridors for utilitarian trips. Most portions of the Ecusta Rail Trail will be multi-use trails constructed within an abandoned railroad right-of-way ("rails-to-trails").

Multi-use trails can provide a desirable facility for novice riders and cyclists of all skill levels. Multi-use trails should generally provide new travel opportunities. Facilities may be constructed adjacent to roads, through parks, or along linear corridors, such as active or abandoned railroad lines or waterways.

Multi-use trails serve bicyclists, pedestrians, and equestrians and provide additional width beyond that of a standard sidewalk. Pedestrians and equestrians can share trails straightforwardly, as they both travel easily on unpaved surfaces and move at relatively slow speeds. However,

Multi-use trails (also referred to as "paths", "shared-use paths", or "greenways") are often viewed as recreational facilities, but they are also important corridors for utilitarian trips.

The Cedar Lake Regional Trail in Minneapolis, MN has sufficient width to accommodate a variety of users.

equestrians and bicyclists are not typically compatible on the same tread. For instance, quiet, fast-moving cyclist can startle a horse. Trail etiquette signage can help mitigate such conflicts.

Equestrians include youth, elders, leisure riders, professional riders, organized groups, novices, and people with disabilities. Riders may recreate individually or in groups for pleasure, exercise or challenge.

Multi-use trails that make up the Ecusta Rail Trail can be categorized as greenways, side paths, and connectors.

- A greenway is a facility that has an exclusive right of way.
- A side path is a two-way trail on one side of the road that is located within the road right-of-way.
- A connector is a shorter connection, usually between a residential area and a larger trail or park.

Basic design elements remain the same for all types of multi-use trails, although additional considerations should be noted for side paths. Elements that enhance multi-use trail design include:

- Providing frequent access points from the local road network; if access points are spaced too far apart, users will have to travel out of direction to enter or exit the trail, which will discourage use
- Placing directional signs to direct users to and from the trail
- Designing trails to allow heavy maintenance equipment to use the trail without causing it to deteriorate
- Limiting the number of at-grade crossings with streets or driveways
- Terminating the trail where it is easily accessible to and from the street system, preferably at a controlled intersection or at the beginning of a dead-end street; if poorly designed, the point where the trail joins the street system can put pedestrians and cyclists in a position where motor vehicle drivers do not expect them
- Identifying and addressing potential safety and security issues up front
- Whenever possible - and especially where heavy use can be expected - separate bicycle and pedestrian ways should be provided to reduce conflicts.
- Providing accessible parking space(s)

Multi-use Trail Design

Width:

- 10' is the minimum allowed for a two-way, multi-use trail and is only recommended for low traffic situations
- 12' is recommended in most situations
- For equestrian users, trail facilities should provide enough space so that a horse feels at ease. Horses prefer to travel away from walls or barriers that they cannot see through or over.
- 12' or greater is recommended for heavy use situations with high concentrations of multiple users such as joggers, bicyclists, rollerbladers , equestrians, and pedestrians

Lateral Clearance:

- A 2' or greater shoulder on both sides

Overhead Clearance:

- Low vertical clearance presents a potential safety hazard for riders when their horse needs maneuvering space. A horse with rider is nearly eight feet in height.
- Clearance of physical barriers including bridges, underpasses, and vegetation should extend at least 10' above the surface tread with 12' preferred.

Site Distance

The added height of equestrians allows them to see farther than on the ground trail users. Trails that intersect with roadways are subject to AASHTO guidelines with respect to sight and stopping distance. A walking horse generally travels at a rate of two and a half to four miles per hour. A trot is approximately eight miles per hour. The ideal sighting distance should be 100 feet for every 10 mph of average traffic speed. The minimum sighting distance should be 200 feet.

Surface Treatments:

Asphalt is the most common surface for multi-use trails. However, the material composition and construction methods used can substantially affect the longevity of the pathway. Thicker asphalt sections and a well-prepared subgrade will reduce deformation over time and reduce long-term maintenance costs.

The use of concrete surfacing for trails has proven to be the most suitable for long-term use. Using modern construction practices, concrete provides a smooth ride with low maintenance costs. Concrete trails can be placed with a slip-form paver. The surface must be cross-broomed. Crack-control joints should be saw-cut, not troweled. Depending on current economic conditions, concrete trails may cost more to build than asphalt trails but do not become brittle, cracked and rough with age or deformed by roots.

Smooth paved surfaces, such as asphalt or concrete, are not considered ideal for equestrians due to poor traction. Such trails can accommodate equestrians, however, and provide links to equestrian trails with a preferred surface, such as compacted native soil, wood chips, decomposed granite or crusher fine material.

Multi-use trails should be designed with sufficient surfacing structural depth for the subgrade soil type to support maintenance and emergency vehicles. Where the trail must be constructed over a very poor subgrade (wet and/or poor material), treatment of the subgrade with lime, cement, or geotextile fabric should be considered.

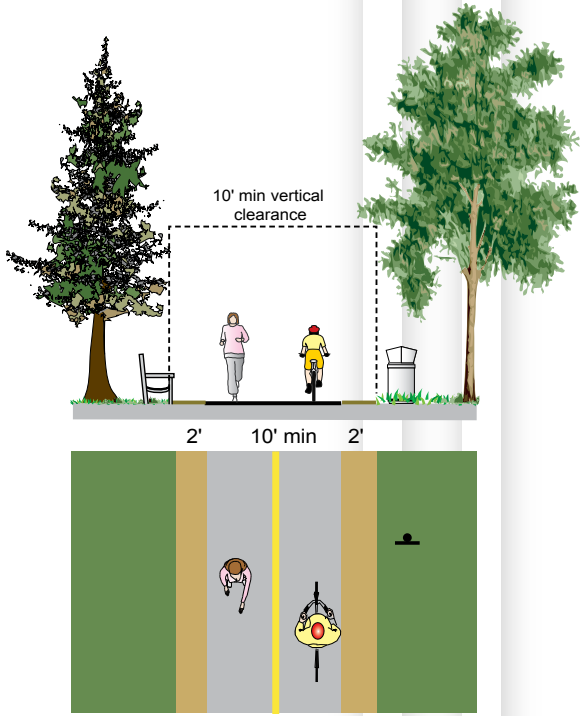
These standards are described in additional detail in:

- *U.S. Access Board, Public Rights-of-Way Accessibility Guidelines (PROWAG).*
- FHWA. *Designing Sidewalks and Trails for Access.*

Side Paths

The AASHTO Guide for the Development of Bicycle Facilities generally recommends against the development of multi-use trails directly adjacent to roadways.

Also known as "side paths," these facilities create a situation in which a portion of the bicycle traffic rides against the normal flow of motor vehicle traffic and can result in wrong-way riding where cyclists enter or leave the trail. This can create an unsafe situation in which motorists entering or crossing the roadway do not notice bicyclists coming from their right, as they are not expecting traffic from that direction. Stopped cross-street



Recommended shared-use path design

Side Path

Example of a substandard side path in Molalla, OR

motor vehicle traffic or vehicles exiting side streets or driveways may frequently block path crossings. Bicyclists coming from the left may also be unnoticed, particularly if sight distances are poor.

Regardless of the type, paths constructed next to the road must have some type of vertical (e.g., curb or barrier) or horizontal (e.g., landscaped strip) buffer separating the path area from adjacent vehicle travel lanes.

Where a multi-use trail must be adjacent to a roadway, a five foot minimum buffer should separate the path from the edge of the roadway, or a physical barrier of sufficient height should be installed.

Additional concerns about multi-use trails directly adjacent to roadways with minimal separation are:

- When the path ends, cyclists riding against traffic tend to continue to travel on the wrong side of the street, as do cyclists making their way to the path. Wrong-way bicycle travel is a major cause of vehicle/bicycle crashes.
- At intersections, motorists crossing the path often do not notice bicyclists approaching from certain directions, especially where sight distances are poor.
- Bicyclists on the path are required to stop or yield at cross-streets or driveways, unless posted.
- Stopped vehicles on a cross-street or driveway may block the path.
- Because of the proximity of vehicle traffic to opposing bicycle traffic, barriers are often necessary to separate motorists from cyclists. These barriers serve as obstructions, complicate facility maintenance, and waste available right-of-way.
- Paths directly adjacent to high-volume roadways diminish users' experience by placing them in an uncomfortable environment. This could lead to a path's underutilization.
- When equestrian activity occurs near roadways, there is a chance that a vehicle may startle a horse.

Intersection treatments for side paths should be designed with care to minimize conflicts between path users and motor vehicles.

As bicyclists gain experience and realize some of the advantages of riding on the roadway, some riders stop using paths adjacent to roadways. Bicyclists may also tend to prefer the roadway as pedestrian traffic on the multi-use trail increases due to its location next to an urban roadway. When designing a bikeway network, the presence of a nearby or parallel path should not be used as a reason to not provide adequate shoulder or bike lane width on the roadway, as the on-street bicycle facility may be superior to the side path for experienced cyclists and those who are cycling for transportation purposes. Bike lanes should be provided as an alternate, more transportation-oriented facility whenever possible.

Multi-use trails may be considered along roadways under the following conditions:

- The path will generally be separated from all motor vehicle traffic
- Vegetative screening is provided for equestrian users to increase animal comfort
- Bicycle and pedestrian use is anticipated to be high

- To provide continuity with an existing path through a roadway corridor
- The path can be terminated at each end onto streets with good bicycle and pedestrian facilities, or onto another well-designed path
- There is adequate access to local cross-streets and other facilities along the route
- Any needed grade separation structures do not add substantial out-of-direction travel
- The total cost of providing the proposed path is proportionate to the need

Separation

There are many means of separating trail users including: time, distance, screening, and barriers. In corridors where adequate right-of-way is available, trail users may be separated by physical space. Vegetated buffers or barriers have successfully been used in many trail scenarios. Elevation changes are another means of effectively separating trail users. Differing surfaces suitable to each user group, also help create a visual separation and clarity of where each user group should be. When trail corridors are constrained, the approach is often to locate the two different trail surfaces side by side with no separation. Oftentimes, an expanded trail shoulder serves the role of the equestrian facility.

