

# Pennsylvania Trail Design & Development Principles

*Guidelines for Sustainable, Non-motorized Trails*







**Equestrian Trail**  
Elk State Forest, Cameron County

Photo Credit: Pashek Associates

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**Bellefonte Central Rail Trail**  
Centre County

Photo Credit: Pashek Associates







# Acknowledgements

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**North Country Trail**  
Allegheny National Forest  
Forest County

Photo Credit: Pashek Associates



# Foreword

Every five years, states across the nation must produce a State Comprehensive Outdoor Recreation Plan to remain eligible to receive federal Land and Water Conservation Funds (LWCF). By design, SCORP directs use of the LWCF.

The required elements of the plan include a statewide assessment of outdoor recreation needs and supplies, as well as an action plan for future steps to help enhance outdoor recreation.

Recommendation 3.2 of the [PENNSYLVANIA OUTDOOR RECREATION PLAN](#) states:

“standardize trail planning guidelines, information, and funding decision criteria to build a sustainable statewide trail system.”

SCORP further tasked the PA State Trails Advisory Committee with:

“adopting statewide guidelines to encourage uniform trail construction, maintenance, and signage; developing a non-motorized trails standards and guidelines publication; and promoting best practices to ensure continued maintenance and future sustainability of trails and related facilities.”

As a leader with a mission to “conserve and sustain Pennsylvania’s natural resources for future generations’ use and enjoyment,” and with representation on the PA State Trails Advisory Committee, DCNR took it upon itself to develop these guidelines as identified by SCORP’s Action Step B.

To accomplish such an undertaking, DCNR assembled an internal work group with representation from the Bureau of Facility, Design, and Construction, the Bureau of Forestry, the Bureau of Recreation and Conservation (BRC), and the Bureau of State Parks. Building on the past success in developing the [PENNSYLVANIA TRAIL DESIGN](#)

[MANUAL FOR OFF HIGHWAY RECREATIONAL VEHICLES](#), for motorized trails within Pennsylvania, DCNR used this process as a model for the development of these non-motorized trail guidelines.

During the initial phase of developing these guidelines, the Bureau of Forestry’s Recreation Section developed an outline for its content and a scope of work with the assistance of the Bureau of Facility Design and Construction. The Department’s internal work group then reviewed and commented on the table of contents and scope of work.

In order to remain responsive and transparent, key representatives from SCORP’s Technical Advisory Committee (TAC) – PA State Trails Action Committee and DCNR’s Recreational Advisory Committee (RAC) helped review and comment on the guidelines prior to having Pashek Associates, Ltd. design and compile these guidelines and produce this document.

DCNR’s internal work group met with Pashek to discuss project goals and outputs. Both parties recognized that a variety of good references already existed related to trail planning, design, construction, and operations and maintenance, ranging from guidelines and manuals produced by state agencies, such as Minnesota; to organizations like the International Mountain Biking Association (IMBA) and the Pennsylvania Equine Council (PEC); to Federal Agencies such as the United States Forest Service.

Rather than trying to reinvent the wheel, the DCNR and Pashek Associates decided the best course of action involved synthesizing the technical material contained in existing guidelines and manuals, adding real-world input from both the vendors and internal work groups’ past experiences with trail development, and incorporating examples of best management practices that have occurred on PA trails, to create these guidelines for non-motorized trails in Pennsylvania.





The National Park Service defines sustainable trails as:

- Supporting current planned and future uses with minimal impact to the natural systems of the area
- Causing negligible soil loss or movement while allowing naturally occurring plant systems to inhabit the area
- Recognizing needed pruning and eventual removal of certain plants over time
- Not adversely affecting the naturally occurring fauna
- Accommodating existing and future uses while only allowing appropriate uses
- Requiring little rerouting and minimal maintenance over extended periods of time

- *National Park Service;  
Rocky Mountain Region,  
January 1991*

In an effort to ensure that the needs, wants, and desires of our recreational stakeholders did not get lost during this process, the Department and Pashek reached out to stakeholders at a subsequent TAC meeting for comments on the design chapter relative to their particular form of recreation. At this time, the Department and Pashek also solicited photos of good trails, photos of best management practices, and identification of Pennsylvania trails that meet the unique needs of their particular user group.

Upon completion of each of the individual chapters, members from TAC and RAC had the opportunity to review and comment on these guidelines in order to remain responsive to our users.

In the end, the content of these guidelines remains just as important as the process used to develop it.

In this document, you will find a compilation of best practices and guidelines for the planning, design, construction, and management of your trail. Equally important, we present techniques for developing trails that create desirable and enjoyable experiences for your trail users. At the same time, these techniques employ sustainable design elements and construction practices that allow the trail to make use of natural systems so that the trail remains both physically and environmentally sustainable, which in turn leads to minimal maintenance and operational costs, making the trail economically sustainable over the long run.

Every trail project has its own unique set of challenges and opportunities. A trail project needs specific evaluation of the site (which extends to the surrounding area beyond the trail's physical corridor), trail alignment, potential resource impact(s), potential environmental opportunities, and existing physical and environmental constraints, in order to determine the design parameters of the trail. These unique challenges and opportunities may require that you stray from or refine these guidelines to take advantage of a particular opportunity, overcome a particular challenge or ensure the health and safety of your trail user.

The safety and well-being of visitors to your trail must always remain your primary concern. This guide does not provide a substitute for the professional expertise needed to make informed decisions regarding design, planning, construction, management, operation, and maintenance specific to your trail.

This comprehensive reference does, however, provide trail advocates, agencies, organizations, local officials, regional officials, and decision-makers with the basic knowledge needed to undertake a trail project with the assistance of professionals.



# Planning

The foundation of a sustainable trail ethic requires proper planning, design, layout, and construction and continues with the management, operation, and maintenance of the trails once they are established.

During the planning process you will define a vision, develop goals, and establish implementation strategies to reach your goals. Always ensure your goals and implementation strategies support your project's vision.

For trails, this means understanding the:

- ability of the landscape to accommodate your vision
- capacity of your organization to develop, manage, and operate the trail
- required level of financial and human resources to achieve your vision

A sustainable trail supports responsible outdoor recreation and has a positive impact on the environment, heritage and communities. It also addresses landowner and user needs and concerns.

## DCNR Assistance Available

If you need of technical assistance or desire to discuss the potential of acquiring DCNR funding for your trail project, please contact your DCNR regional adviser. You can find your adviser [HERE](#) and clicking the Regional Offices tab.

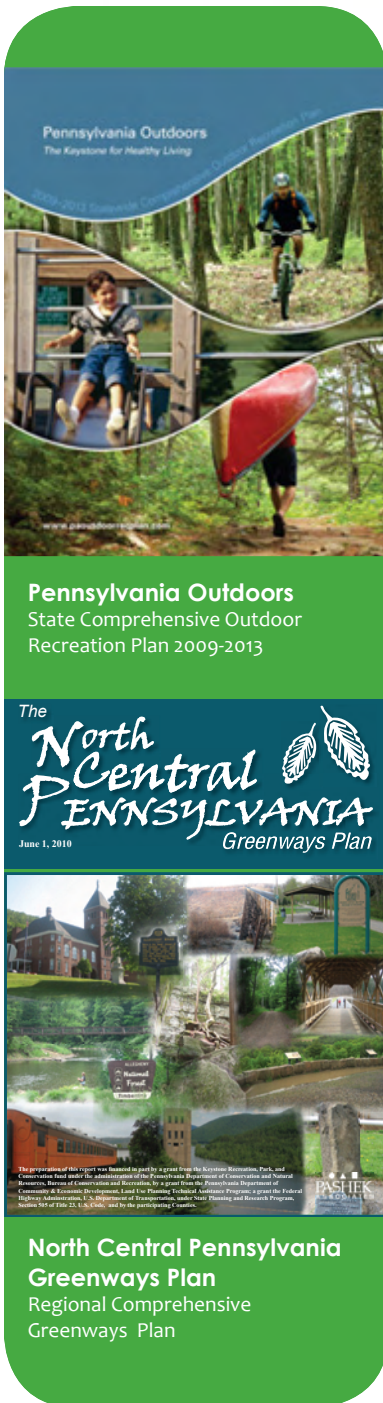
## The Planning Process

The design of a trail system begins with sound planning, consisting of the following steps:

### The Trail Planning Process

1. Reviewing relevant state, regional, and local planning efforts
2. Selecting a qualified trail designer
3. Engaging the public
4. Identifying the needs, wants, and concerns of the land manager, property owner, and adjacent neighbor(s)
5. Identifying the needs, wants, and desires of trail users
6. Assembling the mapping
7. Analyzing the property to identify opportunities and constraints for developing your trail
8. Determining the type of trail system and level of difficulty
9. Determining the locations of potential trailheads
10. Determining regulatory requirements
11. Identifying environmental and cultural resources
12. Planning for accessibility
13. Establishing the preliminary trail alignment
14. Evaluating potential management structures for management, maintenance, and operations of your trail
15. Planning for management, maintenance, operation, and construction costs
16. Securing funding for trail planning, design, construction & maintenance





## Step 1: Determining Consistency with State, Regional, County, and Local Planning Efforts

Before planning for a new trail, review state, regional, county, and local planning efforts to determine whether the proposed trail system is consistent with the strategies of other planning efforts. Typical planning efforts that you should review include:

- Pennsylvania State Comprehensive Outdoor Recreation Plan [www.paoutdoorrecplan.com](http://www.paoutdoorrecplan.com)
- Regional and/or County Comprehensive Recreation, Park, and Open Space Plans/Regional and/or County Greenway Plans, [CLICK HERE](#)
- Local Comprehensive Recreation, Park, and Open Space Plans
- Local Greenway Plans
- Other local municipal plans, e.g. trail feasibility studies, park master plans, corridor studies, waterfront studies

If your proposed trail is not identified in current planning efforts, contact the county and municipal planning agencies having jurisdiction over the project area to determine if the proposed project is consistent with current planning efforts.

## Step 2: Selecting a Trail Designer

Whether you appoint someone within your organization to design your trail, or hire a consultant to guide you through the process, it is important to ensure they possess the knowledge and experience in the following areas of sustainable trail design:

- Trail planning
- Trail design
- Trail layout and survey
- Trail construction
- Trail bridge design and construction
- Trail signage design and construction
- GPS, GIS and CADD capabilities
- Construction document preparation
- Construction observation experience

When you select a trail designer, ask for names and contacts of past clients and conduct reference checks to determine whether they meet the needs of your project. Trail designers are usually landscape architects, engineers, and park, recreation, and forestry professionals with sustainable trail planning and development experience.



Depending on the resources present and the complexity of addressing them, your trail designer may recommend including other professional disciplines on the design team. These may include surveyors, archeologists, soil scientists, environmental engineers, civil engineers, structural engineers, and architects.

You can find DCNR's Consultant Selection Guidelines [HERE](#).

### Step 3: Engaging the Public

A critical component of all planning projects is determining the public's needs, interests and concerns related to a proposed undertaking. A well-designed public participation process engages the stakeholders and the public. Involving stakeholders, the public and decision-makers helps diffuse conflict and increase volunteer participation.

Public participation is important because it:

- Provides the stakeholders, leaders and decision makers an opportunity to voice their opinions
- Informs the elected officials of citizen attitudes and needs
- Helps to express broad-based public support for the planning process and planned proposals
- Provides the general public and community leaders with an opportunity to support and be involved with the development of the plan

Public participation techniques typically include some or all of the following:

- Establishing a steering committee
- Preparing a communication strategy
- Conducting public meetings
- Conducting surveys
- Interviewing key persons
- Conducting focus group meetings

You can find DCNR's Public Participation Guide [HERE](#).

### Steering Committee

Establish a steering committee to assist your trail designer. The committee also helps you maintain important connections with your community. The committee should be well rounded and include trail user groups, adjacent property owners, local businesses, community leaders, service clubs, cultural and historical groups, recreational groups, citizens concerned about your project and citizens interested in your project.



North Central PA Greenway Plan  
Clearfield County



Bellefonte Central Rail Trail  
Centre County



Anthracte Outdoor Adventure Area  
Northumberland County

**Stakeholder Involvement**  
is critical during all phases of  
your trail project.

Photo Credits: Pashek Associates





### 2012 Lehigh Valley Trail Summit

Lehigh County

Photo Credit: Delaware & Lehigh National Heritage Corridor

The size of the committee will depend on the size of the project, but a general rule of thumb is to limit participation to 15 persons or less. You can invite additional people to specific meetings to address a particular area of concern.

### Public Meetings

Types of public meetings include informational, data gathering, brainstorming, and work sessions. Before the first public announcement of your meeting, notify your elected officials of the scope and intended schedule for the project, so that they may become well-informed and responsive to their constituents once you make a public announcement.

Traditionally the local media has been the primary avenue to get the word out to the public and to advertise these meetings. However, with the growing popularity of email and social networking, techniques such as email blasts and blog posts can be helpful in encouraging participation in public meetings.

### Surveys

Developing a survey provides planners with an option for gathering input from local citizens. Some people are reluctant to attend or speak out at public meetings. Sometimes you can reach these individuals by giving them an opportunity to complete and return a survey or simply by providing a place for them to mail comments.

Web-based surveys are an efficient means to collect data and tabulate responses automatically. You can use email blasts to advertise the survey and encourage participation. Whether you use a random sample survey or web-based survey you should compare the demographics of the respondents to the overall demographics of your study area to determine whether the results are skewed towards a particular demographic.

### Key Person Interviews

A key person interview typically consists of questioning one individual or groups of individuals with common interests or areas of expertise. Conducting key person interviews can validate and expand upon information gathered by the trail designer, steering committee, or obtained through other public participation means.

Prepare a list of questions or discussion points ahead of time. Additionally, if you intend to request detailed information, inform the interviewee as early as possible so they may gather information and provide it to you during their interview.

A successful public participation process results in understanding the issues and concerns of those who may oppose your project. A successful planning

### Consensus

Consensus is a decision that takes into account all of the legitimate concerns raised by participants in the process.

Consensus is not unanimity.

Sometimes voluntary agreement of all participants proves impossible to achieve, and a majority decision should be taken.



process responds with a plan that adequately addresses the issues and concerns of both those that support and oppose the project. Therefore, identifying concerns and issues early in the public participation process remains crucial to future implementation of your project.

## Step 4: Identifying the Needs, Wants, and Concerns of the Land Manager, Property Owner, and Adjacent Neighbors

Understanding the needs, wants, and concerns of the land manager, property owner, and adjacent land owners is just as important as interpreting the needs, wants and desires of your trail's users. Often members of these groups do not use trails. Therefore, their priorities for the land will differ and they will often have legitimate concerns that the designer can address. They may also have concerns based on perceptions, rather than facts. It remains important to identify these concerns early in the planning process. By incorporating an educational component into the planning process you can alleviate most fears.

By listening to land managers, property owners, and adjacent property owners, your trail designer gains an understanding of their views and perspectives. With this information, the designer interprets and evaluates how to address those views and perspectives through the planning and design process. Your designer should have a willingness to listen, to field criticism, and allow angry individuals to vent. However, it is better to have this occur early in the process so you can adjust and respond, rather than later when it can derail the project.

## Step 5: Identifying the Needs, Wants, and Desires of Users

When planning, you should gain an understanding of the needs, wants, and desires of potential users to your trail. Users have different goals, desires, and expectations as they travel a trail. If the design of the trail does not meet the standards of its users, the design has failed.

An important step involves defining objectives for creating your trail by answering the following questions:

- What is the purpose of the trail?
- Who will visit the trail?
- How often will they visit the trail?
- What level of trail difficulty will meet the needs of the users?
- Where will the users access the trail?
- What destinations will users want to access from the trail?

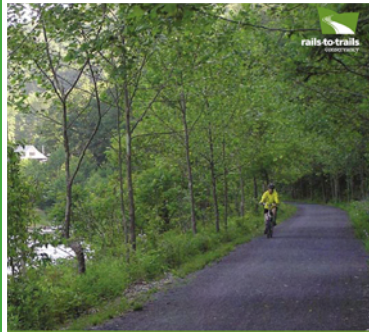


**North Country Trail Hikers**  
Kellettville Campground,  
Allegheny National Forest  
Forest County



**Shenango Trail Hike**  
Mercer County

Photo Credits: Pashek Associates



Pine Creek Rail Trail  
2006 User Survey  
and Economic Impact Analysis

Financed in part by a grant from:  
Pennsylvania Department of Conservation and Natural Resources,  
Bureau of Recreation and Conservation, Community Conservation  
Partnerships Program

### Pine Creek Rail Trail User Survey Rails to Trails Conservancy

- What potential does the trail have to promote tourism and economic development in the area?
- Who will manage the trail?
- What will it cost to maintain the trail?
- What is the liability of developing a trail?

Throughout the planning process, your designer will incorporate and balance users' needs, wants, and desires with the opportunities and constraints presented by the land's natural and cultural resources.

To review survey results conducted along some of the existing trails in Pennsylvania [CLICK HERE](#), and then click on the Trail Studies tab.

## Step 6: Assembling the Mapping

Planning a trail system begins with identifying the location of the proposed trail system and developing a base map of the area.

### USGS 7.5 Minute Quadrangles

7-1/2 minute quadrangles, 1-inch = 2,000-feet with 20 foot contour intervals, produced by the United States Geographical Survey (USGS) serve as the most common and readily available mapping. You can download them electronically from the Pennsylvania Spatial Data Access (PASDA) website, [CLICK HERE](#). Typically, USGS maps provide a good resource for initial planning and design, but do not provide a sufficient level of detail for final trail design.

### PAMAP Program

The PAMAP Program has collected and processed high resolution Light Detection and Ranging data (LiDAR) for most of the state. Those familiar with geographic information system (GIS) software can transform LiDAR data to produce various elevation data products including point based digital terrain models (DTM), grid-based digital elevation models (DEM), and contours. The PAMAP Program has processed the LiDAR data using DEMs to provide two-foot contours, and breaklines (e.g. cultural features such as the edge of a road). LiDAR products are available for download from PASDA.

Your trail designer can evaluate whether to use these base maps for design and construction purposes. LiDAR data does not contain property boundaries and parcel information. Therefore, you will need to obtain that information from other sources.

### Ortho Photography

Ortho photography is geographically and geometrically corrected aerial photography. A digital form of ortho photographs is frequently used as a base map using GIS or CADD software. Ortho photos are particularly useful in

### Map Sources

- United States Geological Survey
- PA Map Program
- Penn Pilot
- County Planning Departments
- Municipal Planning Departments





identifying the location of features and destinations. Planners overlay other layers of electronic data over the ortho photos using GIS or CADD. The use of these additional layers enables trail designers to establish the preliminary trail layout. You can obtain digital ortho photography from county GIS departments. Digital ortho quarter quadrangles (DOQQs) are available for download from PASDA. A DOQQ covers one quarter of the area contained on a USGS 7-1/2 minute quadrangle.

## Historic Photographs

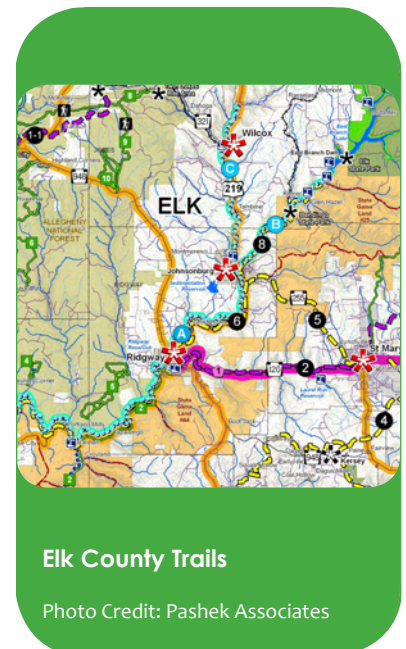
Your trail designer may find historically sequenced aerial photographs extremely useful. They use historical photographs to see how land use has changed over time. With this information the designer can identify potential problem sites or areas of potential interest to the user; such as historical sites. Aerial photographs covering the past 50 years or more may be available from your county conservation district, and downloaded from Penn Pilot, [CLICK HERE](#). Historical photographs on Penn Pilot date from 1937 to 1942 and 1967 to 1972.

## Geographic Information Systems (GIS)

GIS is a tool to combine graphic images and databases of information. GIS is used to analyze data and display the results as spatially oriented visual images. Data sets are graphic representations, with links to all of the data in that particular set. For example, a data set for property may graphically portray property boundary lines and include a link to a database that contains property information, such as: tax parcel number, landowner name, address, acreage, etc. With GIS software you can overlay many data sets to create a map of features and desired data sets for analysis. County GIS, planning, 911, and/or assessment offices may have data sets available. You can also download a significant amount of GIS data from PASDA.

All of the information displayed is using real world coordinates and can be displayed to scale. You can quickly measure distances and calculate areas utilizing GIS. You can geo-reference the position of specific point locations acquired with Global Positioning Systems (GPS) to the GIS data.

Data sets of interest to trail designers include: streets and roads, trails, property boundaries, contour lines, streams and lakes, wetlands, floodplains, soils, geology, natural and cultural resources, and sensitive areas. Further, most counties have completed greenway and trail plans. These greenway planning efforts have created data sets that identify sensitive natural resources, as well as proposed trail corridors. Your designer should determine if this data is available for your project area at the beginning of the planning process, and acquire the data if it exists.





### Railroad Valuation Maps

Railroad valuation maps are warehoused in the National Archives in College Park, Maryland. For more information on accessing these archives click [HERE](#).

The National Archives maintains a database of its archives in its Archival Research Catalog. You can conduct key word searches in the on-line catalog by [CLICKING HERE](#).

### Railroad Valuation Maps

Railroad valuation maps can be a good source of information when planning for a rail trail. Valuation maps typically provide detailed information about the physical features of the corridor. Most indicate the width of the rail corridor and identify all structures, bridges, culverts, etc., associated with the corridor at the time the maps were prepared.

### Base Information

Trail planning starts with a good base map of the project area and typically includes:

- boundary survey, locating the metes and bounds of the property, right-of-way, and easements
- topography survey, identifying the change in elevation throughout the property and including physical features such as streams, wetlands, rock outcroppings, trees and stands of vegetation, buildings, roads, fences, etc.

The scale of the base map can vary. You and your trail designer should mutually agree on the scale of the base map. Ideally, your base map of the trail study area should include the following information:

- Trail name
- Name of municipality, landowner, and trail manager
- Scale, graphic scale, north arrow, date, and legend
- Acreage of site
- Site boundaries with bearings and distances
- Site zoning and zoning of surrounding properties
- Boundary lines of adjacent property parcels where they intersect with the planning site
- Existing uses and ownership of surrounding property
- General location and type of easements on the site
- Deed restrictions on the site
- Topography represented with contours
- Existing structures and facilities including utilities and storm water facilities and rights-of-way
- Circulation patterns (existing access roads/service drives/parking/trails/walks/ramps/paths and bridges)
- Natural and man-made barriers
- Water features (streams/rivers/ponds/lakes)
- Wetlands immediately adjacent to site
- Floodplain - 100 year flood level
- Drainage structures (culverts/catch basins/inlets/ditches/under drains)
- Site control structures (fences/dikes/walls)
- Soils and limiting subsurface conditions
- Boundaries of existing riparian buffers
- Other site features impacting the use and development of the site



## Step 7: Identifying and Documenting Opportunities and Constraints for Developing Your Trail

Once the base map is complete, your designer will then add information to the drawings to help identify opportunities and constraints of the project area. This step typically includes a desktop analysis followed by a site visit to the trail corridor.

This data should include:

- Topographic features such as high points, low points, rock outcroppings, features of topographic and/or geologic interest
- Physical, environmental, historic, and/or aesthetic points of interest
- Views
- Surrounding land uses
- Wind direction
- Environmental issues
- Soil types and drainage capabilities
- Water quality classifications of watersheds
- Riparian (streamside) buffer areas
- Wildlife areas
- Noise/Odors
- Zoning
- Deed restrictions
- Easements that limit use
- Steep slopes
- Abandoned mine features and/or current drilling areas
- Evidence of abandoned mine drainage
- Potential environmental hazards
- Observations on compatibility with adjacent land uses
- Locations and recommended buffers around rare, threatened, and/or endangered species
- Potential vehicular conflicts, note posted speed, estimate traffic volume, and evaluate sight distances
- Locations of buildings and structures including observations of age and historical integrity
- Identification of erosion and sedimentation problems
- Preliminary observations on conditions of structures including bridges, canals, culverts, and/or tunnels
- Locations of infrastructure and utilities noting constraints to potential trail development
- Vehicular intersections and access points
- Potential off-site connections to main streets, adjacent trails, other environmental, cultural, and/or historic resources
- Proximity to motorized trails

### Locating Existing Trails in Your Area

While conducting your inventory determine if there are trails in your area and whether there is potential to connect to those trails, as part of your project, in the future. To locate existing trails near you visit the online ExplorePAtrails website by **CLICKING HERE**.





A thorough understanding of these elements allows your trail designer to maximize the potential of the trail system while respecting and avoiding sensitive resources that your trail could negatively impact.

Your trail designer will also inventory, locate and analyze any existing non-motorized trails in the area of the proposed system. Document this inventory and analysis on a Trail Assessment Form (described in Chapter 5 - Management). This analysis should determine whether you can incorporate existing trails into the proposed trail system. For planning purposes, locate existing trails with a handheld GPS unit, accurate to three meters. Then integrate this data into GIS.



**Recording Features with GPS**  
Allegheny National Forest  
Equestrian Trails Project

Photo Credit: Pashek Associates

While collecting GPS points along a trail, note basic information about the trail such as:

- Grade of the tread
- Cross slope of the tread
- Tread width
- Tread surface character
- Tread condition
- Road/Railroad crossings
- Location of trailhead and trail access points
- Designated trail use
- Designated level of difficulty
- Location and condition of drainage structures
- Location and condition of signs
- Location and extent of erosion and other negative impacts to the trail
- Location where trail had negative impacts on sensitive resources
- Features the trail intersects
- Sustainability of the trail design and layout

This information can also be collected utilizing mobile phone GPS applications and displayed not only on GIS mapping but also in Google Earth.

With this information the trail designer can determine whether you can incorporate the existing trails, in whole or in part, into the proposed trail system; provided the trail meets the designated Trail Management Objectives (refer to Chapter 5 - Management). Consider closing and obliterating unsustainable segments of the trail and/or segments that you cannot easily maintain. You can incorporate sustainable portions of an existing trail into the new trail system if desired.



## Step 8: Determining the Type of Trail System and Level of Difficulty

Your trail designer should synthesize all of the input, mapping and data collected for the proposed trail corridor to determine the appropriate trail system layouts and level of difficulties for your trail.

### Trail System Layouts

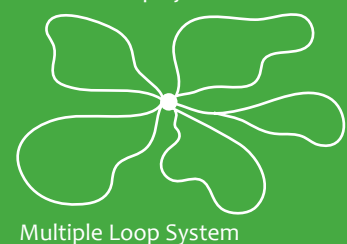
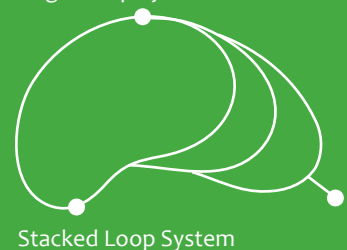
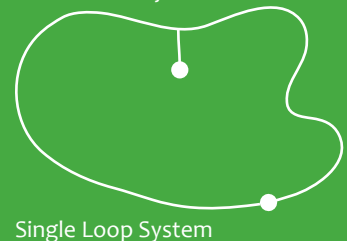
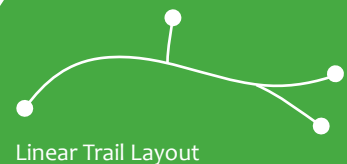
When establishing the preliminary trail layout the first step is to determine the type of layout that best achieves your goals and vision for your trail or trail system. Secondly, it is important for you to determine the level of trail difficulty that you want to provide for your trail users.

Trail designers typically lay out trail systems in one of the following ways:

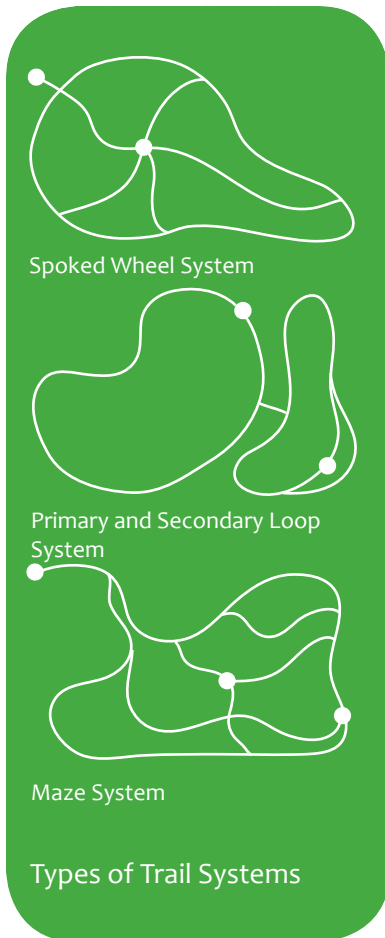
- **Linear Trail Layout (Point-to-Point)** - The simplest trail layout has a point of origin and a destination. It connects two points or links two trails. Use this layout where there are points of interest or destinations along a single narrow corridor or to connect other trail systems where the terrain or land ownership restricts the trail to a single narrow corridor. This system may consist of several point-to-point trails that intersect.

Multiple trail access points and trailheads may exist along the corridor. A disadvantage of this layout is that the visitor to the trail must return to the point of origin. In addition, the trail must have a single level of difficulty over its entire length.

- **Single Loop System** - A single loop system is most often used for a single, long-distance trail, and for a shorter duration trails around lakes, reservoirs, wetlands, and other topographic features. Multiple trailheads may be located along the loop. Its disadvantage is that the design limits users' choices and the trail must have a single level of difficulty over its entire length.
- **Stacked Loop System** - With a stacked loop system the designer can provide multiple levels of difficulty, with each stacked loop becoming more difficult. This system generally has only one trailhead. A stacked loop system can provide users the opportunity to choose the length and duration of their trail experience. This system can allow a party of trail users with varying skill levels to enjoy an outing together.
- **Multiple Loop System** - The multiple loop system typically has a single trailhead, with several loops radiating out from one point of origin. Each loop may have differing level of difficulty, provide a different experience, or provide access to a destination. This system provides the trail designer with the capability to meet user expectations for a variety of users.



Types of Trail Systems



- **Spoked Wheel System** - A spoked wheel system consists of an outer loop connected by linear trails to a center trailhead, destination, or center loop. Multiple trailheads along the outer loop may also be established. This system can provide varying levels of difficulty and experiences on each of the spokes.
- **Primary and Secondary Loop System** - This system has a primary loop, with multiple secondary loops. The secondary loops may offer a different level of difficulty, provide a different experience, or provide access to a destination. This system provides the designer with the most flexibility to meet expectations for a variety of users.
- **Maze System** - The maze layout incorporates a system of loops and linear trails that provide many alternative routes. A maze system can provide a variety of experiences, however, it usually accommodates a single level of difficulty. Orienteering events can use this trail system, where participants visit checkpoints in a particular sequence. Users can become disoriented or temporarily lost in this system. A maze trail layout should be well-mapped and well-marked.

### Trail Difficulty Rating System

The second step in establishing the preliminary trail layout is to plan the level of difficulty for your trail(s).

Users of your trail desire to know what to expect before arriving at your trail. In DCNR's publication, "*Guidelines for Marking Recreational Trails*"<sup>11</sup>, the National Trail Difficulty Rating System, [AVAILABLE HERE](#), has been adopted.

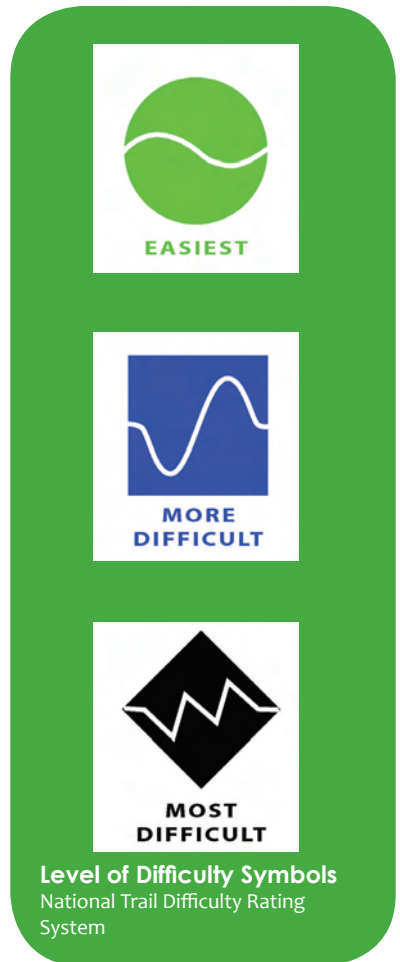
DCNR's rating system is consistent with the National Trail Difficulty Rating System. It evaluates measurable criteria to determine the trail rating. Criteria in this rating system includes tread width, tread surface, trail grade, and natural obstacles. Other conditions can affect difficulty, such as exposure, steep drop-offs, and remoteness.

<sup>1</sup> Guidelines for Marking Recreational Trails, PA DCNR: 2008





- **Easiest** - Suitable for beginning trail users and those who do not have the skill or desire to use “more difficult” trails. These trails have a low level of risk for the user and consequently offer less variety than those of greater difficulty. The layout of these routes are appropriate for novice to advanced users and generally follow obvious, well-marked routes. Grades are gentle and few obstacles should be encountered. They require little skill and entail little physical challenge. The tread should be smooth, level, and wide, with generous clearing of trees, limbs, and other vegetation above and to each side of the trail to permit easy passage. Elevation gain or loss is minimal. Most often stream crossings have bridges at this level of difficulty.
- **More Difficult** - Designed to meet the expectations of the majority of trail users. These trails require skills beyond that of a novice and at times should challenge the average trail user. These routes are appropriate for intermediate to advanced users. Terrain may be steeper, trails narrower, and some obstacles may be encountered. They require a minimal skill level and provide a minimal physical challenge. The tread surface can contain roots and embedded rocks. Clearing of trees, limbs, and other vegetation above and to each side of the trail may result in occasional contact by trail users. Elevation gain or loss is moderate. Most often streams are crossed with fords.
- **Most Difficult** - Designed for trail users with advanced skill, who are seeking a higher risk level. Only advanced to expert users should attempt these routes. The design incorporates steep terrain, and routes with few marks. Trail users should have considerable skill in their chosen activity, as well as knowledge of navigation and survival before attempting these trails. They require a high degree of skill and provide a definite physical challenge. Trail users should seldom encounter a graded tread except on steep side slopes, for safety and prevention of soil erosion. Minimal clearing of trees, limbs, and other vegetation hampers the progress of the user. Usually elevation gain or loss is severe. Streams crossings generally consist of fords and they can sometimes present a challenge.





## Step 9: Determining the Locations of Potential Trailheads

Another step in the planning process is determining potential locations for trailheads. Since most trail users drive to the trail for day and weekend trips, emphasize trailhead planning during the earliest phases of planning. Take into account the same concerns you do for trail design: recreation, safety, convenience, and minimal environmental impact.

Not every road crossing should have a trailhead. Avoid or limit trailhead development at dangerous road crossings. Selective development of trailheads regulate the volume and location of users along the trail. Where the trail would deteriorate under heavy traffic, discourage overuse by limiting parking or by developing trailheads only along other nearby, more stable sections of trail.

Trailheads, more than any other trail features, influence the relationship between the trail users, neighbors, and communities. People living near the trail judge trail users by what they see at trailheads. Local residents will quickly become impatient with overnight parking in inappropriate locations, noise and littering, late-night arrivals, and invasions of their privacy from hikers requesting use of phones and facilities.

To be thorough during trailhead planning consider the following<sup>2</sup>:

- **Study existing use patterns:** Document use levels along 5 to 15 mile sections of trail by counting parked cars on average and peak weekends. Look at the whole trail system. Remember, you do not need to develop a trailhead at all road crossings. Trailheads at several key road crossings may be all that is required to meet your trail's needs.
- **Check with local residents:** Local police, municipal or county officials, PennDOT, and local residents can help you avoid or correct potential problem spots. They will appreciate your concern and interest.
- **Look for good spots:** Inquire or field-check locations that might accommodate parking without additional construction. Wide-shouldered roads, picnic areas, state waysides, sections of old roadbed, and old gravel pits often provide ample space for parking.
- **Evaluate motor vehicle access safety:** Seek advice from highway safety engineers and local residents to evaluate the safety of access to the roadway, pedestrian crossings, and the local impact of any proposed lot.
- **Adhere to standards:** Follow local or state standards when planning parking access. On blind hills and curves, parking is unacceptable. On all roadways, clear lines of sight must extend down the roadway,

<sup>2</sup> Appalachian Trail Design, Construction, and Maintenance: Appalachian Trail Conference, 2000.



**Ernst Trail - Rural Trailhead**  
Crawford County

Photo Credit: Pashek Associates



**Kinzua Valley Trailhead**  
McKean County

Photo Credit: Pashek Associates



usually 200 to 500 feet, depending on the speed limit.

- **Avoid overused areas:** Plan to keep parking space to a minimum if an area appears fragile or threatened by overuse.
- **Consider landforms:** Choose well-drained sites above the 100-year floodplain, without steep banks, on slopes of less than five percent grade; otherwise, the development of sites may be costly, impractical, or require excavation.
- **Determine necessary permitting requirements:** You may need to acquire a driveway permit to access public roads.
- **Discourage vandals:** Make policing for vandalism easy by locating parking lots where they are clearly visible from the main road.

Trailhead facilities may include a permanent shelter with restrooms, modular/portable restrooms, picnic areas and shelters, utility or storage buildings, information kiosks, parking, drinking fountains, seating, bike racks, and waste receptacles.

A trail may cross several jurisdictions so it is important for your designer to determine which municipalities have jurisdiction over the proposed improvements.

## Step 10: Determining Regulatory Requirements

During the planning process it is important for you to identify the regulatory requirements your trail and trail related facilities should meet.

### PennDOT Highway Occupancy Permits (HOP) and Highway Occupancy Agreements (HOA)

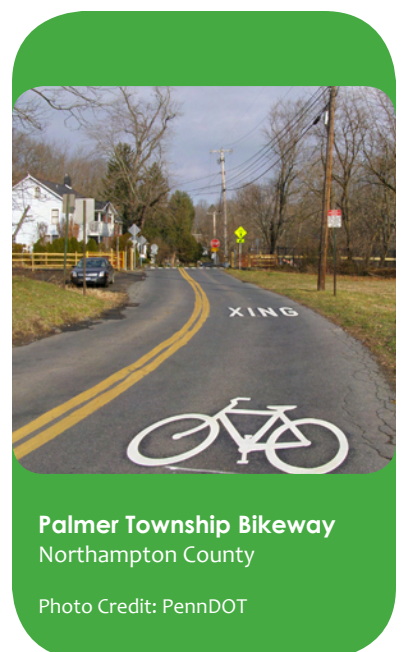
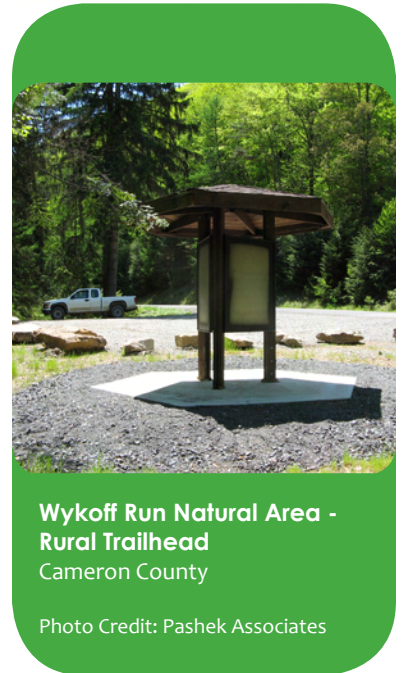
Trail or trailhead access through PennDOT rights-of-way or location of extended utilities, such as sewer, water, and electric, may require a HOP and/or HOA.

Obtain instructions for HOP applications, and sample HOAs from PennDOT Engineering Districts. Click [HERE](#) for a link to PennDOT Engineering District HOP contacts.

Trail designers should identify this need early in the process, so there is sufficient time to coordinate with the PennDOT District Permit Section in order to acquire the necessary permit and/or agreement.

### PennDOT Memorandums of Understanding (MOU) in Lieu of Highway Occupancy Agreements (HOA)

The HOA process establishes a relationship between PennDOT and trail owners/sponsors when the trail crosses a State highway. Since this process does not differentiate between types of trails or crossings, PennDOT has decided that these unique areas should be subject to procedures other than







the HOA process. This is reflected in the MOU between PennDOT and either a trail sponsor, or DCNR, depending on who is responsible for the respective trail. There are five specific PennDOT agreements for trails. They include:

- MOU Between DCNR and PennDOT Regarding Footpaths on DCNR Lands Crossing State Highways
- Amendment to the MOU Between DCNR and PennDOT Regarding State Forest Hiking Trail Crossings State Highways
- Master Agreement Between Trail Sponsors and PennDOT Regarding Footpaths on Lands Crossing State Highways
- MOU Between DCNR and PennDOT Regarding Shared Use Paths on DCNR Lands Crossing State Highways
- Master Agreement Between Trail Sponsors and PennDOT Regarding Shared Use Paths on Lands Crossing State Highways

The above agreements can be downloaded [HERE](#).

These agreements are subject to revisions from time to time due to programmatic and policy changes by PennDOT and/or future directives affecting Commonwealth agencies. Therefore, always check for the current version of these agreements.

### Uniform Construction Code (UCC)

Trail related structures like picnic shelters and restrooms may fall under the jurisdiction of the Commonwealth of Pennsylvania's Bureau of Occupational and Industrial Safety. They administer and enforce the UCC, Fire and Panic Law, Universal Accessibility Law, Energy Conservation Law, General Safety Law, Boiler Law, and Elevator Law. The UCC applies to construction, alteration, repair, and occupancy of all buildings in the Commonwealth.

In Pennsylvania, the Department of Labor and Industry has adopted the International Code Council's International Building Code as Pennsylvania's UCC. It is updated triennially.

Over 90% of Pennsylvania's municipalities have elected to administer and enforce the UCC locally, using their own employees or certified third party agencies. The state enforces the UCC for the remaining municipalities. Inspections required during construction may include:

- Foundation inspection
- Plumbing, mechanical, and electrical inspection
- Frame and masonry inspection
- Wallboard inspection
- Final inspection



If a municipality has “opted out,” the Pennsylvania Department of Labor and Industry is responsible for code enforcement in that municipality.

For more information on the UCC visit the *Pennsylvania Department of Labor and Industry’s website* [HERE](#).

## Local Codes

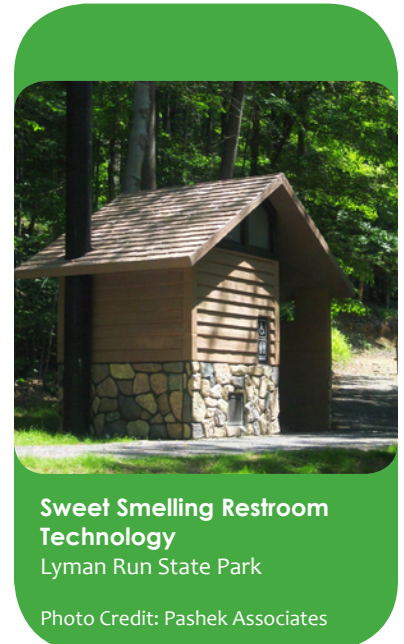
Trail related development may also be required to meet regulations of local municipalities. Each county has a planning commission to oversee the development of land in its county. Further, some municipalities have their own planning commissions to regulate development under their jurisdiction.

When designing trails or trailhead facilities you may need to prepare, submit, and obtain approval of a land development plan. You may be required to submit detailed plans showing the proposed development, such as: proposed building locations, road/trail alignments, and stormwater management facilities. Additionally, local authorities generally require evidence indicating that you have obtained other required permits. Contact your county and/or local planning commission and inquire about any requirements to determine if you need such a plan.

Further, if the zoning classification does not include trails or trail-related facilities as a permitted use, you may need to apply for a zoning waiver or special exception in order to build a trail or related facility on the property. Similarities exist between this process and the land development process; however, the zoning board grants approval rather than the planning commission.

## Sewage Facilities

If the design of the trail includes restroom or other sanitary facilities, there are a few things to consider regarding permitting. If the facilities will connect to a public sewerage system, you should complete a sewage planning module or a sewage planning module waiver. If the facilities are in a remote location and will be self-sufficient, then you may need either a holding tank permit for a holding tank structure or need to complete a sewage planning module for a septic tank, sand mound structure, or other approved system. When considering the type of sanitary facilities to install, first contact the sewage enforcement officer (SEO) responsible for the municipality in which the facility will be located. If there is no SEO for the area, locate your regional PA Department of Environmental Protection office [HERE](#) for guidance.



**Sweet Smelling Restroom Technology**  
Lyman Run State Park

Photo Credit: Pashek Associates



## Step 11: Identifying Environmental and Cultural Resources

### Environmental Review Agencies

- Department of Conservation and Natural Resources  
Bureau of Forestry  
Ecological Services  
Section  
400 Market St.  
PO Box 8552  
Harrisburg, PA 17105-8552
- Pennsylvania Fish and Boat Commission  
Natural Diversity Section  
Division of Environmental Services  
450 Robinson Lane  
Bellefonte, PA 16823-7437
- Pennsylvania Game Commission  
Bureau of Wildlife  
Habitat Management  
Division of Environmental Planning and Habitat Protection  
2001 Elmerton Avenue  
Harrisburg, PA 17110-9797
- United States Fish and Wildlife Service  
Endangered Species  
Section  
315 South Allen Street  
Suite 322  
State College, PA 16801

When planning for a sustainable trail, you should identify sensitive environmental and cultural resources and determine whether your proposed trail may have any negative impacts on the identified resources. If negative impacts are possible, then you should determine whether the potential negative impacts can be avoided or appropriately mitigated.

### Pennsylvania Natural Heritage Program (PNHP)

To determine whether rare, threatened, or endangered species are located within the vicinity of your project area conduct an online search of the PNHP database.

PNHP partners include: DCNR, Pennsylvania Fish and Boat Commission, Pennsylvania Game Commission, U.S. Fish and Wildlife, and the Western Pennsylvania Conservancy.

The PNHP maintains an inventory of areas throughout the state that are home to endangered and/or rare species of plants and/or animals. The identified areas are located and organized within an [ON-LINE DATABASE](#), referred to as the Pennsylvania Natural Diversity Inventory (PNDI).

The online search compares the proposed project location to the PNDI database and identifies any conflicts that might occur between the proposed project and existing natural features, vegetation, wildlife, and habitats. A report then features these results with instructions in instances where potential conflicts exist. Potential conflicts with identified species should be resolved with the appropriate agency.

A PNDI database search should occur when acquiring any DEP permit. Trail designers typically need to conduct a PNDI search for trail projects.

Large projects that cannot be drawn utilizing the online Environmental Review Tool interactive map should be submitted by mail to all of the Jurisdictional Agencies in Pennsylvania for review.

“Large Projects” consist of:

- Projects that exceed 15,000 feet (2.84 miles) East/West x 15,000 (2.84 miles) feet North/South (5,165 acres)
- Township-wide, county-wide or state-wide projects. Examples: Act 537 sewage plans, wind farms, or roadway improvements exceeding map limits above.





Most counties have completed County Natural Heritage Inventory (CNHI) studies that also identify rare, threatened, or endangered species of plants and animals and other critical natural areas within the county. To see if a CNHI is available for your project area [CLICK HERE](#). If one is available, review it to determine if your proposed project poses any potential conflicts to avoid or remediate during the planning of a trail.

### DCNR Bureau of Forestry Environmental Review Policy

Before initiating any project on state forest lands that has the potential to disrupt or alter the environment, the impacted districts should complete an environmental review. DCNR Bureau of Forestry's Environmental Review Guidelines can be obtained [HERE](#).

The DCNR Bureau of Forestry environmental review consists of an assessment of the project's likely adverse and beneficial impacts on each factor. Where the Bureau of Forestry predicts an adverse impact, the review should contain an explanation of the corrective measures that should be taken, or justification if no corrective action takes place.

### Watershed and Water Resources Management

Avoid stream corridors, wetlands, floodplains, and lower portions of north-facing slopes. Placement of trails within these areas can interfere with stream transport of sediment and debris, groundwater movement, and floodplain dynamics.

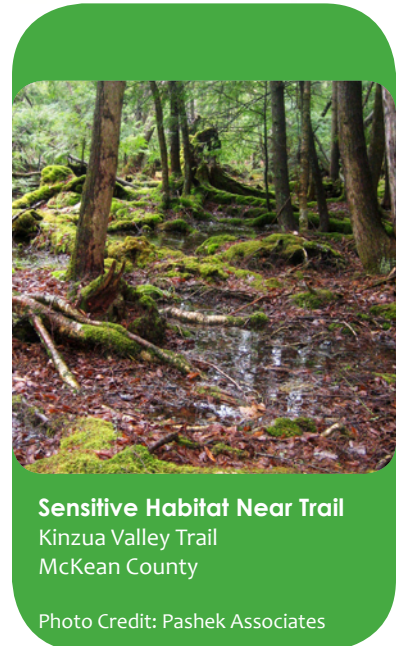
Lower portions of north-facing slopes tend to remain wet because groundwater moving downhill comes to the surface in these areas. Furthermore, the northerly aspect generally receives less direct sunlight than south, east, or west-facing slopes, allowing these areas to remain wetter.

#### *Fish Habitat*

Locate trails outside the riparian (streamside) corridor to protect stream banks from erosion, and conserve riparian shade. This habitat helps maintain cooler temperatures during warm weather to protect cool-water fish like steelhead and trout.

The roots of riparian vegetation help to anchor soil and stabilize banks. Major disruptions to roots can result in sediment delivery exceeding the natural level of suspended sediment. This may lower water quality and contaminate fish spawning beds. If unchecked, erosion can result in an increase of stream width, sediment in the water, and higher water temperatures.

Social trails and trail crossings located close to streams or wetlands lead to trail compaction and usually loss of vegetation. This can result in an increase of erosion and delivery of sediment to nearby water bodies.



**Sensitive Habitat Near Trail**  
Kinzua Valley Trail  
McKean County

Photo Credit: Pashek Associates



**Parker Dam State Park**  
Boardwalk over sensitive habitat  
Clearfield County

Photo Credit: Pashek Associates

### *Cursory Wetland Review*

The Commonwealth of Pennsylvania, in 25 PA Code Chapter 105, describes wetlands as:

“Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions...”

This definition describes seeps, marshes, bogs, swamps, wet meadows, and shallow ponds. Wetlands play a very important role in the Pennsylvania ecosystem. Wetlands help control flooding, help purify water supplies, and offer habitat for many of Pennsylvania’s rare, threatened, or endangered species.

A site must display each of three characteristics to be considered as a wetland:

1. The presence of hydric soils;
2. The presence of hydrophytic plants (water-tolerant plants); and
3. The presence of hydrology in the form of spring seeps, high water table, or inundated/saturated soils during the growing season.

A majority of Pennsylvania’s wetlands occur inland and are not subject to tidal influence; however, some regions of Pennsylvania, including areas around Erie and Philadelphia, do support areas of coastal wetlands.

During the planning process for any new trail or trail facility, conduct a desktop analysis of on-site soils through the USDA National Resources Conservation Service (NRCS) [WEBSITE](#). This analysis should identify all areas containing hydric soils as well as non-hydric soils with hydric inclusions.

National Wetland Inventory (NWI) maps may also be used to help locate potential wetland areas. These maps can be obtained through the PASDA [WEBSITE](#). However, NWI maps are based on aerial photography analysis from the 1970’s and 1980’s. Therefore, they do not indicate current wetlands and site conditions. A qualified soil or wetland scientist should conduct a field investigation to determine the presence of wetlands and delineate wetland boundaries.

Federal and state regulations protect wetlands from adverse impacts and permits are required for work in these areas. If wetlands are present within the trail corridor, a pre-application meeting should be scheduled with the US Army Corps of Engineers (USACOE) and the Pennsylvania Department of Environmental Protection (PADEP). They will review and advise applicants what permits are necessary. To begin this process contact your local PADEP Regional Office. To find your regional PA DEP office [CLICK HERE](#).



## Stormwater Management

Do not underestimate the significance of water on the trail. High volume and high velocities of concentrated water flow on a trail results in significant erosion. Erosion also has a negative impact on water quality and adjacent habitats, as well as significantly increases the maintenance needs of the trail.

A smaller footprint limits the amount of water a tread receives and reduces the time it takes to direct the water from it. A sustainable trail follows the contour of the land in lieu of going against the grain of the contour, provides positive drainage away from the trail tread, avoids negative impacts to adjacent sensitive resources, and uses control points and features to keep users on the trail and to define the trail experience.

**Avoid Steep Trail Pitches:** To prevent water from concentrating on steep trails, avoid creating short trail segments steeper than 10 percent. If water concentrates itself on a trail, erosion occurs where the water runs off the trail. Further, it is difficult to control drainage on steep earthen trails and repairs can be expensive.

**Encourage Infiltration:** Before selecting a trail's design and materials, evaluate the trail's location and width, as well as the range and level of user groups. Then select designs and materials that facilitate infiltration and prevent stormwater runoff.

**Avoid Aligning Trails with the Slope:** To avoid water running down the surface of the trail, align trails perpendicular to the slope.

**Water Crossings:** Perpendicular routes should descend to water crossing on both sides to prevent the stream from flowing down the trail. Consider armoring the trail in areas that dip down to avoid sediment and trail runoff from entering the watercourse.

**Avoid Long, Sustained Grades:** Do not construct trails with long, sustained grades that can concentrate runoff on their surface. By installing rolling dips and grade breaks, runoff will direct itself off the trail and grade breaks provide areas for users to rest.

**Avoid Flat Ground and Steep Cross-Slopes:** Construct sustainable trails on sideslopes with cross-slopes between 5 and 25 percent, to maximize drainage and decrease trail construction and maintenance efforts. Trails on flat ground do not drain well. However, trails with steep slopes require larger excavations and run the risk of sloughing. Increased erosion and degradation can increase maintenance costs and lead to users forming bypass trails.

**Avoid Discharging Trail Runoff:** Concentrated runoff from trails can cause damage to fill slopes and unprotected soils adjacent to the trail. Carefully



**What Not To Do**  
Unsustainable grade, trail on poor soils, fall line trail

Photo Credits: PA DCNR





### **Streambed**

Avoid flowing stream crossings

Photo Credit: Pashek Associates

select trail locations to slow runoff velocity so sediments can settle out. Armor fill slopes where you intend to discharge runoff onto them or convey runoff off-site where it can be infiltrated.

Trails can change the timing, quantity, and quality of the natural hydrological system by delivering both sediments and runoff directly to streams, wetlands, and riparian resources.

**Avoid Removing Trees and Shrubs at Stream Crossings:** Use existing roads and bridges to avoid removing trees and shrubs at crossings and to avoid new stream corridor disturbances. Consider routes that can handle drainage without affecting nearby water resources. Some measures to avoid these impacts include trail narrowing, encouraging filtration, providing frequent drainage, and spreading crushed aggregate to enhance drainage.

**Avoid Stacking Switchbacks and Climbing Turns:** Carefully locate climbing turns and switchbacks to prevent user cut-throughs and short cuts. Offset them from one another to take advantage of natural benches, slope breaks, and natural screening. To discourage shortcuts, you may increase grades and use rocks, trees, or log barriers while constructing the turn.



## Pennsylvania Department of Environmental Protection Permits

DEP requires permits for many construction activities that may negatively affect the environment and/or its citizens. The permits described here are a sampling of the number of permits that DEP could require. Look for information on these and other potential permit requirements at [www.depweb.state.pa.us](http://www.depweb.state.pa.us), keyword: Permit.

### *Chapter 102 - Erosion and Sediment Control (E&SC) and Stormwater Management Requirements*

PA DEP's Chapter 102 - Erosion and Sediment Control and Stormwater Management regulates earth disturbance activities. Chapter 102 requires that persons proposing or conducting earth disturbance develop, implement, and maintain E&SC Best Management Practices (BMPs) to decrease erosion and the potential for pollution to water resources. In addition, under the Federal Clean Water Act, projects that have one acre or more of earth disturbance over the life of the project may require an National Pollutant Discharge Elimination System (NPDES) Permit for Stormwater Discharges Associated with Construction Activities.

Chapter 102 regulations require all earth disturbance activities to have an adequate E&SC plan designed for the site. Earth disturbance activities exceeding 5,000 square feet require an E&SC plan to be reviewed by the county conservation district and approved in writing. The plan should show the locations and details of E&SC BMPs that protect against accelerated erosion. Examples of E&SC BMPs include compost filter logs, mulch, diversion channels, sediment traps and basins, and the planting of grasses or similar vegetation. The plan should show the site, location of the BMPs, and timing and sequence of their installation for maximum erosion control.

The county conservation district can offer guidance to anyone developing a plan. To find your conservation district [CLICK HERE](#). Once a plan is prepared, submit it to the conservation district for review.

### *National Pollutant Discharge Elimination System Permit*

Projects disturbing one or more acres should acquire authorization through a NPDES Permit for Stormwater Discharges Associated with Construction Activities before beginning any earth disturbance activity.

Major components of a NPDES Permit application include:

- Erosion and Sediment Control Plan
- Pennsylvania Natural Heritage Program Clearance
- Post Construction Stormwater Management Plan
- Thermal Impact Analysis
- Antidegradation Analysis

### Typical Water Obstruction & Encroachment General Permits for Trail Projects

- PAG-2 NPDES GP: Stormwater Discharges Associated with Construction Activities
- GP-03: Rehabilitation, Bank Protection & Gravel Bar Removal
- GP-04: Intake & Outfall Structures
- GP-05: Utility Line Stream Crossings
- GP-06: Agricultural Crossings & Ramps
- GP-07: Minor Road Crossings
- GP-08: Temporary Road Crossings
- GP-11: Maintenance, Testing, Repair, Rehabilitation, or Replacement of Water Obstructions and Encroachments



Look for information on these and other potential permit requirements at [www.depweb.state.pa.us](http://www.depweb.state.pa.us), keyword: Permits. Additional departmental permits, approvals and coordination could include Water Obstruction and Encroachments Permit, Chapter 105 general permits, and brownfield remediation. Failure to apply for and obtain all necessary permits and approvals may result in the delay of construction.

### *Chapter 105 Waterways and Wetlands Management Requirements*

PA DEP's Chapter 105 – Waterways and Wetlands Management Program regulates work in and around streams, wetlands, and other bodies of water with a focus on avoiding or minimizing impacts on water quality, flooding frequency, wetlands, stream channels and riparian habitats. Under a Delegation Agreement, the local conservation district administers DEP General Permits for various types of work in waterways, including wetlands and stream crossings, streambank stabilization, boat ramp and dock installation, intake and outfall structures, and utility line crossings. District staff inspects permitted sites, investigates complaints, and provides regulatory and permitting assistance.

As of 2013, roughly half of the county conservation districts remain delegated to administer DEP Chapter 105 General Permits. To determine if your conservation district is eligible **CLICK HERE**.





## Cultural Resources Management

Under the Pennsylvania History Code and the National Historic Preservation Act, the Pennsylvania Historical and Museum Commission (PHMC) serves as the State Historic Preservation Office (SHPO). The Commission's Bureau for Historic Preservation administers all official state historic preservation programs and activities.

Pennsylvania Historical and  
Museum Commission  
Bureau of Historic Preservation  
400 North Street, Second Floor  
Harrisburg, PA 17120-0093

One role of PHMC involves advising and aiding state and federal agencies in complying with legislation including the National Historic Preservation Act and the PA History Code, which protect historic properties. To meet this goal, the Bureau has established the Environmental Review process, through which it reviews projects for their potential to affect historic properties.

When planning a construction project that may disturb a historic structure or area, contact the PHMC to determine if the structure or area has significant historical value. If a site has historic significance the PHMC may require additional research, possibly including archeological surveys of the area.

Any construction on land within the Commonwealth requires a PHMC review. PHMC can also provide assistance upon request of your designer. When planning trails or trail facilities it is prudent to contact PHMC during preliminary design. This allows them to locate any nearby cultural or historical resources and eliminate the need to redesign the project if a resource is found later.

Start by completing and submitting a cultural resource notification. PHMC has developed the Request to Initiate Consultation in Compliance with the *State History Code* and *Section 106 of the National Historic Preservation Act* form, [AVAILABLE HERE](#).

Document all construction activities involving structural and/or ground disturbance on the form and submit it to PHMC for review.

## Cultural Resource Geographic Information Systems

Cultural Resource Geographic Information Systems (CRGIS) is a map-based inventory of the historic and archaeological sites and surveys stored in PHMC's Bureau for Historic Preservation.

Currently there are 21,473 archaeological sites and 128,985 historic properties on record. CRGIS is a means of accessing some of this data without a trip to Harrisburg.

Web access to all of the historic resource data is open to the public. Access to archaeological site locations and detailed site information is restricted and password protected and will be granted to qualified individuals on a need to know basis. Two levels of restricted access are available: one for planning professionals and one for archaeological professionals.

To access the CRGIS [CLICK HERE](#).



Cameron County  
Historical Society

Photo Credit: Pashek Associates

The following basic project information is required on the form:

- **Map Location:** Include a 7.5 USGS Map showing the project boundary and the Area of Potential Effect (APE). The APE should include indirect effects, such as visual and audible impacts. Federal projects must provide an explanation of how the APE was determined.
- **Photos:** Include photos of all buildings or structures in the APE. For properties over 50 years submit a Historic Resource Survey Form with the initial request.
- **Project Description Narrative:** Provide a detailed project description describing the project, any ground disturbance, any previous land use, and age of all affected buildings in the project area. Attach a site map showing the location of all buildings in the project area.

You should typically receive a written response from PHMC within 30 days.

PHMC's response may take one of the following forms, depending on the circumstances:

- A determination of no resources and/or no effect for the project, indicating you have completed consultation with the SHPO office.
- Notification that historic structures and/or archaeological resources exist within the project area and that project area needs a survey or other investigation completed to evaluate the National Register eligibility of these resources.
- Notification that, although no known archaeological sites exist within the project area, the physical setting of the project, combined with comparative information from similar settings nearby, suggests a high probability that archaeological sites exist within the project area and that the project area will require a survey to locate these sites.
- Notification that, although no known historic buildings, structures, districts, or objects exist within the project area, USGS quadrangle maps show buildings present. Therefore, a survey of the project area is required to identify potential historic buildings, structures, districts, and object.
- Determination that the project will have no adverse effect on known or newly identified historic and/or archaeological resources and that, unless plans change, consultation is complete.
- Determination that the project will have an adverse effect on known or newly identified historic and/or archaeological resources and the project will require further consultation.
- A notice that PHMC received too little information to perform a review, in which case the PHMC will attach an itemized checklist of types of information with its response.



## Step 12: Planning for Accessibility

In 1981, the World Health Organization published the International Classification of Impairment, Disability, and Handicap (ICIDH) to create a standardized level of communication and terminology on an international level. Within this document, the ICIDH defined three health-related restrictions of an individual's level of function: 1) impairment, 2) disability, and 3) handicap. Impairment is a function of the individual, while a disability or handicap occurs because of limitations imposed on the individual by the community in which he or she lives. Thus, disability and handicap are functions of the environment rather than the individual.

Functions such as agility, balance, flexibility, endurance, sight, hearing, and problem-solving ability help determine an individual's ability to safely access a facility. Persons with activity limitations, resulting from impairment, may have trouble when performing various actions. It is important for designers to consider these users' needs, as well as to consider how they may meet demands in the future to promote active lifestyles. The term accessible refers to a facility that persons of all abilities can approach, enter, and use.

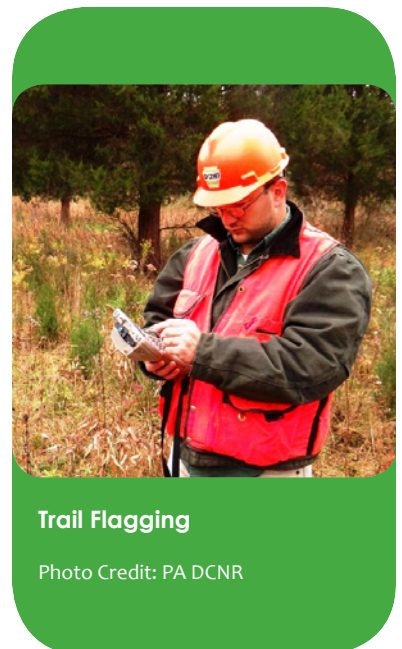
During the planning phase it is important to incorporate the philosophy of universal design in the planning process. Specific design requirements for accessible trails are detailed in Chapter 2 - Design Needs for Specific Non-Motorized Trail Users.

Designers should integrate universal design strategies into the design process whenever possible. Newly constructed trails should address these issues during the planning process to eliminate changes in a design during and after construction.

Every aspect of a trail experience should be considered including planning for accessible facilities, amenities, trailheads, and trail corridors to ensure a design's versatility. Moreover, a trail's environment and benefits should be enjoyable and appeal to those with and without disabilities.

## Step 13: Establishing the Preliminary Trail Alignment

Once your trail designer has a firm understanding of your vision and goals, the locations of sensitive resources, the opportunities and constraints presented by the land, the desires of the users, and the concerns of land managers, property owners, and adjacent neighbors, you can begin to establish the preliminary alignment for the trail system. Take into consideration the sustainable trail requirements, detailed in Chapter 2, and the specific trail-user design criteria, detailed in Chapter 3, to achieve the desired level of difficulty.



