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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

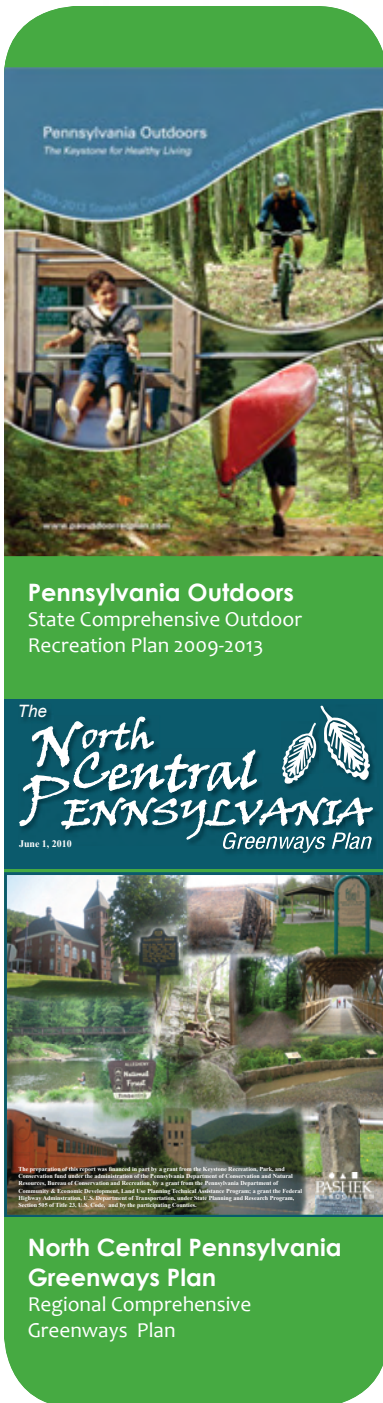
If you need of technical assistance or desire to discuss the potential of acquiring DCNR funding for your trail project, please contact your DCNR regional adviser. You can find your adviser [HERE](#) and clicking the Regional Offices tab.

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
- 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?

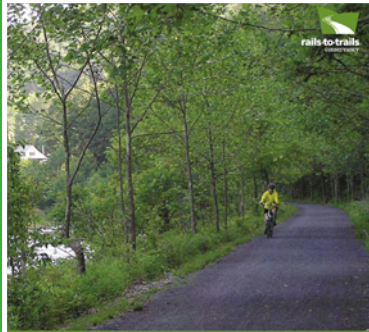


North Country Trail Hikers
Kellettville Campground,
Allegheny National Forest
Forest County



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

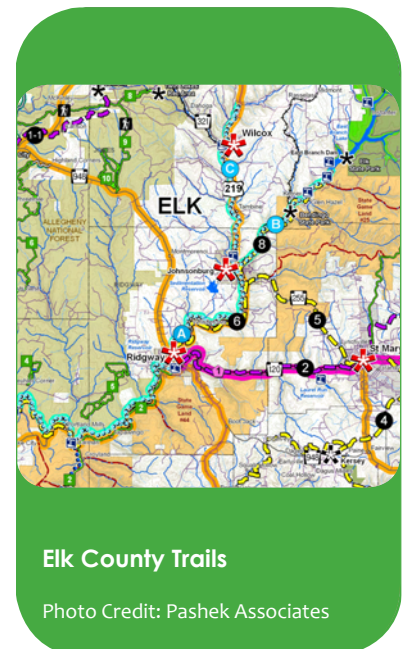
Your trail designer may find historically sequenced aerial photographs extremely useful. They use historical photographs to see how land use has changed over time. With this information the designer can identify potential problem sites or areas of potential interest to the user; such as historical sites. 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

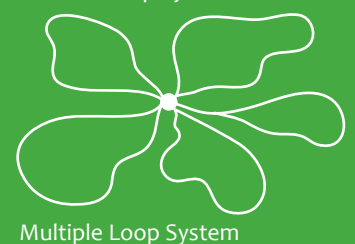
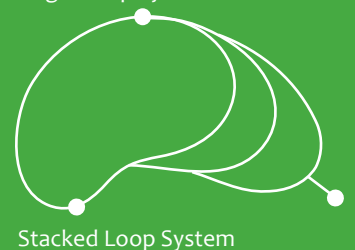
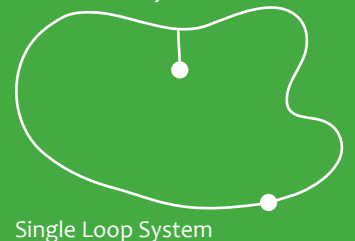
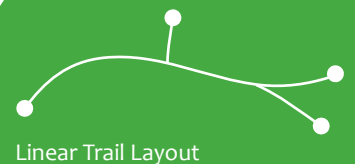
When establishing the preliminary trail layout the first step is to determine the type of layout that best achieves your goals and vision for your trail or trail system. Secondly, it is important for you to determine the level of trail difficulty that you want to provide for your trail users.

