BASIN RECREATION

Snyderville Basin Special Recreation District Trail Design Standards

APRIL 2019

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INTRODUCTION

HISTORY AND MISSION

The Snyderville Basin Special Recreation District (SBSRD, or the District) is an independent special service district of Summit County, Utah. The District boundaries include the western end of Summit County, excluding the incorporated area of Park City. SBSRD's mission statement is as follows:

To be the leader in providing outstanding and diverse parks, trails and recreational experiences in an environmentally and socially responsible way.

Purpose of this document

Trails are an important and valued form of land use in the Snyderville Basin. These designs and development standards have a three-fold purpose.

1. To implement policies set forth in the Snyderville Basin General Plan (2015) regarding trail advocacy within the Snyderville Basin, in order to achieve the overall trail objectives for the community- wide trail system.
2. To provide the Summit County planning staff, Snyderville Basin Planning Commission, and Summit County Council guidance in their interpretations of the District's Trails Master Plan when responding to projects submitted for development review.
3. To provide the development community an understanding of the planning and design standards to be applied to each individual trail project within the community-wide trail system.

Use of these standards by neighborhoods or other trail management agencies is encouraged to provide trail continuity throughout the Basin. In addition to these Trail Design Guidelines, Summit County ordinances also influence how trails should be developed. It is understood that certain conditions or situations may warrant deviation from these Standards and the District, in its professional judgment, will decide whether such deviation is justified.

History

The District was established by the Summit County Board of County Commissioners (BCC) in 1986 for the purpose of providing public recreation facilities and services, within the boundaries of the District.

In September 1995, District residents approved a $7.5 million General Obligation Bond to fund community parks and recreation in the Snyderville Basin. In 1996, policies supporting the development of community parks and trails were incorporated into the Snyderville Basin General Plan. These policies were further defined and adopted in the District's Recreation and Trails Master Plan. This represented the first opportunity for new development to contribute toward recreational needs in the Snyderville Basin. The Recreation and Trails Master Plan was adopted by the BCC on December 1, 1997.

Initial expenditures (1) funded land acquisition and improvements at Trailside Park; (2) allocated $2 million to begin the implementation of the community-wide trail system master plan; and; (3) provided financial assistance in the construction of an enhanced community swimming pool and four playing fields at Ecker Hill Middle School.

In November 2001, voters in the District

authorized another $11 million General Obligation Bond with these uses: (1) recreational open space ($3 million); (2) additional trails ($2 million); (3) capital facility improvements including an indoor sports center ($4 million); and (4) a contribution toward an ice rink to be built in partnership with Park City ($2 million).

In November 2004, voters in the District authorized $10 million for passive recreational open space land acquisition, including trails and trailheads. This initiative was placed on the ballot at the request of the Basin Open Space Advisory Committee (BOSAC) whose purpose is to advise and provide input to the Summit County Council regarding the creation, preservation and identification of open space within the Snyderville Basin. Following the approval of the open space bond, the Summit County Council adopted Summit County Ordinance No. 520, the Revised General Plan for the Snyderville Basin, in which the preservation of open space is the "central premise" of the Plan.

In November 2010, electors in the District voted to approve the issuance of $20 million General Obligation Bonds for the purpose of financing $12 million to acquire recreational open space property and $8 million for trails construction and trail-related improvements. 72% of voters were in favor of the issuance. The District issued the full $20 million and bonds were sold in March 2011.

In November 2014, electors voted to approve issuance of $25 million General Obligation Bonds for the purpose of financing $15 million to acquire recreational open space property, $8 million for recreation facilities and $2 million for trails construction and trail- related improvements. 71.8% of voters were in favor of the issuance. The District issued the full $25 million and bonds were sold in March 2015.

Summit County Ordinances

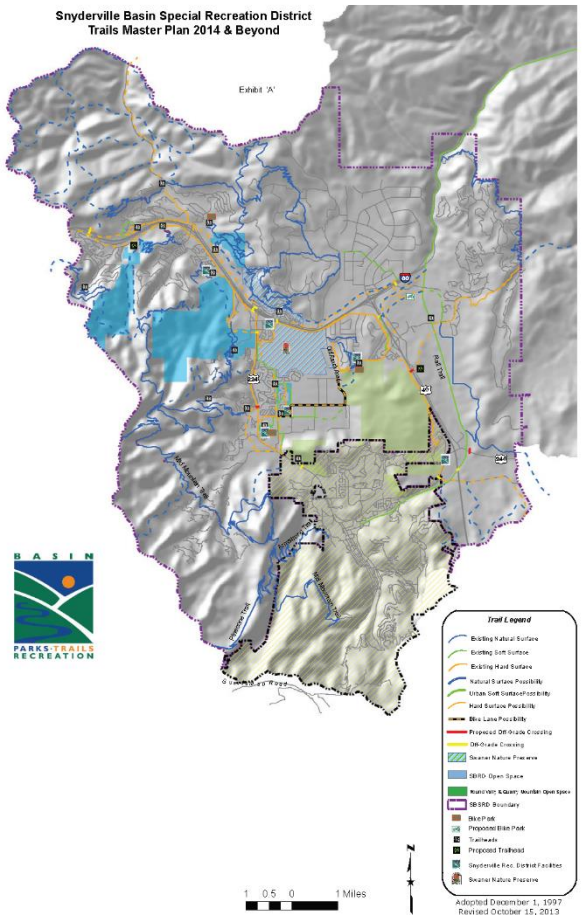
As specified in the 2006 SBSRD Master Plan, new development is required to provide and maintain neighborhood park facilities, as new demand for recreation will arise as a result. Section 10-4-16.B specifies that all neighborhood trails provided by developers shall be consistent with SBSRD's Trail Design Standards.

Additionally, lands along proposed community-wide trails (established by the trails master plan) shall be developed as long as the developer agrees to provide the proportional share of the community wide trail system running through the site. The proportional share may be provided by deed, easements or rights-of-way (ROW) for the community-wide public trail system managed by the District. New development should also connect the internal neighborhood trail system to community-wide trail systems wherever feasible. Summit County ordinances also specify requirements for open space preservations set for new developments. The landowner/developer for all other development shall determine how the open space will be held for ownership purposes, and the County may choose not to accept ownership of open space that is not compatible with the County and District objectives.

Section	Applicable Summit County Ordinances for Trail Development
7-5	Snyderville Basin Parks and Recreational Facilities
10-4-16	Parks, Trails, and Trailheads

* Note: Other Summit County ordinances may pertain to trail development in some cases.

SBSRD Master Plan



The most recent SBSRD Master Plan was adopted in 2006 with the goal to amend, restate and supersede the previously adopted 1997 Master Plan. The study identified key objectives that influence the development and improvement of parks, trails, and recreation resources within the District:

Continue efforts towards land preservation through the Recreation Open Space Bonds;

- Achieve an effective balance of recreational open space preservation while meeting the need for active park space to include developed sports fields and support buildings;
- Achieve connectivity in the community- wide trail system to meet the non-motorized transportation and backcountry recreation needs of residents and visitors to the Snyderville Basin;
- Continue to assess needs as they relate to swimming pools and other capital facility improvements to meet the diverse recreational needs of a growing population, as funding is available; and
- Provide recreational trail facilities such as stacked loop systems, bike parks, and/or single-use trails.

The plan also highlights that SBSRD is not responsible for owning or managing neighborhood recreational facilities such as parks and trails, and that all new development will be required to mitigate the absence of appropriate neighborhood recreation infrastructure as a condition of development approval.

Development Process

Recreation and trails are an important part of the quality of life of Summit County residents. In order to preserve and enhance the trail system for existing and future residents, close coordination is needed between the District, Summit Countyand developers. As a service provider in the Basin, all new development, plats, and property improvements are subject to review by the District through Summit County's development review process.

TRAIL TYPES & FUNCTION

TRAIL FUNCTION

SBSRD's mission is to provide recreational opportunities for Summit County residents. Therefore, all trails should provide some level of recreational value for one or more users. In addition, trails may also serve non-motorized transportation needs where possible and appropriate.

Recreation Trails

Trails can be purely recreational, such as a loop trail through an open space parcel. District recreational trails can also provide connections with and access to other trails of any type, including trails managed by other agencies and governmental bodies. In addition to adding recreation, all trails should consider and balance public access with the scenic, natural, historic, geologic, open space, wildlife habitat, and floodplain values of the property.

Recreation and Transportation Trails

Through alignment, design, and construction, trails can also be useful for transportation by connecting destination points and/or by providing alternatives to the road system. These are primarily multiple use trails, which consist of hard and soft surfaces, but can also be crusher fines surface or natural surface trails that connect destinations. Consistent with the goals and objectives of the Snyderville Basin Special Recreation District Trails Mater Plan, a trail useful for transportation should also provide a good trail experience which encourages people to use the trail, optimize the trail for the same recreational and open space values as given above, and optimize the transportation function through alignment and design which strives to create safe and easy movement along the trail. The design and construction specifications for each trail type are meant to enhance both recreation and, where appropriate, transportation functions.

TRAIL TYPES

The SBSRD Trail Master Plan identifies three primary trail types including hard surface trails, soft surface trails, and natural surface trails.

Hard Surface Trails

Hard surface trails serve both recreation and transportation functions within Summit County. These trails can accommodate a wide variety of users from wheelchair users to pedestrians to road cyclists. Hard surface trails should be ADA-accessible, meet applicable ABA standards, and typically take the form of shared use paths (p. 16) or sidepaths (p.18). Nordic use is possible in the winter and should be considered in the trail design.

Soft. Surface Trails

Soft surface trails may serve both transportation and recreation functions. Soft surface trails utilize many of the same horizontal and vertical alignment criteria as hard surface trails and primarily differ in the treatment of the trail tread. Some trail users such as people in wheelchairs or road cyclists may prefer hard surface trails while other users such as joggers or equestrians may prefer soft surface trails. Soft surface trails typically take the form of shared use paths (p. 16) or sidepaths (p. 18).

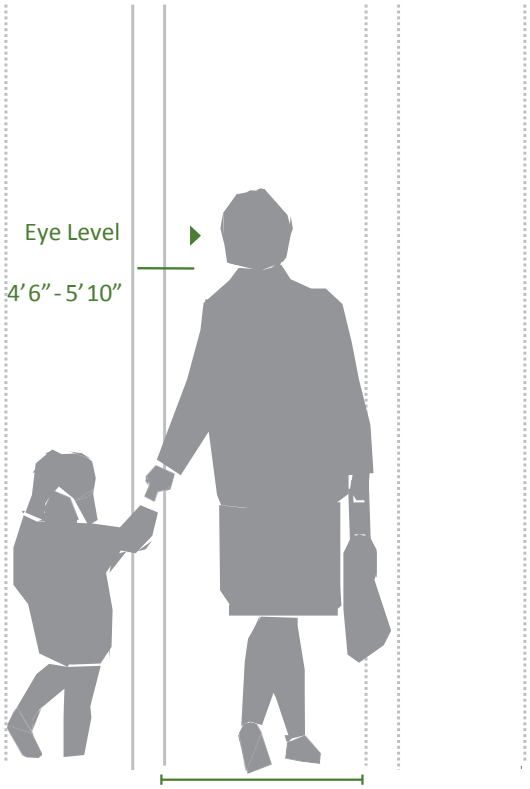
Natural Surface Trails

Natural surface trails serve a predominantly recreational function and are appropriate where a natural and undeveloped feel is desired. Natural surface trails may be designed to support a single recreational user, such as hikers or mountain bikers, or may be designed to accommodate multiple users. Natural surface trail treads and detailing may vary according to site conditions and the anticipated use. Natural surface trail design guidance can be found starting on p. 21.

DESIGN NEEDS OF PEDESTRIANS

Pedestrians include a wide variety of trail users such as walkers, hikers, joggers, trail runners, and people pushing baby strollers.