**Trail Flagging**

Photo Credit: PA DCNR





## DCNR's Top 10 Best Green/Sustainable Trails

1. Design an experience into your trail.
2. Control access to wet areas, steep slopes, critical habitats and other culturally or environmentally sensitive areas. Design periphery routes with access points.
3. Manage stormwater through natural infiltration practices to keep water off and away from the trail by using porous surfacing, water bars, cross vanes, swales, etc.
4. Sustainable trailhead improvements may include: pervious paving for the parking lot, solar lighting, certified lumber for structures, composting toilets, native landscaping, etc.
5. Enhance riparian areas between the trail and the rivers, streams, lakes and wetlands.
6. Manage/control invasive plants along the trail. Replant these areas with natives

With this information your designer can establish the preliminary trail layout by reviewing the inventory and analysis mapping, and laying out the trail segments following the sustainable trail design criteria referenced in these guidelines.

### Sustainable Trail Planning

The design of sustainable trails begins during the planning phase. Sustainable trails follow the contour of the surrounding landscape, gradually climb, and direct water away from the trail. Regardless of trail type, your trail can be sustainably designed by following the International Mountain Bicycling Association's (IMBA) five essential elements of sustainable trails<sup>3</sup>:

1. **The Half Rule:** A trail's grade should not exceed the half grade of the hillside or sideslope that the trail traverses. If grade does exceed half of the sideslope, consider it a fall line trail that may be susceptible to erosion.
2. **The Ten Percent Average Grade Guideline:** Generally, a trail with an average grade of 10 percent or less is most sustainable. This does not mean you need to keep all grades less than 10 percent. Many sections of a trail will have short steep sections greater than 10 percent, and some unique situations will allow average grades of more than 10 percent.
3. **Maximum Sustainable Grade Trails:** Maximum sustainable grade equals the steepest section of trail that is more than 10 feet in length. When designing a trail, it is essential to determine early in the process the maximum grades the trail will be able to sustain given local conditions. Variables that impact the maximum sustainable grade include:
  - Soil Type
  - Rock
  - Annual Rainfall Amount
  - Grade Reversals
  - Type of Users
  - Number of Users
  - Planned Level of Difficulty
4. **Grade Reversals:** A grade reversal occurs at spot where a climbing trail levels out and then changes direction, dropping subtly for about 10 to 50 linear feet before rising again. This change in grade forces water to exit the trail at the low point before it can gain volume, velocity, and erosive power. Other names for grade reversals include dips, grade breaks, drainage dips, or rolling dips.

3 Trail Solutions, IMBA's Guide to Building Sweet Single Track, International Mountain Bicycling Association: 2004



5. **Outslope:** As the trail contours across a hillside, the downhill or outer edge of the trail tread should tilt slightly down and away from the high side. This encourages water to flow across and off the trail.

When you are designing sustainable trails, consider the level of trail development required based upon the location, use, and other factors. Some trails may consist of a natural surface, while others may consist of more developed surfaces. Refer to Chapter 3 - Design Requirements for Sustainable Trails for additional information.

### Common Trail Building Mistakes

Make every effort to avoid the ten most common trail building mistakes<sup>4</sup> as summarized by IMBA to ensure for the design and maintenance of safe, sustainable trails.

**Not Getting Land Manager Approval:** An important step to complete before starting trail work is to obtain approval from the landowner or manager. Failure to secure permission, usually ends up being the single biggest cause of trail closures and may result in further complications for users, builders, and designers.

**Following the Fall Line:** Fall line trails usually follow the shortest route down a hill, following the same path water flows. Natural and user-created erosion strips the trail of soil, exposes roots, creates gullies, and scars the environment. To build trails that last, use the Half Rule: trail grade, or steepness, should not exceed half the grade of the hillside; and the 10 Percent Rule: Keep the overall trail grade 10 percent or less.

**Guessing the Grade:** Always use a clinometer to confirm the grade when laying out a trail, because no amount of trail improvement can fix a trail built at an unsustainable grade. This accurate, relatively inexpensive tool measures the grade, or steepness, of a trail in degrees or percent for designers and builders to construct a trail route correctly.

**Going Against the Flow:** All trail builders should ensure a trail has smooth transitions and good flow. This ensures an enjoyable trail experience. By designing smooth turns that users can safely navigate at a consistent speed, designers can limit user conflicts and decrease safety hazards with minimal trail degradation.

**Not Constructing the Tread on a Full Bench:** The only instances where you should not construct a full bench cut trail are:

- (a) When the sideslope is so steep—80 percent or greater—that the backslope exceeds 6 feet in height, or;
- (b) When a trail design forces trail builders to build close to the downhill side of a large tree.

### DCNR's Top 10 Best Green/Sustainable Trails (Continued)

7. Select recycled content materials for interpretive signage, benches, observation areas, mile markers, etc.
8. Keep users on the trail with clear markers and signs; educate on the importance of staying on the trail to limit environmental damage.
9. Foster a sense of stewardship responsibility/ethic among the trail users.
10. Whenever possible use local contractors to design and develop the trail using local resources.

<sup>4</sup> Ibid



In both cases, build either a crib or retaining wall to support a partial bench, and, as in all trails, the tread should maintain a 5 to 7 percent outslope.

**Steep Climbing Turns:** Avoid fall line turns, they result in extensive trail erosion. Trail designers should build climbing turns on sideslopes at grades no steeper than 7 to 10 percent to ensure their endurance.

**Using Poor Materials:** Using poor quality materials when building trail structures reduces their safety and longevity. Doing so leaves trail designers and builders vulnerable to user and trail safety concerns.

**Opening a Trail Too Soon:** Do not open newly constructed trails until they are ready and free of all safety hazards.

**Log Lined Trails:** A properly constructed trail should not have logs lining its edges. In fact, lining a trail with logs or rocks traps water on the tread and increases erosion.

**Ignoring Old Wounds:** Always reclaim eroded areas with check dams—natural obstacles like logs or rocks that divert the flow of water and soil—and reclaim all closed trails with transplanted native vegetation that conceals the old corridor.

Old logging roads, designed for temporary rather than long-term use, typically make poor trails. They often include sections of fall-line trail (prone to erosion), flat land sections that collect water, and have a wide tread to accommodate logging equipment. When used for recreational trails, old logging roads need frequent maintenance to address erosion and tread degradation. Unsustainable trails consume valuable time and resources.

#### Logging Road

Photo Credit: Pashek Associates







## Vegetation and Wildlife Habitat Management

Equally important to sustainable design of the trail, is locating the trail in a sustainable manner. Wildlife species function in areas specific to their size, needs, season, and quality of habitat. Within these areas animals most often feed, breed, and winter throughout their lifespan. As a result, human activities can have a negative impact within these sensitive habitat areas.

These impacts affect some species more than others do. For example, some species prosper in the presence of humans while others prefer habitats in seclusion. Especially for bird species, human disturbance may cause shortened feeding times, lowered reproductive success, a decline in parental care, and nest abandonment.

Since most human recreation areas are located in riparian corridors and near streams, conflict between humans and these natural habitats occurs. Most terrestrial species of wildlife depend on riparian corridors for feeding, breeding, moving, and dispersing. Consider the following guidelines when planning for trails located in natural areas:

**Minimize Trail Construction:** Initial human disturbances sometimes have more impact on wildlife than continuing disturbance. As a result, avoid locating trails in areas that contain high quality habitat, sensitive natural resources, and a variety of species. Consider locating trails in locations with lower habitat quality where you can concentrate use.

**Use Existing Disturbance Corridors:** Align trails along existing disturbance corridors such as existing rail lines, old roads, utility maintenance corridors, and construction routes. By locating trails in previously disturbed areas, you conserve sensitive resources from additional disturbance and long-term environmental impacts.

**Locate Trails at Habitat Edges:** Align trails in previously disturbed habitats and in areas with invasive vegetation. Replace invasive plants with native vegetation to restore the natural plant community and provide better transition zones between the trail and intact habitat zone.

**Avoid Sensitive Habitat Areas:** Diverse species and sensitive ecological areas typically occur in areas usually associated with large habitat patches. For this reason, avoid locating trails in areas that may fragment large, intact species.

**Maintain Connectivity:** Diversity of water resources, access, and seasonal availability help determine the quality of wildlife habitats. Avoid constructing water crossings in areas with high connectivity to prevent wildlife barriers from occurring.

**Avoid Small Areas of High-Quality Connector Habitat:** Avoid small habitat patches, especially those that contain sensitive or rare species, when planning a trail. Not all habitats need to interconnect to thrive; but in some instances, connection to nearby habitats is essential.

**Avoid Habitat for Threatened, Endangered, and Sensitive Species:** Avoid placing trails in habitats of threatened, endangered, or sensitive species. Consult a biologist in the preliminary planning stages to determine a precise trail location.



Once the designer has prepared the preliminary layout, they should flag the trail in the field and refine the design as necessary to achieve the final layout of a sustainable trail system. Chapter 2 describes this process in greater detail.

### DCNR Publications

DCNR has published resources on multi-municipal cooperation and trail maintenance and operation. They include:

- *Multi-Municipal Cooperation for Recreation and Parks*
- *Rail-Trail Maintenance & Operation*

*These publications serve as valuable resources during the trail planning process.*

*To access the DCNR publications **CLICK HERE**.*

## Step 14: Evaluating Potential Management Structures for Management, Maintenance, and Operations of Your Trail

There are many successful models for managing, maintaining and operating a trail. Typically they fit into one of the following categories:

- County/Local Government
- Municipal Authority
- Non-Profit Organization

Each management structure has its own unique set of strengths and weaknesses depending on the capacity of the participating partners. Potential management structures and the capacity of the participating partners should be evaluated on a case by case basis to determine which management structure would best meet your trail's needs.

Factors to consider when evaluating each structure and the capacity of potential partners includes:

- Project management
- Planning and design
- Acquisition of land or right-of-way or easement
- Property management
- Construction funding
- Other Resources - In-Kind and Donated materials, equipment, labor, etc.
- Maintenance or maintenance agreements
- Insurance or insurability/risk management
- Organization and financial administration
- Stability of operating funding
- Public Relations
- Geographic Area of Jurisdiction and geographic relationship to project area

For additional information on Management Structures refer to Chapter 5 - Management.



## Step 15: Planning for Construction, Management, Maintenance and Operation Costs

During the planning stage it is important to plan for management, maintenance, operation, and construction costs. The trail organization should be confident of its ability to securing funding, resources, and volunteer/in-kind support before advancing into the design of the trail.

Before projecting your costs the designer should determine who should build and maintain your trail. You can build and maintain trails in many ways. Nonprofit trail clubs (with professional and volunteer workers), municipalities, landscape companies, and construction firms all construct trails. For many projects on both public and private land, volunteers and conservation corps are responsible for building trails.

Many projects use both professional and volunteer labor to construct and maintain trails. It is important to determine who will build the trail in order to include the appropriate labor costs into the project estimate. Obtain estimates from nonprofit trail clubs, contractors, and conservation corps before completing your project budget. These final numbers may vary widely depending on the labor costs and any hidden costs like food, travel expenses, and safety equipment.

### Construction Costs

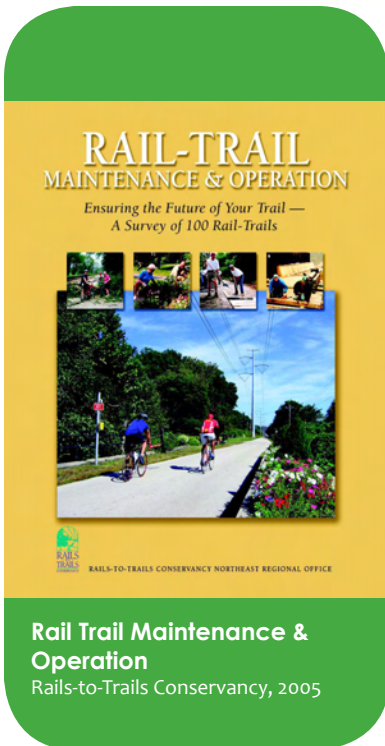
Trail managers and designers often use one or more of the following methods to project trail construction costs:

1. Unit costs
2. Crew weeks of labor
3. Per foot or mile costs

With unit costs a predetermined cost exists for features associated with the construction of the trail. You simply multiply a tally of features by their unit cost to determine the total project cost. When using the unit cost method a completed trail work log serves as an important tool for the designer.

Often trail designers estimate construction costs by using crew weeks of labor to determine the amount of time it may take to complete a project. Experienced trail leaders can estimate how much work a crew can complete in a week and divide the project into a number of crew weeks. Usually, one estimates project material costs and labor costs separately, then combines them to estimate the overall cost. Both volunteer and professional trail crews use the crew week method to determine trail project costs. As with other methods, the person estimating the project costs should have a solid background in trail work and first-hand knowledge of the work a crew can perform in a given time period.





Ideally, trail construction would occur in one phase, minimizing construction activities, disruptions, and realizing “economies of scale” savings. However, you may find it more appropriate to phase construction over a period of time.

Typically trail improvements are constructed in a series of logical phases, as determined by the owner’s financial capabilities.

### Management, Maintenance and Operation Costs

Management, maintenance and operation costs typically include:

- Land acquisition or purchase of easements
- Office space
- Salaries for paid staff
- Liability and other insurance policies
- Printing and mailing expenses
- Telephone expenses
- Fuel expenses
- Continuing education expenses
- Large equipment expenses
- Small equipment expenses
- Consumable expenses
- Maintenance materials and supplies
- Utility expenses

Your organization should project anticipated expenses and likely revenue by developing a five year management, maintenance and operations budget. This can be accomplished by interviewing staff of similar trail organizations who have trails of similar scope and size.

Potential expenses and revenues can also be estimated using resources available in the Rails to Trails Conservancy Trail Building Toolbox. These resources can be viewed [HERE](#).



**Volunteer Trail Crew**  
Lonberger Trail, Centre County

Photo Credit: PA DCNR



## Trail Studies

Potential funders want to see an overall plan for the proposed trail system. Completing a trail study for your trail is a way to demonstrate you have developed a plan to manage, construct, maintain and operate your trail. The trail planning process is typically designed to address all of the planning steps described in this chapter.

A trail study should document the process, analyze the feasibility, recommend specific improvements, identify the overall costs, provide recommendations for phasing the construction of the trail system, and provide detailed implementation strategies to guide your organization in development of the trail.

DCNR's Community Conservation Partnership Program is a competitive grant program that can provide a source of funding to complete a trail study. The cost to complete a trail study varies. This cost depends on the length of the trail, complexity of land ownership, number of features, structures, and crossings, potential for environmental hazards, etc.

If your organization is interested in exploring the possibility of completing a trail study, contact your regional DCNR adviser who will advise you on the process. [CLICK HERE](#) to find your regional adviser.

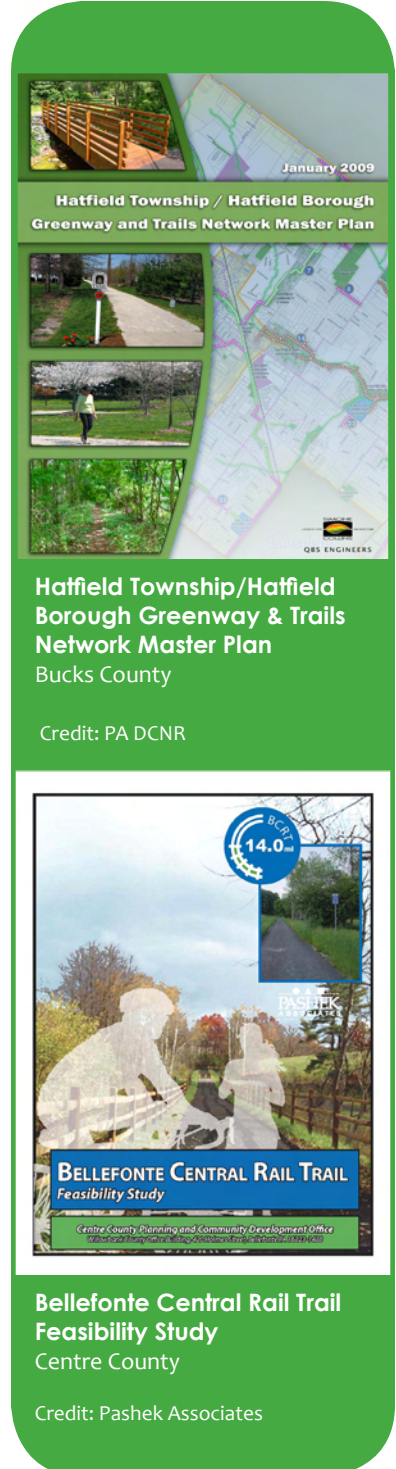
To view a sampling of DCNR funded trail studies [CLICK HERE](#).

## Step 16: Securing Funding for Trail Planning, Design and Construction

Where will the money come from to support your proposed trail? Trail projects often receive funding from various federal, state, local governments, and private sources to pay for project costs. Other sources of funding such as donations, trail user fees and taxes offer creative ways to fund a trail project.

The trail sponsor is responsible for seeking funding sources, soliciting volunteer labor, and applying for grants. When considering whether or not to apply for federal or state grants, speak with grant administrators and past recipients to ensure your project and application will meet their needs. Be particularly aware of application deadlines, award dates, and the reporting process to prepare for and continue a project during the waiting period. Always have a backup plan and make allowances for moving forward with any project.

Raising funds for new projects, especially where strong partnerships are developed, remains easier than raising funds for trail maintenance projects. Establish strong community support and solid relationships with donors





before seeking funding. You can phase construction over time by dividing the project into smaller components.

Typical sources of funding for trail development include:

- Allocations from municipal government
- Grants from non-profit foundations
- In-kind and donated services in the form of materials, labor, equipment, operators
- State and Federal grant programs

DCNR's Community Conservation Partnership Program is the primary source for recreational trail funding in Pennsylvania. For information on these grant opportunities [CLICK HERE](#).

The screenshot shows the DCNR website with a green header. The main content area is titled 'Sample Plans' and lists seven different plan types, each with a thumbnail image and a short description:

- Comprehensive Recreation, Park and Open Space and Greenway Plans**: Comprehensive Recreation, Park and Open Space and Greenway Plans are in-depth studies that focus on developing and improving municipal recreation and parks programs, services, facilities and natural resources.
- Land Conservation and Stewardship Plans**: Land Conservation and Stewardship Plans are in-depth site specific studies that focus on preservation and management of natural lands.
- Network Greenways and Trail Plans**: Network Greenways and Trail Plans are municipal, or regional based plans that identify a greenway/trail network, highlight opportunities for connections beyond the study area's borders, and provide a context for more local and detailed greenway trail/planning.
- Trail Plans**: Trail Plans can be a feasibility study and/or master plan that target a specific land corridor. These studies lead to acquisition, rehabilitation or development of recreational, aesthetic, alternate transportation or environmental educational opportunities to both motorized and non-motorized users of all ages and abilities.
- Master Site Development Plans**: Master Site Development Plans are site-specific studies that lead to development or redevelopment of a park or other recreational-use site. The final narrative report includes: site information and analysis, analysis of activities, facilities, maintenance, operations and a site development drawing.
- Feasibility Studies**: Feasibility Studies are in-depth studies to determine community support, market characteristics, physical/structural assessment and the legal and financial capability to acquire, develop or rehabilitate, manage and sustain an existing or new recreation or park facility such as a swimming pool or indoor recreation/environmental center.
- Rivers Conservation Plans**: Rivers Conservation Plans are in-depth studies that lead to the development of a long-term watershed or river corridor management program.

The footer of the website includes links for 'DCNR Home', 'Contact DCNR', 'Privacy Policy', 'Security Policy', and 'PA Home'.





# Design Needs for Specific Non-Motorized Trail User Groups

In order to design a trail it is important to understand the type of trail you are designing and the intended users of the trail.

This chapter details the characteristics of each non-motorized trail type, their respective users, and the corresponding design requirements, as they vary between the different uses. This includes:

- Hiking Trails
- Mountain Biking Trails
- Shared Use Paths and Rail-Trails
- Rails-with-Trails
- Equestrian Trails
- Cross Country Skiing Trails
- Snowshoeing and Winter Hiking Trails

While this chapter details the characteristics and design requirements for each type of trail use, all trails should strive to be accessible. The last section in this chapter discusses the requirements for accessible trails. These requirements should be applied to all trails where practical, as required by law.

Chapter 3 discusses aspects of sustainable trail design that should be incorporated into your trails. Ultimately your goal is to prepare plans and specifications to communicate all aspects of the design to those responsible for building trails, amenities, and support facilities in a sustainable manner.

## **Allegrippis Trails at Raystown Lake** Huntingdon County

32 miles of sustainably planned, designed and constructed single track mountain bike trails.

Photo Credit: Lesile Kehmeier





## Trail Design

Design and construction of trails is a complex combination of skills and should be accomplished by experts. Experience in trail design, construction, and management is essential for implementing projects that involve poor soils, complex topography, high levels of use, and extensive improvements, such as surfacing or structures. Experience is also essential for the design of multiple-use trail corridors that meet standards to allow for the safe use of a trail.

In addition to consulting experts in trail design and construction, it is important to seek advice from experts in resource disciplines. Two of the most common problems of backcountry trails, deterioration through overuse of popular trails and the development of undesired routes at popular destinations, can be avoided by drawing on personnel or outside experts with trail design and management experience and by following commonly accepted standards of trail design after thorough field study.

Observing proposed or existing routes through several seasons, including winter, will assist the planning team in determining the fitness of new corridors for trail development, as well as the level of improvement or rerouting required to achieve sustainability for rebuilt trails.

There are a variety of factors necessary for a sustainable, low-impact trail. By carefully fitting the trail profile to the local topography, erosion will be minimized, thus increasing the durability and sustainability of the natural surfaces.

*Natural Resource Management Manual # 77<sup>1</sup>*



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<sup>1</sup> Natural Resource Management Manual # 77, National Park Service: 2006 available [HERE](#).



## User Characteristics and Design Requirements for Non-Motorized Trails

### Hiking Trails

The development of hiking trails provides naturally surfaced routes for pedestrian use. These trails offer hikers and joggers the opportunity to experience and interact with nature with little disturbance from other trail users.

#### General Characteristics of Hikers<sup>2</sup>

The following information defines the general preferences and motivations of hiking trail users and the design requirements to accommodate use.

##### *User Information*

Whether the intended users are walkers, hunters, hikers, overnight backpackers, or destination hikers, hiking trails accommodate users seeking multiple experiences. Motivations for using natural trails vary widely, ranging from physical challenge to experiencing nature.

A large percentage of hikers enjoy escaping from motorized activity and value experiencing nature. Maintaining a natural setting with wooded, rolling terrain that features wildlife-viewing opportunities remains especially important to users of this type of trail. To accommodate overnight backpackers, remember to incorporate some amenities like camping areas, access to water, and composting toilets.

Include signage containing trail difficulty ratings at trail access points to aid users in determining which routes they will select. Include maps, route guides, and general information about trail features in publications and signage along each trail. Trail length preferences vary widely based on individual skills and preferences.

#### Destination Hiker Characteristics

##### *Trail Use Pattern*

- Seeks out trails for a desired experience (such as solitude), whether near home or at some travel distance
- Prefers looped systems over out-and-back trails to vary the experience
- Will seek out trails of varying difficulty
- Likes to stop along the trail to rest, observe, and socialize if hiking in a group
- Expects trail to be of varying difficulty consistent with landscape characteristics

<sup>2</sup> Adapted from Trail Planning, Design, and Development Guidelines, Minnesota Department of Natural Resources: 2007, available for purchase [HERE](#).



**West Rim Trail**  
Lycoming and Tioga Counties

Photo Credit: PA DCNR





### Recreation Setting Preferences

- Natural settings remain important to all users, with wooded, rolling terrain and wildlife viewing opportunities commonly preferred
- Trail difficulty often serves as an important determinant in trail selection, with a desire for a wide range of challenges
- Access to the trail is predictor of use levels
- Length preferences vary widely with skills and preference, with beginners liking shorter loops of 2–4 miles and day hikers preferring 5–9 miles
- Minimum preferred width is 18 inches

### Overnight Backpacker Characteristics

Overnight backpackers have many of the same preferences as destination hikers, only with a few nuances associated with overnight stays. Those preferences include:

- Camping areas at intervals of 5–10 miles are desired, with average daily hiking distance up to 10 miles
- Access to water, especially at camps
- A desire and need for composting/pit toilets at designated camp areas to minimize environmental impacts
- Outing length varies from 5–100 miles, with 25–35 miles being a common distance

### Hiking General Speeds and Distances

#### *Hunter Walker*

- 1-2 miles per hour
- 2-4 miles

#### *General Hiker/Backpacker*

- 2-3 miles per hour
- 4-10 miles

#### *Fitness Hiker/Backpacker*

- 3-4 miles per hour
- 6-15 miles

#### *Trail Jogger*

- 6-7 miles per hour
- 3-15 miles

### Hiking Trail Classifications

The design of natural hiking trails should accommodate trail users on a local, county, regional, and state level. Designers can further subdivide these trails to accommodate general hikers, walkers, hunters, and overnight backpackers.

**General Hiking Trail:** General hiking trails often have a natural surface tread. You can find this type of trail in parks or greenways where adequate open space exists to form a trail loop. These trails provide users various opportunities to observe wildlife and interact with nature.

**Nature Interpretive Trail:** Nature interpretive trails, similar to general hiking trails, allow users to interact with, enjoy, and learn about nature and wildlife. You can typically find trails of this kind within designated conservation areas and arboretums.

**Walker/Hunter Trail:** Walker/hunter trails often take advantage of old logging access trails and roads. These routes typically have a non-motorized designation. Authorized forest management activities often occur near them.



## Hiking Trail Layout Configurations

Hiking trail design normally responds to the landscape's topography and highlights a sequence of naturally occurring events that enhances the trail users' experience. In parks and natural areas the design often integrates a looped trail system at a specific site, while larger landscape settings normally incorporate a linear trail design. Designers should carefully employ design elements in the trail that fit with the existing landscape on all levels to decrease ecological degradation, maximize views, and embrace natural features along the route.

## Difficulty Rating System

*Difficulty Standards for Hiking Trails, as defined by the Pennsylvania DCNR<sup>3</sup>*

| Trail Type           | Easiest<br>(Interpretive)   | More Difficult   | Most Difficult   |
|----------------------|---|--|--|
| Clearing Height      | 8-10 feet   | 8 feet   | 8 feet   |
| Clearing Width*      | 4 feet  | 3-4 feet   | 3 feet   |
| Treadway Width**     | 1.5 to 2+ feet  | 1-1 ½'   | 1-2 feet   |
| Treadway Slope***    | Less than: 5%   | Less than: 12%   | Less than: 18%   |
|                      | Maximum: 20% up to 100 feet   | Maximum: 30% up to 300 feet  | Maximum: 30+% up to 500 feet   |
| Treadway Cross Slope | 0-3%  | 0-5%   | 0-8%   |
| Turning Radius       | NA  | NA   | NA   |
| Sight Distance       | NA  | NA   | NA   |
| Surface Materials    | Uniform, firm and stable surface. Smooth tread with no obstacles. Pavement may be appropriate in highly developed settings. | Native surface with some imported material. Sidehill trail is constructed. Generally clear of obstacles, steps to 10 inches. | Native surface with constructed sidehill trail. Obstacles, roots, rocks, and steps to 24 inches. |

\* Curve alignment to avoid cutting large trees.

\*\* Increase tread width six inches on switchbacks or where side slopes exceed 60%.

\*\*\* Upper limit of treadway slope and distance depends on soil type, amount of rock, vegetation type, and other conditions affecting trail surface stability.

Note: Some features on this chart are not considered sustainable for most situations and may be existing trails or trails in an unusual circumstance like the Appalachian Trail.



**Golden Eagle Trail Hikers**  
Lycoming County

Photo Credit: PA DCNR

3 Guidelines for Marking Recreational Trails, PA DCNR: 2008, available [HERE](#)



**Woodbourne Forest and Wildlife Preserve**  
Susquehanna County

Photo Credit: The Nature Conservancy



*Two-Way Hiking Trail*

## Sustainable and Accessible Hiking Trail Guidelines and Considerations<sup>4</sup>

### *Technical Provisions*

#### Trail Grade

- No more than 30% of the total trail length may exceed a trail grade of 8.33%.
- Trail grade of up to 5% can occur for any distance.
- Trail grade of up to 8.33% can occur for up to 200 feet if resting intervals are provided at distances no greater than 200 feet apart.
- Trail grade of up to 10% can occur for up to 30 feet if resting intervals are located at distances no greater than 30 feet apart.
- Trail grade of up to 12.5% can occur for up to 10 feet if resting intervals are located at distances no greater than 10 feet apart.
- At drain dips, a trail grade of 14% can occur for up to 5 feet where the cross slope does not exceed 5%.

#### Cross Slope

- The cross slope should not exceed 5%.
- At drain dips, a cross slope of up to 10% can occur at the bottom of the dip where the clear tread width equals at least 42 inches.<sup>5</sup>

<sup>4</sup> Requirements as proposed in Draft Final Accessibility Guidelines for Outdoor Developed Areas, United States Access Board: October 19, 2009, available [HERE](#), refer to discussion on accessible trails later in the chapter for additional information.

<sup>5</sup> As provided for in US Forest Service Forest Service Trail Accessibility Guidelines (FSTAG); May 22, 2006, and available [HERE](#).





### Resting Intervals

- Where the trail grade exceeds 5%, provide resting intervals. Resting intervals should be at least 60 inches long, be at least as wide as the widest portion of the trail segment leading to the resting intervals, and have a slope not exceeding 5% in any direction.

**Exception:** This provision does not apply where resting intervals cannot be constructed because one or more conditions for departure exist.

### Surface

- The trail tread surface should be both firm and stable.

### Clear Tread Width

- The clear tread width of the trail should equal at least 36 inches.

### Passing Spaces

- Where the clear tread width of the trail is less than 60 inches, provide passing spaces at intervals of no more than 1000 feet. Passing spaces should be at least 60 inches by 60 inches in size or an intersection of two walking surfaces that provide a T-shaped space complying with 403.5.3 of the [2010 ADA Standards for Accessible Design](#)<sup>6</sup> (ADA Standards) available [HERE](#), where the arms and stem of the T-shaped space extend at least 48 inches beyond the intersection.
- The cross slope of passing spaces should not exceed 5% in any direction.

### Tread Obstacles

- Where tread obstacles exist, they should not exceed a height of 2 inches.

**Exception 1:** Tread obstacles with a maximum height of 3 inches are permitted where trail grade and cross slope are 5% or less.

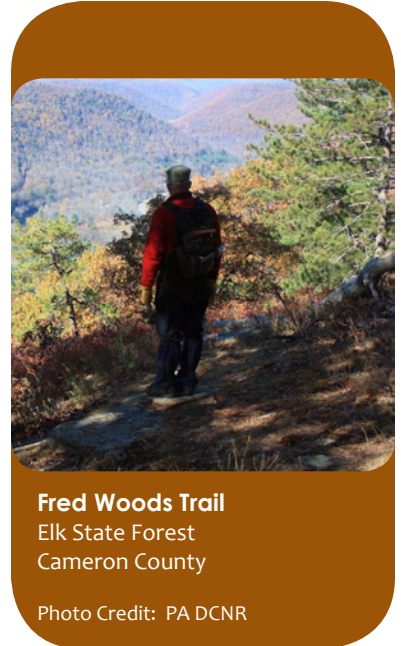
**Exception 2:** Where one or more conditions for departure exists that prevent you from meeting exception 1.

### Protruding Obstacles

- Objects protruding over the trail should provide at least 80 inches of headroom.

### Openings

- Openings in trail tread surfaces should be small enough to prevent passage of a 1/2-inch diameter sphere. Elongated openings should be placed so that the long dimension is perpendicular or diagonal to the dominant direction of travel.



**Fred Woods Trail**  
Elk State Forest  
Cameron County

Photo Credit: PA DCNR

6 2010 ADA Standards for Accessible Design, U.S. Department of Justice: 2010



**Old Loggers Path**  
Lycoming County

Photo Credit: PA DCNR



**Standing Stone Trail**  
Huntingdon, Mifflin, and Fulton Counties

Photo Credit: PA DCNR

### Edge Protection

- When you provide edge protection, the edge protection should have a height of at least 3 inches.

### Signs

- If an individual needs to obtain materials from or manipulate a sign or kiosk, the sign or kiosk should be designed to meet the reach ranges specified in the 2010 Standards<sup>7</sup>. You should post signs at the trailhead of new or altered trails. In addition to the standard information including the name and length of the trail, these signs should include the typical and maximum trail grade, typical and maximum cross slope, typical and minimum tread width, surface type and firmness, and obstacles. These signs should also state that the posted information reflects the condition of the trail following construction or assessment. The signs should include the dates of these procedures.
- When providing more extensive trail information (e.g., an aerial map of the trail and related facilities), identify the location of specific trail features and obstacles that do not comply with the Forest Service Trail Accessibility Guidelines technical provisions and include a profile of the trail grade.

### Sequence of Events

Creating a sequence of events through trail design remains especially important when maximizing the hiker's trail experience. This includes the attempt to decrease a user's visibility from another section of trail. Varying land character coupled with numerous access points, overlooks, and camping opportunities are necessary to offset the out-and-back aspect of looped or linear trails and provide specific points of destination along each route.

### Ecological Buffers

Maintaining adequate buffers between trails and sensitive ecological systems, as well as limiting the impact on transitional zones between plant communities remains an integral component of natural trail design. If designed effectively and responsibly, natural trails should blend seamlessly into the existing landscape, with minimal impact on an area's natural systems.



## Complementary Publications

The following publications are valuable resources that may be consulted:

- *Federal Trail Data Standards*, U.S. Forest Service, 2011, available [HERE](#).
- *Trail Assessment and Condition Survey (TRACS) System*, U.S. Forest Service, 2009, available [HERE](#).
- *Trails Accessibility Guidelines*, U.S. Forest Service, 2006, available [HERE](#).
- *National Trail Drawings and Specifications*, U.S. Forest Service, 2010, available [HERE](#).
- *Trail Construction and Maintenance Notebook*, U.S. Forest Service, 2007, available [HERE](#).
- *Trail Bridge Catalog*, U.S. Forest Service, 2007 Update, available [HERE](#).
- *Complete Guide to Trail Building and Maintenance, 4th Edition*, Appalachian Mountain Club, 2008, available for purchase [HERE](#).
- *Appalachian Trail Design, Construction, and Maintenance*, William Birchard, 2000, available for purchase [HERE](#).
- *Appalachian Trail Club Presidents Handbook*, 2002, Marty (Martha) Lawthers, Kevin Peterson, Katharine Wroth, et. al., available [HERE](#).

You can obtain additional information by contacting the Keystone Trails Association (KTA), a volunteer-directed federation of membership organizations and individuals dedicated to providing, preserving, protecting, and promoting recreational hiking trails and hiking opportunities in Pennsylvania. KTA represents and advocates for the interests and concerns of the Pennsylvania hiking community.

Keystone Trails Association  
101 N. Front Street, 3rd Floor  
Harrisburg, PA 17101  
(717) 238-7017  
[www.kta-hike.org](http://www.kta-hike.org)

## Hiking Trails Best Practices

- Fred Woods Trail, Cameron County
- Timberdoodle Flats Wildlife Interpretive Trail, McKean County
- Tracy and Johnnycake Trailheads, McKean and Warren Counties
- Minister Creek Recreation Area, Warren and Forest Counties
- Old Loggers Path, Lycoming County
- Standing Stone Trail, Huntingdon, Mifflin, and Fulton Counties
- Woodbourne Forest and Wildlife Preserve, Susquehanna County





**Nockamixon State Park  
Bucks County**  
Single Track Trail

Photo Credit: Valley Mountain Bikers

## Mountain Biking Trails

The development of mountain biking trails provides a sustainable approach to trail design that encourages more people to explore the outdoors. As a goal the designer should attract bicyclists seeking a challenging experience that many shared use paths lack and users desire.

### General Characteristics for Mountain Bicyclists

The following information defines the preferences and motivations of mountain bikers, as well as common trail building mistakes and alternatives designers should take into consideration when planning mountain bike trails.

#### *User Information*

Mountain bikers, ranging from beginner to expert, enjoy the excitement and outdoor activity of the sport. Since mountain bikes typically have shock absorbers and wider tires, bikers have the ability to go off-road and take on more challenging courses than traditional biking allows. Prime motivators of mountain bikers include obtaining exercise, experiencing natural settings, and testing riders' technical skills.

Mountain bike trails commonly provide 2- 3 hour riding opportunities that consist of approximately 20-25 miles of contiguous trail. Beginner trails typically have a wider tread and bypass routes at technical challenges like boulder or log obstacles. The most technically challenging mountain biking trails require balance, fitness, and strength. In addition to challenging courses with varying terrain, riders appreciate amenities like water spigots located at trailheads to clean bikes after their rides.

### Rider Type Considerations<sup>8</sup>

Mountain biking represents one of the fastest growing recreation experiences across all public lands. Those who share an interest in this sport enjoy various types of riding experiences that appeal to a range of skill levels. Riders ranging from novice to advanced can take part in many types of biking, including:

*Local Access and Utilitarian Biking:* Utilitarian bicycle riders ride for the fun and fitness benefits of the sport. These riders rely on ease of accessibility to local trail loops and desire courses ranging in both length and technical requirement.

*Long Distance Biking:* Long distance biking requires determination, endurance, and hard work. Bicyclists dedicated to this sport will often seek out new trails to experience on day or overnight trips.

*Downhill Biking:* A downhill trail allows riders to test the technological limits of bicycles while finding the best lines for the smoothest rides.

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<sup>8</sup> Trail Solutions: IMBA's Guide to Building Sweet Singletrack, International Mountain Bicycle Association: 2004, available for purchase [HERE](#).



Advanced riders seek out faster lines, vertical drops, and jumps that require a higher level of reaction, strength, and agility. This type of riding often includes a lift, like at a ski resort, to get cyclists to the top of the hill.

***Progressive Skills Development:*** This style of mountain biking celebrates the challenges of technical riding, encouraging riders to soar off jumps, balance on log rides, and teeter on high-rise stunts. Speed and on-edge elements do not mix well with equestrians, hikers, and even other mountain bikers.

## Mountain Biker User Characteristics<sup>9</sup>

### *Trail Use Pattern*

- Seeks and travels to trails away from home as a day or overnight trip
- Commonly desires 2- 3 hour riding opportunities, 20–25 miles of contiguous trail (although fewer miles are acceptable in challenging terrain)

### *Recreation Setting Preferences*

- Best trails have a natural, challenging character and immerse the rider in nature while providing a good workout and opportunity to test skills
- Use a combination of roads, logging roads, and trails as available, safe, and convenient
- In urban/suburban areas, highly prefer developed mountain bike trails offering looped configurations with varying levels of challenge

## Mountain Bike Trail Classifications

***Cross-Country Trail:*** Bikers normally find mountain biking trails in county, regional, and state parks or forests where adequate open space exists to form loop trail systems. These naturally surfaced trails offer casual, dual-track trails, single track, and technical single tracks to accommodate the riders’ goals and abilities. In addition, mountain bike trails should incorporate sustainable design techniques to respond to a site’s specific setting and geographic location.

***Progressive Skills Park:*** A technical challenge or “Skills Park” consists of numerous dirt jumps, elevated boardwalks, and drops. Technical challenge areas should include a wide variety of challenges, from easy to difficult, to provide for skill progression. Typically you will find these bike parks located in the middle of a trail system, near parking and other recreation facilities.

Best practices recommend surrounding these courses with natural barriers consisting of deadfall to ensure safety and seclusion from other trail users.

### Mountain Bike General Speeds and Distances

#### *Recreational Trail Riding*

- 6-15 miles per hour
- 10-15 miles

#### *Recreational Technical Riding in a Park Setting*

- 3-12 miles per hour
- 3-12 miles

#### *Advanced Recreational Trail Riding*

- 10-20 miles per hour
- 15-50 miles

#### *Advanced Recreational Technical Riding in a Park Setting*

- 6-18 miles per hour
- 6-20 miles

<sup>9</sup> Adapted from Trail Planning, Design, and Development Guidelines, Minnesota Department of Natural Resources: 2007, available for purchase [HERE](#).



**Dr. J Freeride Trail**  
North Park, Allegheny County

Photo Credit: Jon Pratt

**Downhill/Freeride:** Downhill trails cater to downhill-specific bicycles. They are generally one-way routes with technical trail elements designed to test the limits of advanced bicycle technology. Jumps and vertical drop-offs represent key features that designers should include in downhill trails. Designers should separate downhill courses from trails designed for other users to avoid conflict. Furthermore, these trails normally need more tread maintenance and drainage structures than other trails due to their steep nature.

### Mountain Bike Trail Layout Configurations

Mountain bike trail design should provide users with one or two-way trails to accommodate challenging features that appeal to riders. These trails respond to the landscape and highlight interesting natural features throughout. Trails should maintain a consistency or rhythm to create an appealing trail layout. The easiest of trails should maintain a relatively gentle flow with predictable curves, while the most challenging may have tight curves with demanding technical requirements. The design of transitions between sections, which can vary in their degree of openness, should allow riders to predict the upcoming transition and maintain control of their bicycles.

### Mountain Bike Trail Guidelines, Level of Difficulty and Other Considerations

#### *Essential Elements of Sustainable Mountain Biking Trails<sup>10</sup>*

Take the level of development needed into consideration and base the trail design on a trail's location, use, and other factors. Some trails may have a natural surface tread, while others may consist of more developed surfaces.

Mountain bike trail designs should follow the International Mountain Bicycling Association's (IMBA) essential elements of sustainable trails as detailed in Chapter 3.

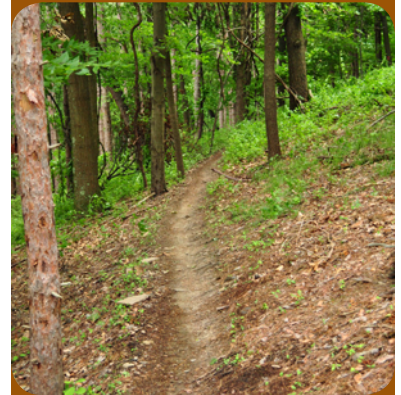
<sup>10</sup> Trail Solutions: IMBA's Guide to Building Sweet Singletrack, International Mountain Bicycle Association: 2004, available for purchase [HERE](#).





## IMBA Difficulty Standards for Mountain Biking Trails<sup>11</sup>

| Aspect   | Easiest<br>(White<br>Circle) | Easy (Green<br>Circle)   | More<br>Difficult<br>(Blue<br>Square)   | Very Difficult<br>(Black<br>Diamond)  | Extremely<br>Difficult<br>(Dbl. Black<br>Diamond)   |
|--|------------------------------|--|---|---|---|
| Trail<br>Width                                       | 72 inches or<br>more         | 36 inches or<br>more   | 24 inches or<br>more  | 12 inches or<br>more  | 6 inches or<br>more   |
| Tread<br>Surface                                     | Hardened or<br>surfaced      | Firm and<br>stable   | Mostly stable<br>with some<br>variability   | Widely<br>variable  | Widely<br>variable and<br>unpredictable   |
| Average<br>Grade                                     | Less than 5%                 | 5% or less   | 10% or less   | 15% or less   | 20% or less   |
| Maximum<br>Grade                                     | Maximum<br>10%               | Maximum<br>15%   | Maximum<br>15% or<br>greater  | Maximum 15%<br>or greater   | Maximum 15%<br>or greater   |
| Natural<br>Obstacles<br>and<br>Technical<br>Features | None                         | Unavoidable<br>obstacles 2<br>inches tall or<br>less<br><br>Avoidable<br>obstacles<br>may be<br>present<br><br>Unavoidable<br>bridges 36<br>inches or<br>wider | Unavoidable<br>obstacles 8<br>inches tall or<br>less<br><br>Avoidable<br>obstacles<br>may be<br>present<br><br>Unavoidable<br>bridges 24<br>inches or<br>wider<br><br>Technical<br>trail feature<br>24 inches<br>high or<br>less, width<br>of deck is<br>greater than<br>½ the height | Unavoidable<br>obstacles 15<br>inches tall or<br>less<br><br>Avoidable<br>obstacles may<br>be present,<br>including<br>loose rocks<br><br>Unavoidable<br>bridges 24<br>inches or<br>wider<br><br>Technical trail<br>feature 48<br>inches high<br>or less, width<br>of deck is<br>greater than<br>½ the height<br><br>Short sections<br>may exceed<br>criteria | Unavoidable<br>obstacles 15<br>inches tall or<br>less<br><br>Avoidable<br>obstacles may<br>be present,<br>including loose<br>rocks<br><br>Unavoidable<br>bridges 24<br>inches or<br>narrower<br><br>Technical trail<br>feature 48<br>inches high or<br>greater, width<br>of deck is un-<br>predictable<br><br>Many<br>sections may<br>exceed criteria |



**Single Track Trail**  
North Park, Allegheny County

Photo Credit: Jon Pratt

<sup>11</sup> Ibid



*Two-Way Mountain Biking Trail*

### *Trail Treads*

The construction of a trail's surface should accommodate the current and anticipated level of wear and tear from its users. Materials used may provide varying tread conditions that determine the level of stability and difficulty of a mountain biking trail. For example, a trail that contains a paved or surfaced material that remains firm and stable and then transitions to a trail that possesses a loose condition will provide a level of excitement and unpredictably throughout a designated course.

### *Natural Obstacles*

Riders consider the technical design of a mountain bike trail important. Therefore, the success of a trail design hinges on incorporating technical elements. By incorporating a sequence of events through the use of gateways and existing natural features, designers provide riders with destinations along a trail that increase the trail's interest and challenge. By incorporating natural features and technical challenges throughout a trail system, designers distinguish mountain bike trails from shared use natural trails. Some of these features include natural drop-offs, rock gardens, rock slabs, rock chokes, and fallen trees or limbs.



**Mountain Bike Skills Park**  
North Park, Allegheny County

Photo Credit: Pashek Associates





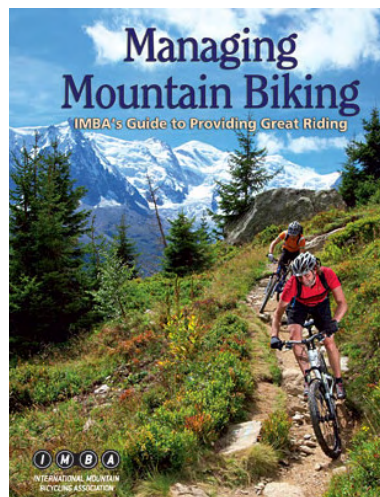
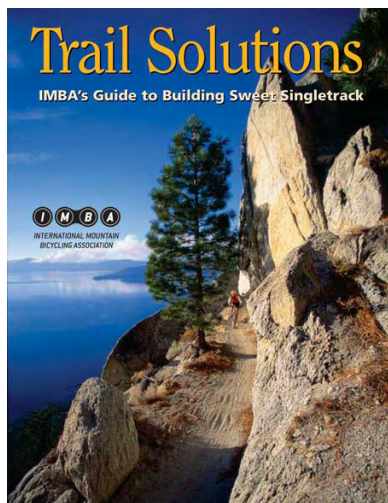
### Constructed Technical Design Features

A mix of technical features, both natural and man-made, consistent with each trail rating is important to holding the interest of riders. If the design meets user expectations, riders are more likely to stay on the trail rather than creating new routes. Man-made technical features that improve interest and increase technicality without limiting space requirements include narrow bridges, ladder bridges, anchored bridges, boulders, boardwalks, and stabilized curves. These various elements provide alternate routes and increase the longevity of each trail.

### Complementary Publications

Two IMBA publications provide guidelines for addressing each of these aspects. These publications are:

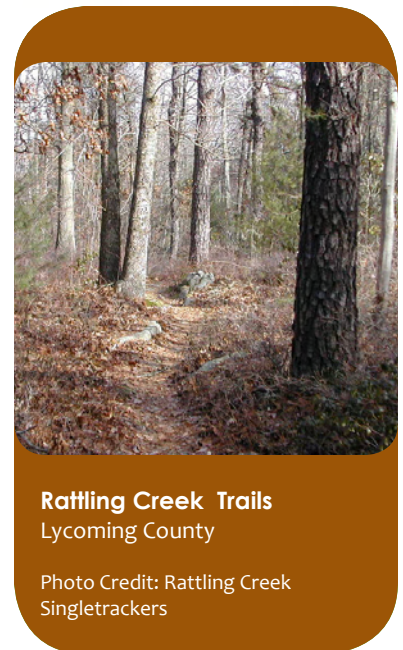
1. *Trail Solutions: IMBA's Guide to Building Sweet Singletrack*, available for purchase [HERE](#).
2. *Managing Mountain Biking: IMBA's Guide to Providing Great Riding*<sup>12</sup>, available for purchase [HERE](#).



The International Mountain Bicycling Association - Trail Building Resources, available [HERE](#), also provides a wealth of information about:

- Advocacy and Organizing
- Bike Parks and Freeriding
- Grants and Fundraising
- Kids and Mountain Biking
- Land Access and Protection
- Liability and Insurance
- Logos and Graphics
- Maps and Signs
- Mountain Bike Research
- National Mountain Bike Patrol
- Resource Conservation
- Risk Management
- Trail Building and Design

<sup>12</sup> Managing Mountain Biking: IMBA's Guide to Providing Sweet Riding, International Mountain Bicycling Association: 2007



**Rattling Creek Trails**  
Lycoming County

Photo Credit: Rattling Creek  
Singletrackers





For additional information contact the International Mountain Biking Association:

**International Mountain Biking Association**

P.O. Box 7578  
Boulder, CO 80306  
[www.imba.com](http://www.imba.com)

Frank Maguire, Mid-Atlantic Regional Director  
[frank.maguire@imba.com](mailto:frank.maguire@imba.com)  
814-441-7865

**Single Track Mountain Bike Trails Best Practices**

- Allegrippis Trails, Raystown Lake Army Corps Project, Huntingdon County - This 32 mile destination trail system has over 26,000 visitors a year and requires minimal maintenance. Built with mechanized trail building equipment, the system represents the best example of new trail building techniques in the Commonwealth.
- Swatara State Park, Lebanon and Schuylkill Counties - The 11 miles of trails built by the Susquehanna Area Mountain Bike Association represent a great example of stacked loop trail design, allowing riders to take on as much of an adventure as they desire.
- Lake Nockamixon State Park, Bucks County - the 8 miles of lakeside trails demonstrate good examples of using limited topography to deliver a quality sustainable trail system.
- Rattling Creek Trails, Weiser State Forest, Dauphin County - A more advanced trail system, this 24 mile network above the town of Lykens, including trails on the borough's water authority land, are challenging but still offer great examples of well executed design.

**Technical Challenge/Free Ride Courses Best Practices**

- Dr. J Trail, North Park, Allegheny County



## Shared Use Paths and Rail Trails

A shared use path is a facility within its own right-of-way, which is separate from the vehicular right-of-way. As its name suggests, many different types of users may use a shared use path. Users generally include walkers, joggers, bicyclists, and in-line skaters and sometimes equestrians. Similarly, rails-with-trails often use the same standards and guidelines for their development as shared use paths.

The trail community recognizes the American Association of State Highway Transportation Officials (AASHTO) publication titled *Guide for the Planning, Design, and Operation of Bicycle Facilities*<sup>13</sup> as the authority for shared use path guidelines. During the design phase of a shared use path it is important to consult this guide to ensure that your design follows the guidelines specific to your particular scenario.

### General Characteristics of Shared Use Paths

The following information defines a shared use path's various users and how each trail's design can accommodate its use.

#### User Information

Shared use paths serve virtually every type of user group, whether users want to walk a dog, push a stroller, jog, bicycle, in-line skate, or even horseback ride. The hard surfacing of this type of path provides a high level of accessibility to users of all abilities. For this reason, shared use paths can accommodate the interests of various users, while minimizing ecological impacts and the amount of trails constructed.

Shared use paved trails function at local, county, regional, and state levels. The amount of use, character, width, length, location, and the type of user(s) accommodated serves as a major distinction between the various levels. Moreover, the extensiveness of a shared use trail network depends on the level of service, rate of use, and geographical characteristics.

The amount of value the public places on a shared use path also serves as a determining factor in the development of shared use trails at all levels. These values include convenience, safety, fitness, recreation, as well as transportation. Planners and designers should consider these values heavily in the planning and design of any trail system.

13 Guide for the Planning, Design, and Operation of Bicycle Facilities, American Association of State Highway Transportation Officials, 4th Edition: 2012



**Schuylkill River Trail**  
Montgomery County

Photo Credit: Montgomery County Planning Commission



**Montour Trail**  
Allegheny & Washington Counties

Photo Credit: Pashek Associates



**East Branch Trail**  
Crawford County

Photo Credit: Crawford County Planning Commission



**Hanover Trolley Trail**  
York County

Photo Credit: PA DCNR



**Schuylkill River Trail**  
Montgomery County

Photo Credit: Montgomery County  
Planning Commission



**Butler Freeport Trail**  
Butler County

Photo Credit: Butler Freeport Trail

## User Type Characteristics<sup>14</sup>

Shared use paths offer versatility and can accommodate a wide range of user groups. These paths enable users to pursue various activities and may offer connections to local and regional trail networks.

### *Pedestrian (Walker/Jogger)*

Pedestrians utilize shared use trail networks to walk and run for recreational and fitness value. Walkers and joggers of all types use trails year-round for social interaction, scenic beauty, health benefits, and close-to-home recreation.

### *Bicyclist*

Bicyclists of all types utilize shared use trails for convenient, safe travel between parks, rest areas, and other local destinations. Whether a bicyclist uses the path for family, recreational, fitness, or transportation purposes, these trail networks provide invaluable economic and health benefits.

### *In-line Skater*

Recreational, fitness, and commuter in-line skaters value smooth, wide paths that allow for easy navigation. These users' primary motivations revolve around getting exercise, being outdoors, enjoying skating, and ease of transportation.

### *Wheelchair User*

Disabled persons and wheelchair users value smooth, level, wide paths that are easily navigated. Shared use trail networks allow users to be outdoors, experience nature, and socialize.

### *Equestrian*

Shared use paths allow equestrians to take part in social activity and ride on a local scale. These trails should allow for single-file and staggered riding alongside other types of trail users.

## *Walker, Jogger, In-Line Skater/Recreational and Fitness Walker/Jogger Characteristics*

### *Trail Use Pattern*

- Will use the same trails daily or several times per week if paths offer convenience and ease of access (most live within 3 miles of the trail they use)
- Recreational user wants trails that provide social interaction, scenic beauty, or both
- Will use sidewalks to get to a trail system in urban and suburban settings

<sup>14</sup> Trail Solutions: IMBA's Guide to Building Sweet Singletrack, International Mountain Bicycle Association: 2004





- Want trails close to home and will use trails year-round, although spring, summer, and fall are the most popular seasons

#### Recreation Setting Preferences

- Recreational user finds sense of place, natural setting, scenery, and being away from traffic important (less so with fitness user)
- Prefers looped configurations in all settings, with 2-4 miles suitable for beginners and 5-9 miles for fitness walkers
- Has a strong desire for safety and security.

#### Recreational In-line Skater Characteristics

##### Trail Use Pattern

- Seeks out nearby trails for daily use, but will travel to a specific trail on weekends
- Prefers loop system, with 10-15 miles minimum (will use out and back if no other choice is available)

#### Recreation Setting Preferences

- Values smooth, wide trails; rough trails prove especially troublesome for beginners
- Seeks trails that do not receive heavy use
- Does not prefer technically difficult trails with sharp turns, too many steep hills, or poor stopping conditions
- Does well on trails designed similar to bike trails, especially when they are 10 feet wide or wider
- Routine sweeping of the trail is important

#### Fitness In-Line Skater Characteristics

##### Trail Use Pattern

- Prefers routes that offer challenges and have enough distance to get in a good workout (10- 25 miles)
- May go out daily or several times per week and will routinely use the same trails close to home
- Prefers loop system

#### Recreation Setting Preferences

- Values smooth, wide trails; rough trails prove especially troublesome for beginners
- Primarily uses a series of streets, roads, and trails to create a long enough route
- Does not desire technically difficult trails with sharp turns, too many steep hills, or poor stopping conditions
- Has facility needs similar to those of bicyclists

### Walker, Jogger, and In-Line Skater General Speeds and Distances

#### Strolling Walker

- 1-2 miles per hour
- 2-3 miles

#### Casual Walker

- 2-3 miles per hour
- 3-6 miles

#### Fitness Walker

- 3-4 miles per hour
- 6-9 miles

#### Fitness Jogger

- 6-7 miles per hour
- 3-15 miles

#### Casual Inline Skater

- 5-10 miles per hour
- 6-10 miles

#### Recreational In-line Skater

- 10-15 miles per hour
- 10-20 miles

#### Fitness In-Line Skater

- 15-20 miles per hour
- 10-25 miles

#### Elite/ Commuting In-Line Skater

- 15+ miles per hour
- 20-30 miles



### *Commuting In-Line Skater Characteristics*

#### *Trail Use Pattern*

- Uses skating as a form of transportation
- Uses trails where available, but will also use streets and roads
- Needs traffic enforcement, security, skate-friendly routes to and from work sites

### **Bicyclist General Speeds and Distances**

#### *Family Bicyclist*

- 6-10 miles per hour
- 5-10 miles of distance

#### *Recreational Bicyclist*

- 10-15 miles per hour
- 10-20 miles

#### *Fitness Bicyclist*

- 15-20 miles per hour
- 20-40 miles

#### *Transportation Bicyclist*

- 20+ miles per hour
- 40+ miles

### *Family Bicyclist Characteristics*

#### *Trail Use Pattern*

- Prefers trails with a lot of visibility
- Prefers limited number of safe road crossings
- Most activity happens close to home, but will also use trails extensively on vacation
- Rides in family groups, often including small children
- Prefers bike trails and quiet streets (to avoid heavy traffic), with preference for trails if conveniently located

#### *Recreation Setting Preferences*

- Controlled, traffic-free access to trails is the most important consideration
- Quality of the riding experience is of primary importance, with length being secondary (20 miles maximum)
- Needs good information for planning trips and access to support facilities (rest areas, parking lots, water sources) and prefers permanent restrooms to portable toilets
- Connections to parks and playgrounds are important
- Prefers scenic areas but not challenging terrain, especially when children come along

### *Recreational Bicyclist Characteristics*

#### *Trail Use Pattern*

- Seeks out and travels to trails and bicycle-friendly areas away from home, either as a day or overnight trip
- Prefer trails, but will use low volume roads that offer safety, and convenience

#### *Recreation Setting Preferences*

- Repeat users do not desire trails shorter than 10 miles; 20 miles is the desired minimum
- Prefer looped configurations of varying lengths over out and back systems
- Sense of place and an interesting experience are important, with riders seeking places that possess scenic quality and interesting natural or built forms



### *Fitness Bicyclist Characteristics*

#### *Trail Use Pattern*

- Will use a combination of roads and trails that are long and/or challenging experiences offering a good workout
- Prefers trails of sufficient length (20 or more miles) and width to allow for faster speeds and reduced user conflicts
- Will routinely use the same routes for challenges and timing, daily
- Frequently extends the season by riding earlier in the spring and later in the fall than recreational riders

#### *Recreation Setting Preferences*

- Trails need to offer varying difficulty and lengths; prefers interconnected loops
- Not primarily motivated by experiencing a natural setting, but will select this type of trail if other needs are met

### *Transportation Bicyclist Characteristics*

#### *Trail Use Pattern*

- Not dependent on trails, but will use them if convenient, safe, and direct

#### *Recreation Setting Preferences*

- Lack of a safe system of roads (with bike lanes or routes) is a major barrier
- Prefers low volume roads with low percentage of truck traffic
- Trail design remains critical, with the most important criteria being the ability to go fast with good sight lines and direct routes

## **Shared Use Paths Guidelines and Considerations<sup>15</sup>**

### *Shared Use Path Widths*

The appropriate pavement width for a shared use path is dependent on the context, volume, and mix of users. The minimum width for a two-directional shared use path is 10 feet. However, trends vary in width from 10-14 feet depending on a trail's level of use and variety of users.

In very rare circumstances, designers may use a reduced width of 8 feet in the the following conditions:

- Expectation of low bicycle traffic, even on peak days or during peak hours
- Expectation that pedestrian use of the path is only occasional
- Horizontal and vertical alignments provide safe and frequent passing opportunities
- Regular maintenance traffic will not occur on the path

<sup>15</sup> Guide for the Planning, Design, and Operation of Bicycle Facilities, American Association of State Highway Transportation Officials, 4th Edition: 2012



**Recumbent Bicyclist**



**Tandem Bicyclists**



**Electric Tricyclists**

Photo Credit: PA DCNR





In addition, designers may specify a path width of 8 feet for a short distance when physical constraints such as environmental features, bridge abutments, utility structures, or fences exist. Designers should consider the addition of warning signs that indicate when a pathway narrows, per the *Manual on Uniform Traffic Control Devices*<sup>16</sup> (MUTCD), available [HERE](#), at these locations.



*Two-Way Shared Use Path*

Shared use paths require a wider tread when paths are frequently used by both pedestrians and other users. AASHTO<sup>17</sup> recommends wider pathways, typically 11-14 feet, in locations that serve high user volumes. Eleven-foot wide paths enable a bicyclist to pass another user going the same direction, while another user is approaching from the opposite direction at the same time. AASHTO recommends that designers should incorporate wider paths in the following situations:

- Where significant use by in-line skaters, adult tricycles, or other users that need more operating width, occurs
- Where larger maintenance vehicles use the path
- On steep grades to provide an added passing area
- Through curves to provide more operating space

<sup>16</sup> Manual on Uniform Traffic Control Devices for Streets and Highways, U.S. Department of Transportation, Federal Highway Administration, 2009

<sup>17</sup> Guide for the Planning, Design, and Operation of Bicycle Facilities, American Association of State Highway Transportation Officials, 4th Edition: 2012



### Shared Use Path Shoulders

Ideally, AASHTO<sup>18</sup> recommends the design should maintain a graded shoulder at least 3 to 5 feet wide with a maximum cross-slope of 6:1 on each side of a pathway. At a minimum, the design should provide a 2 foot graded shoulder that has a maximum slope of 6:1 to provide clearance from lateral obstructions such as shrubs, large rocks, bridge abutments, and poles.

Where the design introduces features such as bicycle railings or fences with appropriate flaring end treatments, a lesser clearance (not less than 1 foot) is acceptable. Mark barrier or rail ends that stray from the 2 foot clear area with object markers and warning signs.

Where a path is adjacent to parallel water hazards or downward slopes are 3:1 or steeper, consider a wider separation. A 5 foot separation from the edge of the pavement to the top of a slope is desirable. Depending on the height of the embankment and condition at the bottom, the shoulder design may require a physical barrier such as dense shrubbery, railing, or fencing.

### Recovery Area or Protective Rails

Where a recovery area (i.e., distance between the edge of a path pavement and the top of a slope) is less than 5 feet, AASHTO<sup>19</sup> recommends physical barriers or rails be constructed in following situations:

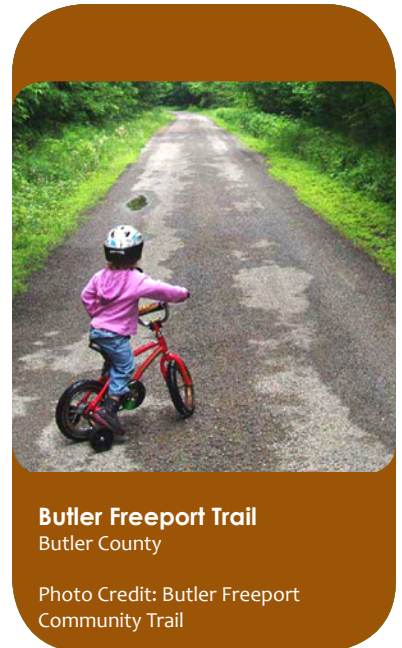
- Slopes 1:1 or steeper, with a drop of 1 foot or greater
- Slopes 2:1 or steeper, with a drop of 4 feet or greater
- Slopes 3:1 or steeper, with a drop of 6 feet or greater
- Slopes 3:1 or steeper, adjacent to a parallel water hazard or other obvious hazard

Protective railings, fences, or barriers on either side of a shared use path should be a minimum of 42 inches. In some locations consider a 48 inch high railing to prevent bicyclists from falling over the railing in the event of a crash. This includes bridges or bridge approaches where high-speed and/or steep-angle (25 degrees or greater) impacts between a bicyclist and a railing may occur. For example, at a curve at the end of a long, descending grade where the curve radius is less than that appropriate for the design speed or anticipated speed.

On elevated structures, the openings between horizontal or vertical members on railings should be small enough that a 4 inch sphere cannot pass through them in the lower 27 inches. For the portion of railing higher than 27 inches, openings may be spaced so that an 8 inch sphere cannot pass through them. This prevents children from falling through the openings. Where a bicyclist's handlebar may encounter a railing or barrier, a smooth, wide rub-rail may be

<sup>18</sup> Ibid

<sup>19</sup> Ibid



**Butler Freeport Trail**  
Butler County

Photo Credit: Butler Freeport  
Community Trail



**Pine Creek Trail**  
Tioga and Lycoming Counties

Photo Credit: PA DCNR



installed between 36 inches to 44 inches in height, reducing the likelihood that the railing will contact or catch a bicyclist's handlebar.

Railings that protect users from slopes or where the design uses railing to discourage path users from venturing onto a roadway or neighboring property can typically have relatively large openings. A typical design includes two to four horizontal elements with vertical elements spaced widely, but frequently enough to provide the necessary structural support. Where the path-side hazard is a high vertical drop or a body of water, use engineering judgment to determine whether to use a railing suitable for bridges.

