Mountain Bike Trail Development
Guidelines for Successfully Managing the Process

PRESENTED BY:

GREATER MINNESOTA REGIONAL Parks and Trails COMMISSION

ROCK SOLID TRAIL CONTRACTING

IMBA
INTERNATIONAL MOUNTAIN BICYCLING ASSOCIATION

CLEAN WATER LAND & LEGACY AMENDMENT

"Mountain biking is unique in the world of trails. For the mountain biker, the trail is the experience. No other trail user feels, relishes and appreciates every undulation and nuance of a well-crafted trail that has been purposefully and creatively planned, designed and built for the bike. Mountain Bike Trail Development - Guidelines for Successfully Managing the Process is an indispensable resource for anyone who wants to bring mountain bike-optimized trails to their community. This book dives deep into the process of creating high quality trail experiences, building upon the substantial work mountain bikers, trail builders and advocates have crafted and honed throughout years of innovative trail development."

DAVE WIENS, IMBA EXECUTIVE DIRECTOR

Cover photo – Split Rock Wilds in Beaver Bay, Minnesota.
Photo by Paul Vincent Photography

High Climber trail in Lutsen, Minnesota.
Photo by Bryan Hansel Photography

Contents

Contents

Photo by Bryan Hansel Photography

Content Contributors

This book was a collaborative effort and the following organizations and individuals all contributed in some way, shape, or form.

Greater Minnesota Regional Parks and Trails Commission:

Renee Mattson - Executive Director
Joe Czapiewski - System Plan Coordinator
Tim Kennedy - Former Commissioner District 1
Kathy Bergen - Evaluation Team

Rock Solid Trail Contracting:

Aaron Rogers - President
Jon Schubbe - Senior Planner/Vice President
Kyle McGurk - Project Manager / Lead Foreman
Eli Glesmann - Marketing and Media Coordinator

International Mountain Bicycling Association (IMBA) Trail Solutions:

Mike Repyak - Director of Planning and Design
Shane Wilson - Project Manager
John Cox - Education Coordinator
Marty Caivano - Community Engagement Coordinator

Becton Trails:

Martha Becton - Owner/NEPA Navigation Lead

City of Duluth Parks and Recreation:

Jim Shoberg - Senior Parks Planner - Landscape Architect

Lake County Minnesota:

Nate Eide - Land Commissioner

Minnesota Department of Natural Resources (DNR):

Trent Luger - Senior Landscape Architect

Minnesota Department of Transportation:

Bryan Anderson - District 1 Planning Director

Tony Boone Trails/Timberline Trailcraft:

Tony Boone - Principal at Tony Boone Trails/COO at Timberline Trailcraft

Foreword

The Greater Minnesota Regional Parks and Trails Commission (GMRPTC) recognized the need to create a resource for mountain bike (MTB) trail construction that would assist land and park managers seeking to build sustainable trails. The result of this effort is the Mountain Bike Trail Development Guidelines, a comprehensive "how to" that breaks down the process from start to finish beginning with assessing the project and ending with how to maintain the newly built trails.

GMRPTC partnered with Rock Solid Trail Contracting to undertake the massive project. From the Rock Solid team, author Jake Carsten created the content and researched photos to provide solid visual representations. Rock Solid owner and president Aaron Rogers invested his, as well as his staff's, time and effort to ensure content was accurate and included the most up-to-date construction techniques.

Along the way, the International Mountain Bicycling Association (IMBA) developed an interest in the project and provided direction, copy editing, and assisted with content and examples. They also became a sponsor and promoter of the project.

Behind the content creation was a team of reviewers, photographers and designers, all providing insight, experience and viewpoints, the result of which is this document. Deep gratitude to all.

This resource is made possible by the Minnesota Clean Water, Land and Legacy Amendment, a constitutional amendment that Minnesotans voted to pass overwhelmingly in order to protect Minnesota's water and wetlands, preserve the arts and cultural heritage of the state, and support parks and trails.

The Greater Minnesota Regional Parks and Trails Commission was established in 2013 to conduct system planning and provide recommendations to the Minnesota legislature for grants funded by Legacy in counties and cities of Greater Minnesota. The creation of this resource guide is but one example of Legacy funds at work.

The Mountain Bike Trail Development Guidelines are available at no cost on the GMRPTC website, gmrptcommission.org. Hard copies are available for purchase at IMBA.com. More information about how Legacy Amendment funds have made significant improvements in parks and trails throughout Greater Minnesota can also be found on the GMRPTC website.

Sincere thanks and gratitude to all who gave their time and talents to ensure this document evolved from concept to creation!

RENEE MATTSON, EXECUTIVE DIRECTOR
Greater Minnesota Regional Parks and Trails Commission
gmrptcommission.org

Rock Solid Trail Contracting
rocksolidtrails.com

IMBA
IMBA.com

About the Author

Photo by Eli Glesmann / Rock Solid

Jake Carsten

Jake Carsten started his career in the bike industry in 2011 by working on the IMBA-Subaru Trail Care Crew, traveling coast to coast representing, speaking, and teaching trail building on behalf of IMBA in local communities. He has attended training courses through Professional Trail Builders Association (PTBA) and has worked with and learned from a wide variety of top trail planners and trail building firms in the industry. Jake has also worked as an instructor trainer in the Bike Instructor Certification Program (BICP) and obtained certifications to teach mountain bike handling skills at all three levels of certification, which he has found invaluable for understanding and planning skills progression on trails and in bike parks.

Jake founded his own trail consulting firm (Dirt Dojo LLC) in 2012, delivering on a wide variety of trail planning and construction contract services including site assessment, trail assessment, conceptual planning, field design, and trail construction.

Jake joined Rock Solid Trail Contracting in January of 2018, leading the planning and design efforts at Rock Solid for four years until returning to run Dirt Dojo full-time. While with Rock Solid, Jake led planning and design efforts on notable projects such as Split Rock Wilds (Beaver Bay, MN), Two Rivers Park (Little Rock, AR), Fitzgerald Mountain (Springdale, AR), Devil's Den State Park (Winslow, AR), Mount Nebo State Park (Dardanelle, AR), Mount Magazine State Park (Paris, AR), and the Slaughter Pen Bike Park (Bentonville, AR), to name a few.

Jake specializes in trail planning and especially enjoys helping clients develop their project visions and goals, guiding them through all phases of the trail development process. Jake was honored to be asked to develop this resource and pulled from his years of experience and the input of many contributors to write the contents of this guide.

JAKE CARSTEN
dirtdojo.com

Overview

Who should use this guide?

The *Guidelines for Successful Mountain Bike Trail Development* book was written for land managers (professionals in city, county, state, federal, land trust, and special use permit entities such as ski area managers) who have the responsibility of bringing bike-optimized mountain bike trails to their communities. This guide is solely focused on mountain biking and the unique aspects that the activity brings to the park planning process. As a result, this guide will not address general park infrastructure such as parking lots, restrooms, and trailhead kiosks, other than to mention when they should be considered.

Bike-optimized trails are designed and constructed to maximize the fun and efficiency of riding a bike. Key differences from traditional trail construction include enhanced tread shaping (shaping of the trail surface), directional or one-way travel, and the use of constructed technical trail features (TTFs).

What will you learn?

The goal of this guide is to provide a high-level understanding of mountain bike trail development so that land managers are able to manage the process and communicate knowledgeably with stakeholders, partners, trail contractors, trail users, and advocates. The guide assumes the reader has no current knowledge or experience in the mountain bike and/or trails industry.

MnDNR staff at Cuyuna Country State Recreation Area in Ironton, Minnesota - an inspiring success story and worthy case study! Photo by Eli Glesmann / Rock Solid

Upon completing this guide, readers should gain a high-level, conceptual understanding of the following:

The eight *phases* of the trail development process and the key *activities* within each phase:

1

ASSESS

Assess the available land and terrain to determine if the site or sites are feasible for trail development

2

PLAN

Conceptually plan the trail corridors

3

DESIGN

Flag the trail corridors and create detailed design drawings and construction documents

4

CONTRACT

Contract with a trail builder for the build

5

BUILD

Build the trails

6

PROMOTE

Promote the trails so people learn about them and can find them

7

MAINTAIN

Maintain the trails to keep the conditions and user experience optimal

8

EVOLVE

Evolve the trails to keep people engaged and coming back

Overview

- **Trail development timelines**
- **What makes a trail sustainable (physical, environmental, financial, and social/user-focused)**
- **What makes a quality mountain bike trail experience**
- **Different trail types and trail features**
- **Different trail construction contracting methods**
- **Different trail construction pricing methods**
- **Unique elements to include in a mountain bike bid package**
- **How to compare bids and evaluate trail builder qualifications**
- **Basic construction metrics for trail crews**

Trail Development Resources

In addition to this guide, there are a wide variety of other resources available for exploring the mountain bike trail development process. For certain topics, rather than duplicate existing external resources, we may introduce a topic and then reference the outside resource for more detailed information.

Organizations

INTERNATIONAL MOUNTAIN BICYCLING ASSOCIATION (IMBA)

Since 1988, IMBA has been a leading force in helping to make natural surface trails become not only accepted, but the number one requested amenity in communities all over the country. There was a time when having natural surface trails in a community was not as typical an amenity as things like basketball courts and baseball fields. Through grass roots advocacy armed with a wealth of knowledge in regard to sustainable trail development, and the support of nonprofit 501c3 mountain bike clubs all around the country, IMBA and local mountain bike clubs fought hard to convince municipalities that users wanted and would appreciate access to green space through natural surface trails.

Today, IMBA continues to evolve and has moved beyond just the education component of helping communities understand what makes a trail sustainable. IMBA is focusing on creating more trails close to home and helping communities take a much broader look at what it takes to become a mountain bike destination. This is achieved through a combination of IMBA's programs that support local advocacy, community engagement, and professional trail development services provided by IMBA Trail Solutions, along with IMBA Trail Labs workshops and Trail Accelerator Grants.

PROFESSIONAL TRAIL BUILDERS ASSOCIATION (PTBA)

The PTBA was founded in 1976 with the goal of creating a professional association to promote professional trail contracting and consulting as cost-effective ways to plan, design, build, and maintain high-quality, sustainable trails. While the PTBA is not exclusive to mountain bike trail builders, the PTBA is the only association in the United States that is recognized as a professional association for all types of natural surface trail builders. While the association is predominantly made up of US-based firms, the international presence is expanding.

The PTBA website has a search tool for finding PTBA members anywhere in the world. In addition, the PTBA offers the service of sending bid requests and trail contracting needs out to all their members to ensure contracts reach qualified trail contractors.

The PTBA also hosts an annual week-long training conference in a different city each year that is open to the public. This conference is packed with both classroom and hands-on field training sessions that are taught by trail contracting professionals and is a great way to expand your knowledge and network with other trail professionals.

Trail Development Resources

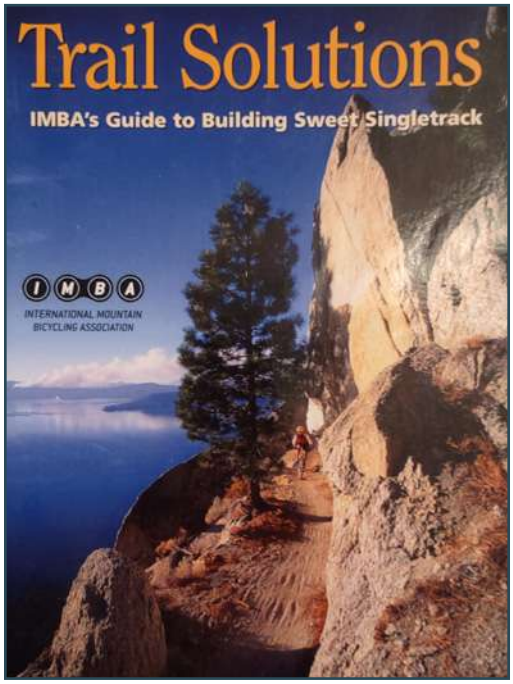
AMERICAN TRAILS

American Trails is a national nonprofit organization working on behalf of all trail interests, including hiking, bicycling, mountain biking, horseback riding, water trail activities, off-highway vehicle use, and more. American Trails members want to create and protect America's network of interconnected trails.

Since 1988, American Trails has been a training resource and collective voice for a diverse coalition of enthusiasts, professionals, advocates, land managers, conservationists, and friends of the outdoors and livable cities. American Trails strives to enrich the quality of life, mental health, and physical health for all people and the sustainable development of communities by advancing and promoting the development, preservation, and enjoyment of diverse, high-quality trails and greenways.

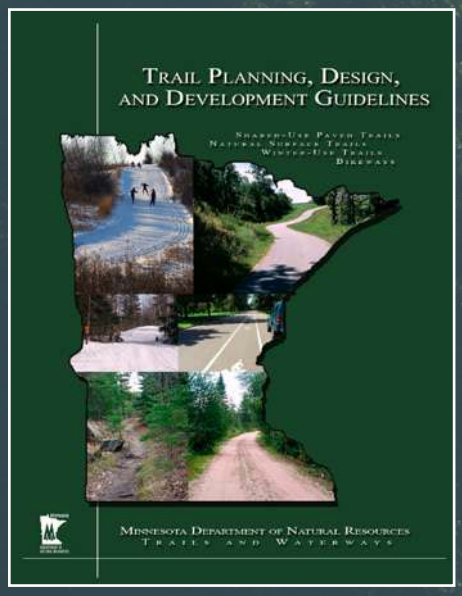
American Trails has a training portal with links to a wide variety of trail planning and design content. American Trails has also recently partnered with the Professional Trail Builders Association (PTBA) to produce training webinars on a wide variety of trail development topics.

Publications



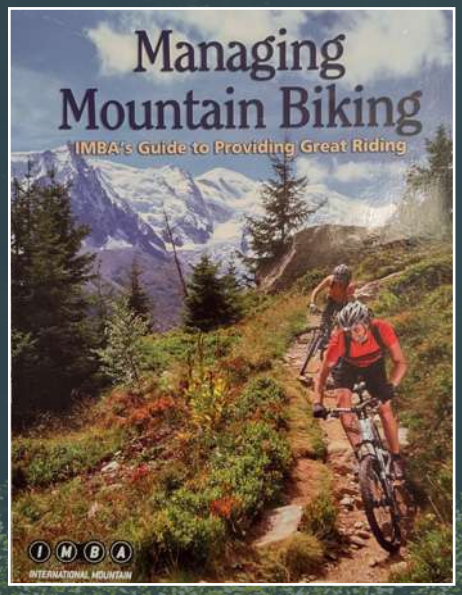
TRAIL SOLUTIONS: IMBA'S GUIDE TO BUILDING SWEET SINGLETRACK (2004)

Published in 2004, this book emerged as the leading source of proven fundamentals in sustainable trail building techniques presented in a colorful, easy-to-read format. Nearly 10,000 copies have been distributed throughout over 40 countries, and the guidelines within have been adopted as official policy by hundreds of land agencies and recreation providers around the globe. Though developed in 2004, the book's contents, including many of the images and illustrations, are still routinely referenced in trail building contracts to convey the types of trail building techniques and features that will be expected of trail contractors.



MN DNR: TRAIL PLANNING, DESIGN, AND DEVELOPMENT GUIDELINES (2006)

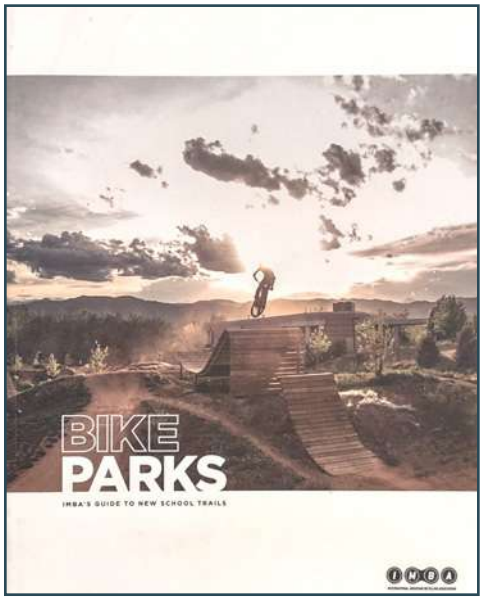
The Minnesota Department of Natural Resources (DNR) goal of the project was to develop a consistent set of guidelines and common language for developing motorized and non-motorized trails at the local, county, regional, and state levels. Extensive attention is given to developing trails that are physically, ecologically, and economically sustainable. The principles of trail design put increased emphasis on the art of design in order to make trails as visually appealing and enjoyable as possible. Collectively, the guidelines provide a comprehensive reference for agencies, trail advocates, and policy makers as they embark on various types of trail development projects.



MANAGING MOUNTAIN BIKING: IMBA'S GUIDE TO PROVIDING GREAT RIDING (2007)

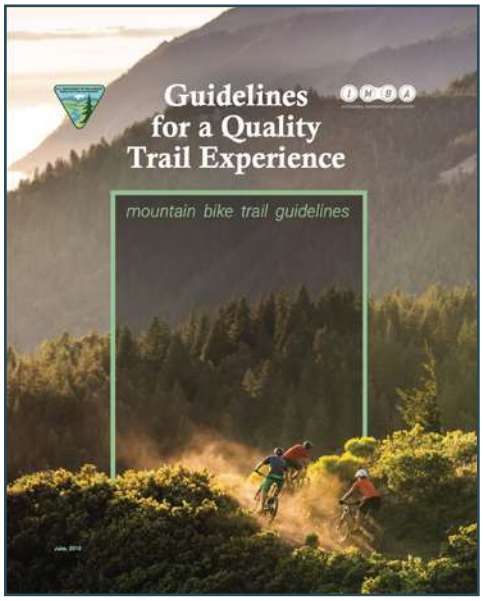
Managing Mountain Biking is IMBA's guide to overcoming user conflict, minimizing environmental impact, managing risk, and providing technically challenging riding for all levels.

Trail Development Resources



BIKE PARKS: IMBA'S GUIDE TO NEW SCHOOL TRAILS (2015)

Bike parks are being built in attractive, easily accessed locations, and municipalities are funding them at the same level as other types of recreational facilities. Modern bike parks are designed to appeal to every skill level, with enough variety to keep riders coming back for years. This book examines all phases of planning, designing, building, and operating a bike park facility.



BLM: GUIDELINES FOR A QUALITY TRAIL EXPERIENCE (GQTE) (2017)

This publication was developed as a collaboration between the Bureau of Land Management (BLM) and IMBA. As the mountain biker's quest for extraordinary riding experiences has evolved, so has the evolution of how trails are described, planned, designed, constructed, and managed. The overarching vision for the GQTE was to establish key characteristics that define a range of trail-based experiences that, when applied properly, form the foundation for an experience which meets targeted trail objectives and outcomes.

Chapter 1: Why Develop Mountain Bike Trails

In recent decades, professionally planned and built natural surface trail systems have evolved from relative obscurity to becoming the most requested amenity in communities, parks, and recreational areas. Mountain biking has played a key role in this transformation, attracting people of all ages to the joys of recreating in nature. As mountain biking has grown, so has the desire and demand for more trails, creating a boom-period as land management agencies and municipalities strive to catch up with demand.

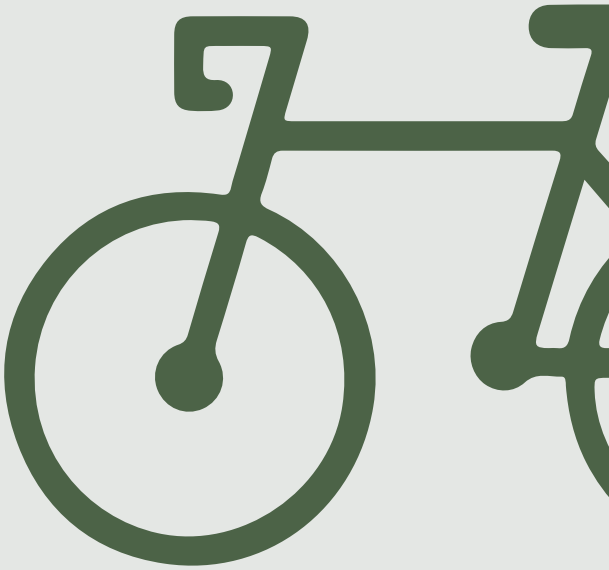
The Evolution of Mountain Bicycling

In the beginning (the 1980s), bicyclists began tinkering with fat tires to hybridize existing cruiser or touring bicycles so that they could leave the paved roads to explore dirt roads and singletrack trails. Bicycles allowed riders to go farther in a single backcountry outing than hikers or runners. The development of lower gearing, powerful brakes, and lightweight frames further improved the distances that could be traveled while improving the overall experience. When the sport began, there was a strong emphasis on advanced riding. Trails were very difficult, often more suited to hiking than biking, and bikes were not kid friendly. Both issues have now been solved with the development of progressive, modern trail systems, bike park facilities, and bike technology that fits every ability and riding style.

Mountain bikes and riders continue to evolve, with numerous types of mountain bikes and sizes available today. Tiny kids can propel their balance bikes around tot tracks, enduro riders can fly down steep trails and drops, and trail riders can enjoy scenic climbs and fun descents. And that is just a sample of the current mountain biking smorgasbord.

Sixty million adult Americans ride a bike each year, and bicycling creates major economic growth in the United States:

- Contributes ***$133 billion*** annually to the US economy
- Supports nearly ***1.1 million*** jobs across the US
- Produces ***$53.1 billion*** annually in retail sales and services



A 2018 economic impact study released by the Walton Family Foundation describes in detail the $137 million in benefits from trails in Northwest Arkansas to the Arkansas economy in 2017, of which $51 million came from in business benefits, $27 million came from tourism dollars and $86 million came from health care-related cost savings.

Developing a Community Mountain Bike Vision

The trail development process in this guide focuses on creating an individual trail system. However, it is important to have a trail vision for your entire community, whether the community is small or large. A community-wide trail vision can be informal or formal, and as simple as a map graphic showing all existing trail systems (if any exist) along with the possible locations and trail projects that your community wants to see happen. Each project should identify the types of trail experiences desired at each site to help avoid duplication of trail types that are close to each other.

Photo courtesy of IMBA

One of the first steps in creating great trails is creating a vision plan. A vision plan is different from a master plan in that a vision plan identifies opportunities and possibilities that your community hopes will happen, whereas a master plan identifies agreed-upon future realities. It is far more difficult and time consuming to get community agreement on a master plan than it is for a vision plan. A vision plan aids in the process of deciding what opportunities and properties to pursue first for master planning. Having a community-wide vision will help keep land managers, decision makers, and stakeholders focused on projects that add value to the community without duplicating experiences or exhausting valuable resources.

Photo courtesy of IMBA

The primary elements to address for a community vision plan are:

EXISTING TRAIL INVENTORY - Inventory all existing trails in your community. This will give you a picture of what currently exists, and as a result, what might also be missing. Capturing key data identified earlier in this guide, such as mileage, trail type, trail difficulty level, user type, and so forth will help to form a complete picture of what current trail experiences are being fulfilled. Trailforks, MTB Project, Strava, and AllTrails are good sources of data to support on-the-ground inventories.

DESIRED TRAIL EXPERIENCES - Reach out to the local community via public meetings and online surveys to understand which trail experiences are desired, what is missing, what trails near them they consider high quality (or not), and what is important to them.

LANDSCAPE ANALYSIS - Inventory and assess all public land parcels in and around the community for their trail development feasibility. Also, identify private lands that exhibit optimal trail feasibility characteristics or provide strategic connectivity between parcels and could potentially be used for trail development. (Do not show private lands on publically viewable maps without communication/approval from that land owner to do so.) Capture key data such as ownership, size, zoning, terrain characteristics, soil composition, vegetation types, regulatory authorities, and environmentally sensitive areas. All of this will be helpful when analyzing and prioritizing the viability of each property.

PLANNING GUIDANCE - Review existing or ongoing planning efforts for trails, pathways, paved hike and bike trails, parks, or related recreation infrastructure. Look at park department master plans, regional planning documents, comprehensive growth plans, Statewide Comprehensive Outdoor Recreation Plans (SCORPs), etc.

ACCESS ROUTES AND POINTS - Identify pathways, trailheads, staging areas, gates, and community connectivity.

USER ORIGINS AND DESTINATIONS - Overlay schools, neighborhoods, commercial zones, etc. on your mapping datasets that will help you make decisions on important connectivity routes.