Sidewalks as Multi-use Trails

Utilizing a sidewalk as a multi-use trail is unsatisfactory because sidewalks are designed for pedestrian speeds and maneuverability and are not safe for higher bicycle speeds. Conflicts are common between pedestrians traveling at low speeds (e.g., exiting stores, parked cars, etc.) and bicyclists, as are conflicts with fixed objects (e.g., utility poles, mailboxes, and parked cars extending into the sidewalk from a driveway). Walkers, joggers, skateboarders, and in-line skaters can (and often do) change their speed and direction almost instantaneously, leaving bicyclists insufficient reaction time to avoid collisions.

Similarly, pedestrians often have difficulty predicting the direction an oncoming cyclist will take. At intersections, motorists are often not looking for bicyclists (who are traveling at higher speeds than pedestrians) entering a crosswalk area, particularly when motorists are making a turn. Sight distance is often impaired by buildings, walls, fences, and shrubs along sidewalks, especially at driveways. In addition, bicyclists and pedestrians often prefer to ride or walk side-by-side when traveling in pairs. Sidewalks are typically too narrow to enable this to occur without conflict between users.

It should also be noted that developing extremely wide sidewalks does not necessarily add to the safety of sidewalk bicycle travel. Wide sidewalks might encourage higher speed bicycle use and can increase the potential for conflicts with motorists at intersections, as well as pedestrians with fixed objects.

Unique Trail Applications

Special trail design treatments may be required on segments of the Ecusta Rail Trail to complete the trail system. These trails may be constructed along a creek, within a floodplain, or through sensitive biological areas or wetlands. In these circumstances, special attention should be paid in the planning, design, and construction phases.

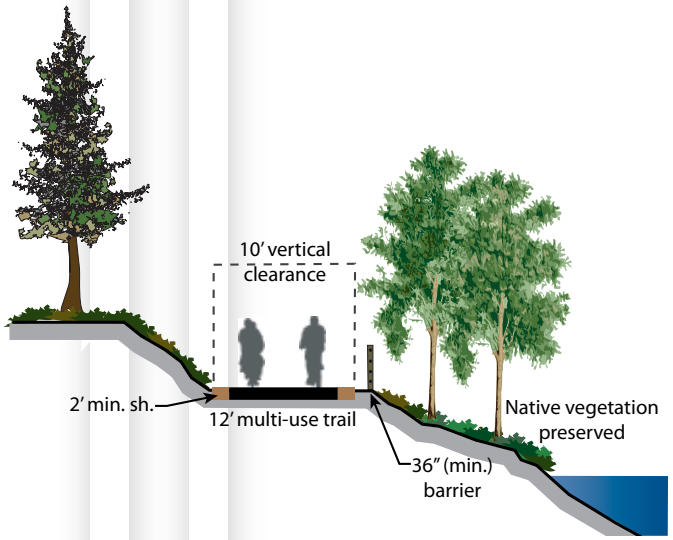
Floodway and Floodplain Trails

Trails that are developed in the floodway and floodplain due to right-of-way constraints and channelized streams present challenges for the

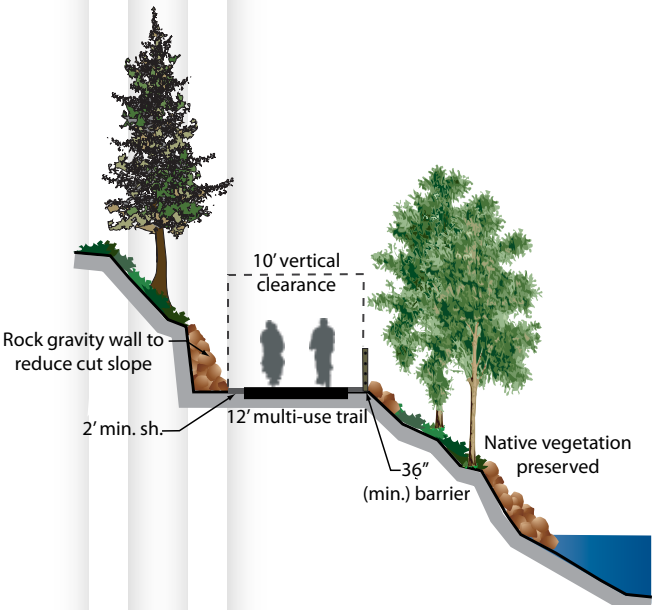
Paved multi-use trail in a floodway

Paved multi-use trail on a bank

Retaining wall doubles as seating



Floodway Trail

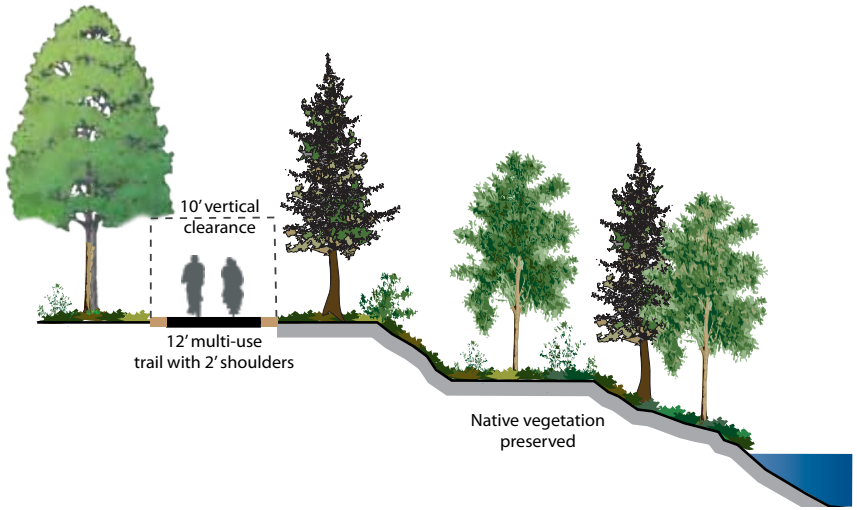


Floodway Trail on Steep Slope

trail's managing agency. It is anticipated that the Ecusta Rail Trail will be located on top of the creek bank in the floodway and on a slope in the floodplain. These conditions affect how each trail is constructed, although there are common standards that apply to both conditions.

Floodway and Floodplain Trail Standards

- In general, trails should be located outside of riparian forest buffer zones and active stream channels to protect water quality and reduce erosion of stream banks. Appendix I of this document outlines local ordinances relevant to floodplain development and permitting.
- Because trails located in floodways can be impacted by flood events, trails that are developed in the floodway are recommended to be constructed of concrete. Concrete trails are better suited to withstand high-velocity stream flows than other surface materials. Although concrete surfaces can be expensive, concrete is a better community investment as it lasts much longer than asphalt and is easier to maintain. When properly installed, concrete will last 25 years or longer and will need little maintenance. In wetland areas or perennially wet areas, boardwalk or elevated trails should be installed.
- Where the trails are located in drainage areas, and are expected to be inundated on an annual basis, the trail should be constructed of concrete of sufficient thickness to allow for regular blading (cleaning) of the surface by equipment.
- Trail shoulders should be a minimum of 2 feet
- The trail should have a 2% cross slope to direct water to a sub drainage or swale.
- The trail should be designed to discourage trespass into environmentally sensitive areas by using natural barriers - such as split rail fencing, rocks, and native vegetation buffers - to steer people away from sensitive areas. Interpretive signs should be installed to explain why areas are sensitive.



Floodplain Trail

- Trail amenities (benches, signage, and trash receptacles) in floodways should be carefully considered. Where amenities are appropriate or necessary, they should be installed to withstand high velocity flows.
- Retaining walls can double as seating areas and increase pedestrian comfort along trails
- Concrete trail surfaces should be broom finished for traction.
- Joints should be saw-cut to reduce bumps
- Concrete may be dyed any color to complement the surrounding environment, if desired.

Trails in the Floodway

The trail elevation in floodways should be set to minimize flooding impacts. The top of the creek bank is generally a good location for a creek trail. The top of the bank (or a bench on a slope) is generally flat and can provide a good platform for a trail. Because these areas are flat, grading is kept to a minimum and existing vegetation can be preserved. Erosion and bank stabilization problems are also minimized. However, flooding frequency and high water lines may require trail elevations to be set above the creek bank. A geotechnical engineer should be consulted to assess flood elevation levels and soil conditions, and determine appropriate trail profile materials and quantities.

Additional Recommendations

- A vegetative buffer between the stream and trail should be preserved
- Trail shoulders should not consist of loose materials to reduce replacement costs after a flood event
- Install guard rail or fence where vertical drop of 18 inches or greater exists at edge of trail
- Guardrail or fence should be 36 inches high (minimum) to meet ADA guidelines
- A retaining wall may be required to protect the trail base when the side slope grade exceeds 50 percent; water must be allowed to drain around, beneath, or through the wall and must not be allowed to accumulate behind it

Trails in the Floodplain

Floodplain trails are located outside of the floodway but within the floodplain. These trails are subject to flooding when large storm events occur.

Additional Recommendations

- A wide vegetative buffer should be maintained
- Existing terraces above the floodway can be utilized for trail alignments
- Concrete is recommended for the trail surface, unless it is cost prohibitive. Asphalt could be used as an alternative surfacing material with the expectation of a lower life expectancy

Elevated Trails

Sections of the Ecusta Rail Trail may require an elevated trail treatment (i.e. boardwalk). Elevated treatments can minimize impact to sensitive wet areas and create "showcase" trail segments that allow users to experience riparian ecosystems with minimal impact.

Biological conditions may require platforms to be located so as not to shade sensitive resources. Trail treads should allow light to penetrate to vegetation under the trail. Screw piles are recommended for building boardwalks and viewing platforms along the Ecusta Rail Trail. They are less disruptive to the creek bed than wooden

An example of a trail system that clearly separates trail users

Boardwalk railings assist in keeping trail users away from sensitive areas

Elevated trail segment allows trail connectivity along a sensitive slope

Bike lanes with signage on a popular commuting and recreational route in California

Bike lane pavement markings in Portland, OR provide character to the roadway

This bike lane provides parking "T's" to minimize the danger of 'dooring'

pier foundations and more environmentally sensitive than using chemically treated lumber. Boardwalks can be very expensive. They should go through an extensive design process so they do not contribute to flooding hazards, are ADA compliant, and minimize impact to the surrounding environment.