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

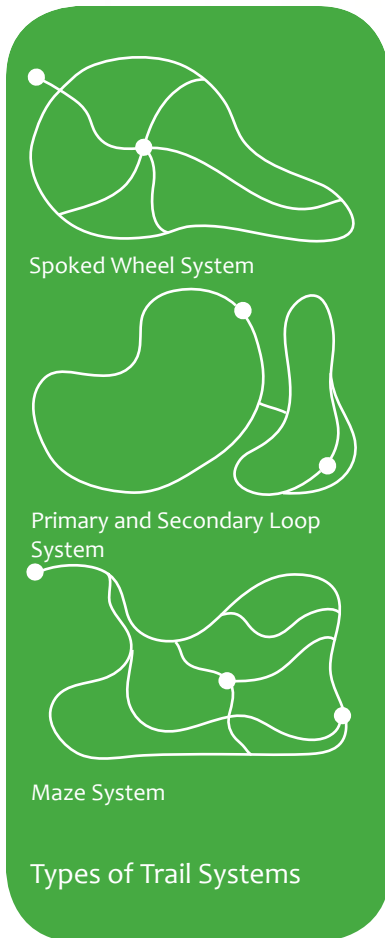
- **Linear Trail Layout (Point-to-Point)** - The simplest trail layout has a point of origin and a destination. It connects two points or links two trails. Use this layout where there are points of interest or destinations along a single narrow corridor or to connect other trail systems where the terrain 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*"¹¹, 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.

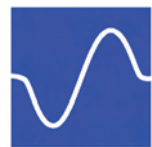
¹ Guidelines for Marking Recreational Trails, PA DCNR: 2008



- **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.



EASIEST



MORE
DIFFICULT



MOST
DIFFICULT

Level of Difficulty Symbols
National Trail Difficulty Rating
System



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 following²:

- **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,

² 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)

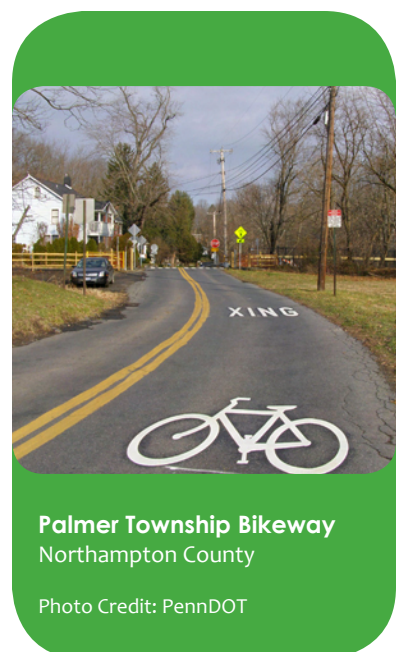
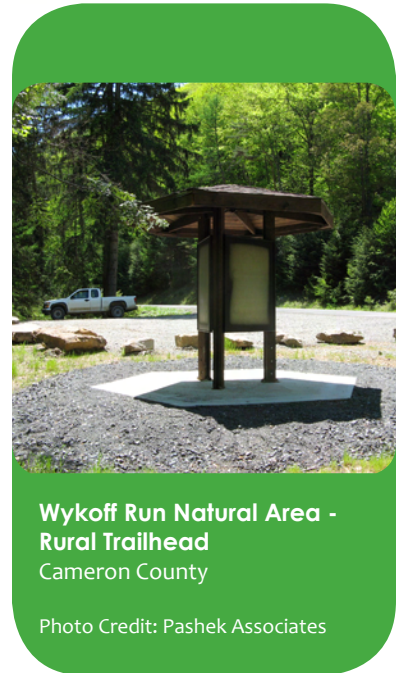
Trail or trailhead access through PennDOT rights-of-way or location of extended utilities, such as sewer, water, and electric, may require a HOP and/or HOA.

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.

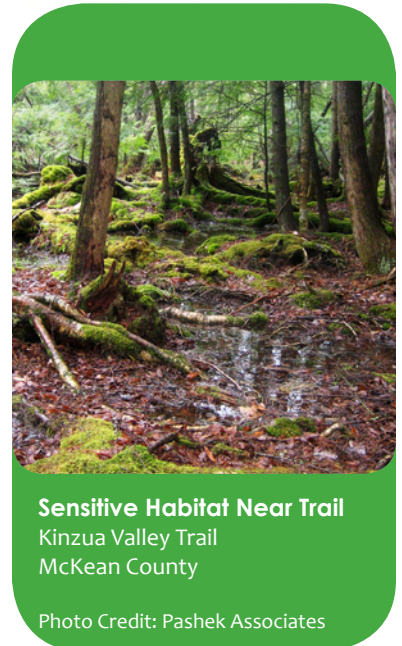
Lower portions of north-facing slopes tend to remain wet because groundwater moving downhill comes to the surface in these areas. Furthermore, the northerly aspect generally receives less direct sunlight than south, east, or west-facing slopes, allowing these areas to remain wetter.