TRAIL GOALS - Identify long-term trail goals that align (or, at times, challenge) long-term community goals. Goals may include youth engagement, improved health and wellness indicators, connecting underserved neighborhoods to nature, and/or increased economic impact. Indicate what trail experiences help to achieve the goals and the key attributes that support the experiences such as total mileage, total mileage by trail type, neighborhood access connections, and paved hike and bike trails. Paved hike and bike trails can play a vital role in connecting riders to soft surface trail experiences that may be offered throughout a community.

VISION PLAN - Incorporate the findings from the previous elements in this list into a cohesive community vision plan that shows the "dream state" of what your community could look like once fully built-out. The vision plan should show the various project sites, identify the proposed types of amenities at each site, and show potential connectivity through town and from site to site. A vision plan should be kept short and simple with a high-level graphic showing project sites and connectivity, and only enough slides to address the who, what, when, where, why, how, how long, and how much.

The vision plan is a living document to guide long-term goals. Prior to creation of a vision plan, though, even just understanding your current trail inventory and property options, along with trail experiences desired by the community, will go a long way towards guiding your trail development efforts and initiatives.

Becoming a Mountain Bike Destination/Trail Town

The term "mountain bike destination" is commonly used to identify a community or trail system that is fun, engaging, interesting, and unique enough to draw people from neighboring communities, whether that be from nearby counties, within the state, or coming from the larger region. Understanding what goes into becoming a mountain bike destination can also help make a community a great mountain bike town for its residents. The following information applies to both.

How trail systems are typically categorized:

NEIGHBORHOOD TRAIL SYSTEM - A very small trail network with 1-5 miles of trail that serves a local neighborhood, providing up to two hours of unrepeated riding.

COMMUNITY TRAIL SYSTEM - A trail system with up to 10 miles of trail that serves one or more surrounding neighborhoods, providing up to a half-day of riding.

REGIONAL TRAIL SYSTEM - A larger trail system with roughly 10-25 miles of trail that serves an entire city, county, or state, providing half- to full-day (or potentially more) of riding. Ideally features a full mix of trail types and difficulty levels with high-quality riding experiences.

DESTINATION TRAIL SYSTEM - A larger trail system with 25-50+ miles of trail that attracts riders from all over the country or world, providing multiple days of riding. Typically features a full mix of trail types and difficulty levels and provides high-quality rider experiences.

Typical trail elements factored into building a destination-worthy trail system:

MILEAGE - How many miles of trail exist? In general, the more unique trail mileage in a system, the more people are willing to drive from farther distances to experience the trail system. While someone might not drive eight hours to ride a 5-mile trail system, they just might for a 25-mile or 50-mile trail system.

TRAIL VARIETY - How diverse are the trail riding experiences? Are there trails for all skill levels? Do all the trails "feel" the same or does each trail have its own character and provide a different type of experience?

UNIQUENESS - Do the trail experiences offer something that riders do not have in their own communities? Is the terrain unique? Are the features or riding styles provided by the trails unique? Lack of unique or desirable terrain may mean memorable experiences must be manufactured, driving up the cost of construction. A good example is a downhill trail system that is served by a chairlift. Since these types of systems are not prevalent in most communities, people that enjoy gravity-based riding are generally more willing to travel many hours by car or plane to visit these types of facilities.

Having great trails is a requirement for a trail system to become a mountain bike destination. Creating longer stays and repeat visits from riders usually requires additional non-mountain bike elements that factor into that decision-making. These elements do not need to be present when a trail system is developed; a quality trail system can be the catalyst for their development.

Typical non-trail elements factored into what helps make a community a destination include:

RESTAURANTS/COFFEE SHOPS/BARS/BREWERIES - A variety of types and price points is important.

LODGING - A variety of options such as homes, hotels, motels, RV parks, and campgrounds to accommodate different visitor profiles is ideal. Bike-friendly lodging options that are close to the trails and offer secure bike storage, bike wash stations, bike repair stands, and community gathering areas are popular among those traveling for mountain biking.

ENTERTAINMENT - Since not all family members are always mountain bikers, it's important there are entertainment options available to accommodate a variety of recreation needs.

POINTS OF INTEREST - Historical or cultural sites and related activities can serve as excellent alternatives for families when they are not mountain biking, or for group members who do not mountain bike.

TRAIL PROGRAMMING - Programming such as mountain bike events, races, skills clinics, and guiding services can help riders connect to the local culture and make the most of their visits.

While focusing on developing a destination-worthy trail system can be a noble pursuit, having a network of neighborhood and community trail systems that are accessible to all residents by bike will do more to grow a true riding culture in your community than having a single high-quality destination. A lot of this has to do with accessibility. If residents can walk out their doors, hop on their bikes, and ride to a local trail network, they are far more apt to do so on a regular or daily basis than they are to load up the bikes, hop in the car, drive to a larger destination-type system, ride, load the bikes bike up, drive home, and unload the bikes. Plus, having a network of local trail systems will grow overall ridership and produce a natural demand for a larger destination-worthy trail system.

If becoming a destination is one of your goals, make sure to also assess the community's public infrastructure to support increased visitation to your community. Parking, roadway capacity, and public restrooms are some of the first components to be stressed when trail tourism visitation increases. Be prepared for that increase.

There is no one right answer for what combination of trails and non-trail amenities will convert your property or town into a mountain bike destination. But being aware of what mountain bikers are seeking can help in both your trail and tourism planning.

Common Issues and Pitfalls of Trail Building:

Mountain bike trail development is still a young industry when compared to industries like architecture, engineering, or home-building. As a result, definitions, processes, and contracting language are not as developed or standardized. Add in the fact that trail planning and construction are a mix of artistry and science, and an opportunity for disconnect between customers and contractors is created. One of the goals of this guide is to help close that gap. See call-out boxes throughout this book for common pitfalls.

Obviously, developing a high-quality trail system is not as easy as picking parts out of a catalog and placing them strategically around a park. Developing a high-quality trail system requires as much artistry as it does scientific method, as well as a collaborative process with the trail planner, trail builder, and stakeholders. Despite the challenges, the potential rewards of a well-planned and executed trail system can lead to a transformed community that positively influences multiple generations.

Chapter 2: Professionals or Volunteers?

It is important to think about the kinds of support and expertise necessary to create a quality experience for trail users. The trail building industry is unique in that volunteers have played and continue to play a very important role. It is highly likely you will end up working with both volunteers and trail building professionals in the process. Later in this guide we will discuss in more detail how to properly evaluate professional trail building contractors.

Volunteers

The vast majority of trails built in the early days were built with hand tools and by volunteers of local mountain bike clubs. While some clubs have evolved to use machinery to construct trails, others do not due to necessary insurance and other concerns. Most trails are still constructed and maintained by volunteer groups using hand tools. Volunteers are still a prominent and vital resource of the trail building microcosm as most trails, even if constructed by professional builders, are quite often maintained by volunteers. As the industry matures, more land agencies are funding paid maintenance staff or professional maintenance contracts. Even in these cases, there is usually still a local mountain bike club that has a relationship with the land manager to assist with maintenance.

Volunteer work day at Tioga Recreation Center in Cohasset, Minnesota. Photo by Chris Guibert/Rock Solid

The primary challenges in relying on volunteers include a potential lack of production volume and maintaining consistent quality standards. Volunteer workdays are infrequent, usually on weekends, and normally no longer than four hours long. Ten volunteers hand building 20 linear feet of trail each amounts to 200 linear feet of trail per volunteer day. At this rate, it would take approximately 26 volunteer days to complete one mile of trail. If we assume one volunteer day every weekend (which is not typical) it would take just over six months to construct one mile of trail. An experienced, three-person professional trail building crew working full-time (five days a week) with a machine can construct 300-400 linear feet of bike-optimized trail per day, completing one mile in two-and-a-half to three-and-a-half weeks.

Utilizing volunteers can also increase a land manager's workload. If a highly experienced and seasoned local mountain bike club does not exist in the community, the land manager will have the added work of finding volunteers, scheduling workdays, identifying the job sites and work to be performed, mobilizing tools to and from the job site, and managing the actual workdays. Building and growing an experienced, local volunteer community takes time, but in the long run can be highly effective if there is a shared vision and commitment between land managers and passionate citizens.

The former model of trails built and maintained by volunteers has shifted to an expectation that most trail systems need to be professionally planned, designed, and built to deliver the construction quality and riding experience desired by both land managers and riders. Many clubs are now more valuable for their networking and fundraising capabilities, and as a result, the standard is shifting to professionally built, volunteer-maintained trail systems.

The mythical trail fairies do exist after all! We finally know how all those trails have been magically maintained all these years.. Photo by Tammy Barringer/Women of OZ NWA

Trail Professionals

Professional trail development specialists exist for all phases of the trail development process. Though it is very common for all the roles and specialties to be lumped together and referred to simply as “trail builders,” it is more accurate to refer to all the roles collectively as “trail contractors” and then identify the specific job roles or areas of expertise.

The trail profession job roles are:

PLANNERS - Define project vision and goals, perform site assessments and feasibility studies, identify the best land for trail projects, gather and interpret key field data, develop concept plans, design and flag trail corridors, and produce planning and design reports.

GIS/CAD PROFESSIONALS - Obtain key geographical data for a property, develop quality geo-referenced base maps, and collect/organize/assess large amounts of field-based data.

MACHINE OPERATORS - Build trails and features using equipment such as mini excavators and mini skid steers, which require hundreds of hours to become proficient and thousands of hours to master. Lead operators typically also act as Crew Supervisor, managing logistics and hand-finishing crews, and even assisting with hand-finishing tasks as needed.

HAND-FINISHING CREWS - Clear the trail corridors with chainsaws, then follow behind the machine operators cleaning the corridor, performing rock-armoring work, shaping features, finishing tread and backslope, and naturalizing areas surrounding the trail.

JUMP SPECIALISTS - Design, build, sculpt, and field test jump lines. Jumps require extensive experience and a high degree of skill to construct, so it’s important to hire a builder with specific experience and expertise in jumps. Ideally, at least one person on the crew should be a highly skilled jumper to be able to test ride the lines.

WOODWORKING SPECIALISTS - Design and build bridges, boardwalks, and other custom features using wood. Most build crews strive to have at least one woodworking specialist on their crew.

MASONRY SPECIALISTS - Perform intricate rock armoring work, build special rock features and retaining walls, use jackhammers to carve rock tread, and utilize special rock breaking materials to fracture and shape rocks.

METAL FABRICATORS - Design and build bridges, boardwalks, and other custom features using various types of metal.

PROJECT MANAGERS - Manage the trail development process, interfacing with trail planners and trail builders, tracking budgets, inspecting work quality, and helping ensure the product (trail network) matches the client’s expectations. A project manager may be an employee of the trail builder or a separate entity, known as a professional client representative, who acts as an intermediary between the client and the trail contractors. This is a somewhat newer role that has developed as trail projects have grown larger and more complex.

Many trail professionals have most of the skills mentioned above (with the exception of building dirt jumps and metal fabrication), although to varying degrees of expertise. It is important to verify skill sets, review photos of work (or better yet, ride their work!), and ask for references. Not all professional trail development firms have GIS/CAD expertise, which is very specialized. For that reason, many firms outsource this skill or rely on the hiring firm since most public agencies have a GIS/CAD resource.

Similarly, not all trail builders are professional trail planners, though most can plan and design trail. As the field has grown, planning has evolved as more clients expect detailed, professional reports to support fundraising efforts, public input meetings, and approval processes. As a result, more firms are hiring professional landscape architects to elevate the quality of deliverables.

Currently, very few trail development firms are both large and diverse enough to employ experts in all of the roles mentioned above. As a result, trail development firms might subcontract with other firms to provide the level of scale and expertise needed to execute contracts. Land managers should research trail building firms both in your region and nationwide to learn each of their skill sets and reputations while also building relationships early in the process. It is common for land managers to utilize larger firms for big builds requiring multiple crews and smaller firms for smaller jobs, so it is important to have relationships with a variety of firms to balance the diverse needs of a multitude of project situations.

IMBA Trail Solutions trail planners at Cacapon State Park, West Virginia. Photo by Daddio/IMBA

Hybrid Approach

A hybrid approach involves using a mixture of volunteers and professionals to complete a trail project. Volunteers are sometimes used to develop concept plans, flag trail corridor, clear trail corridor, hand finish tread, or build short sections of hand-built trail. While this can potentially reduce financial cost, it can also have the unintended consequence of increasing costs if the volunteers are not sufficiently skilled for the tasks performed. If a professional trail builder has to reflag a trail corridor for example, it is highly likely it would have been cheaper to hire a professional trail planner from the start.

Rock Solid mechanized build crew. Photo by Eli Glesmann/Rock Solid

Potential Downsides of Utilizing Volunteers

Volunteers can be managed by the land manager or the professional builder, depending on the activity and timing. Either way, additional time must be invested to schedule the work (which will happen mostly on weekends due to the nature of volunteering), train the volunteers, manage workdays, and oversee the quality of the final work. Liability concerns and increasing professional trail building standards can also make the hybrid approach difficult. Not all professional builders are willing to take on the added risk and complexity of working with volunteers, so be sure to discuss this with your builder before entering into a contract.

If there is a required warranty period as part of a contract, most professional trail builders will want to perform all the work themselves to maintain control over the final product, or alternatively, not be held responsible for warranty work. Each land manager will need to assess the quantity, quality, and availability of volunteers to determine what is right for their situation.

Potential Upsides of Utilizing Volunteers

While there can be many challenges to using volunteers during the trail development process, establishing and growing a dedicated volunteer base over time can be a vital element to the overall success of a trail community. Having volunteers participate in the process, where feasible, can substantially help them develop a sense of ownership and perceived value in their trail system. The sense of pride that develops in a local volunteer group that participates in the development of a trail system can help establish a foundation for growing and sustaining a viable volunteer organization. A strong volunteer organization can also help fulfill ongoing maintenance needs that might otherwise be more challenging to fulfill on a timely basis with trail professionals or limited staff.

Conservation Corps organizations can also be utilized for a hybrid approach. Conservation Corps strengths tend to be in the construction of classic non-bike-optimized trails rather than bike-optimized trail construction. Conservation Corps can potentially be a lower-cost alternative if the trails being built do not require bike optimization.

Conservation Corps hand crew at Cacapon State Park, West Virginia. Photo by Klein/IMBA

Which to Choose?

Each situation is unique, so you will need to assess the volunteer landscape (quantity, quality, and availability of volunteers) and determine what is right for your project.

Some key questions to ask yourself and your partners:

GOALS

- Are you planning trail types or bike park amenities that require skilled machine operators or require moving large volumes of soil or rock?
- Are you trying to build a local, regional, or world-class facility?

FUNDING

- Do you have funding available to hire professionals?
- Can you raise funds to hire professionals?

STAFF

- Do you or someone on your staff have experience in the trail development process?
- With what areas of the trail development process does your staff excel or struggle?

VOLUNTEERS

- Can you partner with a high-functioning trail organization that has experienced volunteers?
- Can the volunteer group accomplish the project within the desired time frame?
- Does your agency have a model in place for working with volunteer groups?
- What types of trail building experience and expertise does the local club possess?
- Does the club have a reputation for building fun and sustainable trail experiences?
- Has the club built the specific types of trail experiences you're looking to have built?
- Does the club have liability insurance?
- Will your agency insure volunteers performing work on your property?

Lowelifes Respectable Citizens Club (U.S. Forest Service partner) volunteering at Angeles National Forest in California. Photo by Eric Arce Photography

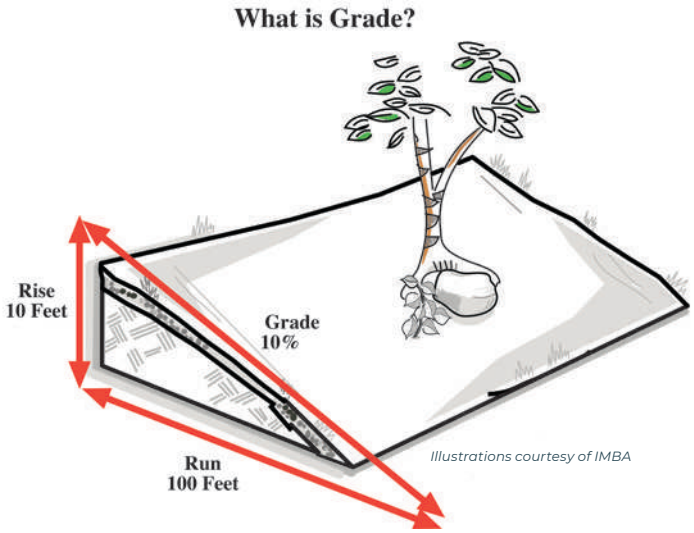
Answers to the above questions should help to define who the project partners should be. A brilliant trail plan is still only as good as the execution, so be sure to qualify the trail building partners who will be involved, whether they are volunteers or professionals.

Chapter 3: Building Sustainable Trails

Trail sustainability means more than just the physical sustainability of the constructed trail. For a trail system to be truly sustainable requires looking at four categories of sustainability: physical, environmental, financial, and social.

Physical Sustainability

While there will always be a need to maintain an existing trail system, constructing a trail using sustainable techniques can minimize the amount of ongoing maintenance. The five sustainable construction guidelines laid out in Trail Solutions: IMBA's Guide to Building Sweet Singletrack (2004) are still relevant today. All five of the guidelines require the understanding of grade as it relates to the natural hillside and constructed trail tread. Grade is measured by rise over run using a pocket-sized instrument called a clinometer.



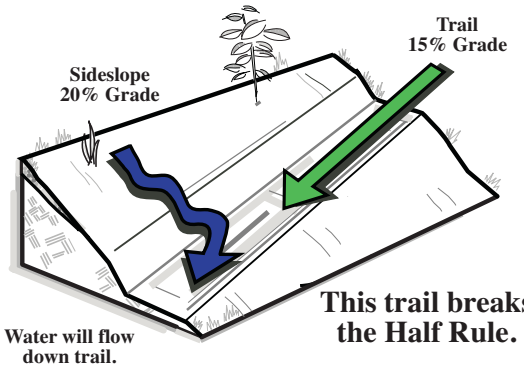
Illustrations courtesy of IMBA

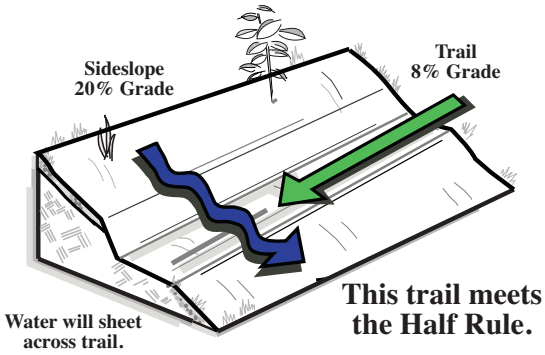
Trail builder using a digital clinometer for measuring slopes and determining trail grades in the field at a project in Chattanooga, Tennessee. Photo by Chrisman/IMBA

The five guidelines of building physically sustainable trails are:

1) The Half Rule

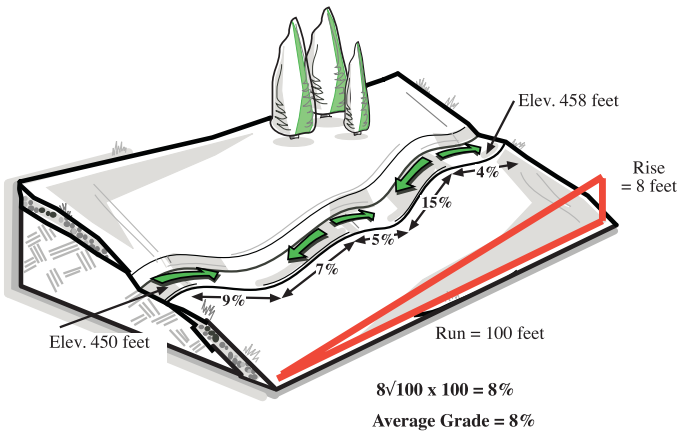
A trail's grade should not exceed half the grade of the hillside or side slope that the trail traverses. If the trail *does* exceed half the side slope, it is considered a "fall-line trail." Water will flow down a fall-line trail rather than run across it, and therefore cause significant rutting and erosion. There are exceptions to this rule, but those types of trails require significant expertise to execute and should be left in the hands of qualified professionals.





2) Average Trail Segment Grade

Historically, the thought has been that an average grade of 10% or less minimizes erosion. This guideline has evolved and while a 10% average or less may be acceptable for an expert-level trail, the industry practices have become more specific to trail difficulty level: Beginner trails range from 0-5% average grade, intermediate trails range from 5-7% average grade, and advanced trails average 7-9% (or higher) grade. Trail segment grades are directly related to the amount of exertion required when climbing, as well as the speeds that can be reached when descending. This is extremely important for planning rider experiences, as an average 7% or higher grade on a climbing trail can be excruciating for a newer, less fit rider and potentially turn them off completely from riding again. The same can be true for having a descent that is too steep for a less-skilled rider, also potentially scaring them away from mountain biking.

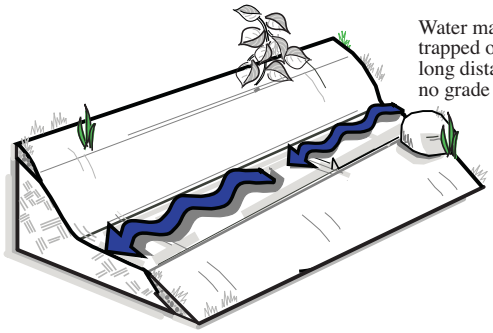


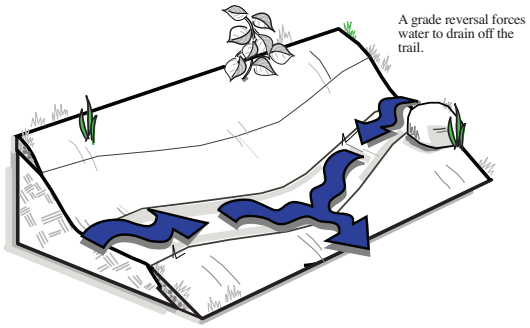
3) Maximum Sustainable Trail Grades

Maximum grade is the steepest section of trail that is more than 10 feet in length. This grade is soil composition dependent, but 15-20% maximum grade is considered typical. These grades can be exceeded if trail tread reinforcement techniques such as rock armoring are used.

4) Grade Reversals

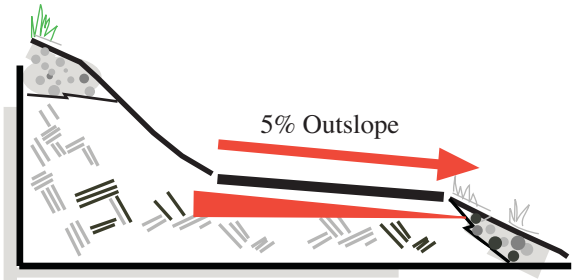
Grade reversals occur when a trail that is going down (negative grade) transitions into a trail that is going up (positive grade). This results in a low spot on the trail, which is commonly referred to as a drain, because this is where water exits from the trail. Frequent grade reversals every 20 to100 feet are critical for a healthy trail system to ensure water can flow from the trail as frequently as possible. Grade reversals are also a critical element of the overall user experience.

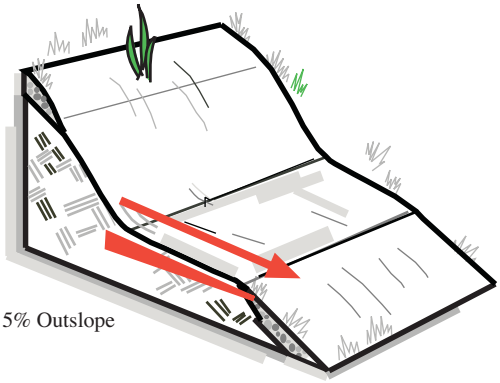




5) Outslope

As the trail contours across a hillside, the downhill or outer edge of the tread should slope slightly down and away from the inner/high side at about a 5% slope. This tilt is called “outslope,” and it encourages water to sheet across and off the trail. Modern mountain bike trail building techniques focus heavily on insloped trails to maximize fun, but still rely on outslope at drains and any part of the trail where an inslope is not required to keep the rider on the trail.