Pedestrian Spatial Characteristics



Pedestrian Characteristics by Age

0-4	Learning to walk
	Requires constant adult supervision
	Developing peripheral vision and depth perception
5-8	Increasing independence, but still requires supervision
	Poor depth perception
9-13	Susceptible to “darting out” in roadways
	Insufficient judgment
	Sense of invulnerability
14-18	Improved awareness of traffic environment
	Insufficient judgment
19-40	Active, aware of traffic environment
41-65	Slowing of reflexes
65+	Difficulty crossing street
	Vision loss
	Difficulty hearing vehicles approaching from behind

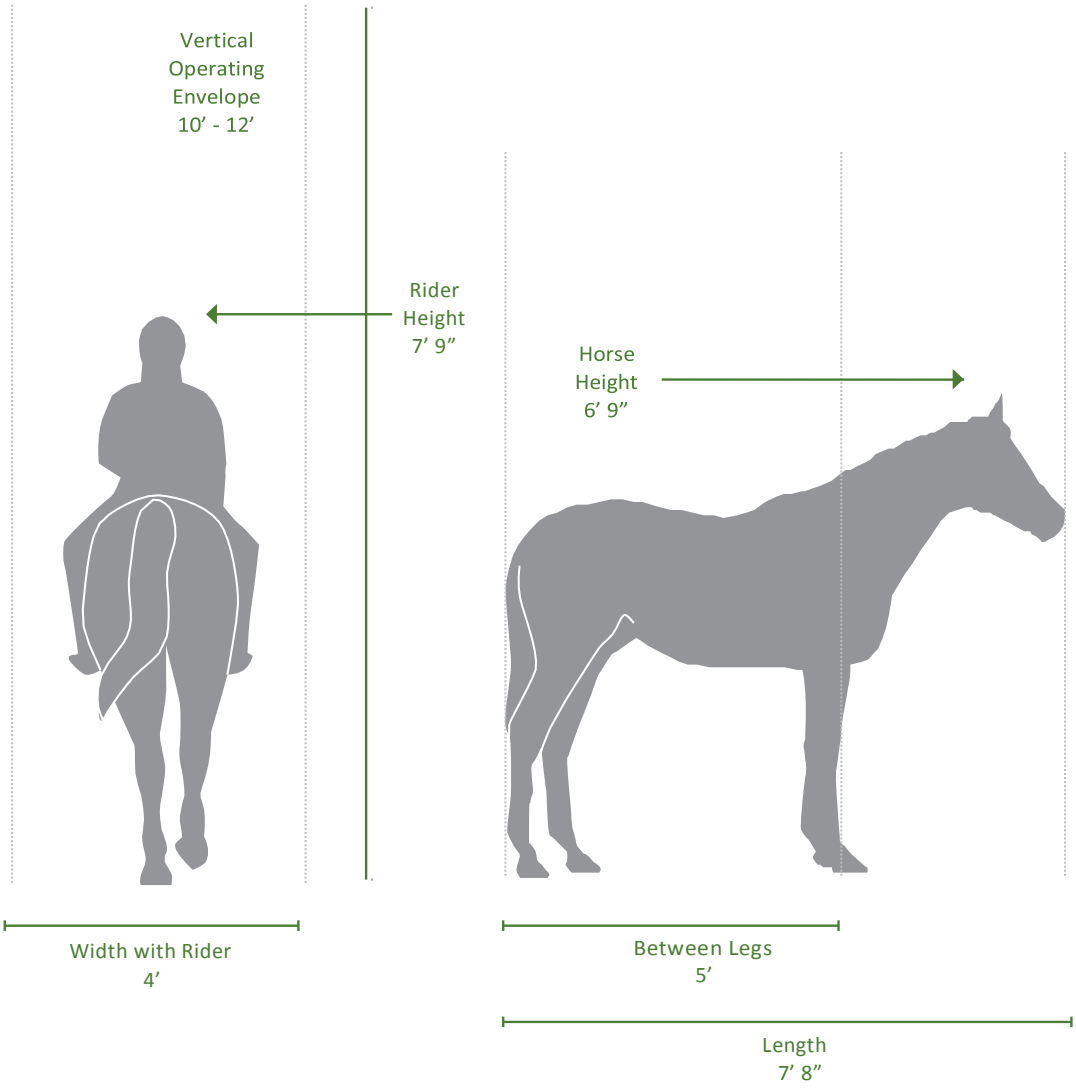
Source: AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, Exhibit 2-1. 2004

DESIGN NEEDS OF EQUESTRIANS

On trails that permit equestrian uses, riders on their mounts are the heaviest, widest and tallest potential user type. Mounts include horses, mules and donkeys, which all vary in size. Size depends on breed and age. Trail stock usually weigh between 800 and 1,500 pounds, and a well-conditioned horse or mule can carry up to 20 percent of its body weight.

Equestrian Spatial Characteristics

Equestrian users include youth, elderly, leisure riders, professional riders, organized groups, novices, and people with disabilities. Riders may recreate individually or in groups for pleasure, exercise or challenge. Trails reserved exclusively for equestrians are also called “bridle trails,” “bridle paths,” or bridleways.”



Source: US Forest Service. Equestrian Design Guidebook for Trails, Trailheads and Campgrounds 2007

DESIGN NEEDS OF BICYCLISTS

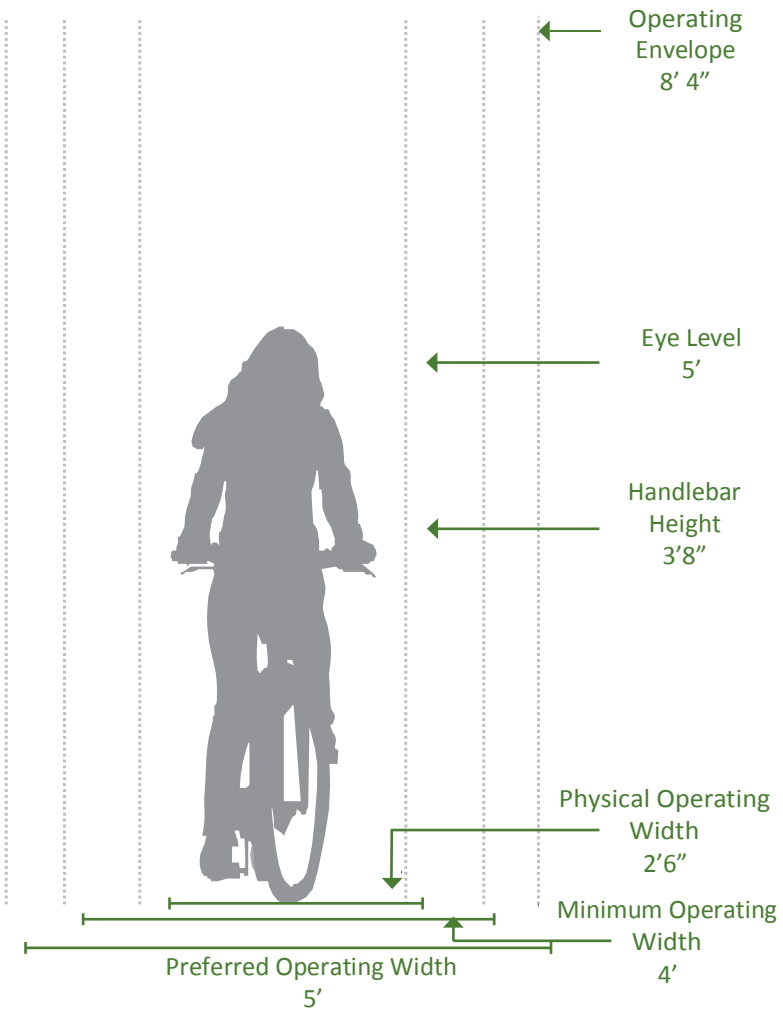
Similar to motor vehicles, bicyclists exist in a variety of sizes and configurations. These variations occur in the types of vehicle (such as a conventional bicycle, a recumbent bicycle or a tricycle), and behavioral characteristics (such as the comfort level of the bicyclist). The design of a shared use path should consider expected bicycle types on the facility and utilize the appropriate dimensions.

Bicycle as a Design Vehicle

The figure below illustrates the operating space and physical dimensions of a typical adult bicyclist, which are the basis for typical facility design.

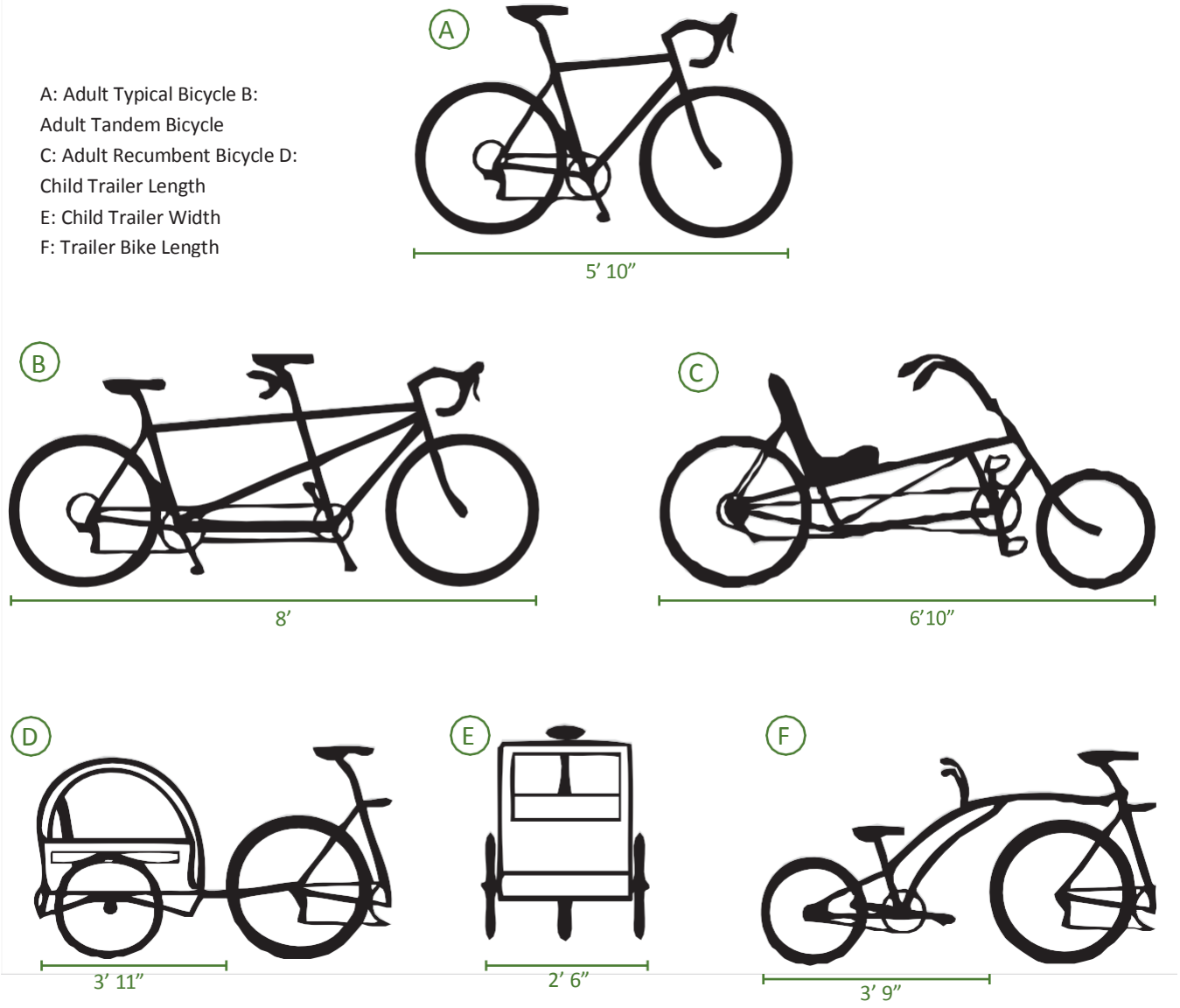
Bicyclists require clear, open space with no visual obstructions to operate within a facility. This is why the minimum operating width is greater than the physical dimensions of the bicyclist.

Bicycle Rider - Typical Dimensions



Bicycle Design Vehicle - Typical Dimensions

A: Adult Typical Bicycle B: Adult Tandem Bicycle
C: Adult Recumbent Bicycle D: Child Trailer Length
E: Child Trailer Width
F: Trailer Bike Length



Source: AASHTO *Guide for the Development of Bicycle Facilities*, 4th Edition

Design Speed Expectations

The expected speed that different types of bicyclists can maintain under various conditions also influences the design of facilities such as shared use paths. The table to the right provides typical bicyclist speeds for a variety of conditions.

Bicycle as Design Vehicle - Design Speed Expectations

Bicycle Type	Feature	Typical Speed
Upright Adult Bicyclist	Paved level surfacing	8-12 mph*
	Crossing Intersections	10 mph
	Downhill	30 mph
	Uphill	5 -12 mph
Recumbent Bicyclist	Paved level surfacing	18 mph

* Typical speed for causal riders per AASHTO 2013.

DESIGN NEEDS OF NORDIC SKIERS

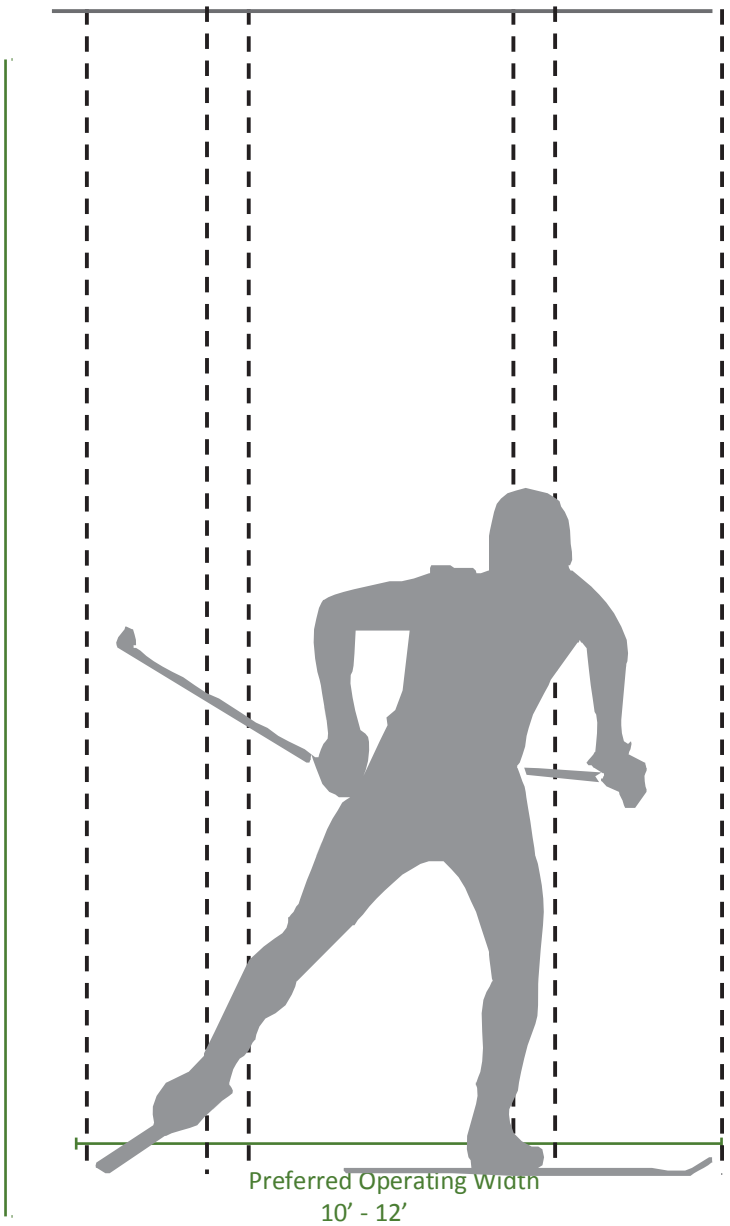
Many multi-use trails used for bicycling, walking, and horseback riding during warm weather months are suitable for cross-country skiing in winter months. If trail grooming for track setting is to take place, trail clearance should be at least 14 feet wide.