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, 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, 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.

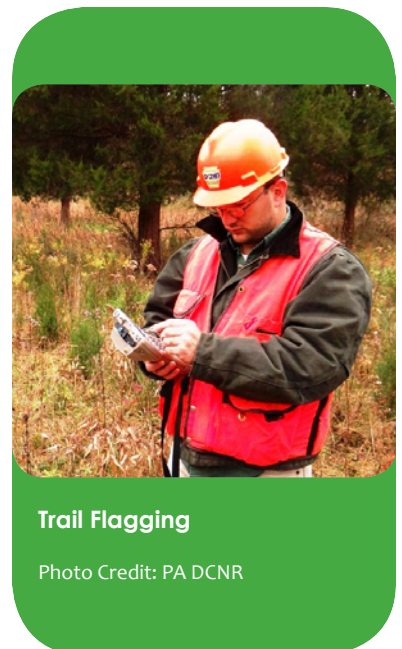
During the planning phase it is important to incorporate the philosophy of universal design in the planning process. Specific design requirements for accessible trails are detailed in Chapter 2 - Design Needs for Specific Non-Motorized Trail Users.

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 trails³:

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 mistakes⁴ 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.

⁴ 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.

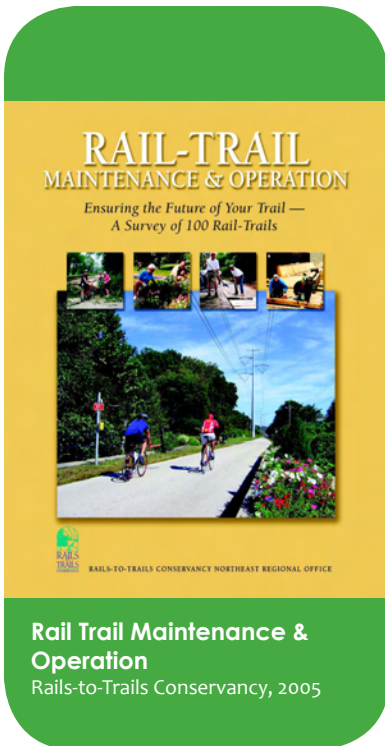
Construction Costs

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.

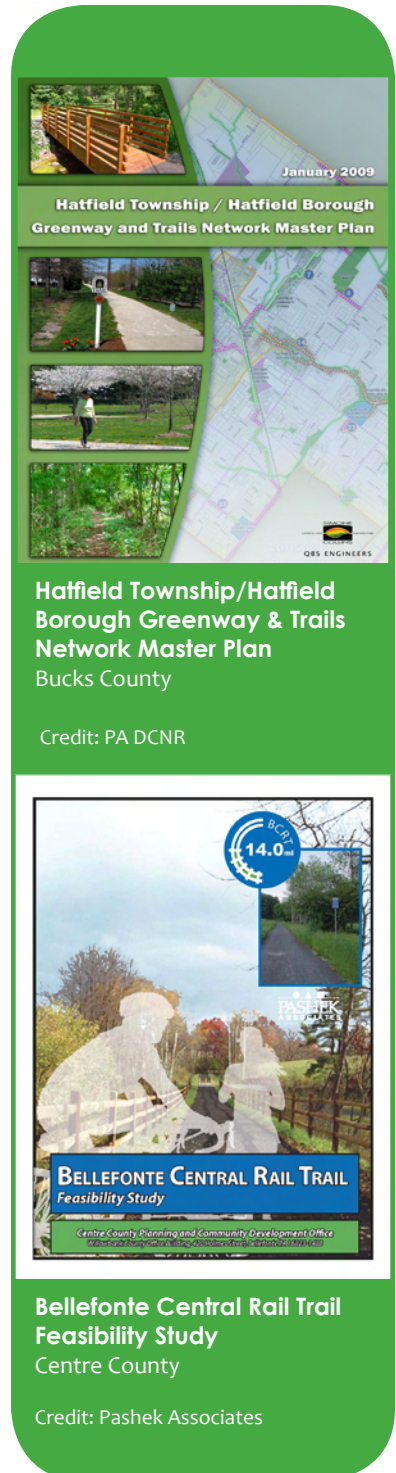
To view a sampling of DCNR funded trail studies [CLICK HERE](#).

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 Pennsylvania website. The header includes the DCNR logo, the text 'pennsylvania DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES', and navigation links for 'PA STATE AGENCIES', 'ONLINE SERVICES', and a search bar. Below the header, there are links for 'Tom Corbett, Governor' and 'Richard J. Allan, Secretary'. The main content area is titled 'Sample Plans' and features a grid of seven plan types, each with a thumbnail image and a 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'.