Last but definitely not least, the five guidelines form the foundation for what we refer to as "rolling contour trail". Rolling contour trail means that the trail alignments run perpendicular to the fall line and continually "surf" the hillside with grade reversals. Rolling contour trail creates an optimal combination of frequent drains for water management and continuous opportunities to create engaging experiences for riders. For more details on physical sustainability please refer to Trail Solutions: IMBA's Guide to Building Sweet Singletrack.

Rolling Contour Trail

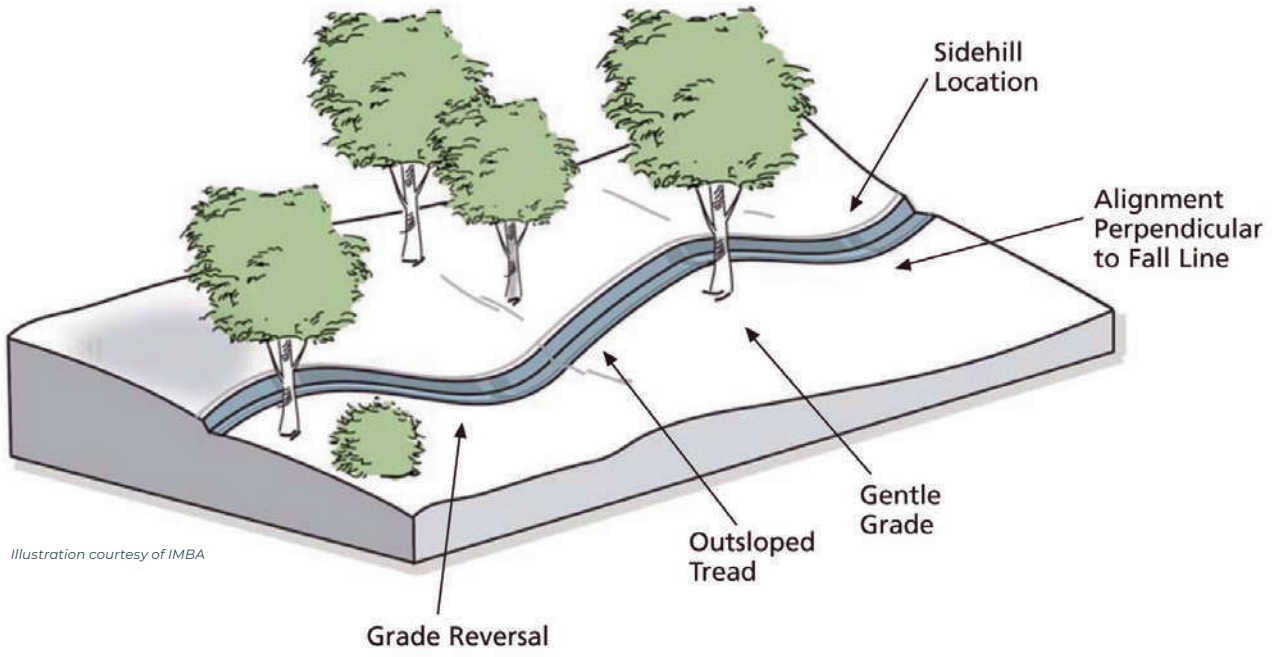


Illustration courtesy of IMBA

COMMON PITFALL:

Poor execution of sustainable trail building guidelines

A trail builder who does not understand or adhere to professional trail building guidelines can end up constructing trails that do not meet user expectations, erode quickly, and require extensive, recurring maintenance and/or sizable additional investments to correct problems that should not have happened in the first place.

Environmental Sustainability

While physical sustainability refers to the construction of the trail itself, environmental sustainability looks at the land as a whole, with an attempt to ensure that development does not impact resources that make the property special or in ways that have unintended consequences.

Ask yourself the following questions to make sure the development plan is environmentally sustainable:

- **Do you know what natural and cultural resources are present on the land, and where they are located?**
- **Are you complying with laws and regulations designed to protect natural and cultural resources?**
- **Are you utilizing the character of the landscape to influence the planned trail experience? For example, if you are planning to design and build a rocky, technical trail experience, are you placing it in an area that is already rocky and thus requires minimal use of imported rock and/or major relocation of resources from one part of the land to another?**

Environmental sustainability in the context of trail development includes an environmental review process used to make informed decisions that protect, restore, and enhance the environment by understanding potential environmental consequences from the proposed project. It is necessary to work through the environmental review process to ensure compliance with environmental laws and regulations. In this context, “the environment” includes both natural and cultural resources.

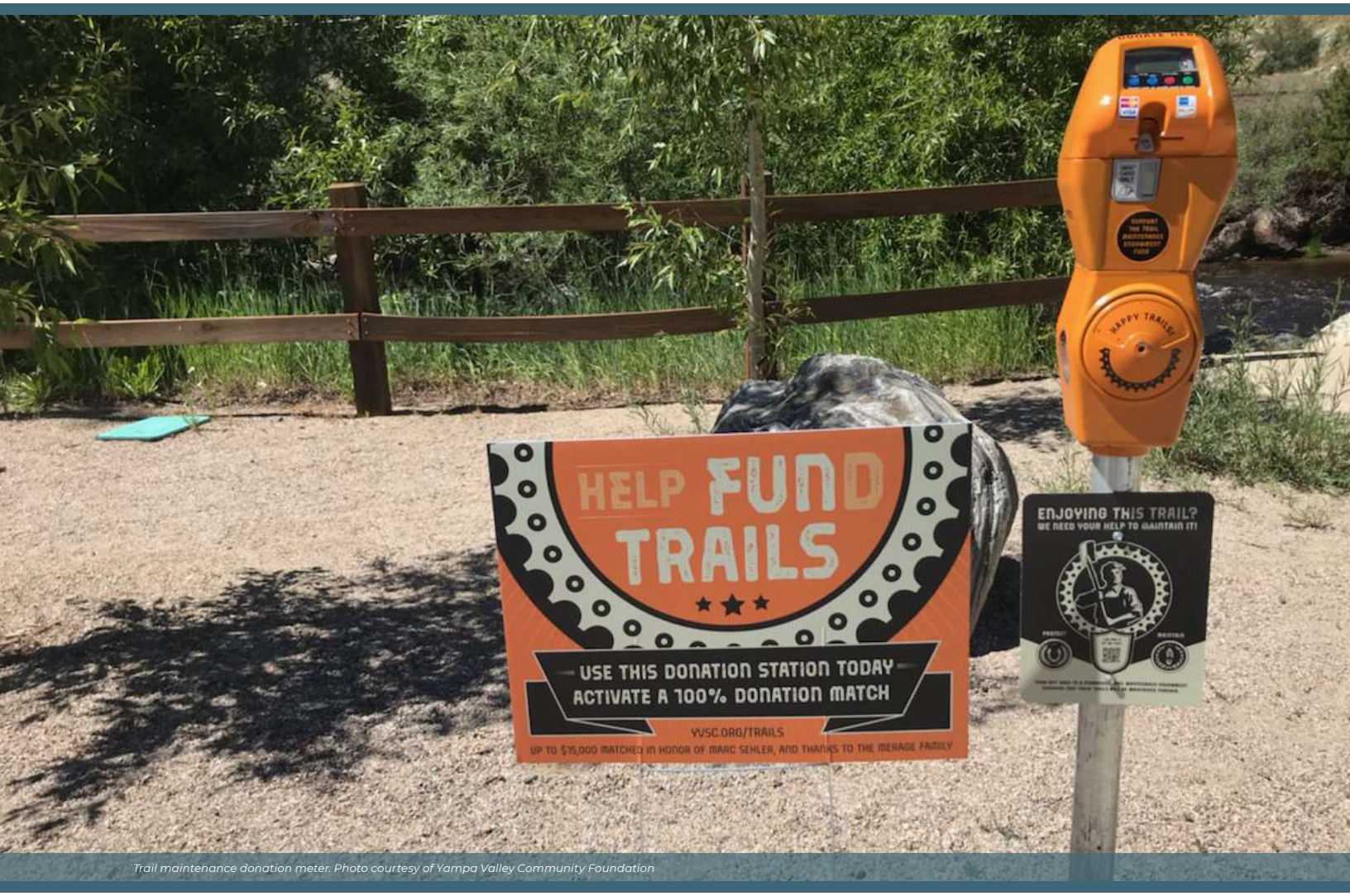
Navigating the environmental review process with federal, state, and local regulatory resource agencies can be complex and require significant time. Understanding the requirements and potential impacts to project timelines is vital for developing project schedules. This guide will provide a high-level introduction to the environmental review process. Due to the complexity of this topic, more details will be addressed in a companion training resource.

Economic Sustainability

Economic sustainability is an often-overlooked element of the long-term sustainability of a trail system. A trail system requires maintenance, and maintenance requires people. Having a plan to fund and staff the required level of maintenance is vital. Whether you plan to rely on volunteers, or utilize land manager staff, professional contractors, or some combination of the three, ongoing maintenance is key to ensuring that the user experience is consistent and positive. Trail users will not revisit a neglected trail, but rather ride other trails that are better maintained and meet their experience expectations. A commonly used planning metric is to expect to spend 3-10% of the original construction budget annually for professional trail maintenance on natural surface singletrack trail systems with typical technical and flowy features, and 10-20% for bike parks and gravity trail systems.

An additional element that is rarely considered are long-term rebuilds. As mountain biking continues to evolve, so do the bikes and the types of riding experiences desired by riders. If one of the management goals of a trail system is to keep up with changing interests and stay current with new experience goals (think about how playground design has evolved throughout the years), it will be necessary to plan for periodically redesigning and rebuilding trails. A good time frame to plan for major rebuild projects is roughly 5 to10 years after initial construction. This does not necessarily mean a complete rebuild of a trail system, however. Even updating a key section or individual trail after two to three years can breathe new life into a mature trail system that reignites visitation and stewardship.

While economic sustainability and long-term rebuilds involve expenditures, revenues should also be considered. Having a trail system that sees a lot of use can generate tax revenue in several different ways. The first is through the avoidance of recreational flight. Mountain bikers with no local trails will drive to neighboring trail systems to ride. This potentially removes money from the local neighborhood economy in terms of gas, grocery, and restaurant expenditures that translate to sales for local business and tax revenues for the local government. The second is through attracting users from other areas. Residents in surrounding areas who do not have access to good trail systems will travel to areas that do, bringing in gas, grocery, restaurant, and lodging expenditures. The third is through the attraction of new businesses and residents. Trail access is consistently ranked the number one amenity desired by new homeowners. As a result, when employees or businesses are looking to relocate, trail access is almost always a top consideration.



Trail maintenance donation meter. Photo courtesy of Yampa Valley Community Foundation

Social Sustainability

Social sustainability refers primarily to user experience. Will the trails being designed and built provide the experiences that riders and other trail users want? Is mountain biking compatible with existing trail uses? Are other trail experiences being considered/allowed on the property? Do the experiences being created already exist in other parts of the community? Why would a rider choose to ride one trail system versus another? Which skill levels will the trails appeal to and is there a demand for those levels? These are the types of social sustainability questions to consider and address during the planning phase.

Also key to consider are park and trail amenities that encourage socializing and group activities. Are there any plans for open fields, overflow parking, start/finish areas to accommodate the staging of races and events? Will there be trailhead amenities that encourage riders to gather, practice, socialize, and gain proficiency on terrain such as pump tracks and skills areas? Performing a thorough inventory of what types of riding experiences already exist within a community is a key first step in identifying what types of experiences are missing, and thus probably desired. A good next step is to hold public/stakeholder input meetings, giving community members the opportunity to directly voice their wants and desires. Filling in the gaps of missing experiences can help a trail system stand out while providing much needed balance to the riding community as a whole.

Chapter 4: What Makes a Quality Trail Experience?

Historically, most trail development publications have focused on the physical construction of a trail rather than what elements go into making a trail a high-quality experience for the riders. The three key topics for understanding and creating a quality mountain bike trail experience include:

1. **Outcomes-focused recreation management**
2. **Trail user objectives**
3. **Bike-specific experience factors**

Outcomes-Focused Recreation Management (Experiences/Benefits)

The first step to creating a quality trail experience is understanding what types of recreational experiences trail users are seeking, and how these impact their states of mind. In this case, an "experience" is defined as an immediate state of mind resulting from participation in recreation activities that result in benefits.

Typical **experiences** sought by mountain bikers include:

- Developing skills and abilities
- Testing endurance
- A feeling of risk or adventure
- Exposure to nature
- A sense of solitude, isolation, or independence
- Releasing or reducing stress
- Opportunities to spend time with friends or family
- Meeting new people with similar interests
- Having others nearby who can help if needed

A "benefit" is defined as the result of a satisfying recreation experience that improves or maintains a desired condition. Benefits accrued from recreation participation can be both short-term and long-term, and are realized both on-site and off-site.

Typical **benefits** obtained through mountain biking activities include:

- A more holistic sense of mental and physical health
- Improved outdoor recreation skills
- Greater sense of adventure
- Improved physical fitness
- Greaters sense of connection to others

Enjoying the view on Lizard Tail at Mount Nebo State Park in Dardanelle, Arkansas. Photo courtesy of Arkansas Parks and Recreation Foundation

Trail User Objectives

The second step in creating a quality trail experience is identifying the trail user objectives for each trail you are planning within a trail system. Knowing the trail user objectives helps us to then decide what types of specific trail elements and features could be incorporated into the design to meet those objectives.

Typical trail user objectives include:

NATURE - Connecting to nature

ESCAPE - Something that takes you away from your daily grind and allows you to get lost in the experience of riding

SOLITUDE - Getting away from the urban environment and people; being active, alone, and quiet in the outdoors

CHALLENGE - Seeking to improve technical riding abilities; conquering or mastering a trail feature; creating a sense of accomplishment

RISK - Exposure to danger, harm, or loss; intentional interaction with uncertainty

FUN/PLAY/PLAYFULNESS - Engaging in the activity purely for the enjoyment. On a trail, this can mean simply riding from point to point for the enjoyment it brings, or it can mean seeking features to enhance or alter the experience (playfulness). Playfulness is an extremely important characteristic of mountain bike trails and distinguishes mountain bike trail users' experiences from many other trail-users' goals (such as the goals of hikers or equestrians)

EXERCISE - Health and fitness. For some, this is a primary goal; for others a bonus, and for some, an obstacle. Defining the physical fitness needed for a particular ride is important in setting user expectations appropriately. Recognition that some riders have a high skill level and low fitness level (or vice versa) plays an important role in trail planning

VARIETY - Multiple trail options as well as diversity of experience within a trail system. Variety should be provided in several forms where possible: trail skill rating, features, surface, setting, grade, distance, etc.

CONNECTIVITY - Series of loops and/or trail segments linked by other trails or transportation routes. This allows for a customized experience, change of plans, adding onto a ride

SOCIALIZING - Provides a shared experience and improves the comfort level for riders. Mountain biking is often a social activity. Offering "go-arounds" for more challenging features can allow riders of differing skill levels (within reason) to still ride together and both have fun, adding to the social value

SAFETY/SECURITY - Could range from trailhead security for parking to personal safety unrelated to recreational use

EFFICIENCY - Getting to a destination or accomplishing a task with the least amount of time or effort expended. In mountain biking, efficiency is more commonly associated with trails that are designed to get riders to the "good stuff," such as a return climb that allows riders to repeat fun trail sections over and over, or a road connection between trails

How many trail-user objectives can you spot in this photo? Redhead Mountain Bike Park in Chisholm, Minnesota. Photo by Chris Guibert/Rock Solid

Bike-Specific Experience Factors

The third step in creating a quality trail experience is to understand and implement bike-specific experience factors that differentiate bike-optimized trails—sometimes referred to as "purpose-built mountain bike trails"—from traditional trails. Bike-optimized trails are designed and constructed to maximize the fun and efficiency of riding a bike. Key differences from traditional trail construction can be enhanced tread shaping, directional or one-way travel, and the use of constructed technical trail features (TTFs). We will be addressing these three differences in more detail throughout this guide.

Types of Trail Users

Although this guide is focused on the mountain bike trail experience, it is necessary to understand and consider the other types of users that might be sharing the trails. Thinking about shared access, the demands of multiple user types, and management considerations in the planning stages can minimize conflicts and ensure the best possible experiences for mountain bikers alongside other users.

Hikers tend to be more focused on the setting and destination rather than the trail, prefer efficient routes, most mobile of the user types as they can easily venture off trail.

Photo by Chris Guibert/Rock Solid

Equestrians are less affected by tread condition, prefer loops, require access to water for horses to drink, desire longer distances to achieve a valued experience.

Photo courtesy of Pexels/Pixabay

Trail runners move at similar speeds as mountain bikers, preferring an experience similar to mountain bikers where the primary focus is on interaction with the trail.

Photo courtesy of Arkansas Parks and Recreation Foundation

Mountain bikers' primary focus is on the trail experience, with setting and destination as secondary objectives.

Photo by Eric Arce Photography

Photo by Eric Arce Photography

Mountain bikers at Pine Valley Park in Claquet, Minnesota. Photo by Hansi Johnson

Mountain bikers come in all sizes, shapes, and ages. Photo by Chris Guibert/Rock Solid.

EQUESTRIANS AND BIKE TRAILS

Equestrians and bike trails Of the user types listed, equestrians have the greatest potential to negatively impact the dynamic features (such as berms and rollers) of bike-optimized singletrack trails. Due to their weight and small hoofprint, horses can cause extensive damage to the tread surface of a bike-optimized trail. Unless a trail is primarily made of rock or is heavily reinforced in some fashion, horses pose a significant risk to the carefully sculpted tread surfaces and may erode the experience for the mountain biker.

Types of Mountain Bikers

Mountain bikers are a complex and constantly evolving category of trail user. While there are a variety of rider types that help us understand the desired types of riding, many riders partake in some or all of these riding types, often having a bike for each type. Understanding the different types of riders will also help explain the different mountain bike trail types. Please keep in mind that the following descriptions are generalizations and there will always be exceptions to these characterizations.

CROSS-COUNTRY (XC) RIDERS are characterized by their preference for the lightest possible bikes with a focus on pedaling efficiency over comfort, durability, or control. “Cross-Country” is primarily the domain of riders who are competitive and focused on racing and training. Physical fitness is favored over riding skill. These riders will embark on longer backcountry rides but tend to prefer diverse trail systems that are close to home and work to accommodate their frequent riding needs. They will rarely use a shuttle or lift service. They prefer traditional singletrack trails and enjoy modern, flowy trails if they provide a physical challenge. Using mountain bike gravity trails is unlikely for cross-country riders. Cross-country riders are sometimes referred to as “traditional” or “XC” riders.

UCI World Cup cross-country racers in Bentonville, Arkansas, and Snowshoe, West Virginia

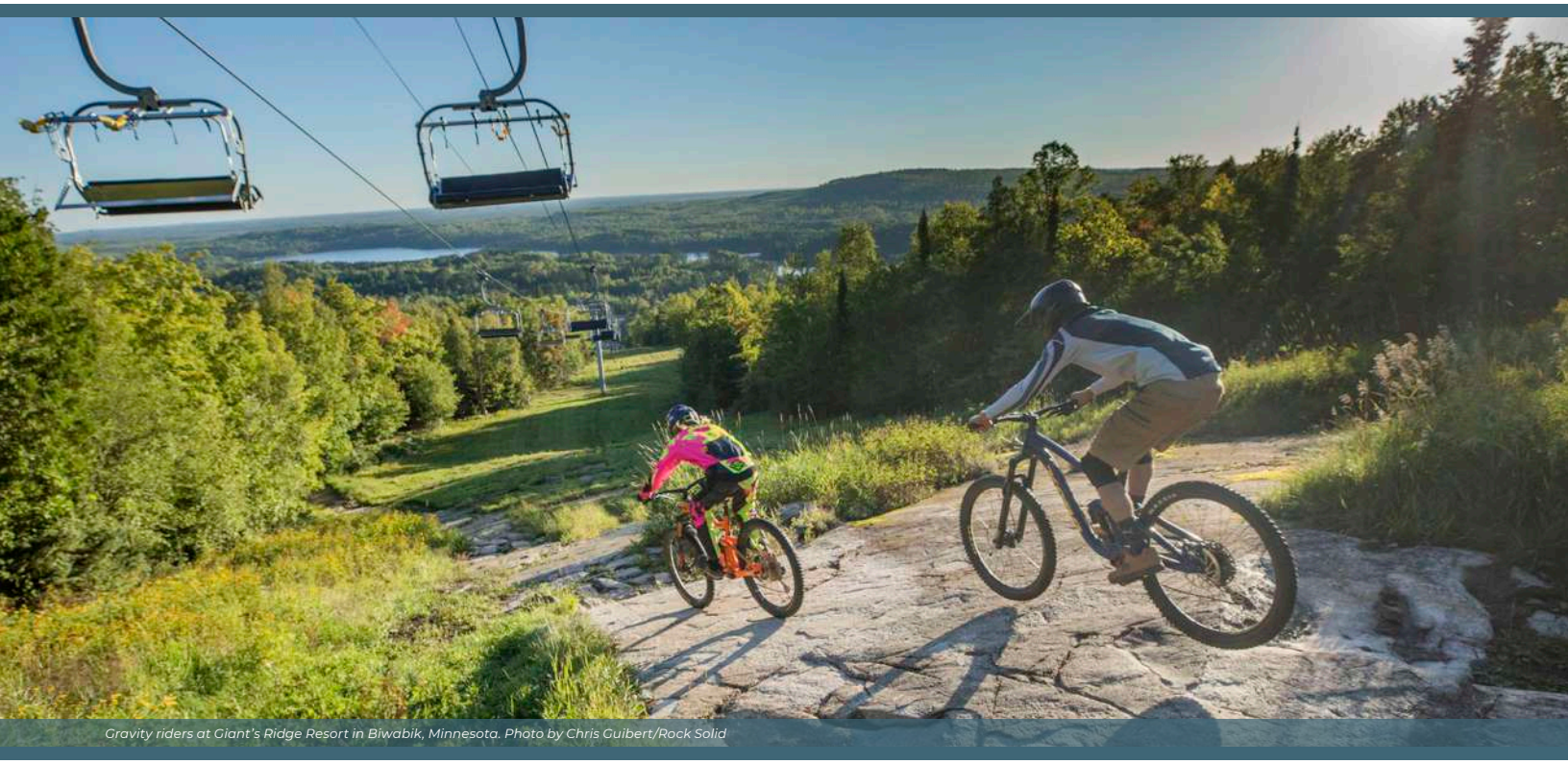
Photo by Eli Glesmann/Rock Solid

Photo by Kurtis Schachner

All-mountain riding at Split Rock Wilds in Beaver Bay, Minnesota
Photo by Chris Guibert/Rock Solid

ALL-MOUNTAIN RIDERS utilize a wide range of bike types with a multitude of wheel sizes, suspension, and gearing options to provide a personalized riding experience. Bicycle pedaling efficiency is marginally sacrificed for more stability and comfort. Riders in this category frequently endeavor themselves to long backcountry rides where scenery, solitude, challenge, and self-sufficiency are key. However, they are equally attracted to quick after-work rides on trails that are close to home. They will occasionally use a shuttle or lift service. This type of rider enjoys both traditional singletrack trails and modern flowy trails, with occasional trips to downhill gravity bike parks.

GRAVITY RIDERS prefer bikes with long travel suspension that helps them absorb extremely rough terrain and the impacts of repeated jump landings. Gravity riders focus on the challenge of technically difficult conditions, including constructed and natural jumps, drops, rocky areas, and steep terrain. They will expect that nearly all of the momentum they need to maintain speed will come from gravity, with pedaling only becoming necessary at strategic moments. Because their bikes are difficult to pedal uphill for long distances, they will almost always use a shuttle or lift service. Gravity riders will use traditional singletrack and other trail types but only if there are few, if any, climbs. Downhill gravity bike parks are their dominant preference. This group of riders is also referred to as "downhillers," "freeriders," and "park riders."



Gravity riders at Giant's Ridge Resort in Biwabik, Minnesota. Photo by Chris Guibert/Rock Solid

Expert step-down jump at Giants Ridge in Biwabik, Minnesota. Photo by Chris Guibert/Rock Solid

Truck shuttle back to the top for more gravity runs! East Bluff Bike Park, Copper Harbor, Michigan Photo by Chris Guibert/Rock Solid

eMTB RIDERS ride eMTBs equipped with a small electric motor to help propel the bike. eMTBs are available for all types of riders.