Characteristics

Nordic Skiers prefer loop trails over linear trails. It is important to develop internal connector trails to allow different trail lengths. Multiple, short loops are often preferred to one long loop.

Turning Requirements

Cross country skiers prefer gradual curves that allow skiers to glide through them easily. At sharp turns, provide additional trail width to allow skiers to snowplow and negotiate the turn.



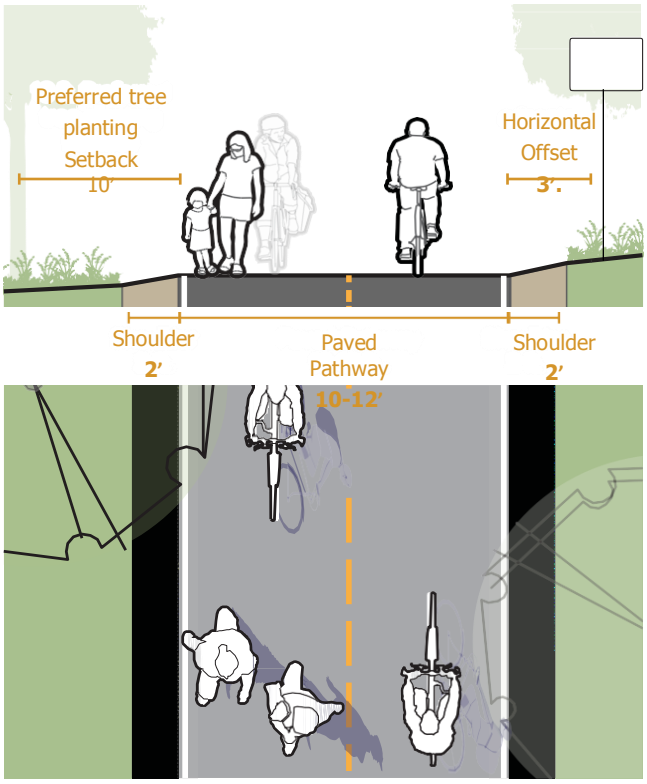
Reference: Rathke, D. and Baughman, M. Recreational Trail Design and Construction. Minnesota Extension Service, University of Minnesota. 1997

HARD & SOFT SURFACE TRAIL DESIGN

SHARED-USE PATHS

A shared-use path allows for two-way, use by pedestrians, bicyclists, and other non-motorized trails users. These facilities are frequently found in parks, along streams or drainages, and in greenbelts or utility corridors where there are few conflicts with motorized vehicles.

Refer to guidance on sidepaths for information on shared-use paths adjacent to roadways.



Alignment Considerations

Shared-use paths are frequently located in parks, open spaces, stream corridors, or utility ROWs where there are few conflicts with motorized vehicles. Path facilities can also include amenities such as lighting, signs, and fencing (where appropriate).

Key features of shared-use paths include:

- Frequent access points from the local road network.
- Directional signs to direct users to and from the path.
- A limited number of at-grade crossings with streets or driveways.
- Terminating the path where it is easily accessible to and from the street system.

Design Standards

Shared-use paths shall be designed to meet recreation and transportation standards as defined by AASHTO, PROWAG, ABA, and MUTCD.

- Materials: Asphalt (hard surface trails), crushed gravel (soft surface trails), concrete may be used in areas prone to flooding.
- Standard Width: Standard shared-use path width is 10 feet. Where heavy volumes and higher speeds are anticipated, 12 feet should be used.
- Minimum Width: The minimum width of a shared-use path is 8 feet. This should only be utilized for short distances and in very constrained situations.
- Horizontal Clearance: A 1 foot minimum and 2 foot maximum shoulder on both sides of the path should be provided free of obstacles. Horizonal clearance should be greater in corners. An additional foot of lateral clearance, for a total of 3 feet is suggested where possible by the MUTCD for the installation of signage or other furnishings.

- Vertical Clearance: Standard clearance to overhead obstructions should be 10 feet, 8 feet minimum (to be determined by the District).
- Cross Slope: Maximum cross slope of 2%. Design for a 1.5% cross slope to account for tolerance in construction. Variance may be approved by the District.
- Running Slope: Generally limited to 5% maximum to accommodate all user types Running slopes greater than 5% may be designed in shared use paths and sidepath scenarios where terrain does not allow for 5%. See ASHTO Guide for the Development of Bicycle Facilities, Chapter 2 for guidance on running slopes greater than 5%. Variances may be approved by the District.

Markings

- Under most conditions, center line markings are not necessary. Solid center lines can be provided on tight or blind corners, and on the approaches to roadway crossings.

Further Considerations

- Terminate paths where they are easily accessible to and from the street system, preferably at a trailhead, controlled intersection or at the beginning of a dead-end street.

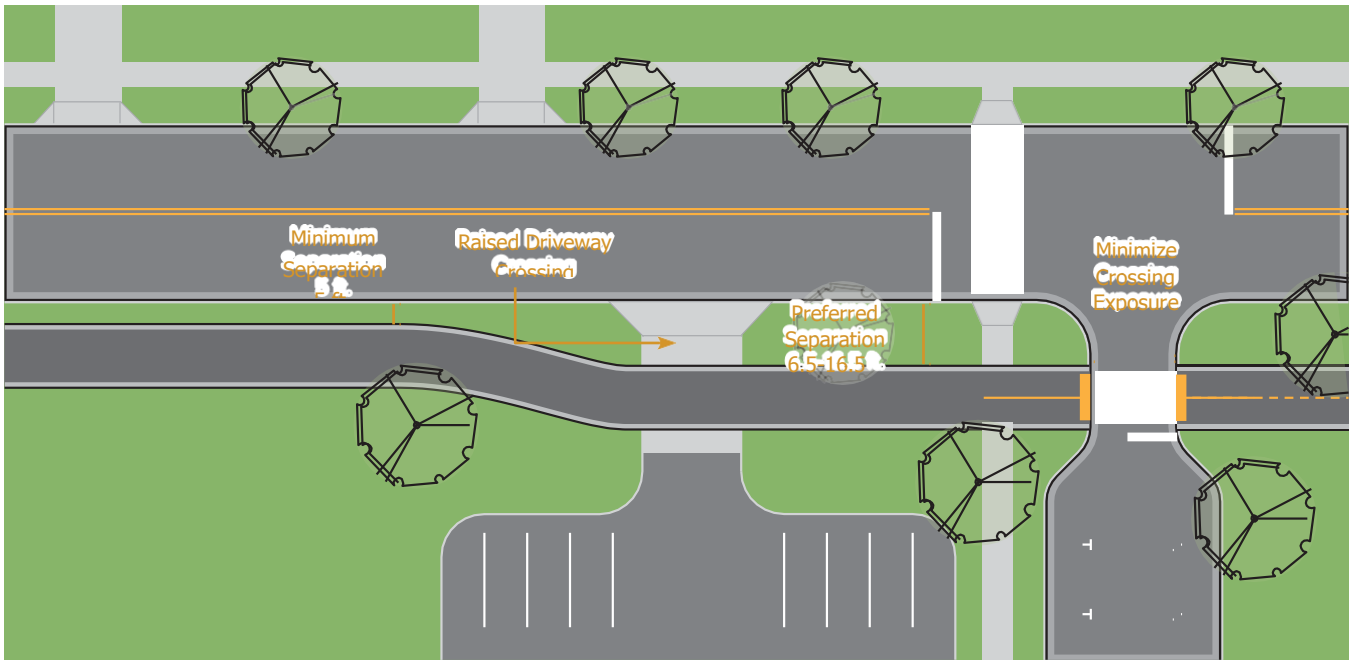
Additional References

AASHTO. Guide for the Development of Bicycle Facilities. Chapter 5. (2012)

FHWA. Manual on Uniform Traffic Control Devices. Chapter 9. (2009)

SIDEPATHS

A sidepath is a bidirectional shared use path located immediately adjacent and parallel to a roadway. Sidepaths can offer a high- quality experience for users of all ages and abilities as compared to on-roadway facilities in heavy traffic environments, allow for reduced roadway crossing distances and maintain community character.



Alignment Considerations

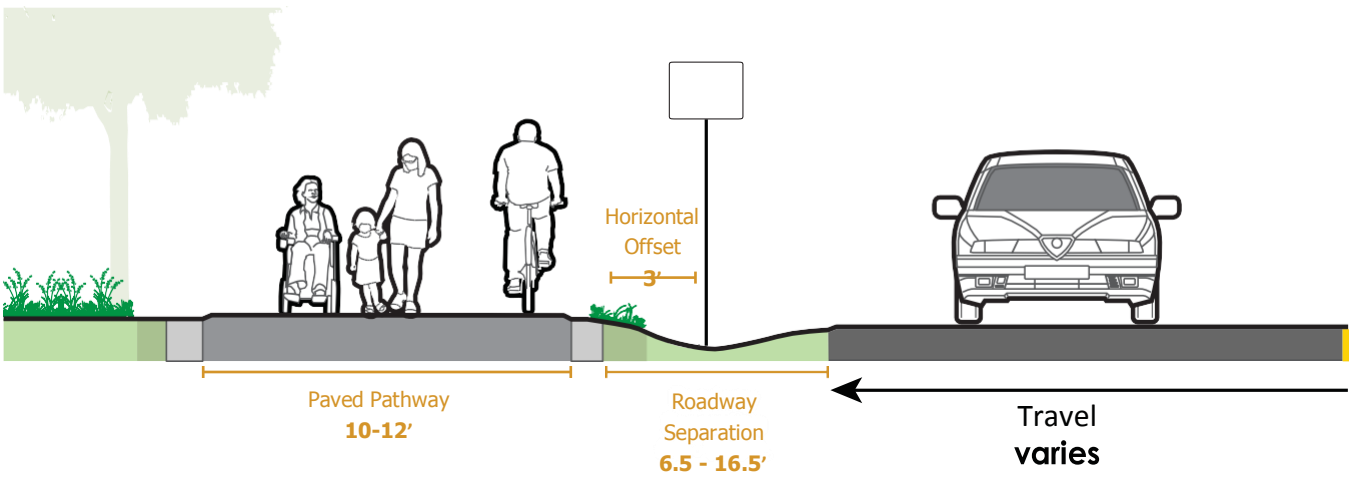
Although paths outside of the road ROW are preferred, sidepaths may be considered where one or more of the following conditions exist:

- The adjacent roadway has relatively high- volume and high-speed motor vehicle traffic that might discourage many bicyclists from riding on the roadway.
- To provide continuity between existing segments of shared use paths.
- For use near schools and neighborhoods, where increased separation from motor vehicles is desired.
- To provide a trail connection in the absence of other potential trail corridors.

Design Standards

Trails shall be designed to meet recreation and transportation standards as defined by AASHTO, PROWAG, and MUTCD.

- Materials: Asphalt (hard surface trails), crushed gravel (soft surface trails), concrete may be used in areas prone to flooding
- Standard Width: Standard shared use path width is 10 feet. Where heavy volumes and higher speeds are anticipated 12 feet should be used.
- Minimum Width: The minimum width of a shared use path is 8 feet. This should only be utilized for short distances and in very constrained situations.
- Roadway Separation: The preferred



minimum roadway separation width is 6.5 - 16.5 ft. (Schepers, 2011). The target minimum separation width of 5 feet. (AASHTO Bike Guide 2012, p. 5-11). Type B1 or M1 Curb and Gutter may also be used to separate the roadway and pathway where space does not allow for more distance.

- Horizontal Clearance: A 2 foot or greater shoulder on both sides of the path should be provided free of obstacles. An additional foot of lateral clearance, for a total of 3 feet. is suggested by the MUTCD for the installation of signage or other furnishings.
- Vertical Clearance: Standard clearance to overhead obstructions should be 10 feet, 8 feet minimum.
- Cross Slope: The target cross slope is 2%. Design for a 1.5% cross slope to account for tolerance in construction.
- Running Slope: Because sidepaths are located within a roadway ROW, the running slope may match the general grade established for the adjacent roadway.
- Sight Lines: It is important to keep approaches to intersections and major driveways clear of obstructions due to parked vehicles, shrubs, and signs on public or private property.

Further Considerations

Crossing design should emphasize visibility of users and clarity of expected yielding behavior.