In addition to railings, you may use other materials to separate paths from adjacent areas and hazardous conditions, or to discourage pathway users from venturing onto adjacent properties. Berms or vegetation can serve this function.

A 10 foot vertical clearance to obstructions is desirable. Design should not permit fixed objects to protrude within the vertical or horizontal clearance of a shared use path. Eight feet is the recommended minimum vertical clearance for constrained areas. In some situations, the design may require a vertical clearance greater than 10 feet to provide access for maintenance and emergency vehicles.

### *Grade*<sup>20</sup>

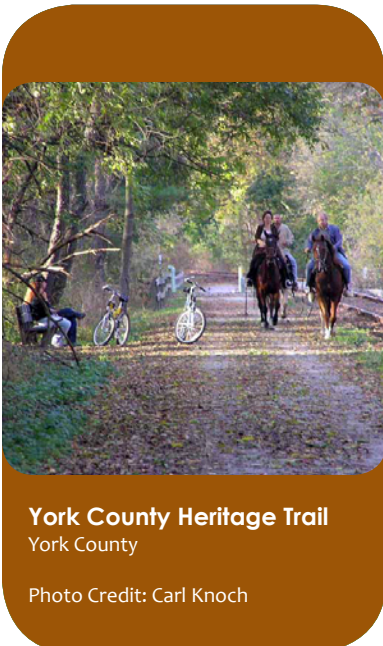
Keep grades on shared use paths, in independent corridors, to a minimum, especially on long inclines. Grades greater than 5 percent are undesirable because the ascents prove difficult for many users, and the descents cause some users to exceed speeds which they can navigate competently. In addition, shared use paths generally remain open to pedestrians, therefore the grades on paths should also follow ADA guidelines.

Limit the grades on paths as follows:

- 5% maximum for any distance
- 8.3% maximum for up to 200 feet
- 10% maximum for up to 30 feet
- 12.5% for up to 10 feet

Additionally, no more than 30 percent of the total path length should have a grade exceeding 8.3 percent. Where grades exceed 5 percent, the design should incorporate a resting interval at the end of any segment of maximum length as described above. A resting interval should be at least 5 feet long, be as wide as the path, and have a maximum slope not exceeding 5 percent.

<sup>20</sup> As of this writing the Architectural and Transportation Barriers Compliance Board, May 2013, issued an advance notice of proposed rulemaking (ANPRM) announcing their intent to develop accessibility guidelines for shared used paths. Those designing shared use paths should check for updates related to this pending legislation before finalizing their designs for shared use paths.



**York County Heritage Trail**  
York County

Photo Credit: Carl Knoch





Provide smooth, gradual transitions between sloped segments and resting intervals.

Options to mitigate excessive grades on shared use pathways include the following:

- Use higher design speeds for horizontal and vertical curvature, stopping sight distance, and other geometric features.
- When using a longer grade, consider an added 4-6 feet of width to permit slower bicyclists to dismount and walk uphill, and to provide more maneuvering space for fast downhill bicyclists.
- Install a hill warning sign for bicyclists and an advisory speed plaque, if appropriate, per the MUTCD.
- Provide signing that alerts path users to the maximum percent of grade as shown in the MUTCD.
- Exceed minimum horizontal clearances, recovery area, or protective railings.
- If other designs prove impracticable, use a series of short switchbacks to traverse the grade. If using this method AASHTO recommends widening the path by 4 to 6 feet to provide additional maneuvering space.
- Provide resting intervals with flatter grades to permit users to safely stop periodically to rest.

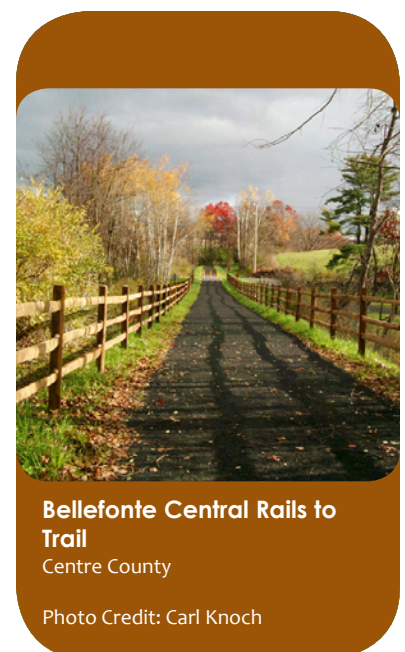
Grades steeper than 3 percent may prove impractical for shared use paths with crushed stone or other unpaved surfaces for both bicycle handling and drainage erosion reasons. Typically, avoid grades less than one-half percent, because they do not efficiently convey surface drainage. When building paths on flat terrain, increase the proposed grades to provide a gradual rolling vertical profile. This design conveys surface drainage to outlet locations.

### *Drainage*

Design trails to shed water from the trail as soon as possible, as discussed earlier in Chapter 1 – Planning. Typically, a minimum cross slope of one percent provides adequate drainage for a shared use path. A cross slope design is preferred over a crowned design due to ease of construction and simplification of the drainage design. A smooth, even surface prevents the ponding of water on the tread during the winter months. On compacted stone treads, pay particular attention to drainage design details to avoid erosion of the tread and adjacent surfaces.

### *Motorized Vehicle Barriers and In-Line Gates*

The unauthorized use of paths by motor vehicles is a problem on many paths. Typically, this is a greater issue on paths that extend through independent corridors as the path may not be visible from adjacent roads and properties.





AASHTO<sup>21</sup> discourages the use of bollards and barriers unless a known history of use by unauthorized motor vehicles exists. Bollards, fences, or other similar devices and barriers create permanent fixed object hazards to path users. Bicyclists and other path users often strike bollards on paths, resulting in serious injury.

The preferred design method to restrict entry to motor vehicles is to split the entryway into two sections, by using low landscape features. Each section should be half the nominal path width; for example, split a 10 foot path into two 5 foot sections. Emergency vehicles can still enter if necessary by straddling the landscaping. However, a more appropriate method may be defining emergency vehicle access through secured access drives. Delineate the approach to the split with solid line pavement markings to guide the path user around the split.

Where you can justify the need for bollards or other vertical barriers in the pathway, despite the hazard posed to cyclists, take measures to ensure the bollards or barriers are as safe as possible:

- Mark bollards with a reflective material on both sides and appropriate object markers, per the Section 9B. 26 of MUTCD, [AVAILABLE HERE](#).
- Bollards should permit passage, without dismounting, for adult tricycles, bicycles towing trailers, and tandem bicycles. Bollards should not restrict access for people with disabilities. Accommodate all legally permitted users; failure to do so increases the likelihood that the bollards will pose a hazard.
- Bollard placement should provide adequate sight distance to allow users to adjust their speed to avoid hitting them.
- Bollards should be a minimum height of 42 inches and minimum diameter of 4 inches.
- AASHTO recommends striping an envelope around the approach to the post to guide path users around the object.
- One strategy involves using flexible delineators, which may reduce unauthorized vehicle access without causing injuries commonly incurred by rigid bollards.
- Only install bollards in locations where vehicles cannot easily bypass the bollard. The preferred method is to use one bollard in the center of a path. When using more than one bollard, space them 6 feet on center. AASHTO does not recommend using two bollards because they direct opposing path users towards the middle, creating conflict and the possibility of a head-on collision. Wider spacing allows motor vehicles to enter the path, while narrower spacing may prevent adult tricycles, wheelchair users, and bicycles with trailers to enter the path.
- Set bollards back from the roadway edge a minimum of 30 feet. Bollards set back from the intersection allow path users to navigate the potential

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21 Guide for the Planning, Design, and Operation of Bicycle Facilities, American Association of State Highway Transportation Officials, 4th Edition: 2012



hazard before approaching the roadway.

- Install hardware in the ground to hold a bollard or post flush with the surface to avoid creating a safety hazard.
- Lockable, removable (or reclining) bollards allow entrance by authorized vehicles.

## Intersections

The way intersections between trails and roads are designed significantly impacts the users' comfort and safety. Intersection designs should address cross-traffic movements, as well as trail users entering and exiting the path. Since conflicts may arise at these junctions, it is important to design intersections in a simple manner, in order to maintain orderly movement between trail traffic and other traffic.

The principles that apply to general safety at crossings, regardless of where a trail crosses a roadway, also apply to trail intersection design. There are a wide range of design features that improve pedestrian and bicyclist safety at such intersections. The AASHTO Guide<sup>22</sup> provides a general overview of recommended intersection crossing measures as summarized here.

Trail crossings come in many configurations with many variables, including the number of lanes crossed, divided or undivided roadways, speed and volume of traffic, as well as traffic controls. Since each intersection is unique, designers should exercise judgment to determine an appropriate intersection treatment.

Due to the mixed nature of trail traffic, remember to consider the speed variability of each mode of travel and its resulting effect on design values, when considering design solutions for trail and roadway intersections. Use the fastest vehicle for determining approach speeds, as these users are the most likely to surprise cross traffic at the intersection.

General considerations for the design process include:

### Intersection Design Considerations

- Provide positive guidance to pedestrians, bicyclists, and motorists to ensure full awareness at intersections.
- Minimize conflicts and channelize intersections to separate moving conflicts.
- Unavoidable conflicts should occur at right angles.
- Optimize sight triangles, ensure stopping, intersection crossing, and decision sign distances.
- Provide adequate staging and refuge areas for pedestrians and bicyclists.

<sup>22</sup> Guide for the Planning, Design, and Operation of Bicycle Facilities, American Association of State Highway Transportation Officials, 4th Edition: 2012



**Great Allegheny Passage**  
Allegheny County

Photo Credit: Pashek Associates





- Avoid obstacles and highlight unavoidable obstacles.
- At signalized intersections, minimize trail user delay by minimizing traffic signal cycle time.
- Provide adequate signal crossing time for pedestrians.
- Provide easily accessible tactile/audible push buttons.
- Design to assist the user to look into the direction of the potential hazard.

### *Traffic Control Features*

Adding additional signage to assign the right of ways to pedestrian and bicycle users provides a simple measure of traffic control, especially on rural roads. On more developed roadways, municipalities should ensure they meet the needs of bicyclists and pedestrians in the initial design process.

Typically, traffic control signals are a last resort if you cannot incorporate pedestrian and bicycle users into a controlled intersection environment. Some current traffic control features include activated traffic control signals and pedestrian countdown signals. Only consider these controls after completing a detailed engineering study for an intersection.

### *Intersection Treatments*

#### *Curb Ramps and Aprons*

The opening of a trail at a roadway should be at least the same width as the trail itself. If provided, a curb ramp should also be the full width of the trail. The approach should provide a smooth and accessible transition between the trail and the roadway, with a 5 foot radius or flare at appropriate turns. On unpaved trails the design of a trail-road intersection should include paved aprons that extend a minimum of 20 feet from paved road surfaces.

#### *Widening Paths at Intersections*

For locations where queuing at an intersection results in crowding at the roadway edge, consider widening the path approach. This can increase the crossing capacity and help reduce conflicts at path entrances.

#### *Chicanes*

Designers can use chicanes, or horizontal curvatures, to reduce trail users' approach speeds at intersections where sight distance is limited or where users should stop and yield. End chicanes far enough in advance of the intersections to allow the user to focus on the curves of the pathway and then the approaching intersection. Design chicanes for speeds less than 8 mph with a solid centerline to reduce users from cutting corners.

#### *Restricting Motor Vehicle Traffic*

Unauthorized access by motor vehicles on pedestrian-only trails, especially those that extend through independent corridors, poses a



major issue. The MUTCD<sup>23</sup> permits the R5-3 NO MOTOR VEHICLES sign to be used to reinforce the rules. You can also use bollards or similar barriers to restrict motor vehicle access, but determined individuals who often use the path illegally usually find ways around the physical barrier.

### Crossing Islands

Raised medians significantly lower pedestrian crash rates at multi-lane crossings. Crossing islands particularly benefit trail-roadway intersections with high volumes of speeds, multiple lanes, or excessive roadway width. In addition, crossing islands benefit children, the elderly, and those with disabilities. Design crossing islands to be large enough to accommodate multiple trail users including groups of pedestrians or bicyclists, wheelchairs, and equestrians. Design crossing islands in accordance with the *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way*<sup>24</sup> (PROWAG), available [HERE](#).

## Additional Crossing Considerations

### Transition Zones

It is important to integrate a trail into the existing system of sidewalks and bicycle facilities when the path crosses or terminates at an existing roadway. The terminus should transition smoothly into a safe merging or diverging situation. Use appropriate signage to warn and direct both trail users and motorists regarding these transitions. Each crossing serves as an access point whose design should facilitate movements of path users either entering or exiting the path from the road.

### Traffic Calming for Intersections

Traffic calming measures may affect crossing locations positively when the speed of approaching traffic is a concern. Appropriate calming measures include crossing islands, speed cushions, curb extensions, chicanes, raised intersections or crosswalks, and curb reduction at corners. These improvements prepare motorists to yield to path users, reducing the frequency and severity of collision.

### Shared Use Paths through Interchanges

Provide separation and continuity where a shared use path travels parallel to a roadway intersection. The design should not require users to exit the path, ride on roads or sidewalks through the intersection, and then resume riding on the path. The designer may need to incorporate grade-separated crossings to enable trail users to conveniently and safely navigate through these exchanges.



**R5-3 No Motor Vehicle Sign**

Manual on Uniform Traffic Control Devices

## Shared Use Trail and Rail Trail Best Practices

- Great Allegheny Passage, Allegheny, Westmoreland, Fayette, Somerset Counties
- Pine Creek Trail, Lycoming and Tioga Counties
- Butler Freeport Trail, Butler and Allegheny Counties

## Shared Use Trail and Rail Trail Trailhead Best Practices

- Pine Creek Rail Trail (various locations, various amenities), Lycoming and Tioga Counties
- Little Toby Rail Trail; Elk and Jefferson Counties
- Lowlands Trail (viewing blinds, parking, kiosk); Cameron and Potter County
- Youghiogheny Trail, Cedar Creek Park, Westmoreland County

23 Manual on Uniform Traffic Control Devices for Streets and Highways, U.S. Department of Transportation, Federal Highway Administration, 2009

24 Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way, Architectural and Transportation Barriers Compliance Board: 2011



### Shared Use Path Best Practices

- Great Allegheny Passage, southwestern Pennsylvania
- Pine Creek Trail, north central Pennsylvania
- Delaware and Lehigh Trail, southeastern Pennsylvania

The MUTCD<sup>25</sup> regulates the use and design of all traffic control devices. Trail designers may use signs, pavement markings, and signals in compliance with MUTCD standards to guide and regulate trail user traffic on roads and paths.

### Urban Bikeway Design

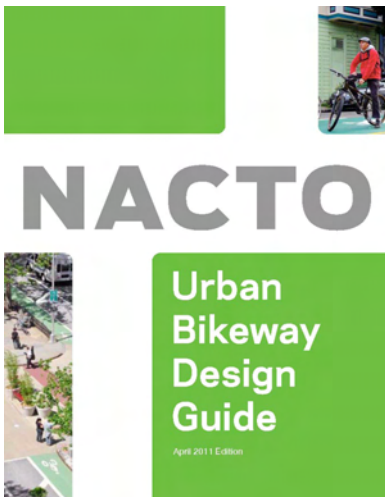
The National Association of City Transportation Officials (NACTO) *Urban Bikeway Design Guide*,<sup>26</sup> available [HERE](#), provides guidance on solutions that can help create complete streets that are safe and enjoyable for bicyclists.

This guide stems from the experience gained from the best cycling cities in the world. The designs were developed by cities for cities, since unique urban streets require innovative solutions. Those planning trail connections through main street and downtown areas will find the guide useful.

### Complementary Publications

For more information on shared use paths and rail trails visit the Rails to Trails Conservancy's on line Trail Building Toolbox, available [HERE](#), which provides a wealth of information on each of these topics.

PennDOT recognizes the AASHTO Guide<sup>27</sup> as the standard for designing shared use paths funded through state and federal programs.



### Urban Bikeway Design Guide

National Association of  
Transportation Officials

You can obtain additional information by contacting the Northeast Regional office of the Rails to Trails Conservancy at:

- **Rails-to-Trails Conservancy**  
2133 Market Street  
Suite 222  
Camp Hill, PA 17011  
(717) 238-1717  
[www.railstotrails.org](http://www.railstotrails.org)

- 
- 25 Manual on Uniform Traffic Control Devices for Streets and Highways, U.S. Department of Transportation, Federal Highway Administration: 2009
- 26 Urban Bikeway Design Guide, Second Edition, National Association of City Transportation: 2012
- 27 Guide for the Planning, Design, and Operation of Bicycle Facilities, American Association of State Highway Transportation Officials, 4th Edition: 2012





## Equestrian Trails

When planning trail opportunities, give consideration to equestrians. Equestrian trails attract horseback riders seeking a safe, contiguous trail experience in a natural setting. When designing trails for equestrian use strive to meet the goal of providing accessible and pleasurable trail riding experiences with few or no environmental impacts.

### General Considerations for Equestrian Trails<sup>28</sup>

The following information defines the common equestrian trail user, the nature of a horse, and design elements to accommodate equestrians.

#### User Information

Horseback riders may desire to have an individual experience seeking solitude in nature with their horse, or they may desire a social experience riding with a friend or in groups. Trail riding occurs at a walking pace or slow canter in a couple hours time. This slow pace allows riders to travel safely in groups, but may increase a trail's difficulty for both the rider and animal.

Horseback riders do not need a wide or highly developed trail but they do prefer variety. Water crossings, fallen logs, grade climbs and descents, open areas, and woods create interesting dynamics throughout a trail system. At trailheads where camping is permitted, high lines or roofed tie stalls are preferred and are more desirable than corrals. Horses can easily kick down corrals, corrals take up a lot of space, and require horses to be familiar with each other.

Dedicated equestrians travel to local and regional areas to ride designated trails or a network of varying length looped trails. Local trail riders' trips in the immediate area usually range from 7 to 10 miles per day. Destination trail riders often travel long distances to publicized trail networks and ride about 10 to 15 miles per day and 25-30 miles on an average weekend trip.

#### Understanding Horses

The average horse used for recreational riding or driving weighs approximately 800 - 1400 pounds and travels 3 to 5 mph at a walk or slow gait. As herd animals, horses feel more secure in groups because there is safety in numbers.

A major concern of equestrians is safety. The safety of horses and their riders depends on minimizing opportunities for horses to be frightened and providing an acceptable trail tread. Good sight lines, clearing width and clearing height of 10 to 12 feet are desirable whether managing the trail as a shared use trail or single use trail.



**Green Lake Park Trails**  
Montgomery County

Photo Credit: Montgomery County  
Planning Commission

<sup>28</sup> Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds, U.S. Forest Service: 2007



## Understanding Horses

*From a horse's point of view, fishing rods look suspiciously like buggy whips. The ticking of bicycle gears may sound like an electric fence charger at home. Boisterous dogs look like wolves and persons with high backpacks or carrying canoes look like large animals. Horses that are not usually scared or spooked by cars, tractors, or ATVs in their home setting may have an entirely different attitude in an unfamiliar area. Although wildlife usually may not concern seasoned trail horses, anything novel such as a grouse flying overhead or a deer dashing across the trail is always something of which to be aware.*

**From the U.S. Forest Service Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds, available [Here](#).**

## Equestrian General Speeds and Distances

### *Walking*

- 3-5 miles per hour
- 7-10 miles

### *Walking/ Trotting*

- 3-9 miles per hour
- 10-15 miles

## Local and Destination Equestrian Rider Profile

### *Trail Use Pattern*

- Destination trail riders travel to trails and public land areas to ride designated trails or a network of trails through the forest; local trail riders use trails in the immediate area where they keep or board their horses
- Destination riders ride 10–15 miles per day, 25–30 miles on an average weekend trip; local riders average 7–10 miles per day
- Prefer looped configurations with varying conditions and mileage
- Local riders need direct access to trails from boarding areas
- Riders like to remain self-contained, with special trailers used for hauling horses and to house riders at night
- Often travel long distances to trail systems that provide many miles of trail

### *Recreation Setting Preferences*

- Do not need a wide or highly developed trail
- Single-file trails make horses easier to handle and need less maintenance
- Need water nearby for stock
- Variety in a trail is desirable, including water crossings, hill climbs and descents, open areas and woods
- Bridges need to be about 6' to 8' wide and clear zone above the trail has to be at least 9' high but prefer 10' to 12' high
- Large, open flat field with good drainage is best for parking; gravel lots are also acceptable
- High lines or hitch rails are preferred over corrals for day use
- High lines 7' from the ground or roofed tie stalls are recommended for overnight camping



## Equestrian Trail Classifications

You will usually find equestrian trails in state, regional, and county trail systems. These trails are typically classified by their managed use, as either accommodating equestrian use, shared use, or carriages.

*Equestrian Trail:* Equestrian trails typically have natural surface. They are located in natural settings offering scenic beauty, wildlife observation opportunities, and adequate open space for looped trail systems.

*Carriage Trail:* Carriage trails are routes that have the ability to accommodate both horseback riders and carriage drivers. When considered in a design, a minimum trail width of 8 feet is necessary to accommodate carriages.

*Shared Use Path:* A shared use path is a path physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Pedestrians, bicyclists, skaters, wheelchair users, joggers, equestrians, and other non-motorized users share this type of path.

## Equestrian Trail Layout Configurations

Plan equestrian trail systems based upon a designed riding experience. This layout should highlight scenic qualities of an area, as well as limit impact on nearby ecological systems. In a normal walking gait, horses travel about 3 to 5 miles per hour. Therefore, it is important to plan trails based on the amount of time needed to complete each ride. Looped trail systems offer a desirable experience for riders, as trails of varying lengths are interconnected, giving riders the option of shorter or longer trail rides.

### Rule of Thumb for Ride Distances

- One hour loop  
3-5 miles
- Two hour loop  
6-10 miles
- Three hour loop  
8-15 miles





## Equestrian Trail Guidelines, Level of Difficulty and Other Considerations

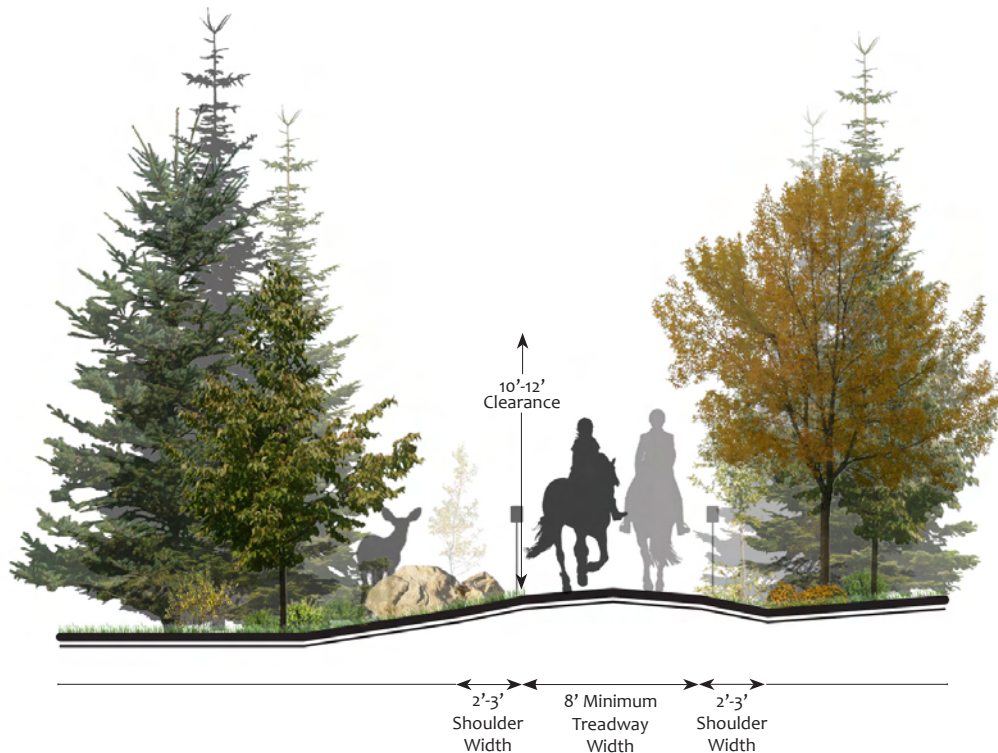
*PA DCNR Standards for Equestrian Trails<sup>29</sup>*

| Trail Type           | Easiest<br>(Interpretive)   | More Difficult  | Most Difficult  |
|----------------------|---|---|---|
| Clearing Height      | 10 feet   | 8 feet  | 8 feet  |
| Clearing Width*      | 8 feet  | 6-8 feet  | 3-6 feet  |
| Treadway Width**     | 2 feet  | 2 feet  | 18 inches   |
| Treadway Slope***    | Less than: 10%  | Less than: 10%  | Less than: 15%  |
|                      | Less than 5%<br>Maximum: 15% up<br>to 200 feet  | Less than 10%<br>Maximum: 25% up<br>to 300 feet   | Less than 15%<br>Maximum: 30% up<br>to 500 feet   |
| Treadway Cross Slope | 0-2%  | 0-5%  | 0-10%   |
| Turning Radius       | Not critical but<br>avoid sharp turns on<br>steep slopes or<br>using switchbacks<br>(30 inches if<br>necessary)   | Not critical but avoid<br>sharp turns on<br>steep slopes or using<br>switchbacks<br>(30 inches if<br>necessary) | Not critical but avoid<br>sharp turns on<br>steep slopes or using<br>switchbacks<br>(30 inches if<br>necessary) |
| Sight Distance       | Two-way<br>traffic: 50-100 feet<br>Motorized road<br>crossings: 100-200<br>feet   | Two-way<br>traffic: 50-100 feet<br>Motorized road<br>crossings: 100-200<br>feet                                 | Two-way<br>traffic: 50-100 feet<br>Motorized road<br>crossings: 100-200<br>feet                                 |
| Surface Materials    | Surfacing as needed<br>for stability. Native<br>surface with<br>some imported<br>material. Sidehill<br>trail is constructed.<br>Smooth tread with<br>few obstacles. | Native surface with<br>constructed sidehill<br>trails. Occasional<br>roots and rocks to 6<br>inches.            | Native with limited<br>grading. Roots, rocks,<br>and logs to 12 inches.   |

\* Along a precipice or hazardous area, the trail clearing width should be at least to 5 feet to provide safety to riders and their animals.

\*\* Increase tread width 1 foot on switchbacks.

\*\*\* Upper limit of treadway grade and distance depends on soil type, amount of rock, vegetation type, and other conditions affecting trail surface stability.



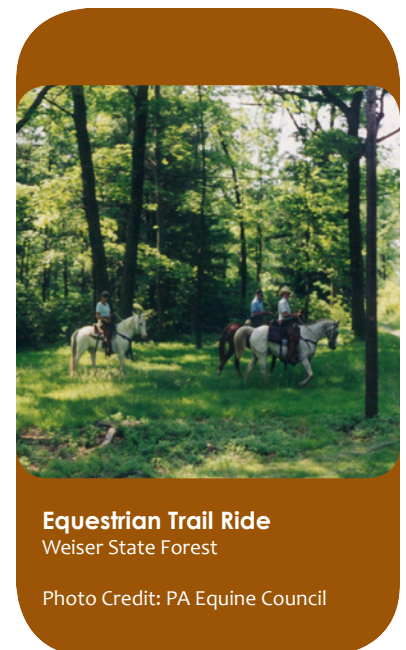
*Two-Way Equestrian Trail*

### Equestrian Trail Treads

Design the treadway to accommodate the weight and motion of animals and riders. The choice of varying tread surface treatments affects the speed at which horses and mules can travel. Fine aggregate provides good traction and provides a surface conducive to safe cantering. However, hard surfaces offer poor traction and limit travel to a walk. Remove tread obstacles such as tree roots, holes, dead or leaning trees, and projecting objects for safety. Natural soils can serve as the tread material provided they meet the requirements described in this chapter.

For durable, all-season urban equestrian trails, plan at least a 4 foot wide tread surface to accommodate single-file use and 8 foot width for side-by-side use. Where existing soils cannot adequately support equestrian use, construct a treadway using geotextile, base rock, compacted aggregate, and compacted cushion layer of rounded stone. Horses do not like to walk across large angular stone; it is uncomfortable on their hooves. Angular stone on the tread surface should be AASHTO No. 57 or smaller in size. Horses tend to favor the outside edges of sidehill trail treads.

The trail designer should recommend proper placement and compaction of fill material at trail edges for equestrian safety. This is of special concern where trails are constructed on fill and where the quality of the fill material



**Equestrian Trail Ride**  
Weiser State Forest

Photo Credit: PA Equine Council



and the construction methods are unknown. Fill consisting of large stones does not accommodate barefoot trail horses, whose numbers are increasing with the natural horsemanship movement. Build retaining walls for newly constructed sidehill trails to stabilize older, deteriorating trails.

## Equestrian Trail Amenities

### *On-Trail Amenities*

On-trail amenities encourage equestrian use and enhance a trail user's experience. The design of a loop trail system is preferable to linear trails, allowing the connection of multiple routes. By providing these connections, as well as maintaining natural components of the landscape, the design can feature compelling trail sequences and can provide access to water sources throughout the system. Designers should incorporate a hardened, gentle slope leading to trailside streams or ponds to allow horses to access natural sources of waters and to prevent riparian and stream bank impacts.

### *Trailhead Amenities*

Designers should locate trailheads at the beginning of a trail system. Many equestrian campers are self-contained and include water, toilet, and sleeping quarters. Therefore they do not require as many amenities. Depending on the type of equestrian user, amenities to consider include: parking, restrooms, picnic areas, signs, and maps. Equestrian trailheads should also include specific amenities to accommodate equestrian use including: potable water, accessible mounting platforms, ordinary mounting blocks (stones or stumps), bunkers for manure disposal, and parking to accommodate haul vehicles and their trailers.

Designers should clearly separate equestrian parking from other trail parking by designing parking lanes approximately 30 feet wide by 80 feet long to accommodate large truck and trailer combinations, as well as to allow for the loading and unloading of animals.

Riders also desire high lines or hitching posts, covered horse tie stalls for overnight camping, and dedicated equestrian access to the shared use trails or paths.

Mapping, camping literature, and signage should clearly indicate the availability and locations of potable water and stock water as well as toilet facilities and manure pits.

### **Shared Use Paths Accommodating Equestrian Use**

Heavy equestrian use of a shared use path with a compacted stone surface, or a natural surface trail, may result in the displacement of the trail's surface, and will require a higher level of maintenance to correct. In areas with low horse populations, the amount of equestrian use typically remains limited and results in less tread displacement. In corridors that provide sufficient width,



**Moshannon State Forest**  
Quehanna Wildlife Equestrian Camp  
Cameron County

Photo Credit: PA Equine Council





a dual-tread trail can separate equestrians from other trail users. See the section on shared use paths earlier in this chapter.

Manure remains a concern of non-equestrian users. When visiting a stable, horse show, or rodeo, visitors expect the atmosphere surrounding these activities. In particular, horse manure is an accepted nuisance. Although visitors walking or biking on trails that allow equestrian use should expect these conditions, tolerance sometimes wanes. Recognizing this concern, a trailhead can address this issue by providing a length of dedicated equestrian trail connecting a shared use path. Horses tend to relieve themselves at the start of their ride. Therefore, providing a separate trail for the first 500 to 2,500 feet can reduce the non-equestrian users' encounters with horse manure.

Trail managers can minimize conflicts by conveying the message that a trail intends to accommodate equine use from the beginning of the planning process. Equestrian-specific amenities by their very nature establish expectations. Trail users who see these amenities at a trailhead and along the trail corridor often accept horses more readily. This is because they realize the trail supports equine activities. Emphasize equestrian use of a shared use path with signage at trail access points and along the trail to remind users of expectations and etiquette. This understanding should work both ways on shared use paths. Encourage equestrian users to clear the path of horse manure when possible, just as hikers are expected to clean up after their animals.

### Accessibility on Equestrian Trails

In addition to meeting typical ADA requirements documented elsewhere in this guide, the addition of mounting blocks and ramps at trailheads provides accessibility to those who may not otherwise be able to mount a horse. Mounting blocks and ramps serve a broad range of riders.

Installing mounting blocks or ramps<sup>30</sup> in areas where riders normally dismount and mount can increase usage of trails, trailheads, or campgrounds. Many riders have difficulty getting on and off a horse or mule, especially young children, small or older riders. Many riders in this situation search out large rocks, stumps, or mounds to boost themselves. Such objects can be unstable or slippery. Therefore, designers should provide mounting blocks or ramps instead.

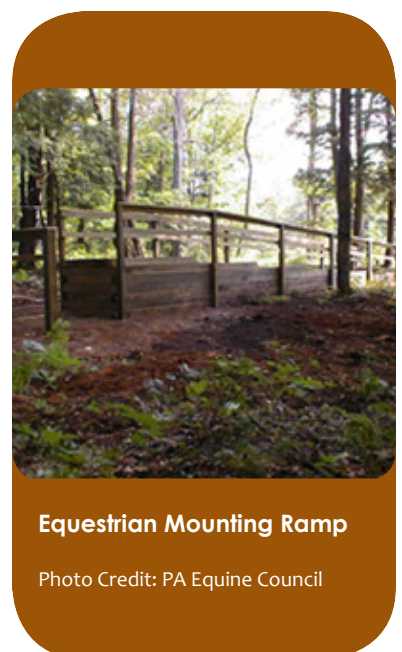
Riders of all abilities and ages can use mounting blocks. A mounting block resembles a short staircase that ends in midair. The rider climbs the stairs to reach the saddled animal standing at the elevated end. Mounting blocks may be made of wood, steel, concrete, plastic, fiberglass, or a combination of these materials. Structures that are more permanent, for example those

30 Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds, U.S. Forest Service: 2007



**PA Grand Canyon**  
Tioga and Lycoming Counties

Photo Credit: PA Equine Council



**Equestrian Mounting Ramp**

Photo Credit: PA Equine Council



### Equestrian Trail Best Practices

- Tiadaghton State Forest
- Bald Eagle State Forest
- Tuscarora State Forest
- Weiser State Forest
- Pine Grove Furnace State Park
- Forbes State Forest
- French Creek State Park
- Jacobsburg Environmental Center, Northampton County
- Bucks County Horse Park

### Equestrian Trailheads and Camping Area Best Practices

- Showaker Trailhead, Tuscarora State Forest, Perry County
- Thunder Mountain Trailhead, Elk State Forest, Cameron County
- Dyer CCC Camp, Susquehannock State Forest, Potter County
- Kettle Creek State Park, Clinton County
- Quehanna Shared Use Trail (Reservoir Road Camping Area)
- Moshannon State Forest, Clearfield and Cameron Counties
- Keystone Mountain Country Shared Use Trail (12 Mile and Dyer Farm Equestrian Trailheads) Tioga and Lycoming Counties

made of concrete or steel, are most suitable at trailheads or campgrounds that have easy access for construction equipment. Permanent structures also discourage theft. Structures made from wood, fiberglass, or plastic are easier to transport, install, and place along trails.

To meet accessibility requirements, the treads on mounting blocks should be at least 11 inches deep and 36 inches wide. Risers should be uniform and measure between 4 and 7 inches high. Mounting blocks commonly have an overall height of 16 to 28 inches. The need for handrails remains a source of debate. While handrails keep users from falling off platforms, they may catch the animal, rider, assistants, or equipment.

Riders usually mount from the left side of the animal, passing their right leg over the horse's back. Handrails on the right-hand side of the stair will interfere with the rider's leg movement. This makes a compelling case for leaving handrails off mounting blocks, or for installing handrails that stop before the top step. To meet the ADA/ABAAG requirements, handrails should have extensions, also called returns, at the top and bottom. In this case it is not appropriate to have handrail returns extending into the animal's space.

### Complementary Publications

The U.S. Forest Service publication *Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds*<sup>31</sup>, available [HERE](#), is an excellent resource.

For additional information contact the Pennsylvania Equine Council's Trail Stewardship Program:

- Pennsylvania Equine Council  
Post Office Box 62  
Huntington Mills, PA 18622-0062  
(888) 304-0281  
[info@pennsylvaniaequinecouncil.org](mailto:info@pennsylvaniaequinecouncil.org)  
[www.pennsylvaniaequinecouncil.org](http://www.pennsylvaniaequinecouncil.org)

31 Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds, U.S. Forest Service: 2007



## Cross-Country Skiing Trails

Cross-country skiing routes provide naturally surfaced trails used during the winter season. The design and grooming of these trails provide for a variety of trail users including traditional or classic, skate, and backcountry skiers. Traditional or classic cross-country skiers use a kick or gliding motion, while skate-skiers use a unique skating motion to move forward along a trail.

### General Considerations for Cross-Country Skiing Trails<sup>32</sup>

The following information defines the general preferences and motivations of cross-country skiers, and provides suggestions for the most effective design of these routes.

#### User Information

Cross-country skiing is attractive to people of all skill levels and abilities. This winter sport appeals to recreational, fitness, event, and backcountry skiers who enjoy skiing for its range of benefits. Although motivations for skiing differ for each individual, all users enjoy groomed trails whose design meets their specific needs.

Trail networks that offer convenience and diverse opportunities for all types of use prove attractive to dedicated skiers. Recreational and fitness skiers prefer a combination of traditional and skate-ski style trails that can accommodate varying skills and preferences. Event skiers prefer hilly, lighted trails that allow skilled users to participate in organized events and train throughout the year.

Cross-country ski trails generally serve as a part of a looped trail system which provides varying conditions and difficulty levels. While recreational skiers do not depend on the technical difficulty of a trail, highly skilled skiers seek out well-groomed trails that offer a mixture of difficulty and length. Trailheads and trail systems alike should offer amenities such as restrooms, warming areas, and drinking water to accommodate users.

### Recreational/Family Skier User Characteristics

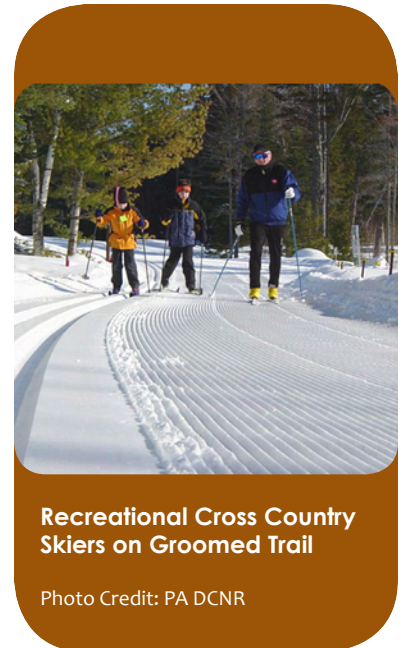
#### Trail Use Pattern

- Seeks out and travels to designated, groomed trails
- Often skis as a family, but you will commonly encounter couples and individual skiers
- Prefers looped configurations with varying conditions

#### Recreation Setting Preferences

- Prefers larger natural settings
- Attracted to convenience and diverse activity opportunities in the area to accommodate all family members

<sup>32</sup> Adapted from Trail Planning, Design, and Development Guidelines, Minnesota Department of Natural Resources: 2007



**Recreational Cross Country Skiers on Groomed Trail**

Photo Credit: PA DCNR





- Strong preference for well-groomed trails offering a mixture of difficulty and length, with places for children to practice
- Generally does not want all skate-skiing or too many fast skiers on trails
- Prefers a combination of traditional/classic and skate-ski styles to accommodate varying skills and preferences
- Prefers that skate-skiers and traditional/classic skiers be on different trails (not side-by-side) at least once in a while in order to have their own space
- Drinking water, restrooms, and warming areas at trailheads remain important
- May do multi-day trips and stay at local lodging facilities or resorts

### *Fitness Skier User Profile*

#### *Trail Use Pattern*

- May go daily or several times per week; many use local trails routinely
- Primarily skis on local trails in a park or on a golf course that offers trails providing enough length and challenge

### *Recreation Setting Preferences*

- Needs trail of varying difficulty and length, with looped systems preferred for training
- Should have well-groomed trails; groomed trails are a significant factor in trail selection
- Prefers a natural setting, but having ample trail distance is most important
- Prefers a combination of traditional/classic and skate-ski styles to accommodate varying skills and preference; many participate in both kinds of skiing
- Needs and highly supports lighted trails to enable training in the evening during the work week
- Drinking water, restrooms, and warming areas at trailheads remain important

### *Racer/Event Skier User Profile*

#### *Trail Use Pattern*

- Uses trails as part of an organized event or competition
- Often falls into the fitness skier category on a day-to-day basis and commonly trains on local trails

### *Recreation Setting Preferences*

- Prefers hilly terrain for good skiing and avoiding boredom during longer events
- Needs support facilities for rest, staging, and comfort
- Needs same trail facilities as fitness skiers for training, including lighted trails

## **Cross-Country Ski General Speeds and Distances**

### *Backcountry Skier*

- 0.6 to 3.7 miles per hour
- 2.5 to 9.3 miles per hour

### *Recreational/Family Skier*

- 1.8 to 6.2 miles per hour
- 2.5 to 6.2 miles

### *Fitness Skier*

- 3.1 to 9.3 miles per hour
- 5 to 15.5 miles

### *Racer/Event Skier*

- 6.2 to 12.4 miles per hour
- 3.1 to 31 miles



- 6-75 mile loops are good for events, as are linear courses of up to 30 miles

### *Backcountry Skier User Profile*

#### *Trail Use Pattern*

- Prefers natural areas with extensive opportunity for skiing
- Does not need groomed trails
- May camp during winter as part of an outing

#### *Recreation Setting Preferences*

- Beginners need marked trails with maps and some level of basic maintenance
- Traditional/classic style is predominant
- Prefers looped system, but linear trails offer an acceptable alternative if shuttle service is available
- Length of trail can be less than 5 miles for a day outing and up to 50 miles for a winter camping trip
- Prefers remote settings free of motorized activity

### **Cross-Country Skiing Classifications**

Cross-country skiing trails accommodate trail users on a local, county, regional, and state level during the winter months. Local trail systems typically do not support skiing because of their need for specialized grooming. All trails accommodate traditional and skate-style skiers on groomed trails that vary in form. Backcountry skiers typically follow routes with little to no formal maintenance.

#### *Traditional (Classic) Style – one track set/one direction:*

Traditional cross-country trails are usually located in county, regional, and state parks. Total width is 6 to 8 feet.

#### *Traditional (Classic) Style – two track set/one or two directions:*

Two-way traditional style routes are the most common type of groomed trails in state parks. These trails receive routine maintenance, especially after snowfall over a few inches. Total width is 8 to 10 feet.

*Skate Style – single width/one direction:* These trails are typically located in county, regional, or state parks as connector trails from one loop to the next. Trails of this type are common in high use areas where users prefer the separation of skiing styles. Total width is 8 to 10 feet.

*Skate Style – double width/one or two directions:* This configuration is typically found in county, regional, and state parks. Trails of this type are common in high use areas where users prefer the separation of skiing styles. However, uses are often combined because of the increased mileage needed to accommodate separate uses. Total width is 14 to 16 feet.



**Ungroomed  
Cross-Country Trail**  
Nescopec State Park  
Luzerne County

Photo Credit: PA DCNR



**Combination Traditional and Skate Style – one direction:** One-directional use trails are typical in county, regional, and state parks and most popular among skiers. This type of trail helps avoid confusion and conflict, keeps overall tread width narrow, and accommodates high levels of use and a diversity of skier types. Total width is 12 to 14 feet.

**Combination Traditional and Skate Style – two direction:** This type of trail serves as a linear connector between loops or at trailheads with two-directional use. Total width is 16 to 20 feet.

**Cross-Country Skiing Trail Layout Configurations :** Cross-country ski trails should offer 5-10 mile looped trail systems of varying terrain consistent with the trail difficulty ratings shown in the following table. Internal connector trails and cutoffs allow different trail lengths and permit easy return access for skiers. Users prefer multiple, short loops ranging from ½ to 3 miles in length, to one long loop.

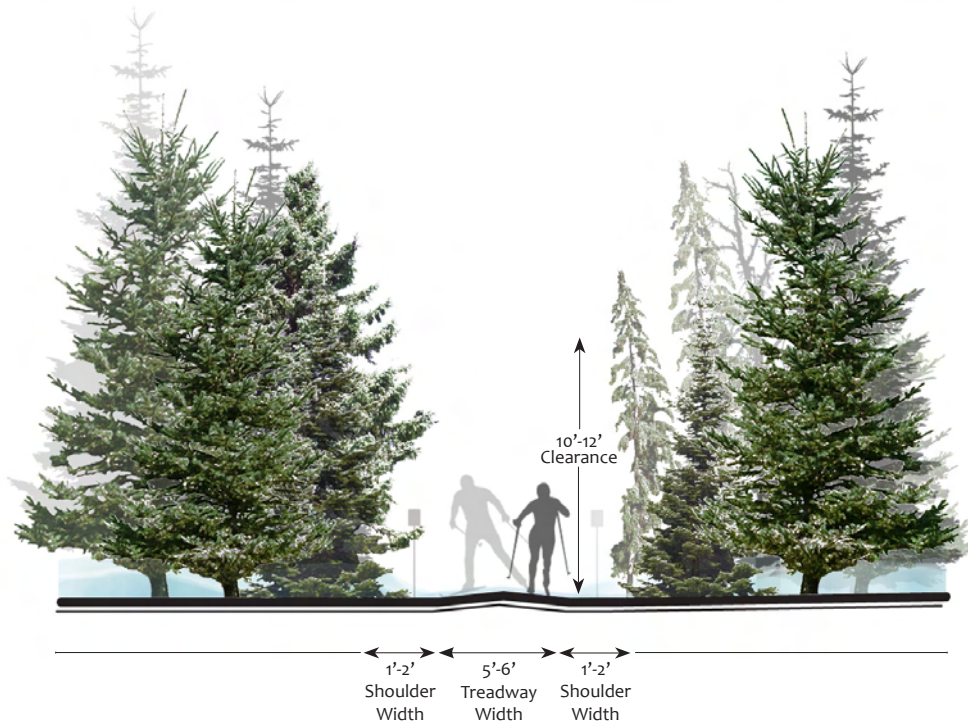
In addition to looped configurations, linear or point-to-point cross-country ski trails commonly occur with greenways and trail corridors located in developed areas. This approach allows nearby trail users to conveniently access cross-country skiing areas as a major advantage.

### PA DCNR Cross-Country Trail Guidelines, Level of Difficulty, and Other Considerations<sup>33</sup>

| Trail Type           | Easiest (Interpretive)  | More Difficult   | Most Difficult   |
|----------------------|---|--|--|
| Clearing Height      | 10-12 feet  | 10 feet  | 8-10 feet  |
| Clearing Width       | 18-24 inches outside of treadway  | 12-18 inches outside of treadway   | 12 inches outside of treadway  |
| Treadway Width       | One-way: 2-4 feet<br>Two-way: 5-6 feet  | 1 ½-4 feet   | 1-2 feet<br>Typically not designed for two-way travel  |
| Treadway Grade       | Less than 8%<br>Maximum: 15% up to 150 feet   | Less than 10%<br>Maximum: 20% up to 150 feet   | Less than 15%<br>Maximum: 20% up to 200 feet   |
| Treadway Cross Slope | 0-4%  | 0-4%   | 4-8%   |
| Turning Radius       | 50-100 feet<br>Gentle turns on downhill slopes. Avoid sharp turns. Never locate a turn at the base of a downhill run. | 50-100 feet<br>Incorporate more turns in trail layout. Avoid sharp turns. Never locate a turn at the base of a downhill run. | 50-100' feet<br>Incorporate more turns in trail layout. Never locate a turn at the base of a downhill run. |
| Sight Distance       | 50 feet on downhill runs, streams, and road crossings.  | 50 feet on downhill runs, streams, and road crossings.   | 50 feet on downhill runs, streams, and road crossings.   |

33 Guidelines for Marking Recreational Trails, PA DCNR: 2008





*Two-Way Cross-Country Skiing Trail*

Many multi-use trails that accommodate pedestrians, bicyclists, and equestrians during warmer months provide ideal opportunities for cross-country skiing throughout winter months. A minimum of 6 inches of snow on a trail offers excellent skiing opportunities with minimal to no damage of the trail or ski equipment. If the trail sees other winter use, cross-country skiers will often ski off to the side to avoid having their tracks trampled.

### *Trail Grades, Curves, and Sight Distances*

Grade variations enhance the skier's experience, consistent with the desired difficulty level of a trail. Generally, 1/3 of a given trail provides uphill skiing, 1/3 should provide downhill skiing, and 1/3 should have a rolling grade.

Designers should consider downhill runs as an important feature in the design of cross-country ski trails. The longer and steeper the run, the straighter and longer the run-out area should be at the bottom of a hill. This allows skiers to dissipate speed to regain a sense of control. Where limited space exists, a rise in grade can offset a loss of run-out distance. Within clearance zones and on two-direction trails, the trail should be wide enough to separate various user types, as well as allow skiers to safely fall and slide several feet.

Since most skiers are not experts, avoid sharp bends at the base of hills. Long, gentle curves are the preferred design on downhill ski trails; however, in some situations where the design of a trail cannot avoid a curve at the end of a downhill, the design should incorporate a radius of 100 feet or more. This



also holds true for all other curves along the trail. In these situations, locate warning signs at least 100 feet before the beginning of the slope.

Forward sight distances are critical on steep downhill runs, and where trails cross waterways, motorized roadways, and other potential hazards. In these cases, incorporate level approaches with forward sight distances of at least 50 feet. On sharp curves and downhill sections, designers need to incorporate a sight distance of at least 100 feet.

## **Trail Alignment and Preparation**

### *Trail Alignment*

The tread of a cross-country skiing trail refers to the underlying trail beneath the compacted and groomed snow. Proper off-season evaluation of trail alignments, tread surface preparation, and trail maintenance should occur to ensure the quality of a trail. Locate trails in areas where snow will remain the longest and offer the most stable skiing. Important consideration in determining the location of a cross country skiing trail include: sun and wind intensity, solar orientation, location, and overall trail tread. By designing with these factors in mind, trail designers can locate trails geographically to maximize their use throughout the season.

Cross-country ski trails are usually well suited for hardwood and coniferous forests. Hardwood forests offer an excellent setting for these trails because the sun's intensity is lower and the air temperature remains colder than in wide-open flat areas. Incorporating changes in topography offers designers another effective strategy to reduce the extent of sunlight on the trail. Use this strategy along the base of north-facing slopes where the sun is less intense. Also, avoid locating skiing trails at the base of south facing slopes where the sun is most intense.

Before permanently establishing a trail, the designer should conduct field tests of a trail's alignment, snow displacement patterns, and seasonal wind effects. Even relatively minor shifts in the location of a skiing trail can make a dramatic difference in the impact natural elements will have on it.

Avoid wetland areas and water bodies when aligning cross-country ski trails to minimize ecological impacts, surface quality issues, and safety issues. Do not place ski trails on lakes for safety.

### *Trail Cross Grades*

The optimal skiing trail cross-section has a consistent, even grade with a 0 to 2 percent cross-slope. Avoid abrupt changes in grade along a trail to make the route more enjoyable and easier to maintain.



### *Tread Surface Conditions*

The tread surface of a trail is important to consider for overall preparation and grooming maintenance. A level, smooth trail with a short grass cover of 3 to 4 inches across the entire width of the trail offers ideal conditions. This type of tread prevents off-season foot traffic and erosion from creating an uneven tread surface and holds snow better than bare ground or pavement.

Routine mowing maintains the tread surface, as well as reduces the need for brush trimming and controls the growth of woody plants. In protected or environmentally sensitive areas, employ a two-step approach to mowing as the preferred method. The first mowing should occur in late September to cut grass to the desired length and the second mowing should occur a few weeks later to mulch debris left from the first pass. Remove logs, rocks, and other woody debris from the trail shortly before the season begins.

If grass cannot be maintained, wood chips offer the next best alternative. Other surfaces such as bare ground and aggregate surfacing have certain limitations. Asphalt and concrete are the least desirable surfaces since asphalt absorbs more sun energy, loses snow earlier, and is hard on ski equipment when snow cover is thin.

Tread drainage and erosion are important design considerations evaluating overall trail quality and the dual use of ski trails. To prevent erosion the design should stabilize the trail with ground cover during the off-season.

## **Cross-Country Ski Trail Amenities**

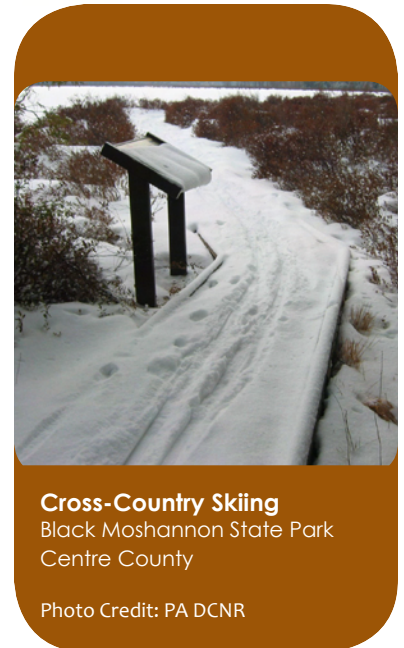
### *Lighted Cross-Country Ski Trails*

When trails are lighted they are typically designed as 3 mile loops. By lighting a previously unlit trail, skiers have the opportunity to use the trails for longer periods throughout the day. While it may seem reasonable to light a loop of the recommended length, anything more or less should take into account the added costs for development and maintenance, as well as provide justification through user counts and satisfaction surveys. Consideration should be given to exploring solar lighting options to reduce utility costs.

### *Trailhead Facilities and Signage*

In larger park settings, the main trailhead is commonly located adjacent to a visitor center. On the local level trailheads usually consist of simple amenities such as a plowed parking area, trail shelter, warming area, portable restroom, and self-registration station.

The signage for cross-country ski trails should be generally consistent with the signage recommendations contained in Chapter 3. It is important to include maps, trail distance, level of difficulty, and warning signs on all cross-country ski trails.



**Cross-Country Skiing**  
Black Moshannon State Park  
Centre County

Photo Credit: PA DCNR





### Best Practice Examples

The following represent the use of best practices in the development of cross-country ski trails and amenities. We encourage you to research and visit these locations before planning, designing, and constructing your trail.

- Parker Dam State Park, Clearfield County: Grooms and sets track on five miles of ski trails, provides cross-country skiing programming and classes, provides equipment, and guides learners on the trails.
- Bald Eagle State Park, Centre County: Some park trails and open areas are suitable for cross-country skiing. About seven miles of ungroomed trails are available with proper snow conditions.
- Chapman State Park, Warren County: The 4.4 miles of ski trails connect with numerous trails in the adjoining national forest and state game land. There is a warming hut.
- Clear Creek State Park, Jefferson County: A three-mile cross-country ski trail uses portions of Truby, Sawmill, Clear Creek and Ox Shoe trails to make a loop.
- Little Pine State Park, Lycoming County: The five-mile Lake Shore Trail follows level terrain and parallels the lake and headwaters and then returns to the starting location. Motor vehicles and snowmobiles are prohibited in this area.
- Ole Bull State Park, Potter County: Cross-country skiing and snowshoes are allowed throughout the park.
- S. B. Elliott State Park, Clearfield County: There are more than four miles of easy to moderate roads and trails.
- Sizerville State Park, Cameron and Potter Counties: Park trails provide access to many miles of trails on adjacent state forest land. The average yearly snowfall is 60-70 inches. The park provides parking and restrooms.



For additional information visit the Pennsylvania Cross Country Skiers Association at [www.pacsa.org](http://www.pacsa.org).

## Snowshoeing and Winter Hiking Trails

The development of naturally surfaced trails for winter use allows routes to accommodate the sport of snowshoeing and winter hiking. The amount of snow, as well as the level of grooming on a trail depends on the type of user group that uses the trail throughout the winter season.

### General Considerations for Snowshoeing Trails<sup>34</sup>

The following information defines the general preferences and motivations of both snowshoers and winter hikers, as well as how the design of each type of route can best accommodate its use.

#### User Information

Snowshoers and winter hikers enjoy being outdoors during the winter season. Winter hiking trails, used for alternative uses during the summer months, can accommodate trail users seeking multiple experiences.

A large percentage of natural trail users seek to escape from motorized activity and value experiencing nature. Winter hikers usually seek groomed trails of varying difficulty that provide observation points for users to rest, observe, and socialize. Snowshoers like trails that vary in skill and difficulty levels whether they are groomed or not.

Given the limited demand, designers can typically accommodate both uses on the same trail. With deeper snow, snowshoers tend to frequent the trail most often. Conversely, hikers tend to use trails when the snow is less than a foot deep on unpacked trails. Since both user groups prefer a trail with varying snow conditions, it usually allows users to enjoy the trail without disturbing others.



**Recreational Snowshoers**  
Sinnemahoning State Park  
Cameron and Potter Counties

Photo Credit: PA DCNR

<sup>34</sup> Adapted from Trail Planning, Design, and Development Guidelines, Minnesota Department of Natural Resources: 2007



## **Snowshoe and Winter Hike General Speeds and Distances**

### *Snowshoer/Winter Hiker*

- 2-4 miles per hour
- 3-5 miles

### *Snowshoer User Profile*

#### *Trail Use Pattern*

- Uses trails whether groomed or ungroomed, depending on personal preference and type of snowshoe
- Frequently leaves the established trail
- May walk along groomed ski trails

#### *Recreation Setting Preferences*

- Needs unplowed, ungroomed surfaces, although some prefer to follow a groomed trail
- Prefers natural areas
- Snowshoers interested in exercise seek a trail with hills and adequate length

### *Winter Hiker*

#### *Trail Use Pattern*

- Seeks out trails for a desired experience, whether near home or some travel distance
- Prefers looped systems over out-and-back trails to vary the experience
- Prefers groomed or plowed trails for ease of walking
- Will seek out trails of varying difficulty
- Likes to stop along the trail to rest, observe, and socialize if hiking in a group
- Expects trail to be of varying difficulty consistent with landscape characteristics

#### *Recreation Setting Preferences*

- Large percentage seeks escape from motorized activity, and values experiencing nature
- Natural setting is important to all, with wooded, rolling terrain with wildlife viewing opportunities commonly preferred
- Trail difficulty is an important determinant in trail selection
- Access to the trail serves as a major predictor of use levels
- Length preferences vary widely with skills and individual user preference
- Minimum preferred width should be 18"





## Snowshoeing Trail Layout Configurations

Although snowshoeing and winter hiking have grown in popularity over the years, the demand for specialized trails remains small. As a result, the layouts for snowshoeing and winter hiking trails generally remain consistent with cross-country skiing trails. A looped trail system of 3 to 5 miles offers the most desirable design for this type of trail layout in most park settings. If snowshoers have permission to use cross-country ski trails, trail managers commonly limit access to specific areas of a trail route. Trail blazes often define a route in order to guide trail users and keep them in a specific area and trail managers may relocate the blazes throughout the season.

## Snowshoeing Trail Guidelines and Considerations

### *Slope Considerations for Snowshoeing Trails<sup>35</sup>*

| Aspect                          | Easy     | Intermediate | Expert/Advanced                        |
|---------------------------------|----------|--------------|--|
| Corridor Clearance (Horizontal) | 6-8 feet | 6-8 feet     | 6-8 feet                               |
| Corridor Clearance (Vertical)   | 10 feet  | 10 feet      | 10 feet                                |
| Average Trail Grade             | 4%-10%   | 6%-12%       | >12% (most challenging loops)          |
| Maximum Hill Grade              | 10%-12%  | 12%-18%      | >18%, with 40% max. for short distance |

The design and grooming standards for snowshoeing and winter hiking trails are generally consistent with those defined for cross-country ski trails. To accommodate users for both trail types, trail grades should be consistent with easy or intermediate cross-country ski trail difficulty levels. Determine trail widths by the type and level of use the trail will receive. To accommodate one or two-way snowshoeing and/or winter hiking, the tread should be 6 to 8 feet wide.

### Trail Treads

Maintain packed trails for hiking and snowshoeing once a week or after a significant snowfall. This rate is far less than cross-country ski trails since snowshoes and foot traffic easily accommodate loose or uncompacted snow on a trail. Most often, these trails are located on existing summer-use natural surface trail corridors.

While hikers usually prefer a groomed trail system, snowshoers are more tolerant of ungroomed and uneven surfaces. For ungroomed snowshoeing trails, trail managers typically use tree markers and trail blazes to mark the route. For cross-country travel, maps and directional signs typically highlight specific areas designated for snowshoeing.

<sup>35</sup> Trail Planning, Design, and Development Guidelines, Minnesota Department of Natural Resources: 2007



**Snowshoeing**

Sinnemahoning State Park  
Cameron and Potter Counties

Photo Credit: PA DCNR



## Difficulty Rating System for Snowshoeing Trails

### Difficulty Standards for Snowshoeing Trails<sup>36</sup>

| Aspect              | Easy   | Intermediate   | Expert/Advanced  |
|---------------------|--|--|--|
| Length              | 1 ½-3 miles  | 3-10 miles   | 3-20 miles   |
| Average Trail Grade | 4-10%  | 6-12%  | >12% (most challenging loops)  |
| Maximum Hill Grade  | 10-12%   | 12-18%   | >18%, with 40% max. practical  |
| Character of Trail  | Wide trails with ample run-out on hills, nice rolling terrain with easy grade changes. | Introduction to steeper, longer, and more frequent hill climbs, but with ample run-out on hills still important; steepest hills are relatively short; intermediate trails should be combined with easy trails to provide user with diversity and opportunity to work on various skills and endurance | More frequent, steeper, and longer hills with less recovery time in between; run-out area on hills is more constricted, but still safe for skill level; expert trails should be combined with intermediate and easy trails to provide user with diversity and opportunity to work on various skills and endurance; upper end hill grades should be shorter than 50 yards |

<sup>36</sup> Ibid



## Accessible Trails

As noted in Chapter 1, designers should integrate universal design strategies into the design process whenever possible. Newly constructed trails should address these issues during the planning process to eliminate changes in a design during and after construction.

Every aspect of a trail experience should include accessible built facilities, amenities, trailheads, and trail corridors to ensure a trail's versatility. Moreover, a trail's environment and benefits should be enjoyable and appeal to those with and without disabilities.

### Access Routes

Accessible routes are governed by the Department of Justice regulations titled the [2010 ADA Standards for Accessible Design](#)<sup>37</sup> (ADAADS), available [HERE](#). Accessible routes are exterior pathways, including sidewalks, with a prepared surface intended for pedestrian use.

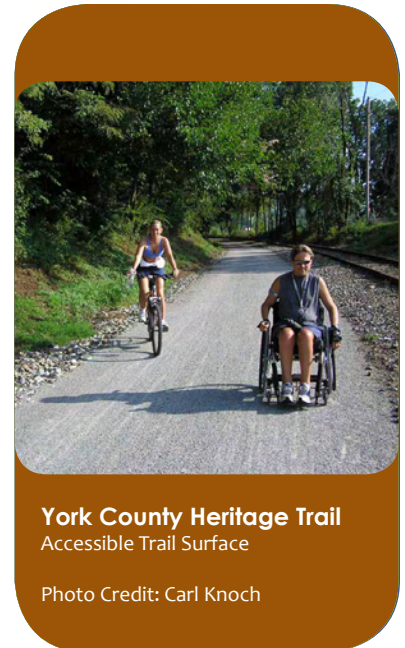
In the trail environment accessible routes are typically associated with building environments such as comfort stations and nature centers.

[ADAADS](#) requires at least one accessible route within the site from accessible parking spaces and accessible passenger loading zones; public streets and sidewalks; and public transportation stops to the accessible building or facility entrance they serve.

Accessible routes should meet the following requirements:

- **Floor or Ground Surface:** Floor or ground surfaces should be stable, firm, and slip resistant. Openings in floor or ground surfaces should not allow passage of a sphere more than 1/2 inch diameter.
- **Vertical Changes in Elevation:** Changes in level of 1/4 inch high maximum should be permitted to be vertical.  
Beveled: Changes in level between 1/4 inch high minimum and 1/2 inch high maximum should be beveled with a slope not steeper than 1:2.  
Ramps: Changes in level greater than 1/2 inch high should be ramped.
- **Protrusion Limits:** Objects with leading edges more than 27 inches and not more than 80 inches above the finish floor or ground should protrude 4 inches maximum horizontally into the circulation path.
- **Vertical Clearance:** Vertical clearance should be 80 inches high minimum.
- **Slope:** The running slope of walking surfaces should not be steeper than 5 percent. The cross slope of walking surfaces should not be steeper than 2 percent.
- **Clear Width:** The clear width of walking surfaces should be 36 inches minimum.

<sup>37</sup> 2010 ADA Standards for Accessible Design, U.S. Department of Justice, 2010



**York County Heritage Trail**  
Accessible Trail Surface

Photo Credit: Carl Knoch





### Accessible Route to Picnic Shelter

Ernst Trail, Cawford County

Photo Credit: Pashek Associates

- Clear Width at Turn: Where the accessible route makes a 180 degree turn around an element which is less than 48 inches wide, clear width should be 42 inches minimum approaching the turn, 48 inches minimum at the turn and 42 inches minimum leaving the turn.
- Passing Spaces: An accessible route with a clear width less than 60 inches should provide passing spaces at intervals of maximum. Passing spaces should be either: a space 60 inches minimum by 60 inches minimum; or, an intersection of two walking surfaces providing a T-shaped space complying with 304.3.2 where the base and arms of the T-shaped space extend 48 inches minimum beyond the intersection.