Though there has been controversy in the trail industry over whether eMTBs should be classified as motorized or non-motorized transport, eMTBs can be an equalizer in positive ways. eMTBs allow riders with health issues or other fitness limitations to continue enjoying the activity of mountain biking when they otherwise might have had to give up riding altogether. eMTBs can help riders ride farther and explore more terrain than might have been possible under just their own pedal power. They can also help riders of varying fitness levels enjoy riding together without the less-fit riders feeling completely worn out when trying to keep up with their fitter counterparts. eMTBs still require a rider to pedal, maneuver, and manipulate the bike up, down, around, and through trail features; it is still a workout, just with a bit of assistance.

For more information on eMTBs and current management strategies, refer to: **imba.com/education/emtb**

Riders on eMTB rides. Photo by Chris Guibert/Rock Solid

Riders on eMTB rides. Photo courtesy of IMBA

aMTB RIDERS are people with physical and/or neurological disabilities that ride adaptive mountain bikes. Due to the wide variety of types of disabilities there are also a wide variety of aMTB bike types to accommodate the various rider types. Since most adaptive bikes are wider than a typical mountain bike, special trail construction techniques must be used to ensure a good experience for these riders. Here are a selection of organizations that provide a range of aMTB resources: (The US Forest Service and American Trails Organization also have general guidance on adaptive trail development.)

- ***Kootenay Adaptive Sport Association*** is a Canadian nonprofit organization that provides adaptive mountain bike programs, experiences, and rentals. Kootenay also offers a free aMTB trail standards document as well as aMTB instructor training in conjunction with the Bike Instructor Certification Program (BICP).
- ***Break the Boundary*** is an Australian nonprofit organization that provides nature-based off-road cycling and hiking opportunities for people living with a disability. Break the Boundary also has aMTB guidelines and signage templates available for sale.
- Jeremy McGhee with ***The UNPavement*** offers aMTB consulting services and has his own rating system to inform aMTB riders on the level of support needed to ride a trail.

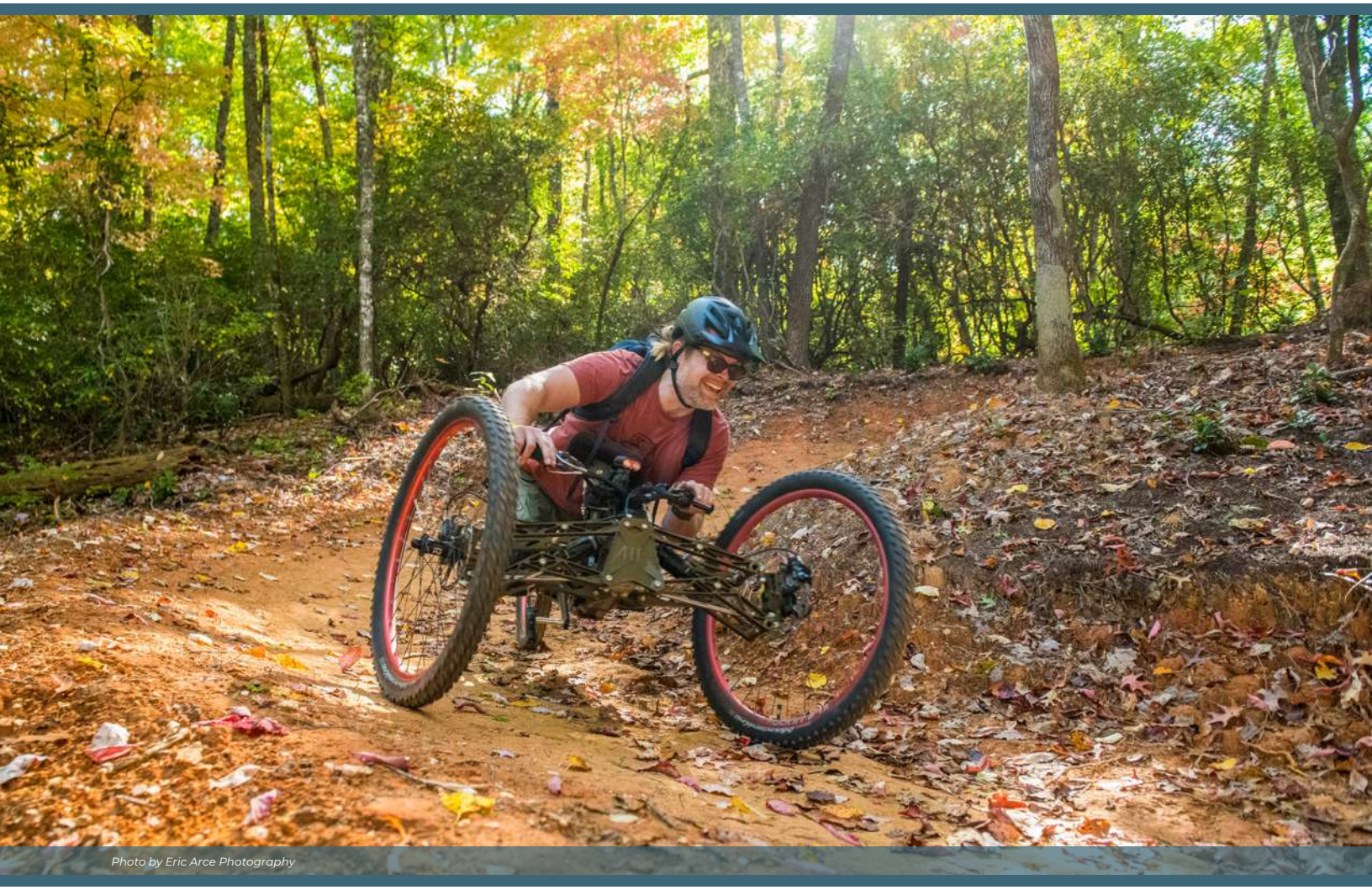


Photo by Eric Arce Photography

Chapter 5: Trail Types and Features

The trail types that riders seek out are in a constant state of change. Mountain biking is a progressive activity that encourages riders to creatively explore trail surfaces, the capabilities of their bike, and the sensations generated by the interplay between them. This results in steadily evolving trail experience goals from riders, and therefore, trail types have expanded and will most likely continue doing so in the future. The trail building industry may not all be on the same page in terms of types and terminology, so you may encounter variations from what you see below.

Before we get into the complex world of mountain bike trail types, we must first define singletrack. Singletrack is a narrow, natural surface trail ranging from 12 to 48 inches in width. Singletrack gets its name from its appearance as a single track in the woods, as opposed to a dirt road, which is wide enough for vehicle traffic.

Dirt roads are often referred to as doubletrack, jeep roads, fire roads, skid roads, or gravel roads. Before purpose-built mountain bike trails came into existence, dirt roads were commonly adopted as mountain bike trails to keep riders off of hiking trails and provide them a place to recreate in the woods. However, dirt roads do not provide the experiences that modern mountain bikers are seeking. Riding on a dirt road can feel like riding on a highway, whereas singletrack provides a more intimate experience that connects riders to the terrain. While there are mountain bike specialty trails that can be as wide as roads, these are typically reserved for high speed, downhill-only trails with large features.

Optimizing Trails for Bikes

Mountain bike singletrack trail falls into one of two general categories, bike-optimized or non-bike-optimized.

NON-BIKE-OPTIMIZED SINGLETRACK TRAILS

"Non-bike-optimized" refers to a classic style of trail that you would typically equate with those that were built by the Civilian Conservation Corps during the Great Depression. These types of trails are built with sustainable techniques, but the turns and tread slopes are built with the primary consideration of not trapping water on the trail rather than creating a dynamic experience for mountain bikers. As a result, surface tread is outsloped and turns are flat. These methods are great for encouraging water to move across the trail, but they are less than ideal for riders who are trying to maximize traction and avoid braking. Mountain bike tires tend to lose traction when turns are flat rather than cambered. To counter this, riders generally travel at a slower pace or are forced to brake more frequently and aggressively before turns on these types of trails. The slower speeds and frequent hard braking may not meet the experience goals that most mountain bikers seek. These types of trail are often referred to as "shared-use" or "hiking" trails by non-mountain bikers, and "classic," "legacy," or "old school" trails by mountain bikers.

BIKE-OPTIMIZED SINGLETRACK TRAILS

Bike-optimized singletrack refers to a trail that has been constructed to optimize the experience of a bike rider. While trail grade and distance are important elements to consider when optimizing a trail for bike riders, the primary elements we think of as bike-optimization are focused on tread manipulation and include the following:

Insloping

Insloped trail tread and turns aim to maintain a rider's momentum and speed. Insloping allows the rider to keep the bike perpendicular to the ground for maximum traction, minimizing the need for braking or slowing down. Insloped turns are often referred to as banked turns. Berm turns are a specialized form of insloped turns and, due to their uniqueness, are covered separately in this section.

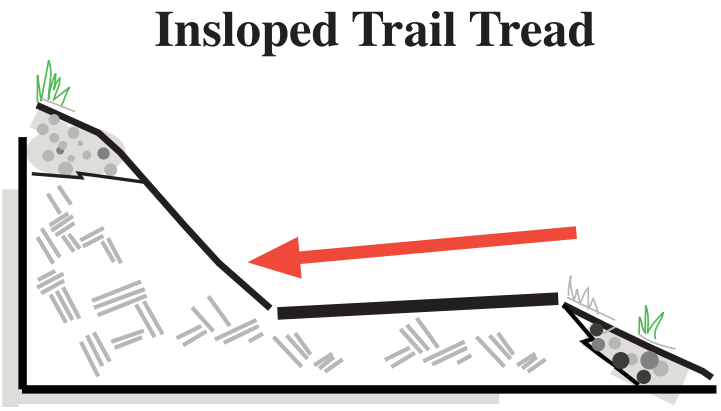


Illustration courtesy of IMBA

Insloped tread maximizes traction and flow. Photo by Hansi Johnson

Rollers

Rollers are grade reversals that have been shaped and spaced to optimize a fluid riding experience. When properly designed and constructed, rollers allow a rider to maintain or increase speed simply by “pumping” the bike as opposed to pedaling. Pumping is a technique where riders use the terrain to maintain or increase speed without pedaling. The concept is very similar to elements and sensations you would see and feel on a roller coaster.

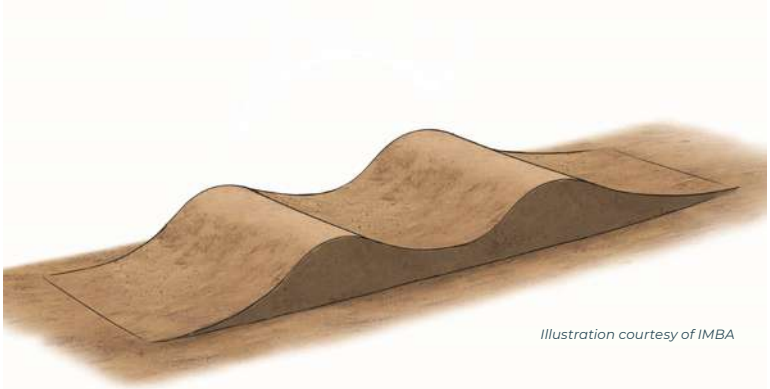
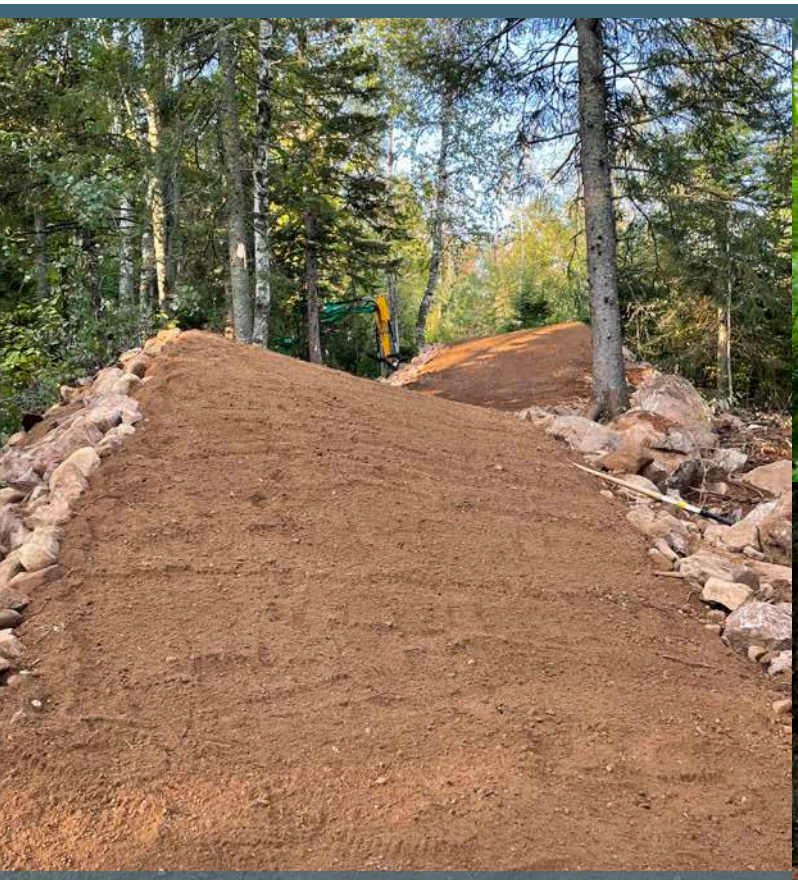
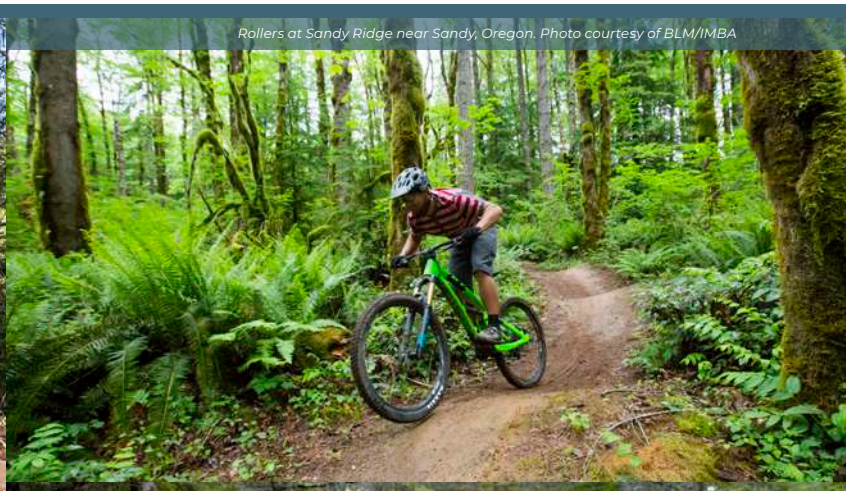


Illustration courtesy of IMBA



Monster banked berm rollers (brollers!) pre-compaction at Giants Ridge in Biwabik, Minnesota Photo by Adam Buck/Pathfinder Trail Building



Rollers at Sandy Ridge near Sandy, Oregon. Photo courtesy of BLM/IMBA

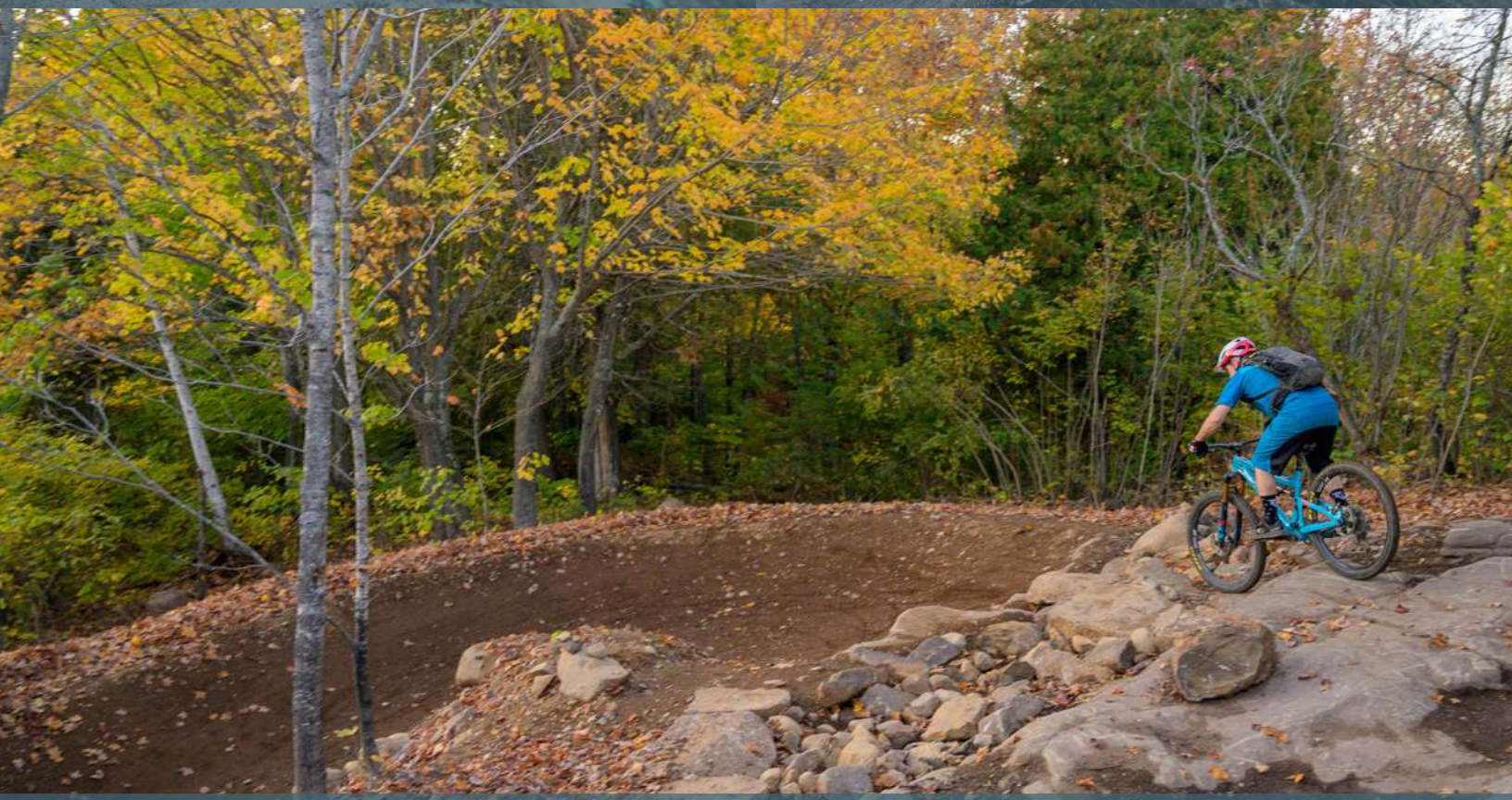
Big roller line at Tioga Recreation Area in Cohasset, Minnesota. Photo by Ryan Taylor Visual

Berms (bike-optimized turns)

A berm is a specialized insloped turn that is built up and shaped like a bowl. They allow a rider to take a turn at higher speeds than if the turn were flat or just banked. Berms also require a larger/wider turning radius than standard hiking trails in order to provide a fluid experience for riders.

Berm turn at Sandy Ridge in Sandy, Oregon. Photo courtesy of BLM/IMBA

Berm turn along the World Cup Downhill course on Snowshoe Mountain Resort, West Virginia Photo courtesy of IMBA



Rider entering a berm turn on Cook County Mountain Bike Trails in Minnesota. Photo by Bryan Hansel Photography

Technical Trail Features (TTFs)

TTFs refer to sections of trail that are purposefully constructed to challenge a rider's skill set. The calculated risk involved in riding TTFs also heightens the emotional experience of overcoming fear and conquering a challenge. TTFs can be constructed or naturally occuring and are typically made from either rock or wood, and include features such as rock gardens, drops, rock-overs (rocks you ride up and over), ledges, skinnies (narrower sections of trail that require focus and balance), and jumps, to name a few.

Constructed technical rock tread at Tioga Recreation Area in Cohasset, Minnesota
Photo by Chris Guibert/Rock Solid

Technical rock garden section at Cuyuna Country State Recreation Area in Crosby, Minnesota
Photo by Corey Lunsford

Technical trail section with progressive line choices of drops, roll-downs, and rock gardens at Lake Leatherwood in Eureka Springs, Arkansas. Photo by Eli Glesmann/Rock Solid

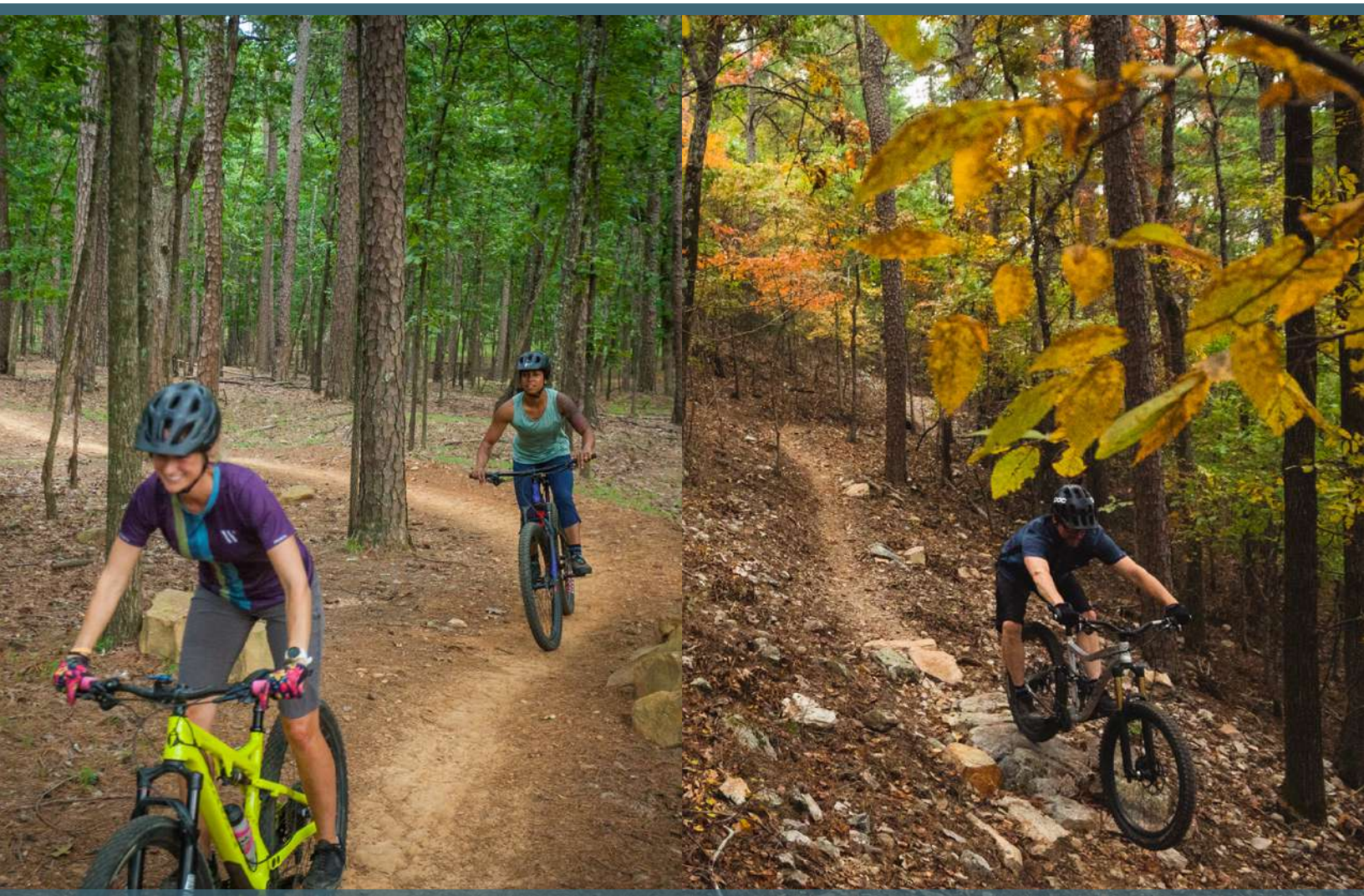
Engineered trail feature made from steel and wood at Railyard Bike Park in Rogers, Arkansas
Photo courtesy of OZ Trails

Bike-Optimized Trail Types

A trail type can refer to the entire length of a trail, or just for a section (segment) of a trail.