Additional References

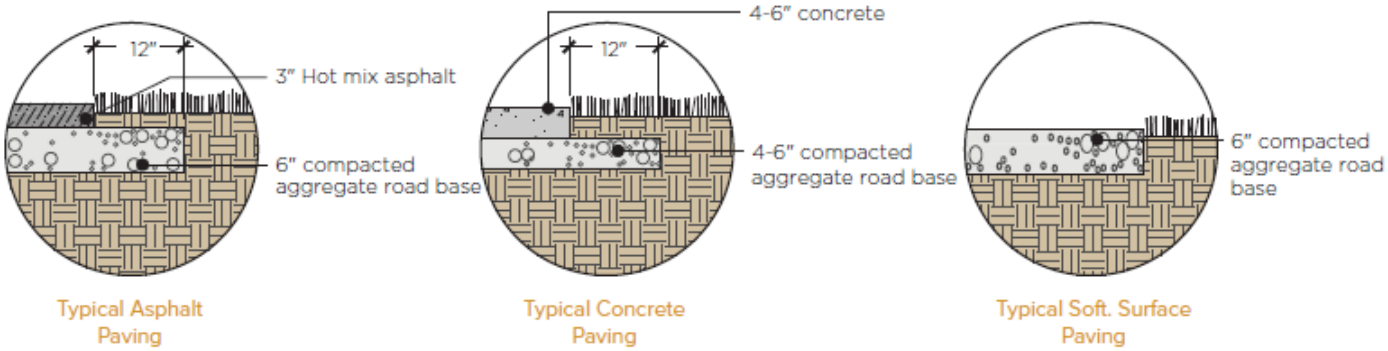
AASHTO. Guide for the Development of Bicycle Facilities. Section 5.2.2. 2012

FHWA. Manual on Uniform Traffic Control Devices. Chapter 9. 2009

PATH CONSTRUCTION

Shared use path, sidepath, and neighborhood access path construction should be designed to provide a durable trail surface capable of withstanding Summit County's winters, Nordic groomingequipment, and normal trail user wear and tear.

Typical Pavement Construction



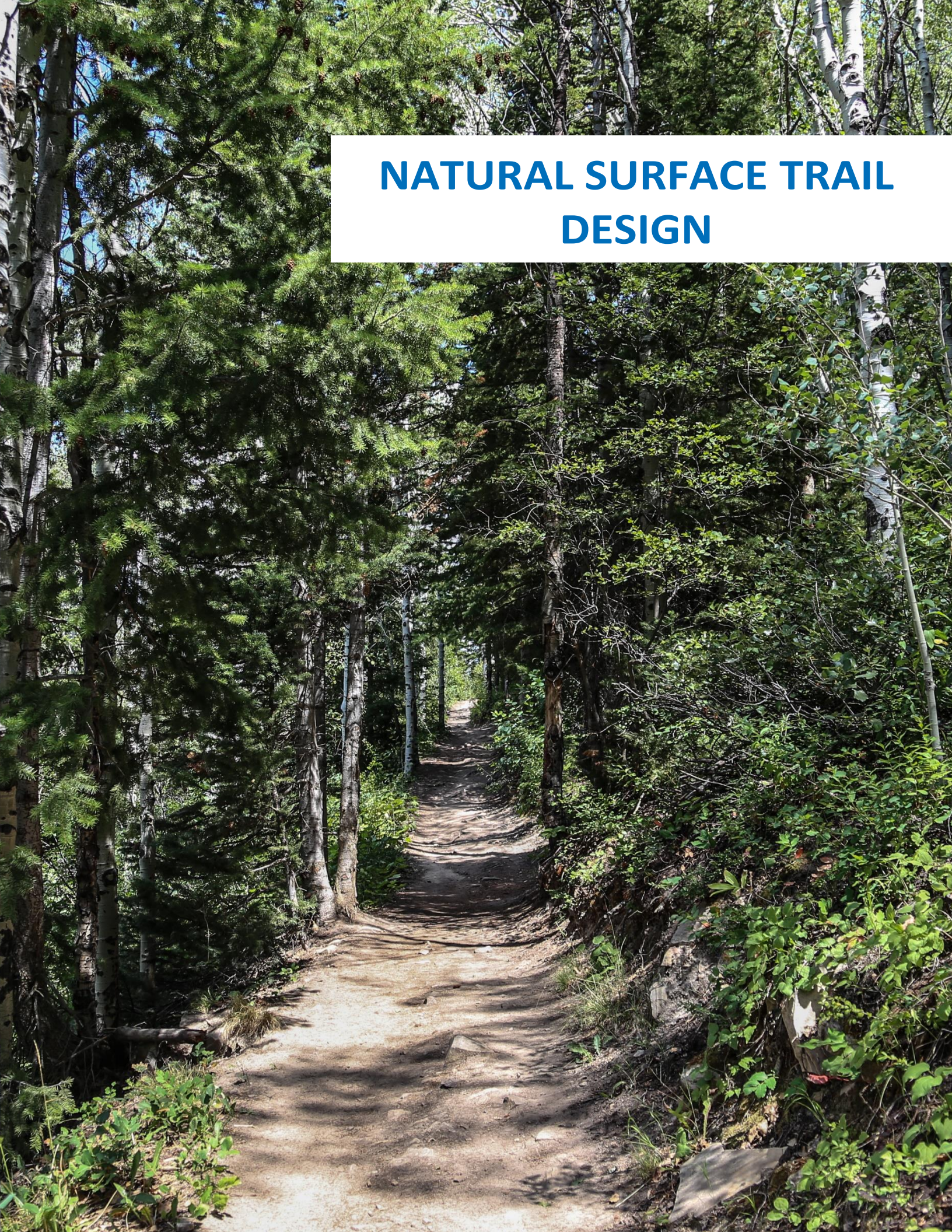
*Note that all pavement designs should comply with site-specific geotechnical report recommendations for non-motorized trails. Cross-sections provided above are intended as examples only.

Construction Considerations

Refer to Chapter 5 of the Summit County Land Use and Development Codes Road and Bridge Standards for applicable specifications.

- Aggregate Base Course: Provide 4-6 inches of aggregate base course or comply with site-specific geotechnical report. Refer to Summit County aggregate base course specifications.
- Shoulder: Provide subbase preparation 12 inches beyond proposed edge of trail.
- Asphalt Paving: Refer to Summit County hot mix asphalt specifications.
- Concrete Paving: Utilize concrete paving in areas prone to flooding. Reference Summit County concrete specifications. Saw-cut all control joints.
- Soft-Surface Paving: Road base shall be moisture conditioned and compacted to 95% of the maximum dry density as determined by ASTM D-1557.
- Materials and specifications must be approved by the District in writing in advance of the beginning of the project.

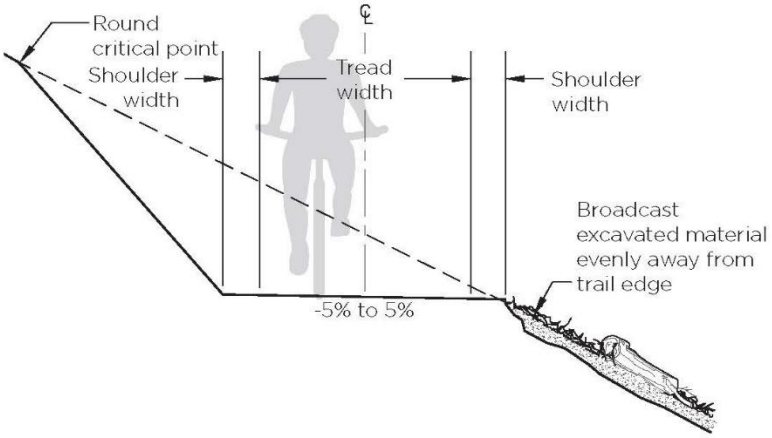
NATURAL SURFACE TRAIL DESIGN



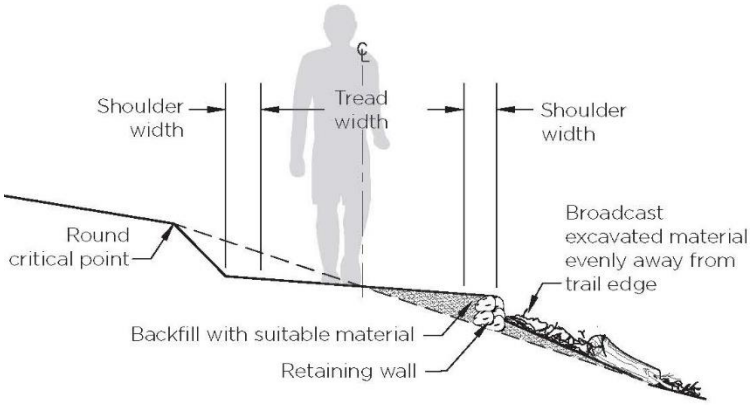
TRAIL CONSTRUCTION

Natural surface trails meet recreational demands of hikers, mountain bikers, equestrians, and other non-motorized recreational trail users.

Full Bench Construction Trails



Partial Bench Construction Trails



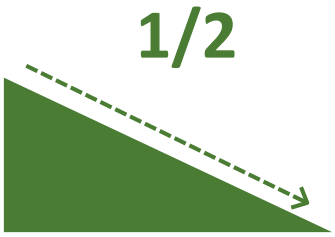
Design Standards

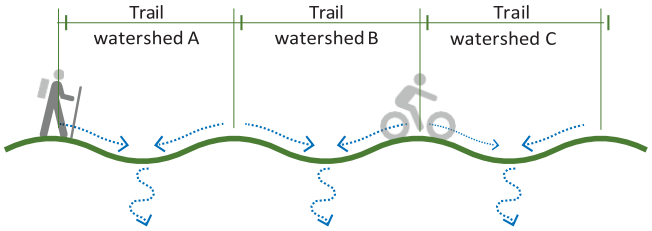
- Tread: Trail surface should be compacted native material soil.
- Trail Benching: Full bench trails provide the most durable trail construction however partial bench trails provide a surface and minimal impact technique where full bench trails are not possible or where “singletrack” is desired without waiting for vegetation to re-naturalize adjacent tothe trail.
- Smoothness: See project specific specifications for acceptable height of surface irregularities such as rocks and roots.
- Tread Width: Varies by anticipated use levels and types of users (24 inches – 8 feet-0 inches, to be determined by the District).
- Horizontal Clearance: A 1 foot shoulder maintained with minimum vegetation should be provided free of obstacles.
- Vertical Clearance: 8 foot minimum, 10 feet where equestrian use in anticipated.
- Cross Slope: Cross slope may vary from -5% to 5%.
- Running Slope: 20% maximum for less than 20 feet, 7% overall trail grade (up to 10% with SBSRD approval for multi-use trails.) Any variances would be approved by the District based on specific trail style.
- Inspections: Regular inspections will be conducted by SBSRD to ensure the trail is constructed to District guidelines and expectations Inspections by SBSRD are mandatory. The contractor must notify SBSRD for inspection and approval when each of the following phases of construction are completed, and not proceed to the next phase of construction until the sign off has been given. Inspection phases include the following: conceptual design and mapping, flagging/surveying, rough bench cut, finish bench cut, final inspection.

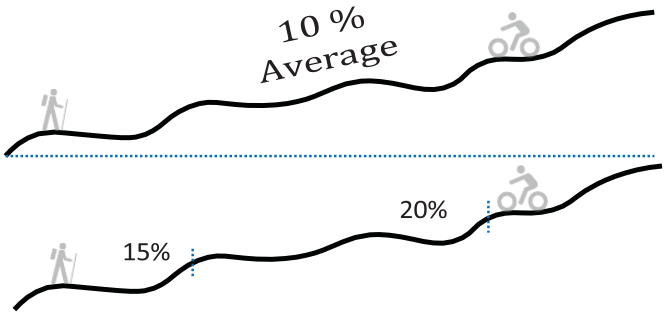
Additional Resources

- US Forest Service Standard Trail Plans and Specifications
- IMBA Trail Solutions: IMBA’s Guide to Building Sweet Singletrack (2004)

TRAIL ALIGNMENT PRINCIPLES







Identify Control Points

Positive control points are places that people want to go. These points might include scenic overlooks, trail access points, interesting landforms, water, or historic sites. Negative control points are places that the trail system should avoid. These could include places like private property, sensitive environmental resources, or safety hazards. By routing trail users to places they instinctively want to go and avoiding potential liabilities, trail planners can mitigate the potential for unauthorized social trails while limiting opportunities for trail users to go places that could lead to management issues.

Adhere to the Half Rule

Trails whose running slope generally exceeds more than half the grade of the sideslope it is crossing are considered “fall line” trails. Drainage crossing a fall-line trail will follow the trail rather than crossing it creating a high probability for erosion.

Rolling Contour Trails

Rolling contour trails gently undulate while traversing side slopes to divide trails into distinct trail watersheds. Trail watersheds limit the amount of drainage flowing across a trail by combining an outsloped trail tread with frequent high and low points (grade reversals) along the trail profile.

10 % Max. Average Grade

An overall trail grade of less than or equal to 10% provides a general framework for a sustainable trail profile. A preferred trail grade of 5-7% allows for some undulation and for short sections approaching 10%. Overall trail grades below 10% are also suitable for most soil types and minimize erosion.

Avoid Flat Ground

Flat ground is to be avoided when possible for trail placement. If it is necessary to route a trail across flat ground then more elaborate trail construction techniques must be implemented such as causeways, tread hardening, or boardwalks. The technique used will be decided by the district.

Maximum Sustainable Trail Grades

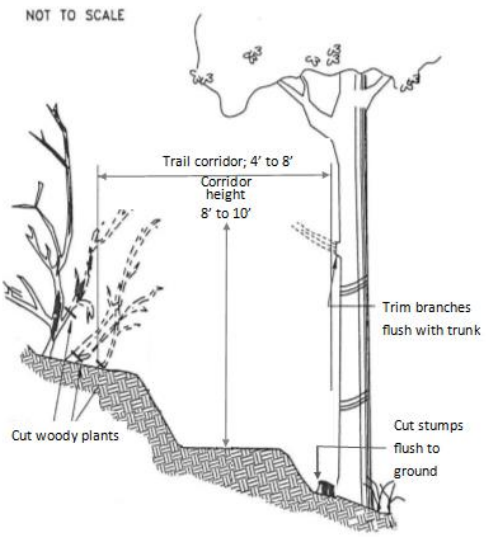
Maximum sustainable trail grades relate to short segments (10’ or more) that may exceed the recommended overall average grade of 10%. Typically, maximum sustainable trail grades vary between 15% and 20% depending on soil type, rock, annual rainfall, style of trail or many other factors.