### Americans with Disabilities Act Standards for Accessible Trails

Currently, there are no accessibility standards under the Americans with Disabilities Act that apply to trails. In Chapter 10 of the [ADAADS](#)<sup>38</sup> recreation facilities are addressed, but trails are not included in those recreation facilities. The U.S. Access Board (creator of the accessibility standards) defines a trail as:

*“A pedestrian route developed primarily for outdoor recreational purposes. A pedestrian route developed primarily to connect elements, spaces, or facilities within a site is not a trail.” In other words a trail is constructed for the primary purpose of hiking. A “trail” is not shared use pathway, or the route that connects facilities in a campground or other area.*

In 2009 the Federal Access Board released the [Draft Final Accessibility Guidelines for Outdoor Developed Areas](#)<sup>39</sup> (ODAAG), available [HERE](#). This document proposes accessible design requirements for outdoor recreation access routes and accessible trails located on federal lands, including the U.S. Forest Service, National Park Service, Fish and Wildlife Service, Bureau of Land Management, Bureau of Reclamation, and Army Corps of Engineers. These guidelines are also proposed for non-federal entities that construct or alter facilities on federal lands on behalf of the federal government.

<sup>38</sup> Ibid

<sup>39</sup> Draft Final Accessibility Guidelines for Outdoor Developed Areas, U.S. Access Board: 2009



The following table summarizes the proposed accessibility requirements for trails on federal lands.

#### Technical Provisions for Trails<sup>40</sup>

| Aspect                    | Trail  |
|---------------------------|--|
| Surface                   | Firm and Stable<br>Exception*  |
| Maximum Running Slope     | 1: 20 (for any distance)<br>1: 12 (for max 200 ft)<br>1: 10 (for max 30 ft)<br>1: 8 ( for max 10 ft)<br>Exception: 1: 7 (for 5 ft max for open drainage structures)<br>Exception*  |
| Maximum Cross Slope       | 1:20<br>Exception: 1: 10 (at the bottom of an open drain where clear tread width is a min of 42 inches)  |
| Minimum Clear Tread Width | 36 inches for any distance<br>Exception: 32 inches when * applies.   |
| Edge Protection           | Where provided, 3 inches minimum height  |
| Tread Obstacles           | 2 inches high max<br>Exception: 3 inches max (where running and cross slopes are 1: 20 or less) Exception*   |
| Passing Space             | Every 200 feet where clear tread width is less than 60 inches, a minimum 60 X 60 inch space, or a t-shaped intersection of two walking surfaces with arms and stem extending min of 48 inches.<br>Exception: every 300 feet where * applies. |
| Resting Intervals         | 60 inches min length, width at least as wide as the widest portion of the trail segment leading to the resting interval and a maximum slope of 1: 20.<br>Exception*  |

\* Refer to the discussion on Conditions for Departure on the following page.

The U.S. Access Board has been working for many years to develop the **ODAAG** for campgrounds, picnic area, overlooks, and the outdoor recreation access routes that connect them, connect the facilities within those areas and for trails.

Once finalized and published in the Federal Register they will only apply to federal agencies, under the Architectural Barriers Act. They will not apply to those under ADA (state and local government and private businesses and organizations that are open to the public). Sometime in future years the same **ODAAG** guidelines will likely move forward and be adopted under the ADA.

The **ODAAG** is a good “best practice” - keeping in mind its goal is to maximize accessibility without changing the setting.

<sup>40</sup> Ibid



**French Creek State Park**  
Accessible Trail

Photo Credit: PA DCNR



ODAAG is very similar to the US Forest Service accessibility guidelines that are legally required to be used on National Forest System lands. These guidelines include the *Forest Service Outdoor Recreation Accessibility Guidelines*<sup>41</sup> (FSORAG), available [HERE](#), and the *Forest Service Trail Accessibility Guidelines*<sup>42</sup> (FSTAG), available [HERE](#). Further, the FHWA Recreational Trails program strongly supports integrating accessibility into new trails. For more information visit [HERE](#). The trail accessibility guidelines only apply to trails that meet all three of the following criteria:

1. New (no trail there before) or altered (there is a change in the purpose for which the trail was originally designed and built)

and

2. It has a Federal Trails Data Standard of Hiker/Pedestrian (it is being constructed around the parameters for pedestrian hiking)

and

3. It connects directly to the trailhead or to a trail that currently substantially meets the trail accessibility guidelines.

Only if the trail meets all three of the above criteria do the trail accessibility guidelines apply.

#### Conditions for Departure and Exceptions from the Draft Final Accessibility Guidelines for Outdoor Developed Areas<sup>43</sup>

Compliance will not always result in facilities accessible to all persons with disabilities. Therefore the guidelines recognize this by providing four conditions for departures from the required technical provisions. The Access Board permits departures from certain technical provisions where at least one of four conditions is present for trails, picnic and camping facilities, and beaches.

The four conditions that permit departures from specific technical provisions include:

1. **Where compliance would cause substantial harm to cultural, historic, religious, or significant natural features or characteristics.**

Example: A significant natural feature such as a large rock, outcrop, tree, or water feature may interfere with trail construction or be altered to the extent that the trail could not be made accessible. This includes areas protected under federal or state laws, such as areas

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<sup>41</sup> Forest Service Outdoor Recreation Accessibility Guidelines, US Forest Service: 2006

<sup>42</sup> Forest Service Trail Accessibility Guidelines, US Forest Service: 2006

<sup>43</sup> Draft Final Accessibility Guidelines for Outdoor Developed Areas, US Access Board: 2009





with threatened or endangered species or designated wetlands that could be threatened or destroyed by full compliance with the technical provisions. It also includes areas where compliance would, directly or indirectly, harm natural habitat or vegetation.

2. **Where compliance would substantially alter the nature of the setting, the purpose of the facility, or portion of the facility.**

Examples: A trail intended to offer a rugged experience such as a cross-country training trail with a steep grade or a challenge course with abrupt and severe changes in level. If these types of trails are constructed to comply with the technical provisions for accessible trails, they cannot provide the intended and desired level of challenge and difficulty for users.

Trails that traverse over boulders and rocky outcrops are another example. The purpose of such a trail is to provide people with the opportunity to climb the rocks. To remove the obstacles along the way or reroute the trail around the rocks would destroy the purpose of the trail. The “nature of the setting” may also be compromised by actions such as widening for the construction of imported surfaces on a remote trail or removing ground vegetation in meadows or alpine areas.

3. **Where compliance would require construction methods or materials that are prohibited by federal, state, or local regulations or statutes.**

Example: Federally designated and some state-designated Wilderness Areas prohibit use of mechanized equipment. Imported materials may be prohibited in order to maintain the integrity of the natural ecosystem. For traditional, historic, or other reasons, many trails are built using only the native soil for surfacing and may not be firm or stable. Some constructed water crossings, which would be needed to provide accessibility, are not permitted under certain laws or regulations.

4. **Where compliance would not be feasible due to terrain or prevailing construction practices.**

Example: Complying with the technical provisions, particularly running slope, in areas of steep terrain may need extensive cuts or fills that would be difficult to construct and maintain, or cause drainage and erosion problems. Also, in order to construct a trail on some steep slopes the trail may become significantly longer, causing a much greater impact on the environment. Certain soils are highly susceptible to erosion. Other soils expand and contract with water content. If compliance requires techniques that conflict with natural



drainage or existing soil, the trail would be difficult if not impossible to maintain.

This condition may also apply where construction methods for particularly difficult terrain or an obstacle would require the use of equipment other than that typically used throughout the length of the trail. One example is requiring the use of a bulldozer to remove a rock outcropping when hand tools are otherwise used.

These conditions for departure do not provide an overall exemption of the entire trail. When the condition for departure no longer exists, the technical provisions are applicable.

These conditions for departures are consistent with the conditions for departure specified in ADAAG and the ADA as well. Example: It may be impracticable in new construction to follow ADAAG where soil and terrain pose obstacles that cannot be remedied. Compliance with the provision for a firm and stable surface might conflict with the prevailing construction practices by requiring the use of a new surfacing material. If the prevailing construction practices do not include importing new surface material and the natural surface material is not firm and stable, the trail may not comply with that specific provision.

The term “not feasible” specifies what is “reasonably do-able.” It does not refer to the feasibility or possibility of full compliance with the technical provisions. For example, it may be feasible to provide a trail with a 1:20 slope or less up a 1,500 foot tall mountain using heavy construction equipment, but the trail would be at least 5.8 miles long, rather than 2 miles long under a traditional backcountry layout. Further, although feasible, the longer route may cause inappropriate environmental and visual impacts. The intent of this conditional departure is to recognize that the effort and resources needed to comply would be disproportionately high relative to the level of access created. Although technically feasible, the effort and resources needed are not “reasonable.” Therefore, this can be classified as an acceptable condition for departure.

Further, trail construction practices vary greatly, from the use of volunteer labor and hand tools, to professional construction with mechanized equipment. For alterations to an existing trail, the prevailing construction practices are defined as the methods typically used for construction or maintenance of the trail. For new trails, the land manager determines the construction practices employed on each trail. However, this choice of construction practice is primarily determined by the available resources (e.g. machinery, skilled operators, finances) and the environmental conditions (e.g., soil type and depth, vegetation, natural slope). The intent of this conditional departure is to ensure that compliance with the technical provisions does not require the use of construction practices that are beyond



the skills and resources of the trail building organization. It is not intended to automatically exempt an organization from the technical provisions simply because of a particular construction practice, (e.g. the use of hand tools or to suggest that hand tools should be used to avoid compliance) when more expedient methods and resources are available.

An accessible trail meets the technical provisions included within the guidelines. A trail is also accessible where one of the exceptions within the technical provisions addresses a specific condition. This is limited to certain exceptions and does not include those that allow for departure from the entire provision.

*ODAAG*<sup>44</sup> recommends that when specifying new signs at trailheads and on newly constructed or altered trails, designers include signs that provide the following information related to each trail:

1. Length of the trail or trail segment
2. Surface type
3. Typical and minimum tread width
4. Typical and maximum running slope and
5. Typical and maximum cross slope

These signs allow users to determine whether a particular trail is accessible to them at any given time given their abilities.

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44 Draft Final Accessibility Guidelines for Outdoor Developed Areas, U.S. Access Board: 2009





**Tiadaghton Hike**  
Lycoming County

Photo Credit: PA DCNR



# Design Requirements for Sustainable Trails

Once you have completed the initial planning, and before proceeding with construction, you need to establish the details of the design. The design process builds upon the work completed during the planning phase and results in defining the specific locations, details, and specifications that will guide the construction of the trail. Further, you must consider requirements for designing sustainable trails, trail amenities, and support facilities. These requirements apply to all trail types. When designing trails, you must also consider and address the requirements of all applicable permits as discussed in Chapter 1 - Planning.

With an understanding of the site gained during the planning process, your designer refines the trail alignment based on the trail's design requirements, users' needs, and sustainable design practices. The design requirements for your trail are based on the uses you desire to accommodate.

Your ultimate goal during the design phase is to develop plans and specifications that will communicate all aspects of the design to those responsible for building trails, trail amenities, and support facilities in a sustainable manner.



**Dr. J Skills Park**  
Hardened tread  
North Park, Allegheny County

Photo Credit: Jon Pratt



**Allegrippis Trails**  
Huntingdon County

Photo Credit: Leslie Kehmeier





### Unsustainable Trails

Photo Credits:  
Steve Bloser, Director  
PSU Center for Dirt & Gravel Road  
Studies





## Design Requirements for Sustainable Trails

To be successful, a trail must be designed to be physically, ecologically, and economically sustainable. This includes:

- Physical Sustainability**  
 Designing trails to retain their structure and form over years of use and under forces of humans and nature is a key factor in sustainability. Trail use promotes change, so trails must be designed in anticipation of change to ensure that they remain physically stable with appropriate maintenance and management.
- Ecological Sustainability**  
 Minimizing the ecological impacts of trails, and protecting sensitive natural and cultural resources is fundamental in sustainable trail design and development.
- Economic Sustainability**  
 For any trail to be sustainable, the implementing agency or advocacy group must have the capacity to economically support it over its life cycle. Developing and committing to a long-term maintenance strategy is a critical aspect of a successful trail program.

### *How Does this Translate on the Ground?*

While there are many factors that can influence the sustainability of trails, when you design them, they should achieve the following objectives.

#### *Connect Positive, and Avoid Negative, Control Points*

Sustainable trails lead users to desired destinations such as water features, historic sites, vistas, interesting landforms and user facilities; while avoiding wet areas, steep slopes, critical habitats, and other culturally or environmentally sensitive areas.

#### *Keep Water Off the Trail*

Erosion is the number one problem for sustainable trails. It damages trails, is expensive to repair and diminishes the user experiences. Water is the primary erosive force. Trails that collect water or channel water will be both environmentally and economically un-sustainable.

#### *Follow Natural Contours*

Trails lie on the land in three ways: 1) Fall Line Trail - along a fall-line, parallel with the direction of the slope, 2) Flat Trail - on flat ground with little slope or cross slope, and 3) Contour Trail - along the contour with subtle elevation changes. Of these types of trails, only the contour trail easily sheds water and is thus sustainable.



**Elk State Forest**  
 Shared-Use Trail  
 Cameron County

Photo Credit: Pashek Associates



**Hillside Before Trail**

Vegetation stabilizes the slope, slows down stormwater runoff, thereby preventing erosion.



**Wintergreen Gorge**  
Braided Trail  
Erie County

Photo Credit: Pashek Associates

### *Keep Users on the Trail*

When users leave the trail tread, they widen it, create braided trails, and create social trails. These can cause environmental damage and raise maintenance costs. Users leave the trail when it becomes eroded or wet, or when the trail does not meet their needs or expectations.

Ultimately, a sustainable trail design will most often be a contour trail that connects desired control points by contouring along the sides of slopes while making subtle changes in grade.

Upon establishing your Trail Management Objectives (see Chapter 5 – Management) and referring to the user characteristics and design requirements for the respective trail type (as detailed in Chapter 2 - Design Requirements for Specific Trail Users), you are ready to begin the design of your trail.

Important considerations in sustainable trail design include:

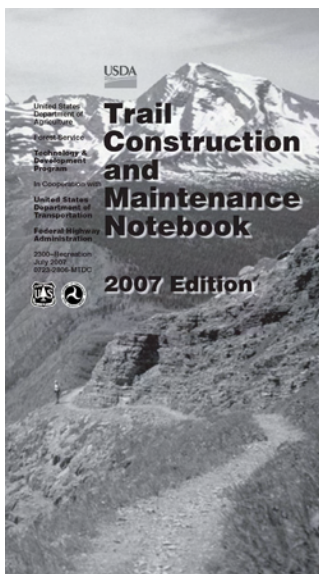
- Trail Corridor
- Tread Design
- Tread Drainage
- Changes in Trail Grade
- Drainage Solutions
- Tread Reinforcement & Trail Structures
- Trailhead Design
- Signage and Markings
- Trail Gates and Barriers
- Bridges
- Landscaping with Native Plants

Each of these considerations are described in this Chapter.

### **Trail Corridor<sup>1</sup>**

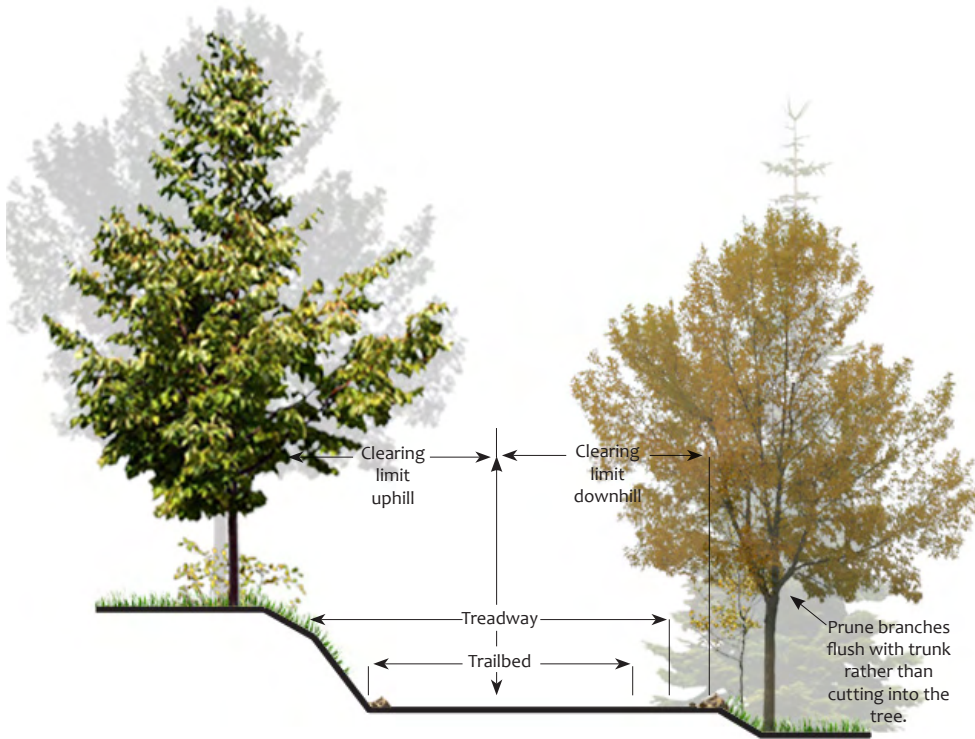
The trail corridor is the area that your trail will pass through. The trail corridor includes the trail's tread and the area above, below, and to the sides of the tread. Trail standards typically define the edges of the trail corridor as the clearing limits. Vegetation is trimmed back, and obstacles, such as boulders, fallen trees, and branches, are removed from the trail corridor to make it possible to walk or ride on the tread.

The dimensions for the trail tread, shoulders, upper clearing limits, lower clearing limits, and the clearing height are determined by the needs of the target users and the level of difficulty established for the trail.



**Trail Construction and Maintenance Notebook**  
U.S. Forest Service

<sup>1</sup> Trail Construction and Maintenance Notebook, U.S. Forest Service: 2007



Typical Trail Corridor Elevation

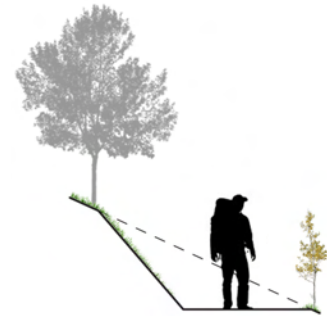
## Tread Design

After clearing the trail corridor, clear the treadway of organic material and then shape into a slightly outsloped walking surface. In most cases your work will occur on a slope, so excavation will occur across the side of a hill. A “sidehill” trail has a near level, slightly outsloping bench for the trail surface. In many cases this type of design allows for trail construction to occur without manmade structures. There are two ways to build a sidehill trail: full bench and partial bench.

### Full Bench Trail Tread<sup>2</sup>

A full bench trail tread has its entire width excavated into the hillside. Trail designers generally prefer a full bench tread for most trails, especially on steeper terrain with poor soils. The steeper the side slope, the closer the construction will resemble a full bench.

Use full bench tread construction where possible. If not possible, construct a partial bench tread and reinforce it with a retaining wall on the downslope side of the fill, if necessary. Typically it is more costly and time consuming to construct a partial bench tread as compared to constructing a full bench tread.



### Full Bench Cut

Entire tread width is cut into firm mineral soil. Tread compacts uniformly and is sustainable. 5% outslope ensures water sheets across tread. Back cut is blended into back slope. Proper back slope, out slope, and full bench cut minimize maintenance.



### Incomplete Full Bench

Left with unfinished vertical back cut, soil will slough off, making tread narrower. Obtrusive back cut also forces rider to outside of tread.



### Partial Bench

Relatively easy to construct, but fill soil may collapse and creep downslope, requiring excessive maintenance.



### Partial Bench with Cribwall

In some cases, tread must be supported by a cribwall. Wall holds fill soil in place and tread is outsloped over top of wall.





### *Partial Bench Trail Tread<sup>3</sup>*

Partial bench construction is when part of the tread is excavated and the soil that is removed is placed on the lower edge of the trail corridor to fill and build up the tread. The fill should make up no more than half of the tread width. Remove all organic material from the tread to mineral soil and place organic soil on the outside of the bench.

Common failures resulting from improper construction of trail treads include:

- Fill material slipping downhill resulting in sliding of the trail.
- Fill material compacting and creating a berm on the downslope side of the trail.

### **Trail Tread and Materials**

Selecting the tread surface is one of the most important decisions when designing your trail. When several different types of users will use the trail the surface material selected must meet the needs of all users.

### *Various Considerations*

#### *Loading*

Designing and selecting trail surfaces is similar to designing and selecting highway pavement sections. Consideration must be given to the loads being placed on the surface. Conduct a soils investigation to determine the load bearing capabilities of the native soil, or former railroad bed (if ballast has been removed), and the need for any special treatments. A soils investigation will also help determine whether subsurface drainage may be applicable and how freeze-thaw cycles may affect a trail. Consider using geotextile fabrics to reinforce weak sub-grades or subsoils.

While loads on trails will be much less than roadways, trail managers may require the tread design to sustain the wheel loads of occasional emergency, patrol, maintenance and other motor vehicles that may travel on or cross the trail.

When motor vehicles drive on trails, their wheels often will be at, or very near, the edges of the trail. This can cause edge damage that, in turn, will reduce the effective operating width of the trail. Therefore, when designing a trail to accommodate emergency response vehicles, construct it wide enough and with adequate edge support to accommodate vehicles. You can reinforce the edges of the tread by stabilizing the shoulders with geotextile and/or stabilizing products.

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3 Ibid



### Surface Texture

On shared use paths and rail trails, it is important to construct and maintain a smooth riding surface. Use machines to lay aggregate and asphalt pavements; use soil sterilizers where necessary to prevent vegetation from erupting through the pavement. On concrete pavements, saw cut the transverse joints necessary to control cracking, rather than tooling the joints to provide a smoother ride.

Do not sacrifice skid resistant qualities for the sake of smoothness. Users prefer a broom or burlap drag concrete finish. Where a shared use path crosses an unpaved road or driveway, pave the road or driveway a minimum of 20 feet on each side of the crossing to reduce the amount of gravel scattered onto or along the path by motor vehicles. The pavement cross section at the crossing should adequately sustain the expected loading at that location.

### Accessibility

Upon construction the tread must be stable and firm. The following table lists commonly used tread surface materials and summarizes each surface's ability to provide a firm, stable, and slip resistant surface.

#### Tread Surface Options<sup>4</sup>

| Surface Material                                    | Firmness | Stability         | Slip Resistance    |
|---|----------|-------------------|--------------------|
| Asphalt   | Firm     | Stable            | Slip Resistant     |
| Concrete, Broom finish                              | Firm     | Stable            | Slip Resistant     |
| Soil with Stabilizer                                | Firm     | Stable            | Slip Resistant     |
| Compacted Aggregate, 3/4" minus, with Stabilizer    | Firm     | Stable            | Not Slip Resistant |
| Compacted Aggregate, 3/4" minus, without Stabilizer | Firm     | Stable            | Slip Resistant     |
| Wood Planks   | Firm     | Stable            | Not Slip Resistant |
| Grass or Vegetation/Groundcover                     | Soft     | Moderately Stable | Not Slip Resistant |

### Reflectivity

When selecting the tread surface for a rail trail that will also accommodate cross-country skiing, consider constructing a compacted stone surface in lieu of asphalt. Dark asphalt surfaces absorb energy from the sun and therefore, tend to melt snow more quickly than a surface, such as compacted stone, which has a higher coefficient of reflection (albedo).

<sup>4</sup> Designing Sidewalks and Trails for Access: Part I of II, US Department of Transportation, Federal Highway Administration: 1999



Construct the trail tread on stable and compacted soils to achieve structural stability. Trail treads can be constructed from a variety of materials. Materials should be selected based on:

- User needs
- Maintenance needs
- Construction costs

### *Natural Surface Trails*

As noted in Chapter 1 – Planning, sustainable trail design begins in the planning phase and continues through the design, construction, and management of your trail. To design a natural surface trail you must have an understanding of:

- The characteristics of the soil where you will construct the trails;
- The grades of trail;
- The watershed above your trail and its impact on the trail; and,
- The trail users and how they will impact the trail tread.

### *Soil Characteristics and their Impact on Sustainability*

Soil scientists use a soil texture triangle to classify the texture of soil. Soil is comprised of sandy, silt, and clay. To determine a soil's texture, soil scientists analyze the soil's make-up to determine the percentages of sand, silt and clay.

| Soil Component | Particle Size                 |
|----------------|-------------------------------|
| Clay           | less than 0.002 mm            |
| Silt           | between 0.0002 mm and 0.05 mm |
| Sand           | 0.05 to 2 mm                  |

Components greater than 2 mm are further designated as gravel, stone, and boulders.

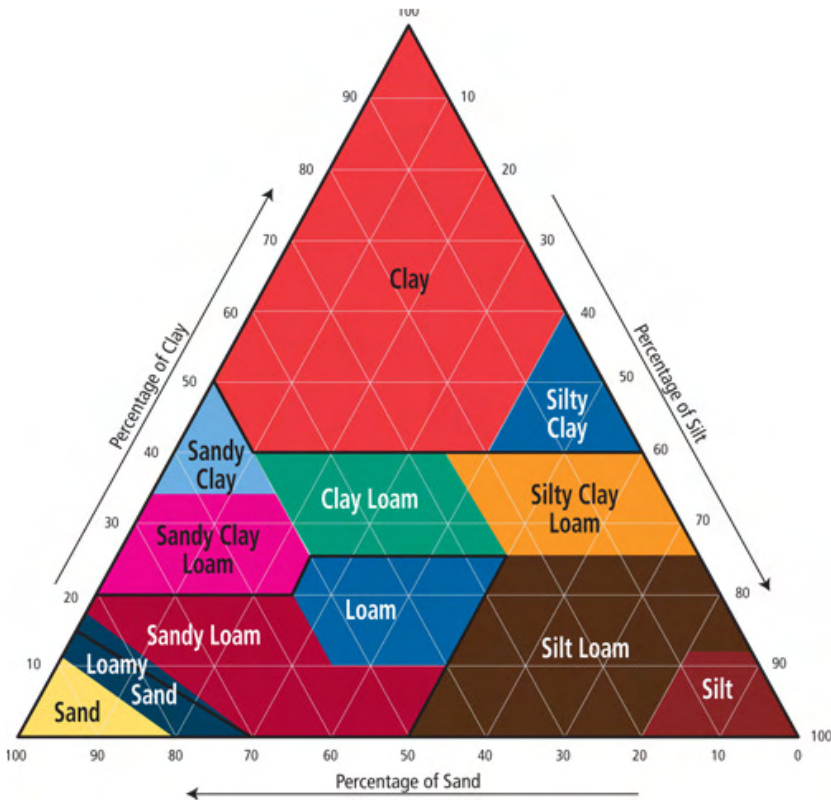
- Clay compacts easily, but holds water for long periods given the small void space between its fine particles.
- Silt drains well, can be easily compacted, and easily rutted.
- Sand has large pore spaces between particles and drains well, yet it does not compact easily.





### USDA Soil Texture Triangle<sup>5</sup>

Soils as classified according to the percentage of clay, silt, and sand that they contain by plotting the percentages of each on the USDA Soil Texture Triangle.



Soils that are a combination of silt, sand, and clay are classified as loam soils. A loam soil comprised of equal parts clay, silt, and sand provides a better natural trail surface than a trail comprised of just clay, silt, or sand.

Soil texture can be estimated in several ways:

#### By Measurement

1. Spread soil on a newspaper to dry. Remove all rocks, trash, roots, etc. and crush lumps and clods.
2. Finely pulverize the soil.
3. Fill a tall, slender jar (like a quart canning jar) 1/4 full of soil.
4. Add water until the jar is 3/4 full.
5. Add a teaspoon of non-foaming dishwasher detergent.
6. Put on a tight fitting lid and shake hard for 10 to 15 minutes. This shaking breaks apart the soil aggregates and separates the soil into individual mineral particles.
7. Set the jar where it will not be disturbed for 2-3 days.

<sup>5</sup> <http://soils.usda.gov/education/resources/lessons/texture/>

### Soils Desktop Analysis

To determine the types of soil present in your trail corridor, begin by reviewing your site on-line through the USGS' Web Soil Survey on-line [HERE](#).

Here you will find information related to soil limitations, soil stability, and many more factors important to trail designers. Once you complete the desktop analysis you must then evaluate the trail corridor's soils in the field.



8. Soil particles will settle out according to size. After 1 minute, mark on the jar the depth of the sand.
9. After 2 hours, mark on the jar the depth of the silt.
10. When the water clears mark on the jar the clay level. This typically takes 1 to 3 days, but some soils may take weeks.
11. Measure the thickness of the sand, silt, and clay layers.
  - a. Thickness of sand deposit \_\_\_\_
  - b. Thickness of silt deposit \_\_\_\_
  - c. Thickness of clay deposit \_\_\_\_
  - d. Thickness of total deposit \_\_\_\_
12. Calculate the percentage of sand, silt, and clay.
  - a. Clay thickness / total thickness = \_\_\_\_ percent clay
  - b. Silt thickness / total thickness = \_\_\_\_ percent silt
  - c. Sand thickness / total thickness = \_\_\_\_ percent sand
13. Plot the values on the soil texture triangle to determine the soil texture class.

#### By Feel

Feel test - rub some moist soil between fingers.

- Sand feels gritty.
- Silt feels smooth.
- Clays feel sticky.

Ball squeeze test – Squeeze a moistened ball of soil in the hand.

- Coarse texture soils (sand or loamy sands) break with slight pressure.
- Medium texture soils (sandy loams and silt loams) stay together but change shape easily.
- Fine textured soils (clayey or clayey loam) resist breaking.

Ribbon test – Squeeze a moistened ball of soil out between thumb and fingers.

Ribbons less than 1"

- Feels gritty = coarse texture (sandy) soil
- Not gritty feeling = medium texture soil high in silt

Ribbons 1-2"

- Feels gritty = medium texture soil
- Not gritty feeling = fine texture soil
- Ribbons greater than 2" = fine texture (clayey) soil







It is important for you to know the texture of your soils, so you can understand the limitations of the soils along your trail. Understanding these limitations will allow you to align the trail and design features to respond to these limitations.

The properties desired in soils as a base for trails include:

- Adequate strength
- Resistance to frost action
- Acceptable compression and expansion
- Adequate drainage
- Good compaction

Soils that do not exhibit all of these properties may still be suitable for trails if the missing properties can be supplied through proper construction methods. For instance, materials having good drainage characteristics are desirable, but if such materials are not available locally, adequate drainage may be obtained by diverting water away from the trail and by providing a base layer of aggregate. Another example is increasing low strengths in subgrade materials by increasing the thickness of overlying base materials or using geotextile products.

For example, a loam soil with high clay content compacts well. However, it also tends to hold water. Therefore, it is likely that sections of a trail located on relatively flat terrain will not be sustainable. This is because relatively flat terrain does not provide enough slope for positive drainage, and the high clay content of the soil does not allow the water to infiltrate into the ground.

Soils containing gravel and stones, combined with loam soils are very sustainable. Rocky areas are the most sustainable, but are difficult to traverse because there usually are transitions between rocks.

### *Compacted Aggregate Trails*

A compacted aggregate trail surface is considered to be an environmentally friendly alternative to an asphalt tread for the following reasons:

- The compacted aggregate trail has a higher rate of permeability than asphalt.
- The compacted aggregate trail has greater texture, and therefore, reduces the velocity of water run-off to a higher degree than asphalt.

In addition to the environmental incentives, a compacted aggregate trail is typically less expensive to install than an asphalt cross section. Another benefit of a compacted aggregate trail is that it provides the users with a more forgiving tread due to its resiliency under foot.



**Shaver's Creek  
Environmental Center**  
Centre County

Photo Credit: PSU Dirt & Gravel  
Road Program



A popular tread material is a compacted aggregate surface. This material can be a practical solution popular when a tread cannot be constructed from natural soils, and on trails that need to support heavy loads. Many rail trails are constructed with a compacted aggregate cross section. Over the years, many formulas have tried to achieve the perfect mix of aggregate sizes to provide a stable, firm, and high-density trail surface. The Penn State Center for Dirt and Gravel Road Studies developed, and continues to refine a Trail Surface Aggregate (TSA) specification<sup>6</sup> ideally suited for trail surfaces. For the current TSA specification visit the Center for Dirt and Gravel Roads [HERE](http://www.dirtandgravel.psu.edu/Trails/trails.html).

Properly placed and compacted TSA will meet the Americans with Disabilities Act requirements for a firm and stable trail surface.

The TSA specification allows trail surfaces to achieve very high densities that withstand traffic and erosion better than traditional aggregates. The Center designed the mix by “downsizing” its successful Driving Surface Aggregate (DSA) mix for use on roads. TSA functions as wearing surface for trails. It is different from traditional materials used to surface trails such as “number 10’s.” TSA has a uniform mixture of a range of rock sizes from 3/8-inch all the way down to fine material. This uniform mix allows excellent compaction to achieve a higher in-place aggregate density than commonly used aggregates to resist wear and erosion.

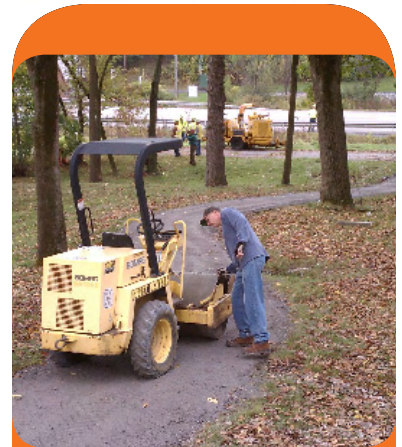
### Asphalt Tread

Sometimes trail managers prefer hard, all-weather pavement surfaces over those of crushed aggregate, sand, clay, or stabilized earth, since these unpaved surfaces provide a lower level of service. On unpaved surfaces, bicyclists and other wheeled users must use a greater effort to travel at a given speed compared to a paved surface. Some users, such as in-line skaters cannot use compacted aggregate surfaces. In areas that experience frequent or even occasional flooding or drainage problems, or have moderate or steep terrain, compacted aggregate unpaved surfaces often erode.

Asphalt has many benefits. It is a durable material for trail surfaces. It can be placed on slopes and curves and remains stable where native soils or compacted aggregate trails can erode. Asphalt provides a more durable surface than compacted aggregate, requiring less maintenance and less frequent resurfacing. An asphalt surface eliminates the concerns over dust which can be associated with compacted aggregate trails. Further, asphalt’s smooth surface is quieter, enhancing wildlife viewing experiences.

One of the drawbacks to consider is asphalt’s dark color. Asphalt trails absorb the sun rather than reflect it, resulting in a increase in the “heat island” effect. The heat that reflects off the pavement increases temperatures on and near the trail.

<sup>6</sup> <http://www.dirtandgravel.psu.edu/Trails/trails.html>



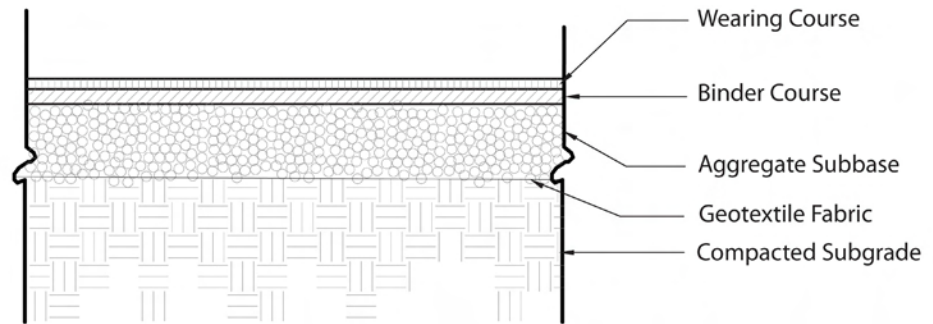
**Centre Furnace Mansion**  
Centre County

Photo Credit: PSU Dirt & Gravel Road Program



**D & L Trail**  
Lehigh County

Photo Credit: Delaware & Lehigh National Heritage Corridor



### *Asphalt Trail Tread*

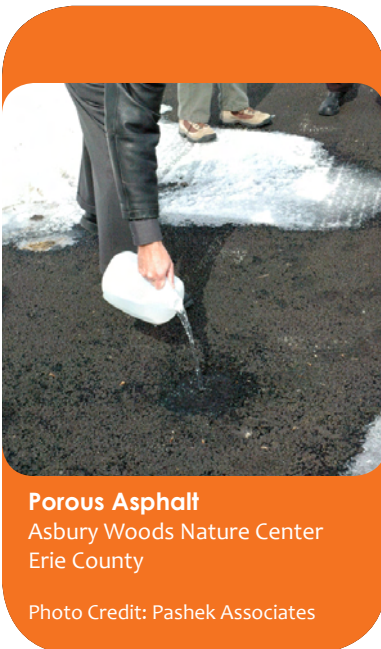
#### *Porous Asphalt Tread*

Porous asphalt is created by eliminating the smaller, graduated sizes of crushed rock and using a larger, uniform size, resulting in a rougher surface that has open voids. By maintaining pore space water will infiltrate through the tread surface instead of running off. Provided the trail's subbase has suitable infiltration rates, stormwater is conveyed through the tread and infiltrated into the ground. If the subgrade cannot provide adequate infiltration, then porous asphalt should not be used for the trail tread. Some subgrades of old railroad berms or gravel roads may be impervious, so runoff will drain to the side of the trail rather than infiltrate under the trail surface. Avoid using porous asphalt in areas that flood or where debris will clog the voids in the pavement.

#### *Concrete Tread*

Concrete is the most durable material for trail surfaces, but it is the most costly. Concrete trail treads are used in urban environments. Advantages of concrete include longer service life, reduced susceptibility to cracking and deformation from roots and weeds, and a more consistent riding surface after years of use and exposure to the elements. The joints in concrete trail treads can degrade the experience of using the path for some wheeled users. In addition, users can see pavement markings more easily on asphalt than on concrete, particularly at night. Concrete's light color on a trail reflects the sun, rather than absorbing it, resulting in a reduction in the "heat island" effect.

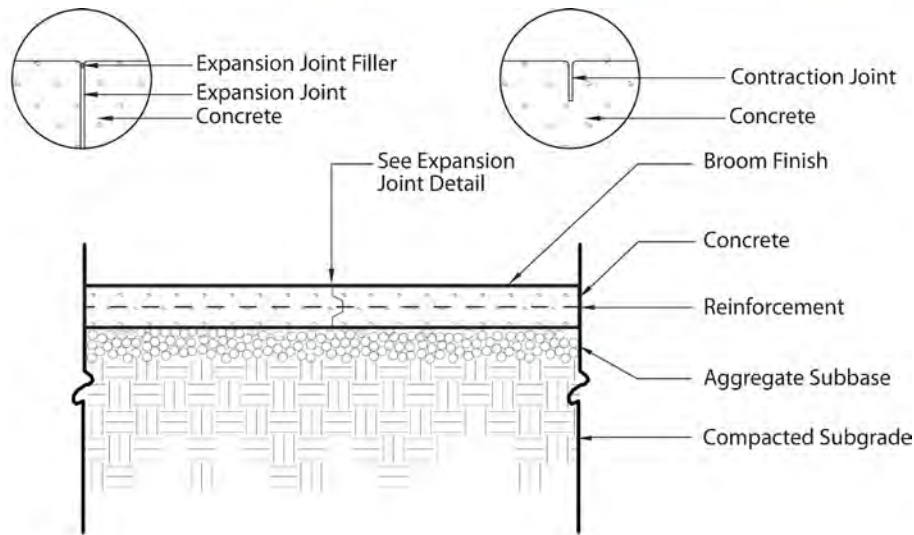
The traditional concrete mix is impermeable. Like asphalt, porous concrete mixes are also available for consideration and have the same drainage qualities and concerns of porous asphalt.



**Porous Asphalt**  
Asbury Woods Nature Center  
Erie County

Photo Credit: Pashek Associates





### Concrete Trail Tread

#### Tread Drainage

Drainage is the most important aspect of trail design, regardless of the trail tread material selected. Without sufficient drainage, a trail will require a high level of maintenance and may eventually fail. Although drainage improvements are designed on a case-by-case basis, some general rules of thumb apply.

Natural surface trails tend to catch and direct rain, as well as non-point-source runoff. When designing a trail system, it is important to consider all sources of water within the tread's immediate watershed. Some water sources may include rain or snowfall, seeps, springs, streams, ephemeral drainages, hanging or perched water tables, or floodplains.

Water typically drains on a treadway beginning at the top of the tread's immediate watershed and continues until water is directed away from the treadway. Therefore, the location of high points, such as crests, and dips in the tread further determine the length of the segment that drains between them. Since the locations of these features are not necessarily related to a site's topography, a tread's watershed size and location is flexible. Adding drainage dips, swales, waterbars, and other devices can reduce the length of drainage areas associated with the tread. The larger the drainage area and the steeper the slope above the tread, the more likely runoff will occur. A steeper slope is more likely to produce runoff.

#### Watershed Above the Trail and Its Impact on Sustainability

Water runoff is the one physical force that contributes most to erosion. When you design a trail to direct water away from or around the trail, you are reducing the amount of erosion potential along the trail.



Therefore, analyze and evaluate the watershed located above each segment of the trail to determine how to direct drainage away from the trail. A watershed is the land area that drains to a given location. Typically, this location is a body of water such as a wetland, stream, or river. Traditionally designers associate the term watershed with streams. All of the land between the ridgelines on either side of a stream is located within the stream's watershed.

In the case of trails, however, look at watersheds at a much smaller and more detailed scale. For a trail, the watershed is the amount of land above the trail between a high point above the trail, and low point along the trail.

During the planning and design phases, locate the trail to take advantage of the topography. Trails located at higher elevations typically have less watershed above them. Align the trail so undulations in the landscape can serve as drainage locations for grade reversals and dips. This type of alignment utilizes the topography to limit the maximum tread length.

Flat areas with little slope in either direction are poor locations for trails. There are fewer opportunities in flat areas to direct water away from the trail tread. Therefore, the tread becomes saturated; trail users go around the saturated areas, widening the tread, reducing vegetative cover, which in turn increases compaction and reduces infiltration. This typically results in a large mud puddle on the trail.

### *Trail Users and Their Impact on Sustainability*

The volume and type of use your trail receives will affect the sustainability of the trail. A hiking trail with steeper grades but few users can be just as sustainable as a trail with less grade but many more users. Equestrian trails with few users can be unsustainable if the trail is located on soils that cannot support the load of the horses on the trail.

Design the trail to disperse use along the length of the trail and throughout the trail network, rather than concentrate use at specific locations.

### *Runoff and Erosion*

Tree canopy, vegetative cover, and forest litter help reduce runoff and absorb rainwater. On the other hand, bare soil and rock surfaces produce more runoff and increase runoff speed. Therefore, both the amount of vegetative cover, and the amount of trail tread are important considerations. The amount of runoff will depend on the proportions of each type of materials present in the trail corridor. Without vegetative cover, heavy rainfall will dislodge fine particles and erode part of a tread. The steeper the slope of the treadway the higher the runoff velocities and therefore the greater the erosion potential of stormwater runoff.



#### **Erosion from High Velocity of Concentrated Flow**

Lower Trail, Huntingdon County

Photo Credit: PSU Dirt & Gravel Road Program



### *Weather, Climate, and Microclimate*

When planning a trail consider the location's overall climate, seasons of use, and microclimates. Always assume intense rains or rapid snowmelt will occur and design trails to sustain these events. The only way to limit runoff caused by severe precipitation is to limit a tread's drainage area. On north facing slopes and in deep ravines, trails are generally cooler and wetter. These conditions affect an area's humidity, temperature, and speed of snowmelt.

### *Tread Grade and Length*

A sustainable tread depends on its grade, length, tread texture, type, amount of use, and tread watershed factors. The steeper the tread grade, the more likely it is to erode. To prevent washouts on grades, install grade breaks into the trail alignment. Grade breaks should be integrated into the trail. The steeper the grade, the more often grade breaks are required. This further limits the continuous length of running grade on the trail reducing the tread's susceptibility to erosion. Grade breaks are described in further detail later in this Chapter.

### *Cross Slopes, Side Slopes, Swales, and Culverts*

Every part of the trail surface should pitch water at a minimum slope of 2%. Typically, a surface pitches downhill. When the trail is constructed on land with a cross slope of 30% or greater, best practices recommend crowning the trail.

Side slopes, side swales, and culverts prevent water from reaching, and direct water away from, the trail surface and provide the water with a place to drain. Design side swales and culverts to correspond with a trail's grade and width, as well as the location's uphill watershed.

1. Where side slopes of the trail are less than 5%, the trail needs no swales unless construction occurs in a wet area.
2. Where side slopes are greater than 5% and/or when side slopes extend over 25 feet in length, these conditions typically require a swale on the uphill side of the trail to collect water, pipe it beneath the trail, and outlet the flow of water to daylight. Size all pipes to adequately contain a 10 year storm event, or as required by local ordinance.
3. Where trails are constructed on an embankment, designers need not incorporate swales, assuming trail runoff drains away from the trail.
4. When trails are constructed in cut, swales are typically required on both sides and piping installed as required to drain water to daylight.
5. Where swales are required along trails, pitch the trail surface toward the swale on the high side of the trail.

Culvert crossings take the water from side swales and crowned surfaces and route the water beneath the trail surface. Each culvert crossing should have a headwall and endwall to prevent erosion at pipe openings, prevent flowing water from damaging the trail structure, and provide structural support for



**Natural Stone Endwall**

Photo Credit: PSU Dirt & Gravel Road Program





the trail. Furthermore, headwalls and endwalls increase flow capacity of the pipe by reducing turbulence and directing flow, as well as visually identifying pipe openings to protect them from traffic and maintenance equipment.

### Waterbars and Drainage Dips

Constructed waterbars and tread dips prove problematic and often need maintenance. Some of these problems include ponding water, clogging, and slow or poor drainage. The most sustainable dips, those requiring minimal maintenance, incorporate several key characteristics in their design. These include a wide outflow, sufficiently sized dip, substantial crest, quick drainage, minimal erosion, as well as resistance against tread compaction and displacement. If a trail lacks any number of these characteristics, the more likely the feature will fail. In short, when designing a trail ensure the dip's ability to handle both water and physical forces to minimize its need for maintenance. Further details concerning waterbars and dips follow later in this Chapter.

### Contour Trails

The contour trail is the most sustainable design, but how does one lay out and create contour trails so they do not collect or channel water? As described in Chapter 1, sustainable contour trails should follow five best practices<sup>7</sup>:

1. **The Half Rule:** A trail's grade should not exceed the half grade of the hillside or sideslope that the trail traverses. If grade does exceed half of the sideslope, consider it a fall line trail that will be susceptible to erosion.
2. **The Ten Percent Average Grade Guideline:** Generally, a trail with an average grade of 10 percent or less is most sustainable. This does not mean all grades must be kept less than 10 percent. Many sections of trail will have short steep sections greater than 10 percent, and some unique situations will allow average grades of more than 10 percent.
3. **Maximum Sustainable Grade Trails:** Maximum sustainable grade equals the steepest section of trail that is more than ten feet in length. When designing a trail, it is essential to determine early in the process the maximum grades the trail will be able to sustain given local conditions. Variables that impact the maximum sustainable grade include:
  - Soil Type
  - Rock
  - Annual Rainfall Amount
  - Type of Users
  - Number of Users
  - Planned Level of Difficulty



**Contour Trail**  
North Park  
Allegheny County

Photo Credit: Pashek Associates

<sup>7</sup> Trail Solutions: IMBA's Guide to Building Sweet Single Track: International Mountain Bicycling Association: 2004



4. **Grade Reversals/Dips:** A grade reversal occurs at a spot where a climbing trail levels out and then changes direction, dropping subtly for about 10 to 50 linear feet before rising again. This change in grade forces water to exit the trail at the low point before it can gain volume, velocity, and erosive power. Other names for grade reversals include dips, grade breaks, drainage dips, or rolling dips.
5. **Outslope:** As the trail contours across a hillside, the downhill or outer edge of the trail tread should typically tilt slightly down and away from the high side. This encourages water to flow across and off the trail.

When designing sustainable trails, consider the level of trail development required based upon the location, use, and other factors. Some trails will consist of a natural surface, while others will consist of more developed surfaces.

## Changes in Trail Grade

Steep changes in grade prove difficult for both trail designers and builders to tackle, especially when they occur over short distances. Climbing turns, switchbacks, and grade reversals provide unique solutions for designers to accommodate trail users on challenging terrain. It is important to locate these design features in appropriate areas to maximize both their longevity and their ability to withstand the effects of erosion.

### Trail Grades and their Impact on Sustainability

The grade of a trail also has a significant impact on the sustainability of the trail. As noted earlier steeper grades are less sustainable. Steeper grades also result in water runoff becoming concentrated in shorter distances, less water infiltration resulting in higher volumes of runoff, and water runoff flowing faster over the terrain. Each of these aspects contribute to soil erosion.

### Climbing Turns

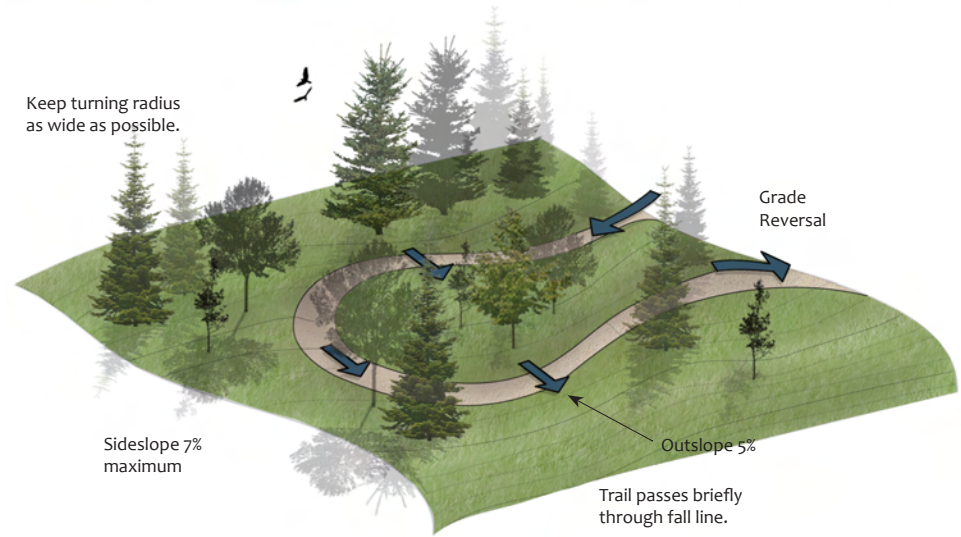
Climbing turns require trails to follow the fall line for a short segment. Therefore, in general, a climbing turn should only occur on cross slopes of no steeper than 7 to 10 percent. When constructing a climbing turn designers must locate a grade reversal just above, and after, a turn to divert water away from the fall line portion of the trail.

Constructing climbing turns on cross slopes greater than 10 percent typically results in erosion of the trail. This a common trail-building mistake.



**Climbing Turn**  
**Allegrippis Trails**  
 Huntingdon County

Credit: Leslie Kehmeier



### Climbing Turn

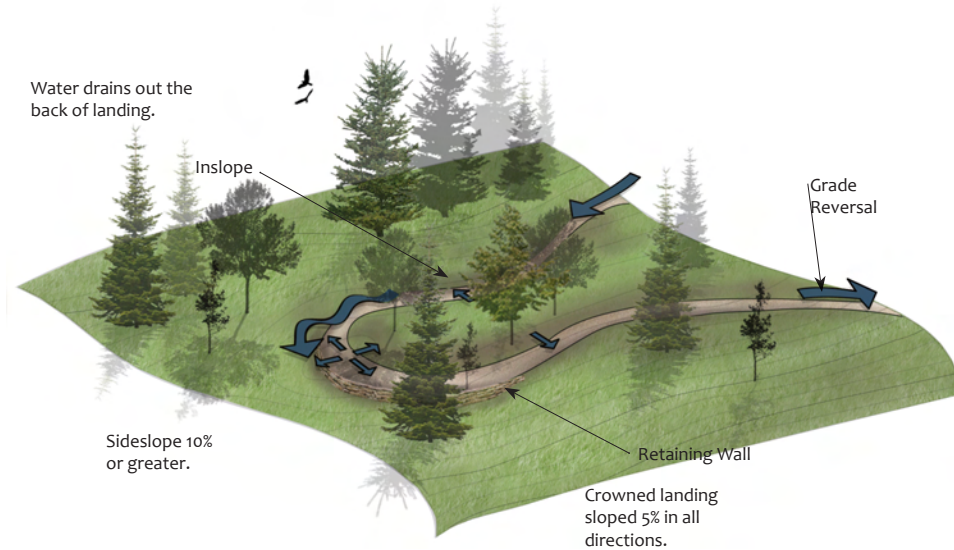
#### Switchbacks

A switchback reverses the trail's direction by constructing a relatively level landing between trail segments traveling opposite directions. They are difficult to build but are more durable on steep slopes than climbing turns, because the trail does not follow the fall line. Moreover, construct switchbacks in lieu of climbing turns when sideslopes of a climbing turn exceed 10 percent.

Key features to designing switchbacks:

1. Drain water away from all sides of the turn.
2. Crown the platform slightly so that water drains in all directions.
3. Stay on contour for both approaches.
4. Combine bench cuts and retaining walls as needed to facilitate the change in grade.
5. Carefully construct retaining walls, when required, to ensure stability.
6. Use excavated material from the top leg as backfill behind the retaining wall along the bottom leg.
7. Inslope the upper leg to direct water away from the trail.
8. Outslope the lower leg to direct water off of the trail.
9. Design approaches to control user speed.
10. Construct grade reversals at the approaches to divert water.
11. Stagger switchbacks to prevent water accumulation.

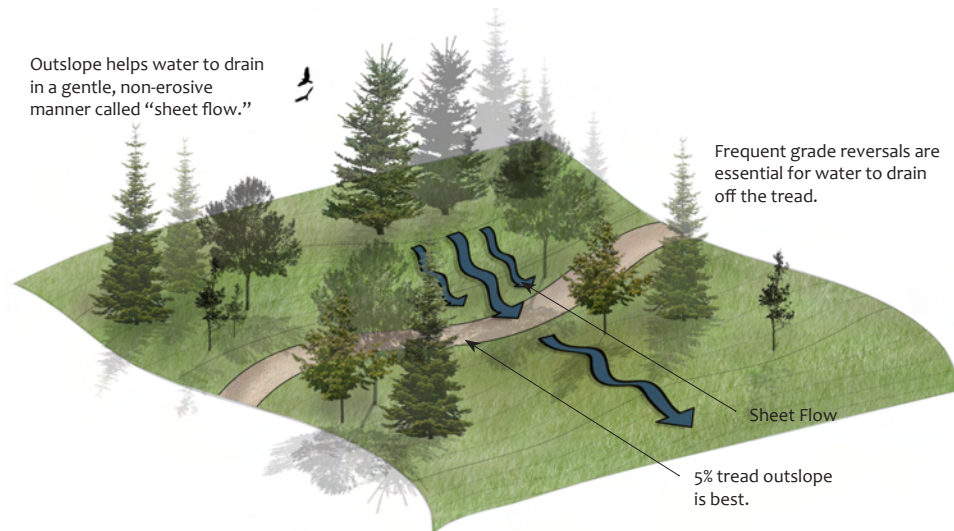




### Switchback

### Outslope

Outsloping is a method of grading the tread where the downhill edge of a trail is lower than the uphill edge of the trail to shed water. This deflection of water prevents concentration of flows that produce rilling, gullying, and rutting on trail treads. Users should barely notice the outslope which is generally between 2 and 5 percent.



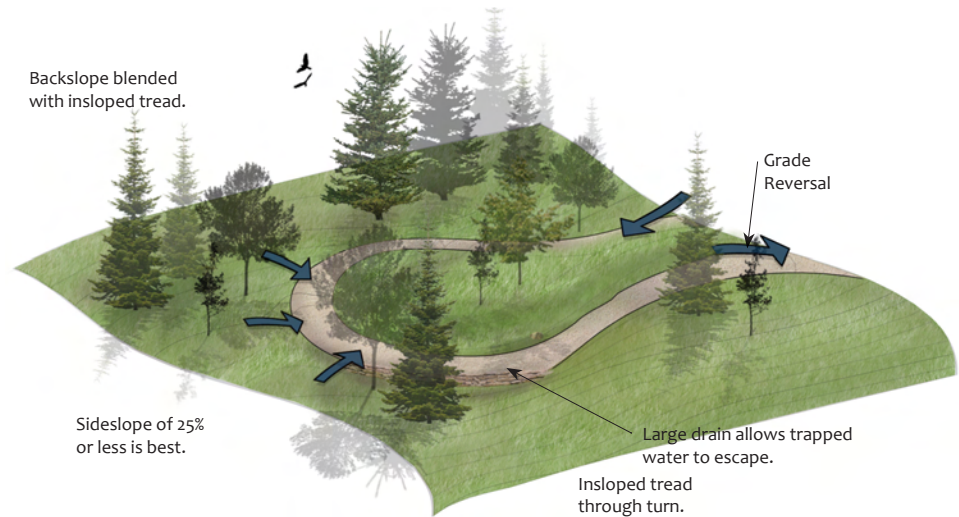
### Outslope

### Insloped Turn

Insloped turns can be constructed on either single use or shared use trails and provide a sustainable method of stabilizing turns on natural surface and compacted aggregate trails. Insloped turns reduce tread widening and



displacement that can occur on flat or outsloped turns. A 5 percent slope to the inside of the turn helps stabilize the turn. When sideslopes are steeper than 25 percent a platform and/or retaining wall may be required.



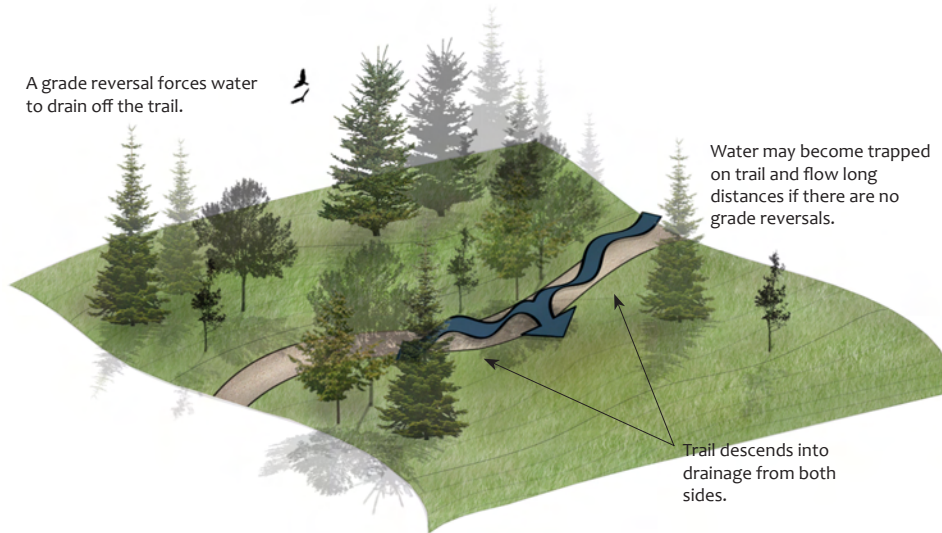
### *Insloped Turn*

## **Drainage Solutions**

Proper excavation, outsloping/insloping, and stabilization of a trail all contribute to create a stable treadway. However, even perfect construction cannot completely neutralize water's damaging effects on a trail over time. It is important to rely on contour trail construction to maximize a trail's sustainability. A well-constructed trail will incorporate a number of features into the construction of the trail to direct water away from and off of the trail. Consider installing more drainage than necessary to ensure proper water flow, in the event that one or more drainage methods fail.

## **Grade Reversals/Dips**

A grade reversal is a reverse in the trail grade, usually a short dip followed by a rise, that forces water off the trail. Grade reversals are also referred to as grade dips, drainage dips, and/or rolling grade dips. Frequent grade reversals are a critical element of sustainable trail design. Most trails will benefit from grade reversals every 20 to 50 feet, depending on soil type and rainfall.



### Grade Reversal

The table on the following page, adapted from *Natural Surface Trails By Design: Physical and Human Design Essentials of Sustainable Trails*<sup>8</sup> provides rules of thumb for maximum tread lengths for various soil textures.

These guidelines are based on the following assumptions:

1. The trail's grade does not exceed the half grade of the hillside or sideslope that the trail traverses.
2. Water reaching the trail drains along the trail to a dip.
3. The tread is well compacted.
4. Trail receives moderate use.
5. Watershed above the trail has moderate runoff potential.
6. Little to no tree canopy above the trail tread.
7. Intense rain events are limited to a few times a year.
8. There are no other contributing water sources present, i.e. high water table, spring seeps, etc.

<sup>8</sup> Natural Surface Trails by Design: Physical and Human Design Essentials of Sustainable, Enjoyable Trails, Troy Scott Parker: 2004

### Dips Are In, Bars Are Out

For existing trails with water problems, we encourage the use of rolling grade dips or knicks instead of waterbars. Here's why.

By design, water hits the waterbar and is turned. The water slows down and sediment drops in the drain.

Waterbars commonly fail when sediment fills the drain. Water tops the waterbar and continues down the tread. The waterbar becomes useless.

A good dip can be built quicker than installing a waterbar, and a rolling grade dip works better.

*USDA Trail Construction and Maintenance Notebook*





| Maximum Tread Length between Grade Reversals/Dips by Soil Texture<br><i>Rule of Thumb - based on running percentage of the trail grade</i> |      |      |      |     |     |     |     |     |     |     |
|--|------|------|------|-----|-----|-----|-----|-----|-----|-----|
| Soil Texture   | 0%   | 2%   | 4%   | 6%  | 8%  | 10% | 12% | 14% | 16% | 18% |
| Clay Loam with high quantity of gravel and stone   | 215' | 160' | 120' | 90' | 67' | 50' | 35' | 24' | 16' | 10' |
| Gravelly clay  | 180' | 132' | 96'  | 69' | 49' | 34' | 22' | 14' | X   | X   |
| Loam with high quantity of gravel and stone  | 160' | 117' | 83'  | 57' | 39' | 26' | 17' | 10' | X   | X   |
| Clay   | 145' | 104' | 74'  | 51' | 34' | 22' | 13' | X   | X   | X   |
| Loam   | 135' | 90'  | 57'  | 37' | 23' | 14' | X   | X   | X   | X   |
| Crushed stone, angular particles, 3/4" or less   | 125' | 78'  | 49'  | 30' | 17' | X   | X   | X   | X   | X   |
| Organic soil   | 110' | 68'  | 39'  | 22' | 12' | X   | X   | X   | X   | X   |
| Sand   | 100' | 55'  | 30'  | 16' | X   | X   | X   | X   | X   | X   |

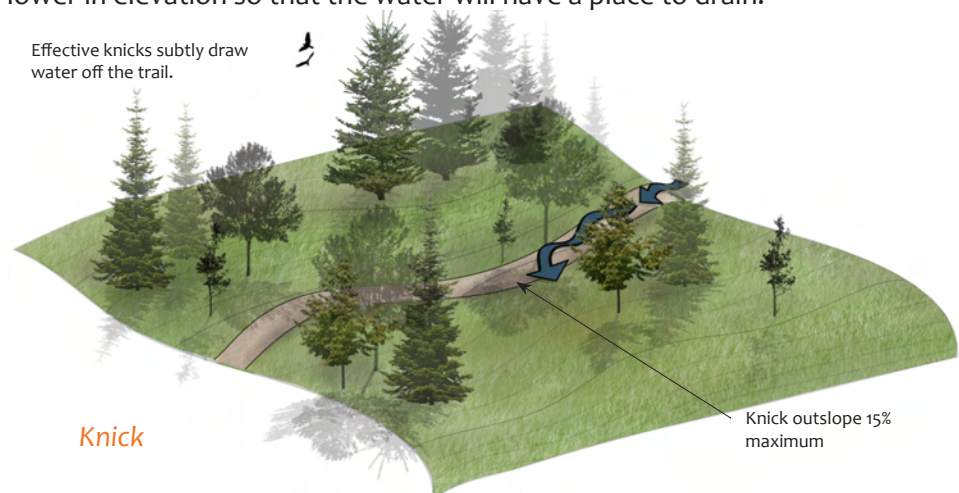
This Rule of Thumb is not only modified by soil texture, but should also be modified as required to respond to:

- Amount of stone and rock in the tread.
- Annual rainfall amount.
- Location and frequency of grade reversals and dips.
- Type of users and their impact on the tread.
- Number of users, more users = more impact to the tread.
- Desired level of difficulty for the trail.

## Knicks

Knicks are tapered, semi-circular sections of a trail that measure approximately 10 feet in diameter. Knicks are usually built on gentle, smooth sections of a trail tread where water tends to puddle. For the knick to be effective, its center must be outsloped at least 15 percent towards an area lower in elevation so that the water will have a place to drain.

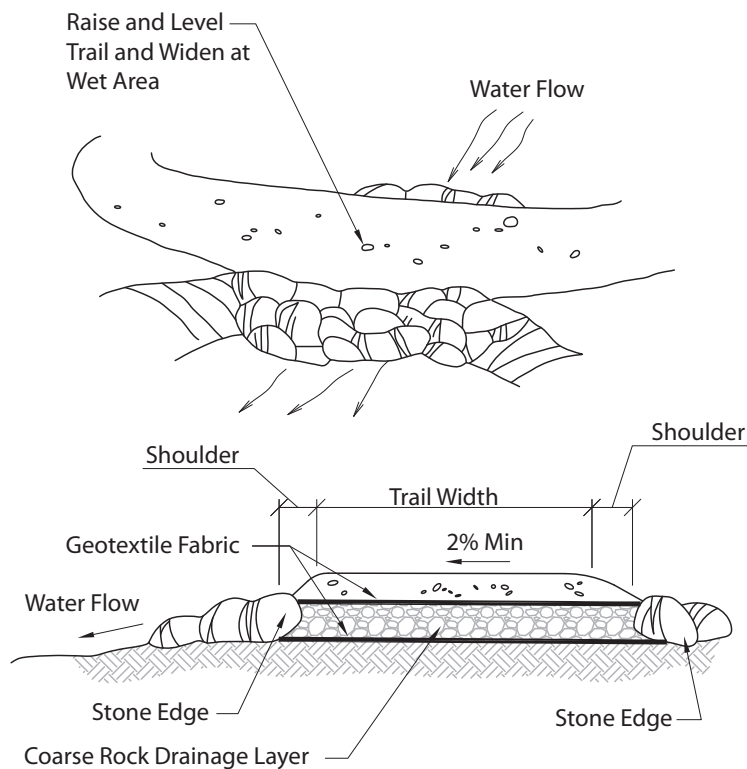
Effective knicks subtly draw water off the trail.