TRADITIONAL TRAILS: Traditional trails are associated primarily with a user's desire to travel longer distances, experience nature, and challenge their riding skills. As a result, traditional trails tend to be narrower (1- to 4-feet wide), have less manipulated tread, and have less frequent and more natural-looking features. Traditional trails are often referred to as cross-country or XC trails.

a. ***Trail user objectives*** **-** nature, escape, solitude, exercise, connectivity, challenge
b. ***Trail features*** **-** rock gardens, rock overs, ledges, drops, skinnies
c. ***Feature frequency*** **-** low (occasional, sporadic, opportunistic)
d. ***Trail direction***
    i. one-way or two-way
    ii. climbing and descending
e. ***Trail use*** **-** shared-use (hike, bike, trail run, etc.) or single-use (bike only)



Traditional bike-optimized singletrack trail at Mount Nebo State Park in Dardanelle, Arkansas and Northwoods Trails in Hot Springs, Arkansas. Photos courtesy of IMBA

Technical trail at Split Rock Wilds in Beaver Bay, Minnesota. Photo by Chris Guibert/Rock Solid

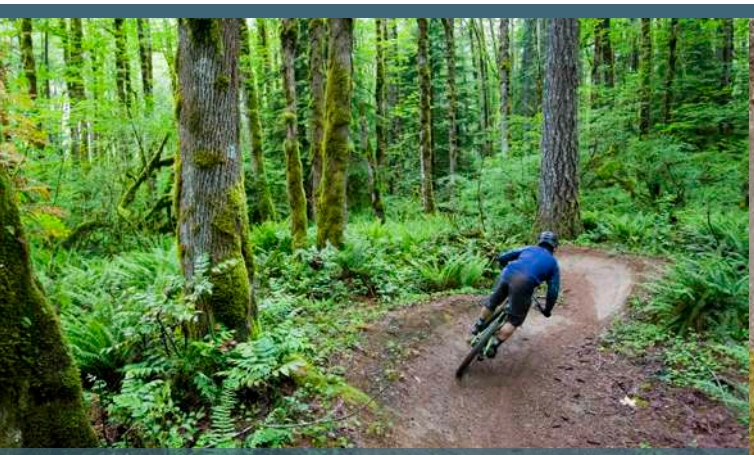
Lizard Tail technical trail at Mount Nebo State Park in Dardanelle, Arkansas. Photo by Eli Glesmann/Rock Solid

TECHNICAL TRAILS: Technical trails are those favored by riders wanting to be challenged by obstacles and changing or unpredictable tread characteristics. Technical trails can be narrow or wide depending on the types of technical features, but in general, technical trails tend to be more narrow (1- to 4-feet wide).

a. ***Trail user objectives*** **-** challenge, risk, fun, play/playfulness
b. ***Trail features*** **-** rock gardens, rock-overs, ledges, drops, skinnies
c. ***Feature frequency*** **-** high (technical features are frequent and prominent)
d. ***Trail direction***
    i. one-way or two-way
    ii. climbing and descending
e. ***Trail use*** **-** shared-use or single-use (bike only)

FLOWY TRAILS: Trails referred to as "flowy" most often refer to ones that riders seek to have a roller coaster-like experience, with lots of fluid up/down, left/right changes in direction via rollers and berms. Features are shaped and spaced to help riders maintain speed and momentum. Flowy trails are often slightly wider (2- to 6-feet wide) than traditional or technical trails to allow for more side-to-side play and wider landing areas for features that allow riders to get airborne. Rolling contour trail construction is the foundation from which flowy trails were born.

a. ***Trail user objectives*** **-** challenge, risk, fun, play/playfulness
b. ***Trail features*** **-** rollers, berms, jumps and drops
c. ***Feature frequency*** **-** high (features feel continuous with one feature starting as another is ending)
d. ***Trail direction***
    i. typically one-way descents, but since climbs can be designed to be flowy as well (versus a technical climb, for example), a two-way trail with flowy sections is possible as long as the descent sections do not create impossible climbing sections or unnecessary risk of high-speed collisions for riders traveling in the opposite direction
    ii. climbing and descending
e. ***Trail use*** **-** typically single-use (bike only), but shared-use is possible if similar precautions are taken as listed in the "trail direction" section above.



Flowy trail section at Sandy Ridge near Sandy, Oregon. Photo courtesy of BLM/IMBA

Chip-seal surfaced flowy berm trail at Slaughter Pen in Bentonville, Arkansas. Photo by Eli Glesmann/Rock Solid

Tech-flow at Devil's Den State Park in Winslow, Arkansas. Photo by Chris Guibert/Rock Solid

Step-up jump at Northwoods Trails in Hot Springs, Arkansas. Photo courtesy of IMBA

Jump trails at Tioga Recreation Center in Cohasset, Minnesota. Photo by Chris Guibert/Rock Solid

Slopestyle trail with constructed features on Devil's Racetrack in Knoxville, Tennessee. Photo courtesy of IMBA

JUMP/SLOPESTYLE/FREERIDE TRAILS: Jump trails consist of intentionally spaced and shaped ramps intended to launch riders into the air, setting them up to flow from one jump into the next. Jump trails require a high degree of skill to design and construct properly. Grade, approach distance, takeoff speed, takeoff radius, jump distance, and landing radius are just a few of the critical elements for a jump trail to function properly. Slopestyle and freeride trails combine jumping with constructed (and natural) technical features such as drops and wall-rides, focusing on a mixture of jumping, executing tricks, and performing skilled maneuvers. These trail types tend to be wider (3- to 12-feet wide) than other trail types to allow for variances in landings.

a. ***Trail user objectives*** **-** challenge, risk, fun, variety, play/playfulness
b. ***Trail features*** **-** jumps, rollers, berms, drops, wall rides
c. ***Feature frequency*** **-** high (features feel continuous with one feature starting as another is ending, spaced to allow just enough time to set up for the next feature)
d. ***Trail direction*** **-** one-way, descending
e. ***Trail use*** **-** single-use (bike only). Due to higher speeds and riders "catching air" it is not recommended to allow foot traffic; when a rider is in the air it is impossible to slow down or change direction

GRAVITY TRAILS: Gravity trails are typically associated with ski resorts, chair lifts, and/or shuttle vans for gravity-based, one-way descending experiences that include technical and flowy features. Common industry terms are flow trail (rollers, berms, jumps), technical trail (steep, rocky, technical), and slopestyle trail (feature-rich with constructed wooden structures such as wall rides). Gravity trails can vary greatly in width (1- to 12-feet wide) depending on the trail type. The common theme is not having to pedal up the mountain.

a. ***Trail user objectives*** **-** challenge, risk, fun, variety
b. ***Trail features*** **-** rock gardens, rock-overs, ledges, drops, berms, skinnies, jumps, wooden structures
c. ***Feature frequency*** **-** high
d. ***Trail direction*** **-** one-way, descending
e. ***Trail use*** **-** single-use (bike only) – due to higher speeds and terrain that is not conducive to walking, it is not recommended to allow foot traffic

Lift-served downhill bike parks are the pinnacle of gravity riding.- Giants Ridge in Biwabik, Minnesota. Photos by Chris Guibert/Rock Solid

Flowy gravity trail with big berms and jumpable features at Spirit Mountain in Duluth, Minnesota. Photo by Hansi Johnson

While it is fine to have an entire trail dedicated to one specific trail type, such as a flowy trail, for example, it is becoming more common for trails to be designed and built that bring flowy sections and technical sections together, combining to create a rich and diverse trail experience. This is especially true when space or resources are limited and it is not physically or financially possible to have different trails dedicated to every trail type.

Trail Difficulty Levels

There are two primary factors that influence the difficulty level of a trail experience: grade and obstacles. The steeper the descending grades, the faster the descents. The steeper the climbing grades, the harder the climbs. The bigger the obstacles, the more challenging the trail. Thus, as trails get steeper and with larger obstacles, riders need to have progressively better bike handling skills and physical fitness.

The mountain bike industry has historically used the same difficulty rating signage as downhill ski resorts: A green circle for easy, blue square for intermediate, single black diamond for advanced, and double-black diamond for expert. This system is accepted as the industry standard and is widely used on maps and trail signs.

IMBA Trail Difficulty Rating System

	EASIEST WHITE CIRCLE	EASY GREEN CIRCLE	MORE DIFFICULT BLUE SQUARE	VERY DIFFICULT BLACK DIAMOND	EXTREMELY DIFFICULT DBL. BLACK DIAMOND
TRAIL WIDTH	72" (1,800 mm) or more	36" (900 mm) or more	24" (600 mm) or more	12" (300 mm) or more	6" (150 mm) or more
TREAD SURFACE	Hardened or surfaced	Firm and stable	Mostly stable with some variability	Widely variable	Widely variable and unpredictable
AVERAGE TRAIL GRADE	Less than 5%	5% or less	10% or less	15% or less	20% or more
MAXIMUM TRAIL GRADE	Max 10%	Max 15%	Max 15% or greater	Max 15% or greater	Max 15% or greater
NATURAL OBSTACLES AND TECHNICAL TRAIL FEATURES (TTF)	None	Unavoidable obstacles 2" (50 mm) tall or less Avoidable obstacles may be present Unavoidable bridges 36" (900 mm) or wider	Unavoidable obstacles 8" (200 mm) tall or less Avoidable obstacles may be present Unavoidable bridges 24" (600 mm) or wider TTF's 24" (600 mm) high or less, width of deck is greater than 1/2 the height	Unavoidable obstacles 15" (380 mm) tall or less Avoidable obstacles may be present May include loose rocks Unavoidable bridges 24" (600 mm) or wider TTF's 48" (1,200 mm) high or less, width of deck is less than 1/2 the height Short sections may exceed criteria	Unavoidable obstacles 15" (380 mm) tall or less Avoidable obstacles may be present May include loose rocks Unavoidable bridges 24" (600 mm) or narrower TTF's 48" (1,200 mm) high or greater, width of deck is unpredictable Many sections may exceed criteria

IMBA Trail Difficulty Rating System

Trail Rating Guidelines

The following trail rating guidelines are intended to help you better understand how to collect data and implement difficulty ratings on your trails.

RATE TECHNICAL CHALLENGE ONLY - Rate the technical challenge of the trails, not the physical exertion required for that trail. Instead, identify trail length, elevation change, and average grade, so that riders can assess the exertion required to that trail based on their own levels of fitness and skill.

COLLECT TRAIL MEASUREMENTS - Collect trail measurements such as trail width, trail length, average grade, maximum sustained grade, trail feature dimensions, and trail feature frequency.

EVALUATE DIFFICULTY RELATIVE TO LOCAL TRAILS - Rate trails relative to other trails in the region so that riders can reasonably expect some similarity in difficulty ratings levels of trails within the same region.

CONSIDER OTHER TRAIL QUALITIES - When assigning difficulty ratings, consider additional factors such as exposure (the steepness of the hillside on the downhill edge of the trail), corridor clearance, turn radius (tighter radius equals more challenge), natural obstacles, and constructed TTFs.

USE GOOD JUDGMENT - Rating a trail will involve a degree of subjective judgment. Combine quantitative, tangible data with subjective judgment to reach the final rating. Use professional and stakeholder feedback when feasible.

INCLUDE DIFFICULTY AND TRAIL MEASUREMENTS ON SIGNS AND MAPS - Providing the difficulty symbol, trail length, and average grade on signage provides valuable information to riders.

Criteria to Consider

The following trail rating criteria are intended to further aid your understanding and implementation of trail difficulty ratings.

TREAD WIDTH - the average width of the active tread of the trail

TREAD SURFACE - the material and stability of the tread surface that is a determining factor in the difficulty of the trail. Some descriptive terms include: firm, stable, variable, widely variable, loose, and unpredictable

TRAIL GRADE - measured using a clinometer (or software that can display grades on GPS tracks) and always referenced as a percentage.

- **Average grade** – Average grade is the steepness of the trail over its entire length, calculated by total elevation gain of the trail divided by total length of the trail and multiplied by 100 to calculate the percent grade.
- **Maximum sustained grade** – Maximum sustained grade is defined as the steepest section of trail sustained for more than 10 feet in length.
- **Average climbing and descending grades** – It is helpful to define climbing and descending grades separately from one another to accurately assess the level of physical exertion required on the climbs as compared to the level of speeds potentially obtained on the descents.

The average grade is very influential on how difficult a trail may or may not be. Average grade percentages depicted in the IMBA Trail Difficulty Rating System help to determine the appropriate skill-level category a trail falls into.

BEGINNER/EASY

0%-5% Average Grade

INTERMEDIATE/ MORE DIFFICULT

5%-8% Average Grade

ADVANCED/VERY DIFFICULT

8%-12% Average Grade

EXPERT/EXTREMELY DIFFICULT

10%-15% Average Grade

The difference between a 5% and 8% stretch of intermediate trail is significant. The physical exertion required to climb a sustained 8% grade is significantly more challenging than what is required to climb a sustained 5% grade. Similarly, potential descending speed on an 8% grade is significantly faster than a 5% grade.

For example, a one-way trail planned with 8% descents and 5% climbs will maximize speeds for the descending portions and minimize physical exertion on the climbs, creating a fast, flowy experience that focuses on speed and minimal exertion. Whereas a one-way trail planned with 5% descents and 8% climbs will reduce descending speeds and maximize physical exertion on the climbs, creating a more physically demanding trail experience with reduced descending speeds.

This is the type of knowledge an experienced trail planner will use to tailor the trail experience to match user objectives. It is also excellent foundational knowledge for a land manager to possess when providing oversight on trail development projects.

COMMON PITFALL:

Poor grade management

Trail grades not planned with the benefit of best practices and tools such as geographic information system (GIS) terrain analysis and clinometers can have a direct impact on rider speed, rider exertion, drainage, erosion, and other critical variables when planning trail corridors.

Trail Features

Bike-specific trail features are what truly make a trail experience unique and specific to mountain biking. This distinction can not be overstated enough. Bike-specific trail features are essential to creating a high-quality mountain bike trail experience.

Custom designed and engineered trail feature at Lake Vian in Vian, Oklahoma. Photo by Eli Glesmann/Rock Solid

Hiking trails, shared-use trails, and mountain biking trails are all constructed with similar techniques in an attempt to minimize erosion and make the trails physically sustainable. However, trails designed and constructed to optimize the experience for mountain bikers pay great attention to detail in how grades are utilized, where grade reversals are located and how they are spaced/shaped, with extensive focus on how riders will interact with the trail tread. In addition to the typical sustainable trail building techniques, a trail planner has to constantly think about overall rider speeds, as well as the riders' speeds when entering and exiting trail features, to craft the experience intended for the level of skill indicated on that specific trail. Execution of this level of trail planning requires a high degree of understanding of the physics of riding and the interaction of the rider and bicycle with the terrain and features.

The analogy of a roller coaster is highly relevant in terms of mountain bike trail design. A rider is routinely transitioning from one trail feature to the next, much like a passenger on a roller coaster, so spacing and timing are critical. Though roller coasters are associated with flow, there is also an anti-flow style of constructing trail features that intends to make it difficult to time and transition from one feature to the next. While this may sound counter-intuitive to the non-rider, this kind of anti-flow creates a unique style of riding that can be as rewarding as it is challenging. Understanding these concepts becomes especially critical for trail features such as jumps and drops, which require a rider's wheels to leave the ground.

Extensive rock armoring at Cacapon State Park in West Virginia. Photo by Daddio/IMBA

The term "trail feature" can apply to any type of obstacle or element on the trail that the rider has to respond to or interact with, whether it is made of dirt, wood, rock, or steel. While the types of bike-specific trail features are only limited by available materials, budget, and imagination, the following 10 types are most commonly utilized. Understanding each of these will help ease communication between riders in your community and professional mountain bike trail building contractors.

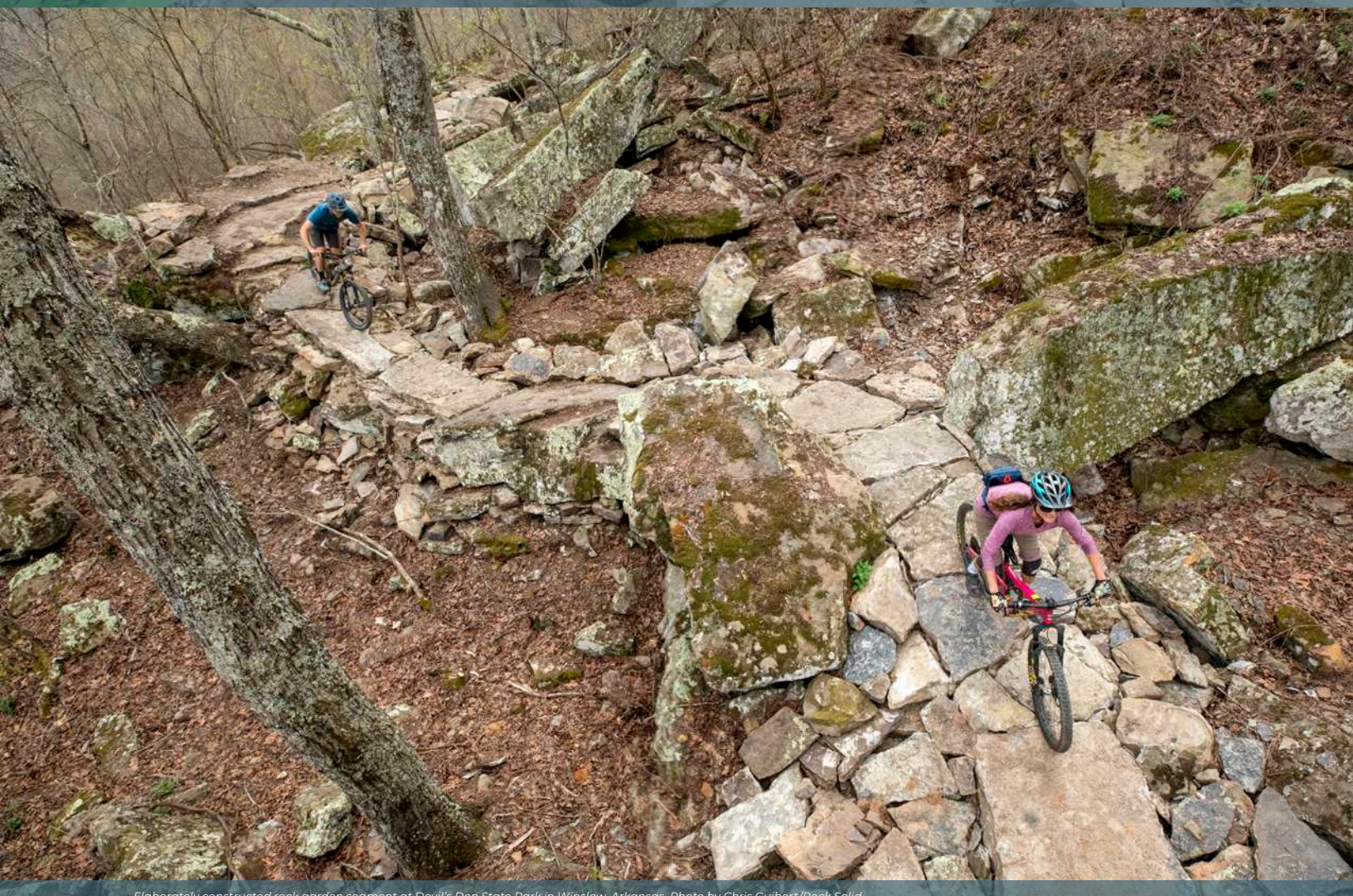
ROCK GARDEN

A rock garden refers to a section of trail that has rocks embedded in the tread. Rock gardens vary from beginner- to expert-difficulty ratings. A rock garden can be on flat trail, descending trail, climbing trail, or a combination of the three. Rock gardens can exist naturally within a trail, or they can be constructed by trail builders by gathering and placing rocks to create the feature. The "rugosity" of the rock garden, the difference in height from one rock to the next, determines how difficult the rock garden is to navigate. With less height difference between rocks, the rock garden feels smoother and easier to ride, while more height variation presents more difficulty and challenge to the rider.

Riders navigating a constructed rock garden in Deep Creek State Park, Maryland. Photo by Daddio/IMBA

Climbing a constructed rock garden in Copper Harbor, Michigan. Photos by Chris Guibert/Rock Solid

Descending rock garden at Giants Ridge in Biwabik, Minnesota. Photo by Chris Guibert/Rock Solid



Elaborately constructed rock garden segment at Devil's Den State Park in Winslow, Arkansas. Photo by Chris Guibert/Rock Solid

ROCK SLAB

Rock slabs are large slabs of rock. They can be smooth or textured, flat or undulating. Rock slabs vary from beginner- to expert-levels of difficulty. A rock slab can be on a flat trail, descending trail, climbing trail, or a combination of the three. Rock slab features tend to exist naturally, with the trail routed to the rock slab. If a rock slab is steep enough, it would also be considered a roll down feature.

Natural rock slab features tend to offer many different line choices. Above: Old Forge, New York. Photo by Kyle Lieberman Photography

Natural rock slab riding at Lunch Loops in Grand Junction, Colorado. Photo courtesy of BLM/IMBA

Natural rock slab used for a steep, technical fall-line descent at Hartman Rocks in Gunnison, Colorado. Photo courtesy of BLM/IMBA

ROCK-OVER

Rock-overs are large rocks that require the rider to ride up and over them. A rock-over can vary from beginner- to expert-level of difficulty. These can be found in nature and ridden as is, though they will often require an approach trail built or routed onto or off the feature. They can also be constructed by moving large rocks into place. A rock-over can be on a flat trail, descending trail, or climbing trail.

Riding down the backside of a rock-over feature at Sandy Ridge in Sandy, Oregon Photo courtesy of BLM/IMBA

Riding up a rock-over feature at Mount Nebo State Park in Dardanelle, Arkansas. Photo by Eli Glesmann/Rock Solid

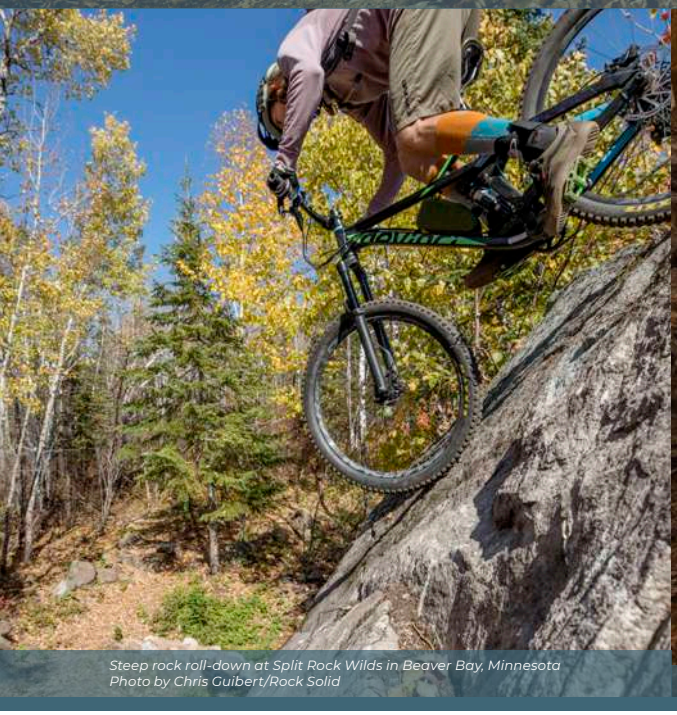
Riding a rock-over feature in Cuyuna, Minnesota. Photo by Hansi Johnson

Rock-over feature at La Larr Ba Guawa Park at Harcourt in Central Victoria, Australia. Photo by Dirt Art

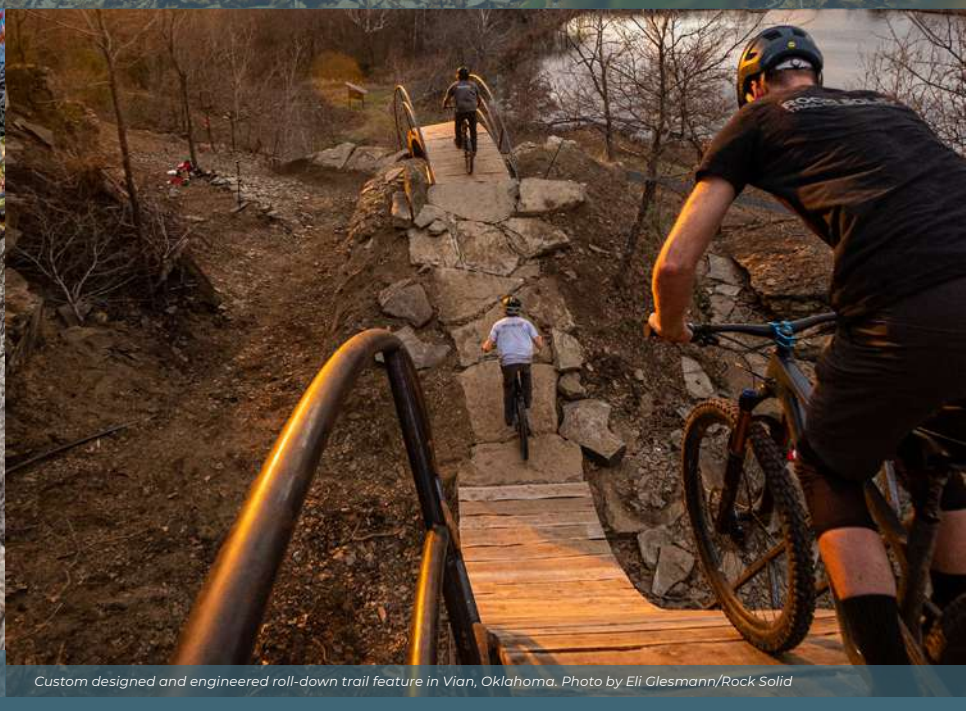
ROLL-DOWN

A roll-down is a feature that is steep enough and long enough to make it hard to brake or limit speed while descending; a rider controls their speed management after they exit the feature. A roll-down tests a rider's balance on the bike, requires proper body positioning, timing, and braking skills. Roll-downs can be made out of dirt, trees, lumber, rock, and even metal-framed structures, but trail builders often take advantage of large, steep rock slabs for naturally occurring roll-downs. Roll-downs can vary from beginner- to expert-level of difficulty. A roll-down is a descending feature, but is not limited to descending trails and can appear on a variety of trail types.