TRAIL CORRIDOR

Aligning Trail around trees

All organic debris, trees, logs, limbs, branches, brush, plants, and other protruding obstructions within corridor shall be removed and disposed of. It is ideal to route the trail above larger trees to avoid cutting through roots. If the trail is routed below large trees the bench should be at least 3 feet below the base of the tree.

Woody and herbaceous plants, tree branches



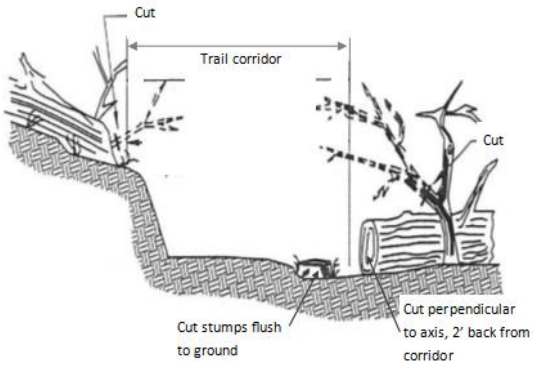
Cut all plants and branches that protrude in to the corridor. All limbs and branches that extend into the corridor shall be cut flush with the tree trunks. Cut perpendicular to the axis and cleared to 2 feet outside of corridor.

Removal of stumps and roots

All stumps and root balls within the bench shall be removed. All roots 1/2 inch and larger within the bench and back slope shall be removed. All logs, limbs, lopped tops, brush, and grubbed stumps and roots shall be scattered uniformly to the side of the trail to a height no more than 18 inches.

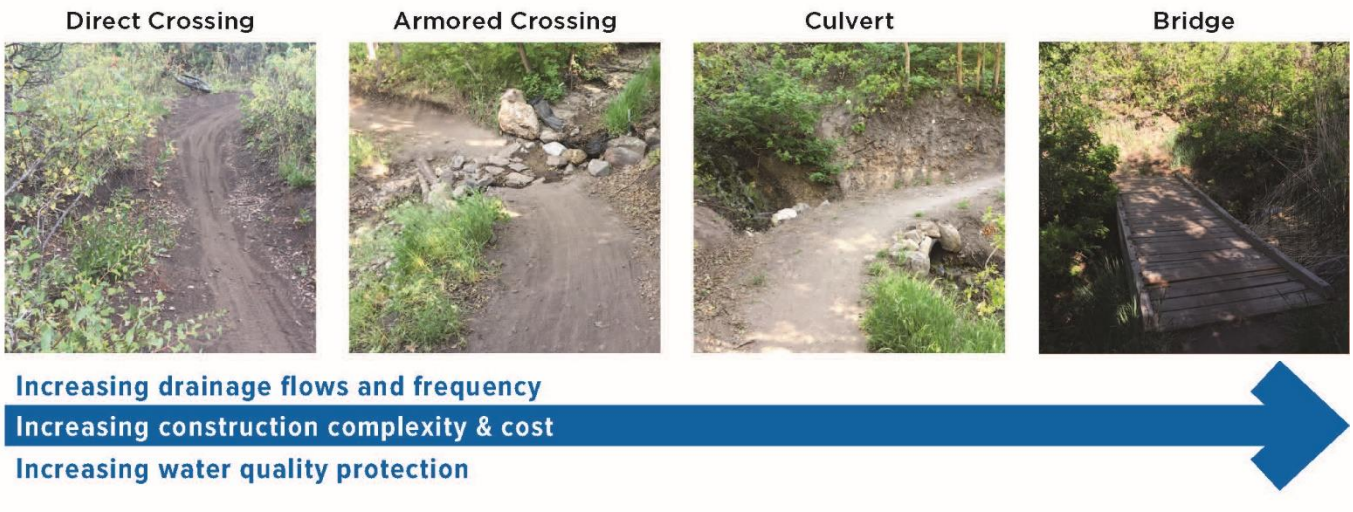
Disposal of clearing slash

Debris from clearing and grubbing shall not be placed in streams, water courses or in a location that will impede flow through or from drainage facilities. No clearing debris shall be placed within 2-feet of the trailbench.



NATURAL SURFACE TRAIL DRAINAGE CROSSINGS

Backcountry trail crossings of drainages can span a variety of treatments depending on the size, flows, and frequency of water flowing through the drainage.



Recommended Application

Direct Crossing

- Direct crossings can be utilized for drainages where flows are spread out and clearly intermittent.

Hardened Crossings

- Hardened crossings are most appropriate for drainages that experience seasonal, slow moving water that would otherwise erode a trail.
- Trail hardening can be accomplished through a variety of materials such as road base or large flat stones tightly fitted together.

Culverts

- Culverts are most appropriate for drainages with periodic flows in narrow, defined channels where ramping up to the crossing is not necessary.
- Culverts shall be armored around the inlet.

Bridges / Boardwalks

- Bridges or boardwalks are the preferred crossing strategy for all drainages with flowing or continuously present water.
- Deck width shall match the trail width.
- Confirm anticipated loading needs of bridges with SBSRD prior to design and construction.
- Schematic designs of bridges over 12 feet shall be approved by SBSRD and, in some cases, Summit County Engineering.

Permitting

- All trail construction shall comply with the Summit County SWPPP/ECA Plan for Narrow Backcountry Trails.
- Secure all necessary permits from appropriate agencies before constructing trail improvements in or around drainages.

TRAIL DRAINAGE DEVICES:KNICKS

Knicks are effectively outsloped drains. Knicks can be utilized to redirect water off of poorly draining sections of trails.

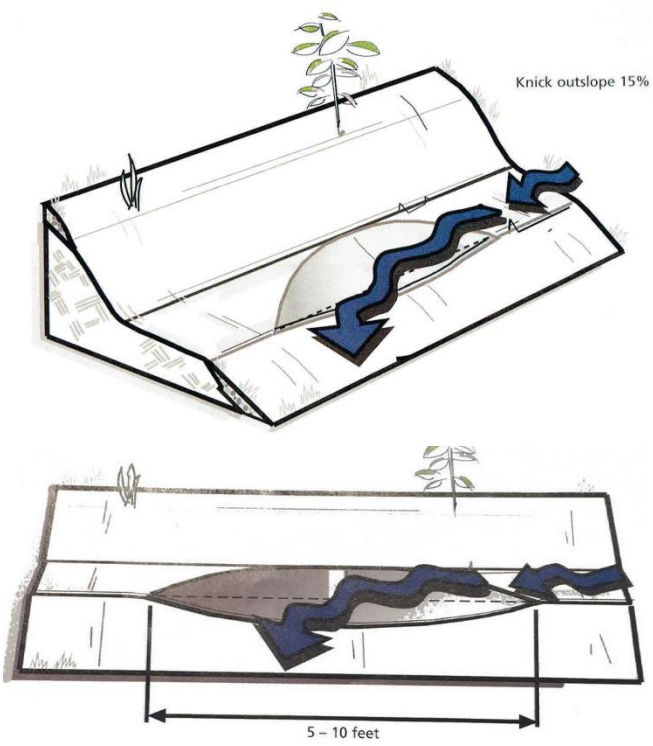


Photo Credit: IMBA. Trail Solutions: IMBA's Guide to Building Sweet Singletrack (2004)

Photo Credit: Trail Solutions: IMBA's Guide to Building Sweet Singletrack (2004)

Recommended Application

Typical Placement

- Knicks are normally located on gradual segments of existing trail where puddling occurs.
- Knicks should be located adjacent to ground lower than the trail so that the knick will have a place to drain.

Typical Construction

- Knicks should be constructed as semi- circular depressions, about 10-feet in diameter, that direct water to the outside of the trail.
- Knicks should extend across the entire bench / tread.
- Knicks should be constructed with a 15% maximum outslope.

TRAIL DRAINAGE DEVICES: ROLLING GRADE DIPS

Rolling grade dips are useful in draining water from a trail whose slope is too steep to be drained by a knick alone. Rolling grade dips are preferred over waterbars which require frequent maintenance and compromise the trail user experience.

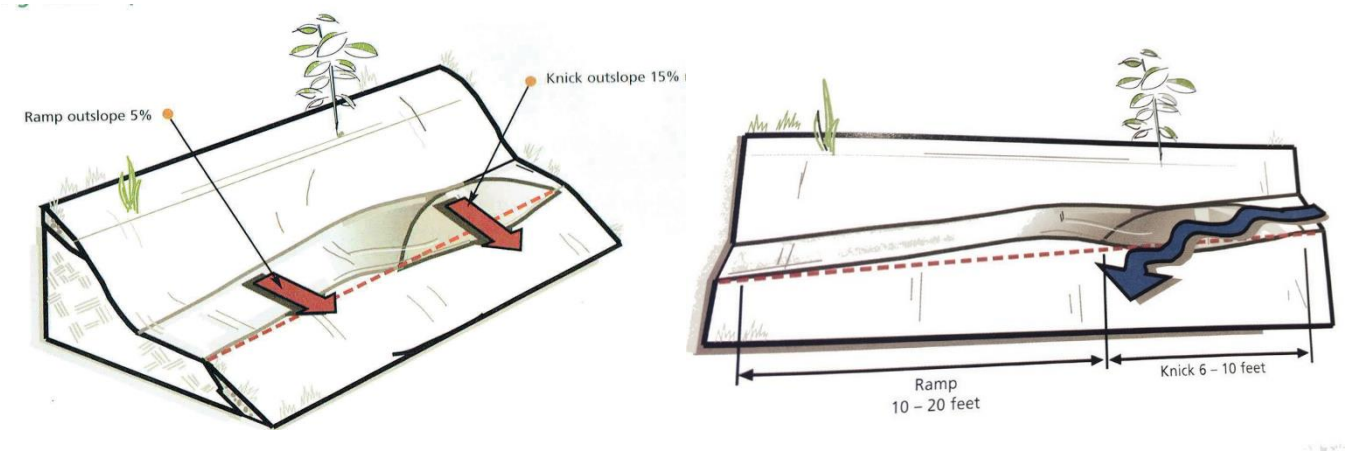


Image Credit: IMBA. Trail Solutions: IMBA's Guide to Building Sweet Singletrack (2004)

Recommended Application

Typical Placement

- Rolling grade dips are typically located at sections of trail where water flows down the trail rather than across it.
- Rolling grade dips can be employed on steeper slopes than knicks.
- Rolling grade dips should only be installed on cohesive soils. Sandy or gravelly soils are not conducive to construction of rolling grade dips.
- Rolling grade dips are best located at a natural roll or change in trail grade that can be enhanced.
- Rolling grade dips are generally most useful when placed near the midpoint of a segment of descending trail.

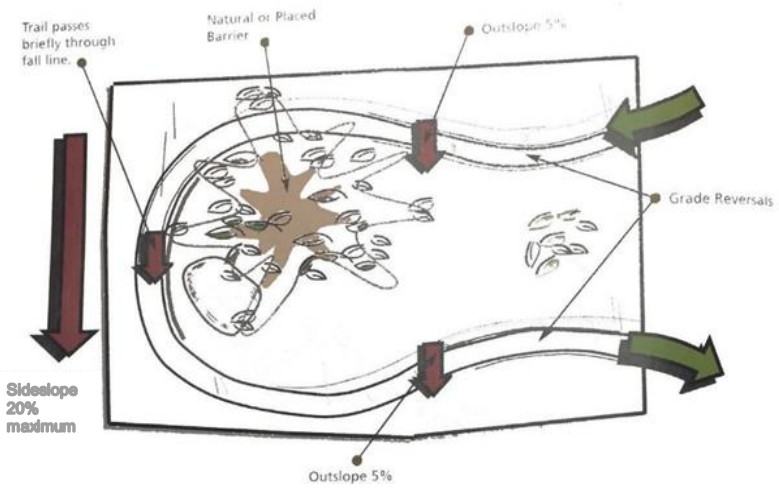
Typical Placement

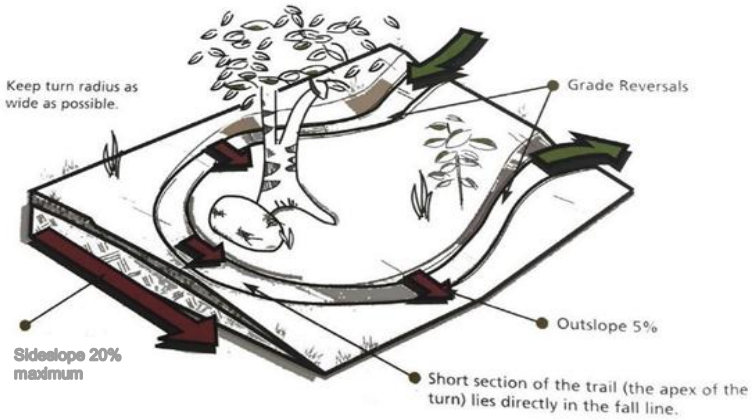
- A rolling grade dip features a knick followed by a crest and a long, gentle ramp hindering water from flowing down the trail.
- Ramps and crests should be thoroughly compacted and consolidated to resist the velocity of water running down the trail.

8

TRAIL TURNS: CLIMBINGTURNS

Climbing turns can be utilized on shallow slopes to gain elevation at sustainable grades.





Recommended Application

Typical Placement

- Climbing turns can be located on shallow slopes at or below 20%.

Typical Construction

- Climbing turn radii should be kept as wide as possible, ideally 20 feet or more.
- Upper and lower legs of the turn are joined by a short section of trail that lies in the fall line. Armoring can be used to reduce maintenance or drains on the fall line section of trail.
- Grade reversals should be located above and below the turn.
- Climbing turns can be insloped where mountain bikes are a significant user group.