On-Road Bicycle and Pedestrian Facilities

Although the Ecusta Rail Trail is expected to follow the abandoned railroad right-of-way, some sections of the former railroad right-of-way may encounter unexpected constraints in the future. In cases where this occurs, on-road facilities can provide alternative routes around gaps. Such facilities may also be used to provide links from activity centers to the trail. On-road facility types are outlined in this section.

Bike Lanes

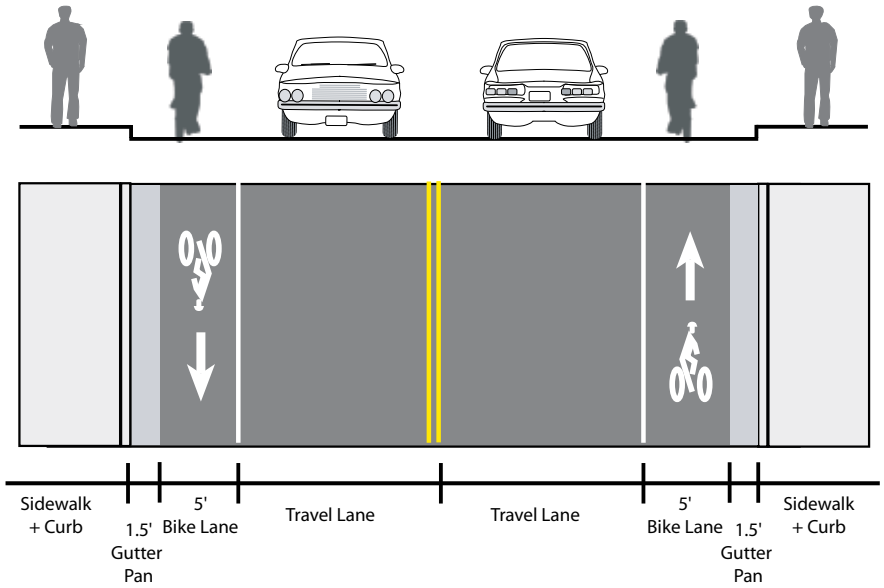
Designated exclusively for bicycle travel, bike lanes are separated from vehicle travel lanes with striping and also include pavement stencils. Bike lanes are most appropriate on arterial and collector streets where higher traffic volumes and speeds warrant greater separation.

Most commuter bicyclists would argue that bike lanes are the safest and most functional facilities for bicycle transportation. Bicyclists have stated their preference for marked, on-street bike lanes in numerous national surveys. The fact is that many bicyclists – particularly less experienced riders – are far more comfortable riding on a busy street if it has a striped and signed bike lane. One of the goals of the construction of the Ecusta Rail Trail is to encourage new riders, and providing marked facilities such as bike lanes is one way of helping to persuade residents and visitors to try bicycling.

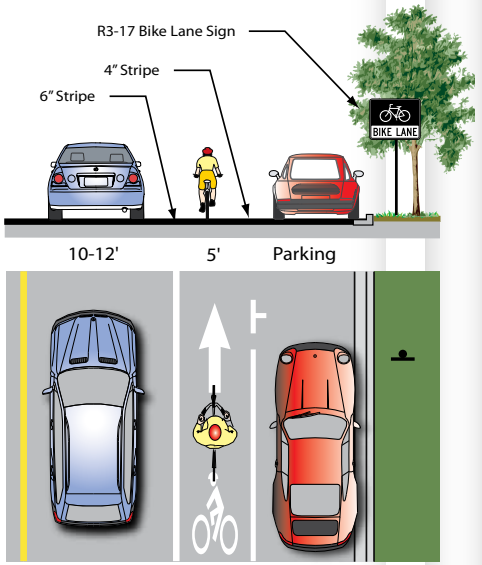
If properly designed, bike lanes can increase safety and promote proper riding. For this reason, bike lanes are desirable for bicycle commuter routes along major roadways. Bike lanes help to define the road space for bicyclists and motorists, reduce the chance that motorists will stray into the cyclists' path, discourage bicyclists from riding on the sidewalk, and remind motorists that cyclists have a right to the road. One key consideration in designing bike lanes is to ensure that bike lanes and adjacent parking lanes have sufficient width so that cyclists have enough room to avoid a suddenly opened vehicle door.

The AASHTO Guide for the Development of Bicycle Facilities notes that "longitudinal pavement markings should be used to define bicycle lanes." The guideline states that "if used, the bicycle lane symbol marking shall be placed immediately after an intersection and other locations as needed. The bicycle lane symbol marking shall be white. If the word or symbol pavement markings are used, bicycle lane signs shall also be used, but the signs need not be adjacent to every symbol to avoid overuse of the signs."

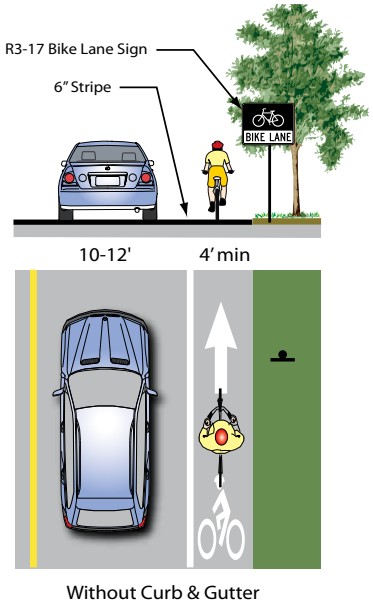
The following sections of this document describe guidelines for implementing bike lanes on streets with on-street parking and without parking. Additional design guidelines may be found in the most recent version of the AASHTO Guide for the Development of Bicycle Facilities manual, the North Carolina Bicycle Facilities Planning and Design Guidelines, and the NACTO Urban Bikeway Design Guide (http://nacto.org/cities-for-cycling/design-guide/).



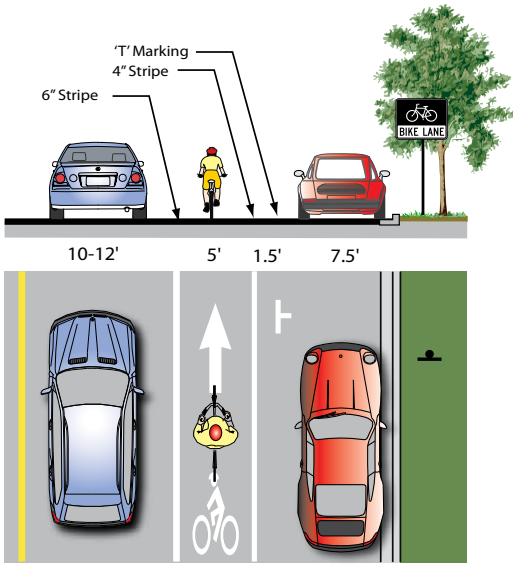
*Two Lane Cross-Section with No Parking**
**Bike lanes may be 4' in width under constrained circumstances*



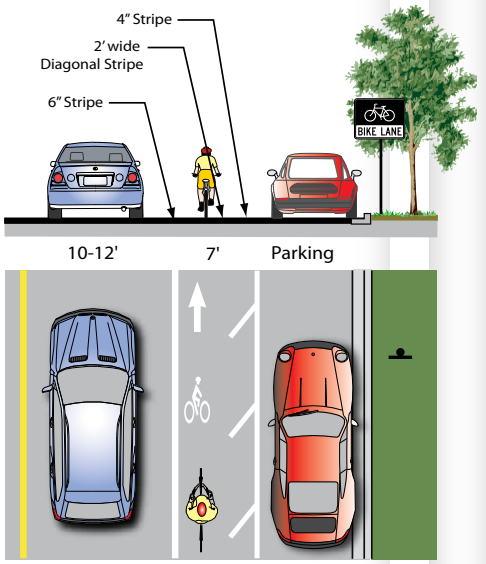
Bike Lane with Parking: Minimum Design



Bike Lane with No Parking: Recommended Design

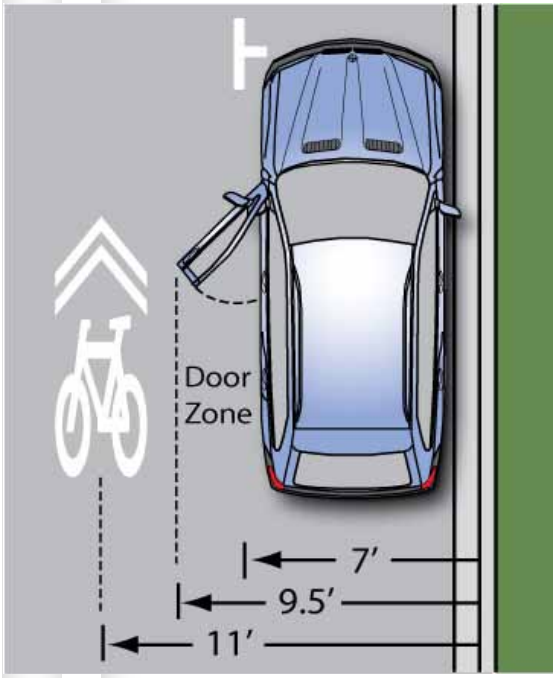


Bike Lane with Parking: Preferred Design (if space is available)



Bike Lane with Parking: Maximum Width

Shared lane markings can be used on minor and major roadways



Shared lane marking placement guidance for streets with on-street parking

Bike Lane Configurations

Table D.1 - Bike Lane Configurations

Type of Bike Lane	Recommended Width (Min-Max)
Adjacent to on-street parallel parking	6' (4'-7')
Adjacent to on-street diagonal parking	6' (5'-7')
Without on-street parking, no gutter	6' (4'-7')
Without on-street parking, curb & gutter	6' (5'-8')

Bike Lane Adjacent to On-Street Parallel Parking

Bike Lane Width:

- 6' recommended when parking stalls are marked
- 4' minimum in constrained locations
- 5' acceptable if parking not marked
- 7' maximum (may encourage vehicle loading in bike lane)

Travel Lane Width:

- 12' for a shared lane adjacent to a curb face,
- 11' minimum for a shared bike/parking lane where parking is permitted but not marked on streets without curbs.