Naturally occurring rock roll-down feature with an alternate, easier line to the side on Double Barrel trail at Wheelerville Trails in Caroga Lake, New York. Photo by Kyle Lieberman Photography



Steep rock roll-down at Split Rock Wilds in Beaver Bay, Minnesota
Photo by Chris Guibert/Rock Solid



Custom designed and engineered roll-down trail feature in Vian, Oklahoma. Photo by Eli Glesmann/Rock Solid

SKINNY

A “skinny” is a narrow section of trail that requires increased skill and balance to navigate. Skinnies are commonly constructed out of downed trees, lumber, rock, and even metal-framed structures, and can vary from beginner- to expert-level of difficulty. Skinnies can be on flat trail, descending trail, climbing trail, or a combination of the three.

Wooden skinnies in Bentonville, Arkansas. Photos by Eli Glesmann/Rock Solid

Wooden skinnies in Rogers, Arkansas. Photos by Eli Glesmann/Rock Solid

Wooden skinny(ish) with roll-down at Pine Valley Park in Cloquet, Minnesota. Photo by Hansi Johnson

Chainsaw-milled wooden skinny alternate line at Blackhawk Ski Area in Madison, Wisconsin Photo by Chad Landowski/Traction Trailworx

Wooden skinny with alternate riding lines at Fitzgerald Mountain in Springdale, Arkansas. Photo by Erik Nelson/Rock Solid

Steel fabricated skinny on Chunky Trail at Centennial Park in Fayetteville, Arkansas Photo by Eli Glesmann/Rock Solid

Naturally occurring rock skinny in Old Forge, New York. Photo by Kyle Lieberman Photography

Rock skinny as an optional feature at Slaughter Pen in Bentonville, Arkansas. Photo by Chrisman/IMBA

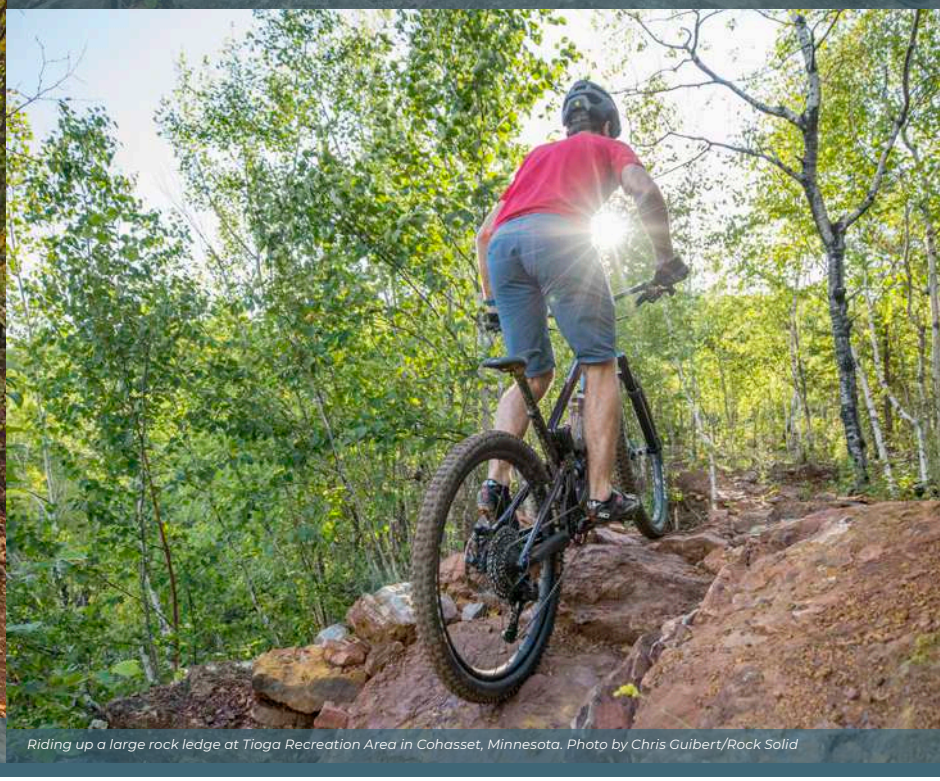
LEDGE

In mountain biking terms, a ledge is a vertical face that a rider must either ride up or down. For example, a street curb in a parking lot is technically considered a ledge because it has a vertical face and a rider could ride down it or up it. Riding up a ledge requires a rider to be able to perform a front wheel lift technique. Ledges can vary from beginner- to expert-level of difficulty. Ledges can appear naturally or they can be constructed. For added challenge and interest, multiple ledges can appear one after the other. With enough speed and skill, a rider can ride off a ledge and execute a drop maneuver. Ledges can be made out of dirt, wood, rock, or metal-framed structures. Ledges can be on flat trail, descending trail, climbing trail, or a combination of all three.

Rock ledge roll-down at Lake Pueblo State Park, Colorado. Photo by Evan Green

Series of small rock ledges at Split Rock Wilds in Beaver Bay, Minnesota. Photo by Chris Guibert/Rock Solid

Riding down a rock ledge on the Duluth Traverse in Duluth, Minnesota Photo by Hansi Johnson



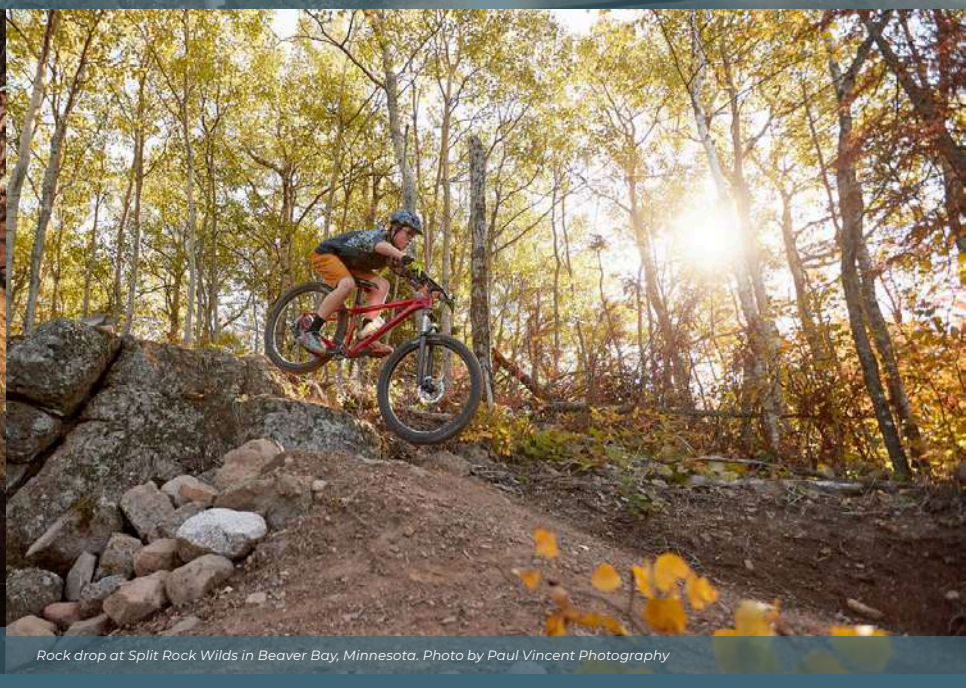
Riding up a large rock ledge at Tioga Recreation Area in Cohasset, Minnesota. Photo by Chris Guibert/Rock Solid

DROP

A drop is a ledge that is too tall for a rider to roll down, forcing the rider to execute a skill maneuver known as the same name, a "drop." With enough speed and the proper technique, a rider can ride off of a drop so that both wheels are in the air briefly before landing back on the ground. Whenever both of a rider's wheels leave the ground, the level of risk goes up significantly. However, effectively executing a drop results in increased adrenaline and excitement, which can add an overall sense of fun and feeling of accomplishment. A drop can vary from beginner- to expert-level of difficulty and be made out of dirt, rock, wood, engineered materials, metal, or any combination of these. Due to the momentum required to ride a drop, these features are typically only built on flat or descending trail.

Buck Wylde jump trail with drops at Detroit Mountain Recreation Area in Detroit Lakes, Minnesota. Photo by Adam Buck/Pathfinder Trail Building

Large wooden drop at Cuyuna Country State Recreation Area in Cuyuna, Minnesota Photo by Chad Landowski/Traction Trailworx



Rock drop at Split Rock Wilds in Beaver Bay, Minnesota. Photo by Paul Vincent Photography

Large rock drop with alternate go-around at Devil's Den State Park in Winslow, Arkansas. Photos by Eli Glesmann/Rock Solid

ROLLER/PUMP SECTION

A roller refers to trail tread that has been shaped into a mound that a rider will roll up and over. A roller can vary from beginner- to expert-level of difficulty depending on the size, shape, and rider speed coming into the roller. Multiple rollers back-to-back create a pump section (also called a rhythm section) that a rider can "pump" through without pedaling and still maintain, or even gain speed. The size, spacing, and approach speeds are critical for a pump section to be fun and effective. A roller can be made out of dirt, wood, rock, or metal-framed structures. A roller can be on flat trail, descending trail, climbing trail, or a combination of all three. A roller can be in a straight line or banked to help a rider change direction.

Roller section on Mama Bear chip-seal pump trail in Bentonville, Arkansas Photos by Chris Guibert/Rock Solid

Roller section on Mama Bear chip-seal pump trail in Bentonville, Arkansas. Photos by Chris Guibert/Rock Solid

BERM

A berm is a banked turn designed to help a rider change direction while maintaining speed and maximizing traction. A berm can vary from beginner- to expert-level of difficulty depending on the size, shape, and turn radius, and is also affected by the speed in which the rider takes the berm. The smaller the turn radius, the tighter and more difficult the berm. A berm can be made out of dirt, wood, rock, or metal-framed structures. A berm can be on flat trail, descending trail, and/or a climbing trail.

Large dirt berm at Centennial Park in Fayetteville, Arkansas. Photo by Eli Glesmann/Rock Solid

Large wooden berm at Detroit Mountain Recreation Area in Detroit Lakes, Minnesota Photo courtesy of Detroit Mountain Recreation Area

Large dirt berm at Giants Ridge in Biwabik, Minnesota. Photo by Chris Guibert/Rock Solid

Berm entry, apex, and exit at Lake Atlanta in Rogers, Arkansas. Photo by Eli Glesmann/Rock Solid

JUMP

A jump is a feature designed to send a rider upward into the air. A jump consists of a take-off, a landing, and the space between the two. Designing and building jumps requires a high degree of skill and experience, especially with the increased risk of riding a jump. A jump section refers to a section of trail having multiple jumps in a row, which adds challenge and fun. A jump can vary from beginner to expert difficulty and can be made out of dirt, wood, rock, or metal-framed structures.

Jumps with optional, easier go-arounds at Giants Ridge in Biwabik, Minnesota. Photo courtesy of Rock Solid

Jump trail at Giants Ridge in Biwabik, Minnesota. Photo by Chris Guibert/Rock Solid

Rock jump alt-line at Iron HIlls Trails in Cedar City, Utah. Photo courtesy of IMBA

Common jump types:

1. Table-Top Jump

A table-top jump has trail tread connecting the top of the take-off to the top of the landing so that if a rider does not clear the jump, they land on the tread between the two.

Typical table-top jump. Photo by Eli Glesmann/Rock Solid

2. Step-Up Jump

A step-up jump refers to a jump where the landing is higher than the take-off. Step-up jumps are typically easier to learn on since the rider will not be as high off the ground or in the air for as long as on a normal jump.

Step-up jump at Northwoods Trails in Hot Springs, Arkansas. Photo courtesy of IMBA

Rock step-up jump at Split Rock Wilds in Beaver Bay, Minnesota. Photo by Chris Guibert/Rock Solid

3. Step-Down Jump

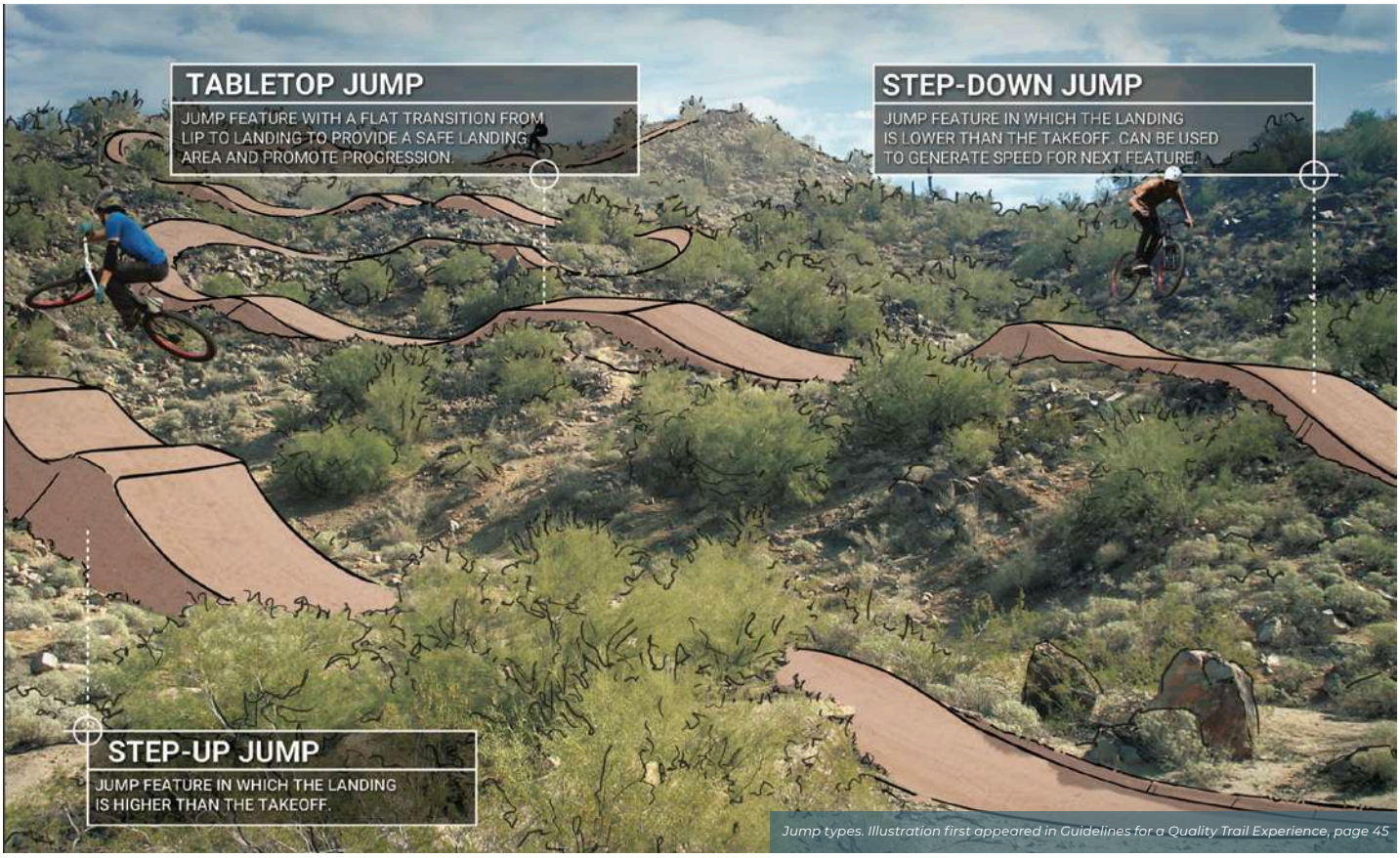
A step-down jump refers to a jump where the landing is lower than the take-off. Step-down jumps can be more challenging to learn on since the rider can be in the air longer than they would for a table-top or step-up jump.

4. Gap Jump

A gap jump has no trail tread connecting the top of the take-off to the top of the landing. This creates a high degree of consequence for not clearing the jump, usually resulting in a rider having to ditch or bail off of their bike while in the air. Since riders can not gradually work their way up to clearing gap jumps and consequences are big, constructing and maintaining these types of jumps requires extreme care by builders, those who maintain the jumps, and land managers due to the increased potential for injury and additional liability.

Expert-level gap jump at Centennial Park in Fayetteville, Arkansas. Photo by Eli Glesmann/Rock Solid

Same gap jump but with a custom steel fabricated gap-fill to reduce risk and make the jump more suitable for riders to progress their skills. Photo by Eli Glesmann/Rock Solid



Jump types. Illustration first appeared in Guidelines for a Quality Trail Experience, page 45

DUTY OF CARE FOR TECHNICAL FEATURES WITH HIGH RISK OF INJURY

Scott Chapin, Bicycle Industry Risk Specialist, Marsh & McLennan Agency LLC

"There really isn't any actuarial data specific to various types of features, including gap jumps. However, the more technical the feature the more apt someone is to get hurt which could potentially lead to a lawsuit. You have to think about how a plaintiff attorney would argue about a feature in court. Gap jumps, for example, are easier for a plaintiff attorney to come up with arguments about how the approach was too short, the approach speed was too slow, the landing radius and length were too short, or a myriad of other findings. Plaintiff attorneys are known for hiring expert witnesses to perform these kinds of calculations and create visuals to support their findings, so great care should be taken when selecting a contractor responsible for designing and building technical features that introduce high risk of injury."

A rider enjoys a jump in the snow at Tioga Recreation Area in Cohasset, Minnesota. Photo by Weisguy Images

ROOTS

Natural, exposed tree roots that riders must ride over as part of the trail should not be planned as trail features. Repeatedly riding over tree roots can cause stress to the tree and possibly kill it. Exposed tree roots are usually the result of erosion caused by excessive use, weather events, improper trail design, poor trail construction, or soft soils. If tree roots become exposed they are at risk of constant damage by traffic, leaving the tree in a compromised state. It is recommended to either reroute a section of trail riddled by tree roots, or use a variety of techniques to raise the tread above roots, such as rock armoring or bridging.

While there are other types of specialty features, rock gardens, rock slabs, rock-overs, roll-downs, skinnies, ledges, drops, roller/pump sections, berms, and jumps of all sorts account for the vast majority of feature types desired by riders. Combining different types of features on one trail can create a diverse and unique experience for a rider. It is important to always be mindful of the desired trail user objectives and varying difficulty levels when adding features to a trail.

Photo by Eli Glesmann/Rock Solid

SPACING AND FREQUENCY

How far apart should features be spaced? And how frequently should features appear on a trail, even if they are spaced far enough apart for a rider to “recover” in-between features? These questions are partly answered by understanding the trail user objectives and difficulty levels. If play is an important trail user objective, then the trail should typically include more features. Spacing and frequency will vary depending on the desired experience, terrain, difficulty level, and budget. In general, features can be more frequent with less time to react between features as the degree of difficulty increases for a trail. The opposite is true for a trail with a lower degree of difficulty, which may have less frequent features and more time to react between features. Budget plays a role, too. Even though you may desire a feature-packed trail, features are far more time-consuming to build than normal bench-cut trail, so balancing feature types and how many with the project budget early in the trail planning phase can help set realistic expectations for everyone involved.

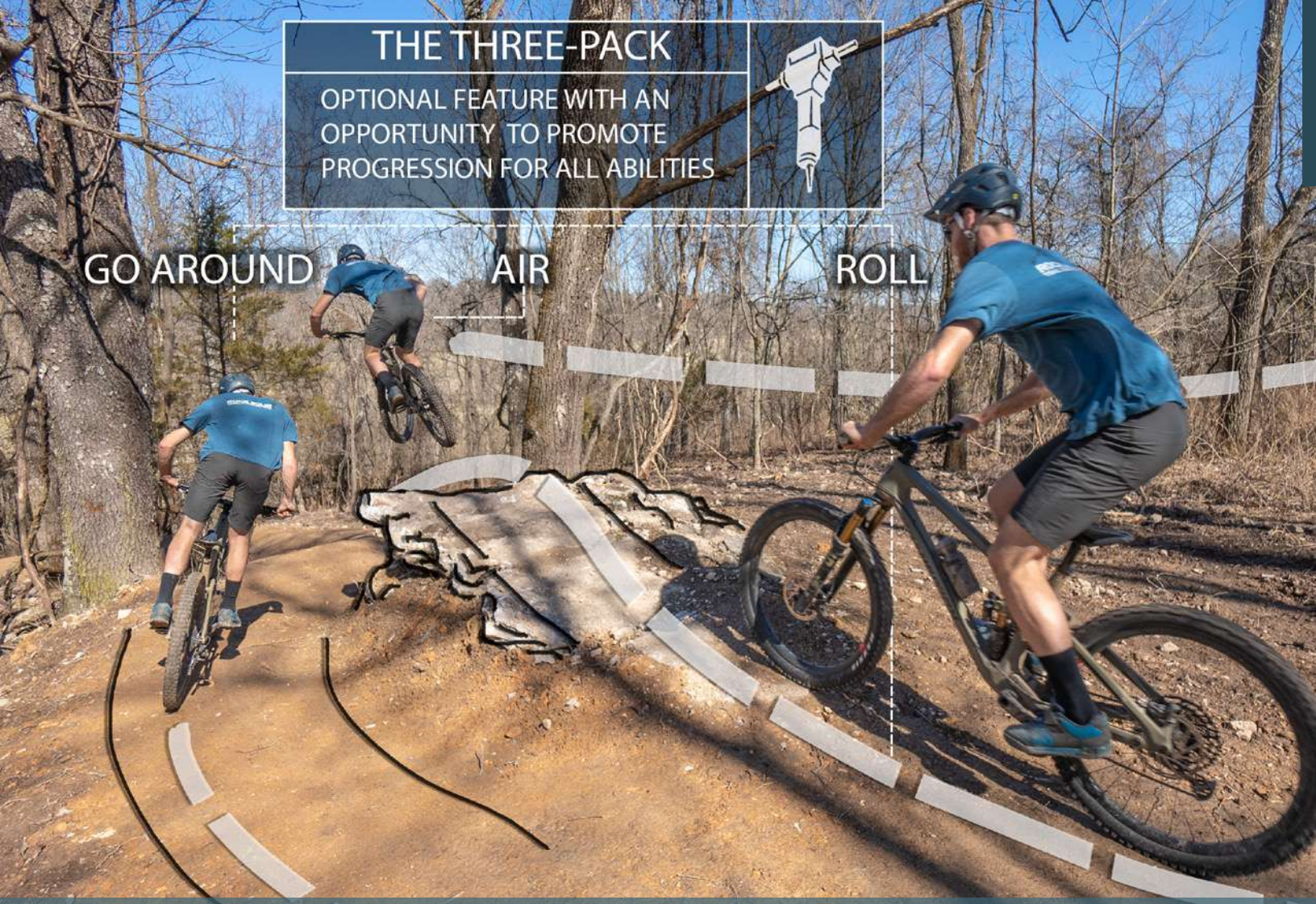
Illustration showing desired feature frequency. Illustration first appeared in Guidelines for a Quality Trail Experience, page 44

MANDATORY VS. OPTIONAL (ALT-LINES)

If there is an easier route available to riders around any certain feature, then the feature is considered to be optional. Optional lines are also referred to as "alt-lines," short for alternate lines. If there is no easier route around a feature, then the feature is considered to be mandatory. Having optional features allows riders to be able to pick and choose which features they ride without having to disrupt the flow of the trail. This also increases the number of ways a rider can choose to experience a trail, and lets riders of varying skill levels to more easily ride together on the same trail. Optional features also allow riders to improve their bike handling skills because they let riders pick and choose which features they will attempt during a ride.