## Drainage Lens

Low-volume water flow caused by spring seeps or cross swales can often be managed with a drainage lens. Beginning with a firm subbase, construct the drainage lens by placing large stone and progressively smaller stone capped with fine aggregate or suitable native fill. In wet areas, placing the drainage lens between two layers of geotextile material helps to stabilize the base. Perforated pipes can be placed at the base of the drainage lens to collect water that seeps through the stone, and outlet the water to daylight.



## Drainage Lens

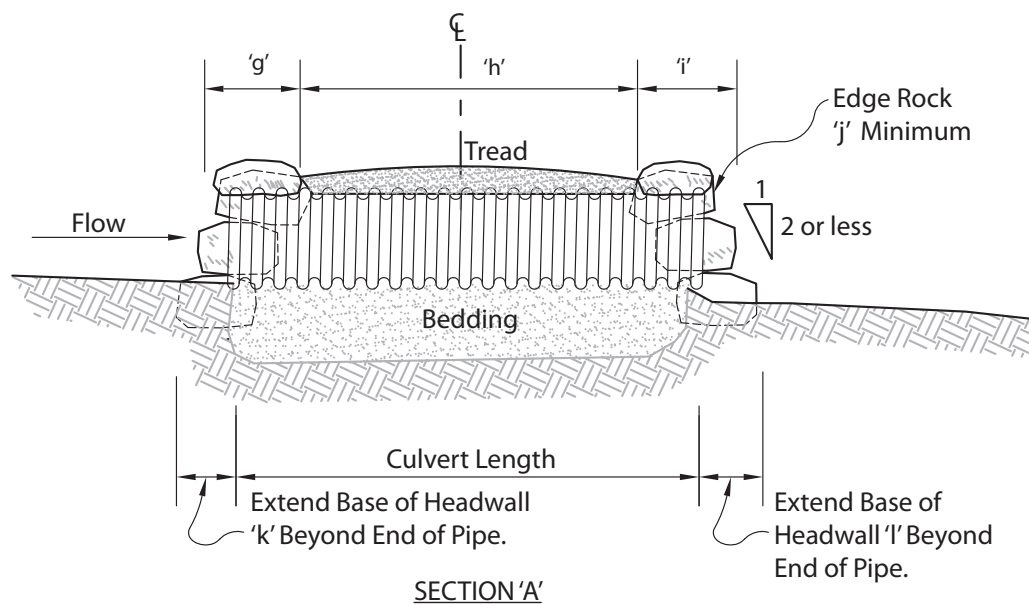
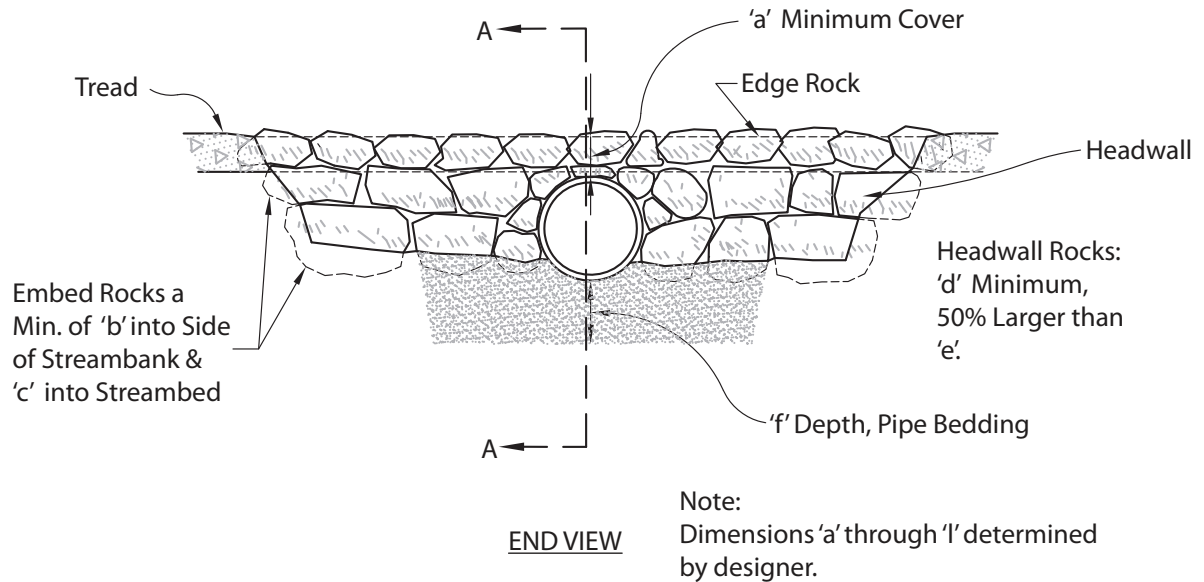
### Bleeders

Bleeders are constructed swales angled to drain water off and away from the treadway. Build them by digging a shallow dip in the tread at a slant towards the outside edge of the treadway. Bleeders work best on sidehills, especially in spots where topography, roots, and rocks naturally facilitate drainage. Bleeders often work as effective backups where drainage dips will not fit. They also work well at the apex of turns and switchback corners. However, they work poorly along straight, unobstructed graded trails where they may clog with silt.



## Culverts

Culverts are a form of drainage structure designed to convey water beneath a trail. Culverts can be constructed from natural rock, or plastic, metal, of concrete pipe. The fact that the trail tread extends across a culvert without interruption serves as an advantage over ditches and waterbars. They have relatively little visual impact on the trail, and are not easily displaced by trail users.



*Culvert with Natural Stone Head/Endwalls*





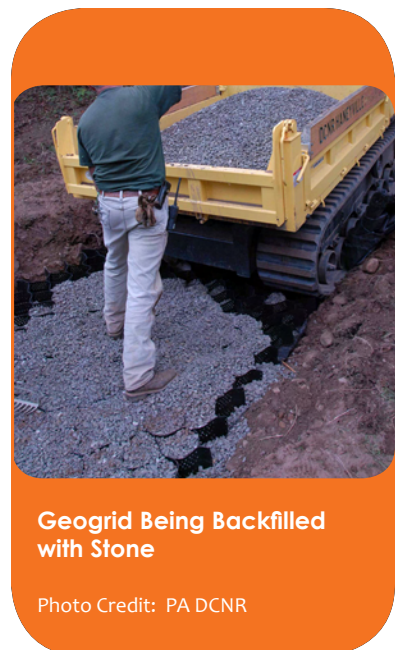
Culverts should be installed with a gentle down stream gradient of 2 percent and should be properly bedded to insure continued performance. Pipe diameters less than 12 inches may present frequent clogging and therefore are not recommended.

## Tread Reinforcement and Trail Structures

Even well designed and constructed trails may need tread reinforcement or trail structures. Since these take a lot of time and effort to construct, they should be kept to a minimum in the initial trail design. However, in any trail section where the grade is steep enough to warrant concerns about erosion, tread reinforcement or trail structures can be constructed either preventatively or as erosion issues become apparent. In some cases, tread reinforcement or trail structures are creative solutions around obstacles on certain routes.

## Geosynthetics

- **Geotextiles:** Geotextiles are fabric sheets of synthetic fibers that provide separation and reinforcement between soil and gravel surfaces. A single layer of geotextile fabric provides soil separation and encapsulates free-draining gravel that trail builders cover with a gravel drainage layer. A wrapped section, with two layers of geotextile, has more strength than the single-layer section alone. With the separation created by using geotextile fabric, the aggregate remains separated from the subgrade, providing a stronger surface that requires less gravel and resists rutting.
- **Geogrids/geocells:** Geogrids/geocells are three-dimensional, expandable panels made from high-density polyethylene, polyester or another polymer material which when backfilled with stone provide a stabilized surface. Trail builders install individual cells in an excavated section, fill with gravel, and then cover with an added layer of gravel. This confinement system reinforces and restores areas easily eroded and reduces the load stresses over a unit area. Some features or benefits of the system include increased soil strength, increased soil bearing capacity, ability to vegetate, ability to utilize local soils, as well as vertical and lateral porosity.



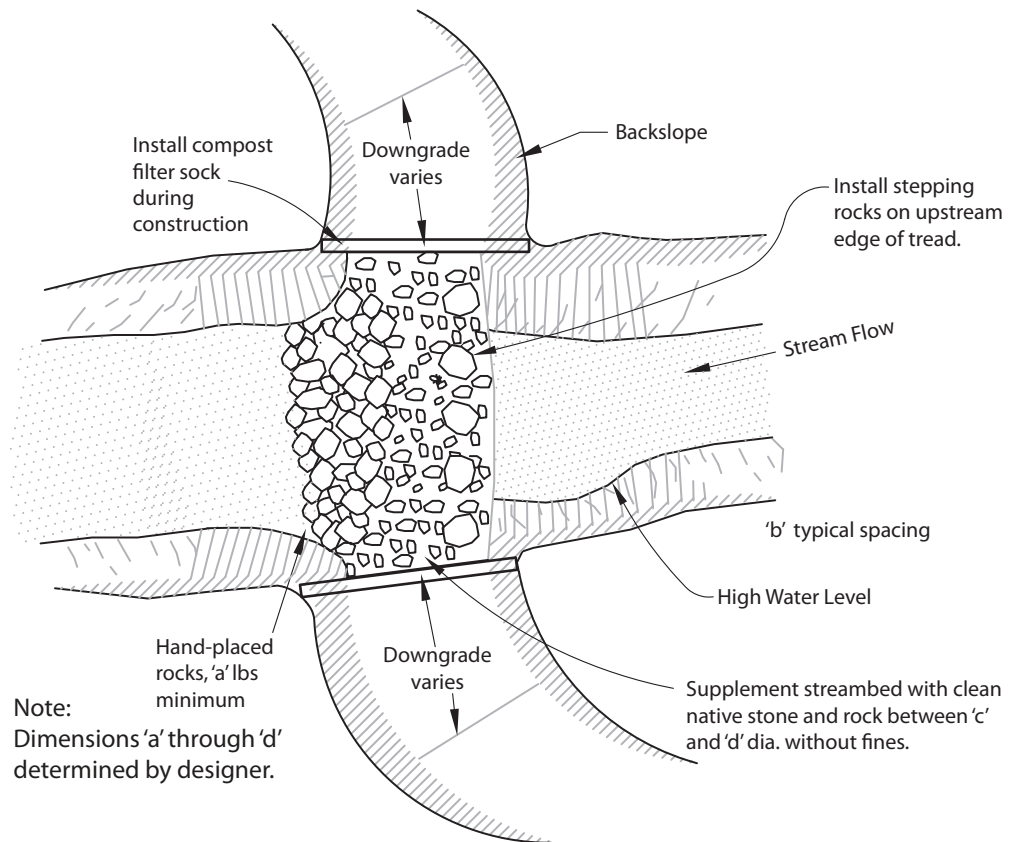
**Geogrid Being Backfilled with Stone**

Photo Credit: PA DCNR



## Armoring and Footpaths

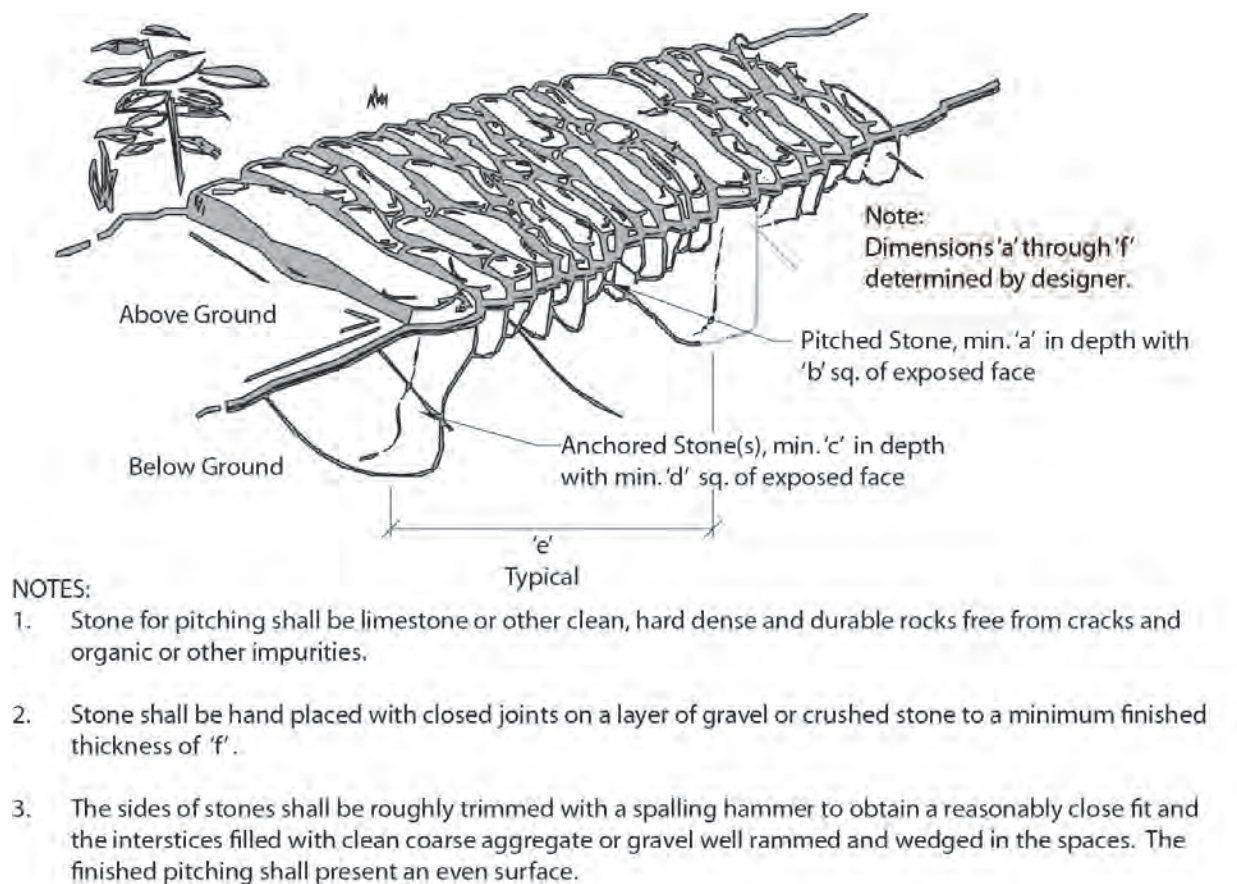
- Fords and Step Stones:** Fords are used on swifter flowing streams in upper watersheds with rocks available for step stones. Naturally occurring or secured stepping stones retain gravel at the ford and can provide an interesting way for hikers, mountain bikers, and equestrians to navigate a small stream. When fords are not sufficient or need to be augmented, use step stones.



## Shallow Ford Crossing



- **Stone Pitching:** Stone pitching is used to create an elevated trail tread above soft terrain when no alternate route is available. Stone pitching provides a durable solution for hardening a section of a trail.



### Stone Pitching

### Retaining Walls

- **Cribbing/Rock Walls:** Rock and log cribbing, sometimes called retaining walls, support the treadway along steep side slopes. In areas difficult to drain, installing trail cribbing will allow regular drainage to occur. On steep sidehill cuts, cribbing stabilizes the upper or lower slopes along the trail. Rock cribbing functions as the most durable and aesthetically pleasing technique; however, designers may use logs to achieve the same effect.
- **Gabion Walls:** Gabion walls are retaining walls made of rectangular containers fabricated of thick, galvanized wire. They are filled with stone and stacked on one another, usually in tiers that step back with the slope, to stabilize slopes against erosion. Gabion baskets can be stacked in various shapes, resist being washed away by moving water, and drain





freely. Their strength and effectiveness may increase with time as silt and vegetation fill the voids and reinforce the structure.

- **Soldier Pile Walls:** Soldier pile retaining walls provide an effective solution to addressing deep, vertical cuts in elevation. Because there is minimal soil displacement, cut and fill requirements are reduced along the trail. Wood, pre-cast concrete panels, or steel plates are used as lagging to temporarily hold back the soil. Depending on the geometry of the wall and soil conditions, builders may install tiebacks to provide lateral resistance of the soil and load.

## Trailhead Design

Locate trailheads in key locations where trail users will likely enter the trail system, at intervals that provide convenience, yet protect neighborhood privacy in urban and suburban areas. Typically, trail access points should be located at equal intervals along the trail corridor. The distance between access points is determined by the type of trail. Typically on rail trails through urban and suburban environments trail access points are located at intervals ranging between 5 and 8 miles. Access points for long distance trails, or rural trail systems are generally located further apart. Clustering of trail facilities provides for ease of maintenance, user convenience, and minimize vandalism. Be sure to locate trail access facilities in areas that are visible from adjacent roads, helping to provide basic security of the facilities.

Each access point should have enough parking to accommodate commuters or cyclists who may drive to trailheads to begin their journey. These areas should be well marked and provide a graphic map showing a trail user's location within the overall trail network.

Recommended trailhead facilities include:

- **Parking:** Consider the length of a trail, number of visitors, and proximity to population centers when determining the parking requirements for a trailhead. Also give consideration to the type of trail, and the typical vehicle used to transport persons and equipment to the trailhead. Visitors to equestrian trails need parking for their towing vehicles/trailers and prefer pull-through parking spaces when available.

Standard parking stalls can be either angled or 90 degrees to the travel lane, measuring 10' wide by 20' long or as established by local zoning. AASHTO states that the minimum inside turning radius of a car is about 6 1/2' and the maximum outside turning radius is 25'. Travel lanes in a one-way parking lot should be a minimum of 12' wide, and 24' wide when designed as a two-way lane.

Specialized parking areas for tow vehicle and trailer combinations are typically between 18 to 28' wide and between 55' to 78' long.



**Ernst Trail**  
Crawford County

Photo Credit: Pashek Associates



- **Loading/Unloading:** Where horses are permitted provide loading and unloading areas for the horses. These areas should measure about 20' wide by 55 to 78' long and should be separate from other areas of the parking lot.
- **ADA Accessibility:** The 2010 ADA Standards for Accessible Design, available [HERE](#), establishes the design requirements to provide accessibility for individuals with disabilities as classified under the ADA. The ADAAG outlines requirements for the number and size of parking stalls and access isles, as well as ground surface conditions and slopes for the parking areas. At least one accessible route must be provided from accessible parking stalls to all accessible facilities. Further, the parking area must have a stable and firm surface. The minimum ratio of accessible parking spaces to standard parking spaces is one accessible parking space for every 25 spaces.
- **Bicycle Rack:** Choose a bicycle rack based on its ability to secure a bicycle while protecting it from vandalism. In addition, consider any potential damage that a bicycle may incur while it is in the rack. The preferred style of rack are those that secure the bike in two locations on the bicycle frame. Traditional bicycle racks, like the comb or toast racks, are also known as wheel benders because of the ease with which one can damage the bicycle by bending the rim. Where an aisle separates the bike racks a minimum width of 48 inches should be provided. Bike racks can be custom designed and fabricated to reflect local heritage or a local theme. The American Association of Pedestrian and Bicycle Professionals' *Bicycle Parking Guidelines*<sup>9</sup>, available [HERE](#), provides recommendations for choosing bicycle racks.
- **Air Station:** For the convenience of bicyclists consider providing an air station in urban and suburban locations, when and where restroom facilities are located, when feasible.
- **Security Lighting:** Limit trail to daylight hours unless the trail manager intends to light the trail corridor. Where feasible, provide at least one dawn-to-dusk security light at each trail access point. If electric service is not available, solar panels can be utilized to generate the electricity necessary for security lighting.
- **Drinking Water:** Select a cost effective frost-free design to provide a water source at all trailheads. Drinking fountains that include a pet fountain are desirable at trailheads when dog walking is a popular trail use. Where municipal water is not available, consider providing a well and hand pump with a water purification system. In these instances trail managers must have the staff and financial resources available to test the water supply for public use.

#### Characteristics of a Good Bike Rack

- Do not bend wheels or damage other bicycle parts.
- Accommodate high security U-shaped bicycle locks.
- Accommodate locks securing frame and both wheels.
- Do not impede or interfere with pedestrian traffic flow.
- Are easily accessed from the street and protected from motor vehicles.
- Are visible to promote usage and enhance security.
- Are covered in locations where users will leave their bikes for a long time.
- Have as few moving parts as possible.

9 Bicycle Parking Guidelines, Association of Pedestrian and Bicycle Professionals



- **Toilets:** Toilets are a necessary amenity and should be provided at trailheads when feasible. Construct restrooms from materials that are in character with the surrounding setting. In urban and suburban areas construct restrooms from vandal resistant materials, and connect them to municipal sewer and water lines when available. If budget is a concern provide one unisex unit. Regardless of the arrangement, all restrooms should comply with ADA accessibility standards. In suburban and rural areas consider sealed vault toilets and composting restrooms when a municipal sanitary sewer system is not available. Use agreements with adjoining facilities can allow trail users to access existing restrooms. Many modular restrooms can be monitored and secured remotely.
- **Benches:** The location of rest opportunities is crucial to ensuring a positive trail experience. Benches should have backrests and at least one armrest to provide support as a user returns to the standing position, as required by ADA. Benches, as well as drinking fountains, bike racks, and other amenities can be funded through dedicated donations/sponsors.
- **Picnic Shelters:** Locate picnic shelters at trailheads. The minimum size of a shelter should be 20' x 28', housing 4 accessible picnic tables, to provide adequate cover from wind and rain. Consider using laminated wood beam shelters, or shelters with a similar roof truss design, as they eliminate roosting opportunities for birds and subsequently are much easier to maintain.
- **Trash and Recycling Containers:** Trash and recycling containers should be located at trail heads, where volunteers or municipal services agree to empty them at regular intervals. Use a 50 gallon drum with a removable plastic liner, as they prove the most cost efficient. The trail's logo can be painted on the container. In areas near populations of black bears, install bear-safe lids on the containers as well.
- **Trail Information Kiosk:** Information kiosks should remain functional and provide enough room for an overall trail map, as well as rules and regulations of the trail, and a map box.
- **Landscaping:** Screening along the trail provides a finished appearance to a trail, as well as protects wildlife habitat, streamside buffers, erosion control, windbreaks, and separates areas of different uses. Limit landscaping along the corridor and at trailheads to the use of native plant species. When selecting trail amenities consider an item's required maintenance, quality, affordability, and construction details. Use high quality, yet affordable items of simple design, reflective of the heritage of the area.
- **Trail Barriers:** There are many options for installing barriers along a trail corridor to limit access. They include boulders, fences, and gates. They





can be ornate and functional by corresponding to the design aesthetic/theme of an urban/suburban rail trail, or they may be purely functional, such as a gate constructed of steel tubing, to prevent motorized access to a trail corridor. Barrier types are further discussed in AASHTO’s publication titled “Guide for the Planning, Design, and Operation of Bicycle Facilities.”

## Kiosks

Kiosks introduce users to a trail. Signs and maps, as well as safety concerns are valuable to both inexperienced and experienced outdoor travelers and are typically posted at kiosks. The kiosk should provide a modest roof to eliminate glare and protect posted information from direct exposure to the elements. Maps and signs should be manufactured from weatherproof materials, designed for the intended use. Encouraging the responsible use of the outdoors conveys an important message for users, setting the stage for future generations utilizing public lands.

Well-designed information kiosks that communicate to persons of all skill levels are important for the continued enjoyment of outdoor recreation areas. It is important to have a common design for all kiosks and trail information signs along a trail corridor.

### Kiosk Design

Kiosks can range from a simple, single panel containing a limited amount of information about an area, to three or more panels describing the location in more detail. Kiosks are constructed in either an angled or linear fashion. The size of the kiosk is determined based on the amount of information to be displayed, average number of visitors, and the type of use an area receives. Trail designers generally locate multi-sided kiosks with roofs at prominent trailheads. At less-visited trailheads, single-paneled kiosks relay key points and messages.

The design and materials of a kiosk must match the character of the location, feel of the trail, and the needs of the user group to contribute to a user’s overall experience. Use materials that fit the character of the landscape and meet the expectations of the user groups. It is also important to consider the potential for vandalism or theft when designing a kiosk. Select durable materials that anchor kiosks firmly in the ground. Use vandal-proof screws and bolts to secure the structure and information panels.





**Sizerville Nature Trail**  
Kiosk, Elk State Forest  
Potter County

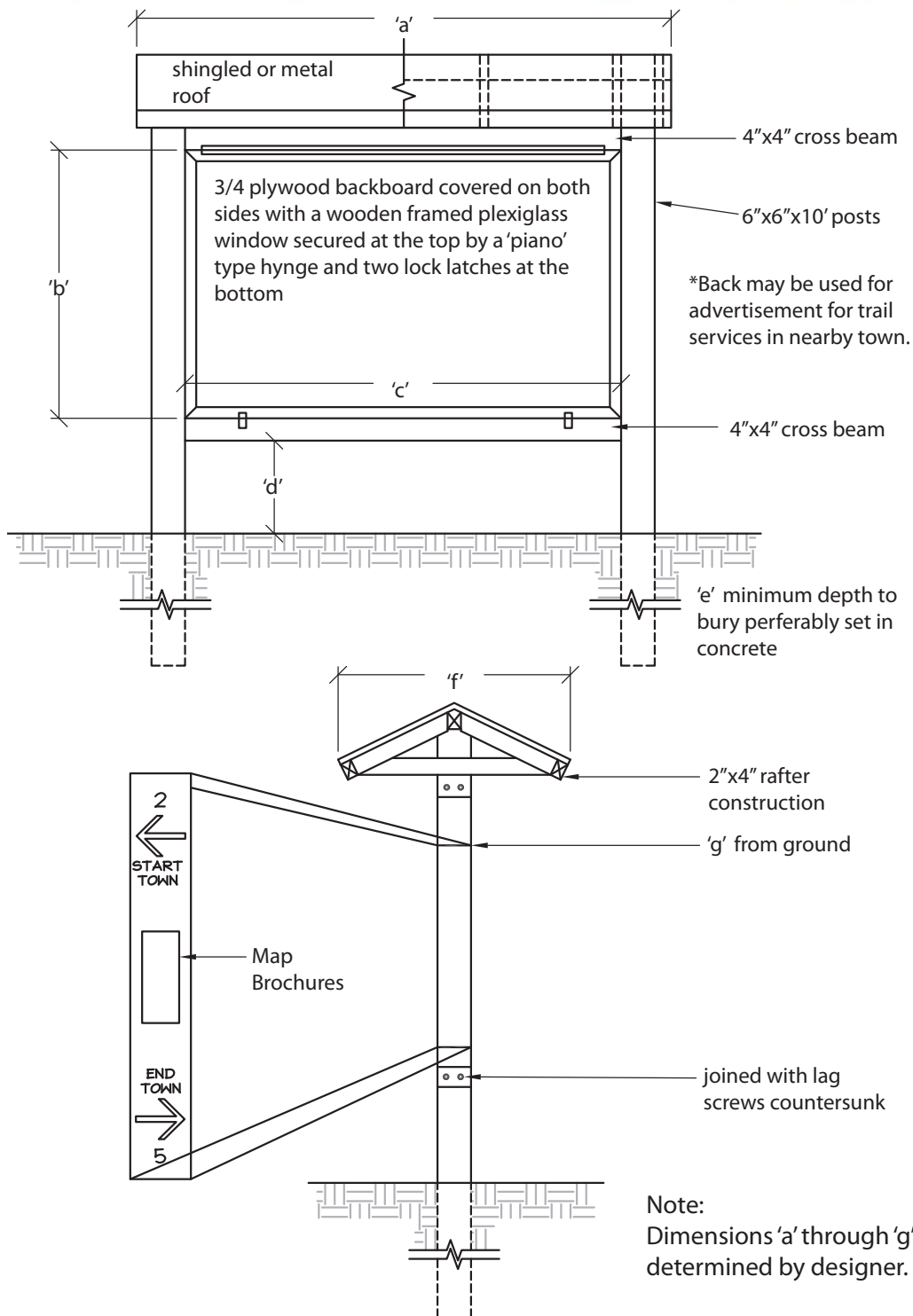
Photo Credit: PA DCNR

Place kiosks at all trailheads. Kiosks should include the following basic information:

- Trail name and logo
- Map showing the location of the trail and associated trail amenities
- Trail distance (in time and mileage)
- Trail level of difficulty and special instructions
- Trail accessibility information
- Rules of the trail
- Warnings of dangers, safety messages and trail closures
- Contact phone numbers for trail manager and emergency services
- Statement indicating the information posted reflects the conditions of the trail when it was last evaluated, events beyond the control of the trail manager can present hazards and make the trails temporarily inaccessible

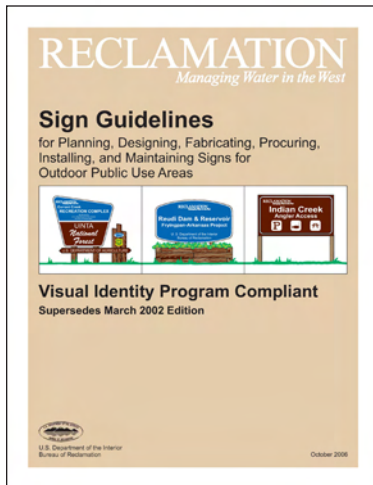
The kiosk/bulletin board trailhead sign may also include:

- Carry in/out, Leave No Trace principles that suggest ways to decrease user impact
- Hours trailhead is open, if applicable
- Trail map handouts
- Trail register
- Information about trail organization partners and/or trail care crews
- Information about how users can get involved in volunteering
- Information about agency partners
- Interpretive information
- Types of trail uses allowed
- Recognition of organizations providing volunteer services



## Kiosk





### Letter Size<sup>10</sup>

Determine the size of letters for pedestrian signs by considering the location, volume, and type of visitors using the area. If the sign is intended for people with disabilities, letter point size should comply with accessibility guidelines. To be easily read, the sign should have sufficient color contrast between letters and background.

The following rules of thumb pertain to the sign's primary message only. Letter size for a sign's secondary message will be two-thirds the height of the primary message.

1. Short messages to be read from some distance: lowercase height and thickness of arrow shaft, 2-1/2 inches.
2. Direction, distance, instructions, listings in moderate visitor use areas where pedestrian traffic is channeled by walks, etc.: lowercase height and thickness of arrow shaft, 2 inches.
3. Plaques, markers, and object identification: capital height, 1-1/2 inches; lowercase height and thickness of arrow shaft, 1 inch; 8-inch recreation symbol.
4. Description sign texts: capital height, 1 inch; lowercase height and thickness of arrow shaft, 5/8 inch; 8-inch recreation symbol.

As a rule, one inch of letter height can be read from a distance of 50 feet; 2 inches from 100 feet, and so on.

### Construction and Installation

To begin the design and construction of a kiosk, first select its location. Common topics showcased in kiosks include local history, safety information, and maps. After determining its location consider the specific placement of the kiosk. Best practices include placing kiosks at trailheads, parking areas, or campgrounds to address a trail's user group before beginning their trip on the trail. Because the area around the kiosk will receive plenty of visitors, place stable and firm materials around the kiosk.

Next, construct detailed plans and an illustrated plan to determine the style, colors, and material choices that will work best for this location. Generally, trail designers will present construction drawings for kiosks to land managers for approval before construction.

### User Education

Consider the information to be placed on the kiosk before finalizing its size and style. Since the trailhead indicates the beginning of the trail, it is important to introduce visitors to unique aspects of a location and quickly convey safety and stewardship information. Concise and interesting signs

### Basic Kiosk Information

- A map or layout of the land, including trail descriptions if appropriate.
- A short description of unique historical, wildlife, and other characteristics that define the location.
- Safety information to warn visitors of dangers and suggestions for safe travel.
- Stewardship information of how visitors can get involved.
- Carry In/Carry Out and Leave No Trace principles that suggest ways to decrease user impact.
- Information on local services; eat, sleep, fuel, etc.
- Contact information for organizations and land managers.

<sup>10</sup> Sign Guidelines for Planning, Designing, Fabricating, Procuring, Installing, and Maintaining Signs for Outdoor Public Use Areas, U.S. Department of the Interior Bureau of Reclamation: October 2006



attract the attention of all users. Incorporating artwork, photos, and maps can keep the attention of trail users. Consider what messages the kiosk will convey to users before they head out on the trail. The real challenge involves keeping the information simple, relevant, and interesting.

Trail designers and trail managers must take the time and give the consideration necessary to plan and construct a kiosk, as it will serve as a source of information for years to come. Further, the information contained at the kiosk should be regularly reviewed and updated to avoid creating any confusion on the part of the trail users.

### Trail Access Information<sup>11</sup>

Signs identifying trails and trail segments that have been officially assessed and designated as accessible to persons with disabilities should be placed at the trailhead and at all designated access points. Display the official symbol designating that the trail or trail segment is accessible, and include the total distance of the accessible trail or trail segment and the distance to the location of the first point of exception to accessible standards.

Use marker posts to display accessibility information at access points without trailhead signs. Decals are readily available to attach to marker posts.

The size of the trailhead sign should be such that both text and graphics are easily readable. The minimum size should be 12"x18". Background colors, margins, and sizes of text and images are subject to change.

### Materials for Signs, Trail/Sign Markers, and Posts

Signs can be constructed from a wide range of materials, including cast aluminum, fiberglass, phenolic resin, porcelain enamel, and vinyl on aluminum. The following is a description of common sign materials, as well as the pros and cons for each.

- **Fiberglass:** Fiberglass panels imbed a digitally produced paper graphic into the sign's surface. These signs are generally easy to maintain and clean, but have a relatively short lifespan of 5 to 8 years. Fiberglass panels will fade and become brittle over time, but are low enough in price to be replaced as needed.
- **Phenolic Resin:** Phenolic resin panels are a high-pressure laminate that encapsulates a digital paper graphic. These panels are appropriate for all locations and require waxing once every year. These colorfast panels are an excellent choice for reproducing high-resolution photographs.
- **Porcelain Enamel:** Porcelain enamel markers are made by fusing glass

<sup>11</sup> Draft Final Accessibility Guidelines for Outdoor Developed Areas, U.S. Access Board: 2009

## Mingo Creek Paved Trail

|                       |           |
|-----------------------|-----------|
| Trail Length          | 2.8 Miles |
| Trail Surface         | Asphalt   |
| Trail Width           | 10 feet   |
| Typical Running Slope | 2%        |
| Maximum Running Slope | 15%       |
| Typical Cross Slope   | 2%        |
| Maximum Cross Slope   | 5%        |

### Trail Access Information Sign

Mingo Creek Park  
Washington County

Photo Credit: PA DCNR

### Trail Accessibility Information

When available, the following additional information should be included on trailhead signs:

- Trail-specific trail symbol
- Running slope (average and maximum grade)
- Cross slope (average and maximum)
- Cumulative elevation change (gain and loss)
- Profile of the trail grade showing changes in surface type and accessibility
- Clear tread width (minimum and average)
- Tread obstacles (magnitude and frequency)
- Any major height obstacle, such as boulders, in the trail tread



**Cook Forest State Park**  
Bald Eagle Interpretive Sign

Photo Credit: Pashek Associates

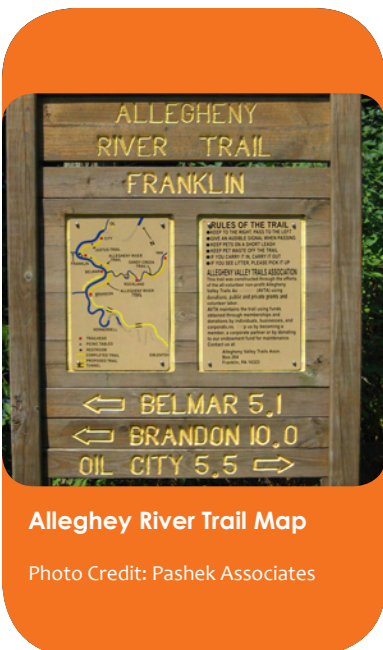
to steel. They are durable and perform well in most environments such as zoos and aquariums. However, if damaged this material will rust and cause surface stains.

- **Vinyl on Aluminum:** Commonly used for highway markers, vinyl graphics on aluminum backers are ideal for semi-permanent wayfinding signs. This type of signage looks professional and offers flexibility, minimizing season-to-season costs.
- **Cast Aluminum:** Durable and heavy, cast aluminum signs require minimal maintenance and can withstand adverse weather conditions. Unfortunately, cast aluminum signs cannot be used for color photographs.

### Fabricating the Posts and Frame

While the graphics are being produced, use the time to fabricate the posts and frames that will hold them. Plastic, wood, steel, aluminum, and steel can be used for posts and frames. The choice will depend on location of the signs, budget, and required annual maintenance.

- **Wood:** Wood signs and posts are visually appealing and the most readily available material for trail posts and frames. When choosing to use wood, select a rot-resistant form and consider using paints and sealers to protect it from the elements. Wood frames are the most easily damaged and require the most maintenance.
- **Steel:** Steel is a durable, strong material for fabricating posts and frames. However, it is prone to rusting and must be galvanized to resist corrosion.
- **Aluminum:** Aluminum frames and powder-coated finishes are more expensive at the outset but will require less maintenance over time. Furthermore, aluminum will not rust or stain when left outside and are usually half the weight of their steel counterparts.
- **Stone:** Stone is durable, but it limits the amount of information that can be carved into the sign. However, it can be a cost effective material to use if found on-site.
- **Plastics:** Plastics vary in quality and durability; therefore, it is important to research the various types before making an investment in them. Fiber-reinforced plastics are a popular choice for marking trails as they are durable and affordable.



**Allegheny River Trail Map**

Photo Credit: Pashek Associates





## Signage and Markings

These trail signing guidelines provide standardization for signs and uniformity in the use of signs. Installing trail signs assists in managing trail use, warning trail users of trail conditions or characteristics, locating the trail, and providing general information to trail users.

Standardizing the size, shape, color, and content of signs improves recognition and safety through trail user familiarity, no matter what trail users visit.

Uniformity in the application of signs remains as important as standardization of sign design and placement. Always mark identical conditions with the same type of sign, regardless of where those conditions occur. Uniformity also enhances safety and the comfort level of trail users. Designers typically classify signs into one of the following groups:

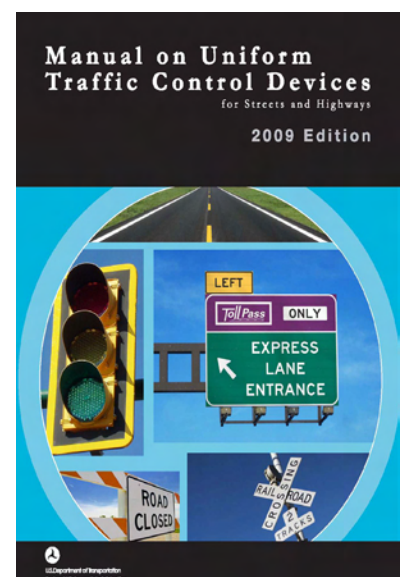
1. **Regulatory and Warning Signs:** Used when trail users must perform an action or to provide warning or caution and promote safety of users and property. Only place signs where potential conflicts are unclear, or to emphasize the significance of a potential conflict.
2. **Identifier Signs, Reassurance Blazes, and Trail Markers:** To identify the type of trail use permitted or prohibited as well as indicate the trail's level of difficulty. These signs reassure trail users that they are following the correct path and provide them with a point of reference along the trail. These signs provide a trail user with a level of comfort that adds to the enjoyment of the overall trail experience.
3. **Information Signs:** Used to indicate location, direction, and/or distance to a point of interest; wayfinding signs to direct trail users to features off the trail corridor; and interpretive signs to uncover points of interest along the trail such as cultural, historic, or environmental features.

### Regulatory and Warning Signs

The *Manual on Uniform Traffic Control Devices*<sup>12</sup> (MUTCD), available [HERE](#), is recognized as the national standard for all traffic control devices installed on any street, highway, bikeway, or private road open to public travel.

The MUTCD defines traffic control devices as all signs, signals, markings, and other devices used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, highway, pedestrian facility, bikeway, or private road open to public travel by authority of a public agency or official having jurisdiction, or, in the case of a private road, by authority of the private owner or private official having jurisdiction. Chapter Nine of the MUTCD addresses traffic control for bicycle facilities.

<sup>12</sup> Manual on Uniform Traffic Control Devices, Federal Highway Administration: 2009

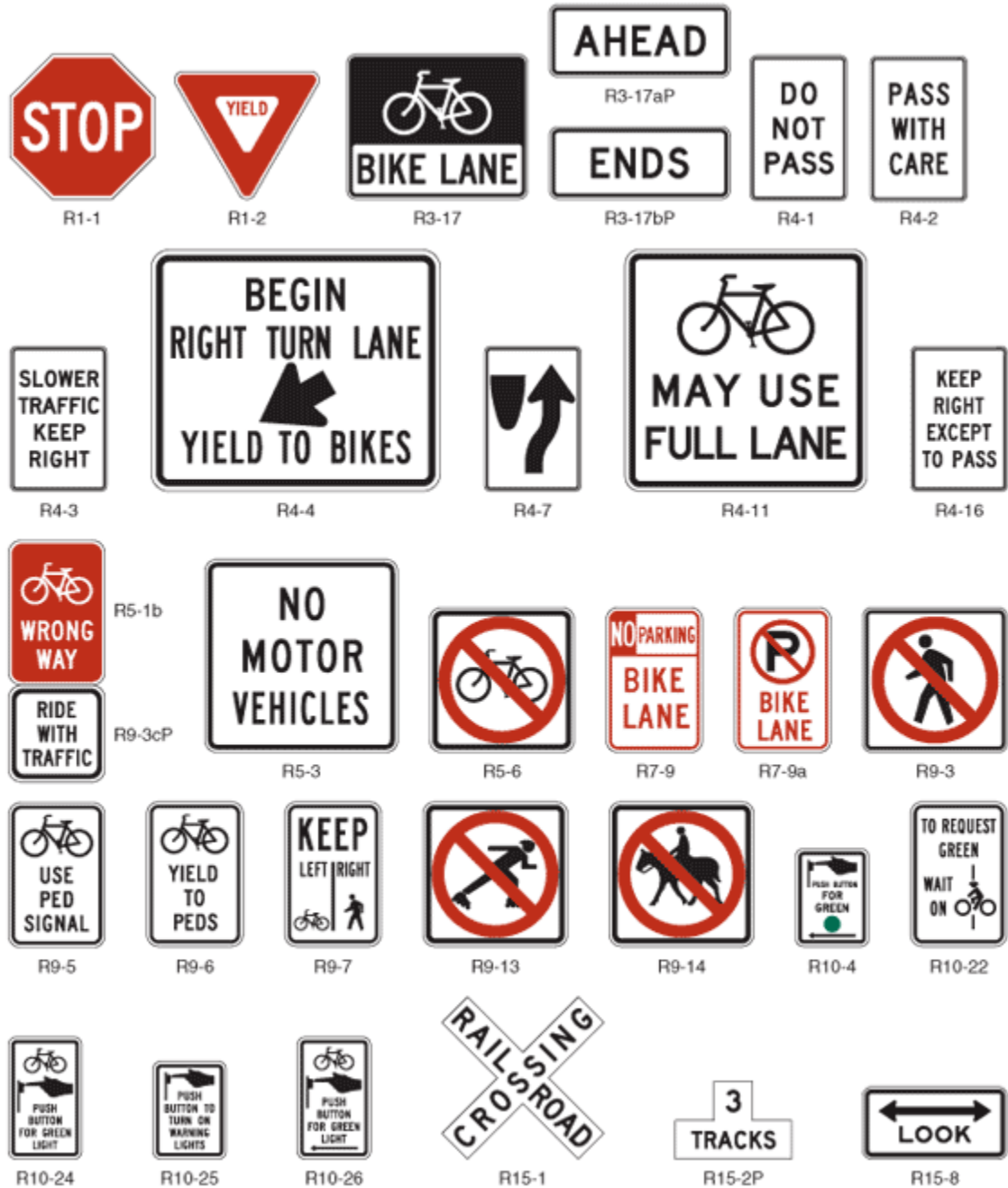


**Manual on Uniform Traffic Control Devices**  
U.S. Department of Transportation



### Common Regulatory Signs

Regulatory signs regulate movement of trail users along the trail in a safe and orderly fashion. Failure of trail users to obey these signs can lead to legal consequences.



Common Regulatory Signs, US Department of Transportation MUTCD



## Common Warning Signs

Warning signs alert trail users to hazards or conditions requiring special attention. Signs are located at a distance suitable to provide ample time for the trail user to react.



\* A fluorescent yellow-green background color may be used for this sign or plaque. The background color of the plaque should match the color of the warning sign that it supplements.

Common Warning Signs, US Department of Transportation MUTCD





## Level of Difficulty Symbols



## Identifier Symbols, Reassurance Blazes, and Trail Markers<sup>13</sup>

Identifier signs indicate the type of trail use permitted or prohibited, the trail's level of difficulty rating, the trail name or number, and the specific location along the trail. Use of these signs provides a trail user with a level of comfort and adds to the enjoyment of the overall trail experience.

### Identifier Symbols

Use recreation symbols on trailhead signs, at trail junctions and road crossings, and on maps to indicate permitted and prohibited uses of the trail.

#### Permitted Use

Hiking

Equestrian

Biking

Cross-Country Skiing

#### Symbols



Level of difficulty ratings are based on the degree of challenge a trail presents to an average user's physical ability and skill by using trail condition and route location factors such as alignment, steepness of grades, gain and loss of elevation, and natural barriers that must be crossed. The sign should note that conditions are subject to change due to weather and other factors.

### Trail Markers

The most basic trail signs are those that identify the trail. These signs may provide the name of the trail, mark the route of the trail, and include simple information, such as difficulty rating, mileage point, and symbols that show allowable uses of the trail. Where directional signs are used, identification of the trail is often incorporated into the directional sign.

Trails can be marked in many ways. Blazes can be painted on trees, stakes, or other objects, posts can be set into the ground, markers can be nailed to

<sup>13</sup> Guidelines for Marking Recreational Trails, Pennsylvania Department of Conservation and Natural Resources; 2008



trees or posts, or cairns (piles of rocks) can be carefully erected. Regardless of the method used or type of trail being marked, each specific trail should be marked clearly and consistently and the marking should conform to a standard color, shape, and size. Where trail conditions prevent the use of the standard marker, an alternative can be used.

One method to mark trails is to use colored plastic or metal markers attached to posts. Plastic markers are less expensive but may not last as long as metal markers. Markers of various colors, shapes, and sizes are useful for distinguishing between multiple trails and between different types of trails. However, it should be noted that a large number of people are unable to distinguish between different colors; therefore, trail intersections should be well-labeled using different symbols or text (on markers or signs) to signify different trails. Use markers with arrows to indicate major changes in direction along a trail.

Use distance markers to show the mileage from either end of the trail or from a designated trailhead. These types of markers can be very useful in emergency situations and for maintenance purposes. Distance markers are often placed every quarter mile, although placement at tenth-mile intervals may be preferable.

Use of distance markers is encouraged along all trails and should include a unique identifier, such as the trail name. Where distance markers are used, other methods of marking the trail are usually unnecessary. Distance markers are often embedded in a post that is placed into the ground alongside the trail using vandal resistant hardware. Alternatively, distance markers can be metal or plastic markers nailed to trees or attached to posts; however, these types of specialized markers are prone to theft. Whichever method is used, the design of distance markers should be consistent along the entire length of the trail on which they are placed.

On long distance trails, it is not cost effective or desirable to use official trail markers as the sole method of marking a trail. Other less costly, less visually obtrusive, and more vandal-resistant methods should be used between widely-spaced markers. The preferred method is to use paint blazes, typically vertical rectangles painted on trees, posts, and other objects along the trail.

### Blazes

Painted blazes along any given trail should eventually conform to a standard color, shape, and size, namely painted rectangles six inches in height and two inches in width. When painted neatly with sharp corners and clean edges, blazes remain visible to users at a distance and distinguish themselves from naturally occurring marks.

Place the blazes on trees at approximate eye height. Remember, the trail should be marked for the benefit of users traveling either way, so place

**PA DCNR's**  
***Guidelines for Marking***  
***Recreational Trails***,  
available [HERE](#), provides  
recommendations for  
marking recreational trails  
on State Forest and State  
Park lands.



**Trail Blaze**  
Mason Dixon Trail  
York County

Photo Credit: Pashek Associates



blazes facing in both directions. If you can't find a suitable tree next to the trail, paint blazes on ledges or trail side rocks. Check with and receive permission from the land manager before painting blazes.

## Keeping Blazing Primitive

### Blaze Less

- Along well-defined trail
- Along highly constructed trail in dense vegetation (example: mountain laurel or rhododendron)
- Along sharp ridgelines

### Blaze More

- At turns, both on and off roads
- Along obscure footpath
- In open forests
- In open areas

### Other points to remember:

- When choosing a blaze tree, remember that one well-placed blaze is better than several that are poorly placed or partly hidden.
- Most importantly, avoid defacing trees and rocks that form distinctive and pleasing elements of the scenery.

### Frequency

Blazing needs to be continuous, even along roads or unmistakable parts of the trail corridor. Immediately beyond any junction, paint a blaze even if there is a direction sign. Place a second "safety blaze" 50 to 100 feet beyond.

Normally, you should change blazing frequency naturally with changes in trail terrain, forest cover, or the clarity of the footpath. When the trail is conspicuous, place one blaze for every five minutes of hiking time, or about six per mile in each direction (800 to 1000 feet apart). Where you run into hard-to-follow sections, often in transitions between field, forest, balds, and other environments, blaze more frequently.

Be careful not to over blaze. Too many single and double blazes can mar the primitive character of a trail. This is a special concern in wild and natural areas, where blazing should remain minimal, or six per mile. Elsewhere, you should place blazes so that no more than one is visible in either direction. In other words, except near trail junctions, keep blazes at least 150 feet apart.

### Double Blazes

A double blaze means "caution". Place a double blaze 25 to 50 feet before abrupt turns and highway or trail junctions. Remove painted arrows, or slanted blazes, and replace them with standard double blazes. Double blazes should be placed one over the other, and about one to two inches apart. Where the double blazes are alerting a trail user to a turn, the top blaze, tree size permitting, can be offset in the direction that the trail will turn.

As with the single blaze, place the blazes sparingly. They are unnecessary at most turns in the trail, and they become unsightly and meaningless with frequent use. Only use double blazes where necessary for the safety of trail users. On switchbacks, for example, use only single blazes, but paint them near the switchback corner, one above the corner and one below. If needed, pile brush, logs, or rocks at the corner to define the trail and guide users around the turn.

Where the route remains ambiguous even with blazes, avoid the urge to paint an arrow to direct the user. The extra, nonstandard paint may hurt the trail's primitive character, detract from the trail users' sense of exploration, or set a precedent for painted arrows. Try to use small directional signs, posts, or cairns, instead.

### When Two Differently Marked Trails Share the Same Path

Sometimes two or more trails briefly share the same path or corridor. When blazing in these areas, avoid confusing over-blazing and consider combining different blaze colors into one blaze.





### Placement

Paint blazes on trees that will easily be seen by trail users. Look down the trail to find a tree that will catch hikers' attention in all seasons. If the tree is far enough away, and within one to three feet of the right side of the trail, you've found your next blaze tree. Try to make sure that leafy summer growth or branches weighted with snow or rain will not later hide the blaze. Clear any interfering growth with lopping shears or hand pruners, if permitted by the land manager.

### Suggested Paint Colors

The following paint colors are recommended in PA DCNR's *Guidelines for Marking Recreational Trails*. Following these recommendations provides uniformity and consistency when blazing trails. Each color includes the Pantone Color ID Number to maintain consistency when purchasing paint from various manufacturers.

- Red PMS 485 2X
- Orange PMS 165 2X
- Yellow PMS 102
- Blue PMS 300
- White
- Brown PMS 161

High quality latex paint is recommended. Enamel is not recommended as it may damage thin-barked trees.

### Trail/Sign Markers

There are many materials that can be used to construct trail signs and markers. They include:

1. **High-Density Overlay (HDO) Plywood:** Marine-quality, 3/4-inch plywood with one side covered with a high density, slick material (the overlay), to which adhesives cling quite strongly. Commonly used as the substrate for pressed-on materials such as reflective vinyl. This substrate should be used extensively for the larger signs. It weathers well, and holes in the vinyl can be easily repaired.
2. **Medium-Density Overlay Plywood:** Marine-quality, 3/4-inch plywood, with one side covered with a smooth but more porous overlay than HDO. This substrate accepts paint much better than HDO. The porosity of the overlay allows the paint to bond with the substrate better.
3. **Medium-Density Fiberboard (MDF):** A pressed-particle board product that accepts paint (silk screening) very well and weathers well. MDF is gaining adherents among transportation departments for large highway signs (green, blue, and brown).

Pennsylvania Department of Conservation and Natural Resources

#### Guidelines for Marking Recreational Trails



July, 2008

**Guidelines for Marking  
Recreational Trails**  
PA DCNR

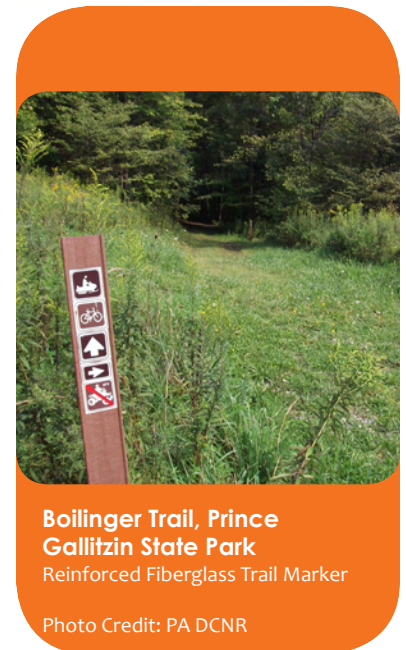
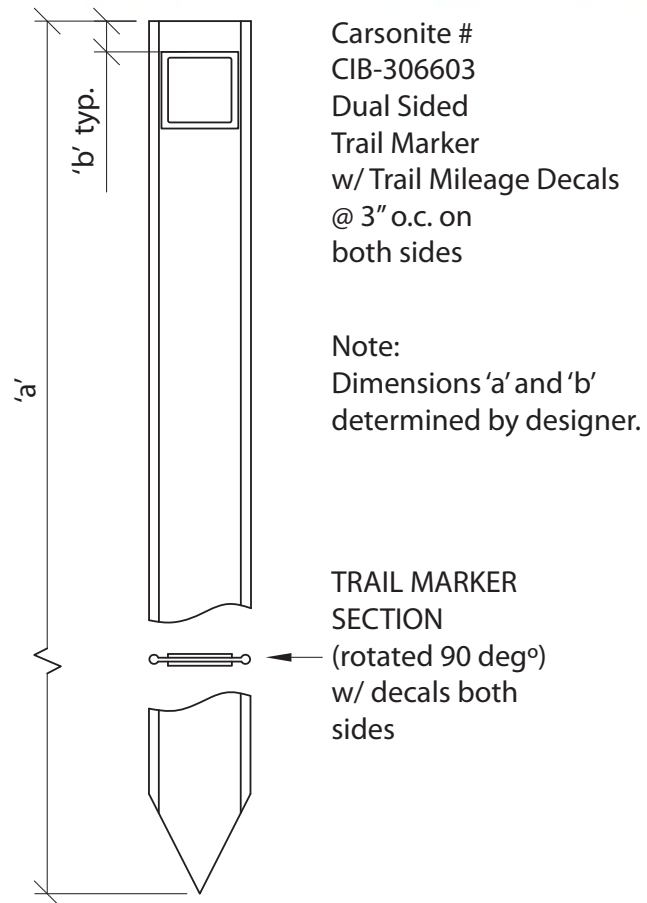


4. **Plastics:** Sign-making can involve a variety of plastics:

- Acrylic, or Plexiglas, is a hard, rigid material that withstands abrasion well but breaks easily. It is often used as a clear protective covering over another sign.
- Polycarbonate, or Lexan, is similar to the acrylic panel but is softer, with a greater flex. Its softness makes it more likely to be marred by dust and blowing sand.
- Polyethylene and polypropylene are fairly common materials that are suitable for most routine sign applications. They are soft materials that have sufficient rigidity to stand up as small signs, but not so rigid that they are easily broken.

They come in basic colors, and accept paint (silk screening) well. Generally, they weather well; however, their softness makes them easy prey to vandals wielding sharp or pointed instruments. Initial and replacement costs are low.

5. **Aluminum:** A long-used, common substrate for routine, smaller signs. Message usually silk screened onto substrate. Easily and significantly damaged by bullets and other forms of vandalism. It has good weather resistance. Moderate initial and replacement costs.
6. **Aluminum-clad plastic:** Similar in character to aluminum signs. The plastic core adds strength; this substrate is highly durable and light weight, making it ideal for kiosk panels or other signs mounted with a backing. The cost of this product is moderate.
7. **Aluminum-clad plywood:** Similar in character to aluminum signs. Plywood backing adds support to the aluminum to provide stability/rigidity for larger size signs. Initial and replacement costs are moderate to high.
8. **High-Density Foam Boards:** Three-dimensional signs made by cutting a matte and sandblasting to the desired depth. Sand blasting and mattes can also be used to make three-dimensional wood signs from 2-inch-thick material.
9. **Reinforced Fiberglass Trail Marker (RFT):** Recreational trails can be marked using dual sided reinforced fiberglass trail (RFT) marker posts with decals to identify type of trail ( horse, hiking, etc.) and the individual trail identification (name, number, or color code).



### Reinforced Fiberglass Trail Marker

#### Marking other Property and Recreational Facilities

You may use any color of RFT posts, with the following exceptions to mark other property facilities.

1. Red: traditionally used to identify safety zones or other danger areas.
2. Orange: traditionally used for boundary marking.
3. Yellow: traditionally used to identify survey marker locations ( corner stones, etc.) with appropriate decal ("Survey Marker"). Survey markers may be on property lines or off line.
4. Blue: traditionally used for marking firewood cutting areas.





**Split Rail Fence**  
Bellefonte Central Rail Trail  
Centre County

Photo Credit: Pashek Associates

## Trail Gates and Barriers

Barrier design depends on an area's intended use, native materials, and character. Consider vandalism as a factor in barrier planning. Generally, wooden barriers are more vandal prone because they can be carved or burned. Concrete and metal barriers are more durable, but still succumb to vehicular ramming.

Some barriers serve as a deterrent for access to a road or a trail, while others keep vehicles on a road or in a parking lot. Most visitors recognize and respond to design features such as a simple curb used to deter vehicles from driving off-road.

Use barriers or fabricate specialized barriers for areas where user or vehicle control problems exist.

To make barriers more difficult to remove, use:

- Steel instead of wood
- Large boulders
- Larger diameter posts
- Posts buried deeper
- Posts set in concrete
- Posts anchored with rebar spikes

## Movement Barrier Types

Generally, there are five types of barriers: bollards, fences, gates, large rocks, and wooden guardrails. The barrier size and its materials vary depending on the problem's severity and the proper scale to fit with the site's resources.

### Bollards

A bollard consists of a large post with no stringer or rail, commonly 1 to 4 feet tall, and used singly or grouped to block vehicle entry from pedestrian right-of-ways. Materials for bollards consist of wood, concrete, steel, or plastic lumber posts. Bollards should be identified with reflective tape.

### Fences

A fence functions as a boundary or barrier, usually made of posts, boards, wire, or rails. Fences are designed to keep people and stock in or out of an area, but generally cannot withstand vehicular impact.

- **Split Rail Fence:** Split rail fences are desirable from a cost and aesthetic standpoint. However, in isolated locations they may be prone to vandalism.
- **Rolled Wire Boundary Fence:** A rolled wire boundary fence also is a cost effective solution. Generally, this fence disappears from sight from a distance. Therefore, when constructing this fence install appropriate



**Schuylkill Trail**  
Montgomery County

Photo Credit: Montgomery County  
Planning Commission



signage or flagging to ensure trail users recognize the location of the fence.

### Gates

Gates made of wood or steel allow passage and may or may not swing open. Secure gates to a fence or a large natural feature to prevent people from navigating around them. Use gates to allow pedestrian and wheelchair access, while blocking stock, motorcycle, and ATV access.

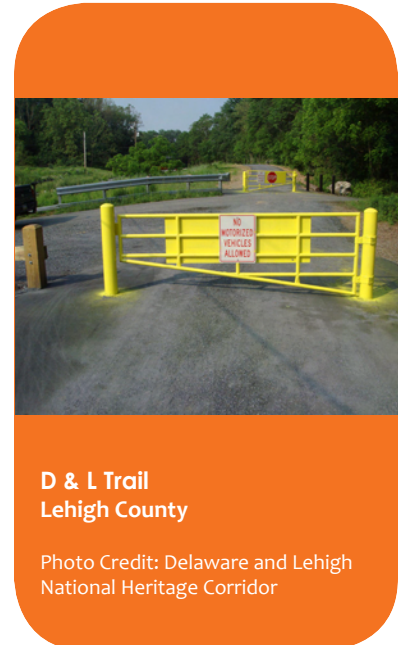
- **Right-Angle Gates:** A right-angle gate creates a passageway for pedestrians and stock. This type of gate is generally constructed from wooden or steel posts with wooden or pipe rails.
- **Steel Road Gates:** Steel road gates prevent vehicle or ATV entry to roads, trails, administrative roads, and campgrounds. Consider using large rocks and berms to block entry around the gate.
- **Steel Trail Gates:** Steel trail gates limit access of 4 wheel vehicles and ATVs while allowing motorcycle access. For safety reasons, this gate must be visible at the trailhead and as one approaches it while riding.
- **Non-motorized Trail Barrier Gate:** Non-motorized trail barrier gates are located at trail access points to allow pedestrian and stock access to pass through. Flank the gate with a steel rail fence to prevent people from skirting the gate.

### Large Rocks

Rocks prove difficult to drive over in a standard automobile and generally deter trail users from navigating over them. Mimic nature by placing rocks, that weigh 200 to 400 pounds each, in groups and vary the space between them to create a natural looking barrier.

### Wooden Guardrails

Wooden guardrails consist of a series of low posts tied together by wooden rails to block and control vehicular access. Combine guardrails with a curb, bumper stop, wheel stop, or shrubbery to increase effectiveness against vehicle intrusion.



**D & L Trail**  
Lehigh County

Photo Credit: Delaware and Lehigh  
National Heritage Corridor



**Walter Dick Park**  
Jefferson County

Photo Credit: Pashek Associates



**East Branch Trail**  
Crawford County

Photo Credit: Pashek Associates

## Bridges

Building a bridge poses one of the biggest challenges to constructing a trail. It requires a strong understanding of engineering and hydrological principles, as well as sustainable design principles. The first step in determining the best way to handle a specific situation involves assessing likely users of the trail, its location, and alternative routes before concluding if a bridge is necessary. It is important to carefully plan and explore all options for a site during the design phase, and before construction begins. Further, the designer must be aware of permitting requirements and design the bridge to be compliant with them.

A wide range of bridge designs exist, from simple designs constructed on-site with native materials to expensive, factory-built models. Only the materials available and creativity of the builders involved in the project limit the variety of bridge designs possible. It remains important to base a bridge design on its aesthetic value, size, and the intended user experience proposed for the trail.

Nearly every trail crosses one or more waterways along its route. Narrow streams can be crossed in several ways depending on the size and the type of the stream. Appropriate crossings can include placement of flat stone along a narrow streambed or the use of culverts. For perennial streams, anchored bridges or culverts typically provide the user with the necessary means to cross the stream. By placing the trail above the water, the impact to the stream is decreased.

The thought that goes into the planning and design of a bridge remains every bit as important as the effort invested in its construction. Location is a key determinant of the durability and ease of construction for a bridge. Some important aspects to consider include: stable banks, banks close together, a sunny location, acceptable approach trails, and a bridge's potential environmental impact. Using the right size of lumber for the span and building supports, if necessary, remain important. Remember to build bridges to meet the needs of the intended users, and to prohibit other uses.

It also remains important to consider other aspects of a design before constructing a bridge or water crossing such as safe approaches and incorporating flat, skid-resistant surfaces. Designers should carefully select bridge types and construction materials for site conditions, building them to support emergency and maintenance vehicles where appropriate. It is also important to avoid sharp and blind curves, as well as drastic changes in elevation, on immediate approaches to minimize adverse effects on sight distance, drainage, and footing for users.