Bike lanes adjacent to on-street parallel parking are common in the United States and can be dangerous for bicyclists if not designed properly. Crashes caused by a suddenly opened vehicle door are a common hazard for bicyclists using this type of facility. Wide bike lanes may encourage the cyclist to ride farther to the right (door zone) to maximize distance from passing traffic. Wide bike lanes may also cause confusion with unloading vehicles in busy areas where parking is typically full. Some alternatives include:

- Installing parking "T's" and smaller bike lane stencils
- Using diagonal stripes to encourage cyclists to ride on the left side of the bike lane
- Provide a buffer zone (preferred design). Bicyclists traveling in the center of the bike lane will be less likely to encounter open car doors. Motorists have space to stand outside the bike lane when loading and unloading.

From the AASHTO Guide for the Development of Bicycle Facilities:

> If parking is permitted, the bike lane should be placed between the parking area and the travel lane and have a minimum width of 5'. Where parking is permitted but a parking stripe or stalls are not utilized, the shared area should be a minimum of 11' without a curb face and adjacent to a curb face. If the parking volume is substantial or turnover is high, an additional 1'- 2' of width is desirable.

Bike Lane Without On-Street Parking

Bike Lane Width:

- 4' minimum when no curb and gutter is present
- 5' minimum when adjacent to curb and gutter (3' more than the gutter pan width if the gutter pan is wider than 2')

Recommended Width:

- 6' where right-of-way allows

Maximum Width:

- 8' Adjacent to arterials with high travel speeds (45 mph+)

Wider bike lanes are desirable in certain circumstances such as on higher speed arterials (45 mph+) where a wider bike lane can increase separation between passing vehicles and cyclists. Wide bike lanes are also appropriate in areas with high bicycle use. A bike lane width of 6 to 8 feet makes it possible for bicyclists to ride side-by-side or pass each other without leaving the bike lane, increasing the capacity of the lane. Appropriate signing and stenciling is important with wide bike lanes to ensure motorists do not mistake the lane for a vehicle lane or parking lane.

Shared Lane Markings

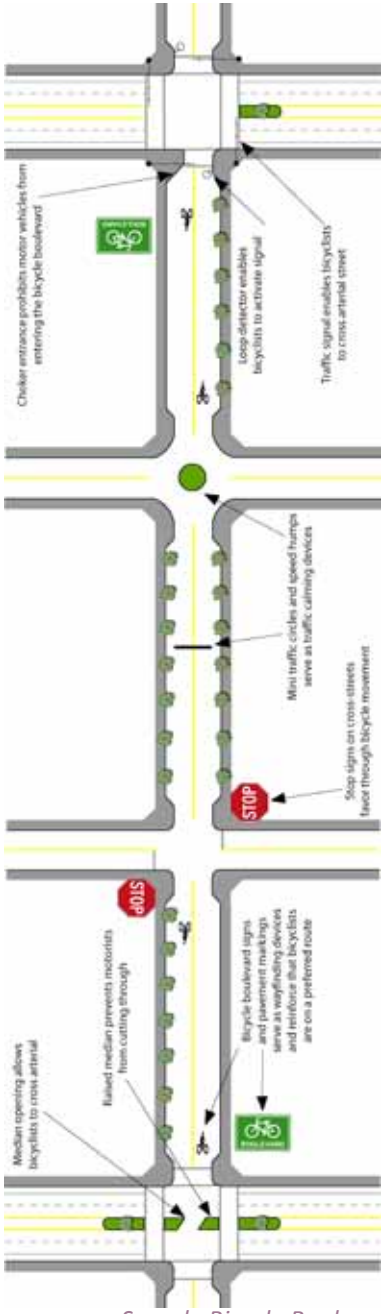
Shared lane markings (also known as "sharrows") are high-visibility pavement markings that help position bicyclists within the travel lane. These markings are often used on streets where dedicated bike lanes are desirable but are not possible due to physical or other constraints. Sharrows are placed strategically in the travel lane to alert motorists of bicycle traffic, while also encouraging cyclists to ride at an appropriate distance from the "door zone" of adjacent parked cars. Placed in a linear pattern along a corridor (typically every 100-200 feet), sharrows also encourage cyclists to ride in a straight line so their movements are predictable to motorists. These pavement markings have been successfully used in many communities throughout the U.S. Shared lane markings made of thermoplastic tend to last longer than painted ones.

Door Zone Width:

The width of the door zone is generally assumed to be 2.5 feet from the edge of the parking lane.

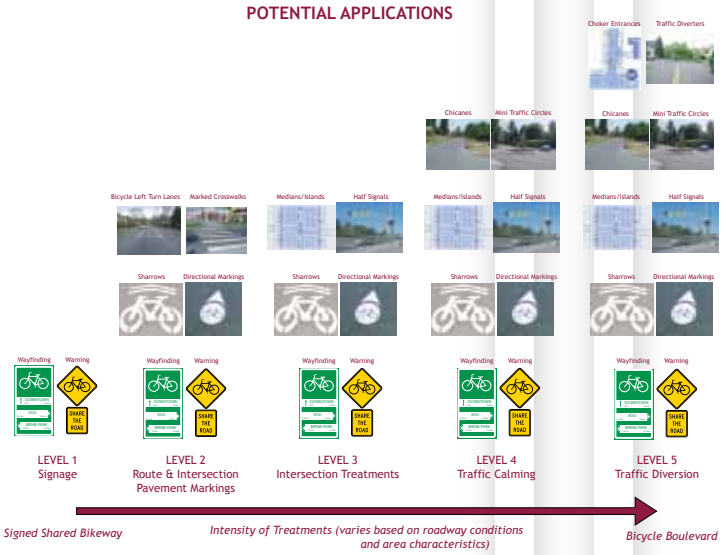
Recommended Placement:

- At least 11' from face of curb (or shoulder edge) on streets with on-street parking



Sample Bicycle Boulevard Treatments

Bicycle boulevards are low-speed streets that provide a comfortable and pleasant experience for cyclists



Bicycle boulevard applications

- At least 4' from face of curb (or shoulder edge) on streets without on-street parking

Discussion

The 2009 MUTCD language notes that sharrows should not be placed on roadways with a speed limit over 35 MPH, and that, when used, the marking should be placed immediately after an intersection and spaced at intervals no greater than 250 feet thereafter. Placing shared lane markings between vehicle tire tracks (if possible) will increase the life of the markings.

Bicycle Boulevards

Bicycle boulevards are low-volume streets where motorists and bicyclists share the same space. Treatments for bicycle boulevards include five "application levels" based on their level of physical intensity, with Level 1 representing the least physically-intensive treatments that could be implemented at relatively low cost. Level 1 treatments may include wayfinding and warning signs. Level 2 treatments may include on-street parking delineation, directional pavement markings, and shared lane markings. Level 3 treatments may include stop signs on cross-streets, mini traffic circles, curb bulb-outs with high-visibility sidewalks, patterned pavements, and medians or refuge islands. Level 4 treatments may include chicanes (raised or delineated curb extensions on alternating sides of a street that form an S-shaped curb) and speed humps. Level 5 treatments may include choker entrances and traffic diverters.

Identifying appropriate application levels for individual bicycle boulevard corridors provides a starting point for selecting appropriate site-specific improvements.

Traffic calming and other treatments along the corridor reduce vehicle speeds so that motorists and bicyclists generally travel at the same speed, creating a safer and more comfortable environment for all users. Bicycle boulevards incorporate treatments to facilitate safe and convenient crossings where the route crosses a major street. They work best in well connected street grids where riders can follow reasonably direct and logical routes and when higher-order parallel streets exist to serve thru vehicle traffic.

Bicycle boulevards have a variety of purposes and advantages:

- *Parallel major streets lacking dedicated bicycle facilities:* Higher-order streets - such as arterials and major collectors - typically include major bicyclist destinations (e.g., commercial and employment areas and other activity centers). However, these corridors often lack bike lanes or other dedicated facilities, thereby creating an uncomfortable, unattractive, and potentially unsafe riding environment. Bicycle boulevards serve as alternate parallel facilities allowing cyclists to avoid major streets for longer trip segments.
- *Parallel major streets with bicycle facilities that are uncomfortable for some users:* Some users may not feel comfortable using bike lanes on major streets for various reasons, including high traffic volumes and vehicle speeds, conflicts with motorists entering and leaving driveways, or conflicts with buses occupying the bike lane while loading and unloading passengers. Children and less-experienced riders might find these environments especially challenging. Utilizing lower-order streets, bicycle boulevards provide alternate route choices for bicyclists uncomfortable using the major street network. It should be noted however that bike lanes on major streets provide important access to key land uses, and the major street network often provides the most direct routes between major destinations. For these reasons, bicycle boulevards should complement a bike lane network and not serve as a substitute.
- *Ease of implementation on most local streets:* bicycle boulevards incorporate cost-effective and less physically-intrusive treatments than bike lanes and cycle tracks. Most streets could be provided relatively inexpensive treatments - like new signage, pavement markings, striping, and signal improvements - to facilitate bicyclists' mobility and safety. Other potential treatments include curb extensions, medians, and other features that can be implemented at reasonable cost and are compatible with emergency vehicle accessibility.
- *Benefits beyond an improved bicycling environment:* Residents living on bicycle boulevards benefit from reduced vehicle speeds and thru traffic, creating a safer and more-attractive environment. Pedestrians and other users can also benefit from bicycle boulevard treatments (e.g., by improving the crossing environment where bicycle boulevards meet major streets).

It should be noted that corridors targeted for higher-level applications would also receive relevant lower-level treatments. For instance, a street targeted for Level 3 applications should also include Level 1 and 2 applications as necessary. It should also be noted that some applications may be appropriate on some streets while inappropriate on others. In other words, it may not be appropriate or necessary to implement all "Level 2" applications on a Level 2 street. Furthermore, several treatments could

fall within multiple categories as they achieve multiple goals. To identify and develop specific treatments for each bicycle boulevard, Henderson and Transylvania Counties should involve the bicycling community and neighborhood groups. Further analysis and engineering work may also be necessary to determine the feasibility of some applications.

Striped/Paved Shoulders

Paved shoulders are the part of a roadway which is contiguous and on the same level as the regularly traveled portion of the roadway. There is no minimum width for paved shoulders, however a width of at least four feet is preferred. Ideally, paved shoulders should be included in the construction of new roadways and/or the upgrade of existing roadways, especially where there is a need to more safely accommodate bicycles.