If a mandatory feature is too challenging for a rider, the rider is forced to stop, dismount their bike and navigate over the feature on foot, disrupting the flow and experience of the ride. It is important to consider what is an appropriate skill-level advancement for optional lines on a trail segment. For example, it is appropriate to have an intermediate alt-line on a beginner trail, but it is not recommended to have an expert alt-line on a beginner trail.

Example of an optional line on the Captain Ahab trail in Moab, Utah. Illustration first appeared in Guidelines for a Quality Trail Experience, page 50



Optional lines: a rollable jump on the right with an easier go-around on the left. Photo by Eli Glesmann/Rock Solid

Alternate lines for multiple skill levels with a mix of rock and wood trail features in Munising, Michigan Photo by Chad Landowski/Traction Trailworx

Large rock slab with an easier go-around at Hartman Rocks in Gunnison, Colorado. Photo courtesy of BLM/IMBA

Skilled planners and builders look for creative ways to route trails to utilize alt-lines provided by Mother Nature. Split Rock Wilds in Beaver Bay, Minnesota Photo by Chris Guibert/Rock Solid

TRAIL FILTER

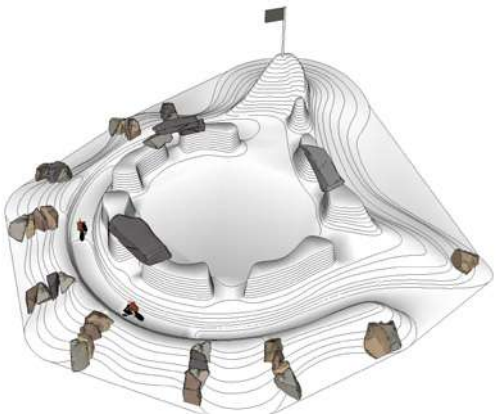
A mandatory feature placed at the entrance of a trail to set the expectation for the level of skill required for that trail is called a "trail filter." A key goal of the filter is to discourage riders from entering a trail beyond their ability. A trail filter is typically built at the highest skill level required for that trail, and ideally of a feature type that is common for that trail experience.

Filter feature at Sandy Ridge, Oregon. Illustration first appeared in Guidelines for a Quality Trail Experience, page 38

TRAIL HUB

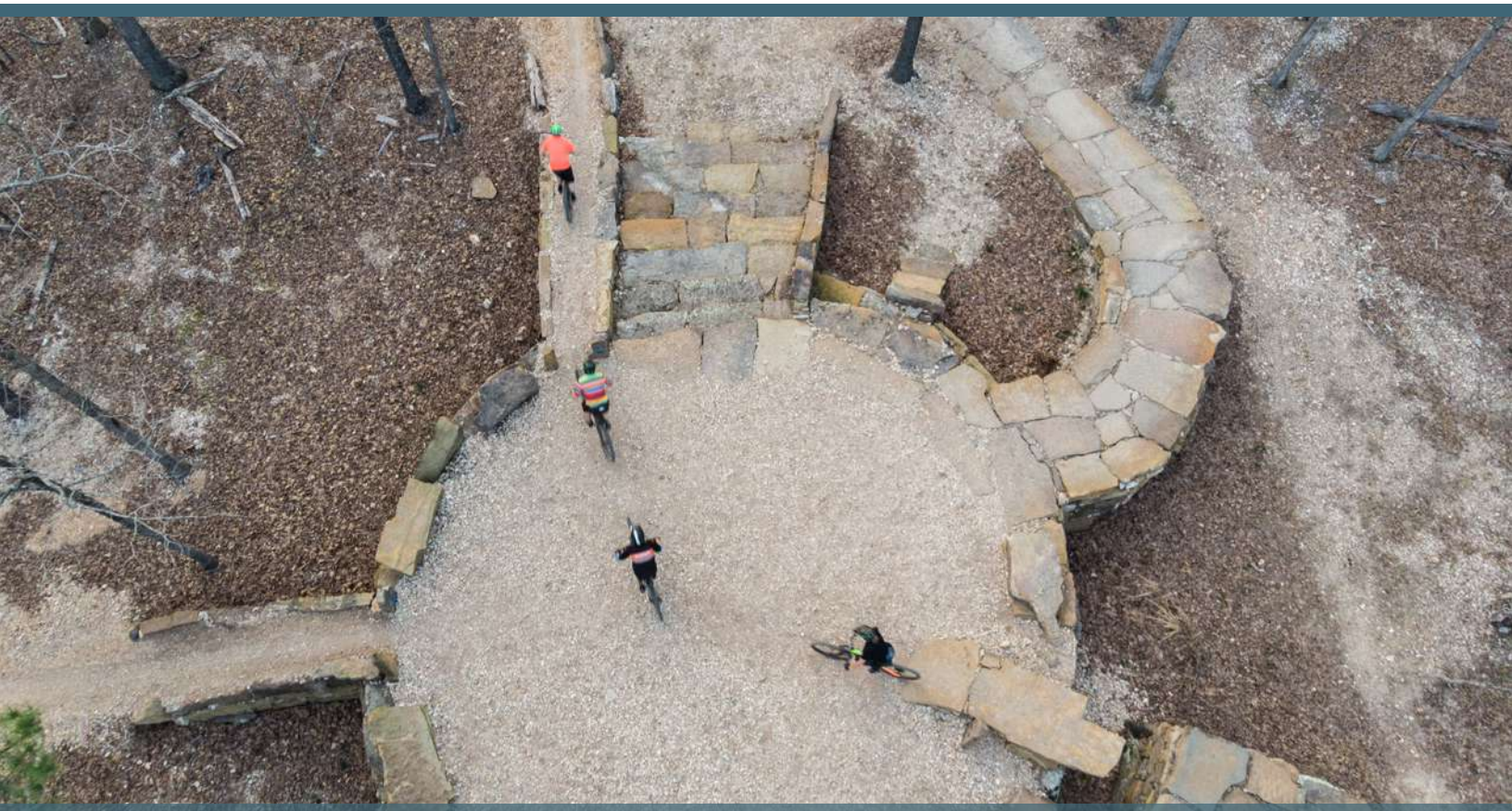
While not technically a trail feature, a "trail hub" is where multiple trails split off from one another or come together, providing an opportunity for riders to gather and wait while the rest of their group arrives. A trail hub is an ideal place to incorporate trail filters and optional lines to help riders select an experience appropriate to their skill levels and desires.

Trail hub at HandCut Hollow in Bentonville, Arkansas. Photo by Eli Glesmann/Rock Solid



TRAIL HUB "CASTLE" - SCHEMATIC DESIGN CONCEPT #1 3D
NOT TO SCALE

Castle hub/start hill original concept, in-progress, and complete at Slaughter Pen in Bentonville, Arkansas. Photos by Eli Glesmann/Rock Solid. 3D concept image by Derek Lehecka/Rock Solid



Start hub with trail filters, optional lines of varying difficulty, and rock benches at Lake Leatherwood DH in Eureka Springs, Arkansas. Photo by Eli Glesmann/Rock Solid

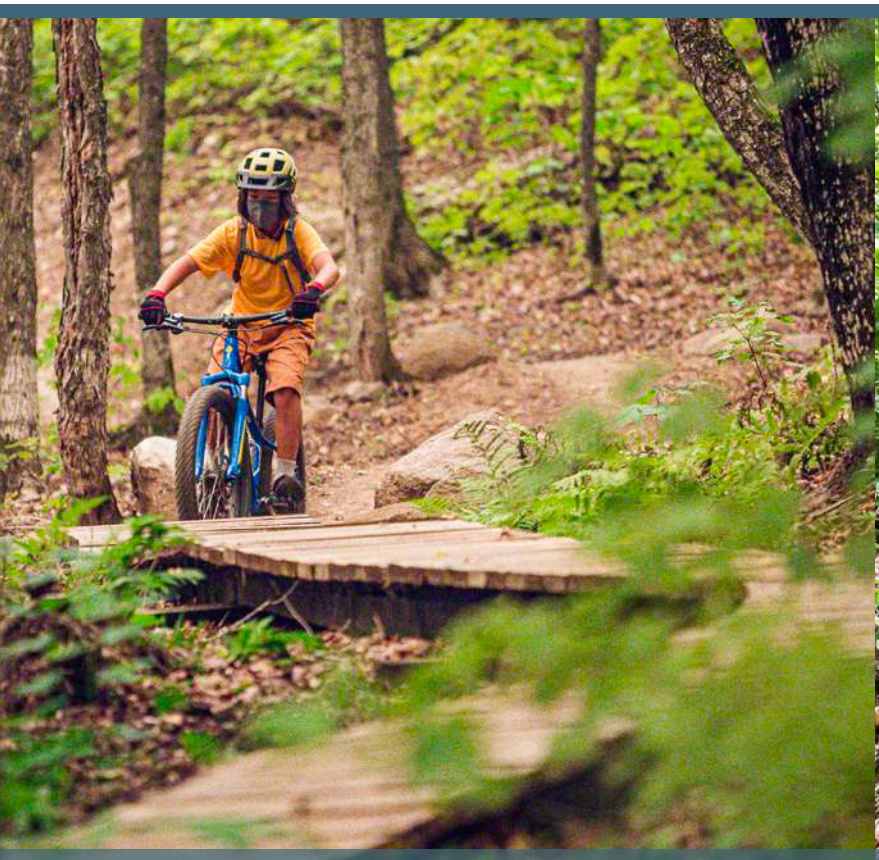
Same hub, different view at Lake Leatherwood DH in Eureka Springs, Arkansas. Photo by Mike Rogan/Rock Solid

BOARDWALKS

Elevated wooden pathways used to traverse terrain or soil that is not ideal for natural surface trail construction, such as sandy or marshy ground, are referred to as boardwalks. The most common materials for boardwalks have historically been raw or finished lumber. Since lumber decays and rots over time, more permanent materials such as synthetic lumber alternatives, steel, and rock, have become very popular to reduce long-term maintenance and replacement costs.

Just like with tread construction, boardwalks can be bike-optimized or non-bike-optimized. While it is possible to ride non-bike-optimized boardwalks, it is far more fun and rewarding to ride a boardwalk that incorporates bike-optimization elements such as canted and rolling surfaces to create the left/right and up/down experiences that riders crave. A boardwalk that has been bike-optimized may start to look more like a trail feature than a boardwalk—it is a blurred line that mountain bikers enjoy.

Skinny boardwalk trail feature. Shakopee, Minnesota. Photo by Adam Buck/Pathfinder Trail Building



Wooden boardwalk on Jackpot trail in Tofte, Minnesota. Photo by Hansi Johnson

Wooden boardwalk with a canted turn for bike optimization. Photo courtesy of BLM/IMBA

Custom steel-frame boardwalk with wooden decking at Giants Ridge in Biwabik, Minnesota. Photos by Adam Buck/Pathfinder Trail Building

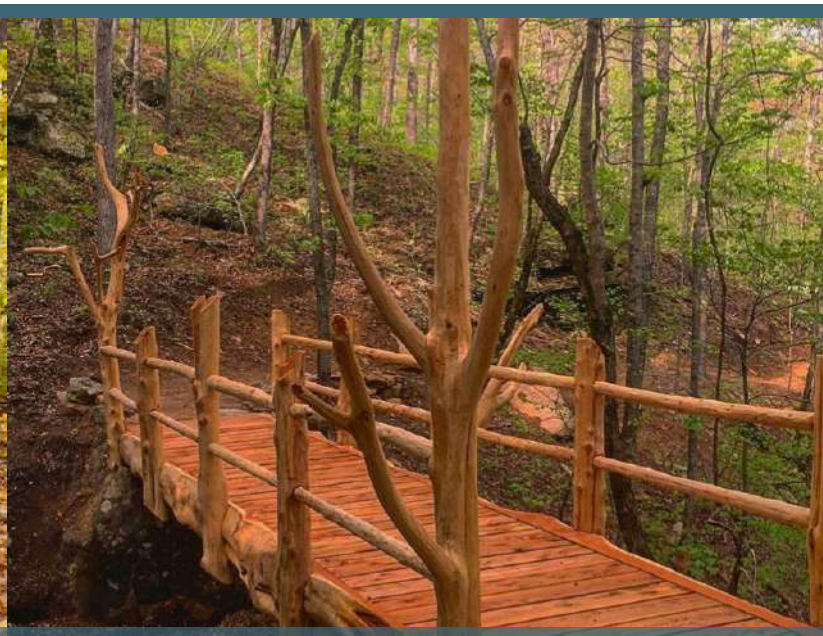
BRIDGES

Bridges can be as simple as a small, ten-foot structure meant for crossing a stream, or they can be wildly elaborate. Sometimes the most unique or breathtaking areas of a property can be extremely challenging or impossible to access with traditional trail construction methods. Incorporating a well-designed, creative solution to an access challenge can help to showcase the unique terrain while being both functional and visually appealing on its own.

While bridges can be a great solution, they can present challenges for getting materials to a build location, especially for remote trail systems without nearby road access. In addition, if wood is used, bridges will require regular inspections and require repairs over time as wood decays. When feasible, armoring a crossing at grade can avoid these issues, especially if native rock or stone is available near the build site.

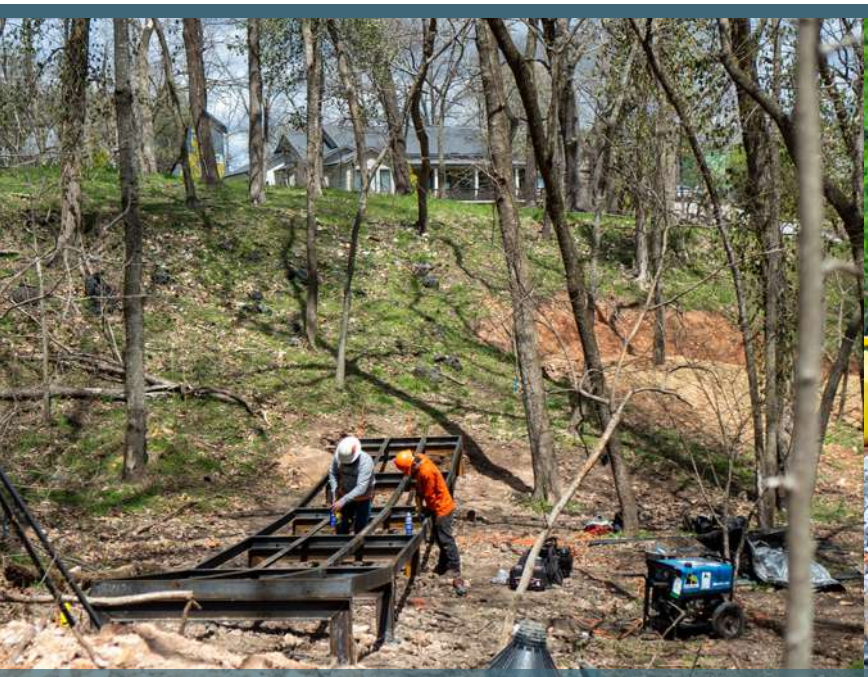
.

Simple, small wooden bridge at Split Rock Wilds in Beaver Bay, Minnesota. Photo by Chris Guibert/Rock Solid



Hand-felled, hand-peeled, and hand-sanded bridges have a unique custom feel. Photo courtesy of Rock Solid

Wooden bridge at Lake Atlanta in Rogers, Arkansas. Photo by Eli Glesmann/Rock Solid



Steel-framed bridge with wooden decking at Headstart to Slaughter Pen in Bentonville, Arkansas. Photos by Eli Glesmann/Rock Solid

Prefabricated steel bridge at Devil's Den State Park in Winslow, Arkansas. Photo by Andy Flietstra/Rock Solid

Complex, custom-engineered and site-built steel framed bridge at Mount Nebo State Park in Dardanelle, Arkansas. Photo by Andy and Michelle Flietstra/Rock Solid

SPECIAL FEATURES

Special features can be virtually anything. (See photos.). Budget and imagination may be your only limitations.

One-of-a-kind trail feature custom-designed and engineered to connect a cliff wall to a large rock "lily-pad" at Lake Vian in Vian, Oklahoma. Photo by Eli Glesmann/Rock Solid

Use of old truck for special jump feature with an easier go-around at Centennial Park in Fayetteville, Arkansas. Photo by Eli Glesmann/Rock Solid

Over-under trail section at Centennial Park in Fayetteville, Arkansas. Photo by Eli Glesmann/Rock Solid

COMMON PITFALL:

Poor understanding of mountain bike trail offerings

A poor understanding of mountain bike jargon, trail types, and trail features can result in trails getting built that do not meet the needs or wants of the community. A basic understanding of these elements (or having someone who does understand them involved in the project) is vital to ensure that the vision and goals of the community align with what gets planned and built.

Chapter 6: The Importance of Trail Signage

The development of a mountain bike trail network requires the development of a comprehensive system of signs. Signs are the most important communication tool between land managers and trail users. A well-implemented and maintained signage system enhances the user experience by helping visitors navigate the trail network and provides information about the area. Signage also plays a critical role in managing risk and deploying emergency services.

Signage for trails should be simple, uncluttered, and obvious, and there should be a sign at every major intersection to help users stay on track. Signs should meet the needs of all users, from the daily trail user to someone who is experiencing the trails for the first time. In order to serve the variety of visitors, sign placement should be strategic and frequent, although, too much signage can be unsightly among a natural outdoor experience. Balancing competing interests is key to developing a successful signage program.

Sign Types

A variety of signs can be created to help users identify trails and their locations, select routes, remain confident in their trail choices, find destinations and key points of interest, and understand regulations and allowed uses. Signage can also be interpretative, helping visitors learn about responsible recreation, trail etiquette, and resource protection, as well as how to reduce risk and hazards.

Informational Signs

Usually positioned at the trailhead and at major intersections, informational signs provide details such as trail length and difficulty. These include signs that identify a trailhead from a road, informational signs at a trailhead kiosk, trail intersection signs, waymarks, and signs that provide information about difficulty ratings, and trail lengths, and/or elevation gain and loss.

Trailhead signage for the Blue Derby trail network in Derby, Tasmania. Photo by Repyak/IMBA

Trail map and information for kiosk signage at the McClellan Trail Network in Anniston, Alabama. Photo courtesy of IMBA

Park information signage at the Saris Foundation Bike Park in Madison, Wisconsin. Photo by Repyak/IMBA

Information signage at Sylvan Hill Park in Wausau, Wisconsin. Photo by Gary Barden Design

Information kiosk at Northwoods Trails in Hot Springs, Arkansas. Photo by Repyak/IMBA

Regulatory Signs

These types of signs delineate rules, such as prohibited activities or other restrictions.

Trailside signage identifying allowable uses, difficulty level, directionality, and who the land managers and funders are for the trail. Iron Hills Trail Network, Cedar City, Utah. Photo by Repyak/IMBA

"Do Not Enter" signage located by a road/trail intersection at Coler MTB Preserve in Bentonville, Arkansas. Photo by Repyak/IMBA

Lakeside Bike Park rules and etiquette signage in Buffalo, New York. Photo by Repyak/IMBA

Directional Signs

Directional signs provide navigational information, direction of travel, and wayfinding.

Wayfinding signage at Walden's Ridge Park in Chattanooga, Tennessee. Photo by Repyak/IMBA

Clear signage indicating downhill direction-only in Avon, Colorado. Photo by Repyak/IMBA

Warning Signs

Often incorporating highly visible design elements, these signs warn trail users of upcoming hazards or risks.

Warning signage for a mandatory gap jump at Centennial Park in Fayetteville, Arkansas Photo by Eli Glesmann/Rock Solid

Warning signage for a technical trail feature at CamRock Park, Cambridge, Wisconsin Photo by Repyak/IMBA

Educational Signs

Educational signs can provide a variety of information for trail users, such as guidelines for responsible recreation and/or trail etiquette, descriptions of natural or cultural resources found on the trail, and guidelines for how to perform specific bike skills required to ride certain types of trail or features.

Share-the-trail education and directionality signage at the start of the Aspen Alley trail in Breckenridge, Colorado Photo by Repyak/IMBA

Educational signage illustrating the importance of keeping speed in check on shared-use trails. Image courtesy of Santa Cruz Mountains Trail Stewardship

Composite Signs

The most commonly used types of signs are composite, which are typically made from fiberglass. The benefits of using composite signs are that they are lightweight and flexible, have a minimal footprint due to their thin profile, and a wide variety of off-the-shelf informational stickers are available to use with them. Weight of sign materials can matter, especially for hauling into trail systems by hand and over long distances. Signs that are flexible and can give way upon rider impact increases safety.

Carsonite Markers, a popular brand of composite signs, shown here along a winter-only trail at CamRock Park in Cambridge, Wisconsin

Sticker package for composite sign posts. Photo by Kasacek/IMBA

Custom Signs

Custom signage is also commonly used, especially to reinforce a strong branding strategy of a community or agency. Custom signs typically utilize wood or steel posts as well as wood or steel sign plates and can thus vary in cost depending on materials used and intricacy of designs. Off-the-shelf sizes of wood and steel posts are readily available, making them easy to obtain and replace. Care needs to be taken when placing these types of signs in sections of trail that allow high speeds, are curved and create blind corners, or that are technically challenging to minimize the chances of a rider impacting an immovable sign post if an off-trail incident should occur.

Custom wayfinding signage at Centennial Park in Fayetteville, Arkansas. Photo by Eli Glesmann/Rock Solid

Custom trail intersection "hub" signage at Northwoods Trails in Hot Springs, Arkansas Photo by Repyak/IMBA

Custom wayfinding signage along the Blue Tier headed into Derby, Tasmania. Photo by Repyak/IMBA

Chapter 7: Introduction to the Trail Development Process

The trail development process includes the following phases:

While this document breaks the process into separate phases, real-world situations are more fluid. At one end of the spectrum might be a large, complex project that has separate contracting and execution for each phase of the project. At the other end of the spectrum might be a smaller design-build project where a builder is hired to assess, plan, design, and build the trail system all under one contract.

Aside from the individual phases from assess to evolve, funding, industry tools, landscape integration, and environmental reviews are also important, as each can permeate multiple phases of the trail development process.

Funding

Obviously, funding is required during all phases of the trail development process. At a very high level, trail construction is typically funded from capital budgets, while trail planning and maintenance activities are typically funded from operating budgets. External funding sources include federal/state grants, local/regional/national foundations, and private donors. The source of funds can also impact how the funds can be used, what entity or entities might have jurisdiction over your project as a result, and the reporting required in order to keep the awarded funding.

Industry Tools

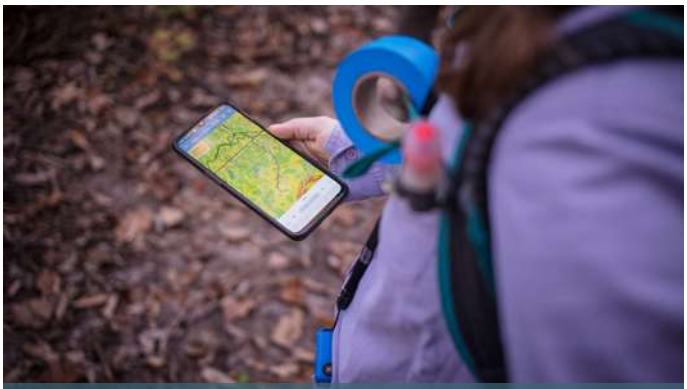
Below is an overview of the various computer hardware and software applications used during the trail development process to provide context and industry terminology useful for communicating with trail professionals.