The USDA Forest Service identifies six general bridge types in their *Trail Bridge Catalog*<sup>14</sup>, available [HERE](#), typically used along non-motorized trails, including:

- **Cable Suspension Bridge:** Cable suspension bridges have two main steel cables for support. Builders create the deck of the bridge using sawn timber planks typically hung from suspended cables or steel rods. They anchor the cables into the streambanks and use intermediate towers for support when necessary.
- **Deck Girder/Truss Bridge:** Deck girder bridges are supported by two or more longitudinal girders (beams). Deck support comes from the tops of the girders and usually consists of timber (log, sawn, or glued laminated timber), but may be concrete or steel.
- **Side Girder/Truss Bridge:** Side girder bridges are supported by two longitudinal girders or beams. The deck hangs on the interior side of the girders on either the floor or ledger beams, attached to the main girders.
- **Arch Bridge:** Longitudinal beams or walls typically support the deck of an arch bridge. Designers use a variety of materials including timber, masonry, concrete-filled, and open spandrel concrete in the design of these bridges.
- **Single Unit Bridge:** Consists of a single, self-supporting bridge. A foot log, nailed or glued-laminated timber, and prestressed concrete are typically used to construct this type of bridge.
- **Covered Bridge:** Traditional covered bridges essentially use a side truss bridge design to span up to 300 feet. Most modern bridges use side girders or deck girders with the covering simply added to the top of the bridge.

Several other types of bridges that can be considered when designing a non-motorized trail include:

- **Puncheon Bridge:** Puncheon bridges consist of wooden walkways used to provide passage over small streams. A puncheon refers to two flattened logs nailed side by side on sills to form an elevated walking surface. Puncheon for a horse trail consists of a deck 48 inches in width with a minimum thickness of 4 inches, laid on stringers with a diameter of at least 10 inches. The design of these bridges accommodates both pedestrian and equestrian uses.

<sup>14</sup> Trail Bridge Catalog, USDA Forest Service; 2008



**Stringer Bridge**  
Nescopec State Park  
Luzerne County



**Reinforced Fiberglass Bridge**  
Quehanna Shared Use Trail  
Clearfield County



**Suspension Bridge**  
Cook Forest State Park  
Clarion County

Photo Credits: PA DCNR



### Standard Dimensions of Puncheon and Bridge Decking

| Trail Type          | Deck Width         | Deck Thickness |
|---------------------|--------------------|----------------|
| Hiker               | 36"                | 3"             |
| Cross-Country Skier | 60" minimum        | 3"             |
| Equestrian          | 48" minimum        | 4"             |
| Rail Trail          | 10' Clear, minimum | 4"             |

\* Nails- For 3-inch decking, use #50 to #60 galvanized nails.

\*\* For 4-inch decking, use 3/8 inch x 8 inch galvanized spikes.

- **Stringer Bridge:** Similar to the USDA Forest Service's Single Unit Bridge, a stringer bridge typically uses a single log or a timber beam to cross a span. These bridges span crossings of 50 feet or less. Two-stringer bridges (the width of two logs are beams) usually prove sufficient for use by hikers, while bridges intended for livestock or cross-country skiers will have 3 or more stringers. Depending on user needs, designers can equip stringer bridges with railings stabilized by longer planks of decking.
- **Ladder Bridge:** A ladder bridge is an elevated boardwalk put in place to get over an obstacle or wet area, or simply to add an interesting trail feature to a mountain biking trail. Elevate these bridges using large rocks, strong tree stumps, or well-designed wooden posts. The trail surface at the entrance or exit of a ladder bridge will require hardening, especially on steeper grades and landing areas.
- **Reinforced Fiberglass Bridge:** A fiberglass bridge system offers significant design and construction advantages. Manufacturers ship components in sections that typically weigh less than 90 pounds, which trail crews can easily carry to any trail construction site. In a matter of a few days workers can easily assemble these bridges with hand tools. The material used to design these bridges withstands harsh weather that can quickly deteriorate traditional materials.



## Landscaping with Native Plants<sup>15</sup>

When landscaping along trails, whether to stabilize recently graded areas, to create natural barriers, or for aesthetics, native plant materials should be used. A native plant is one which occurred within this region before settlement by the Europeans. Native plants include ferns and clubmosses; grasses, sedges, and rushes; perennial and annual wildflowers; and woody trees, shrubs, and vines which covered “Penn’s Woods” when the first settlers arrived. Over 2,100 native plant species occur in Pennsylvania.

An introduced or non-native plant species is one that travelers brought into the state and escaped cultivation to establish itself in the wild. About 1,300 species of non-native plants exist today in Pennsylvania outside of gardens, parks, and agricultural lands. That is 37 percent of Pennsylvania’s total wild plant flora, with more identified every year.

### Basics of Plant Conservation

#### *Protect native plant communities and minimize habitat destruction*

The most important guideline involves conserving existing areas of native vegetation as a whole, functioning unit. The easiest, least expensive, and best way to conserve Pennsylvania’s plant heritage is to protect existing native plant communities from further disturbance. If disturbance must occur, strive for minimum habitat destruction. Some cases may require ecological restoration, which can include planting native species, removing invasive introduced species, controlling erosion, and loosening soil compaction.

#### *Landscape with native plants*

The destruction of native plant communities has occurred in many areas. Intelligent landscaping in parks, yards, and campuses can help redress this loss. Well-chosen native plants can flourish in these landscapes. The Department of Conservation and Natural Resources recommends avoiding rare, endangered, and threatened plants and instead choosing native plant species which grow commonly throughout the state. If you do not want all natives, select adapted introduced plants suited for the site, colorful annuals, or flowering plants that will not escape and become environmental weeds.

#### *Buy nursery-propagated native plants*

Most retail nurseries and mail-order catalogs now offer native plants. If you want guaranteed ornamental characteristics, in some cases cultivars (named varieties) are available; for instance, a cultivar of New England Aster named ‘Purple Dome’ was selected for shorter height and showier flowers. Cultivars have predictable attributes like height, color, blooming period, or absence of seed pods/thorns—qualities many gardeners want. If your goal is genetic diversity, however, ask for straight species, not cultivars, grown from local

### Landscaping with Native Plants in Pennsylvania

This DCNR publication, available [HERE](#), is a good resource for identifying which native plants may be appropriate for your situation.

Additional information on:

- Rare, Threatened and Endangered Plants
- Common Trees of Pennsylvania
- Landscaping with Native Plants
- Invasive Plants
- Plant Communities
- Wild Plant Sanctuaries



**Go Native Tree Farm**  
Lancaster, York County

Photo Credit: Go Native Tree Farm

<sup>15</sup> Landscaping with Native Plants Brochure, Pennsylvania Department of Conservation and Natural Resources





seed sources. Plants grown from seeds have much more variety than cloned cultivars.

### *Do not remove native plants from the wild*

Taking native plants from the wild depletes native populations. In addition, many wild-collected plants do not survive transplanting. Prevent wild collecting of plants by making sure a nursery propagates the plants that you buy, or by starting plants yourself from a local seed supply. Before you collect seeds always obtain the property owner's permission.

### *Practice responsible landscaping techniques*

The first rule of responsible landscaping is planting the right plants in the correct environment: never introduce invasive plants to your landscape that will aggressively spread off your trail and invade native plant communities. They can drastically alter ecosystems and give you and your neighbors maintenance headaches for years to come.

When landscaping with native plants it is important to choose plants that will grow well at the site: wet or dry, shade or sun, acid or neutral soil. By noticing which native plants thrive nearby, you can use those clues to guide plant selection. Other information can be found from plant nurseries, catalogs, books, or the Internet.

## Finalizing the Design

At this point you should have completed the planning inventory and analysis as described in Chapter 1 - Planning. Your trail designer has reviewed the map and identified anything that may have changed since the completion of the inventory that occurred in the planning phase.

You have also established the trail management objectives by completing the Trail Management Objective sheet(s) for your proposed trail during the planning phase, and as described in Chapter 5 - Management. This sheet provides your trail designer with the information needed to develop the preliminary alignments and prepare the specifications for each segment of trail.

During the planning phase, as described in Chapter 1, your designer has also identified potential corridors and control points the trail will pass including destinations, areas of interest, and general trailhead and trail access locations.

Based on all of the design factors covered in this chapter, your trail designer will then finalize the location of the horizontal alignment for your trail in the field, GPS it, and transfer it to the construction drawings. While refining the alignment in the field the designer adjusts the alignment to avoid obstacles and previously unidentified constraints, and flags the locations of specific



construction details, such as the locations of dips, climbing turns, and other features described earlier in this chapter. Your designer will also adjust the alignments to provide a flow for the trail and to take advantage of interesting visual features. These features may include rock outcrops, waterfalls, habitats, and scenic views.

Your designer should flag the trail alignments by placing flags no greater than 50 feet apart, at any change, such as horizontal curves, vertical grade, and cross section, and where the construction of specific trail features will occur. The designer should also flag the clearing limits, and any trees that need to be removed. If the designer cannot see adjacent flags along the alignment, your designer should place more flags along the alignment. Placing too few flags along the alignment is a common mistake in flagging trails. Your designer will document the final alignments on the base map.

Your trail designer will then revise the Trail Management Objective Sheets as necessary, based on the refinement of the preliminary alignments.

Once your trail designer is satisfied with the final alignments, they will record the alignment utilizing GPS equipment to ensure properly located trail alignments on the plans.

Trail design and construction may or may not require a detailed survey. Your trail designer will identify when you may need a property boundary survey. A property survey establishes the locations of the property boundaries and ensures that you build the trail on your property. You may also need to have a topographic survey prepared in certain situations. Generally, the use of topographic surveys occurs to show elevations and geometry when your trail will intersect with a state or local road. Further, topographic surveys prove useful when designing trailheads, and for designing structures, such as bridges and retaining walls.

## Preparing Construction Documents

After completing the final alignment(s) and recording their locations, your designer will prepare the construction drawings. On these drawings, the designer identifies the locations and establishes the details for each section of the trail. This generally includes typical cross sections, horizontal and vertical trail alignments, tread materials, location of water control structures, location of other structures and specific details for trail facilities such as trailheads and amenities. The trail designer should prepare an opinion of probable construction cost to compare the projected cost of constructing the trail to the available funding.



If competitive bidding will occur on your project, your designer will prepare bid documents that also contain regulatory requirements, conditions of the contract, and technical specifications.

Construction drawings typically include:

- **Erosion and Sedimentation Control Plans:** These document the locations of temporary and permanent erosion and sedimentation control features.
- **Layout Plans:** These identify existing conditions with proposed improvements overlaid, GPS coordinates, stationing, and/or dimensions to locate the proposed improvements, detailed call-outs identifying locations of various construction requirements that a construction detail further defines.
- **Grading Plans:** These plans note the existing and proposed topography which indicates the amount of cut and fill needed to establish the trail bed. Grading plans also typically identify locations and the extent of permanent erosion and stormwater control features.
- **Planting or Landscaping Plan:** Plans identifying existing vegetation to remain; location, size, and quantity of proposed plant materials; and extent of seeding.
- **Construction Detail Plans:** These plans provide both graphic and written information about specific parts of the construction. These are drawings showing the area of construction at a larger scale in order to clearly show the materials, dimensions, method of building, and methods of attachment.

Depending on the size and scope of your project, designers can combine information on fewer plans, or separate it into more plans.

## Standard Drawings & Specifications for Construction

The U.S. Forest Service (USFS) has *National Trail Drawings and Specifications*<sup>16</sup>, available for reference [HERE](#). These construction details and specifications are available for professional use by those qualified to adapt these drawings to local conditions. The user accepts full liability for their use. The USFS does not provide supporting data for these drawings and specifications. The USFS makes them available on an as-is basis.

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<sup>16</sup> US Forest Service National Trail Drawings and Specifications, US Forest Service: 1998

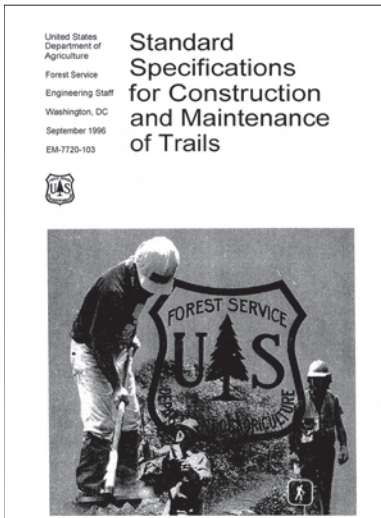




### USFS National Trail Drawings

These include fifty-three standardized set of model construction details that designers can adapt and modify to fit many trail situations.

- |   |  |
|---|--|
| 1. Clearing Limits  | 28. Underdrain   |
| 2. Typical Trail Cross Section                              | 29. Foot Log Trail Bridge with 2 Handrails – Side View |
| 3. Outsloped Climbing Turn                                  | 30. Foot Log Trail Bridge with 2 Handrails – End View  |
| 4. Trailbed and Slope Finish                                | 31. Optional Deck and Handrails                        |
| 5. Talus and Rubble Rock Section                            | 32. Puncheon without Decking                           |
| 6. Grade Dip  | 33. Puncheon with Decking                              |
| 7. Rolling Dip  | 34. Plank Stairway                                     |
| 8. Turnout and Passing Sections                             | 35. Crib Ladder Stairway                               |
| 9. Shallow Stream Ford and Gully Crossing Rock Structure    | 36. Rock Stairways                                     |
| 10. Shallow Stream and Ford or Gully Crossing Log Structure | 37. Pinned Stairway                                    |
| 11. Insloped Climbing Turn                                  | 38. Log and Treated Timber Riser Stairway              |
| 12. Turnpike - Type I                                       | 39. Log Retaining Wall                                 |
| 13. Turnpike - Type II                                      | 40. Rock Retaining Wall                                |
| 14. Switchback - Type I                                     | 41. Aggregate Surfacing                                |
| 15. Switchback - Type II                                    | 42. Bituminous Surfacing                               |
| 16. Switchback - Type III                                   | 43. Grid Pavement Units                                |
| 17. Existing Trail Restoration                              | 44. Sign and Post Installation                         |
| 18. Check Dams  | 45. Rock Cairn Construction                            |
| 19. Culverts with Headwalls                                 | 46. Log Barrier  |
| 20. Culverts without Headwalls                              | 47. Log Barrier on Posts                               |
| 21. Rock Culverts   | 48. Treated Timber Barrier                             |
| 22. Treated Timber Box Culvert                              | 49. Treated Timber Barrier on Posts                    |
| 23. Treated Timber Box Culvert Details                      | 50. Rock Barrier                                       |
| 24. Rock Water Bar  | 51. Trail Obliteration                                 |
| 25. Log or Treated Timber Waterbar                          | 52. Seeding and Fertilizing                            |
| 26. Rubber Belting Waterbar                                 | 53. Illustration of Trail Structure Terms              |
| 27. Rock Spillway   |  |



**Standard Specifications  
for the Construction and  
Maintenance of Trails**  
U.S. Forest Service

## *USFS Standard Specifications for the Construction and Maintenance of Trails*

Further, the companion document *Standard Specifications for the Construction and Maintenance of Trails* provides the technical specifications for each item, along with maintenance specifications for existing trails. These specifications include the following sections:

### *General Specifications*

- 901 Abbreviations, Acronyms, and Terms
- 902 Definitions
- 903 Intent of Contract
- 904 Maintenance for Traffic
- 905 Control of Materials
- 906 Measurement and Payment
- 907 Quality Assurance and Quantity Measurement
- 908 Staking, Flagging, and Cleanup

### *Construction Specifications*

- 910 Earthwork
- 911 Clearing and Grubbing
- 912 Excavation and Embankment
- 913 Turnpike
- 914 Switchbacks
- 915 Existing Trail Restoration
- 916 Removal of Structures and Obstructions
- 920 Drainage
- 921 Culverts
- 922 Waterbars
- 923 Rock Spillways
- 924 Underdrain
- 930 Structures
- 931 Log Stringer Bridge
- 932 Puncheon
- 933 Trail Stairways
- 934 Log Retaining Walls
- 935 Rock Retaining Walls
- 936 Wire Baskets
- 940 Surfacing
- 941 Aggregate Surfacing and Base Course
- 942 Hot Bituminous Plant Mix Trail Surfacing

- 943 Cold Bituminous Mix Trail Surfacing
- 944 Grid Pavement Units
- 950 Incidental Construction
- 951 Mobilization
- 952 Sign, Post, and Cairn Installation
- 953 Barriers
- 954 Obliteration of Abandoned Trailways
- 955 Seeding and Mulching
- 960 Materials
- 961 Rock, Grid Pavement Units, and Aggregate
- 962 Material for Timber Structures
- 963 Drainage Pipe
- 964 Geosynthetics
- 965 Wire Baskets

### *Maintenance Specifications*

- 981 Brush Cutting
- 982 Logging Out
- 983 Danger Tree Removal
- 984 Loose Rock Removal
- 985 Rock and Root Removal
- 986 Borrow
- 987 Slide Maintenance
- 988 Slough and Berm Removal
- 989 Turnpike Maintenance
- 990 Switchback Maintenance
- 991 Drainage Maintenance
- 992 Rock Retaining Wall
- 993 Sign Repair and Placement
- 994 Barrier Maintenance



# Construction

As we build trails we strive to reduce the impact on the environment by ensuring they are stable, safe, and sustainable.

Trails can be constructed by volunteers, agency staff or contractors. Regardless of who constructs the trails, it is important to follow the trail design, layout, details, and specifications to ensure they are properly constructed.

Realize that trail construction and reconstruction is an on-going process because a trail is dynamic. Over time, use and environmental factors will wear on the trail. As time goes by you will find areas

that may need to be re-routed, reconstructed or otherwise improved to address a particular concern.

In this chapter we discuss:

- Trail Construction Options
- Preparing to Build Trails
- Leading a Work Outing
- Safety and Preparation
- Trail Construction Tools
- Trail Construction
- Construction Management



**Hoisting Rocks on the  
North Country Scenic Trail**

Photo Credit: Andrew Bashaw





## Trail Construction Options

Trails can be constructed in several ways. Before you can begin construction, you will need to determine how and who will be constructing your trail.

Options include:

1. Constructing a trail with in-house labor
2. Constructing a trail with volunteers
3. Constructing a trail with a contractor
4. A combination of the above.

Your organization will need to evaluate which option or combination of options will both meet your needs and local, state or federal requirements. If you are unsure whether you need to competitively bid your project, contact the local municipality or governmental organization having jurisdiction to advise you. Often the funding source will dictate whether or not competitive bidding is required.

### Constructing a Trail with In-House Labor

To construct a trail with your organization's staff consider your capabilities:

- Do your employees have the required knowledge and experience, or can you provide them with the proper training in advance of construction?
- Does your agency have the proper equipment?
- Can you allocate the resources and time necessary to complete the project in the desired time frame?
- Can you obtain approval from local labor relations unions?
- Are or can the volunteers be properly trained?
- Do your agency's insurance policies cover volunteers?

If your answer is yes to each of the above questions, then your agency should be able to successfully construct the trail. Carefully and honestly evaluate your organization's capabilities. Assuming your staff has the knowledge, abilities, equipment or time without verifying these important considerations with them can lead to frustration and potentially a failure to complete the construction of the trail.

### Constructing a Trail with Volunteers

If your municipality or organization will be utilizing volunteers to construct a trail you should also be able to answer the questions asked above. Further you need to ensure your organization has done everything within its powers to ensure the safety of the volunteers and minimize the potential for liability before you agree to proceed.



**Manor Rail Trail**  
Manor Township  
Lancaster County

Photo Credit: PA DCNR



This includes evaluating the need for and implementing:

- Release, hold-harmless, and indemnification agreements as discussed in Chapter 5 - Management.
- Insuring your organization with:
  - Nonprofit Directors and Officers Liability Insurance
  - Property Insurance
  - General Liability Insurance with volunteers as insured, with abuse/molestation insurance rider
  - Automobile Insurance with employees and volunteers as insured and non-owned auto liability coverage
  - Accident Insurance to cover injuries incurred by volunteers

When considering insurance policies consult with an attorney who can advise you on the types and amounts of insurance coverage you should retain.

Further, when working with volunteers it is important to follow these child labor and child protective services laws.

### *Pennsylvania Child Labor Laws*

When working with trail crews and volunteers it is important to have an understanding of the Pennsylvania Child Labor Law and how it influences what a child can and cannot do.

The *PA DCNR Conservation Volunteer Manual* typically governs volunteer work conducted on Pennsylvania State Forest land or within State Parks. It requires parental or guardian consent before a minor is permitted to engage in volunteer work. However, when minors are part of a group or organization (e.g., scouting or church group) that is providing volunteer services, the organization may sign on behalf of its minors if the volunteer coordinator has ensured that the organization has obtained parental or guardian consent for the minors to engage in the activity.

### *Pennsylvania Child Protective Services Law*

Pennsylvania Child Protective Services Law requires private and public agencies to secure both child abuse and criminal history background clearances for a broad range of individuals who are in paid employment capacities with children and youth. This clearance process is one mechanism used to address issues of child safety. The background clearances identify substantiated incidents of child abuse and any relevant criminal offenses.

Many private and public agencies also extend these requirements to volunteers and others for whom they are not statutorily required but who are involved in activities with children and youth. FBI clearances are also required for potential employees residing out of state.

#### ***PA Child Labor Laws***

For more information on PA's child labor laws visit the PA Department of Labor and Industry website ***HERE***.

#### ***DCNR Conservation Volunteer Program***

For more information on DCNR's Conservation Volunteer Program visit their website ***HERE***.



These clearances typically include:

1. Pennsylvania State Police Request for Criminal Records Check (Act 34), available [HERE](#).
2. Department of Public Welfare Child Abuse History Clearance (Act 151), available [HERE](#).
3. Federal Criminal History Record Information (CHRI), available [HERE](#).

### Constructing a Trail with a Contractor

If a project involves public funds you will most likely need to follow public bidding requirements to procure materials, or labor and materials, to construct your trail. Even if public bidding is not required there should be a competitive process.

#### Public Bid

In Pennsylvania, purchases by local governments fall into two general categories:

1. those where competitive bidding is required by law; and
2. those where competitive bidding is not required.

Depending on the value of the work, and the source of funding, there may be additional requirements. The following are examples of common requirements that often need to be met:

- Bid Bond
- Performance Bond
- Labor and Material Payment Bond
- Maintenance Bond
- Workers' Compensation
- Prevailing Wage Rates
- Davis-Bacon Act
- Steel Products Procurement
- Separations of Trades

#### Award of Competitive Bid Contract

When a materials and/or construction contract is procured through a competitive bidding process, the owner, if awarding a contract, should award it to the lowest responsible bidder.

#### Purchases Below Bidding Limit

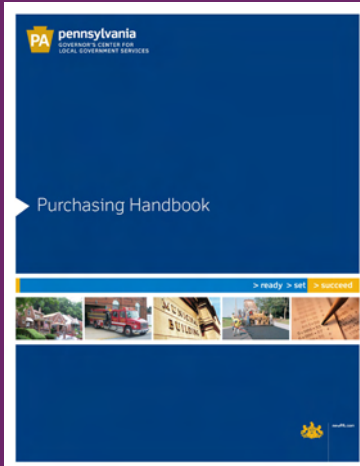
When utilizing public funds you are permitted to award non-bid contracts for small purchases. Refer to the PA DCED Purchasing Handbook for specific requirements and limits.

#### Non-Profit Organizations

There can be different requirements for non-profit organizations. These organizations should check with the program manager of their funding sources to determine the requirements they should meet.

#### Public Bidding Requirements

Detailed information on public bidding requirements can be reviewed in the *Purchasing Handbook* published by PA DCED Center for Local Government Services. You can download this handbook [HERE](#).







### *Trail Building Experience*

When selecting a contractor and/or bidding a trail construction project, it is important to require contractors to have trail building experience.

### **A Combination of the Above Options**

Trail construction can also be accomplished using a combination of the above options. Common arrangements include:

- In-house staff to construct the trail with materials procured through the public bidding process.
- Volunteers to construct the trail with materials procured through the public bidding process.
- Contractors to complete larger, more difficult tasks, and using in-house or volunteers to complete other portions of the trail construction.

## **Preparing to Build Trails**

Regardless of whether you are constructing your trail with volunteers or with a contractor, the construction crew and the trail building techniques will be similar. The following sections provide basic information on each topic.

### **Trail Crews**

Trail crews can consist of paid or volunteer staff. To work on a trail crew workers should be at least 16 years of age and in good physical condition; those younger than 16 can work if accompanied by an adult. Discourage volunteers from bringing children to participate in all-day trail building, as most have a short attention span. Crew leaders should be experienced in trail building, but no previous trail building experience is required for crew members.

### *Education*

A crew leader should participate in crew leadership training and have previous experience as a crew member. Crew leadership training prepares individuals to begin achieving proficiency in the design, layout, construction, and leadership of recreational trails projects. While most courses are detailed and technical, they typically provide only an initial foundation on which to build proficiency through additional experience within volunteer, conservation corps, commercial, and agency trail construction and maintenance organizations.



**French Creek State Park  
Tuesday Night Trail Crew**  
Chester and Berks Counties

Photo Credit: PA DCNR



Crew leadership courses typically cover the following topics and have the following objectives:

### *Crew Leadership Training*

#### *Course Topics*

- Design Concepts
- Trail Project Leadership
- Layout Principles
- Clinometer Orientation
- Topography Map Exercise
- GPS Exercise
- Field Layout Exercise

#### *Course Objectives*

- Understand the broad requirements for creating a recreational trail
- Understand trail corridor design concepts
- Understand trail tread layout principles
- Use a clinometer to determine gradients
- Use a GPS, or topographic map and ruler, to determine corridor parameters
- Layout and flag a trail project in the field.

Trail crew training may be available through local, state, and national trail associations such as PA DCNR, IMBA, Keystone Trails Association, and others. Refer to the websites of the respective organizations to determine where and when training may be available in your area.

### *Crew Leaders*

Crew leaders should spend a considerable amount of time going over safety rules before each work outing.

## *Leading a Work Outing*

Safety is the number one priority in all trail operations. Crew leaders are responsible for briefing crew members to maintain a safe working environment and instilling in them a sense of responsibility. Every work leader should learn and teach his/her crew safe work habits and see that these practices are adhered to. Every tool is a potential source of injury and everyone cannot be watched at all times. Therefore, the crew leader should establish ground rules at the beginning and teach by example.

### *Safety Rules*

1. Carry tools in the safest way. Grip tools by the handle about 6 inches behind the head, or at the balance point, and carry it to the side, on the down-slope side of the body rather than over the shoulder or as a walking stick. This prevents injuries due to falling on the tool, since

#### **Subaru/IMBA Trail Care Crew**

Two teams of professional trail building experts travel year-round throughout the United States and beyond, leading trail work sessions that teach attendees how to design, layout, and construct sustainable trails. To learn more about this program visit their website [HERE](#).



**Swatara State Park**  
Union and Schuylkill Counties

Photo Credit: PA DCNR



it can be easily tossed away when carried correctly. Carry tools with sharp blades by facing the blade to the ground, and equip with a sheath to prevent accidental cuts and to retain its sharp edge. Keep the sheath on the tool while carrying it to the worksite and only remove it when it is being used. Hold bulky or clumsy items with two hands or have two people carry them.

2. Leave plenty of room between volunteers for walking and working, generally 10 feet between crew members.
3. Crew members should always be aware of what others are doing and take full responsibility for their own safety and the safety of others.
4. The right tool should be used for the job.
5. Implement the “Scan-Shout-Swing” order of doing things. Crew members should look around to make sure no one is in harm’s way and to ensure there is plenty of room to swing safely. If necessary, clear brush or limbs first to avoid injury from a deflected tool. Second, communicate intentions and third, crew members may proceed when all is clear.
6. Remove trail hazards as they are encountered, or communicate their presence to other workers down the line, either verbally or with a temporary sign (for instance, a temporary sign could warn others of a nearby yellow-jacket nest or a poorly supported leaning tree). Remove hazards as soon as practical to prevent others from being harmed.
7. Dehydration, heat stroke, lack of energy, and hypothermia are life-threatening concerns. Keep first aid supplies on hand and ensure every crew member knows what is available and where it is kept. When working in remote locations, let someone, park ranger/local law enforcement, etc. - know the crew’s location and expected time of return.
8. Crew members should be aware of their physical condition and limitations. Weariness can lead to accidents.

## Equipment Preparation

Select and inspect the correct tools for the job before using them. Ensure blades are sharp, handles are smooth, and heads are securely fastened. Properly care for tools and use them correctly. Crew leaders should demonstrate proper carrying and handling techniques before leaving the parking lot.

## D & L Trail Tenders

Trail Tenders are dedicated men, women and youths who maintain and enhance the D&L Trail in Northampton, Lehigh, Carbon and Luzerne counties.

Tenders have a variety of responsibilities. They help maintain the ecological balance along the trail by eradicating invasive plants and replacing them with native grasses, wildflowers, shrubs and trees. They maintain the physical integrity of historic structures such as canal locks and railroad turntables, by performing regular site cleanups. And they build picnic tables, benches and bicycle racks for the benefit of trail users.



## Trail Tenders

Photo Credit: Delaware & Lehigh National Heritage Corridor





Careful planning will prevent problems during the outing. A checklist of supplies and safety-briefing points is a must.

### *Sample Checklist*

- Tools (list)
- First Aid kit
- Insect repellent
- High energy food (list)
- Water (adequate amount for conditions and crew members)
- Individual water containers
- Extra rain gear or plastic garbage bags
- Extra gloves
- Hard hats
- Eye & ear protection
- Other personal protective equipment
- Compass
- Topographic maps
- Project maps and plans
- Trail brochures
- Membership information
- Copies of “Safety Rules”
- GPS with extra batteries
- Cell phones/two-way radios

Tell potential participants what they are expected to bring prior to the work-day. Normally, participants are responsible for their own footwear, rain gear, and gloves. There will always be a few who need an item, so crew leaders should bring extra, if they are available.

Sometimes people will bring their own tools. This is fine as long as their tools are in good condition and appropriate for the project. Inexperienced workers, for instance, seem very fond of hatchets. They are ineffective for trail work when compared to loppers, bow saws and other trail tools. Crew leaders should be firm about leaving such tools behind, and should check all personal tools for soundness.

Just because people bring a tool from home does not mean that they know how to use it correctly. Take time to discuss proper use of all tools that are going to be used that day. If there are more tools than people, then determine which ones are really necessary and which ones should be left behind. In most cases crew members should not carry more than one tool, except when walking in to major project sites. An exception to this is when small tools such as wire cutters for old barbed wire can be carried in a pocket or day-pack. In addition to teaching basic rules, a crew leader should also discuss other precautions, such as being aware of poisonous pests or plants suspected in the work area.

Crew leaders should be aware of any signs of fatigue, dehydration, or heat stroke among crew members. If someone seems to be having trouble, crew leaders do not need to draw undue attention to it, but should not ignore it either. Crew leaders should ensure that everyone is getting enough rest periods and water.



Trail building should be a good experience for everyone. If the experience is positive, people will come back for the next work-outing.

Some agencies use non-skilled labor obtained through community service programs and/or prison work release programs to complete tasks such as brush clearing, mowing, etc. If you are interested in determining the availability of non-skilled labor through community service or prison work release programs, contact your local magistrate, Common Pleas Court and/or your local prison board administrator.

### Estimating Work

Before a trail crew goes into the field to begin construction, crew leaders need to understand the goals and expectations for the crew's work, estimate how much work is required and how much work their crew can accomplish in a given time. Crew leaders assist organizational leadership with determining larger management plans and crew leaders should motivate their crews.

Many conditions influence the amount of work that crews can complete during an outing, including: ability of workers, availability of tools and materials, weather conditions, terrain, and time required getting to the work site. Estimating work is an acquired skill mastered with experience.

Visiting a site in advance of a crew's arrival is another essential part of estimating work. Crew leaders should visit a site to find answers to the following questions:

- How long will it take the crew to travel to the work site each day?
- What tools are required to complete the work and how will they be transported to the work site?
- What building materials are required and are they available on-site? If materials need to be moved, will the crew have wheelbarrows, motorized wheelbarrows, or rigging gear, and do they know how to use them?
- Will the trail sponsor have personnel on-site?
- Will the work site be closed to public use during construction? If not, the crew is likely to lose production time allowing trail users to pass through.
- When the work is complete how much time will be required to close down the project, clean up the work area, carry out tools and gear, and store or return equipment?
- Are there seasonal patterns of heat, cold, rain, or snow that will impact production?
- Can the crew complete the work safely?
- Will the project interest crew members and give them a sense of accomplishment?



- Where will the crew stay? Backcountry camp, modern camp, etc.? Will they transport tools and gear to their camp?
- Can the crew stay at the camp for the duration of the project?
- Is there a backup project for the crew if they finish their primary work ahead of schedule?

Crew leaders should take into consideration the age, fitness, ability, experience, and motivation of their crew members. Complex, intensive, or extensive projects may be right for an experienced crew, but too demanding for inexperienced crews.

Attention to the details of construction and clean up of the work site makes a great difference in the appearance and quality of the project. Trail crews often overlook this final 10 percent of a project in the haste to complete it. Crew leaders need to budget time to allow this work to be completed, to motivate crew members to take pride in their work, and to finalize the work in a manner that makes the crew proud.



### AMC's Complete Guide to Trail Building & Maintenance

Appalachian Mountain Club

## Safety and Preparation<sup>1</sup>

Trail work can be challenging and exhausting, and danger is always present. Therefore, trail crews should be properly equipped and prepared to respond to the hazards of the work environment.

### Personal Protective Equipment (PPE)

By using personal protective equipment (PPE) trail builders protect themselves from hazards and injuries. Having appropriate, functioning PPE for an activity should be at the forefront of any trail maintainer's mind before starting a project.

#### Boots and Socks

Well-made, sturdy leather boots are one of the most important pieces of gear a trail worker should have. Boots suitable for hiking will last much longer and provide better protection than traditional hiking boots made of lightweight material. Steel toe boots offer an additional layer of protection, but can be uncomfortable for long hikes.

#### Gloves

Sturdy gloves can help protect hands from potential injury. Although certain tasks require finger dexterity that is limited by using gloves, it is important to wear gloves for most trail activities. Trail workers often choose leather gloves over cotton gloves, because they withstand heavy use and provide better protection from injury.

<sup>1</sup> Adapted from AMC's Complete Guide to Trail Building & Maintenance, Appalachian Mountain Club: 2008





### *Eye Protection*

Safety goggles and glasses provide an inexpensive, lightweight protective barrier during trail construction. It is important to choose ones that are shatterproof and impact-resistant, as well as meet or exceed ANSI Z87.1-2003 standards. Helmet mounted, mesh facemasks may also serve as eye protection while operating a chain saw or brush cutter. When using a chainsaw, users should wear an additional pair of safety glasses underneath a mesh face guard.

### *Ear Protection*

Ear protection is required during some trail activities that include the use of chain saws, rock drills, and other forms of gas-powered equipment. Plastic earmuffs and foam earplugs are two types of ear protection designed to reduce external noise to a level that prevents or limits hearing loss. It is important to know the decibel level of a piece of equipment to choose the appropriate hearing protection. Use hearing protection that meets ANSI S3.19-1974 standards or higher.

### *Hard Hats*

Wear hard hats when doing trail work activities, especially in situations where there may be falling or flying objects. Hard hats should meet all OSHA-ANSI Z89.1-1997 safety standards in their design for an intended activity. Only wear helmets designed or approved for construction activities. Remember to replace damaged hard hats or those that have met their expiration date.

### *Long Pants and Chain Saw Chaps*

When maintaining or building a trail, it is important to wear long pants to protect from cuts, scrapes, and bruises. During warmer months, consider hiking to the work site in shorts and changing into longer pants before beginning work.

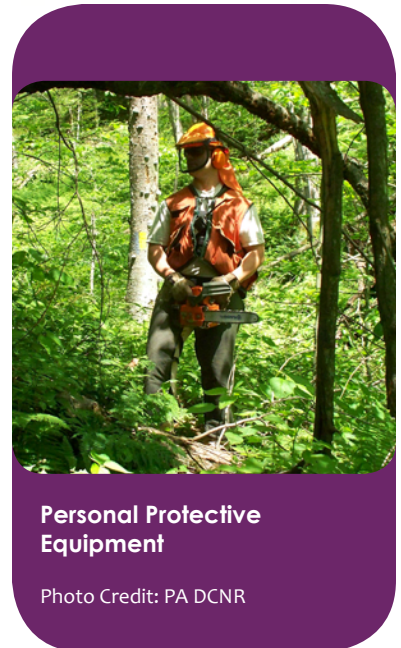
Wear chain saw chaps over pants, covering a person's legs and torso to prevent cuts or more serious injuries from occurring. The fibers of chaps will clog drive sprockets and stop chain rotation quickly, before a serious injury can occur.

### *Dust Masks and Respirators*

It is important for trail workers to wear dust masks and respirators to protect against breathing undesirable contaminants from the air. Moreover, trail workers should receive training on hazardous material identification and safety practices to choose the proper mask. For example, dust or particle masks filter airborne particulates, while respirators have a filtration component that filters hazardous fumes.

### *Rain Gear and Insulation*

Prepare for all types of weather during the construction or maintenance of a trail. Pack rain gear and insulating layers appropriate for your location,



**Personal Protective Equipment**

Photo Credit: PA DCNR



**Clearing the Tread along the McCune Trail**  
Fayette County

Photo Credit: PA DCNR

activity, and worst-case weather scenario. This might require packing several layers of clothing, hats, and gloves even during summer months. Choose synthetic or wool blends designed to keep warm even when wet.

### *Other Considerations*

Clean, inspect, and store all personal protective equipment on a yearly basis. It is a good idea to label and date all PPE at the time of purchase and keep records of the number of uses and stress placed on equipment. Replace personal protective equipment when an item has reached its expiration date or sooner, depending on wear and tear.

Every trail crew or worker should have a first-aid kit handy at all times. Its contents should be based on the hazards posed by the work, remoteness of location, and number of crew members. It is important to become educated on local poisonous plants and pests. Bring soaps, repellents, snake bite kit, and other kits for individuals susceptible to allergic reaction from bee stings and poisonous plants.

Workers who stay properly hydrated are safer, happier, and more efficient. Bring plenty of food and water on the trail and eat it. By eating and drinking appropriate amounts, it is easier to avoid hazardous health risks including exhaustion, heat stroke, hypothermia, impaired judgment, and injuries.

## Trail Construction Tools

By planning and preparing for work outings ahead of time, you will be able to estimate the type and quantity of tools necessary to complete the work. Trail construction tools fall into one of three categories:

1. Hand Tools
2. Gas/Electric Powered Hand Tools
3. Mechanized Equipment

The type of tool you use will depend on the type of work you are performing. Typically, agencies and organizations responsible for trail construction will use hand tools, and/or gas/electric powered hand tools. Professional trail builders, contractors, and sometimes municipal parks departments, will use mechanized tools and equipment where appropriate.

Determine what tools to bring with you ahead of time. Plan what work your trail crew will perform and where the work is located. Focus on one task during each outing and only bring tools required to complete that task. Bringing too many different types of tools or trying to accomplish too many tasks will reduce the crew's efficiency and slow down construction.



**Towing Tools to the Work Site**

Photo Credit: Valley Mountain Biking Club



Before heading to the work site:

- Select high quality tools
- Ensure crew members are properly trained to use the tools
- Review with crew members the safety requirements and procedures related to the tools
- Review the recommended personal protection equipment that should be worn when operating the tools

## Hand Tools<sup>2</sup>

The following is a summary of the various hand tools and the respective tasks that can be accomplished with them.

### Trail Clearing Tools

- **Swizzle Stick:** Also known as a weed whip. It is used in a swinging motion, like a golf club, to clear brush and low growth.
- **Lopping Sheer:** Essential for trail corridor brushing involving nipping small branches and clipping vegetation flush to the ground.
- **Machete:** Most effective when wielded with a vertical stroke to clear brush and vegetation.

### Timber Tools

- **Axe:** Double bit, single bit, and three-quarter axes are effective for making deep cuts when felling trees and chopping through logs.
- **Brush and Bow Saw:** Suited for making vertical cuts involved in clearing modest-sized logs from trails and bucking firewood in camp.

### Trail Tread Tools

- **Pulaski:** Preferred by many trail groups for loosening compacted soil, grubbing tread, chopping roots, and removing slough.
- **Fire Rake:** Suited for cutting, pulling, and scraping debris, mulch, leaves, small roots, and small bushes when clearing a trail.
- **Hoe:** Useful for breaking up sod when constructing a new trail or when leveling an existing trail tread.
- **Shovel:** A spade shovel is most effective for digging holes, moving loose dirt, and digging in tight spaces. As a rule, the longer the sleeve the stronger the shovel will be.
- **Mattock:** Versatile tool for digging, prying, and moving dirt, especially when unearthing rock, digging through roots, and breaking through rock.

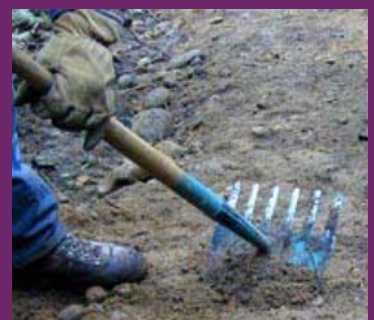
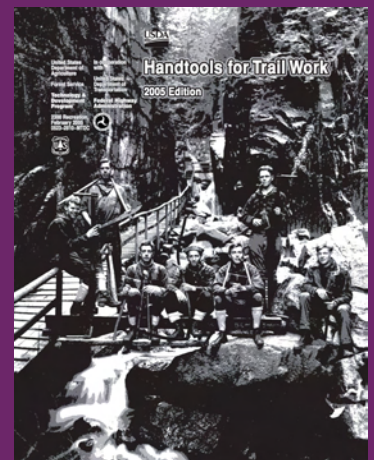
### Rock Tools

- **Rock Bar:** The rock bar, also known as a crowbar, is necessary in heavy trail work to obtain enough leverage to move large boulders and unearth rocks.

Additional information can be obtained from the U.S. Forest Service publication:

*Handtools for Trail Work:*  
2005 Edition

Available **HERE**.



Pulaski (above)  
McLeod (below)

Photo Credit: PA DCNR

2 Handtools for Trail Work, US Forest Service 2005 Edition: Updated 2012





### Grip Hoist

Country Scenic Trail

Photo Credit: Andrew Bashaw

- **Hammer:** Hammers for shaping rock may have a wedge-shaped peen needed to easily chip away parts of a rock.

### Wood Structure Tools

- **Broad Axe:** The beveled head of the broad axe cuts with the grain and hews a flat face in a log.
- **Splitting Wedge:** Wedge for splitting firewood or for laying open logs to support walkways, usually made of soft steel or aluminum.

### Bark Removal Tools

- **Drawknife:** When pulled toward the body, this tool is useful for easily removing dry, hard bark and shaving wood.
- **Barking Spud:** One of the safest tools for removing bark, the spud is valuable for removing green bark.

### Hoisting Tools

- **Grip Hoist:** A lightweight tool capable of dragging tremendous weights on wire rope in rigging systems designed for moving timber, rock, and other building material.
- **Ratchet Winch:** Useful for moving rocks and logs, as well as pulling stumps.

### Power Tools

- **Chain Saw:** A motorized tool effective for felling and bucking trees without the use of an axe.
- **Gas Powered Brush Cutters:** Similar to a heavy duty string trimmer, with a metal blade for cutting wood. A brush cutter can be useful for extensive trail clearing through young/heavy growth.
- **Rock Drill:** Useful in specific construction applications for drilling holes in rock for pinning rock, installing metal rungs or ladders, or splitting rock with feathers and wedges.



### Transporting a Chain Saw by Bike

Photo Credit: PA DCNR



## Mechanized Equipment<sup>3</sup>

### Excavators

The most common excavator configuration is a boom and shovel with a dozer blade mounted below the boom. A tracked undercarriage is usually used. The primary earthworking implement is the bucket used to dig and move earth. If the excavator is equipped with a small blade, the blade is useful in grading off excess material, leveling and back filling. Most excavator manufacturers have grubhoes or different size buckets available as attachments. The smallest excavator has a track width of 19 inches and the largest has an overall width of 63 inches. On some models the track width is variable and can be adjusted depending on trail conditions and operator experience. Horsepower rating varies between 3.5 hp and 43.4 hp.

### Dozers

Dozers are self-propelled machines mounted on either a wheeled or crawler tractor to exert a push/pull force through a blade, drawbar, or ripper and are used to move objects or materials. The primary trail building implement is the dozer blade. Dozers are machines with a width under 72-inches, not including the width of the implement.

The advantages and disadvantages of dozers compared to excavators are listed below. Other advantages/disadvantages may be observed depending on use, terrain, and locale.

### Advantages

- Large dozer blade is faster cutting a rough trail tread than a backhoe bucket
- More stable than the backhoe because the center of gravity remains constant. These machines are usually wider than the compact backhoe thus making them more stable
- Moving large boulders or tree stumps is easier with a dozer. The larger engine available in these machines makes pushing obstacles out of the way faster than digging them out
- The auxiliary hydraulics available makes the dozer an excellent platform to power other hydraulic implements

### Disadvantages

- Larger than most compact backhoes; and cuts a wider trail
- Larger trailers and towing vehicles are required for transport to the job site

### Loaders

Loaders are mounted on either a wheeled or tracked undercarriage. These machines have loader buckets up front with engines mounted in the rear. Loaders are ideal for moving rocks, soil, or other trail building material to the



**Mini-Excavator**

Photo Credit: PA DCNR



**Loader**

Photo Credit: PA DCNR

<sup>3</sup> Mechanized Trail Equipment, US Forest Service: 1996



job site. They are not designed to cut trail tread; however an angled blade and a york rake attachment are available for that purpose. The smallest loader has a width of 35.5 inches, the largest width of 74.1 inches. Some loaders come standard with wheels, but a track to fit over the wheels is available.

The size of the machine dictates the width of the trail on which the machine can operate. Tracks on the vehicle provide more traction because of a large contact area with the ground. The larger contact area also provides better resistance to inadvertent slipping, making it more stable. The larger contact area also provides more “float” over plastic soil conditions. The damping action provided by the pneumatic tires gives the wheeled vehicle a smoother ride. The vast assortment of available attachments for these loaders makes them versatile trail machines. Loaders can be used to haul or move trail materials closer to the job site.

The advantages and disadvantages of the loader compared to the excavator, dozer, and hauler are:

#### Advantages

- With the available attachments the loader performs many other functions. Able to move large volume of material
- Higher travel speeds reduce cycle time
- Parts and service are widely available

#### Disadvantages

- Performance is compromised when used as other than a loader or hauler
- Additional cost to procure attachments

#### Haulers

The basic hauler has two components: cargo area and power unit. The cargo area of the haulers range from a polyethylene tub to a hydraulically tilting dump bed. The power units range from an electric motor to a 4-stroke, liquid-cooled 90°V-Twin.

Haulers are used to haul material to and from a job site. The hauling capacity and travel speed becomes important when hauling to and from a remote location. Although these machines were designed to traverse unimproved areas, in most cases the machines travel on trails being maintained or trails with a rough cut tread.



**Hauler**

Photo Credit: PA DCNR





The advantages and disadvantages of mechanized haulers versus hand haulers are:

#### Advantages

- Greater hauling capacity with shorter cycle
- Reduced physical demand to the user
- Reduced injury due to manual labor
- Traverses rougher areas than a garden cart or wheelbarrow

#### Disadvantages

- Requires more maintenance
- Requires transport
- Need to carry gasoline or batteries
- High initial capital investment when compared to manual methods

#### All-Terrain Vehicles (ATV) and Utility Task Vehicles (UTV)

There are many ATV and UTV models on the market. The models come in either a two or four wheel drive. Both typically have a high ground clearance, and ATVs typically have a short wheel base. Consult with land owner before using these types of vehicles.

ATVs are versatile trail machines used for hauling material and shuttling personnel to and from the job site. An ATV can tow a trailer to haul material and equipment to the job site. There are numerous attachments which can be purchased or fabricated to adapt the machine to all sorts of tasks. The ATVs are used with a drag/plow or a harrow to groom trails. Accessory kits are also available to improve the performance of ATVs and UTVs.

#### Advantages

- ATVs can be fitted with implements used for trail building
- Readily available
- Most ATVs are small and rugged and can travel over rough unimproved terrain or narrow trails
- Able to haul larger loads
- Higher travel speed thus covering a larger area. When used to haul tools and material, the higher travel speed reduces the cycle time

#### Disadvantages

- Need to transport
- Need to carry fuel
- Operator has to be trained to operate and handle the machine



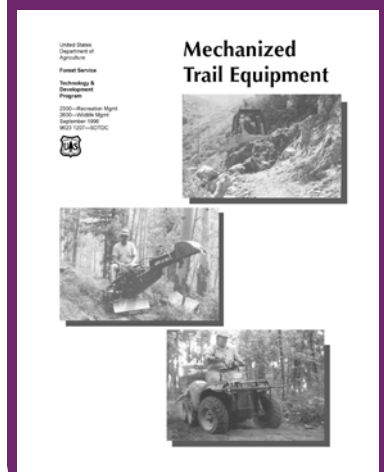
**All Terrain Vehicle (ATV)**

Photo Credit: Pashek Associates

More information can be obtained from the U.S. Forest Service publication:

#### Mechanized Trail Equipment

Available **HERE**.





## Trail Construction

When designing trails, often it is difficult to lay out the trail without having problems in achieving a sustainable route. Especially in mountain environments, it is very difficult to determine a route that follows the lay of the land, encountering few risks of erosion and saturation. Long, steep slopes are a common issue. Designers should compromise in these circumstances and build contour trails while incorporating climbing turns or switchbacks to overcome changes in grade.

When laying out your trail for construction follow the techniques and best practices for laying out a sustainable trail. At this point your trail is ready to be constructed.



Laying Out the Trail

Photo Credit: PA DCNR

### Field Layout

The objective of a field layout aims to provide safety, protect the environment, improve recreation, and minimize conflicts with adjacent properties. After mapping and scouting a future trail route, establish the flag line. A flag line marks where trail builders will cut down trees and brush, excavate a trail's treadway, and construct the trail.

During the planning and design process, as described in Chapters 1, 2 and 3, many small decisions and considerations determined the final location of the trail corridor. Therefore it is important to accurately lay out the trail in the field. The details of layout ultimately determine the quality of a trail. A trail's layout should be safe, appealing, and free of conflicts. When a new section of trail opens, it introduces new pressures to primitive lands, so it is important to keep pressures as light as possible.

Trail layout is generally not complicated. Through a trial and error process, trail designers eventually settle on the most stable, sustainable, and attractive route. Using planning maps, first scout for and flag feasible lines through the woods. Then on return trips, add more flags to refine the line of the trail. Finally, coordinate with agency partners to adjust and approve a final trail route. Most likely the trail corridor has already been flagged during its planning and design. The following is a summary of the field layout process.

### Scouting

The best time of year for scouting is when trees are bare throughout the fall and spring. During these times, an entire sweep of the proposed route can be seen that otherwise may be hidden by foliage during warmer months. Avoid scouting when the ground is snow covered because the quality of soil and drainage underneath are not visible. Its best to scout during the wet season to determine where the ground may be too wet to support a stable treadway.



As discussed in Chapter 1 - Planning, it is important for designers to study maps of the area before scouting in order to confirm all property boundaries discovered during planning. Recent advances in satellite technology have provided trail designers with a new design tool known as handheld global-positioning system (GPS) units. This tool calculates the user's position in latitude, longitude, and elevation by timing signals from satellites maintained by the United States. To prepare to scout a new location, upload flag locations to your GPS unit. The GPS unit will guide you to these locations in the field.

Fieldwork can be dangerous, especially when alone. Scouting is easiest with two or three people who can walk on and assess terrain in multiple areas. By analyzing various routes, as well as taking field notes, designers are able to discover a route that provides the best continuous course.

### Flagging

Trail flagging is essential for accurate trail layout. Flagging is the process of tying plastic ribbons around trees to indicate the center line of a route. Surveyor's flagging tape may be used to wrap around living trees and branches, while wire flags are commonly used in open, treeless terrain. Both surveyor's tape and flags come in various colors and lengths, allowing designers to choose colors that contrast with the prevailing foliage.

Detailed flagging of the trail alignment is critical at this stage. To remind trail builders of elements critical to the design, write notes with a permanent marker on the flags. Walk along a trail route using a measuring wheel and note where important structures, drainage, as well as notable features such as boulders and streams are located along the trail route.

Do not skimp on delineating the final flag line. Tie flags frequently, approximately every ten feet. This also provides backup should flags be removed or blown away. Use different colored flags when flagging alternative routes. During layout, flag carefully at junctions and switchbacks to make the footpath the shortest, easiest, and most logical route for trail users. Use distance, rugged terrain, or vegetation to prevent shortcutting through these areas. Also place flags and label them where features will be constructed.

Small and large obstacles sometimes lead to significant changes in the trail route and can result in a reroute well ahead or behind an obstacle. Willingness to keep making changes to this route often distinguishes the best trails and their designers. The more patience you have in aligning the route, the more likely you will achieve a more sustainable, higher quality location for the trail.

Always attempt to locate a line that keeps the final treadway free of structures such as waterbars, cribs, steps, and other rock and log





improvements. Allow the treadway to maintain a primitive quality by laying out the trail center line in a location that will require minimal maintenance over time. For instance, locate treadways upslope of large trees so excavation does not damage the root system. Large roots extend downslope of trees near the surface, making it difficult to excavate the edge of the treadway.

Sometimes there is no other choice than to navigate treadways through steep terrain that may require heavy trail work. This may occur in areas with a narrow corridor or those surrounded by steep slopes. When this occurs, consider including steps, waterbars, puncheon, and cribs in the layout.

When laying out accessible sections of a trail, exclude the above-mentioned elements within the design. Locate a center line that allows trail builders to excavate a sidehill treadway with grade dips to provide drainage. When constructing accessible trails, anticipate use by designated users and even trespassers that may negatively affect a trail's appearance and accessible character.

Once flagging is finished, a local management partner should review and, if necessary, adjust a flag line. The local management partner should give a trail its final approval, which sometimes includes an environmental assessment. Agency partners are responsible for protecting the environment and should survey the site to ensure that adjacent plants, animals, and other resources are not affected.

## **Final Design Work**

Before construction begins, walk the flag line with the trail builders to make sure they understand a trail's overall layout. Ensure the crew leader and all trail builders understand the important aspects of the layout. Without the establishment of good communication, a trail will most likely differ from what was originally proposed.

### *Trail Clearing*

The first step of construction is the clearing of a trail corridor to adhere to a specific project's design. Cutting new trails can be dangerous, therefore follow all safety procedures.

Trail crew leaders and their crews should understand that clearing too much can create as many problems, if not more, than clearing too little. Clear a trail corridor to the appropriate design specifications to provide an adequate clearance buffer along the edges of the trail tread. Further, the crew leader needs to understand and communicate to the crew that the designer used trees and other features to accentuate turns, limit speeds, prevent trail widening, and screen adjacent trails from view. Therefore it is critically important for them to follow the established flag line.



Before clearing the trail corridor, install all temporary and/or permanent erosion control features that the designer specified for the trail. Clearing involves removing blow downs and brushing the corridor. During the clearing process, avoid cutting large trees to minimize the need for stump removal. Trees left on the side of the trail define the trail and often are stabilizing the soils. Whenever you need to remove a sizable tree consider using the trunk as material for bridges, retaining walls, or other rustic features.

To clear the corridor the trail builders should use the door technique. The door technique involves walking the trail and imaging you are carrying a door vertically, like a shield, along the corridor. The size of the door corresponds to the vertical and horizontal clearing requirements identified in Chapter 2. Everything that falls within the outline of the door should be removed. Look for branches or limbs that touch the door. They should be removed as well to reduce future maintenance requirements. Once the corridor is cleared and brushed, the tread can be constructed.

### *Tread Construction*

At this point your trail corridor should be clear so you can safely and easily work on the tread. To construct the tread the ground should be cleared of organic materials and topsoil so the mineral soil can be shaped into the trail tread. It is necessary to remove the organic materials and soil to provide a firm base for the trail tread. On very flat trails it may be necessary to fill the void created by removing this material, or if borrow material is not available it may be necessary to leave the organic material and soil so the tread is not entrenched into the surrounding grade.

To remove organic material and soil use a mattock, fire rake or other scraping tool. Be sure to mark the sides of the treadway and follow the marks to ensure a consistent tread width. Remove all roots exposed during this process with a fire rake, or a root ax.

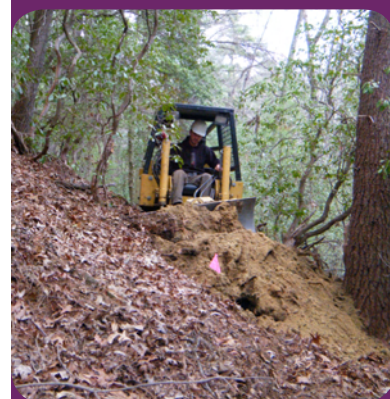
All organic matter should be placed on the downslope side of the trail, far enough way from it that it does not impede drainage. If the trail is near a stream, intermittent water course, or other body of water, transport the organic material away from the tread and the watercourse to ensure it does not enter the water.

Where the designer has specified the use of geotextile, and/or specifies a form of tread hardening, remove saturated mineral soil to firm soil.

After exposing the mineral soil follow the prescribed tread cross section as selected by the designer. You may be constructing the trail on the existing grade, or you may need to construct a bench to accommodate the trail. If a bench construction is prescribed by the trail designer, ensure that all organic material and soil has been removed so you have a sound foundation to work from.



**Tread Construction by Hand**



**Tread Construction with Sweco**



**Rail Trail Tread Construction with Road Grader**

Photo Credits: PA DCNR



With the mineral soil exposed, begin cutting the bench by starting on the uphill side, and pulling excess mineral soil to the downhill side of the tread. Continue working your way across the tread until you have achieved the desired elevation and width for the tread. Ensure the stability of both the upslope and downslope banks you are constructing on the trail.

Typically the sideslopes supporting the tread should be no steeper than 2:1, 50% slope - less is better. As you construct the sideslopes carefully smooth and finish them. Time spent fine tuning their shape will reduce future maintenance requirements. Once you complete construction of the tread, and the sidehills are finished, cover them with humus and leaf litter, or seed them with a native seed mix. This step begins the revegetation process, and in the meantime stabilizes the soils to reduce rilling and splash erosion.

As you progress along the length of the trail follow the designer's specifications and install drainage features such as dips, drainage lenses, culverts, and any other trail structures.

Once the tread has been established it should be finished. This means you may need to rake the tread smooth while maintaining the specified cross slope to direct water off of the tread. Or it may mean the tread is ready to receive a specified cross section to harden its surface.

Follow the specified requirements for compacting the tread base when installing geotextiles, and/or when hardening a tread.

Once construction is completed review the construction with the trail manager and address any areas that are unstable, unsafe, have eroded, or that otherwise do not meet the designer's specifications. Complete any required remedial work as quickly as possible.

Ideally, natural surface trails should not be opened immediately following construction to improve long term stability. The tread should be allowed to settle and bond before use. Ideally the new trail should remain closed to use for three months.

The process is the same whether the trail is constructed by hand or with mechanized equipment.

## Trail Closures and Restoration

The closure and restoration of degraded trails allows for the rehabilitation of the landscape, provided humans cannot access these previously accessible areas. Detailed restoration plans require the planning and implementation of long-term environmental repair efforts. These efforts include monitoring, site and soil preparation, planting vegetation, maintaining the closures and restoration improvements.



**Compacting an Aggregate Tread**

Photo Credit: Penn State Dirt and Gravel Road Program





Take these steps before closing or rerouting degraded trails:

1. Talk before rerouting
2. Educate trail users
3. Design a sustainable, more enjoyable trail
4. Design a smooth intersection
5. Break up the old tread
6. Control erosion on the closed trail
7. Transplant vegetation
8. Disguise the corridor
9. Redirect trail users
10. Block the corridor – Last Resort

## Construction Management

A construction management team is essential for a successful trail building project. This team may consist of an individual or team whose skills are specifically tailored to meet the construction observation requirements of a project. Additionally, the team should have an individual with strong skills in soil identification, soil preparation and soil compaction. This is especially important if the construction plans for a trail are not overly detailed.

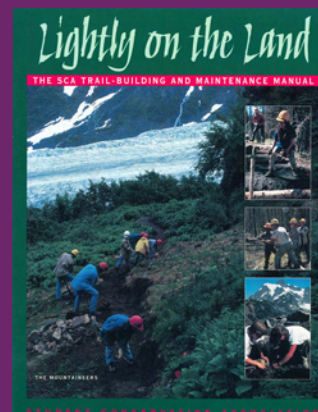
The construction management team represents the agency responsible for the trail and serves as a liaison between the design team, the contractor, and/or volunteers. The construction manager is responsible for ensuring that the materials, procedures and workmanship conform to the appropriate standards and specifications. The construction manager should also ensure that the contractor or volunteers maintain a clean, safe work environment.

## Inspection/Quality Assurance

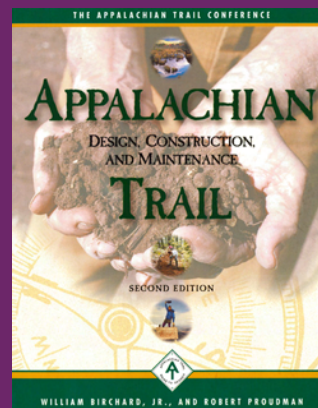
The objective of quality control is to provide a safe, functioning and lasting project, with an acceptable appearance. The trail manager and the trail designer should provide continuous inspection as necessary to ensure the field crew's performance of work meets the standards required. The degree of inspection will depend on the experience of the crew, the complexity of the job, and the specific task being accomplished.

There are several resources available that provide detailed and in-depth information on trail construction, they include:

- *Lightly on the Land: The SCA Trail Building and Maintenance Manual*<sup>4</sup>



- *Appalachian Trail Design, Construction and Maintenance, 2nd Edition*<sup>5</sup>



- *AMC's Complete Guide to Trail Building*<sup>6</sup>

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- 4 *Lightly on the Land: The SCA Trail Building and Maintenance Manual*, Student Conservation Association, 1996
  - 5 *Appalachian Trail Design, Construction and Maintenance, 2nd Edition*, the Appalachian Trail Conference, 2000
  - 6 *AMC's Complete Guide to Trail Building*<sup>1</sup>, published by the Appalachian Mountain Club, 2008



**Trail Construction**  
Black Diamond Trail  
Luzerne County

Photo Credits: Delaware & Lehigh  
National Heritage Corridor

## Permit Compliance

The trail manager should have a copy of all permits that have been issued for the project. In addition to ensuring compliance, the construction manager should monitor completion of reporting requirements. The trail manager should also coordinate and facilitate inspection by permit-issuing agency personnel, such as Conservation District personnel, DEP staff, and local municipal code enforcement officers.

## Erosion Control

Proper installation of temporary erosion control measures during construction not only protects the environment, but also protects new construction until permanent measures have been established. The construction manager should frequently inspect temporary control measures to ensure they are functioning properly, particularly after storm events. Conservation District or DEP personnel may periodically inspect the project site to determine if selected best management practices are effectively controlling soil erosion. Best management practices that have failed or are not effectively controlling erosion as intended, should be replaced or repaired. Alternative measures may be required.

## Final Inspection

When construction is nearly complete, the trail designer, the trail manager and the trail builder should make a final inspection as applicable. The inspection party should walk the trail on foot. A “final punch list” of items to be completed or corrected should be prepared and agreed upon by the inspection party. Upon correction of the items on the punch list, the contractor should complete and submit “As Constructed” plans.



# Management

A management plan is an important component to ensure a positive user experience and to effectively manage the potential risk associated with a trail. Those responsible for managing a trail should adopt a trail management plan before a trail is opened. If you do not have a management plan for your trail use this as a guide to assist you in preparing one.

We encourage all trail managers to develop a management plan by adopting policies and procedures in a written document. A management plan establishes expectations for the operations, maintenance and security of the trail.

This chapter provides you with the tools necessary to develop a trail management plan specific to your organization and your trails. It contains policies and procedures which may or may not be applicable to your specific trail. If you are unsure whether a specific practice is needed for your trail, consult your DCNR regional adviser for assistance.

In this chapter we discuss:

## 1. Trail Management Considerations

- Management Structures
- Trail Management Objectives
- User Safety and Security
- Natural and Cultural Resource Management
- The Physical Corridor
- Programming and Environmental Education Activities
- Conflicting and Competing Uses
- Use of Volunteers
- Monitoring Trail Uses
- Trail Closures
- Trail Accessibility Policy

## 2. Trail Maintenance Considerations

- Frequency of Maintenance
- Trail Assessments and Inspections
- Hazard Tree Identification, Inspection, and Corrective Action
- Revegetation and Restoration
- Training

Trails should be maintained to be safe and usable at all times. Potential hazards should be clearly identified and marked to alert users until they can be repaired.

Failure to properly manage and maintain a trail may result in an unsafe condition that may become a hazard to the trail users and a liability to those responsible for managing the trail.



**Pennsylvania Equine Council Trail Care Crew**  
**Black Moshannon State Park**  
Centre County

Photo Credit: PA DCNR





## Management Plan

Successful trail management plans have two components. The first component addresses the management aspects, including policies and procedures to ensure trail access, provide a quality experience for the user, and minimize maintenance impacts. The second component addresses the maintenance aspects, including policies and procedures for maintaining the trails to provide for user safety, access, and convenience, protect adjacent resources, and preserve trail investment. In the first half of this chapter we discuss the management considerations and in the second half we discuss maintenance considerations.

## Trail Management Considerations

A trail management plan<sup>1</sup> typically consists of the policies and procedures for:

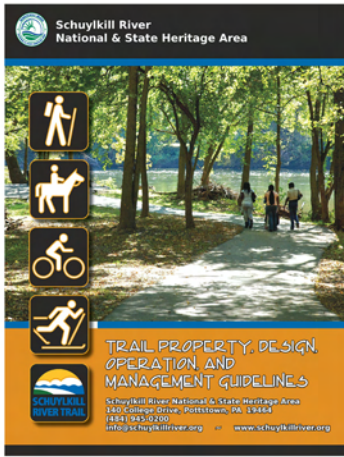
1. Creating the Management Structure
2. Establishing Trail Management Objectives
3. Providing for User Safety and Security
4. Managing Natural and Cultural Resources
5. Managing the Physical Corridor
6. Providing Programming and Environmental Education Activities
7. Managing Conflicting and Competing Uses
8. Managing Volunteers
9. Collecting Trail Use Counts
10. Establishing Trail Closure Policies
11. Establishing a Use of Wheelchairs and Other Powered-Driven Mobility Devices (OPDMD) Policy

The management plan should be adapted to reflect the requirements of the uses being managed on your trail.