Design Guidance:

- These are most often used in rural environments, although are not confined to any particular setting.
- Shoulders should be delineated by a solid white line, and provided on both sides of the road.
- Shoulders should be contiguous and on the same level as the regularly traveled portion of the roadway.
- 4' minimum width; however, if site conditions are constrained, then the option of a smaller shoulder should be weighed against simply having a wider outside lane.
- For roads with speeds higher than 40 MPH with high Average Dailty Traffic (ADT), a shoulder width of more than 4' is recommended.
- Rumble strips should be avoided, but if used, then a width of more than 4' is needed.
- Paved shoulders should not be so wide as to be confused with a full automobile travel lane.

Bicycle Friendly Drainage Grates

Drainage grates usually occupy portions of roadways, such as bicycle lanes, where bicycles frequently travel. Often drainage grates are poorly maintained or are of a design that can damage a bicycle wheel or, in severe circumstances, cause a bicyclist to crash. Improper drainage grates create an unfriendly obstacle a cyclist must navigate around, often forcing entrance into a motor vehicle lane. Bicycle friendly drainage grates should be installed in all new roadway projects and problem grates should be identified and replaced.

Accessible Trail Design

General guidelines have been created in response to the American with Disabilities Act (ADA) for accessible trails. Constructing outdoor trails may have limitations that make meeting ADA guidelines difficult and sometimes prohibitive. Prohibitive impacts include harm to significant cultural or natural resources; a significant change in the intended purpose of the trail; requirements of construction methods that are against federal, state, or local regulations; or terrain characteristics that prevent compliance. The following standards, outlined in Table D.2, serve to accommodate persons with disabilities in feasible situations.

Non-paved surfaces can meet the needs of users with disabilities when properly constructed.

Table D.2 - Accessible Trail Design Standards

Trail Characteristic	Design Standard	Explanation for the Standard
Trail Surface	Hard surface such as, asphalt, concrete, wood, compacted gravel	Provide smooth surface that accommodates wheelchairs
Trail Gradient	Less than 5% maximum without landings 5% - 8.33%	Greater than 5% is too strenuous for wheelchair users With landings at regular intervals
Trail Cross Slope	2% maximum	Provide positive trail drainage, avoid excessive gravitational pull to side of trail
Trail Width	5' minimum	Accommodates a wide variety of users and allows for the passage of two wheelchairs
Trail Amenities, phones, drinking fountains and pedestrian-actuated buttons	Place no higher than 4' off ground	Provide access within reach of wheelchair users
Detectable pavement changes at curb ramp approaches	Place at top of ramp before entering roadways	Provide tactile queues for visually impaired users
Trailhead Signage	Accessibility information, such as trail gradient/profile, distances, tread conditions, location of drinking fountains, and rest stops	User convenience and safety
Parking	Provide at least one accessible parking area per every 25 vehicle spaces at each trailhead	User convenience and safety
Rest Areas	On trails specifically designated as accessible, provide rest areas or widened areas on the trail, optimally at every 300 feet	User convenience and safety

Crossings

The design of trail crossings is one of the most important components of trail design. Safety is important when designing a crossing to avoid potential conflict between a wide variety of users. This section details crossing treatments for the Ecusta Rail Trail.

Roadway Crossings

At-grade trail crossings of roadways generally will fit into one of three basic categories:

- Type 1: Marked/Unsignalized Type 1+: Marked/ Enhanced
- Type 2: Signalized/Controlled
- Type 3: Grade-separated crossings

While at-grade crossings create a potentially high level of conflict between trail users and motorists, well designed crossings have not historically posed a safety problem for trail users. This is evidenced by the thousands of successful trails around the United States with at-grade crossings. In most cases, at-grade trail crossings can be properly designed to a reasonable degree of safety and can meet existing traffic and safety standards.

Evaluation of trail crossings involves analysis of vehicular and anticipated trail user traffic

Table D.3: Summary of Trail/Roadway At-Grade Crossing Recommendations1

Roadway Type	Vehicle ADT <=9,000			Vehicle ADT > 9,000 to 12,000			Vehicle ADT > 12,000 to 15,000			Vehicle ADT > 15,000		
	Speed Limit **											
	30 mph	35 mph	40 mph	30 mph	35 mph	40 mph	30 mph	35 mph	40 mph	30 mph	35 mph	40 mph
2 Lanes	1	1	1/1+	1	1	1/1+	1	1	1+/3	1	1/1+	1+/3
3 Lanes	1	1	1/1+	1	1/1+	1/1+	1/1+	1/1+	1+/3	1/1+	1+/3	1+/3
Multi-Lane (4+) w/ raised median	1	1	1/1+	1	1/1+	1+/3	1/1+	1/1+	1+/3	1+/3	1+/3	1+/3
Multi-Lane (4+) w/o raised median	1	1/1+	1+/3	1/1+	1/1+	1+/3	1+/3	1+/3	1+/3	1+/3	1+/3	1+/3

*General Notes: Crosswalks should not be installed at locations that could present an increased risk to pedestrians, such as where there is poor sight distance, complex or confusing designs, a substantial volume of heavy trucks, or other dangers, without first providing adequate design features and/or traffic control devices. Adding crosswalks alone will not make crossings safer, nor will they necessarily result in more vehicles stopping for pedestrians. Whether or not marked crosswalks are installed, it is important to consider other pedestrian facility enhancements (e.g., raised median, traffic signal, roadway narrowing, enhanced overhead lighting, traffic-calming measures, curb extensions), as needed, to improve the safety of the crossing. These are general recommendations; good engineering judgment should be used in individual cases for deciding which treatment to use.

For each pathway-roadway crossing, an engineering study is needed to determine the proper location. For each engineering study, a site review may be sufficient at some locations, while a more in-depth study of pedestrian volume, vehicle speed, sight distance, vehicle mix, etc. may be needed at other sites.

** Where the speed limit exceeds 40 mi/h marked crosswalks alone should not be used at unsignalized locations.

*** The raised median or crossing island must be at least 4 ft (1.2 m) wide and 6 ft (1.8 m) long to adequately serve as a refuge area for pedestrians in accordance with MUTCD and AASHTO guidelines. A two-way center turn lane is not considered a median.

1= Type 1 Crossings. Ladder-style crosswalks with appropriate signage should be used.

1/1+ = With the higher volumes and speeds, enhanced treatments should be used, including marked ladder style crosswalks, median refuge, flashing beacons, and/or in-pavement flashers. Ensure there are sufficient gaps through signal timing, as well as sight distance.

1+/3 = Carefully analyze signal warrants using a combination of Warrant 2 or 5 (depending on school presence) and EAU factoring. Make sure to project pathway usage based on future potential demand. Consider Pelican, Puffin, or Hawk signals in lieu of full signals. For those intersections not meeting warrants or where engineering judgment or cost recommends against signalization, implement Type 1 enhanced crosswalk markings with marked ladder style crosswalks, median refuge, flashing beacons, and/or in-pavement flashers. Ensure there are sufficient gaps through signal timing, as well as sight distance.

1 *This table is based on information contained in the U.S. Department of Transportation Federal Highway Administration Study, "Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations," February 2002.*

Type 1 crossings (like this crossing of the Springwater Trail in Portland, OR) are used on lower speed, lower volume roadways. Type 1 do not have traffic signals but should include other traffic control devices, such as a clearly marked crosswalk (ladder style is most visible), warning signs, curb extensions, or pedestrian refuges.

Type 2 crossings (like this crossing of the Springwater Trail in Portland, OR) are recommended on higher speed/higher volume roadways. They are signalized and may include other traffic control devices such as a clearly marked crosswalk (ladder style is most visible), warning signs, and possibly curb extensions and pedestrian refuges.

patterns, including vehicle speeds, traffic volumes (average daily traffic and peak hour traffic), street width, sight distance and trail user profile (age distribution, destinations served). Crossing features for all roadways include warning signs, both for vehicles and trail users. The type, location, and other criteria are identified in the AASHTO's *Guide for the Development of Bicycle Facilities* and the MUTCD.

Consideration must be given for adequate warning distance based on vehicle speeds and line of sight, with visibility of any signage absolutely critical. Catching the attention of motorists jaded to roadway signs may require additional alerting devices, such as a flashing light, roadway striping, or changes in pavement texture. Signage for trail users must include a standard "STOP" sign and pavement marking, sometimes combined with other features such as bollards or a kink in the pathway to slow bicyclists. Care must be taken not to place too many signs at crossings lest they begin to lose their impact.

A number of striping patterns have emerged over the years to delineate trail crossings. A median stripe on the trail approach will help to organize and warn trail users of the upcoming crossing. The actual crosswalk striping is a matter of local and state preference, and it may be accompanied by pavement treatments to help warn and slow motorists. The effectiveness of crosswalk striping is highly related to local customs and regulations. In areas where motorists do not typically defer to pedestrians in crosswalks, additional measures may be required.

The following section identifies several trail/roadway crossing treatments that should be considered for the Ecusta Rail Trail.

The proposed intersection approach that follows is based on established standards, published technical reports, and experiences from cities around the country. Table D.3 presents a summary of trail and roadway at-grade crossing recommendations.

Type 1: Marked/Unsignalized Crossings

A marked/unsignalized crossing (Type 1) consists of a crosswalk and signage, often with no other devices to slow or stop traffic. The approach to designing crossings at mid-block locations depends on an evaluation of vehicular traffic, line of sight, trail traffic, use patterns, vehicle speed, road type and width, and other safety issues, such as proximity to schools. The following thresholds recommend where unsignalized crossings may be acceptable:

Maximum traffic volumes:

- ≤9,000-12,000 Average Daily Traffic (ADT) volumes
- Up to 15,000 ADT on two-lane roads, preferably with a median.
- Up to 12,000 ADT on four-lane roads with median.

Maximum travel speed:

- 35 MPH

Minimum line of sight:

- 25 MPH zone: 155 feet
- 35 MPH zone: 250 feet
- 45 MPH zone: 360 feet

If well-designed, crossings of multi-lane, higher-volume arterials over 15,000 ADT may be unsignalized with features such as the following: excellent sight distance, sufficient crossing gaps (more than 60 per hour), median refuges, or

active warning devices like flashing beacons or in-pavement flashers. These are referred to as "Type 1 Enhanced" (Type 1+). Such crossings would not be appropriate, however, if a significant number of schoolchildren used the trail. Furthermore, both existing and potential future trail usage volume should be taken into consideration.