TRAIL TURNS: INSLOPEDTURNS

Insloped turns can limit skidding and trail widening at turns in the alignment while providing a fun and sustainable feature for trail users.

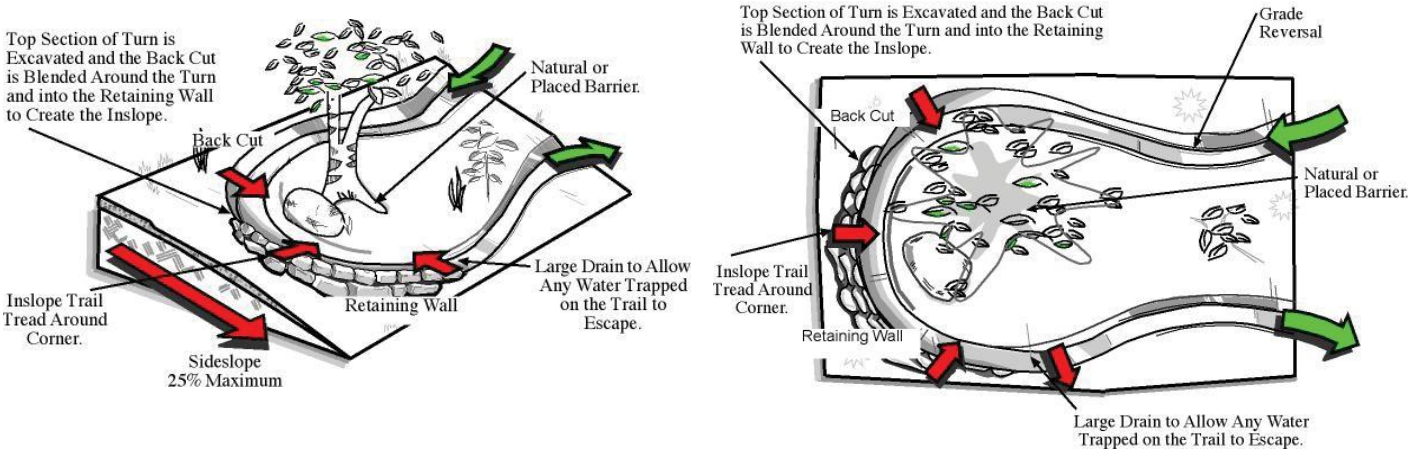


Image Credit: IMBA. Trail Solutions: IMBA's Guide to Building Sweet Singletrack (2004)

Recommended Application

Typical Placement

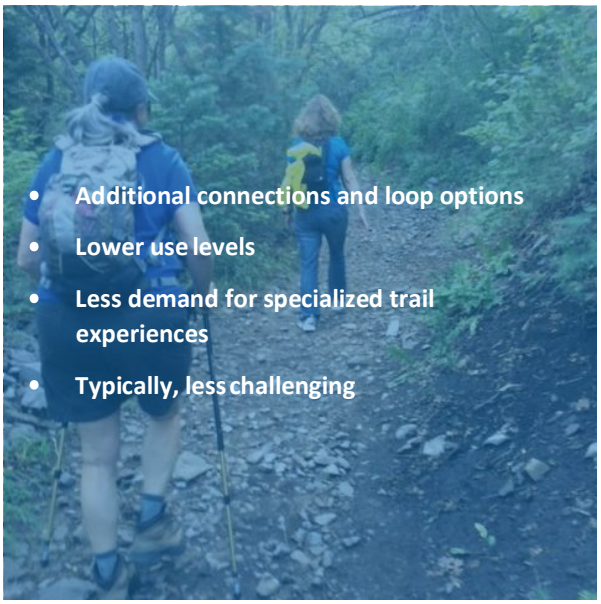
- Insloped turns should be considered for any location where slowing is likely needed to allow a trail user to negotiate a turn.
- Insloped turns work best on gentle sideslopes up to 25%.

Typical Construction

- Approaches should follow the contour and include grade reversals in advance of the turn.
- The approach above the turn should be kept at a relatively gentle grade (5-8%) to keep speeds in check prior to the turn.
- The approach below the turn should be brief but steep (around 15%).
- Should keep the radius of the inslope turn between 10 and 20 feet or with five feet of elevation gain.
- Position the turn around a natural feature, such as a boulder or tree to prevent short- cutting of the turn is a good idea.
- Keep sightlines clear since trail users will be capable of navigating these turns at higher speeds.

SINGLE-USE VS. SHARED-USE TRAIL MANAGEMENT

Natural surface trails can be managed and designed as shared-use (allowing all types of non-motorized trail users) or single-use (allowing a single type of trail users).



Shared- **Single-**

Shared-Use Designation Considerations

- Shared-use trails ideally accommodate the broadest range of users and provide the most mileage available to all user groups.
- Shared-use trails promote shared stewardship of the trail system by all user groups.

Single-Use Designation Considerations

- Single-use trails can alleviate congestion and conflicts among user groups when used in conjunction with shared-use trails.
- Single-use trails can provide technical features or higher quality trail experiences catered to a single trail user group.
- Single-use trails can accommodate higher speeds without compromising the safety or enjoyment of other trail users.
- Single-use trails can also help to mitigate site-specific constraints such as poor sightlines, steep terrain (by allowing construction of stairs), or sensitive environmental areas.

SPECIAL-USE TRAILS

In addition to traditional shared-use natural surface trails, mountain bikers are increasingly seeking specialized experiences to provide technical challenges and expand their skills. Features may be provided in clustered areas or along specific trails designed for mountain bikers.

Pump Tracks

Pump tracks include a series of "rollers" and banked turns that allow bicyclists to navigate through the course without pedaling by "pumping" up and down. Pump tracks are suitable for all ages and allow children and experienced bicyclists a place to grow their skills. Pump tracks should generally be sited on slopes between 3-7%. Flatter sites may be challenging to drain while steeper sites may make it difficult for riders to effectively pump back to the top of the site. Public pump tracks typically can be designed with footprints as small as 5,000 square feet.

Freeride Mountain Bike Trails

Freeride mountain bike trails are built specifically for mountain bikers and often prohibit other types of users, such as hikers or equestrians, to mitigate safety concerns. Trails are typically directional (downhill only) and provide features such as banked turns, rock gardens, drop-offs, jumps, or other man-made technical features. Signage should be used extensively to identify upcoming features and denote the level of difficulty. Providing safe, authorized freeride trails is an important consideration for trail planners because freeride mountain bikers will often seek to create their own freeride trails in the absence of legitimate options.

Bike Parks

Bike parks are a relatively recent development and the growth of compact facilities specifically for mountain bicycling has allowed more people to recreate outdoors. Bike parks often include numerous elements such as pump tracks, jump lines, or freeride trails for a variety of skill levels. Skills areas including log skinnies, rock gardens, teeter- totters and other features to provide additional challenges. Bike parks are often co-located within existing parks or near trail systems.

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TRAIL SIGNAGE

REGULATORY SIGNS

Regulatory signs give a direction that are to be obeyed by trail users, and apply to intersection control, speed, user restrictions and access. The examples below are types of regulation that could be integrated into the shared-use path projects.

Placement Considerations

Located throughout the trail system, these signs inform trail users of rules and regulations along the trail, upcoming street and trail crossings and other potential hazards such as trail width changes.

- Locate warning signs appropriately ahead of the specific hazards to which they refer, such as road crossings, steep terrain, trail narrowing, and stop signs.
- All signage should conform to the Manual on Uniform Traffic Control Devices (MUTCD). Refer to MUTCD section 9B for a detailed list of regulatory sign applications and guidance.
- Smaller scale signs or plaques may be used for shared-use path applications. Refer to MUTCD Table 9B-1 for minimum sizes for signs on shared-use paths.

Regulatory Signs

In addition to providing traffic control at intersections, regulatory signs can be used to clarify user access restrictions, user interactions, and intersection actuation/use instructions. See section 9B of the MUTCD.

Typical Regulatory Sign Examples

R5-3

R9-13

Access Restrictions

R9-6

R9-7

User Interactions

R9-5

R10-4

Signal Actuation/Use

Traffic Control

Priority at a shared-use path/roadway intersection should be assigned by County Engineering with consideration of the relative speeds of shared-use path and roadway users, relative volumes of shared-use path and roadway traffic, and whether the crossing is parallel to or across a major roadway. Coordination with Summit County is required when considering the appropriate traffic control devices.

STOP (R1-1) signs shall be installed on shared-use paths at points where bicyclists are required to stop. YIELD (R1-2) signs shall be installed on shared-use paths at points where vehicular traffic is light and bicyclists have an adequate view of conflicting traffic as they approach the sign, and where bicyclists are required to yield the right-of-way to that conflicting traffic.

R1-1

R1-2

Warning Signs

Warning signs are used to provide notice to trail users of unusual or changing conditions. These signs might inform path users of steep grades, narrow widths, or railroad crossings.

Pavement Legends

Pavement legends may be appropriate for use on shared-use paths to indicate correct position for traffic control signal actuation or to provide advance information for turning or crossing maneuvers. Markings shall be retroreflective. Smaller letters and symbols may be used on shared-use paths than used on roadways. See Part 3B of the MUTCD.

W11-15

W11-15P

W10-12

W5-4a

TRAILHEAD MONUMENTS

SBSRD utilizes consistent signage at all trailheads operated within the District. Trailhead monuments reinforce the SBSRD brand while communicating the name of the individual trailhead.

Application Considerations

- Place trailhead monuments at major vehicular access routes to trailheads.
- Obtain sign permit from Summit County prior to construction.

Design Features

- Post material: Treated timber.
- Panel material: Laser-cut corten steel over aluminum panel.
- Contact SBSRD for logo and artwork.

TRAILHEAD MAP KIOSKS

Trailhead map kiosks illustrate nearby trails, trailheads, and destinations accessible from a specific trailhead. Other site-specific trail user information may also be shown on map kiosks such as wildlife information, use restrictions, or other relevant information.

Application Considerations

- Place trailhead map kiosks along the primary route from the trailhead parking area to the trail system.
- Place map kiosks in ADA-accessible locations.
- Coordinate with SBSRD regarding information to be presented on the map kiosk.

Design Features

- Kiosk Material: Weathered angle iron, wood, metal roofing.
- Contact SBSRD for logo and artwork.

TRAIL MARKERS

Trail markers identify SBSRD trails, provide directional information to nearby trails or trailheads, and communicate access restrictions.

Application Considerations

- Trail markers should be placed at all trail access points and trail intersections.
- Trail markers should be placed at least 2 feet 0 inches beyond the trail but in clear view for all trail users.
- Obtain necessary Summit County permits for any trail markers placed in the public ROW.

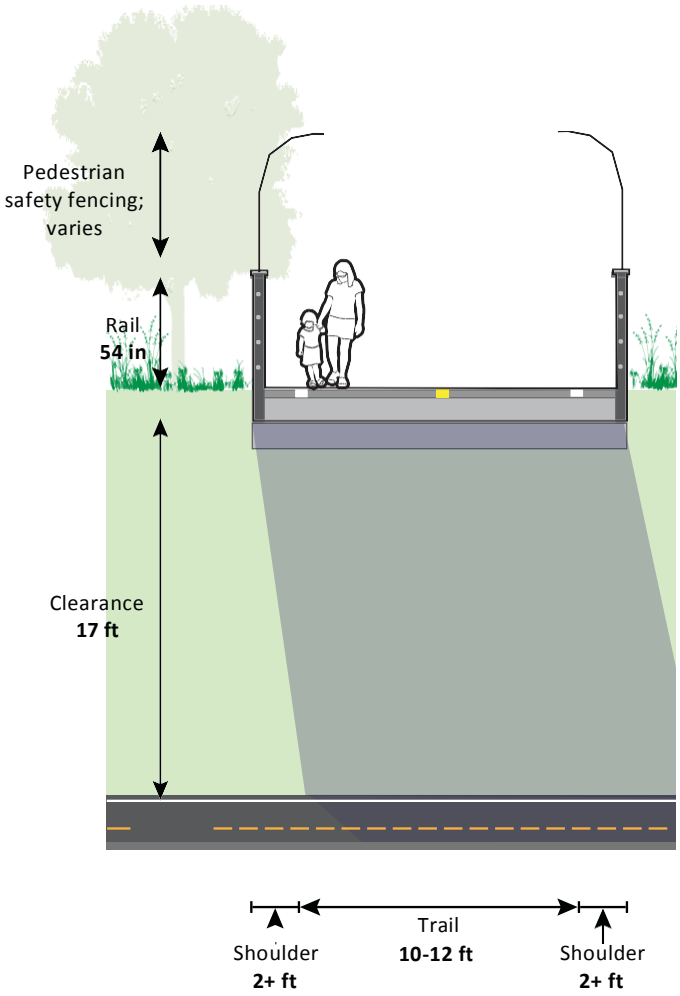
Design Features

- Post material (Frontcountry): 6 inch x 6 inch Treated post.
- Post material (Backcountry): Carsonite marker.
- Top Plaque: SBSRD branding tile.
- Second Plaque: Name of specific trail.
- Additional Plaques: Directional information to connecting or nearby trails.
- Bottom Plaque: “No Motor Vehicles” if located adjacent to a roadway.

TRAIL BRIDGES & STRUCTURES

OVERCROSSINGS

Bicycle/pedestrian overcrossings provide critical non-motorized system links by joining areas separated by barriers such as deep canyons, waterways or major transportation corridors. In most cases, these structures are built in response to user demand for safe crossings where they previously did not exist.



Application Considerations

- There are no minimum roadway characteristics for considering grade separation. Depending on the type of facility or the desired user group, grade separation may be considered in many types of projects.
- Overpasses work best when existing topography allows for smooth transitions.
- Specific design and construction specifications will vary for each bridge and can be determined only after all site- specific criteria are known.
- Coordinate with applicable agencies (UDOT, Summit County, and/or railroad company) to secure permits and determine additional design criteria.