### 1. Creating the Management Structure

In many instances an existing agency or organization will be responsible for managing a trail or trail system. However, in instances where there is not a management structure in place, there are many options to consider when exploring the appropriate management structure for a particular trail. If your trail extends through multiple jurisdictions and/or multiple entities are responsible for its management, a well defined management structure is essential and important to the success of the trail.

<sup>1</sup> Adapted from The Yough River Trail Cooperative Management System, Regional Trail Corporation: unpublished



**Schuylkill River Trail Management Plan**  
Southeast Pennsylvania

Photo Credit: Schuylkill National Heritage Area

## Risk Management

The identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events or to maximize the realization of opportunities.



Before assuming that you need to create a new organization or agency to manage your trail, the first step is to determine whether an existing organization or agency is capable and willing to manage your trail. To accomplish this, identify potential partners and discuss with them your trail management needs and expectations.

The capabilities of agencies and organizations can vary greatly depending on the regulatory, agency, and organizational requirements governing a particular management structure. Therefore, it is important to compare the management needs with the capabilities of existing agencies and organizations to determine if they have the ability and capacity to meet your needs. The following is a list of potential management needs to consider.

### *Potential Management Needs*

1. Organizational and financial administration
2. Organizational sustainability
3. Financial sustainability
4. Administration of volunteers and ability to build and retain pools of volunteers
5. Ability to secure federal, state, and/or municipal funding
6. Ability to secure foundation funding
7. Geographic jurisdiction or potential area of jurisdiction
8. Project planning and design
9. Partnership and relationship building
10. Land acquisition, access easement, and rights-of-way
11. Negotiation/equitable ownership
12. Construction funding
13. Project mobilization and implementation
14. Other resources receipt and management (e.g. donated materials or equipment with operator)
15. Maintenance capabilities/needs or arrangements for maintenance
16. Insurance or insurability/risk management
17. Operations/maintenance funding
18. Accountability to public interest/fiduciary responsibility to public trust
19. Public relations and marketing ability

Your particular trail may have additional management needs. It is important that you identify them early in the process and that you discuss all needs with potential partners who may assist in managing the trail.

If an agency or organization cannot be identified that can manage your trail, then you should determine if there is potential to establish an organization to provide your management needs. There are many types of management

2 Managing Mountain Biking, IMBA's Guide to Providing Great Riding, International Mountain Bicycling Association: 2007



**Regional Trail Corporation  
Office, West Newtown Trail  
Station**  
Westmoreland County

Photo Credit: Betsy Manderino



structures, each type providing opportunities and limitations regarding their ability to manage trails. Management structures typically fall into one of the following categories:

- Municipality Owned/Operated
- Non-Profit Owned/Operated
- A hybrid of the above

### Technical Assistance

DCNR's Recreation and Parks Technical Assistance Program can provide you resources to evaluate management structures for your trail system. For more information visit [HERE](#).

Should it be necessary for you to develop and evaluate alternatives for a new management structure for your trail, PA DCNR may be able to provide assistance through its Peer Grant Program. Peer grants are awarded to help municipalities improve their park, recreation and conservation services through a collaborative process. Projects are accomplished through contracts with experienced park, recreation, and conservation professionals from nearby communities who will work closely with local leaders. For additional information on the PA DCNR grant program contact your regional DCNR adviser or visit the website [HERE](#).

## 2. Establishing Trail Management Objectives<sup>3</sup>

Effective trail management includes establishing trail management objectives during the trail planning process. The Trail Management Objective (TMO) form developed by the U.S. Forest Service synthesizes the management intention of a proposed or existing trail. The TMO provides a means of recording basic information for future trail planning, management, and reporting. TMOs are a prerequisite for completing an effective trail condition assessment, as well as planning future work required to comply with current standards.

A TMO should be developed during the planning process as it will include trail specifications, level of difficulty, and the number and types of users the trail will serve. In the past, trails were maintained based on their type and level of use and not their intended design use. By establishing TMOs for each trail system, a trail's design and management can better correspond with its intended type and level of use. If you have an existing trail that does not have a TMO, one should be prepared for it based on its existing conditions.

### *Developing Effective TMOs*

Trail sponsors should review and approve TMOs before and after the trail design is completed. This ensures that objectives for the trail are consistent with the location's current and future land management practices. Furthermore it ensures consistent use between trails. TMOs should be updated if the management intent for the trail, special considerations, or other factors change.

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<sup>3</sup> U.S. Forest Service Trail Fundamentals,  
<http://www.fs.fed.us/recreation/programs/trail-management/trail-fundamentals/>





It is essential to establish and document TMOs before you construct a trail to ensure proper management of the trail in the future. The following instructions explain the importance of the information to be documented on the TMO worksheet:

### Overall Trail Information

- **Trail Name:** Specify the official trail name.
- **Trail Location:** Specify the trail location based on the naming protocol of the trail sponsor.
- **Trail Length:** Specify the length of the trail in miles. Mileage accuracy recorded on the TMO should correspond to the method of collection: wheel, GPS, map, or unknown.
- **Trail Beginning and Ending Segment:** Specify the location of the trail's beginning and ending segment using coordinates or mileposts.

### Designed Use Objectives

- **Designed Use:** Specify the prescribed use for the proposed trail. The designed use is necessary to establish the standards for which the trail is designed, constructed, operated, and maintained.
- **Season of Use:** Specify the season(s) the trail will be open for use. Indicate the specific date(s) or frequency of seasonal closure.
- **Level of Difficulty:** Specify the prescribed level of difficulty for a specific trail based on its corresponding level of difficulty standards.
- **System Layout:** Specify the type of layout the trail will conform to.

### Trail Specifications

- **Maximum Grade:** Specify the maximum grade of the trail. Indicate the maximum percent grade for a sustained length of tread, as well as a short length of tread along the proposed trail route.
- **Minimum Clearances:** Specify the minimum clearance of a trail. Indicate the width and height in feet based on a trail's design guidelines.
- **Design Requirements:** Specify the trail's proposed tread width, curve radius, and surface material. This information should be based on the trail's suggested design guidelines.
- **Managed Use:** Specify the mode of travel that is appropriate for a trail, based on its design and management.
- **Prohibited Use:** Specify any use or mode of travel prohibited by an official legal order or the trail sponsor.

### Trail Characteristics

- **Sensitive Areas:** Specify all ecologically or hydrologically sensitive areas within the proposed trail corridor.
- **Destinations:** Specify all destinations accessible to or visible from the proposed trail route.

### International Mountain Bicycle Association's 16 Considerations for Risk Management Planning<sup>4</sup>

1. Create a risk management team and designated leader
2. Write a philosophy statement
3. Establish a trail design and construction policy
4. Establish a trail inspection and maintenance policy
5. Maintain the trail system as specified in the policy
6. Eliminate unreasonable hazards
7. Develop an effective sign program
8. Implement a trail difficulty rating system
9. Institute rules and advise users
10. Develop an emergency action plan
11. Purchase or review an insurance policy
12. Create a record keeping system
13. Develop an incident reporting system
14. Deploy a trail patrol
15. Recruit outside advisors

4 Managing Mountain Biking, IMBA's Guide to Providing Great Riding, International Mountain Bicycling Association: 2007



- Structures: Specify all structures currently located along the trail route or that will need to be constructed.

### Trailheads and Amenities

- Trailheads and Access Points: Specify the name and location of all trailheads providing access to the proposed trail route.
- Amenities: Specify all current or proposed amenities located within a trailhead or along the proposed trail route.

### Maintenance Requirements

- Routine Maintenance Schedule: Describe the anticipated frequency for completing routine maintenance tasks within this section. Define which maintenance tasks should occur on a weekly and monthly basis.
- Special Considerations and Notes: Note any additional considerations of which trail managers, design, construction, or maintenance personnel should be aware. Provide details or references for corresponding direction.



## Trail Management Objectives

**Trail Name** \_\_\_\_\_ *Begin Segment* \_\_\_\_\_ identified by mileposts ☐  
**Location** \_\_\_\_\_ *End Segment* \_\_\_\_\_ or coordinates ☐  
 Total Trail Length \_\_\_\_\_ Segment Length \_\_\_\_\_

page 1 of 2

**Designed Use** ☐ Hike / Pedestrian ☐ Bike ☐ Mountain Bike ☐ Equestrian  
☐ Cross Country Ski ☐ Snowshoe

**Season of Use** ☐ Year Round ☐ Winter ☐ Spring ☐ Summer ☐ Fall

**Level of Difficulty** ☐ Easiest \_\_\_\_\_% ☐ More Difficult \_\_\_\_\_% ☐ Most Difficult \_\_\_\_\_%

**System Layout** ☐ Linear ☐ Single Loop ☐ Stacked Loop ☐ Multiple Loop  
☐ Spoked Wheel ☐ Primary & Secondary Loop ☐ Maze

### Trail Specifications

**Maximum Grade** Sustained ..... \_\_\_\_\_%  
 Short ..... \_\_\_\_\_%  
**Minimum Clearances** Width ..... \_\_\_\_\_feet  
 Height ..... \_\_\_\_\_feet

### Tread Specifications

**Tread Surface** ☐ Stable ☐ Firm  
**Tread Material** ☐ Native In-Place ☐ Native Borrow  
☐ Manufactured, \_\_\_\_\_ ☐ Stabilized Soil  
☐ Stone ☐ Pavement

**Design Requirements** Tread Width ..... \_\_\_\_\_feet  
 Target Cross Slope ..... \_\_\_\_\_%  
 Minimum Curve Radius .... \_\_\_\_\_feet

### Accessibility

☐ Complies with ADA – Draft final Accessibility Guidelines for Outdoor Developed Areas

**Managed Use** ☐ Shared Use Path / Rail Trail ☐ Multi-Use / Shared Use Trail  
☐ Hike / Pedestrian ☐ Bicycle ☐ Equestrian  
☐ Cross Country Ski ☐ Snowshoe

**Prohibited Use** ☐ All Motorized Use ☐ ATV ☐ Snowmobile  
☐ Hike / Pedestrian ☐ Bike ☐ Mountain Bike ☐ Equestrian  
☐ Cross Country Ski ☐ Snowshoe

**Sensitive Areas** ☐ Wetlands ☐ Seeps ☐ Habitat ☐ Species  
☐ Cultural / Historical ☐ EV / HQ Streams ☐ Adjacent Land Use  
☐ Other, describe: \_\_\_\_\_

**Destinations** ☐ Parks ☐ Connecting Trails ☐ Wildlife Areas ☐ Control Points  
☐ Stream Crossings ☐ Trailheads ☐ Vistas ☐ Scenic Areas  
☐ Others, describe: \_\_\_\_\_

**Structures** ☐ Culverts ☐ Bridges ☐ Rock Walls  
☐ Crib / Gabion Walls ☐ Other Walls  
☐ Other Structures, describe: \_\_\_\_\_

**Notes**

Prepared by \_\_\_\_\_

Date \_\_\_\_\_





## Trail Management Objectives

Trail Name \_\_\_\_\_ Begin Segment \_\_\_\_\_ identified by mileposts ☐  
 Location \_\_\_\_\_ End Segment \_\_\_\_\_ or coordinates ☐  
 Total Trail Length \_\_\_\_\_ Segment Length \_\_\_\_\_

page 2 of 2

Trailheads & Access Points Name \_\_\_\_\_ Location \_\_\_\_\_ identified by milepost ☐  
 or coordinates ☐

**Amenities**

|   |  |  |
|---|--|--|
| <input type="checkbox"/> Parking, no. of spaces _____ | <input type="checkbox"/> Restroom          | <input type="checkbox"/> Potable Water |
| <input type="checkbox"/> Trash / Recycling Containers | <input type="checkbox"/> Picnic Shelter    | <input type="checkbox"/> Kiosk         |
| <input type="checkbox"/> Message Board                | <input type="checkbox"/> Primitive Camping | <input type="checkbox"/> Warming Hut   |
| <input type="checkbox"/> Bike Rack                    | <input type="checkbox"/> Air Station       | <input type="checkbox"/> High Line     |
| <input type="checkbox"/> Hitch Rail                   | <input type="checkbox"/> Corral            | <input type="checkbox"/> Horse Stall   |
| <input type="checkbox"/> Watering Trough              | <input type="checkbox"/> Fire Ring         | <input type="checkbox"/> Picnic Table  |
| <input type="checkbox"/> Others, describe: _____      |  |  |

**Maintenance Requirements:** Identify the anticipated frequency for completing routine maintenance tasks

| Routine Maintenance Schedule          |     |     |     |      |      |      |      |      |      |     |     |     |
|---------------------------------------|-----|-----|-----|------|------|------|------|------|------|-----|-----|-----|
| Maintenance Activity                  | Jan | Feb | Mar | Apr  | May  | Jun  | July | Aug  | Sept | Oct | Nov | Dec |
| EXAMPLE- Mowing                       | /   | /   | •   | •••• | •••• | •••• | •••• | •••• | •••• | ••• | /   | /   |
| Mowing                                |     |     |     |      |      |      |      |      |      |     |     |     |
| Trimming                              |     |     |     |      |      |      |      |      |      |     |     |     |
| Trash                                 |     |     |     |      |      |      |      |      |      |     |     |     |
| Pruning                               |     |     |     |      |      |      |      |      |      |     |     |     |
| Weeding                               |     |     |     |      |      |      |      |      |      |     |     |     |
| Invasive Removal                      |     |     |     |      |      |      |      |      |      |     |     |     |
| Brush Hog                             |     |     |     |      |      |      |      |      |      |     |     |     |
| Signs - inspect/repair/replace        |     |     |     |      |      |      |      |      |      |     |     |     |
| Blazes - inspect/re-paint             |     |     |     |      |      |      |      |      |      |     |     |     |
| Fence - inspect/repair/replace        |     |     |     |      |      |      |      |      |      |     |     |     |
| Culverts - inspect/repair/replace     |     |     |     |      |      |      |      |      |      |     |     |     |
| Storm Drains - inspect/repair/replace |     |     |     |      |      |      |      |      |      |     |     |     |
| Gates - inspect/repair/replace        |     |     |     |      |      |      |      |      |      |     |     |     |
| Bridge - inspect/repair/replace       |     |     |     |      |      |      |      |      |      |     |     |     |
| Maintain Dips                         |     |     |     |      |      |      |      |      |      |     |     |     |
| Grade Ditches                         |     |     |     |      |      |      |      |      |      |     |     |     |
| Trail Grooming                        |     |     |     |      |      |      |      |      |      |     |     |     |
| Trail Surfacing                       |     |     |     |      |      |      |      |      |      |     |     |     |
| Landscaping                           |     |     |     |      |      |      |      |      |      |     |     |     |
| Storm Damage                          |     |     |     |      |      |      |      |      |      |     |     |     |
| Vandalism                             |     |     |     |      |      |      |      |      |      |     |     |     |
| Repair Washouts                       |     |     |     |      |      |      |      |      |      |     |     |     |
|                                       |     |     |     |      |      |      |      |      |      |     |     |     |
|                                       |     |     |     |      |      |      |      |      |      |     |     |     |

| Special Considerations | Notes |
|------------------------|-------|
|                        |       |

Prepared by \_\_\_\_\_ Date \_\_\_\_\_



### 3. Providing for User Safety and Security

The most important consideration along your trail is the safety of the trail users. Therefore, proactive planning, coordination, and response policies are necessary.

#### Trail Rules

Generally trail rules begin with identifying the permitted uses for the trail. Often the rules also identify uses that are prohibited along the trail. The following rules have been established by the Regional Trail Corporation for the Great Allegheny Passage:

1. No motorized vehicles.
2. Bicyclists and horse riders should wear helmets. Pennsylvania State Law mandates that children under 12 years old wear safety-approved helmets.
3. Keep right, except to pass.
4. Warn before passing. Sound your bell or horn and announce audibly "Passing on your left."
5. Bicyclists yield to walkers/hikers.
6. Equestrians are allowed on specified sections of the trail. Please keep horses off the improved hiker/biker surface. Stay on the grass.
7. Trail open daily, dawn to dusk. No overnight use, except in authorized areas. Reservations are required for groups of 10 or more.
8. Stay on trail.
9. No fires.
10. Keep pets on a leash six feet or less in length, under control, and collect and dispose of pet waste in a proper receptacle.
11. Do not discharge or carry loaded firearms on or near the trail.
12. Please respect private property and stay on the trail.
13. Dumping and littering are prohibited. If you see litter, please pick it up.
14. Permits are required for any special group event of twenty-five or more.

Trail rules should be presented in a multilingual format where appropriate.

#### Cellular Phones and Cellular Service

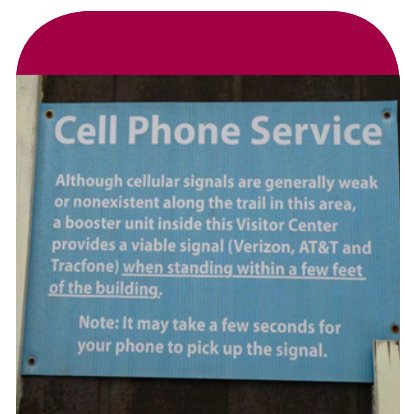
On websites, at trailheads, and on all printed trail maps, identify whether cellular phone service is available along your trail corridor, and provide the telephone numbers for emergency responders. The following is a sample policy:

Cellular phones have become a staple for those traveling. Cell phones provide contact with emergency service personnel during times of need. However, given the remote locations of many trails, one cannot always assume cellular service will be available when needed.



**Dr. J Freeride Trail Rules**  
Allegheny County

Photo Credit: Pashek Associates



**Great Allegheny Passage  
Rockwood Trailhead**  
Somerset County

Photo Credit: Somerset County



Therefore, to promote awareness and eliminate reliance on service that may not be available; place cell service notices at trailheads and access points. Notices should indicate whether cell service is available, and if so what carriers can access it along a particular corridor, further, this notice should indicate where service is ‘spotty’ or where access service is unreliable.

### *Police, Fire, and Ambulance Coordination*

Often a trail will pass through a number of municipalities each having jurisdiction. As a result, this provides potential conflicts for emergency service response. The Pennsylvania Emergency Management Agency (PEMA) facilitates emergency services in a coordinated fashion. PEMA policies and procedures govern emergency response procedures and responsibilities along the trail corridor. Therefore, it is important to have public safety agencies involved in the trail planning and design process to ensure their needs are being met.

Post the phone number(s) for the appropriate first responders at trailheads and trail access locations.

### *Law Enforcement*

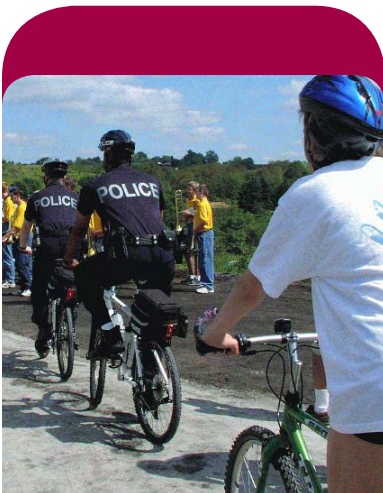
Emergency law enforcement response can typically be activated by dialing 911. On DCNR-owned lands, all responses to emergency and criminal actions are handled by the DCNR Ranger first and then either the State Police or the local law enforcement agency, depending on the location.

Each state agency is empowered to enforce state conservation laws on its lands and, in certain cases, on other lands throughout Pennsylvania. In addition, state conservation agencies can sometimes enforce the state’s criminal and vehicle code on agency-owned conservation lands. State and municipal law enforcement agencies are the primary entities with enforcement powers on all lands.

On non-state owned lands, all responses to criminal actions are handled by either the State Police or by a local law enforcement agency. Where a full-time local law enforcement agency is available, that agency will serve as the primary law enforcement agency and the State Police will function as backup. Where a part-time law enforcement agency exists, that agency will serve as the primary law enforcement agency during its business hours; State Police will fill in during off -hours. Where no local agency is available, the State Police will provide necessary police service on a full-time basis.

### *Emergency Medical Services (EMS)*

Emergency medical service response can typically be activated by dialing 911. Post EMS response contact information at trailheads and trail access points.



**Trail Patrol**  
**Montour Trail**  
Allegheny County

Photo Credit: Montour Trail Council





### Emergency Response Procedures

Trail managers should work with local law enforcement and emergency responders to develop appropriate policies and procedures; often these will vary from place to place. This includes providing the responders with keys to gates so they can access the trail corridor.

### Milepost Signs for Emergency Response

Mile posts should be maintained to allow users to identify their location along the trail. The frequency of the mile posts, i.e. every 1/2 mile, 1/4 mile, etc. depends on the nature of the trail. If a person calling in an emergency, states that the victim is near milepost 8.5, response personnel can easily identify an appropriate vehicular staging area to allow for the quickest access to the victim. This enables response personnel to more easily locate the victim.

Trail managers should create maps of all public and private access points that can be used in an emergency. The maps should show the mileage that corresponds to the mile markers installed on the trail. The maps should be distributed to regional EMS, fire, and police.

### River, Stream, and Pond Related Emergencies

Should a report of a possible drowning be received, a mountain bike emergency response team should be dispatched. If the location of the victim is unknown, the response team will be able to scan the stream's banks faster and more efficiently than can be done on foot or by vehicle. When the victim is located, resuscitation can be initiated, and necessary equipment can be summoned, speeding assistance to the victim while minimizing impact on the environment.

### Winter Emergencies

In the event a skier or hiker should require medical aid, it may be necessary to gain access to the victim by use of snowmobile. Trail conditions may prohibit mountain bikes, ambulances, or other emergency response vehicles on the trail. Local emergency response personnel should identify partners who can provide snowmobiles should the need arise. Snowmobiles should be staffed by EMS personnel and a sled should be available for patient transport. Snowmobile operators must be aware that skiers and hikers may be present on the trail and extreme caution should be used when operating a snowmobile on the trail during the emergency response effort.

### Fire and Wildfire Control

In the event of a fire, or possible fire, on the trail, fire chiefs should verify the nature and extent of the fire before moving equipment onto the trail. Efforts should be taken to limit fire equipment on the trail to the extent possible to limit damage to the trail surface.

Campfires and open burning should be discouraged along the trail through local ordinances. This restriction should be posted on trail maps and brochures, and on signs at trailheads and trail access points.



The DCNR Bureau of Forestry has the legal authority and jurisdiction as the wildfire control agency, and coordinates efforts, regardless of land ownership. Most rural fire companies maintain their own trained volunteers and equipment to fight forest and grass fires and maintain a communication network.

#### 4. Managing Natural and Cultural Resources

The resource is not only the trail itself but also the surrounding environment. Therefore resource protection measures should also be implemented.

##### *Adjacent Land Use – Zoning*

The issue of adjacent land use is central to protection of the trail as a resource. Since the trail is a relatively narrow strip of land, the quality of the trail users' experience is largely a function of how the land adjacent to the trail corridor is developed.

Overall direction and policy should be developed through a broad-based planning process. The resulting development guidelines should be formalized in a model ordinance, which can in turn be used by local municipalities to modify their land use plans and zoning ordinances.

##### *Visual Management and Open Areas*

Open areas and scenic vistas are desirable to maintain at certain points along the trail to ensure variety and an interesting trail experience. Visual management and open area maintenance should be directed primarily by the local municipalities having jurisdiction, and coordinated by the corresponding County Planning Department. The ecological health of the trail corridor should take precedence over aesthetics or providing vistas.

##### *Timber and Vegetation Management*

Timber management is carried out for safety and economic reasons. Since the trail is intended as a scenic recreational corridor, it is unlikely that timber harvesting within the trail proper will be permitted. More likely is the fact adjacent lands could be used for timber harvesting.

Weed control is another issue. All possible steps should be taken to ensure that resulting environmental and aesthetic impacts on the corridor are adequately considered and mitigated. Environmentally friendly alternatives to herbicides and pesticides should be explored and exhausted before resorting to chemical measures to control weeds and pests.

##### *Rare, Threatened and Endangered Species and Other Wildlife*

Threatened and endangered species are protected under state and federal laws. Trail development, use, and interpretation should take into consideration these protections, and work within the state and federal



**Freemansburg Canal  
Education Center**  
Northampton County

Photo Credit: Delaware & Lehigh  
National Heritage Corridor



**Walnutport Heritage  
Attractions Sign**

Photo Credit: Delaware & Lehigh  
National Heritage Corridor



regulations to protect these resources. The protection of rare, threatened and endangered species begins during the trail planning process.

The trail corridor provides narrow but continuous habitat for a wide variety of wildlife. This may benefit both wildlife and trail users alike, since viewing wildlife is one of the many reasons people use trails. Protection of wildlife is the responsibility of the Pennsylvania Game Commission, including game, non-game, endangered and non-endangered wildlife species. Should wildlife disturbance be a concern along your corridor, contact your regional Pennsylvania Game Commission office.

### *Historical and Cultural Resources*

Typically, historical and cultural features are located along trail corridors. These features add to and enrich the trail experience. Strive to protect and enhance historic and archeological resources to the maximum extent possible. When trail development and/or activities might negatively affect or disturb cultural or archeological resources, contact the Pennsylvania Historic and Museum Commission by completing a Cultural Resources Notification as described in The Permitting Process, located in Chapter 1.

## **5. Managing the Physical Corridor**

### *Trailhead Access and Parking*

Policies and procedures should be developed to address issues such as:

1. How to deal with not having enough parking
2. Illegal parking
3. Inappropriate parking lots

### *Signs*

Adopt a standardized sign system consistent throughout the length of the trail during the trail's initial development. An effective sign plan includes:

- Directional signs to nearby trail services
- Mileage markers
- Regulatory signs
- Interpretive signs for historic, cultural, and environmental features

Policy should state who is responsible for maintaining signs. Policies should be in place to avoid sign clutter by balancing information with aesthetics. Consider multilingual text where appropriate. Trail kiosks, maps and brochures should indicate that unless marked, do not drink the water from natural sources along the trail.

### **Visually Speaking**

*Bring your stories to life*

A comprehensive guide to sign development

within the

**Delaware & Lehigh  
National Heritage Corridor**



### **Sign Standards**

Photo Credit: Delaware & Lehigh  
National Heritage Corridor





### *Bridges, Stream Crossings, and Drainage Structures*

Routine maintenance of existing structures should be performed by the trail sponsor. If the structure is associated with other uses, i.e. vehicular, rail, etc., then inspection and maintenance of the structures will likely be the responsibility of the entity responsible for those uses. In these cases a written agreement should be in place to establish the responsibilities of each organization utilizing the structures.

### *Landscape Screening*

Often, during the design and development phase of the project landscape screening is considered along portions of a trails to enhance the trail experience and ensure privacy for adjacent landowners. Consider material and maintenance requirements of screening options so they are in harmony with their surroundings and achieve the desired effect. Further, plant any landscaping along a trail with native plant materials. Maintenance and replacement of plantings will be the task of the maintenance groups. Before installing landscape screening assess the capacity to maintain the plantings upon installation and into the future.

### *Connector Trails*

It is important to maintain the continuity of the trail experience throughout a trail's entire length. Therefore, where appropriate, plan and develop a trail with its regional significance in mind. The addition of connector trails may occur in the future to provide access to nearby parks, historic, cultural, and environmental features. Trail sponsors typically maintain side and connecting trails with the formalized written consent of the agency owning the land.

### *Overnight Use/Camping Areas*

The development and management of overnight facilities requires more detailed policies and regulations. Such areas should be considered, when appropriate, during the planning process. Policies and procedures should be in place before opening overnight use/camping areas.

Typical facilities at overnight use areas include access to potable water, picnic tables, and toilets. Youth hostels, bed and breakfast facilities, and groups of commercial campgrounds with a high level of facilities usually are available in or near towns with public sewer and water utilities. Provide wayfinding signs to direct trail users to these facilities.



## 6. Providing Programming and Environmental Education Activities

### *Special Event and Large Group Use*

Trails may be used for special events, such as walk-a-thons, group bicycle rides and environmental education programs. Policies on large group activities need to be established, such as when a trail can be reserved and for what length of time. Also, permit applications and participant releases/waivers should be used. Local municipalities should be involved in developing regulations and providing subsequent enforcement of them for special events and large group use. Special events and large group uses should be permitted through the agency responsible for the day-to-day management of the trail.

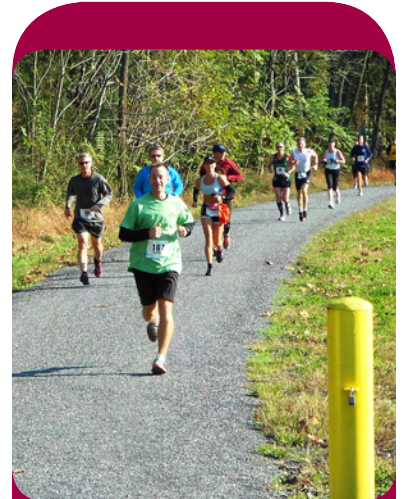
Trail managers may require sponsors to obtain a special use permit when the number of participants will exceed a certain number of registrants, typically in the range of 20 to 25 participants.

Typically the trail's managing agency reviews the application and, barring any conflicts, issues the permit along with the regulations and guidelines letter. Special uses by definition should not occur without appropriate review and control. Sponsors should be required to provide additional facilities, at their cost, as required to meet event needs. This many include: garbage and recyclable collection; providing temporary sanitary facilities; establishing emergency and delivery routes; providing traffic and parking control, etc. All major activities should be centered at a trail access point capable of hosting the special event.

### *Public Information and Education Program Polices*

The success of a trail depends on the awareness of its existence by potential users and supporters. Therefore, it is important to ensure that appropriate means are used to inform the public about the trail. This can be accomplished through direct efforts of state, county, and local agencies and through marketing efforts by local municipalities and commercial interest groups.

Public education programs can be developed to illuminate various aspects of the trail and adjacent areas such as history, plant and wildlife biology, ecology, and recreational workshops. The trail could become a valuable educational resource for local elementary and secondary schools, as well as local colleges and universities within the region of the trail. Cell phone tours and smart phone links can be developed and provide a cost effective way to provide a great source of trail information.



**Trail Marathon**

Photo Credit: Delaware & Lehigh National Heritage Corridor



**PA Wilds Interpretive Panel**

Photo Credit: PA DCNR



Trails and corresponding events should be promoted within their region. A coordinated effort for promoting the trail should begin with the respective county's tourist promotion agency (TPA). TPAs receive funding for tourist promotion through a hotel tax. To locate the TPA in your area visit this [\*\*WEBSITE\*\*](#).

TPAs typically include trail activity and events in their calendars, and can highlight your trails in their publications. Further, TPAs can assist with applying to PennDOT for transit oriented development (TOD) signs and applying for funding to promote and develop tourist opportunities throughout the trail corridor.

## **7. Conflicting and Competing Uses**

Many of the following issues typically require the enactment and enforcement of local ordinances by participating municipalities.

### *Motorized Use*

Many non-motorized trails have adopted policies that prohibit motorized use. In these instances, the design of the trail should be completed in a manner to discourage motorized use of the trail. Cooperative enforcement efforts by municipalities, counties, and the State Police are necessary to preserve motorized use restrictions. Adopt local ordinances to prohibit motorized use of the trail corridor and establish an escalating scale of penalties for offenders.

### *Litter and Graffiti*

Enforcement of litter and graffiti ordinances will be the responsibility of the relevant municipality or the State Police. Routine monitoring and patrolling by trail users and local support groups will help to decrease these problems. Littering and vandalism is less likely to occur repeatedly in areas where trail monitoring occurs and problems are dealt with in a timely manner.

### *Hunting*

The trail's managing agency is responsible for establishing a policy regarding hunting along the trail corridor. Hunting policies should be developed in consultation with the respective regional office of the Pennsylvania Game Commission. To locate your regional office visit their website [\*\*HERE\*\*](#).

### *Horseback Riding*

Where horseback riding is a permitted use, develop guidance and/or signage explaining proper trail etiquette, like who has the right-of-way, should horses, bikers and hikers meet.





### *Utilities and Communications Facilities*

Use of trail corridors by utilities and communications providers is not unusual. The nature of railroad alignments lend themselves to such uses. An example of this is a trail in which a portion of the railway right-of-way was purchased upon abandonment by a local municipal authority. Today, the right-of-way contains a sanitary sewer line and the authority has an agreement with the local municipalities to use the right-of-way for a public trail. Trail managers are encouraged to seek the advice of legal counsel before entering into an agreement with a utility company.

Where the municipalities obtain ownership of the trail corridor, licensing of utility companies for such uses is often a viable means of helping to recoup trail development costs and operational expenses. To the extent that pipelines and cables are buried, the uses generally do not conflict.

Each application for such use should be reviewed carefully, however, with particular attention being paid to expected frequency of maintenance, required access by motorized maintenance vehicles, and the mitigation of any resulting impacts. The local municipality having jurisdiction should take the lead in regulating this policy.

## **8. Managing Use of Volunteers**

In addition to implementing policies to comply with the Pennsylvania Child Labor Law and Pennsylvania Child Protective Services Law, as recommended in Chapter 4, trail organizations should consider adopting liability waivers.

### *Liability Waivers*

Liability waivers should be signed by individuals and groups who desire to perform any form of work associated with a trail. The form on page 195 is a sample waiver of liability. Before adopting such a waiver, your organization should review your proposed waiver with legal counsel to ensure its applicability and durability in a court of law.

### *Trail Patrols*

Trail patrols are critical for many reasons including:

- Security
- Protection from vandalism
- Promoting safe riding
- Handling conflict
- Trail safety inspection
- Emergency aid
- Providing a presence on the trail

Patrolling requires a cooperative effort between the trail sponsor, local municipalities, partner organizations and local trail support groups.



**Armstrong Trail Volunteers**  
Armstrong County

Photo Credit: Allegheny Valley Land Trust



**Trail Patrol**  
Lehigh County

Photo Credit: Delaware & Lehigh National Heritage Corridor

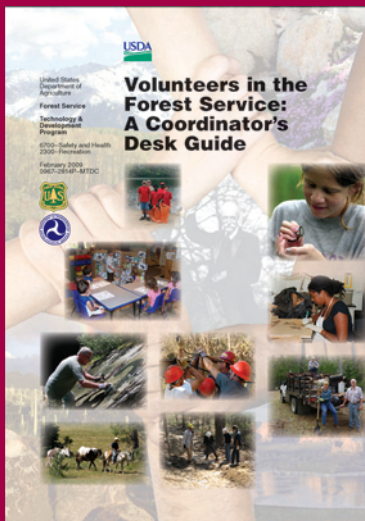


### W&OD Trail Patrol Handbook



April 2009  
(Version 1.0)

**W&OD Trail Patrol Handbook**  
Friends of the W&OD



**Volunteers in the Forest Services: A Coordinator's Desk Guide**  
U.S. Forest Service

Trail monitoring roles may be assigned to an appropriate group or organization, either for the trail as a whole, or by sections similar to PennDOT's "Adopt a Highway" program. Written agreements should document the roles and responsibilities of the trail sponsor and the monitoring/patrol agency or group.

Monitors should obtain certification by attending a training class conducted by trail partnership organizations. Monitors should wear bright shirts with "Trail Patrol" displayed prominently in large contrasting letters. Persons assigned to monitoring and patrolling the trail should also be trained in trail inspection.

They should keep a record of their time and distance at each outing, as well as document any assistance they may have provided trail users during their outing. They should report their monitoring times and distances to their group's monitoring captain, who in turn should submit regular reports to the trail's managing partner.

They can assist with incidents along the trail, such as helping with bike repairs or administering first aid. Any incident of an urgent nature, such as a wash out or fallen tree should be reported immediately to local authority having jurisdiction. Trail monitors and patrols can also provide non-emergency services, such as information about nearby stores and restaurants, historic and environmental interpretation, and information about the management agency including membership and volunteer opportunities.

### *Washington & Old Dominion Trail Patrol Handbook*

The Friends of the Washington & Old Dominion (W&OD) Trail have prepared the *W&OD Trail Patrol Handbook*<sup>5</sup>. This handbook serves as a good example of a how to establish policies and procedures to train, establish, and manage volunteer trail patrols. Download the the handbook from the Rails-to-Trails Conservancy's website [HERE](#).

### *Volunteers in the Forest Services: A Coordinator's Desk Guide*

Another good resource for developing a volunteer handbook is the U.S. Forest Service's publication *Volunteers in the Forest Services: A Coordinator's Desk Guide*<sup>6</sup>, available from [HERE](#).

Volunteer trail patrols can be trained to address urgent, emergency, and other extraordinary situations that might arise for users along a trail. Patrol members are the "eyes and ears" of the trail. For most of the length of many trails, no other users are there specifically for the well-being of other users; the volunteer patrol is there to help in these situations.

5 Washington & Old Dominion Trail Patrol Handbook, Friends of Washington & Old Dominion: 2009

6 Volunteers in the Forest Services: A Coordinator's Desk Guide, U.S. Forest Service; 2009



### Sample Trail Volunteer Release Agreement

WHEREAS, the undersigned, \_\_\_\_\_ wishes to volunteer his/her services by participating in \_\_\_\_\_ Adopt-A-Trail Program, in order to inspect and maintain the \_\_\_\_\_ trail; and

WHEREAS, participation in the project will take place at different times over a year; and

WHEREAS, participation in this project will involve using tools and equipment; and

WHEREAS, the \_\_\_\_\_ wish to cooperate in said endeavor;

THEREFORE, in consideration for said cooperation the undersigned agrees to the following:

1. To release and hold harmless the \_\_\_\_\_, and its employees, officers, and agents for any claim or claims which might arise out of any incident connected with or in any way related to participation in the Adopt-A-Trail program. This includes claims for personal injury, property damage, and/or any other type of harm or injury.
2. To release and hold harmless the \_\_\_\_\_, and its employees, officers, and agents for any claim or claims arising out of any incident connected with or in any way related to the undersigned's participation in the Adopt-A-Trail Program, including claims for personal injury, property damage, or any other type of harm or injury, made or asserted by any other person(s) against the \_\_\_\_\_.

I HAVE READ THIS RELEASE AND UNDERSTAND ALL OF ITS TERMS. I SIGN IT VOLUNTARILY, WITH FULL KNOWLEDGE OF ITS SIGNIFICANCE, AND WITH THE INTENT TO BE BOUND BY IT.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Name (printed)

\_\_\_\_\_  
Telephone Number

\_\_\_\_\_  
Address

### Volunteer Waivers of Liability

Additional Volunteer Waivers of Liability can be found on the American Trails website **HERE**.





## 9. Collecting Trail Use Counts

The level of use for the trail will have a direct correlation to the frequency of maintenance required. Monitoring the type and volume of use, and evaluating the effect that level of use has on the trail, provides the trail manager information needed to schedule inspections and routine maintenance. Monitoring the type and volume of use can be done by several methods.

- Mechanical counters
- Sampling of trailhead parking
- Visual counts
- Trail registers

Monitoring trail use is important to determine the impact of use on the trail and to determine the frequency of routine maintenance activities. Continued monitoring alerts the trail manager to a change in the level of use, which will require a change to the maintenance schedule.

The Rails-to-Trails Conservancy's publication *Trail User Survey Workbook*<sup>7</sup> provides a user-friendly methodology for small trail organizations to collect factual information regarding trail users and the economic impacts of trail development. The workbook includes: methods of data collection, data recordation, reporting and analysis, survey templates, Microsoft Excel formatted spreadsheets and sample reports from other completed trail-user surveys. This workbook can be obtained [HERE](#).

## 10. Establishing Trail Closure Policies

Trail users need to be cautious of the construction and periodic maintenance of trails, as well as roads and other facilities they intersect. Forewarn trail users of trail closures and give reasonable detours to bypass closed sections of the trail. If there is no alternative route, close the entire trail until the respective trail segment can be re-opened. Acknowledge trail closures at trailheads and access points with appropriate signage.

Closure of trails generally occurs for the following reasons:

- Seasonal closures like hunting, snowfalls, breeding seasons, etc.
- Construction closures like trail construction, culvert maintenance and/or replacement, bridge construction/replacement, etc.
- Closures due to overuse or any negative resource impact

Best practices for notifying trail users of closures is to publicize trail closure information on your trail organization's website, municipal websites, etc. Trail construction zones should be signed with standard signage at the



**Trail Counter Box**  
York County

Photo Credit: Pashek Associates



**North Country National Scenic Trail Register**

Photo Credit: PA DCNR

<sup>7</sup> Trail User Survey Workbook, Rails-to-Trails Conservancy: 2005



entrance to the affected segment of trail, and indicate the times and dates of closure. Further it is recommended the trail be gated, barricaded or otherwise blocked to prevent access to the closed segment of the trail.

## 11. Establishing a Wheelchairs and Other Power-Driven Mobility Devices (OPDMD) Policy on Trails<sup>8</sup>

In 2010, the U.S. Department of Justice (DOJ) issued an ADA ruling that addresses the use of wheelchairs and other power-driven mobility devices (OPDMD) on trails.

The DOJ rule, which implements the ADA, applies to state and local governments and public entities. The ADA does not apply to federal agencies with the exception of wheelchair use in federally designated wilderness as detailed in ADA, Title V Section 508 (c). The federal agencies are governed by the 1968 Architectural Barriers Act (ABA) and the 1973 Section 504 of the Rehabilitation Act.

Therefore, to avoid challenges to any restrictions you may impose on your trails, your agency should adopt an OPDMD policy for its trails. Otherwise, your trails are considered open to every type of OPDMD, regardless of whether they have been planned, designed, and/or constructed for those uses.

Your OPDMD policy should to be crafted to respond to your specific trail system. If more than one entity is responsible for a trail corridor, it is important that all parties involved collaborate in developing a uniform policy for the entire trail corridor.

The DOJ now categorizes mobility devices for individuals with mobility related disabilities either as wheelchairs or as OPDMD.

The DOJ defines a wheelchair as:

*“a manually-operated or power-driven device designed primarily for use by an individual with a mobility disability for the main purpose of indoor or of both indoor and outdoor locomotion.”* This definition does not apply to federal wilderness areas; wheelchairs in such areas are defined in section 508(c)(2) of the ADA, 42 U.S.C. 12207(c)(2).

And, the DOJ defines an OPDMD as:

*“Other power driven mobility device: any mobility device powered by*

<sup>8</sup> Additional information on OPDMDs can be found at: <http://www.americantrails.org/resources/accessible/power-mobility-questions-answers.html>



### Other Powered Driven Mobility Devices

Photo Credits:  
Top - Americantrails.org  
Mid - Actiontrackchair.com  
Bottom - Triangleglides.com



*batteries, fuel, or other engines - whether or not designed primarily for use by individuals with mobility disabilities - that is used by individuals with mobility disabilities for the purpose of locomotion, including golf cars, electronic personal assistance mobility devices (EPAMDs), such as the Segway® PT, or any mobility device designed to operate in areas without defined pedestrian routes, but that is not a wheelchair within the meaning of this section. This definition does not apply to Federal wilderness areas; wheelchairs in such areas are defined in section 508(c)(2) of the ADA, 42 U.S.C. 12207(c)(2).”*

The DOJ rule requires a public entity to make reasonable modifications in its policies, practices, or procedures to permit the use of OPDMDs by individuals with mobility disabilities unless the public entity can demonstrate that the class of OPDMD cannot be operated following legitimate safety requirements.

This is based on actual risks and not speculation regarding the device or how it will be operated per § 35.130(h), or on any of the other assessment factors DOJ has provided in § 35.137(c) and § 35.137(b)(2). Public entities can only use these factors in determining whether a particular OPDMD can be allowed in a specific facility as a modification to its policies, practices, or procedures. The focus of the analysis should be on the appropriateness of the use of the device at a specific facility, rather than whether it is necessary for an individual to use it. These assessment factors help public entities to determine whether allowing the use of a particular OPDMD in a specific facility is reasonable.

### *OPDMD Assessment Factors*

1. The type, size, weight, dimensions, and speed of the device;
2. The facility’s volume of pedestrian traffic (which may vary at different times of the day, week, month, or year);
3. The facility’s design and operational characteristics (e.g. whether its service, program, or activity is conducted indoors, its square footage, the density and placement of stationary devices, and the availability of storage for the device, if requested by the user);
4. Whether legitimate safety requirements can be established to permit the safe operation of the OPDMD in the specific facility; and
5. Whether the use of the OPDMD creates a substantial risk of serious harm to the immediate environment, natural, or cultural resources, or poses a conflict with Federal land management laws and regulations.”

Under the DOJ rule, all public entities should make reasonable modifications to their policies, practices, or procedures to allow the use of an OPDMD by an individual with a disability. Further, public agencies should develop and





publicly post their policy stating the following:

- The procedure by which claims that the OPDMD device is being used for a mobility disability will be assessed for legitimacy (i.e., a credible assurance that the device is being used for a mobility disability, including a verbal representation by the person with a disability that is not contradicted by observable fact, or the presentation of a disability parking space placard or card, or State-issued proof of disability);
- The type or classes of OPDMDs that are permitted to be used by individuals with mobility disabilities;
- The size, weight, and dimensions of the OPDMDs that are permitted to be used by individuals with mobility disabilities;
- The speed limit for the OPDMDs that are permitted to be used by individuals with mobility disabilities;
- The places, times, or circumstances under which the use of the OPDMD is or will be restricted or prohibited;
- Safety, pedestrian, and other rules concerning the use of the OPDMD;
- Under which circumstances storage for the OPDMD is made available; and how and where individuals with a mobility disability can obtain a copy of the OPDMD policy.

If that class of OPDMD is allowed, a person who has a disability may not be denied the opportunity to use that device. The public entity may ask a person using a power-driven mobility device if the mobility device is necessary. A public entity should not ask a person using a mobility device questions about the nature and extent of the person's disability.

### *Sample OPDMD Policy*

An OPDMD policy should be based on a rationale that addresses the assessment factors specified in the DOJ ADA ruling.

#### *Sample Policy Statement*

This policy was developed to maximize trail accessibility for individuals with mobility disabilities while at the same time maintaining the safety of other hikers, bikers, and horseback riders who use the trails and being responsible stewards of the environment on and around these trails.

#### *Sample Determining Rationale*

- Electric-powered devices only: Internal combustion powered devices are prohibited as they emit exhaust that is detrimental to the health of other trail users. In addition, many trails are parallel to and in close proximity of waterways thus creating potential for significant environmental risk from a spill of fuel or oil used in a gas or similarly powered combustible- fuel device. Finally, the loud sound generated from combustion powered devices is neither consistent with peaceful enjoyment of the outdoors nor appreciation of nature and is thus



inherently contradictory to the functions of the trails.

- Motors producing 300 watts or less: (One of the DOJ assessment parameters for regulating OPDMDs is speed. Because speed cannot be accessed from vehicle specifications, the power of the motor has been used as an equivalent, with higher power translating to higher top speed.) A fit individual using a traditional bicycle can maintain a power output of approximately 300 watts for a period of ten minutes. Allowing mobility devices equivalent to a fit bicyclist produces no safety threat to other trail users. Allowing OPDMDs with motors of 300 watts and above, and thus higher speeds, does present increased danger to other trail users.
- Vehicles are no more than 36 inches wide: Rail trails are typically built to 8 feet wide specifications. With two-way traffic, that gives a four feet width for vehicles to pass. Any OPDMD wider than three feet begins to encroach on the opposite lane and becomes a safety hazard to both the operator and other trail users. In addition, bollards and gates at trail access areas and road crossings have a limited size and thus are significant barriers to wider vehicles.

DCNR has adopted an OPDMD policy for state parks and state forests. You can find this policy [HERE](#).

**pennsylvania**  
Department of Conservation and Natural Resources

PA STATE AGENCIES ONLINE SERVICES Search PA 190

Tom Corbett, Governor Richard J. Allan, Secretary

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**Access to DCNR Land for Persons With Disabilities**

The Department of Conservation and Natural Resources (DCNR) Bureau of Forestry and Bureau of State Parks permits persons with mobility disabilities to use powered mobility devices for purposes of accessing DCNR lands. In some instances, these areas are not otherwise open for motorized access by the general public. To request this permission or to obtain additional information on DCNR's policy and the permitting process, please click on the following links:

**Policy**  
Download DCNR's policy on access for persons with disabilities.

**Application / Permit**  
Download the application / permit to request permission to use a powered mobility device to access DCNR land.

**Designated Areas**  
Download a list of the areas designated for use with powered mobility devices.

DCNR Home | Contact DCNR | Privacy Policy | Security Policy | PA Home



### Sample ADA Trail Accessibility Policy

A. \_\_\_\_\_ trails are available to individuals with a mobility disability as follows:

Wheelchairs: Wheelchairs, as defined by 28 CFR § 35.104, are permitted on all \_\_\_\_\_ trails approved for pedestrian access.

Other power-driven mobility devices (OPDMDs)

OPDMDs, as defined by 28 CFR § 35.104, are permitted on \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ trails as follows:

1. The OPDMD must be electric-powered. Internal combustion engines are not permitted.
2. The OPDMD must have an electrical output of no more than 300 watts.
3. The OPDMD must be no more than 36" in width.

Please note that electric bikes (ebikes) meeting the above criteria, and which allow the user to pedal or alternatively run on battery power, are permitted on all \_\_\_\_\_ trails approved for bicycle use. User discretion is advised as some approved bicycle trails may not be suitable for all types of ebikes.

B. Users of a OPDMD or wheelchair must operate the device at a safe speed considering the condition of the trail and the other users traveling on the trail.

C. The adoption of this Policy does not represent an endorsement that the park trails or other park properties are safe for the use of an OPDMD or wheelchair. Users must exercise reasonable caution and care while operating such devices on the \_\_\_\_\_ trail system.

If you have any questions regarding this policy or the accessibility of \_\_\_\_\_ trails, please contact \_\_\_\_\_.

### OPDMD Policy Examples

Additional OPDMD policy examples can be found on the American Trails website [HERE](#).







Good trail maintenance practices are important. They:

1. Provide positive user experiences, thus generating repeat customers.
2. Reinforce that the trail is an important regional recreation and transportation resource.
3. Are effective in deterring vandalism, litter, and dumping in the trail corridor.
4. Promote positive relationships with adjacent landowners.
5. Help to create a sense of community throughout the trail corridor, and encourage a sense of pride.
6. Restore native plant communities disturbed by trail construction and other uses.
7. Reduce liability and provide a defense when an accident does occur.

## Trail Maintenance Considerations

The development of a trail does not end with its construction; rather it is the beginning of a process. Proper planning and design, along with quality materials and workmanship during construction will keep the maintenance costs low. Conversely, trail degradation will occur quickly without an effective maintenance program, no matter how well you plan, design, and construct a trail. Overall, if routine maintenance does not occur, maintenance costs will dramatically increase.

It is important to document trail maintenance practices in writing to ensure you have the work force, materials, and finances to maintain your trail properly. Trail maintenance should be an ongoing activity once a trail is dedicated.

To assure the success of the trail system, local partners, agencies, and municipalities should work together to define the roles and responsibilities to maintain the trail and adopt good maintenance practices are adopted. This does not mean the municipalities perform all of the work. More often, it means coordinating the efforts of volunteer organizations and providing aid when needed. State, local, and county agencies may be available to assist groups in planning trail improvements. Further, they may also be able to provide material, equipment and/or in-kind services for trail maintenance. Volunteer efforts should be coordinated to ensure the necessary services are provided in a timely manner. Document all agreements in writing between the participating parties.

Maintenance components of your trail management plan should consider the following:

1. Frequency of Maintenance
2. Trail Assessments and Inspections
3. Hazard Tree Identification, Inspection, and Corrective Action
4. Revegetation and Restoration
5. Training

The maintenance of trails is ongoing and a necessary activity that will ensure the continued use and the safety of the trail users.



## 1. Frequency of Maintenance

The frequency of trail maintenance varies depending on the type of maintenance activity being undertaken.

- Scheduled Maintenance
- Seasonal Closure and Opening
- Winter Maintenance
- Periodic Grooming
- Corrective Maintenance
- Deferred Maintenance

Trail maintenance tasks should be documented in the trail management plan and should be adopted by the agency/organization responsible for the trail. Maintenance requirements are dependent on the type of trail and amount of visitation it receives.

### *Scheduled Maintenance*

Scheduled maintenance is the normal maintenance needed to restore a trail to its intended standard after prolonged wear and tear of normal use and exposure to the elements.

Develop an annual trail maintenance schedule using historical maintenance and known maintenance requirements from previous inspections or deferred maintenance. This living document should be adapted to the changing conditions of the trail.



**Clearing the Trail Corridor**

Photo Credit: PA DCNR



Typically, scheduled maintenance tasks are as follows. This list can be altered as needed to meet the needs of the trail, its users, and the communities that a trail passes through:

- Trimming or removing vegetation, dead limbs, or standing dead trees
- Removing debris, deadfalls, or loose impediments
- Cleaning out ditches, swales and culverts
- Repairing and revegetating minor erosion on slopes or embankments
- Grooming the tread surface
- Minor repairs such as replacing missing or broken posts or signs
- Mowing
- Trimming
- Trash removal
- Pruning
- Weeding
- Invasive Removal
- Brush hog
- Signs – inspect / repair / replace
- Fence – inspect / repair / replace
- Culverts – inspect / repair / replace
- Storm Drains – inspect / repair / replace
- Gates - inspect / repair / replace
- Bridge - inspect / repair / replace
- Maintain dips
- Grade ditches
- Trail grooming
- Trail surfacing
- Landscaping
- Storm damage
- Vandalism
- Repair washouts
- Garbage pick-up at trail access points
- Mowing of berms
- Cleaning of restrooms at trailheads
- Sweeping trails with a rotary brush to remove dirt and leaf litter
- Erosion control, repair of drain pipes and cleaning of swales
- Patching, regrading, and compacting of surface
- Inspecting, repairing, replacing signs, traffic markers, bollards, and gates
- Cleaning culverts, catch basins, and other drainage structures
- Maintaining and completing preventative maintenance on support facilities
- Inspecting trail-related structures to ensure they are in a safe condition
- Plowing trailhead parking lots in the winter





The following is a typical calendar for scheduled maintenance:

| Frequency of Scheduled Maintenance        |     |     |     |      |      |      |      |      |      |     |     |     |
|---|-----|-----|-----|------|------|------|------|------|------|-----|-----|-----|
| Maint. Activity                           | Jan | Feb | Mar | Apr  | May  | Jun  | July | Aug  | Sept | Oct | Nov | Dec |
| EXAMPLE- Mowing                           |     |     | •   | .... | .... | .... | .... | .... | .... | ... |     |     |
| Mowing                                    |     |     |     |      |      |      |      |      |      |     |     |     |
| Trimming                                  |     |     |     |      |      |      |      |      |      |     |     |     |
| Trash                                     |     |     |     |      |      |      |      |      |      |     |     |     |
| Pruning                                   |     |     |     |      |      |      |      |      |      |     |     |     |
| Weeding                                   |     |     |     |      |      |      |      |      |      |     |     |     |
| Invasive Removal                          |     |     |     |      |      |      |      |      |      |     |     |     |
| Brush Hog                                 |     |     |     |      |      |      |      |      |      |     |     |     |
| Signs - inspect/repair/<br>replace        |     |     |     |      |      |      |      |      |      |     |     |     |
| Fence - inspect/repair/<br>replace        |     |     |     |      |      |      |      |      |      |     |     |     |
| Culverts - inspect/repair/<br>replace     |     |     |     |      |      |      |      |      |      |     |     |     |
| Storm Drains - inspect/<br>repair/replace |     |     |     |      |      |      |      |      |      |     |     |     |
| Gates - inspect/repair/<br>replace        |     |     |     |      |      |      |      |      |      |     |     |     |
| Bridge - inspect/repair/<br>replace       |     |     |     |      |      |      |      |      |      |     |     |     |
| Maintain Dips                             |     |     |     |      |      |      |      |      |      |     |     |     |
| Grade Ditches                             |     |     |     |      |      |      |      |      |      |     |     |     |
| Trail Grooming                            |     |     |     |      |      |      |      |      |      |     |     |     |
| Trail Surfacing                           |     |     |     |      |      |      |      |      |      |     |     |     |
| Landscaping                               |     |     |     |      |      |      |      |      |      |     |     |     |
| Storm Damage                              |     |     |     |      |      |      |      |      |      |     |     |     |
| Vandalism                                 |     |     |     |      |      |      |      |      |      |     |     |     |
| Repair Washouts                           |     |     |     |      |      |      |      |      |      |     |     |     |



### *Seasonal Opening and Closure*

If seasonal closures occur along a trail, inspect and maintain portions of the trail that require maintenance. Sometimes this maintenance can be intensive, especially in areas prone to blow downs. For those trails with winter closures the tread surface may need to be graded, compacted, and or groomed in preparation for increased use during wet conditions of the spring season. Fall maintenance should focus on clearing and trimming of vegetation sufficiently to account for the next growing season. Repair and stabilize eroded areas to prevent future erosion.

### *Winter Maintenance*

Collaborating agencies should decide and document what the winter maintenance policy will be for the given trail. Avoid plowing trails that include winter uses such as cross country skiing and snowshoeing. In urban environments, where pedestrian and bicycle use is expected to continue throughout the winter months, consideration may be given to plowing the trail. Regardless of the decision made, it should be communicated to trail users so they know what to expect during inclement weather. This is an important issue and should be posted on a trail kiosk or rules sign.

### *Periodic Grooming*

The frequency of periodic grooming of the tread surface is dependent on the level of trail use and the amount of surface displacement. Simple grooming may require re-grading and compaction of the in-place tread surface materials. More intensive grooming may require placement and compaction of additional tread surface materials to address minor rutting or erosion.

### *Corrective Maintenance*

Corrective maintenance is necessary for the restoration of areas or structures severely damaged or destroyed by overuse, inadequate scheduled maintenance, abuse, vandalism, or unexpected natural events. Corrective maintenance is usually unexpected and may require more planning or design than scheduled maintenance. Corrective maintenance includes:

- Reinforcement and replacement of trail subbase and tread surface
- Stabilization of severely eroded or sloughed embankment
- Reconstruction of grade dips, or other water control structures
- Replacement or major repair of culverts, bridges, or retaining walls

Regardless of the level of planning and effectiveness of the scheduled maintenance program, the unexpected will occur. Address unexpected emergencies by establishing a contingency line item in the annual maintenance budget. Ideally, a long-term capital improvement budget should be in-place to repair/replace major structures.



**Removing Blow Downs**

Photo Credit: PA DCNR



### Deferred Maintenance

Deferring maintenance is a deliberate decision to delay maintenance due to a lack of labor, budget considerations, or specific conditions. Deferring routine and scheduled maintenance can make funds, maintenance personnel, or equipment available to perform corrective maintenance. For example, scheduled maintenance for grading and re-compacting may be deferred to make a crew available to perform corrective maintenance to address a liability. Reschedule deferred maintenance when resources become available. Never defer corrective maintenance that is safety-related unless that section of trail can be bypassed or closed.

### Maintenance of Signs

Incorporate a regular maintenance program for signs into your trail management plan. Sign maintenance is important from a safety and liability perspective. Further, signs are highly visible and their maintenance or lack of maintenance leaves the visitor with a positive or negative impression about the trail. Well-maintained signs convey a sense of pride and reduce vandalism while poorly maintained signs may contribute to a diminished visitor experience, including disorientation of trail users.

The following guidelines are recommended:

- Maintain a record of all signage, including location, GPS coordinates, type of sign, and photo.
- Inspect signs regularly, especially after each winter season, for weathering and visibility.
- Repair or replace damaged or missing signs as soon as possible.
- Secure loose or tilting signs in an upright position.
- Clear vegetation from around signs to maintain visibility.
- For signs mounted on living trees, loosen fasteners as necessary to accommodate growth of the tree.
- Review signage content to ensure continued relevance and accuracy.
- Obsolete, damaged, or surplus signs should be reused or recycled whenever possible.
- When signs have been weathered or otherwise damaged or destroyed, consider the reasons for the damage. If the sign was eaten by wildlife, consider less palatable materials. If weather or natural events damaged the sign, consider stronger materials, a different location, or a different system for mounting the signs. If the sign is damaged by water or decay, consider applying a sealer or preservative (assuring compatibility with color, aesthetics, and environmentally sustainable practices) or replacing the sign with a more water-resistant material. When signs are damaged due to vandalism, managers should consider a different location or temporary signage that is not expensive to replace.

### Sign Maintenance

For additional information on sign maintenance refer to the Delaware & Lehigh National Heritage Corridor's Sign Maintenance: Projecting your image, Protecting your Investment, **AVAILABLE HERE.**







Priorities for sign maintenance are:

1. Signs required for user safety
2. User restrictions and advisory signs
3. Destination and identification signs, blazes, and trail logos, and
4. Informative and interpretive signs

There is a fine balance between providing good information and diminishing the trail experience with too much signage. An abundance of signage can also be a burden on the trail managers and those responsible for maintaining the signs.

### *Maintenance of Road Crossings*

Best practices for maintaining road crossings include:

- Conduct an annual inspection after the winter season to determine the condition of the trail crossing signs, pavement markings, and associated gates or other trail signs.
- Inspect and repair any damaged gates, bollards, delineators, fencing, or signs used for your trail at the crossing.
- Repaint or reapply trail crossing markings as they fade, in accordance with the approved trail crossing plan. Depending on traffic volume, pavement markings last at least two to seven years before noticeable fading occurs.
- Replace signs at trail crossings if damaged or heavily faded. Straighten the sign post if leaning or reinstall if knocked over. Typically signs are manufactured to last fifteen years or more without losing reflectivity. Stop signs, however, lasts only about seven years before fading, depending on sun exposure.
- Examine the vegetation and foliage at the crossing to ensure sight distance requirements are met and the signs are not blocked from view. Do this once each summer with full foliage present.
- Examine and fill in any portion of the trail that has settled where it meets the roadway. If there are ADA accessible ramps examine them and make sure they are in good repair.
- Contact the agency responsible for the road, either the municipality or PennDOT, if any shoulder washouts or roadway damage occurs and ask them to repair those areas.
- In the end your trail crossing should look like it does on the approved trail crossing plan.



Unless there is major damage or vandalism year to year there really isn't much to do. A quick annual inspection should be all that is needed and maybe minor tweaks. Of course if you defer this maintenance more work would need to be done.

On state roads PennDOT will typically take care of the following maintenance items:

- The entire asphalt road surface and paved or unpaved shoulders
- All traffic signs other than those specifically associated with the trail crossing.
- All pavement markings not specifically associated with the trail such as double yellow lines, edge lines, curve warning, etc.
- Drainage structures associated with the roadway.

## 2: Trail Assessments and Inspections

Trail Assessment and Inspection Forms (TAF) provide a means of recording basic information for current and future trail planning, design, construction, and maintenance. TAFs document current trail conditions and help identify subsequent work required to satisfy current trail standards. A sample TAF is at the end of this section.

After completing a TAF, a trail's intended use, overall condition, and necessary maintenance can be determined. Trail sponsors/managers should be responsible for reviewing TAFs and ensuring that any required maintenance on a trail or trailhead be addressed. A review of completed TAFs will help trail managers identify areas or sections of trails that require maintenance attention. In areas that require more maintenance than expected or are too costly to maintain, trail redesign or improvements may be considered. TAFs should be updated if the management intent for the trail, special considerations, or other factors change.

The instructions below explain the significance of each field on the TAF worksheet:

### *Overall Trail Information*

- **Trail Name:** Specify the official trail name, double-checking for correct spelling.
- **Trail Location and County:** Specify the trail location and county.
- **Trail Length:** Specify the length of the trail in miles. Mileage accuracy recorded on the TMO should correspond to the method of collection: wheel, GPS, map, or unknown.
- **Trail Beginning and Ending Segment:** Specify the location of the trail's beginning and ending trail segment.
- **Name and Date:** Specify the name of the person who conducted the assessment.



### *Designed Use Objectives*

- **Designed Use:** Specify the prescribed use for the proposed trail. The designed use is necessary to establish the standards for which the trail is designed, constructed, operated, and maintained.
- **Season of Use:** Specify the season(s) the trail will be open for use.
- **Level of Difficulty:** Specify the prescribed level of difficulty for a specific trail based on its corresponding level of difficulty standards.

### *Trailhead and Access Points*

- **Name:** Specify the name of all trailheads and/or access points.
- **Location:** Specify the location of each trailhead and/or access point.

### *Trail Tread/Surface*

- **Condition:** Specify the current condition of the trail tread or surface.
- **Materials:** Specify the type of materials used to create the trail tread.
- **Average Width:** Specify the average width of the trail tread. Identify the minimum and maximum width observed along the trail.

### *Drainage*

- **Drainage:** Specify the drainage conditions of a trail. Identify any and all drainage issues that need to be addressed.
- **Bridges and Culverts:** Specify the level of condition of bridges and/or culverts along the trail corridor.
- **Dips:** Specify the level of condition of dips along the trail corridor.

### *Road/Railroad Crossings*

- **Condition:** Specify the level of condition of road and/or railroad crossings intersecting with the trail.
- **Sight Line:** Specify the level of condition of sight lines to and from road and/or railroad crossings intersecting with the trail corridor.
- **Accessible:** Specify if there are accessible road and/or railroad crossings intersecting with the trail corridor.

### *Adjacent Land Uses*

- **Adjacent Land Uses:** Specify all current land uses that are adjacent to the trail corridor.
- **Historical and Other Structures:** Specify the level of condition of all historical and/or other structures along the trail corridor.