On two-lane local and collector roads below 15,000 ADT with average vehicle speeds of 35 MPH or less, crosswalks and warning signs ("Trail Xing") should be provided to warn motorists, and stop signs and slowing techniques (bollards/geometry) should be used on the trail approach. Curves in trails that orient the trail user toward oncoming traffic are helpful in slowing trail users and making them aware of oncoming vehicles. Care should be taken to keep vegetation and other obstacles out of the sight line for motorists and trail users. Engineering judgment should be used to determine the appropriate level of traffic control and design.

On roadways with low to moderate traffic volumes (<12,000 ADT) and a need to control traffic speeds, a raised crosswalk may be the most appropriate crossing design to improve pedestrian visibility and safety. These crosswalks are raised 75 millimeters above the roadway pavement (similar to speed humps) to an elevation that matches the adjacent sidewalk. The top of the crosswalk is flat and typically made of asphalt, patterned concrete, or brick pavers. Brick or unit pavers should be discouraged because of potential problems related to pedestrians, bicycles, and ADA requirements for a continuous, smooth, vibration-free surface. Detectable warning strips are needed at the sidewalk and street boundary so that visually impaired pedestrians can identify the edge of the street.

Type 2: Signalized/Controlled Crossings

New signalized crossings may be recommended for crossings that meet pedestrian, school, or modified warrants, are located more than 250 feet from an existing signalized intersection, and where 85th percentile travel speeds are 40 MPH and above or ADT exceeds 15,000 vehicles. Each crossing, regardless of traffic speed or volume, requires additional review by a registered engineer to identify sight lines, potential impacts on traffic progression, timing with adjacent signals, capacity, and safety.

Multi-use trail signals are normally activated by push buttons, but also may be triggered by motion detectors. Push buttons at elevated heights for equestrians (between six and eight feet above the ground) should also be considered. The maximum delay for activation of the signal should be two minutes, with minimum crossing times determined by the width of the street. The signals may rest on flashing yellow or green for motorists when not activated, and should be supplemented by standard advanced warning signs. Various types of pedestrian signals exist that can be used at Type 2 crossings.

Type 3: Grade-separated Crossings

Grade-separated crossings may be needed where existing bicycle/pedestrian crossings do not exist, where ADT exceeds 25,000 vehicles, and 85th percentile speeds exceed 45 MPH. Safety is a major concern with both overcrossings and undercrossings. In both cases, multi-use trail users may be temporarily out of sight from public view and may have poor visibility themselves. Undercrossings, like parking garages, have the reputation of being places where crimes occur. Most crime on multi-use trails, however, appears to have more in common with the general crime

Type 3 crossings (like this crossing in Davis, CA) are grade separated - over or under the roadway - and segregate trail users from motorized traffic completely. Type 3 are recommended on higher speed/higher volume roadways.

rate of the community and the overall usage of the multi-use trail than any specific design feature.

Design and operation measures are available which can address multi-use trail user concerns. For example, an undercrossing can be designed to be spacious, well-lit, equipped with emergency cell phones at each end, and completely visible for its entire length prior to entering. Other potential problems with undercrossings include conflicts with utilities, drainage, flood control, and maintenance requirements. Overcrossings pose potential concerns about visual impact and functional appeal, as well as space requirements necessary to meet ADA guidelines for slope.

Equestrians have particular needs at overcrossings. Only slip-resistant, non-visually permeable materials should be used for decking surfaces where equestrians are crossing. Horses should not be able to see the ground or water below them when crossing an elevated structure. Railings should be visually permeable as horses are resistant to walking next to solid surfaces. In the event of crossing a high speed traffic corridor, a solid barrier topped by an open-view railing is recommended.

AASHTO requires that handrails be a minimum of fifty-four inches high for equestrian traffic. The minimum suggested bridge width on horse trails in areas with low levels of development is 5 feet. In areas with high levels of development, 12 feet of clear width is preferred. For facilities subject to AASHTO guidelines, the clear bridge width should match the width of the shared-use trails that lead up to it. An additional 2 feet of clearance to the railing or barrier should be provided on each side (AASHTO 1999). It also provides maneuvering space when other trail users are encountered.

In addition, bridges and boardwalks anticipating equestrian use must meet engineering specifications to support the weight of a large group of stock. Structures designed primarily for pedestrians and bicycles are typically not strong enough for horses and mules, because the decking cannot withstand the force of horseshoes or the point load per hoof. In addition, bridges must be engineered to withstand the vibration caused by single or multiple animals. Stock, including their riders and/or loads, usually weigh from 1,000 to 1,700 pounds.

Bicycle Facilities at Railroad Crossings

Railroad crossings are particularly hazardous to those who rely on wheeled devices for mobility because they have flangeway gaps that have the potential to catch wheelchair casters and bicycle tires. In addition, rails or ties that are not embedded in the travel surface create a tripping hazard. Recommendations:

- Make the crossing level; raise approaches to the tracks and the area between the tracks to the level of the top of the rail.
- Bicycles should cross railroad tracks at a right angle.
- When bikeways or roadways cross railroad tracks at grade, the roadway should ideally be at a right angle to the rails. When the angle of the roadway to the rails is increasingly severe, the approach recommended by AASHTO (Guide for the Development of Bicycle Facilities, 1999, p.60) is to widen the approach roadway shoulder or bicycle facility, allowing bicycles to cross the tracks at a right angle without veering into the path of passing motor vehicle traffic.
- Provide railroad crossing information in multiple formats, including signs, flashing lights, and audible sounds.
- Perform regular maintenance to clear debris from shoulder areas at railroad crossings.
- Fill flangeway with rubberized material or concrete slab. Normal use of rail facilities causes buckling of paved-and-timbered rail crossings. Pavement buckling can be reduced or eliminated by filling the flangeway with rubberized material, concrete slab, or other treatments. A beneficial effect of this is a decrease in long-term maintenance costs.

Trail Signage

Multi-use trail signs and markings should include: regulatory, wayfinding, identity, and informational or interpretive signs for bicyclists, pedestrians, and motorists. Sign selection and placement should generally follow the guidelines in the Manual on Uniform Traffic Control Devices (MUTCD).

General Standards

All signs shall be retro-reflective on shared-use trails. Lateral sign clearance shall be a minimum of three feet and a maximum of six feet from the near edge of the sign to the near edge of the trail.

Mounting height shall be between four and five feet from the bottom edge of the sign to the trail surface level.

All on-street signs should be oriented so as not to confuse motorists. The designs (though not the size) of signs and markings should generally be the same as used for motor vehicles.

A yellow centerline stripe is standard for multi-use trails in many regions, especially at blind corners, high traffic areas where the trail width

narrows, intersection approaches, or areas where nighttime riding is expected with limited lighting.

The final striping, marking, and signage plan for the Ecusta Rail Trail will be resolved in the full design phase of the trail, and it should be reviewed and approved by a licensed traffic engineer or civil engineer. This will be most important at locations where there are poor sight lines from the trail to cross-traffic (either pedestrian or motor vehicle).

Regulatory Signs

Regulatory signs should state the rules and regulations associated with trail usage, as well as the managing agency, organization, or group. The purpose of trail regulations is to promote user safety and enhance the enjoyment of all users. It is imperative that, before the trail is opened, trail use regulations are developed and posted at trailheads and key access points. Trail maps and informational materials might include these regulations as well. Establishing that the trail facility is a regulated traffic environment just like other public rights of way is critical for compliance, and it often results in a facility requiring minimal enforcement. Be sure to have an attorney review the trail regulations for consistency with existing ordinances and enforceability. In some locations, it may be necessary to pass additional ordinances to implement trail regulations.

Below is a sample of the most common items that should be covered in trail regulations:

- Hours of use
- Motorized vehicles, other than power-assisted wheelchairs, are prohibited
- Keep to the right except when passing
- Yield to on-coming traffic when passing
- Bicyclists yield to pedestrians
- Give an audible warning when passing
- Pets must always be on short leashes
- Travel no more than two abreast
- Alcoholic beverages are not permitted on the trail
- Do not wander off of trail onto adjacent properties

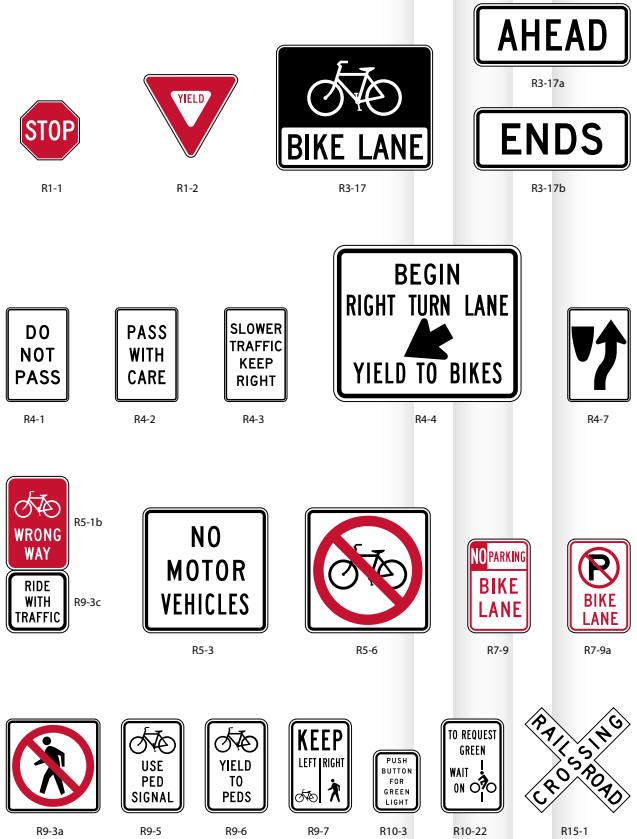
In addition, other warning signs informing users of approaching intersections and crossings of driveways will need to be installed.

Wayfinding and Identity Signs

A comprehensive sign system makes a trail system memorable. Informational kiosks with maps at trailheads and other pedestrian generators can provide enough information for someone to use the trail system with little introduction. A trail wayfinding map typically includes current location, nearby destinations, and prominent natural and built features.