Design Features

- Path Width: 14 feet preferred. If overcrossing has any scenic vistas additional width should be provided to allow for stopping.
- Vertical Path Clearance: 10 foot headroom on overcrossing.
- Vertical Clearance Below: Clearance below will vary depending on feature being crossed.

Roadway:	17 feet
Freeway:	18.5 feet
Heavy Rail Line:	23 feet

- Markings: The overcrossing should have a centerline stripe even if the rest of the path does not have one.

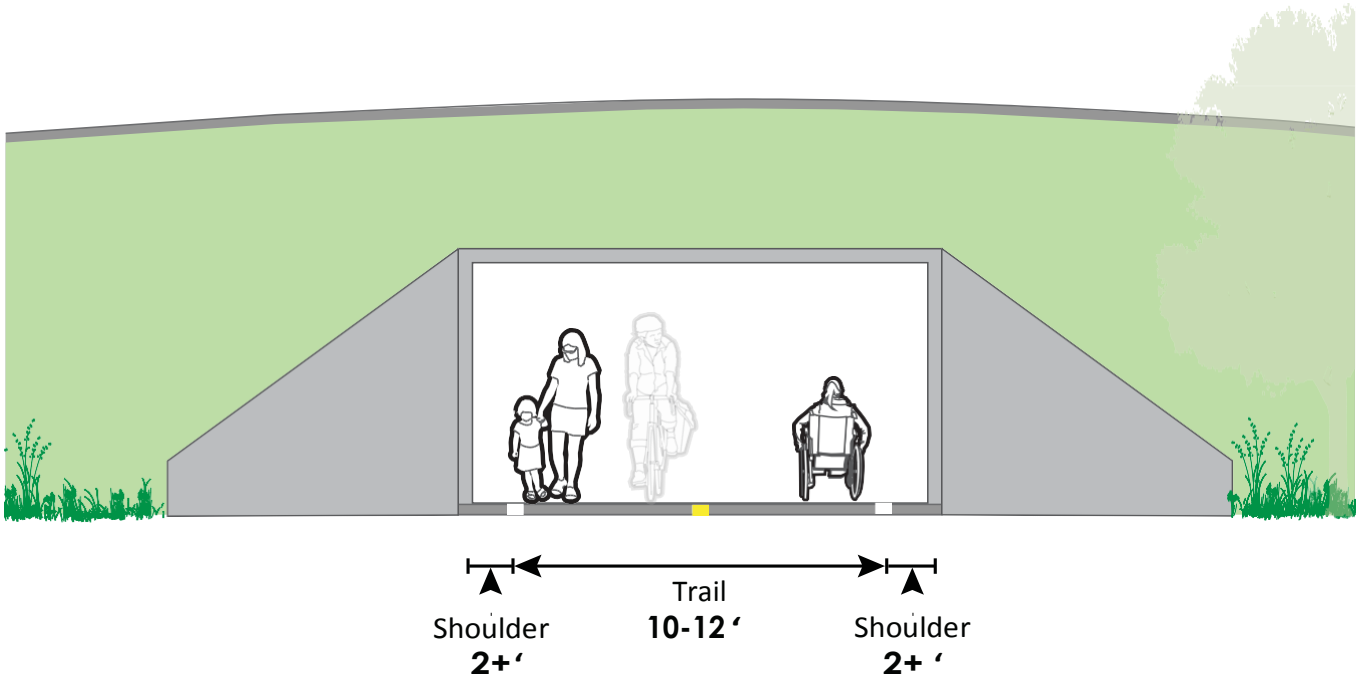
This overpass helps children cross a busy street at a midblock location.

Further Considerations

- Always consult a structural engineer before completing bridge design plans, before making alterations or additions to an existing bridge, and prior to installing a new overpass.
- ADAAG strictly limits ramp slopes to 5 percent (1:20) with landings at 400 foot intervals, or 8.33 percent (1:12) with landings every 30 feet.
- Handrails must be of uniform height, no less than 34 inches and no more than 38 inches in height from the finish surface of the ramp slope. Refer to local or state jurisdiction for guardrail specifications.
- Fencing may be required to protect both users and motorists below.

UNDERCROSSINGS

Bicycle/pedestrian undercrossings provide critical trail system links by joining areas separated by barriers such as railroads and high-speed roadways.



- Undercrossings work best with favorable topography when they are open and accessible and exhibit a sense of safety.
- Undercrossings typically utilize existing overhead roadway bridges adjacent to steams or culverts under the roadway that are large enough to accommodate trail users.
- Proper drainage must be established to avoid pooling of stormwater, however, some underpasses can be designed to flood periodically (after significant rainfall, for instance).

Design Features

- Path Width: 14 foot width preferred.
- Length: Minimize the length of the undercrossing. Greater widths preferred for lengths over 60 feet.
- Vertical Clearance: 10 foot preferred, 8 foot in constrained conditions.
- Markings: The undercrossing should have a centerline stripe even if the rest of the path does not have one.
- Lighting: Lighting should be considered during the design process for any undercrossing with high anticipated use, at long undercrossings, or other areas where lighting levels will be low.

Further Considerations

Safety is a major concern with undercrossings. Shared-use path users may be temporarily out of sight from public view and may experience poor visibility themselves. To mitigate safety concerns, an undercrossing should be designed to be spacious, well-lit, and completely visible for its entire length from end to end.

Underpasses should have a daytime illuminance minimum of 10 foot candles achievable through artificial and/or natural light provided through an open gap to sky between the two sets of highway lanes, and a night time level of 4 foot-candle.

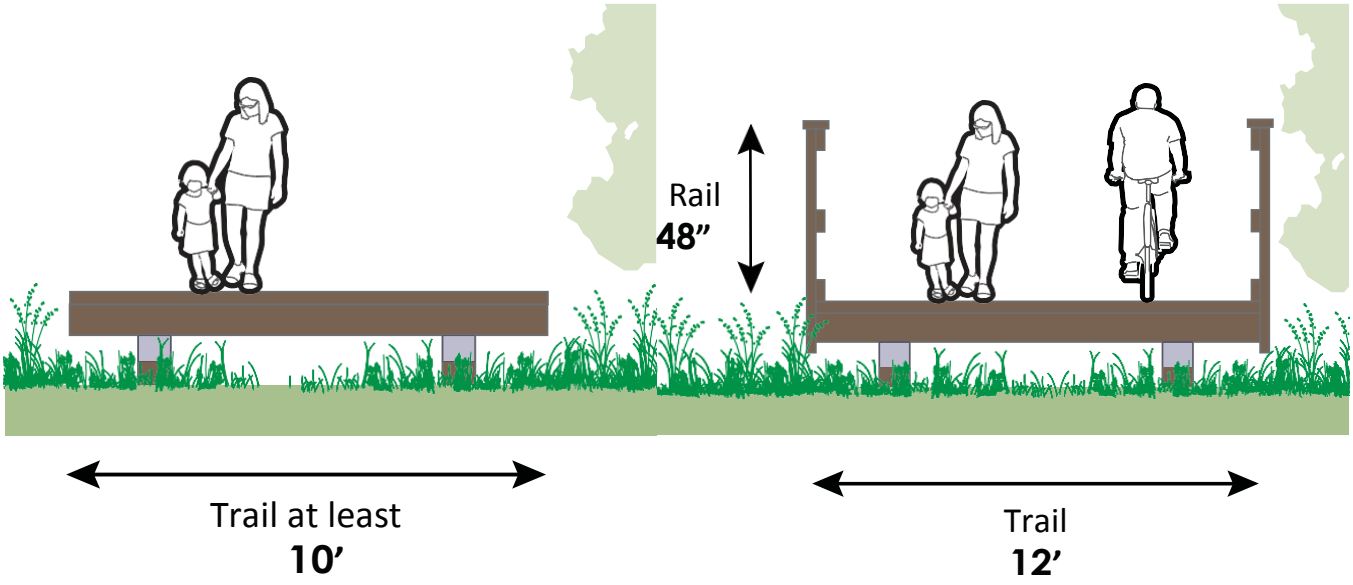
Materials and Maintenance

14 foot width allows for maintenance vehicle access.

Potential problems include conflicts with utilities, drainage, flood control and vandalism.

BOARDWALKS

Boardwalks are structures that bridge over sensitive natural or inundated areas while limiting the potential for environmental impacts. They are typically used when crossing small creeks and wetlands. Boardwalks range in length and can span as little as 10 feet orstretch for longer distances depending on site conditions. Bridges are used where greater span lengths are required and when the objective is to reduce base flood elevations. Boardwalks are usually constructed of timber, concrete, or recycled plastic decking.

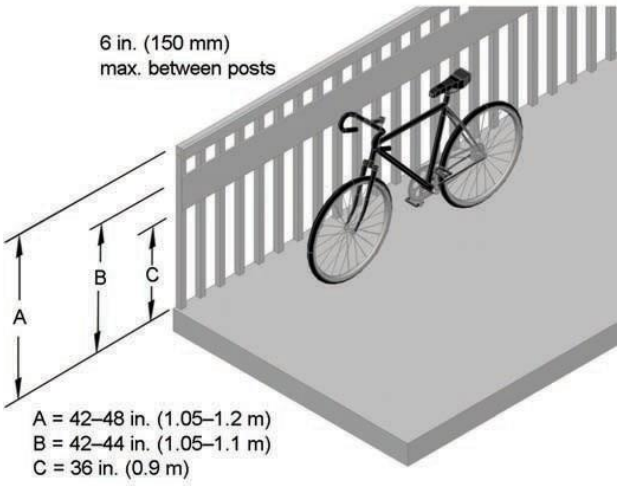


Application Considerations

- Most appropriate for travel through wetlands or other poorly drained areas.

Design Features

- Boardwalk width should be a minimum of 10 feet when no rail is used. A 12 foot width is preferred in areas with average anticipated use and whenever edge rails are used.
- A 4 inch curb rail is recommended; however, a 42 inch guardrail is required at locations where there is a 30 inch or greater difference in the bridge elevation and the ground elevation below (AASHTO 2012).
- If access by vehicles is desired, boardwalks should be designed to structurally support the weight of a small truck or a light- weight vehicle. A structural engineer should be engaged to provide advice.



Source: AASHTO Guide for the Development of Bicycle Facilities (2012), Figure 5-11.

Further Considerations

- Boardwalk surface should be constructed of rough-cut timber decking.
- Local, state, and federal permits will be required where a boardwalk is located within wetlands. In general, building in wetlands is subject to regulations and should be avoided (FHWA 2001).
- Consult a structural engineer for final design.

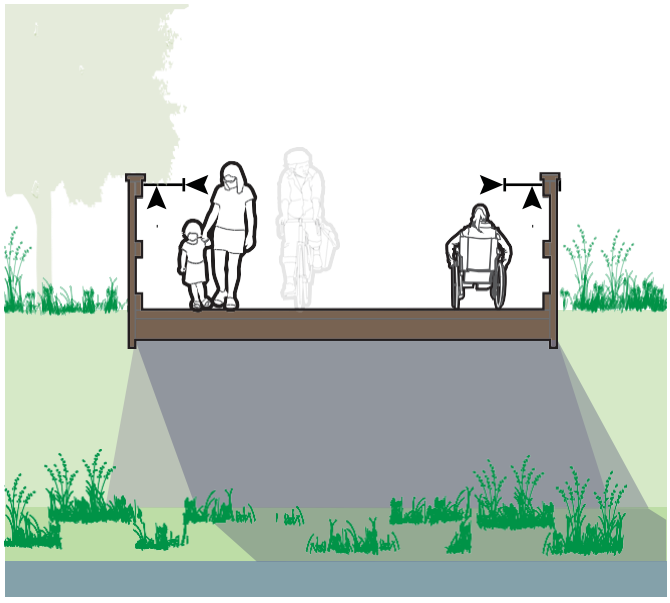
Additional References

AASHTO. Guide for the Development of Bicycle Facilities. 2012. FHWA. Wetland Trail Design and Construction. 2001.

SHARED-USEPATH BRIDGES

Shared-use path bridges provide trail access over natural features such as streams and rivers. The type and size of bridges can vary widely depending on the trail type and specific site requirements. Some bridges often used for multi-use trails include suspension bridges and prefabricated span bridges. When determining a bridge design for multi-use

trails, it is important to consider emergency and maintenance vehicle access.



Typical Application

- Bridges are used to provide trail access over natural features such as streams and rivers, where a culvert is not an option.

Design Features

- The clear width of the bridge should be the same width of the trail.
- Bridge deck height should match that of the path surface to provide a smooth transition.
- Bicycle and shared-use paths should include a 54’ inch guide rail where hazardous conditions exist.
- Refer to AASHTO Bike Guide Figure 5-11 for specifications for a bridge “rub rail.”