### *Signage*

- **Blaze/Marking Color or Style:** Specify the blaze and/or marking color and style at trailheads and along the trail corridor.
- **Overall Condition:** Specify the overall condition of blazes and/or markings at trailheads and along the trail corridor. Identify the condition of specific blazes and/or markings where applicable.
- **Replace Signs:** Specify all areas at trailheads and along the trail corridor where blazes and/or markings need to be replaced.





### Inspection Procedures

A complete inspection of the trail should be a routine scheduled event, performed by trained personnel/volunteers familiar with the trail. Perform trail inspection in conjunction with scheduled maintenance or as a separate action to determine the need for additional work.

Inspectors should review the trail management objectives for a section of trail before inspecting the trail. It is also helpful to review the previous inspection and maintenance records. The inspector should determine the current condition of the physical features of the trail and document deficiencies, change of conditions, and the need for corrective maintenance.

Trail inspectors should carry a trail map, inspection checklists, and tools for minor maintenance relating to safety. Photographing current trail conditions is an excellent way to document and monitor changes in conditions. Inspectors should identify deficiencies that create safety concerns and hazards to the trail users.

Items to look for include:

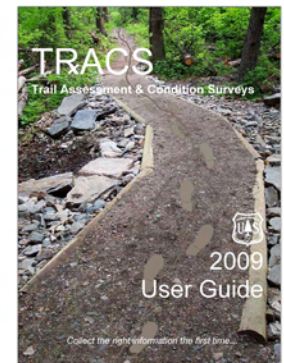
- Erosion
- Failure of water diversion features
- Trail degradation
- Vegetation or materials extending into the horizontal or vertical clear area
- Deadfalls, dead limbs, or standing dead trees that could fall within the clear area
- Loose impediments on the treadway (that exceed the level of difficulty)
- Sloughing or erosion of embankments
- Missing or damaged regulatory or warning signs and other signage
- Vandalism

After identifying and repairing safety hazards, the second highest priority is repairing damage from improperly functioning drainage features. The inspector should inspect the inlets and outlets of all culverts, ditches and swales, to ensure they are free of debris and functioning properly. Evidence of a breakdown of drainage includes erosion, ponding of water, wet areas, and rutting of the trail tread. Correction of improperly functioning drainage may be a matter of maintenance or may require trail improvements or re-routing. Allowing a trail to continue to degrade from poor drainage quickly leads to costly corrective maintenance or trail closure.

The inspector should also be attentive to evidence of heavy use and trail tread condition requiring immediate maintenance. Record the general condition of the tread throughout various sections of the trail.

### Trail Assessment Protocols

For a comprehensive review of trail assessment protocols, refer to the U.S. Forest Service's *Trail Assessment & Condition Surveys (TRACS)* document, available [HERE](#).





The frequency of inspection depends on the maintenance history of the trail, sustained level of use, and special events. Special events include acts of nature, as well as planned events such as organized club events or poker runs. Inspections should be frequent enough to correct potential problems before they become a safety issue or lead to more costly corrective maintenance.

An experienced and licensed professional engineer should be used to inspect structural facilities such as bridges and retaining walls. Schedule the frequency of structural inspections based on the age and condition of the structure.

### *Using Volunteers to Perform Inspections*

The trail management plan should specify who is responsible for conducting trail inspections and the frequency. Either paid staff or trained volunteers can conduct trail inspections.

Regardless of who completes the inspection, results should be documented and retained in case a liability claim is filed by a trail user. By following the policies and procedures documented in the trail management plan, the risk of liability can be reduced. Volunteers should be trained in performing inspections and recording information on the TAFs. TAFs can be adapted to meet your trail's specific needs.



## Trail Assessment Form

**Trail Name** \_\_\_\_\_ **Begin Segment** \_\_\_\_\_ identified by mileposts ☐  
**Location** \_\_\_\_\_ **End Segment** \_\_\_\_\_ or coordinates ☐  
**County** \_\_\_\_\_ **Total Trail Length** \_\_\_\_\_ **Segment Length** \_\_\_\_\_  
**Conducted by** \_\_\_\_\_ **Date** \_\_\_\_\_

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**Designed Use** ☐ Hike / Pedestrian ☐ Bike ☐ Mountain Bike ☐ Equestrian  
☐ Cross Country Ski ☐ Snowshoe ☐ ATV ☐ Snowmobile  
☐ Others, \_\_\_\_\_

**Level of Difficulty** ☐ Easiest ☐ More Difficult ☐ Most Difficult

**Trailheads & Access Points** **Name** \_\_\_\_\_ **Location** \_\_\_\_\_ identified by milepost ☐  
 Latitude N \_\_\_\_\_ or coordinates ☐  
 Longitude W \_\_\_\_\_

**Notes**

**Trail Tread / Surface** **Condition** ☐ Good ☐ Fair ☐ Poor ☐ Needs Improvement

**Materials** \_\_\_\_\_ **Average Width** \_\_\_\_\_, min. \_\_\_\_\_, max. \_\_\_\_\_

**Grade** \_\_\_\_\_% **Cross Slope** \_\_\_\_\_%

**Notes**

**Drainage** ☐ Drains properly ☐ Draining onto or across trail surface  
☐ Water staying on trail ☐ Needs drainage structure

**Bridges and Culverts** ☐ Good ☐ Fair ☐ Poor ☐ Cleanout

**Dips** ☐ Good ☐ Fair ☐ Poor ☐ Cleanout

**Notes**

### Road / Railroad Crossings

**Condition** ☐ Good ☐ Fair ☐ Poor ☐ Needs improvement

**Sight Lines** ☐ Good ☐ Fair ☐ Need to prune ☐ Unsafe

**Accessible (Note Exceptions)** \_\_\_\_\_

**Notes**





## Trail Assessment Form

**Trail Name** \_\_\_\_\_ *Begin Segment* \_\_\_\_\_ identified by mileposts ☐  
**Location** \_\_\_\_\_ *End Segment* \_\_\_\_\_ or coordinates ☐  
**County** \_\_\_\_\_ **Total Trail Length** \_\_\_\_\_ **Segment Length** \_\_\_\_\_  
**Conducted by** \_\_\_\_\_ **Date** \_\_\_\_\_

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### Adjacent Land Uses (Check all that apply)

☐ Forest ☐ Farm ☐ Residential ☐ Commercial ☐ Industrial ☐ Encroachment

### Notes

### Historical and Other Structures

**Condition** ☐ Good ☐ Fair ☐ Poor ☐ Needs Improvement  
☐ Needs to be replaced ☐ Needs to be cleared out

### Notes

### Signage (includes trailhead and reassurance markings, blazes, etc.)

**Blaze / Marking Color or Style** \_\_\_\_\_

**Overall Condition** ☐ Good ☐ Fair ☐ Lacking ☐ Needs Maintenance

**Regulatory** ☐ Good ☐ Fair ☐ Lacking ☐ Needs Maintenance

**Wayfinding** ☐ Good ☐ Fair ☐ Lacking ☐ Needs Maintenance

**Interpretive** ☐ Good ☐ Fair ☐ Lacking ☐ Needs Maintenance

**Wooden / Routed** ☐ Good ☐ Fair ☐ Lacking ☐ Needs Maintenance

**Reassurance Markings** ☐ Good ☐ Fair ☐ Lacking ☐ Needs Maintenance

**Intersections** ☐ Good ☐ Fair ☐ Lacking ☐ Needs Maintenance

**Pavement Markings** ☐ Good ☐ Fair ☐ Lacking ☐ Needs Maintenance

**Others (fiberglass, etc.)** ☐ Good ☐ Fair ☐ Lacking ☐ Needs Maintenance

Replace Signs:

### Notes



## Trail Assessment Form

**Trail Name** \_\_\_\_\_ *Begin Segment* \_\_\_\_\_ identified by mileposts ☐  
*Location* \_\_\_\_\_ *End Segment* \_\_\_\_\_ or coordinates ☐  
*County* \_\_\_\_\_ *Total Trail Length* \_\_\_\_\_ *Segment Length* \_\_\_\_\_  
*Conducted by* \_\_\_\_\_ *Date* \_\_\_\_\_

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**Other Notes and Summary**

Please return this form to

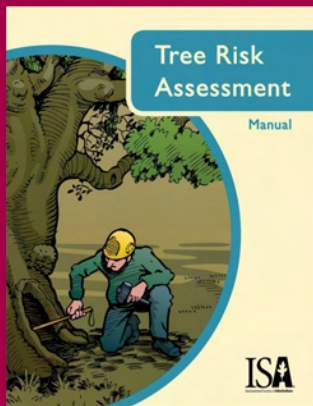
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In their publication *Tree Risk Assessment*, the International Society of Arboriculture provides a tree risk assessment form, available [HERE](#).



### 3 Hazard Tree Identification, Inspection, and Corrective Action

A tree is considered hazardous when structural defects are likely to cause failure of all or part of a tree within striking distance of a target. A target can be a vehicle, building, or an area where people or their equipment are likely to stop and congregate, such as park benches, campgrounds, picnic tables and environmental education areas. Identifying hazard trees is not an exact science. Many times trees will fail though they appear healthy. One cannot always accurately determine the hazard potential of every tree, but following a few basic inspection techniques can identify many hazard trees so corrective action can be taken.

Trees in poor condition should be inspected more closely for structural defects including cracks, cankers, decay, weak branch unions and root problems. Be sure to inspect trees carefully and systematically. Examine all parts of the tree, including the trunk flair, main stem, branches and branch unions. A pair of binoculars or a spotting scope will allow for a more complete examination of the tree canopy.

Close inspection should occur in any public overnight and day use areas, along trails and roadways, and adjacent to buildings. Again, a hazard tree is defined as having a defect and a target. Tree inspections should be conducted using consistent procedures.

A widely accepted method of assessment is the USDA, USFS Risk Assessment Scale, which prioritizes hazard trees based on three criteria. The three assessment criteria are tree condition, failure potential, and probability of target impact. Tree condition considers the amount of deadwood, foliage and trunk decay. Failure potential is rated according to the severity of the defects. Probability of target impact is ranked based on frequency of use. Trees determined to have low probability of failure and target impact should be considered for their value as wildlife habitat.

Tree inspections should occur in the spring before leaf-on, in mid-summer, and after leaf-off in the fall. This inspection schedule allows trees to be observed in various states and provides ample time for corrective action to be taken. Areas more heavily used by the public should be inspected immediately after severe storms that cause blow downs, leaning trees, or large hanging branches.

Tree inspections should be documented. This documentation should include the date(s) of the inspections, the area(s) inspected, the person(s) conducting the inspection, and whether this inspection was a routine inspection or conducted because of a storm event. Using the USFS Risk Assessment Scale allows for easy and consistent documentation over a



multiple year period. If necessary, trail maintainers can provide this document to the landowner as a recommendation for corrective action.

Following the identification and inspection of trees, if a tree is found to have a deficiency, the appropriate corrective action should be taken promptly. Use the USFS Risk Assessment Scale to prioritize hazard trees that require corrective action. These corrective actions could include moving the target, pruning the tree to remove the hazardous portion, or removing the entire tree. Landowners/managers can contact a professional arborist if they do not have sufficient equipment or properly trained people to carry out tree pruning or removal.

Additional information on hazardous trees and the USDA, USFS Risk Assessment scale can be found **[HERE](#)**.

Only properly trained and certified personnel should work with trees, especially when it comes to felling trees and/or working with power equipment, such as chain saws.

#### 4. Revegetation and Restoration

It is important to stabilize and restore vegetation in areas damaged by trail construction. Restoration often leads to better habitat for animals, a richer diversity of species, healthier ecosystems, and cleaner water. Furthermore, this process allows for the establishment of aesthetically pleasing natural areas rather than those marred by overuse and abuse.

Restoration work can vary from simple undertakings to multi-year efforts to revegetate and erase the impacts of human effects on the land. Areas in need of this type of maintenance include: bootleg trails, shortcuts across switchbacks, inappropriate campsites, permanently closed trails, logged-out areas, and barren riparian areas. In some cases, especially in heavily impacted areas no longer subject to erosion, agency personnel may determine that restoration efforts are not necessary. This is because these areas will probably not suffer any further damage regardless of future use.

The decision to restore an area is best made by informed land management personnel. This planning should ensure that the work is appropriate and will be effective, as well as have a realistic understanding of the size, duration, expense, and demands of the undertaking. Restoration projects require careful planning and a commitment to achieve objectives. This work includes activities such as site and soil preparation, seeding, transplanting native vegetation and container-grown plants, as well as on-site plant propagation.

A benefit of proper revegetation and restoration is that it will require less maintenance in the end. This is an important selling point when working with doubtful landowners, officials, and others.

Your trail management plan should provide guidelines on policies and procedures for revegetation and restoration.





## 5. Training

Training is critical to the success of a trail. Management can not assume trail users, volunteers, or staff have the knowledge and skills necessary to properly use the trails, and to perform their duties and functions in the manner required to maintain a safe, inviting, and well-maintained trail environment.

Your trail management plan should incorporate a summary of the various training components to be offered, their intended audience and the intended frequency of the education/training program. The following is a sample summary table:

| Component                   | Audience |              |              |              |            |             | Frequency and Location |
|-----------------------------|----------|--------------|--------------|--------------|------------|-------------|------------------------|
|                             | Designer | Land Manager | Maint. Staff | Trail Patrol | Volunteers | Trail Users |                        |
| Safety Training             |          | •            | •            |              | •          |             |                        |
| Trail Etiquette             |          |              |              |              |            | •           |                        |
| Proper Trail Use            |          |              |              |              | •          | •           |                        |
| Outdoor Ethics              |          |              |              |              | •          | •           |                        |
| Trail Construction          | •        | •            | •            |              | •          |             |                        |
| Trail Maintenance           |          |              | •            |              | •          |             |                        |
| Water Crossing Construction |          |              | •            |              | •          |             |                        |
| Trail Inventory Procedures  | •        | •            |              | •            |            |             |                        |

### *Trail Etiquette*

DCNR's pamphlet *Trail Etiquette: Promoting User Compatibility Through Understanding and Cooperation*, available [HERE](#), provides the recommendations for trail etiquette based on the type of trail users one encounters.



### Land Ethics

A responsible trail management plan would be remiss if it did not include policies addressing use of the outdoors in a sustainable manner, so that its resources will continue to be available for future generations to enjoy.

### Leave No Trace

Leave No Trace is a national and international program designed to assist outdoor enthusiasts with their decisions of how to reduce their impacts when they hike, camp, picnic, snowshoe, run, bike, hunt, paddle, ride horses, fish, ski, or climb. The program strives to educate all those who enjoy the outdoors about the nature of their recreational impacts, as well as techniques to prevent and minimize such impacts. Leave No Trace is best understood as an educational and ethical program, not as a set of rules and regulations. The Leave No Trace principles are summarized as follows:

1. Plan Ahead and Prepare
2. Travel and Camp on Durable Surfaces
3. Dispose of Waste Properly
4. Leave What You Find
5. Minimize Campfire Impacts
6. Respect Wildlife
7. Be Considerate of Other Visitors

Additional information on Leave No Trace, is available [HERE](#).

When trails are designed or managed for equestrian use, Leave No Trace guidelines for equestrian trails should be followed. The Pennsylvania Equine Council's Ride Smart brochure, available [HERE](#), is a good example of equine Leave No Trace guidelines.

### Tread Lightly!

Like Leave No Trace, TreadLightly! is an educational program dedicated to increasing the awareness of how to enjoy the outdoors while minimizing impacts. It emphasizes responsible use of non-motorized, and motorized, travel and low impact principles related to outdoor recreational activities. It is summarized as:

- T**ravel & recreate with minimum impact.
- R**espect the environment and the rights of others.
- E**ducate yourself, plan and prepare before you go.
- A**llow for future use by leaving it better than you found it.
- D**iscover the rewards of responsible recreation.

Additional information on the TreadLightly! program can be found [HERE](#).

"A land ethic, then, reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land. Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity."

*Sand County Almanac*  
Aldo Leopold





**McCune Trail**  
Ohiopyle State Park  
Fayette County

Photo Credit: PA DCNR



**North Country Trail**  
Lawrence County

Photo Credit: Andrew Bashaw





# Glossary of Terms

**Abutment:** Structure at either extreme end of a bridge that supports the superstructure (sill, stringers, trusses, or decks) composed of stone, concrete, brick, or timber.

**Access:** The opportunity to approach, enter, or make use of public lands.

**Access points:** Designated areas and passageways other than a trailhead that allow the public to reach a trail.

**Access, public:** The right of passage, established by law, over another's property. Can be created by an easement dedicated or reserved for public access. Legal public access exists on public land, public waters, public rights-of-way, and public easements.

**Accessible (wheelchair accessible, handicap accessible, disabled access):** A term used to describe a site, building, facility, or trail that complies with the Americans with Disabilities Act (ADA) Accessibility Guidelines and can be approached, entered, and used by physically disabled people.

**Accessible route:** A continuous, unobstructed path connecting all accessible elements and spaces of a facility or building that meets the requirements of ADAAG.

**Alignment:** The configuration of the trail in horizontal and vertical planes. The bends, curves, and ups and downs of the trail. The more the alignment varies, the more challenging the trail.

**Amenities:** Any element used to enhance the user's experience and comfort along a trail or during a trailhead or park visit.

**Americans with Disabilities Act (ADA):** A federal law prohibiting discrimination against people with disabilities. Requires public entities and public accommodations to provide accessible accommodations for people with disabilities.

**Americans with Disabilities Act Accessibility Guidelines (ADAAG):** Design guidelines for providing access to a range of indoor and outdoor settings by people with disabilities.

**Angle of repose:** The maximum angle of a slope, measured from a horizontal plane, at which loose, cohesionless material will come to rest on a pile of similar material.

**Assessment, trail or corridor:** Physical evaluations undertaken to better understand a trail or corridor. Assessments include an accurate description and documentation of native elements and an inventory of built structures along the trail or corridor.

**At-grade crossing:** When a trail intersects and crosses directly in the path of another user.

**Backcut:** The vertical part of a bench cut that is blended into the backslope.

**Backslope (cutslope, cutbank, backcut):** The cut bank along the uphill side of the trail, extending upward from the tread, and transitioning into native hillside by varying degrees, depending on bank composition and slope stability.

**Backfill:** Material used to fill a void behind a trail structure.

**Base course:** The main load-spreading layer of the constructed trail, normally constructed of crushed stone.





**Ballast:** Stone, cinders, gravel, or crushed rock fill material used to elevate a railroad bed above the surrounding grade. It drains water away from the ties, spreads the track load over softer subgrade, provides an even bearing for ties, holds ties in place and checks the growth of grass and weeds.

**Barricade:** A portable or fixed barrier having object markings, used to close all or a portion of the trail right-of-way to traffic.

**Barrier:** A structure installed to protect an environmentally sensitive area. A barrier can be hard (fence); live (planted); a combination of hard and live; or a terrain feature (berm). A barrier can be physical (obstructing passage) or psychological (detering access).

**Barrier-free design:** A trail design that promotes the elimination of physical barriers that reduce access by people with disabilities.

**Base course:** The layer or layers of specified material of designed thickness placed on a trailbed to support surfacing.

**Base map:** A map showing the important natural and built features of an area.

**Batter:** Leaning back from vertical towards the uphill slope.

**Bed:** The excavated surface of a trail upon which the tread or finished surface lies.

**Bench:** The excavated surface of a trail across a sidehill location; a full bench is constructed with no fill, the tread being entirely located on undisturbed mineral soil; partial bench is partially built on fill material.

**Bench cut, full:** The total width of the trail tread is excavated out of the slope, and the trail tread contains no compacted fill material. The most durable and recommended style of bench cut trail.

**Bench cut, half:** Half the width of the trail tread is excavated out of the slope and the downhill (outside) half of the trail tread contains the excavated and compacted material.

**Bench cut, partial:** Part of the width of the trail tread is excavated out of the slope and the rest of the trail tread is made up of fill material.

**Berm:** A raised outside edge of a trail.

**Best management practices:** Practical guidelines that can be used to reduce the environmental impacts of land uses or operations by means of careful planning, location, design, construction, management, and maintenance.

**Best practices:** Those that offer exemplary or model planning guidelines, design standards, development strategies, and management programs that lead to successful trails and programs.

**Blaze:** A painted trail marker.

**Buffer (buffer zone, buffer strip):** Any type of natural or constructed barrier used between the trail and adjacent lands to minimize physical or visual impacts. Buffers also provide a transition between adjacent land uses.

**Capacity building:** Activities that improve an organization's ability to achieve its mission or a person's ability to define and realize goals or perform tasks more effectively.

**Catch basin:** The excavated or constructed basin at the inlet of a culvert cross drain pipe used to collect water and direct it to a culvert pipe. Catch basins slow velocity of moving water, which encourages sediments to drop out of the flow before entering the pipe.

**Center line:** An imaginary line marking the mid-line of the trail tread. During construction, the center line is usually marked by placing a row of flags or stakes.



**Clearing height (vertical clearance):** The minimum vertical height which must be cleared of all tree branches and other obstructions that would otherwise obstruct movement along the trail.

**Clearing limit:** The area over and beside a trail that is cleared of trees, limbs, and other obstructions.

**Climbing turn:** A trail that continuously gains elevation as it changes direction, similar to a switchback but does not include a level platform at the apex of the turn. Rather, the trail follows the fall line for a short segment. On gentle grades a climbing turn is acceptable, on steeper grades it will result in erosion on the fall line segment of the turn.

**Clinometer:** Hand-held measuring tool used to measure the slope between two points.

**Compacted:** The degree of soil consolidation that is obtained by tamping with hand tools or heavy equipment.

**Compaction:** Tendency of soil to lose pore space and become compressed and impermeable to water when repeatedly traveled upon.

**Contour:** Line on a map connecting points of the same elevation. Parallel contour lines on a map represent a vertical change in grade in the landscape.

**Control point(s):** Places that influence where a trail goes. These features should be flagged and used to help layout a trail. The beginning and end of a trail are basic control points. Other control points include parking areas, trailheads, structures, slopes for turns or switchbacks, road or water crossings, and other trails. Also features that trail users will want to naturally head towards, or try to avoid.

**Control point, negative:** Places trail users should avoid.

**Control point, positive:** Places trail users want to visit.

**Creep:** Slow mass movement of soil down relatively steep slopes, primarily by gravity and water.

**Cross drain:** Installed or constructed structures such as culverts and pipes that move water from one side of the trail to the other.

**Cross section:** A drawing depicting a section of the trail sliced across the width.

**Cross slope:** The gradient of the hill slope as measured directly down the fall line.

**Culvert:** Hollow pipe for draining water beneath a trail.

**Cut and fill:** A method of trail construction in which the trail is built by cutting into the hillside and spreading and compacting the spoil materials downslope.

**Cut slope:** An earthen slope that is cut. For example, a trail built lower than the existing terrain would result in a cut slope.

**Daylighting:** Clearing a ditch or drain so that water can run freely, or all the way to “daylight.” Clearing of vegetation that is shading a trail or road corridor.

**Deadfall:** A tangled mass of fallen trees or branches that have died due to disease, insect or other damage, or decay.

**Deberming:** Removing the ridge of dirt that forms on the downhill side of the trail, preventing water from flowing across the trail.

**Debris:** Any undesirable material that encroaches on a trail and hinders the intended use

**Descent:** A downward incline or passage or process of descending from a higher to a lower location.

**Desire line:** An informal path that users prefer to take to get from one location to another rather than using the designated trail.



**Dip (grade dip, drainage dip, rolling dip, rolling grade dip, broad-based dip):** A reverse change in grade or gradual dip in the grade of the trail.

**Displacement:** The forces moving material sideways.

**Disturbance:** Any management activity that has the potential to accelerate erosion or mass movement. Also, any other activity that may tend to disrupt the normal movement or habits of a particular wildlife or plant species.

**Disturbed area:** Area where vegetation or topsoil has been removed, or where topsoil, spoil, or waste has been placed.

**Downed tree:** Fallen tree that blocks the trail.

**Downslope:** The downhill side of a trail.

**Drainage ditch:** Open ditches that collect water and carry it away from the site or trail. A drainage ditch is also an element of a waterbar, providing an escape route for water diverted from the trail by the bar.

**Drainage structure:** A water diversion structure constructed across the trail tread to remove water flowing down the trail tread, or to prevent it from entering the tread.

**Drop-off:** Slope that falls away steeply on the outer edge of a trail.

**Easement:** Grants the right to use a specific portion of land for a specific purpose or purposes. Easements may be limited to a specific period of time or may be granted in perpetuity; or the termination of the easement may be predicated upon the occurrence of a specific event. An easement agreement survives transfer of land ownership and is generally binding upon future owners until it expires on its own terms.

**Easement, conservation:** Places permanent restrictions on property in order to protect natural resources.

**Easement, construction:** Temporary area or corridor needed to construct a trail or facility.

**Easement, maintenance:** Additional permanent area or corridor (not open to the public) needed to maintain the trail and adjacent vegetation.

**Easement, scenic:** Places permanent restrictions on a property in order to protect the natural view.

**Elevation:** The height of a place (mountain or other landmark) given in the number of feet or meters above sea level.

**Embankment:** An artificial deposit of material that is raised above the natural surface of the land and used to contain, divert, or store water, support roads, railways, trails, or for other similar purposes.

**Equestrian:** Of horses, horseback riding, riders, and horsemanship.

**Equine:** Hoofed mammals having slender legs and a flat coat with a narrow mane along the back of the neck.

**Erosion:** Natural process by which soils move downhill or downwind; may be greatly accelerated on trails due to water, wind, and user traffic.

**Erosion, accelerated:** Soil loss above natural levels resulting from human activities

**Erosion control:** Techniques intended to reduce and mitigate soil movement from water, wind, and user traffic.

**Event:** A single, structured, organized, consolidated, or scheduled meeting or occurrence for the purpose of recreational use. An event may be composed of several related activities.



**Exotic species:** A plant introduced from another country or geographic region outside its natural range.

**Exposure:** The relative hazards encountered when on trails; takes into consideration obstacles, alignment, grade, clearing, tread width, tread surface, sideslope, isolation, and proximity to steep slopes or cliffs.

**Fall line:** Straight up or down a slope; flowing water will follow the fall line; the fall line is perpendicular to the contour line.

**Fall zone:** The area on either side of or below a technical trail feature that provides a clear landing for a rider who has failed to negotiate the obstacle.

**Fill:** Material (usually mineral soil and rock) excavated from the trail or a borrow site to fill holes in trail tread, stabilize rock steps, or to pack behind retaining walls and other structures.

**Fill Slope:** Area of excavated material cast on the downslope side of trail cut (also called embankment).

**Firmness:** The degree to which a surface resists deformation by indentation when, for instance, a person walks or wheels across it. A firm surface would not compress significantly under the forces exerted as a person walks or wheels on it.

**Flagging:** Thin ribbon used for marking during the location, design, construction, or maintenance of a trail project.

**Flagline (Flag Line):** A series of flags indicating the intended route for trail construction. Ribbon usually tied in trees or pin flags placed on the centerline, inside edge, or critical edge of the proposed trail project.

**Flags, pin (wire flags, wire stake):** Wire wands with square plastic flags at one end for field layout and marking of new trail or relocations of trail sections.

**Ford:** An unimproved route across a stream usually selected for its wide, shallow character, and typically containing a stone bottom.

**Gabion (gabion baskets):** Rectangular containers that can be wired together, and then filled with gravel or cobble to make quick retaining walls for erosion control.

**Geocaching:** Involves hiding a small object in a remote location and recording its location using a GPS unit. The coordinates, along with a few helpful hints, are then posted on a website for other GPS-wielding geocachers to look up and then hunt for—a modern day treasure hunt.

**Geocells:** Polyethylene strips bonded together to make a three-dimensional honeycomb structure. Fill material placed within the cells stabilizes and reinforces soil by confining substrates in cells to prevent lateral movement.

**Geographic Information System (GIS):** A spatial database mapping system (computer and software) that contains location data for trails and other important features.

**Geogrid(s):** Polyethylene sheeting configured into an open grid with high tensile strength. Used for reinforcement and often placed on top of a layer of geotextiles to provide separation.

**Geotextile fabric:** Textile made of synthetic fibers, usually non-biodegradable, to form a blanket-like product. In trail construction these are used as moisture barriers, for separation, for reinforcement of soils, filtration, and for drainage.

**Global Positioning System (GPS):** Small handheld receiver or unit that reveals a user's latitude, longitude, and altitude by timing signals received from orbiting satellites maintained for navigation by government agencies.





**Grade:** The slope of the trail along its alignment. The slope is expressed in a percent ratio, or the ratio of the elevation compared to the distance traveled, rise over run.

**Grade reversal:** A spot at which a climbing trail levels out and then changes direction by dropping subtly, before rising again. Grade reversals are known by several different terms, including grade dip, grade brake, drainage dip, and rolling dip.

**Grade separated crossing:** When a trail crosses the path of another user independently without impeding the other user.

**Guideline(s):** A statement and/or illustration describing a recommendation or principle for a preferred development technique or a course of action. Guidelines are not mandatory actions.

**Hardening:** Process of improving or firming the trail's treadway so it can withstand traffic and erosion.

**Hazard tree (danger tree, widow maker):** Tree or limb that is either dead or has some structural fault, that is hanging over, or leaning towards the trail or sites where people congregate.

**Hazard(s), foreseeable:** Hazards that trail builders or managers might perceive, but the average user would not see. An example is dead snags that serve as hazard trees when close to a trail.

**Hazardous materials:** Anything that poses a substantive present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

**Headwall:** A support structure at the entrance to a culvert or drainage structure.

**Headwaters:** The area in the upper reaches of a watershed typified by unconfined surface water flows. Headwaters can coalesce to form rivulets or first order streams with distinct channels. Headwaters can often be ephemeral (wet only part of the year).

**Helical pier:** Steel post with auger-shaped bit end that is rotated into wet soils either by hand or with specialized hydraulic tools to establish a foundation for a boardwalk.

**Hub(s):** Area(s) that anchor a network and provide an origin or destination for elements moving to or through it.

**Impermeable material:** A soil or material whose properties prevent movement of water.

**Impervious surface:** Hard surfaces that do not allow absorption of water into the soil and that increase runoff. Examples of such surfaces include concrete or asphalt paved trails and parking areas.

**In-kind contribution(s):** Labor or materials donated toward the match for a grant. Can include value of donated labor or equipment, real property, professional services, materials, etc.

**Infiltration:** The portion of rainfall or surface runoff that moves downward into the subsurface rock and soil.

**Inlet:** The opening in a drainage structure of pipe where the water first enters the structure.

**Inslope:** A trail cross section that is sloped towards the uphill side. Insloped trails drain towards parallel swales that collect water which is periodically conveyed under the trail to suitable discharge areas.

**Interpretation:** Communicating information about the natural and/or cultural resources and their associated stories and values found at a specific site or along a trail. Tours, signs, brochures, and other means can be used to interpret a particular resource.



**Interpretive:** Technique that assists audiences through communication media in making both emotional and intellectual connections with heritage resources.

**Interpretive center:** A facility where opportunities are provided for people to forge emotional and intellectual connections between their interests and the meanings that arise from learning about the resource. The facility may or may not be staffed, and can range in scale from a kiosk to a complex of buildings and natural sites, but always provides information about the natural and cultural resources.

**Interpretive display (sign):** An educational display usually in an interpretive center or at a trailhead that describes and explains a natural or cultural point of interest on or along the trail.

**Intersection:** Area where two or more trails join together.

**Inventory:** The systematic acquisition and analysis of resource information needed for planning and management purposes.

**Invert:** The bottom surface of a pipe, ditch, or culvert over which water flows.

**Invasive exotic:** Non-native plant or animal species that invades an area and alters the natural mix of species.

**Knick:** Shaved-down section of trail, about 10 feet in diameter, with an exaggerated outslope. Like a rolling grade dip, a knick is used to shed water off a trail and is a useful remedy for wet spots on relatively flat trails.

**Land ethic:** The desire humans have to conserve, protect, and respect the native landscape and other natural resources because their own well being is dependent upon the proper functioning of the ecosystem.

**Leadership in Energy and Environmental Design (LEED):** A green building rating system for the design, construction, and operation of high-performance green buildings. LEED recognizes performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.

**Lease:** The temporary grant of an interest in land upon payment of a determined fee. The fee does not have to be monetary, but some consideration must be given for the right to use the land, or the lease will not be legally binding.

**Leave No Trace:** Educational program designed to instill behaviors in the outdoors that leave minimum impact of human activities or occupation.

**Lead off ditches:** Excavations designed to divert water away from the trail or trail side swale in order to reduce water volume and velocity in the swale.

**Length:** Dimension of a feature measured parallel to the direction of travel.

**Level spreading:** A way of preventing concentrated flows and erosion by maintaining water runoff as sheet flow and dispersing it into dense vegetation for filtration and infiltration.

**Low water crossing:** A low water crossing is a constructed feature that creates a temporary stream crossing that is expected to wash out during high water.

**Maintenance:** Repair, improvements, or other work that is carried out on or near a trail to keep a trail in its originally constructed serviceable condition or to improve the safety and sustainability of the site. Usually limited to minor repair or improvements that do not significantly change the trail location, width, surface, or structures.



**Maintenance, annual:** Involves four tasks done annually or more often as needed: cleaning drainage, clearing blowdowns, brushing, and marking.

**Maintenance, cyclic:** Preventive maintenance activities that recur on a periodic and scheduled cycle.

**Maintenance, deferred:** Road/trail maintenance that was not performed when it should have been or when it was scheduled and which, therefore, was put off or delayed for a future period. When allowed to accumulate without limits or consideration of useful life, deferred maintenance leads to deterioration of performance, increased costs to repair, and decrease in asset value. Trail repair, rehabilitation, replacement and/or decommission can reduce or eliminate deferred maintenance. Formerly referred to as “backlog.”

**Maintenance, heavy:** Work usually done to repair damage normally expected from seasonal and occasionally unusual natural conditions or occurrences.

**Maintenance, routine:** Work that is planned to be accomplished on a continuing basis, generally annually or more frequently.

**Marker, trail:** An appropriate and distinctive symbol with the name of the trail, used to mark a trail route.

**Marker, reassurance (confidence marker):** Reconfirms the identity, location, or route of the trail.

**Memorandum of Understanding/Agreement (MOU/MOA):** A signed, written agreement entered into by various governmental agencies and nonprofit groups to facilitate the planning, coordination, development, and maintenance of a trail or trails system.

**Mineral soil:** Soil free of organic matter used for trail tread construction.

**Minimum tool rule:** Use the right tool for the job. A principle that guides the use of tools, and especially equipment, that are efficient, cost effective, and minimize the likelihood of environmental damage.

**Minor field adjustments:** Deviations of the trail alignment made during the course of normal construction or maintenance as determined by the supervisor or crew leader, and not part of an original survey.

**Mulch:** Organic matter spread over recently disturbed areas to help stabilize soils and protect them from erosion.

**Multimodal:** Facilities serving more than one transportation mode, or a transportation network comprised of a variety of modes.

**Multiuse trails (also referred to as shared use paths):** Refers to trails designated for pedestrian, equestrian and mountain bicycle or other non-motorized wheeled use, such as wheelchairs (with or without motors). Multiuse trails can also include accessible trails.

**National Scenic Trail:** a trail designated by the Secretary of the Interior or Secretary of Agriculture as part of the national system of trails authorized under the National Trails System Act of 1968, [www.nps.gov/nts/legislation.html](http://www.nps.gov/nts/legislation.html).

**Nonmotorized:** Trail recreation by modes such as bicycle, pedestrian, equestrian, skate, ski, etc.

**Noxious weeds (noxious plant):** Plant species designated by federal or state law as generally possessing one or more of the following characteristics: aggressive and difficult to manage; parasitic; a carrier or host of serious insects or disease; or nonnative, new, or not common to the United States.



**Organic soil:** Top layer of soil which contains roots, leaf litter, and decomposing branches and other vegetative materials.

**Other power-driven mobility device (OPDMD):** Any of a large range of devices powered by batteries, fuel, or other engines - whether or not designed solely for use by individuals with mobility impairments - that are used by individuals with mobility impairments for the purpose of locomotion, including golf cars, bicycles, electronic personal assistance mobility devices (EPAMDs), or any mobility aid designed to operate in areas without defined pedestrian routes.

**Outfall (outlet):** The drainage channel of a dip, waterbar, or switchback drainage structure where the water exits the structure.

**Outflow:** Water and its sediment load once it leaves the trail and the area it flows through.

**Outlet protection:** Devices or material placed at the outlet of pipes or drainage structures to dissipate energy of flowing water, reduces its flow velocity, and prevent erosion.

**Outslope:** A trail cross section that is sloped towards the downhill side of the trail to facilitate efficient movement of water runoff across and off the trail.

**Overlooks and viewing areas:** Trail features that are specifically designed and constructed to provide unobstructed observation of a vista or a specific point of interest.

**Passing space:** A section of trail wide enough to allow two users to pass one another or travel abreast.

**Passing space interval:** The distance between passing spaces.

**Pavement:** Any hard covering of stones, bricks, tiles, asphalt or concrete formed over a solid base to create a smooth surface. That part of a trail having a constructed hard paved surface for the facilitation of wheeled trail traffic.

**Pavement, porous:** A special type of pavement that allows rain and snowmelt to pass through it, thereby reducing the runoff from a site and surrounding areas.

**Percent slope:** Number of feet rise, vertical, divided by feet of run, horizontal, multiplied by 100 to get percent slope.

**Permit (system):** Use-authorization forms issued by agencies to control the amount of use along trails or in wilderness areas.

**Pitch:** A short section of trail that is steeper than the maximum design grade.

**Porous Concrete:** A concrete mix that has few fines, resulting in many small voids through which water can pass.

**Prescription:** Management practices which are selected and scheduled for application in a specific area in order to attain goals and objectives.

**Quadrangle, 7.5-minute:** A USGS paper map at 1:24,000 scale covering 7.5 minutes of latitude and 7.5 minutes of longitude. Therefore one map covers approximately nine miles in a north-south direction and approximately 6.5 miles east-west. Features shown include elevation contours, roads, railroads, trails, water bodies, buildings, and wetlands. An automated version of the 7.5-minute quadrangle is called the digital raster graphic or DRG. It is informally known as 7.5-minute quad.

**Quiet Title:** An action brought in state court to establish legal rights to property. In the legal proceeding called “action to quiet title,” the word “quiet” means to pacify; to render secure or unassailable by the removal of unsettling causes or disputes. Under this proceeding, the plaintiffs title to land is established by bringing into court an adverse claimant and there compelling them to either establish their claim or be forever after stopped from asserting it.





**Quitclaim deed:** Document that transfers ownership of real estate, but contains no guarantees that the seller has a valid right to do so, or that others do not have rights to the land.

**Rail-with-Trail:** A rail trail constructed within or adjacent to an active railway right-of-way.

**Railbank(ing):** Retaining a rail corridor for future railroad uses after service has been discontinued. The National Trails System Act provides for interim public use of the corridor, allowing the establishment of recreational trails.

**Railroad bed:** The earth bank or bed supporting railroad tracks.

**Rail trail:** Conversion of a railway easement into a shared use path.

**Ravel:** Constant movement of loose or coarse material on a slope. Also a process where the coarse material on a trail surface comes loose and separated from the trail tread because of lack of binder or poor gradation of tread material.

**Rebar:** Steel reinforcing rod, available in a variety of diameters, useful for manufacturing pins or other trail anchors.

**Relocation:** New and different location for the trail.

**Register, trail:** Located at overnight stops or trailheads to allow users to make comments to those behind them, and read comments from those ahead. Registers can be an important safety measure to pinpoint the location of trail users.

**Rest area:** A level portion of a trail that is wide enough to provide wheelchair users and others a place to rest and gain relief from the prevailing grade and cross slope demands of a path.

**Rest area interval:** The distance between rest areas.

**Restore:** To bring back to a former, normal, or productive condition by repairing or rebuilding.

**Restrictions, road or trail:** Limitations placed on the use of a road or trail. Sample codes: S-seasonal closure, Y-closed yearlong to motorized vehicles, R-restriction on types of traffic allowed on road or trail, L-limitations on vehicle dimensions, weight or speed, N-no restrictions applied, B-no bicycles, E-no equestrians, M-no motorized vehicle, P-permit required for use.

**Restroom (comfort station, pit toilet, vault toilet, composting toilet, chemical toilet, latrine, bathhouse):** Facility for human waste disposal.

**Revegetation:** Process of planting or transplanting vegetation on bare soil to develop plant cover.

**Reversionary interest (reversion):** The right of a property owner to the future enjoyment of property presently in the possession or occupancy of another.

**Ridgeline:** A line connecting the highest points along a ridge and separating drainage basins or small-scale drainage systems from one another.

**Right-of-Way:** A linear corridor of land held in fee simple title, or as an easement over another's land, for use as a public utility (highway, road, railroad, trail, utilities, etc.) for a public purpose. Usually includes a designated amount of land on either side that serves as a buffer for adjacent land uses.

**Rills:** The result of concentrated flow of water resulting in erosion, typically up to one inch in depth. Gullies are considered to have developed when rills exceed one inch of depth.

**Right of way:** A legal easement that grants the one person right to pass over the land of another.

**Riparian (riparian zone, habitat zone):** A habitat that is strongly influenced by water and that occurs adjacent to streams, shorelines, wetlands, or other water bodies, dominated by high soil moisture content and influenced by adjacent upland vegetation.



**Riparian vegetation:** Plant species growing adjacent to a wetland area, including a perennial or intermittent stream, lake, river, pond, spring, marsh, bog, meadow, etc.

**Riprap:** Well graded, durable, large rock, ideally with angular surfaces, sized to resist scour or movement by water and installed to prevent erosion of the soil.

**Risk, assumption of:** The legal concept that users assumed and perceived an activity was potentially dangerous and the users willingly assumed those risks and participated anyway.

**Risk, perception of:** Subjective judgment that people make about the characteristics and severity of a risk. For example, perceiving a steep drop off on a trail as being dangerous and therefore not getting too close to the edge.

**Risk management:** An element of safety management that evaluates the effects of potential hazards on safety by considering acceptance, control, or elimination of such hazards with respect to expenditure of resources.

**Road, designated:** Specific roads identified by the land management agency where some type of use is appropriate and allowed either seasonally or yearlong and which have been inventoried and mapped and are appropriately signed on the ground.

**Road, forest:** A temporary or permanent road connecting parts of the forest to existing public roads. They provide access to forestland for timber management, fish and wildlife habitat improvements, fire control, and a variety of recreational activities.

**Road-crossing:** Intersection of trail and road traffic.

**Rolling dip:** Water flowing over the surface of an unpaved trail always carries sediment with it, no matter how carefully the trail is designed and constructed. A rolling dip functions by collecting runoff and sediment at a low point in the trail and routing them off the trail to daylight. The frequency and locations of dips are based on trail width, grade, tread material, and soil erodability.

**Ruts (rutting, entrenchment):** Sunken tracks or grooves in the tread surface cut in the direction of travel by the passage of trail users or water.

**Saddle:** A topographical term for a “sagging” ridge that connects two summits.

**Scour (scouring):** Soil erosion through the force of moving water.

**Sediment:** Soil particles that have been transported away from their natural location by wind or water action and re-deposited in a different area down-slope or down-stream.

**Sediment deposition:** The accumulation of soil particles on the trail tread and banks.

**Sedimentation:** Deposition of soil particles or other material carried in water; usually the result of a reduction in water velocity below the point at which the material remains in suspension.

**Segment:** A portion of a trail.

**Sensitive species:** A species that is listed under the Endangered Species Act as threatened, endangered, candidate or proposed by the Pennsylvania Natural Heritage Program or is a species of concern for listing.

**Shared use path:** A bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users. Rail trails are typically classified as shared use paths.



**Shared use trail (multi-use trail):** A combination of harmonious recreation uses sharing the trail resource.

**Sheet flow:** Desirable condition in which water flows in smooth sheets rather than concentrated flow; slower flow (velocity) and less concentration (volume) results in less erosion.

**Shoulder:** The surfaced or unsurfaced width of a trail next to the tread, or travelway.

**Shy distance:** The distance between the trail's edge and any fixed object capable of injuring someone using the trail.

**Sidehill:** A trail location that cuts across a slope, following the contour, as opposed to a fall line trail that goes straight up and down the slope, or a ridgeline trail that follows the top of slope.

**Sidehilling:** Process of excavating or cutting a bench across a slope.

**Sideslope:** Angle on inclination of land along the fall line, usually measured in percent slope or in degrees from horizontal.

**Sight distance:** How far a person can see along an unobstructed line of sight.

**Sight stopping distance:** Sight distance while taking into consideration the time it takes a traveler to see something, react to it, and to stop safely before the object.

**Sign (signage):** A board, post, or placard that displays written, symbolic, tactile, or pictorial information about the trail or surrounding area. Signage increases safety and comfort on trails. There are five basic types of signs: Cautionary, Directional, Interpretive, Objective, and Regulatory.

**Sign, cautionary:** Warns of upcoming roadway crossings, steep grades, blind curves, and other potential trail hazards.

**Sign, directional:** Gives street names, trail names, direction arrows, mileage to points of interest, and other navigational information.

**Sign, interpretive:** Offers educational information that describes and explains a natural or cultural point of interest on or along the trail.

**Sign, objective:** Provides information about the actual trail conditions, including grade, cross slope, surface, clear trail width, and obstacle height. This allows users to make more informed decisions about which trails best meet their trail needs and abilities.

**Sign, regulatory:** Tells the “rules of the trail” by prohibiting certain uses or controlling direction of travel.

**Slope:** Angle of the ground from a level position measured as a percent of rise over run, or in degrees. Generally refers to the hillside (land) and not the trail, as trail “slope” is called the grade.

**Slope, cross:** The slope or gradient of the undisturbed hillside; the amount or grade of the pre-existing slope that is perpendicular to the direction of the trail.

**Slope, running:** The average slope of a contiguous section that is in the same direction as the trail; measured by averaging the values of slope measurements taken periodically at different points along the trail.

**Slope, running cross:** The average cross slope of a contiguous section of a trail; measured by averaging the values of cross slope measurements taken periodically at different points along a given section of trail.

**Slope, percent:** Number of feet rise (vertical) divided by feet of run (horizontal) times 100 to get percent slope.

**Slope, toe:** When soil and rock move downslope and come to rest, they form a toe slope, named for its similarity to the human form.



**Slope stability:** The resistance of a natural or artificial slope or other inclined surface to failure by mass movement.

**Social trails:** Informal, unofficial paths or shortcuts that have been created over the years by consistent human use. While these may appear no different than other trails to users, social trails tend to impact natural, cultural and historic resources more than other routes that were designed and constructed as trails. Social trails need to be evaluated to determine whether they are appropriate and sustainable, or whether they should be renovated or closed as part of proposed trail system improvements.

**Soils:** The surface material (mineral materials, organic matter, water, and air) of the continents, produced by disintegration of rocks, plants, and animals and the biological action of bacteria, earthworms, and other decomposers. The four fundamental groups of soils are: gravels, sands, loams, and clays.

**Soil, erodible:** Soils that are likely to have high soil loss when exposed to water runoff.

**Soil, heavy:** A soil with a high percentage of clay.

**Soil, Hydric:** Soil that is saturated or flooded during a sufficient portion of the growing season with anaerobic conditions in the upper soil layers. Examples include bogs, marshland, and swampland soils.

**Soil, Inorganic:** Mostly sandy soils containing little or no plant and animal remains.

**Soil, Light:** A coarse-textured soil with a high percentage of sand and a low percentage of clay.

**Soil, mineral:** A soil comprised of rock fragments, sand, and smaller sized particles, and relatively free of organic matter. Mineral soil is typically buried under layers of surface organic matter. It is relatively stable and is the preferred material upon which to build a trail tread. When compacted, it also provides good support to rock walls and other trail structures.

**Soil, organic:** Soil that is made up of leaves, needles, plants, roots, bark, and other organic material in various stages of decay, and has a large water/mass absorption ratio. Generally the first (outermost) layer of soil.

**Soil, residual:** A soil formed from and resting on consolidated rock from which it was formed.

**Soil, saturated:** A condition in which all of the pore space in the soil is filled with water. This may be a temporary condition associated with large amounts of rainfall or snowmelt, a semi-permanent, or permanent condition.

**Soil, surface:** The uppermost part of the soil profile (solum).

**Soil cement (Cement-Treated Base):** A mixture of pulverized soil combined with measured amounts of portland cement and water and compacted to a high density. As the cementing action occurs through hydration, a hard, durable semi-rigid material is formed. It must have a seal coat to keep out moisture and a surface that will withstand wear.

**Soil compaction:** A decrease in the volume of soil as a result of compression stress.

**Soil map:** A map showing the kinds of soil types and their boundaries in all the detail significant to soil use and management.

**Soil profile:** Site-specific arrangement of soil layers from surface to bedrock.





**Soil stabilization:** Measures that protect soil from the erosive forces of raindrop impact and flowing water. They include, but are not limited to, vegetative establishment, mulching, and the application of soil stabilizers to the trail tread.

**Soil stabilizer:** Material, either natural or manufactured, used to hold soil in place and prevent erosion due to water, gravity, or trail users. Stabilizers include soil cement, geogrid, etc.

**Species, invasive or exotic (alien, introduced, non-indigenous):** Non-native plant or animal species that invades an area and alters the natural mix of species by aggressively out-competing native species.

**Species, sensitive:** Any plant or animal species for which population viability is a concern as evidenced by significant current or predicted downward trends in population numbers or density, or habitat capability that would reduce a species' existing distribution.

**Species, threatened or endangered:** Any plant or animal species that is in danger of extinction throughout all or a significant portion of its range, and has been officially listed as endangered by the Secretary of Interior or Commerce under the provisions of the Endangered Species Act. A final rule for the listing has been published in the Federal Register.

**Specifications:** Written provisions and requirements (standards) for the performance of work and type of materials to which trails (tread, clearing, grade) and trail structures (bridge, culvert, puncheon) are built and maintained according to type of use.

**Sponsor:** Organization or government agency that will sign agreements and contracts and be responsible for a trail or greenway project.

**Stakeholders:** Group or individual who can affect, or is affected by, the achievement of the organization's mission; examples include managers, employees, policy makers, citizens, and community groups.

**Stakes, line:** Temporary stakes set by the trail locator to establish the centerline of the trail.

**Standards, design:** The specific values selected and documented from the design criteria become the standards for a given trail or greenway project. These standards will be identified and documented by the designer. Standards will related to the physical characteristics, users, location, and environmental factors of a project.

**Statewide Comprehensive Outdoor Recreation Plan (SCORP):** Recreation management plan developed periodically (about every 10 years) by each State to help federal, state, and local agencies assess recreational use trends and the needs for future management and facilities.

**Station:** One hundred feet or other set measurement along the centerline of the trail or road; used in surveying and construction.

**Steward:** The person taking responsibility for the well-being of land and water resources and doing something to restore or protect that well-being.

**Stewardship:** Taking responsibility for the well-being of land and water resources and doing something to restore or protect that well-being. It usually involves cooperation among people with different interests and sharing of decision-making. It is generally voluntary. It is oriented towards assessment, protection, and rehabilitation of trails and greenways as well as sustainable use of renewable resources.

**Subgrade:** The surface of trail tread upon which the base course is constructed.

**Spur trail:** A trail which terminates at a destination, i.e. vista, campground, water source, etc.



**Stone pitching:** Ancient form of road/trail building similar to cobblestone.

**Stream, alluvial:** Any stream whose banks are subject to attack, allowing soil, sand, or gravel to build up in one area while washing it away in another.

**Stream, ephemeral:** A temporary or short-lived water flow only in direct response to a heavy rain. Most of the year it's a dry bed.

**Stream, intermittent:** Channels that naturally carry water part of the year and are dry the other part.

**Stream, navigable:** A waterway is navigable if it has bed and banks, and it is possible to float a canoe or other small craft in it on a regular reoccurring basis even if only during spring runoff.

**Stream, perennial:** Stream channels that carry water year round.

**Stream bank:** The side slopes of an active channel between which the stream flow is normally confined.

**Stream channel:** A long narrow depression shaped by the concentrated flow of a stream and covered continuously or periodically by water.

**Stream crossing:** A trail crossing a body of running water at grade without the use of a developed structure or bridge.

**Stream bed:** The unvegetated portion of a channel boundary below the baseflow water level. The channel through which a natural stream of water runs or used to run, as a dry streambed.

**Stream flow:** The rate at which water passes through a given point, usually expressed in cubic feet per second.

**Structure:** Anything constructed or erected that requires location on the ground such as a bridge, wall, steps, etc. on or near a trail.

**Surface (surfaced, surfacing):** Material on top of the trailbed or base course that provides the desired tread. It can lessen compaction of soil, provide a dry surface for users, and prevent potential erosion and abrasion. In addition to concrete and asphalt, trails can be surfaced with dirt, rock, gravel, sand, mud, snow, grass, and other substances.

**Surface water:** All water on the surface of the Earth naturally exposed to the atmosphere.

**Sustainable (sustainability):** Community use of natural resources in a way that does not jeopardize the ability of future generations to live and prosper.

**Sustainable development:** Development that maintains or enhances economic opportunity and community well-being while protecting and restoring the natural environment upon which people and economies depend. Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.

**Sustained grade:** A trail grade that is more or less consistent between two points.

**Swale:** A low point adjacent to the trail intended to collect run-off from the trail and adjacent land for transport to a suitable outlet.

**Switchback:** A sustainable sharp turn on a hillside to reverse the direction of travel and to gain elevation. The landing is the turning portion of the switchback. The approaches are the trail sections upgrade and downgrade from the landing. Because of this landing they are more difficult to construct than a climbing turn; however, they are also much more durable and less prone to erosion on steep slopes.

**Switchback, rolling crown:** A sustainable turn on a hillside engineered for drainage. The trail is routed onto a crowned deck where it makes a transition to the opposite direction. The upper approach is insloped to drain water out the back of the landing and the lower approach is outsloped.



**Tamping:** Using a narrow machine compactor, a tamping bar, or the handle of a shovel or other tool to compact earth backfill around a post, pole, or pile.

**Terminus:** Either the beginning or end of a trail.

**Title search:** A legal review of deeds of record in the chain of title to a piece of property analyzing all encumbrances or prior sales of the property, to make sure that a piece of real estate can be sold without anyone else claiming rights to it.

**Toe:** The break in slope at the foot of a bank (trail or stream) where the bank meets the bed.

**Top bank (top of bank):** The break in slope between the bank and the surrounding terrain.

**Topographic (topo, USGS topographic, contour) map:** Maps that indicate built and natural features (buildings, roads, ravines, rivers, etc.) as well as elevation changes and land cover. United States Geological Survey maps are available from many government offices, outdoor shops, and map stores; or from digitized versions on the Internet.

**Topographic:** Of or having to do with topography or the physical features of a place.

**Topography:** The elevation and slope of the land as it exists or is proposed. It is represented on drawings by lines connecting points at the same elevation. Typically illustrated by dashed lines for existing topography and solid lines for proposed.

**Topsoil:** The top layer of earth, dark and rich in organic matter.

**Trail:** Travel routes that are designed, designated or constructed for recreational hiking use or provided as a pedestrian alternative to vehicular routes within a transportation system.

**Trail, access:** Any trail that connects the main trail to a town, road, or another trail or trail system.

**Trail bed:** The tread plus base materials.

**Trail clearing limit:** The area beside and above a trail tread that is cleared of trees, limbs, and other obstructions; often the edges of the trail corridor.

**Trail clearing width:** The space to each side of the trail tread that is cleared for trail users. Typically, there is an uphill and downhill clearing width prescribed.

**Trail corridor:** The strip of land in which trails and other facilities are built. This includes the tread itself, the shoulder, and the cleared area adjacent to the trail. Multiple tread corridors include the tread, clearing, and vertical clearing width for all treads.

**Trail, contour:** A trail constructed or existing such that it follows a contour, with its elevation remaining constant. Constructed at full bench with outslope, grade reversals, and sustained grades.

**Trail, fall line:** Trail constructed on the fall line (direction water flows down a hill) which encourages water to run down the trail.

**Trail, natural surface:** A tread made from clearing and grading the native soil, and with no added surfacing materials.

**Trail, regional:** An extended or longer trail that may cross one or more land management agency jurisdictions and connects diverse trail systems.

**Trail, rolling contour:** A trail characterized by gentle grade, grade reversals, and outsloped tread.

**Trail, sustainable natural surface:** A trail that supports currently planned and potential future uses with minimal impact and negligible soil loss while allowing the naturally occurring plant systems to inhabit the area, recognizing required pruning and eventual removal of certain plants over time. The sustainable trail will require little rerouting and minimal maintenance over extended periods of time.



**Trail access information:** Objective information reported to trail users through signage, about the grade, cross slope, tread width, and surface of a trail.

**Trail design:** Designing and layout of trails requires special training, knowledge, experience, and skill. When designing trails, many different factors are taken into account including hydrology, topography, soils, flora, fauna, management objectives, user expectations and characteristics, and trail design standards. The designer will utilize data collected from area site analysis, environmental assessments, public meetings, and area trail and management plans.

**Trail management objective (TMO):** The goals and objectives pertaining to a specific trail management project (new construction, maintenance, reroute, bridge, etc.). Usually intended to provide guidance for a trail crew leader.

**Trail system:** A collection of individual trails that may or may not be connected to one another, whereby each retains its distinctiveness, and yet belongs to the system by association with a federal, state, local, or bioregional context.

**Trailbed:** The finished surface on which base course or surfacing may be constructed. For trails without surfacing, the trailbed is the tread.

**Trail vertical clearance:** The space over the trail that is clear of obstructions.

**Trailhead:** Points of access to trails intended for public use. Sometimes provides parking, information signs, shelter, etc.

**Trailway:** The portion of the trail within the limits of the excavation and embankment.

**Trailway clearance:** The trailbed plus the area to either side that is needed to accommodate the construction of cuts and fills to accommodate the trail.

**Travel management (access and):** A continuous process of analyzing, controlling, and regulating travel to accomplish management objectives. It is that portion of the planning and implementation process that develops clear specific direction on the appropriate levels of access and travel opportunities to be made available. It takes into account long-term social, biological, economic, and physical considerations; it combines a variety of design considerations that are commensurate with how access will be provided and travel will be managed; and it also involves sharing this information with the public.

**Travel management areas:** Polygons or delineated areas where a rational approach has been taken to classify areas open, closed, or limited, and that have identified or designated networks of roads and trails that provide for public access and travel across the planning area.

**Travelway:** The trail as a whole, including the trail tread and the cleared areas on either side of the trail.

**Traverse:** To cross a slope horizontally going gradually up and across in lieu of the more direct up-and-over (up the fall line) approach.

**Tread (treadway):** The travel surface of the trail.

**Tread, trail (treadway):** The surface portion of a trail upon which users travel, excluding backslope, ditch, and shoulder. Common tread surfaces are native material, gravel, soil cement, asphalt, concrete, or shredded recycled tires.

**Tread creep:** When the loose soil of the trail tread moves (sags or slides) downhill because of erosion or use. Specific causes include bushes or trees protruding into the trail from above, exposure of roots from an uphill tree, an improper bench cut, or poor trail flow.





**Tread Lightly!:** Educational program designed to instill outdoor ethics of responsible behavior when participating in outdoor activities, [www.treadlightly.org](http://www.treadlightly.org).

**Trench (trenched, trenching):** Badly eroded trail in which the user travels in a ditch down the center that may be knee deep or deeper. Any long furrow or ditch cut in the ground.

**Trespass:** The use of private or public land without authority, resulting from an innocent, willful, or negligent act.

**Trespasser:** Person who uses property without the owner's implied or stated permission and not for the benefit of the property owner.

**Tributary:** A river or stream feeding into a larger waterway or lake.

**Turn:** Where a trail or river changes course or direction.

**Turn, climbing:** A turn on a hill to reverse direction that doesn't have a constructed turning platform or landing. The upper and lower legs of a climbing turn are generally joined by a short section of trail (the apex of the turn) that lies directly in the fall line. As a result, climbing turns located on hillsides with a grade of more than 7% are erosion prone and should be replaced with well-built switchbacks.

**Turn, inside:** On a trail traversing a hillside, concave, or naturally banked turns in which the sideslope helps direct trail users around the turn.

**Turn, outside:** Convex or off-camber turn (usually on trails that traverse hillsides) that are more difficult to navigate, as centrifugal force pulls trail users to the outside of the turn. A turn in which the ground slopes toward the outside, making it harder to keep (wheeled) traction as speed increases.

**Turnout:** A place where the trail is widened to permit trail traffic traveling in opposite directions to pass.

**Underdrain:** A buried trench filled with coarse aggregate, coarse sand, or gravel typically placed in a swale line along the trail. An underdrain functions by diverting subsurface water away from trail subgrade and conveying it to a suitable outlet point. Underdrains use uniform sized rock, may be wrapped in geotextile fabric, and may have a perforated drain pipe in the bottom of the trench.

**Underpass:** An underground tunnel or passage enabling trail users to cross under a road or railway.

**Understory:** All forest vegetation growing under the canopy or upper layers of forest vegetation.

**Universal design:** Access without limitation or exception.

**Universal Trail Assessment Process (UTAP):**

An inventory process that can be used by trail managers to assess a trail to determine compliance with design guidelines and to provide objective information to trail users regarding grade, cross slope, tread width, surface, and obstacles.

**Unravel:** To lose material from the edges of a retaining wall (revetment, cribbing).

**Upland:** Land at a higher elevation than the alluvial plain or low stream terrace; all lands outside the riparian-wetland and aquatic zones

**Vegetation, aquatic:** The vegetation that grows as either submerged (below the surface of the water) or emergent (some portion of the plant floating on or rising above the surface of the water) in an aquatic habitat.

**Vegetation, native:** Indigenous species that are normally found as part of a particular ecosystem; a species that was present in a defined area prior to European settlement.



**Walks:** Exterior pathways (including sidewalks) with a prepared surface intended for pedestrian use. Although federal regulations make a distinction between trails and walks, portions of some trails at developed sites are classified as walks and are included under the general classification of trails.

**Wall, retaining** (Revetment, Cribwall, Cribbing, Mono-wall, Multi-Tier Wall): A structure used to prevent soil from slumping, sliding, or falling; usually made of log, stone, bags, block, or pavement. Often used to provide stability and strength to the edge of a trail or stream bank.

**Wall, rubble:** A roughly built wall or structure of irregular or greatly differing sizes of stone usually laid at or nearly at the same angle as the cross slope; frequently used to discourage shortcutting corners and to armor native slopes to prevent erosion.

**Wall, wing (wingwall):** A structural component of a retaining wall, which is interlocked with the facer or front of the wall. The wing generally intersects with the facer at a 45° angle, but may be at an angle between 1° and 90°. This component is anchored by tie logs and both assists the facer in retaining the fill material and helps prevent flanking.

**Wash rack:** Area set aside for cleaning or cooling animals after a ride or washing off bicycles.

**Washout:** Erosion of a relatively soft surface, such as a trail, by a sudden gush of water, as from a downpour or floods; a channel produced by such erosion.

**Water course (watercourse):** Any natural or built channel through which water naturally flows or will collect and flow during spring runoff, rainstorms, etc.

**Water pollution:** The presence in water of enough harmful or objectionable material to damage the water quality.

**Water trough (stock tank):** Used to provide drinking water for animals such as cattle or horses. Troughs or tanks can range in size from 30 to over 1500 gallons and typically are made of galvanized steel. Many riders prefer watering their stock in clean, freshly filled water troughs.

**Water quality:** The chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

**Waterbar:** A drainage structure (for turning water) composed of an outsloped segment of tread leading to a barrier (log, stone, or timber) placed at a 45° angle to the trail. Water flowing down the trail will be diverted by the outslope or, as a last resort, by the barrier. This type of drainage structure is no longer recommended for construction or use on trails. Grade dips are preferred instead.

**Waypoint:** A point between major points on a route, as along a track.

**Waysides:** The side or edge of a trail, road, way, path, or highway. Sites along a trail that allow users a place to stop to sit, rest, eat, enjoy a view, or read an informational display. They can be located where there are noteworthy natural or cultural resources, attractive views, or a lack of other nearby facilities.

**Weathering:** The physical and chemical disintegration and decomposition of rocks and minerals.

**Wetland:** Areas that are inundated by surface or ground water with a frequency sufficient to support, and that under normal circumstances do or would support, a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

**Wetland, jurisdictional:** Area subject to the regulations of the Clean Water Act of 1977; generally concave or low-lying topographical forms that collect, store, or flow water frequently enough to favor a majority of plants that are adapted to saturated soil conditions.



**Wheelchair:** Mobility aid, designed for and used by individuals with mobility impairments; may be manually operated or motorized.

**Width, clearing:** The outer edges of clearing areas (cleared of trees, limbs, and other obstructions) as specified by trail use.

**Widening:** The instance when the main trail has expanded beyond its original width.

**Width, design:** The width specification that a trail was designed to meet, generally considered part of the trail.

**Width, minimum clear:** The narrowest point on a trail; created when significant obstacles, such as utility poles or tree roots, protrude into and reduce the design width.

**Width, tread:** The width of the surface portion of the trail used for travel.

**Wildlife:** Any undomesticated animal species living in its natural habitat including birds (raptors, songbirds, upland game birds), mammals (fur bearers, big game, non-game mammals), reptiles, amphibians, and fish.

**Windfall (windthrow, downfall):** Anything (trees, limbs, brush, etc.) blown down on the trail by the wind.

**Windrow:** A ridge of loose soil that is produced by the spill from a grader or dozer blade.

**Wire flags:** Wire wands with square plastic flags at one end for field layout and marking locations of new or relocated trails.

**Zero-mile mark:** The point at which a measured trail starts.



**Trail Volunteers**  
Lonberger Trail Reroute, Center County

Photo Credit: PA DCNR





**Dr. J Freeride Trail**  
North Park, Allegheny County

Photo Credits: Jon Pratt



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