Trail legibility and identity is enhanced by having a consistent, unique logo or design that will help guide people to and on the trail. Gateways or entry markers at major access points with trail identity information further augments the trail experience. They should be visually clear and distinctive while maintaining consistency with other sign features found on the trail.

Clear, pedestrian-scaled signs and markers will aid in wayfinding and separation of user groups. Signs should be consolidated to avoid clutter and sign fatigue. In addition to a trail logo being posted on bollards, gates, and trailheads, wayfinding markers and signs should be placed at key decision points. Distances may also be marked periodically, so trail users who wish to pace themselves have a means of doing so.



Examples of Regulatory Signs and Plaques for Bicycle Facilities, as depicted in the 2009 MUTCD

Example of wayfinding signage

Informational and Interpretive Signs

Interpretive installations and signs enhance the trail experience by providing information about the history, environment, and culture of the area. Installations may provide educational information while creating a unique and memorable experience. Interpretive signs should use similar materials, forms, and colors as other sign elements found throughout the trail in order to provide a unified trail experience.

Informational kiosks orient users to the trail and its surroundings

Trail Etiquette Signs

Informing trail users of acceptable trail etiquette is a common issue when multiple user types are anticipated. Yielding the right-of-way is a courtesy and yet a necessary part of a safe trail experience involving multiple trail users. Trail right-of-way information should be posted at trail access points and along the trail. The message must be clear and easy to understand. The most common trail etiquette systems involve yielding of cyclists to pedestrians and equestrians and the yielding of pedestrians to equestrians. The education of trail users is a critical part of creating a safe trail environment for all trail users. Guidelines should be clearly posted at trail access points. Education curriculums, similar to the "Safe Routes to Schools" Programs, could be used to encourage safe practices of various trail users on the trail.

A commonly used multi-use trail etiquette sign

Wayfinding signage orients users to destinations along the trail

Trail etiquette signage advises trail users about proper interactions to minimize conflicts.

Alternative bike route sign concept that can be customized with route number and community identity

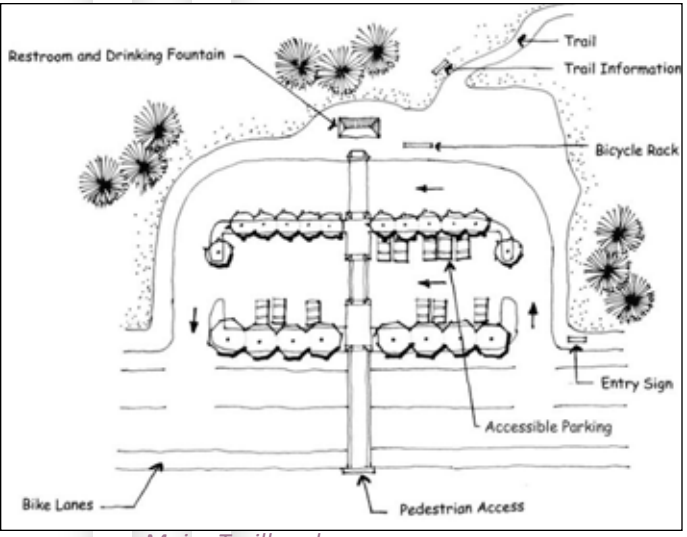
Signs warns trail users of potential hazards

Local identity sign with trail etiquette insert (Source: URS)

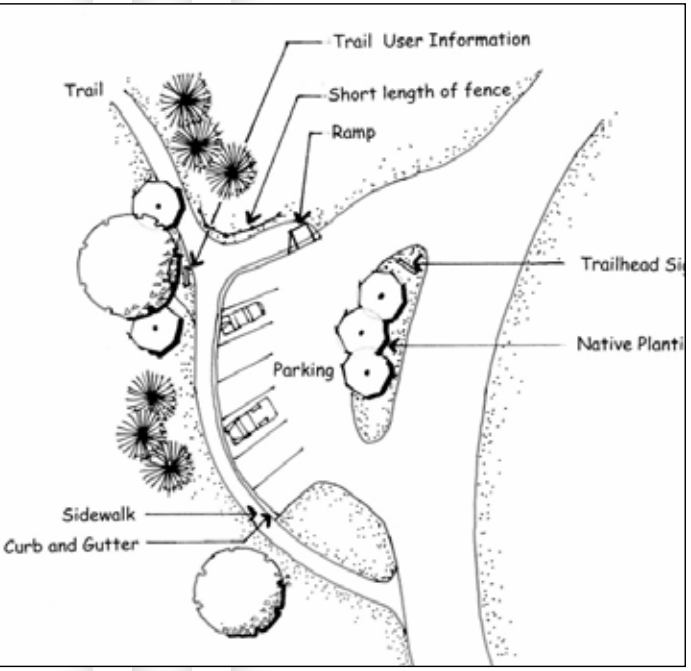
Informational sign about facility funding partners

MUTCD sign for narrow travel lanes that require sharing

MUTCD regulatory sign



Major Trailhead



Trailhead with Small Parking Area

Trailheads

The Ecusta Rail Trail is envisioned as a multi-use trail that will be used by pedestrians, bicyclists (both recreational and utilitarian), equestrians, and in-line skaters. The trail will be accessible to people in wheelchairs and senior citizens with walking aids who require a smooth surface. Good access to the trail for all users is a key element to its future success. Simply put, if people cannot get to a trail easily, they will not use it.

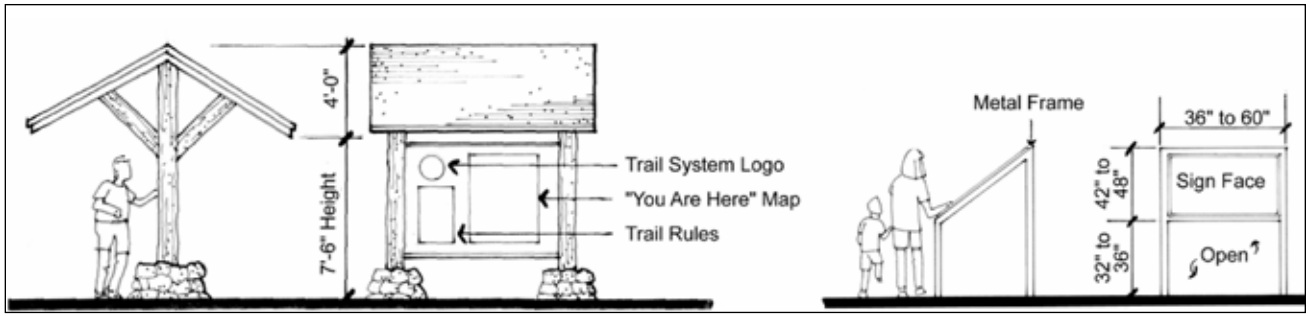
Trailheads (formalized parking and access areas) serve the local and regional population arriving to the trail system by car, transit, bicycle, or other modes. Trailheads provide essential access to the multi-use trail system and include amenities such as parking for vehicles and bicycles, restrooms (at major trailheads), and posted maps. A central information installation also helps users find their way and acknowledge the rules of the trail. They are also useful for interpretive education about plant and animal life, ecosystems, and local history.

Because the trailhead will usually shape a user's first impression of the trail, function and appearance will be key. The typical trailhead design will focus on:

- Maneuvering room for vehicles, pedestrians and cyclists
- Parking stalls for automobiles
- Information kiosks, signs, litter receptacles, fencing, restroom facilities, potable water and landscaping
- Connector trails to the main rail trail.
- Security fencing, lighting, and barrier systems, such as bollards to prevent motor vehicle access to the rail trail

Trailheads with a small parking area should additionally include bicycle parking and accessible parking that meets ADA standards for design, height, and placement.

Neighborhood access should be possible from all local streets crossing the trail. The trail should be identified at each street crossing, and directional signs should be placed at street intersections, identifying destinations and distances along the trail and within the surrounding community.



Informational Kiosk and Informational Sign

Trail Amenities

Trails with high user volumes - particularly those that access a destination point and have drive-in access - should provide amenities to support users. A variety of amenities can make a trail inviting to the user. The following section highlights some common items that make trail systems stand out.

Interpretive Installations

Interpretive installations and signs can enhance the user's experience by providing information about the history of Henderson and Transylvania Counties and the surrounding area. Installations can also discuss local ecology, environmental concerns, and other educational information.

Water Fountains and Bicycle Parking

Water fountains provide water for people (and pets, in some cases), and bicycle racks allow recreational users to safely park their bikes if they wish to stop along the way, particularly at parks and other desirable destinations.

Water for Horses

Stock need an average of 15 gallons of water per day, per animal. Due to concerns about disease transmission, some riders prefer to provide their own water for their stock and do not permit shared use of water with other stock. Other riders prefer to fill their own bucket from a hydrant, while other riders prefer a water trough. To meet the needs of all riders, a hydrant and shallow water troughs are recommended. Self-draining water troughs can reduce standing water problems and algae growth. Raised shallow basins allow horses to see in all directions.

Water facilities should be located at the perimeter of parking areas and along paths and be free from vegetation and obstructions. Water troughs should be installed on a wearing surface. The wearing surface should be on an aggregate base, sloped for drainage, and allow for adequate clearance from the trough and hydrant on all sides.

Pedestrian-Scale Lighting and Furniture

Pedestrian-scale lighting improves safety and enables the facility to be used year-round. It also enhances the aesthetic of the pathway. Lighting fixtures should be consistent with other light fixtures in the counties, possibly emulating a historic or railroad theme.

Lighting improves the safety of the trail or trail user by increasing visibility during non-daylight hours. Lighting should consider the surrounding land use to minimize light pollution in unwanted areas, such as residential areas. Lighting fixtures should be pedestrian scale and installed near benches, drinking fountains, bicycle racks, trailheads, and roadway crossings. Lighting is typically most appropriate along Class I multi-use trails used for transportation purposes.

Providing benches at key rest areas and viewpoints encourages people of all ages to use the pathway by ensuring that they have a place to rest along the way. Benches can be simple (e.g., wood slats) or more ornate (e.g., stone, wrought iron, concrete). Costs vary depending on the design and materials selected for each amenity. Amenities shall be designed and located so as not to impede accessibility.