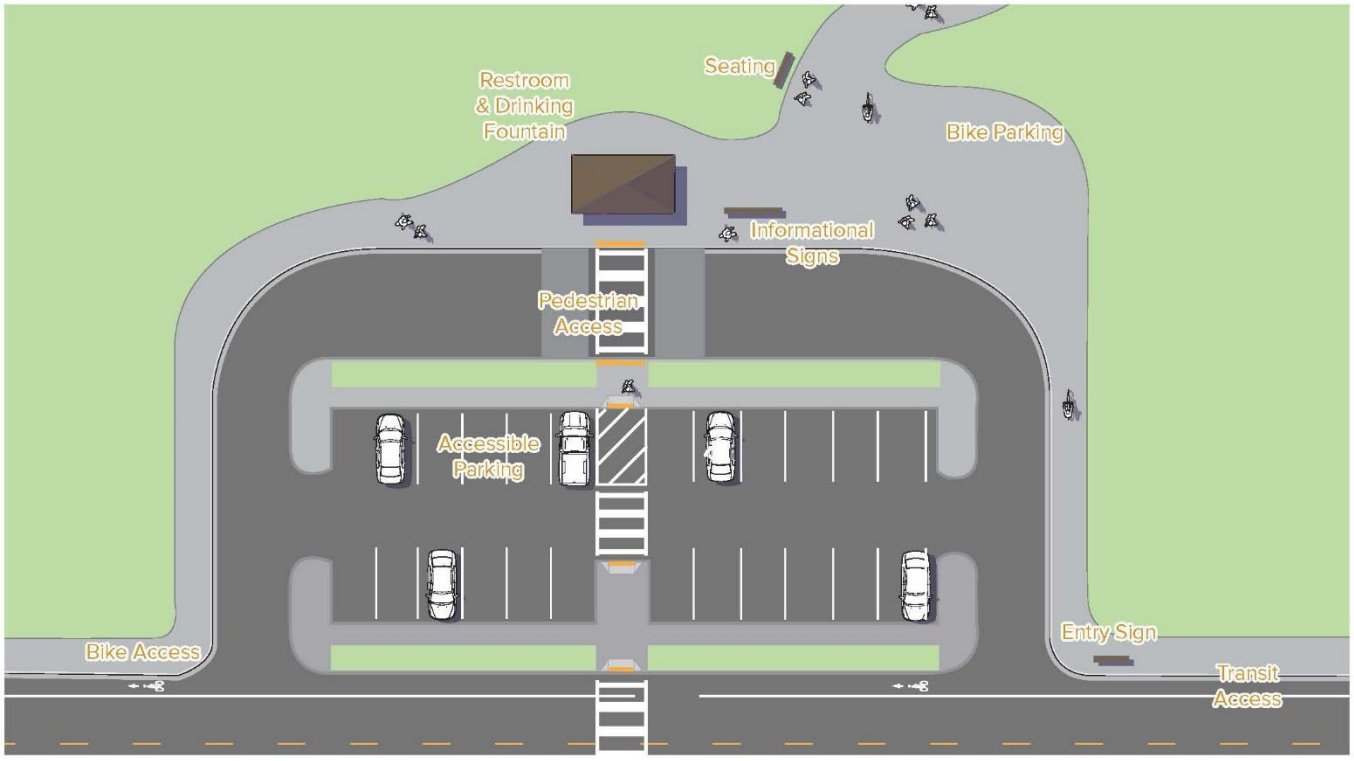
Further Considerations

- Shared-use paths that are poorly designed through water features can impact wetlands and streams, and become conduits for delivering sediments, nutrients, and pathogens to the watershed. Shared-use paths that cross streams can exhibit bank and streambed erosion if not properly constructed.
- All abutment design should be stamped by a qualified structural engineer and all relevant permits should be filed.
- If a corridor already contains a bridge such as an abandoned rail bridge, an engineer should be consulted to assess the structural integrity before deciding to remove or reuse it.

TRAILHEAD PLANNING & DESIGN

MAJOR TRAILHEADS

Good access to a path system is a key element for its success. Trailheads serve the local and regional population arriving to the path system by car, transit, bicycle or other modes. Trailheads provide essential access to the shared-use path system and include information and amenities for trail user comfort.



Design Standards

Major trailheads may provide a wide range of user amenities, such as:

- Convenient access to transit stops (where feasible)
- Motor vehicle parking, including accessible parking spaces
- Where appropriate, short term and long term bicycle parking such as racks or secure parking areas
- Wayfinding kiosks, with orientation and interpretive information
- Accessible trail signs and maps noting trail conditions and degrees of difficulty
- Drinking water fountains (where feasible)
- Restrooms (where feasible)
- Shelters or picnic areas (where feasible)
- Fitness courses (where feasible)
- Scenic viewpoints or overlooks
- Benches and/or picnic tables
- Staging or gathering spaces
- Interpretive signs
- Trash and recycling containers

Location Considerations

Trailheads function as multi-modal transfer points. They connect users to and from motor vehicles, by foot or by bicycle. Site trailheads to interface with walking, bicycle and transit networks (where feasible).

Major access points should be established near commercial developments and transportation nodes, making them highly accessible to the surrounding communities. All trailheads must be open to the public.

Further Considerations

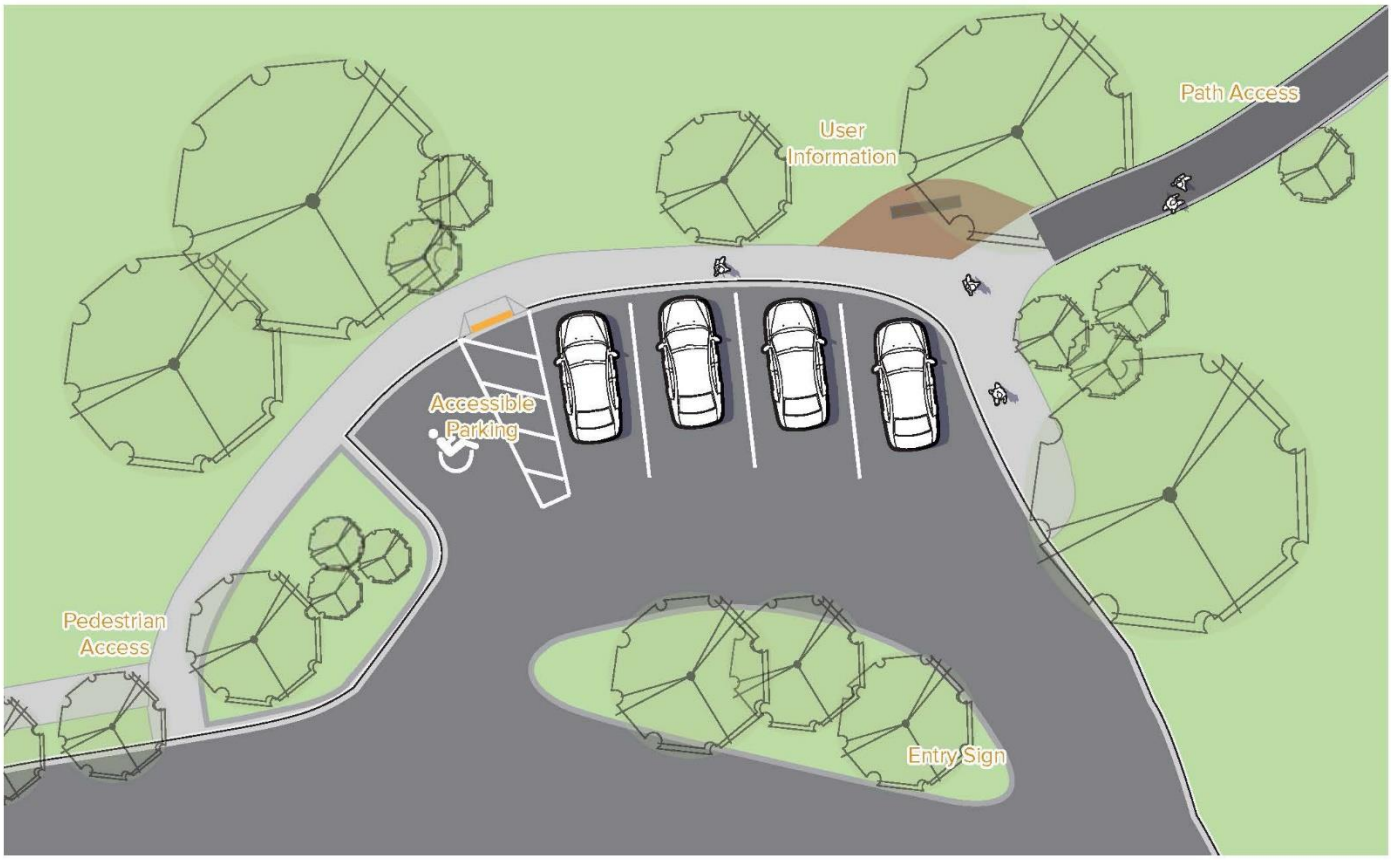
- Trailheads of 10 or more spaces are considered major trailheads and should provide off-street parking and restrooms (where feasible).
- Major trailheads will meet County Planning Department requirements.
- Place accessible parking spaces near the site's accessible route, at a rate of one accessible space per 25 standard spaces. Parking spaces and access aisles should not exceed 2% slope in any direction.
- Parking lot surfaces should not exceed 5% slope in any direction.
- Where major trailheads are located near neighborhoods, provide user access from local streets crossing the trail.
- Reduce the visual intrusion of large parking areas by using vegetative screening.
- Consider one-way vehicle circulation within parking areas to minimize internal roadway width.

Additional References

- Refer to section 10-4-16 of the Summit County Development Code.

MINOR TRAILHEADS

Minor trailheads are shared-use path access points with minimal infrastructure. They can occur at locally known spots, such as parks and residential developments. Minor trailheads could include a small parking lot for up to 10 passenger vehicles.



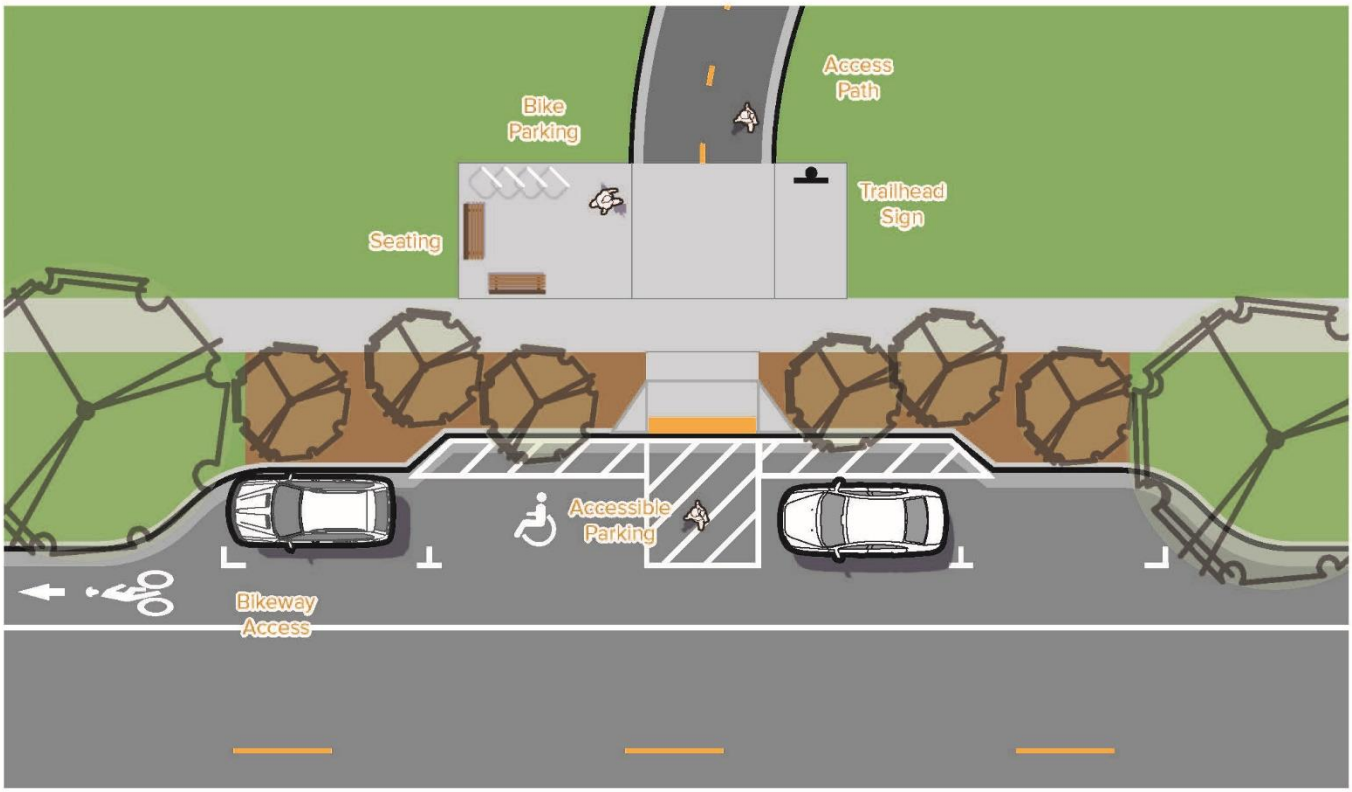
Design Features

Minor trailheads can provide parking for up to 10 vehicles. The parking area may be asphalt or gravel, as long as ADA requirements are met. Minor trailheads may provide:

- Convenient access to transit stops
- Motor vehicle parking for up to 10 vehicles, including accessible parking spaces
- Short term bicycle parking such as racks
- Wayfinding kiosks, with orientation and interpretive information
- Accessible trail signs noting trail conditions and degrees of difficulty
- Drinking water fountains (if feasible)
- Benches and/or picnic tables (if feasible)
- Interpretive signs
- Trash and recycling containers

ON-STREET ACCESS POINTS

On-street trail access points are formalized small trailhead facilities served by on-street parking along an adjacent roadway and connected via an access path. Access points should be designed with a consistent character to larger trailhead locations but may feature fewer amenities due to limited space requirements.



Location Considerations

On-street access points should be located where there are long stretches of path with no public vehicular access.

Design Standards

- Access points should provide parking for a minimum of four vehicles. Two of these parking spaces should meet guidelines for accessible parking spaces.
- Accessible curb ramps should be provided from the parking lane to the access point.
- Furnishings, signs, and amenities should be located outside of the access path corridor to not interfere with access and travel.