Maps and Signage

A comprehensive signing system makes a bicycle and pedestrian system stand out. Informational kiosks with maps at trailheads and other pedestrian generators can provide enough information for someone to use the network with little introduction – perfect for areas with high non-local visitation rates. Signage and wayfinding guidance is provided elsewhere in this section.

Trash Receptacles

Trash and dog waste receptacles help encourage trail users to keep the trail and trailheads free from debris. It is recommended that both types of receptacles be placed at trailheads and key access points along the trail, and all receptacles should be accessible to maintenance personnel. However, the National Park Service's ethic of "pack it in, pack it out" should be encouraged.

Art Installations

Public art along a trail provides an opportunity to add interest to the trail experience and, depending on the scale and form, can become an "event" in itself and serve as a public draw. Public art can be aesthetic or functional, doubling as sitting or congregation areas. Local artists should be encouraged to produce artwork in a variety of materials for sites along the corridor.

Local artists can be commissioned to provide art for the pathway system, making it uniquely distinct. Many pathway art installations are functional as well as aesthetic, as they may provide places to sit and to play.

Landscaping

Landscape features, including street trees or trees along trails, can enhance the visual environment and improve the trail user experience. Trees can also provide shade from heat and protection from rain. When possible, landscaping is the first choice for creating a separation between the trail and adjacent properties. Vegetative buffers have the dual purpose of creating a natural privacy screen, providing habitat, and stabilizing erodible soils. Landscaping can also be an effective barrier to unwanted access where needed.

Restrooms

Restrooms benefit trail users, especially in more remote areas where other facilities do not exist. Accessible restrooms can be sited at major trailheads or at other strategic locations along the trail.

Bollards

Bollards are stout posts sometimes used at roadway and trail intersections and trail entrances to prevent motor vehicles from entering the trail. Bollards can also provide information, such as mile markings, wayfinding for key destinations, or small area maps. Cyclists using the multi-use trail can bump into a bollard, particularly in low light conditions, so when bollards are placed within the trail surface they should be designed to be high-visibility to bicyclists and other trail users - especially at night - with reflective materials and appropriate striping.

Bollards should be placed in the middle of the trail, with sufficient space for trail users of all abilities using a variety of mobility devices to pass. Placement should not block trail travel lanes.

Fixed bollards: Bollards should be metal or heavy timber structures located on the trail centerline or outside of the trail tread. Five foot horizontal spacing is recommended for equestrian passage. In areas where motorcycles or ATVs are anticipated, bollard spacing would need to be closer. In this situation, separate horse specific gateways are utilized.

Removable bollards: Install removable bollards on the trail centerline or outside of the trail tread at intersections where emergency and maintenance access is required. Removable bollards can be keyed and locked to allow maintenance and emergency service vehicle access to the trail.

Alternatives to bollards, such as a median in the trail approaching an intersection, should be considered where space allows. Keep in mind that bollards can create bottlenecks with trail users at intersections and should be used with caution.

Fencing

Fencing may be necessary to indicate separation between adjacent landowners and trail users and to discourage development of informal access trails. Wildlife passage and safety for trail users are important additional factors. Fencing also provides an attractive feature along the trail.

As a general policy, fencing at the edge of the right-of-way should be the responsibility of the adjacent land owners. Although the public often perceives fencing as a means of providing safety by prevention of unwanted access, too much fencing can have the opposite effect by impairing informal trail surveillance. Inappropriate fencing can also degrade the experience of trail users, obscure

views, and create a "tunnel" effect that makes users feel trapped. Fencing of four feet or less can provide a barrier sufficient to denote property boundaries or to deter most access.

Should adjacent property owners choose to build fences, a variety of fencing applications can be considered. Solid fencing that does not allow any visual access to the trail should be discouraged. Fencing that allows a balance between adjacent residents' privacy and informal surveillance of the trail should be encouraged. If separation is desired purely for privacy reasons, vegetative buffers are recommended.

Fencing along approaches to tunnels, overpasses, underpasses, and other interfaces should be provided to prevent trespassing. Fencing, railings, or safety barriers are also recommended when a trail occurs within six feet of a steep slope (more than 3:1) with a vertical grade change or drop off of more than thirty inches.

Mounting Blocks

Mounting blocks typically resemble a short staircase that ends in midair to assist riders in mounting their horses. Mounting blocks can be made from fiberglass, wood, metal, concrete or plastic. Mounting blocks can also be rocks, hay bales, stumps, etc. It is important to note that riders usually mount horses from the left, thus adequate clearance of any obstructions should be allowed around the horse and mounting block. A clearance between 8' to 10' is recommended. Many riders provide their own mounting blocks, but some permanent fixtures are recommended.

Parking Stalls

Pull-through stalls (15' x 45') on a compacted natural surface for trucks and horse trailers is recommended. The pull-through stalls should allow enough room for the loading and unloading of stock and some "tacking up."

Hitch Rails

Hitch or tie rails should be available throughout the trailhead to anchor horses. Hitch rails can be made of wood, metal (i.e. rebar) or other sturdy material and should have "stops" along the rail to prevent reins from sliding.

Trail Safety and Security

Various design and programmatic measures can be taken to address safety issues on a multi-use trail. This section summarizes key safety issues and strategies for minimizing impacts.

Privacy of adjacent property owners

- Encourage the use of neighborhood-friendly fencing and the planting of landscape buffers.
- Clearly mark trail access points.
- Post trail rules that encourage respect for private property.
- Place lighting strategically, utilizing light shields to minimize unwanted light in adjacent homes.

Unwanted vehicle access on the trail

- Utilize landscaping to define the corridor edge and trail, including earth berms or boulders.
- Use bollards at intersections (see previous guidelines)
- Pass a motorized vehicle prohibited ordinance and post signs along the trail.
- Create a Trail Watch Program, and encourage citizens to photograph and report illegal vehicle use of the corridor.
- Lay the multi-use trail out with curves that allow passage of nonmotorized users, but are uncomfortably tight for automobile passage.

Litter and dumping

- Post rules encouraging "pack-it-out" practices.
- Place garbage receptacles at trailheads.
- Manage vegetation to allow visual surveillance of the trail from adjacent properties and roadway intersections.
- Encourage local residents to report incidents as soon as they occur.
- Remove dumpsites as soon as possible.

Trespassing

- Clearly distinguish public trail right-of-way from private property through the use of vegetative buffers and fencing.
- Post rules encouraging respect for property.

Local on-street parking

- Designate residential streets as parking for local residents only to discourage trail user parking.
- Place "no outlet" and "no parking" signs prior to trail access points.

Crime

- Manage vegetation to ensure visibility from adjacent streets and residences.
- Select shrubs that grow below 3 ft in height and trees that branch out greater than 6 ft in height.
- Place lights strategically and as necessary.

Surveillance from nearby buildings and pedestrian-scale lighting can increase shared-use trail safety

Share the Trail' and other community programs raise awareness of safety and other shared-use trail issues

- Place benches and other amenities at locations with good visual surveillance and high activity.
- Provide mileage markers every ¼ mile and clear directional signage for orientation.
- Create a "Trail Watch Program" involving local residents.
- Practice proactive law enforcement. Utilize the corridor for patrol training.

Private use of corridor

- Attempt to negotiate win/win solutions with property owners.
- Eliminate areas where detrimental impact to the trail cannot be reasonably ameliorated.

Vandalism

- Select benches, bollards, signage, and other site amenities that are durable, low maintenance, and vandal resistant.
- Respond through removal or replacement in a rapid manner.
- Keep a photo record of all vandalism and turn it over to local law enforcement.
- Encourage local residents to report vandalism.
- Create a Trail Watch Program; maintain good surveillance of the corridor.
- Involve neighbors in trail projects to build a sense of ownership.
- Place amenities in well used and visible areas.

Community Involvement with Safety on the Trail

Creating a safe trail environment goes beyond design and law enforcement; it should involve the entire community. The most effective and most visible deterrent to illegal activity on the Ecusta Rail Trail will be the presence of legitimate trail users. Getting as many "eyes on the corridor" as possible is a key deterrent to undesirable activity.

Provide good access to the trail

Access ranges from providing conveniently located trailheads along the trail to encouraging the construction of sidewalks to accommodate access from private developments adjacent to the trail. Access points should be inviting and signed so as to welcome the public onto the trail.

Good visibility from adjacent neighbors

Neighbors adjacent to the trail can potentially provide 24-hour surveillance of the trail and can become the rail trail's biggest ally. Though some screening and setback of the trail is needed for the privacy of adjacent neighbors, completely blocking out of the trail from neighborhood view should be discouraged. This eliminates the potential of having the neighbors' "eyes on the trail," and could result in a "tunnel effect".

High level of maintenance

A well-maintained trail sends a message that the community cares about the public space. This message alone will discourage undesirable activity.

Programmed events

Community events along the trail will help increase public awareness and thereby attract more people to use the trail. Neighbors and residents can help organize numerous public events along the trail, which will increase support for the trail. Events might include a day long trail clean up or a series of short, interpretive walks led by long time residents or a park naturalist.

Adopt-a-Trail Program

Nearby businesses, community institutions, and residential neighbors often see the benefit of their involvement in the trail development and maintenance. Businesses and developers may

view the trail as an integral piece of their site planning and be willing to take on some level of responsibility for the trail. Creation of an adopt-a-trail program should be explored to capitalize on this opportunity and build civic pride.

Trail Watch Program

Partnering with local and county law enforcement, a Trail Watch program would provide an opportunity for local residents to become actively involved in crime prevention along the Ecusta Rail Trail. Similar to Neighborhood Watch programs, residents are brought together to get to know their neighbors, and they are educated on how to recognize and report suspicious activity.

Drainage and Erosion Control

Erosion control is necessary to maintain a stable walkway and trail surface. Following land contours helps reduce erosion problems, minimizes maintenance, and increases comfort levels on all trail types.

On paved surfaces, a 2% cross slope will resolve most drainage issues and should be used for both the trail and its shoulders. A maximum 1:6 slope may be used for the shoulders, although 2% is preferred. For sections of cut where uphill water is collected in a ditch and directed to a catch basin, water should be directed under the trail in a drainage pipe of suitable dimensions. In general, water should always be directed away from rail tracks. During trail construction, local erosion control best practices should be followed.

Debris on an asphalt paved trail due to improper drainage design

This Page Intentionally Left Blank