SOFTWARE APPLICATIONS - There are many alternatives to the applications listed below, but these are the most common:

- **Google Maps –** 2D map viewer with no trail mapping functionality
- **Google Earth Pro** – 3D map viewer with trail mapping functions and very limited trail planning/design functionality
- **ESRI ArcGIS/QGIS** – topology-based 3D spatial and terrain analysis programs typically used by professional GIS consultants to create base maps, perform landscape-level analysis, develop trail plans, support required approvals, and output trail maps
- **ESRI Collector/Avenza Maps** – mobile applications used to collect field-based data points, existing/planned/designed trails, site conditions photos, and observational notes. Data that is collected is exported and imported into ArcGIS or AutoCAD.
- **AutoCAD 2D & 3D** – planning and design-focused software platform best used for trail planning/design and detailed design/layout (parking lots and support facilities). Typically used by landscape architects and engineers to create site plans, trail plans, and construction drawings.

GPS RECEIVER - GPS units designed to increase field-mapping accuracy. Devices include small handheld Bluetooth devices, GIS satellite base stations, and also GPS-enabled smartphones (currently the most commonly used for trail planning/design).

DRONES - Consumer- and commercial-grade unmanned aerial vehicles are seeing increased usage for trail scouting, planning, and mapping activities. The Federal Aviation Administration (FAA) requires licensing for commercial drone use.



Geo-referenced base maps are used throughout all development phases. Photo by Chrisman/IMBA

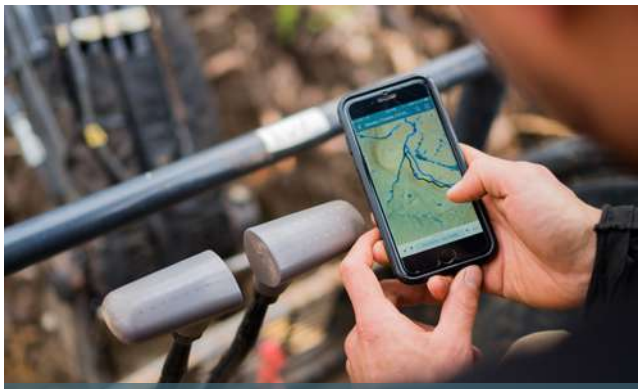


Photo by Eli Glesmann/Rock Solid

Landscape Integration

It is important to discuss the overall integration of a trail system within the given landscape. At its most simple, you can work with the terrain or against the terrain. Designing and developing trails that complement the naturally occurring terrain will be easier and more cost effective than fighting the terrain. While it definitely can be accomplished, attempting to develop a trail type that is not supported by the existing characteristics of the land can dramatically increase development costs.

For a real-world example, building a four-foot-wide, bike-optimized beginner trail on a side-slope with a 20% grade with minimal rock and stable soil characteristics is an optimal build situation. Building the same kind of beginner bike-optimized trail on a side-slope with a 20% grade with rugged, exposed bedrock and minimal compactible soil might cost you two to four times as much, or more, significantly increasing your development cost, not to mention additional maintenance cost to maintain a trail of that kind.

Here's why the cost difference is so extreme: A beginner-level rider experience requires a primarily smooth tread surface, and if the landscape does not have usable and compactable soil, it will be necessary to locate, purchase, and transport usable soil material to create an appropriate tread surface. This involves locating a good dirt source, calculating soil quantities needed, purchasing the material, and arranging delivery. Once the dump trucks have delivered the soil material to the job site, the trail builders will need to transport it from the drop point to wherever in the trail system it is needed. This is typically done with a tracked carrier vehicle, which is basically a large wheelbarrow with an engine and rubber tracks, and in much smaller quantities per load than a dump truck. Once the soil material arrives at its final location, it then must be dumped, worked, shaped, and compacted to its final state.

Rugged, rocky terrain poses a similar challenge as in the example above. Rocks may need to be removed, while exposed bedrock may need to be jackhammered and shaped to make it smooth enough for a beginner riding surface. Thus, the amount of time and expense to create a trail type that is not supported by the given landscape can drive up development costs significantly. Having a knowledgeable and experienced trail planner involved early in the process can help you minimize or avoid costly situations like this one, or at a minimum, help create awareness of the true development costs for your situation.

Environmental Review Process

Environmental sustainability and resource protection includes protection and stewardship of the land, its natural resources, and the stories it holds (cultural resources). Environmental sustainability in the context of trail development includes environmental review—the process of assessing the potential impacts to natural and cultural resources a proposed action may have prior to making decisions about the proposed action. "Action" is a broad term that includes proposed programs and projects such as trail system development, improvement, and maintenance projects.

The process and requirements of environmental review are driven by laws and regulations which define resource protection responsibilities and requirements that ask:

- **What is protected?**
- **How is it protected?**
- **What drives the applicability of the law and/or regulation?**
- **What is the applicable hierarchy of laws and coordination across agencies or parties?**
- **Who is responsible for ensuring compliance with the laws and regulations?**

The process for abiding by applicable resource protection laws and regulations goes by many names that vary by region, agency, and land manager. Examples include environmental review, environmental assessment, cultural resource review, historic preservation, NEPA review, NEPA, the compliance process or simply compliance.

The compliance process and resource protection rules and regulations can impact all phases of the trail development process, sometimes adding months or years to the project. Here are a few tips to minimize potential delays:

START EARLY: Conversations about the compliance process should start early— during the assess phase—to help identify any significant control points or issues to consider. Contact the resource specialist for that site (at the land manager-level or agency-level) to understand the local process and establish an environmental review process point of contact for the proposed project.

KNOW THAT DETAILS VARY: Because of the differences in how federal, state and local laws are carried out, and the varying availability of staff across government agencies, the compliance process is not one-size-fits-all. The process varies greatly depending on the agency, land manager, funding sources, location, nature of the project, and many other factors.

SEEK ADDITIONAL HELP: If it seems the local environmental review process does not provide enough support for the project,seek help from the local government's planning or environmental office. Programs to help guide the process may be available. Additionally, hired professionals who are familiar with the applicable laws and agencies are usually available to assist with the environmental review process. Utilizing this kind of help can save a considerable amount of time and money.

COMMON PITFALL:

Failure to comply with environmental resource protection requirements

Failure to comply with Federal, State, or local rules and regulations when constructing a trail system can lead to fines, project delays, budget increases, or even newly constructed trails being shut down.

Chapter 8: Trail Development Process - Assess

The goal of the assessment phase is to assess the property or properties (also referred to as, "Area of Interest," or, "AOI") and describe the feasibility to develop mountain bike trails in all, a portion, or none of the area of interest. This is accomplished by gathering key project and property data for remote planning, on-site scouting, remote analysis of data and findings, and development of a site assessment and feasibility report. The purpose of the report is to convey findings of the site conditions and identify which areas of the property are feasible or recommended for the intended uses.

The activities listed for each of the trail development phases are typically sequential (though not always), and can be iterative and concurrent depending on the situation. But for the most part, the activities listed in each of the phases generally tend to occur in the order presented.

The key activities of the assessment phase are:

- **Define project vision, goals, and objectives.**
- **Identify property for trail development.**
- **Obtain geospatial data** for the project's AOI, including trails, roads, buildings, boundaries, land ownership, infrastructure, existing trails, hydrology, vegetation, terrain, topography, and orthophotography.
- **Perform desktop analysis and planning,** which can be performed remotely on a computer with thorough GIS data.
- **Create an AOI base map,** which is a geo-referenced PDF map to aid with navigation during the site visit and for recording field data.
- **Investigate environmental review and permitting requirements,** including identifying relevant entities, initiate contact with a resource specialist to understand the necessary environmental review process, permits, and timelines.
- **Plan for initial site visit** to review/define logistics, data collection protocols, required data to collect, and prioritization of ground areas to cover.
- **Scout site and collect field notes and geospatial data** to identify places to build on or avoid (high-level positive and negative control points), project area access points, key connectivity corridors, trail development zones, adjacent property observations, and detailed field notes.
- **Process and analyze field data** including uploading field data, importing into preferred software platform, analyzing data, identifying use zones, identifying support facilities and amenities, and calculating potential trail mileages.
- **Create a feasibility map graphic.**
- **Provide cost considerations for future phases** including consulting services (planning and design phases), construction of trail amenities (build phase), and operations and maintenance (maintenance phase).
- **Create a site assessment and feasibility report.**

Defining Project Vision, Goals, and Objectives

To adequately assess a project site, we need to know how it is intended to be used. Simply having an intention for mountain bike trails is not sufficient.

Here are the key questions for the trail planner to ask at this step:

What are your vision, goals, and objectives for this project?

Open-ended questions such as this help gain insight into the big picture for what is intended. There can be a variety of goals that are quantitative and/or qualitative. A quantitative goal, for example, could be to create 25 miles of bike-optimized trail. A qualitative goal, for example, could be to provide a nature-based experience that provides users an escape from their everyday lives. A great way to start developing vision, goals, and objectives that reflect community desires are to hold community/stakeholder input sessions to find out directly from local mountain bike riders exactly what they want.

Who and what is driving this project?

Knowing what persons, groups, or entities are influencing the motivation for this project, and why, will be helpful throughout the life of the project.

Do you have a budget amount identified?

If there is a fixed budget amount, this is a good time to start discussing project expectations and whether those are realistic within the budgeted amount. If a budget is not defined, the trail planner will help identify expectations during this phase of the process.

Is your budget already funded? If not, how, and when do you intend to have it funded?

These are important questions to help gauge the feasibility of the project as a whole, as well as the potential timeline. Identifying and securing funding for each phase of the project can take months or years, and there is always the chance funding will not be secured.

What types of mountain bike trails already exist in your community/region?

Understanding the types and quantities of existing mountain bike trails can help identify opportunities for trail types that may be missing or underrepresented.

How many miles of trail do you want?

This may not be known, and that is okay. Identifying trail capacity is part of the assessment phase. Or maybe, during the project initiation, the project is not about miles. It is possible that the goal of providing a high-quality trail experience for beginner to advanced riders sets the stage and the total mileage is a result.

What types of trails do you want?

This opens up discussion about trail types (page 49), trail difficulty levels (page 55), and trail user objectives (page 35).

What other mountain bike amenities do you want?

Non-trail amenities such as pump tracks, jump lines, and skills practice areas are popular.

What other types of amenities do you want?

Now is the time to start thinking about things like restrooms, parking lots, and other non-trail-related amenities that might be needed.

What other user types will be sharing some or all of these trails with mountain bikers?

Early in the process, identify what types of users—such as hikers, trail runners, or equestrians—will be sharing the trails with mountain bikers.

Example of Vision, Goals, and Objectives

VISION

Create a city-wide natural surface trail infrastructure that creates opportunities for residents to recreate and connect with nature through walking, running, and mountain biking.

GOALS

- Have at least 25 miles of mountain bike trails
- Have a broad mix of trail types (traditional, flowy, technical, gravity, jump) and difficulty levels (beginner, intermediate, advanced, expert)
- Have practice areas that allow riders to learn and progress in a controlled environment

OBJECTIVES

- Increase overall physical and mental health of residents
- Reduce city-wide obesity levels by 10% within five years
- Improve recruitment results when attracting companies to relocate to our town

Identifying Property for Trail Development

A project site predetermined for mountain bike trail development may not be the best option. It is recommended to take an inventory of all the properties that might be available for use so that each one can be individually assessed and then ranked against the other properties to help prioritize development potential. One way to start this activity is to simply use Google Earth or ArcGIS to remotely scan the area of interest for land that has elevation changes, interesting topography, or unique characteristics, regardless of ownership. Even though an agency might not own a prime parcel or parcels that are ideal for development, it could be worth pursuing to determine if it is possible to acquire the land or gain access via partnerships utilizing land use agreements, easements, or leases.

One of the many reasons the Walton Family Foundation has been so successful at developing a thriving mountain bike scene in Bentonville, Arkansas, is through dogged determination scouting terrain-rich properties and making strategic acquisitions to weave together some of the best terrain in the area, while at the same time preserving and protecting these areas as recreational green space.

Photo by Wazee Motion Pictures courtesy of OZ Trails

COMMON PITFALL:

Poor Land Choice

Developing a property that is not suited for mountain bike trails can lead to overly expensive development costs, poor user experiences, or burdensome and unnecessary maintenance requirements.

Obtaining Geospatial Data for the Project's Area of Interest (AOI)

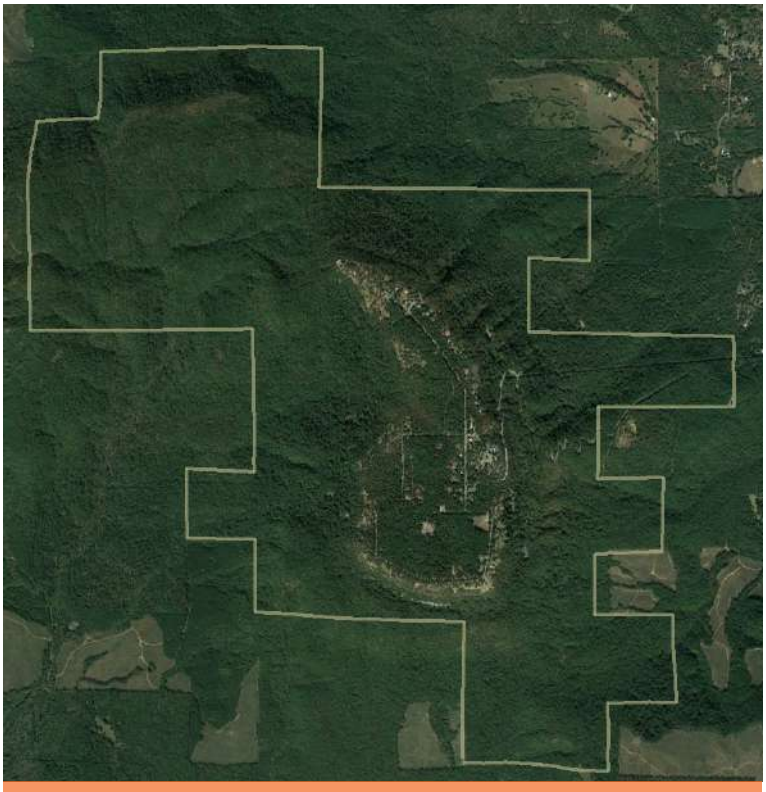
Complete and accurate site data is critical to understanding the scale and scope, as well as the opportunities and constraints, of a specific property or series of parcels. Trail planners utilize publicly available GIS data layers to inventory and analyze the landscape using software applications such as Google Earth, ESRI ArcGIS, or AutoCAD. At a minimum, trail planners will want to obtain maps that help them understand the existing conditions, onsite infrastructure or level of development, and current uses of the property.

Whatever information can not be obtained electronically will need to be verified in the field or acquired by a surveyor, which is time-consuming and expensive. Field verification still needs to happen, but with good data more analysis can be done remotely, saving time and money.

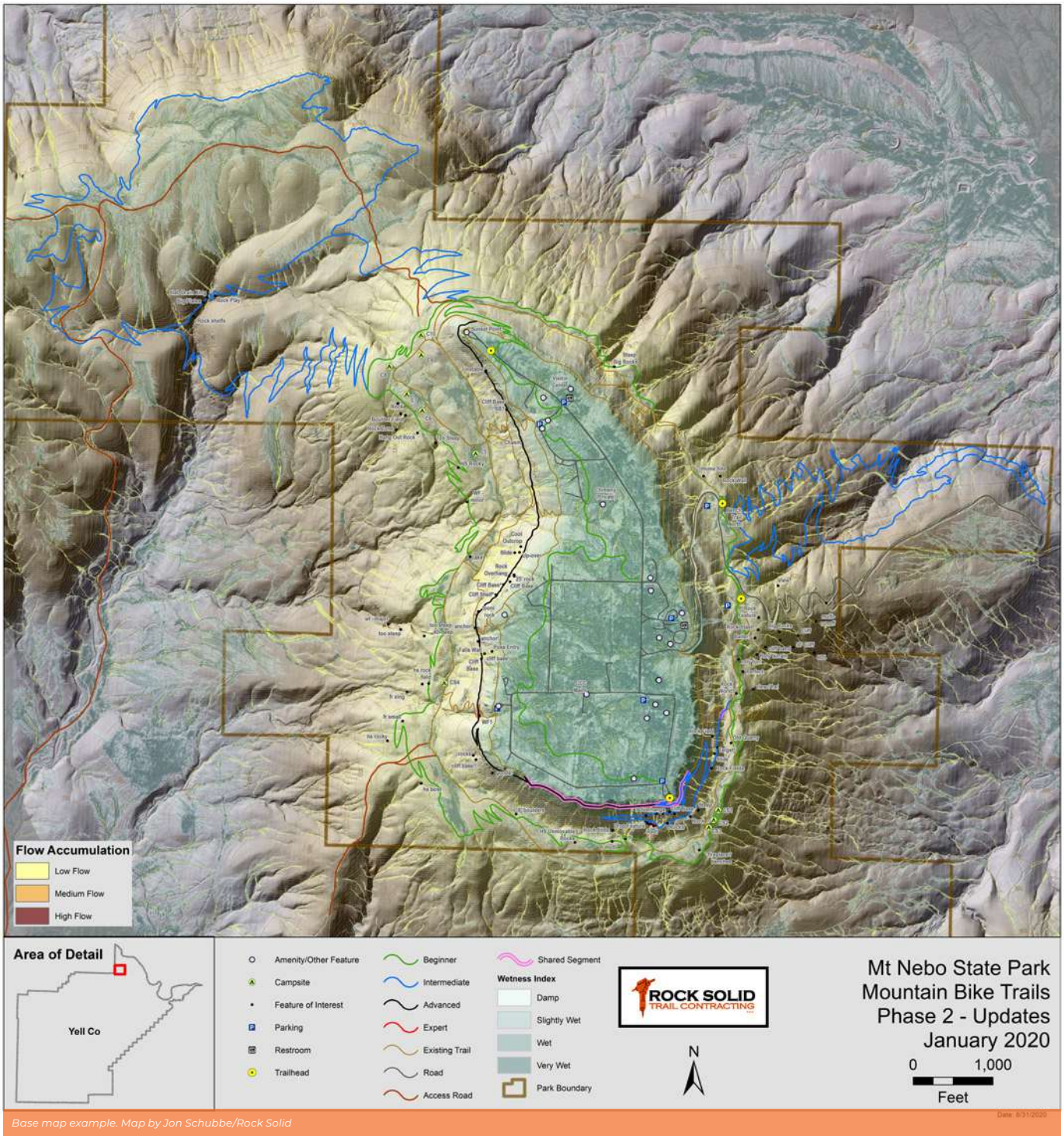
Key geospatial data to obtain include:

MAPS - Digital and hardcopy maps are vital for navigating and getting to know the project site. Although printed maps are becoming far less common in consulting situations, large printed maps are very helpful during team meetings. They allow everyone to gather around the map and collaborate more effectively than squeezing in to view map data on a tablet or cell phone screen, for example.

SITE BOUNDARIES (PARCELS) - Project site boundaries (parcel information) are critical to understanding the project AOI, property ownership, and adjacent property ownership. Staying off of private property during the trail building process is imperative.

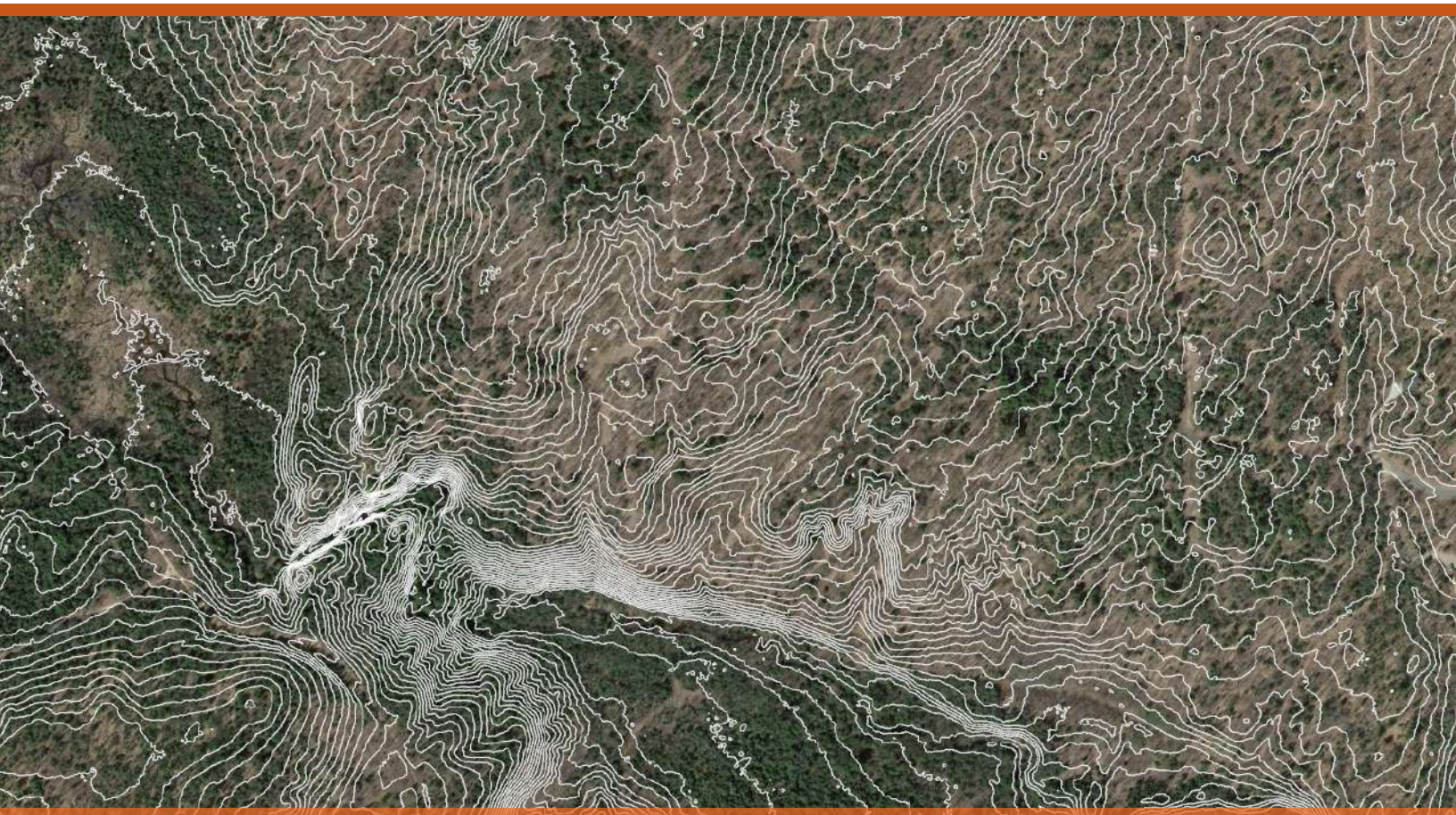


Project site boundaries. Image courtesy of Rock Solid



Base map example. Map by Jon Schubbe/Rock Solid

TOPOGRAPHICAL CONTOURS (TOPO) - Topographic contour lines form the single most important data layer critical to understanding the terrain and are one of the most heavily utilized data sets during all phases of trail development. “Topo” lines allow you to see the overall lay of the land, identify high points and low lands, locate drainages and potential crossings, and quickly see connectivity throughout the property. Using terrain data that can create contour intervals, which allow you to see an appropriate level of detail, is also important. You need enough detail to be able to interpret the terrain, but not so much detail that the data is unusable. Contour intervals between 5 feet and 20 feet tend to be effective for most situations. Forty foot contours from USGS Quad Sheets do not provide enough detail and 1-foot intervals provide way too much detail for a large site.



GIS topographical contour lines. Image courtesy of Rock Solid

EXISTING TRAILS (PAVED) - Knowing where the existing paved trails are helps in planning trail connectivity and minimizing intersection crossings.

EXISTING TRAILS (NATURAL SURFACE) - Being aware of existing natural surface trails such as hiking and mountain bike trails informs current uses and aids planning for additional uses and trail connectivity, and in minimizing intersection crossings.

EXISTING ROADS (PAVED, DIRT) - Paved roads and dirt roads come into play for planning trailheads, parking lots, trail connectivity, and minimizing intersection crossings.

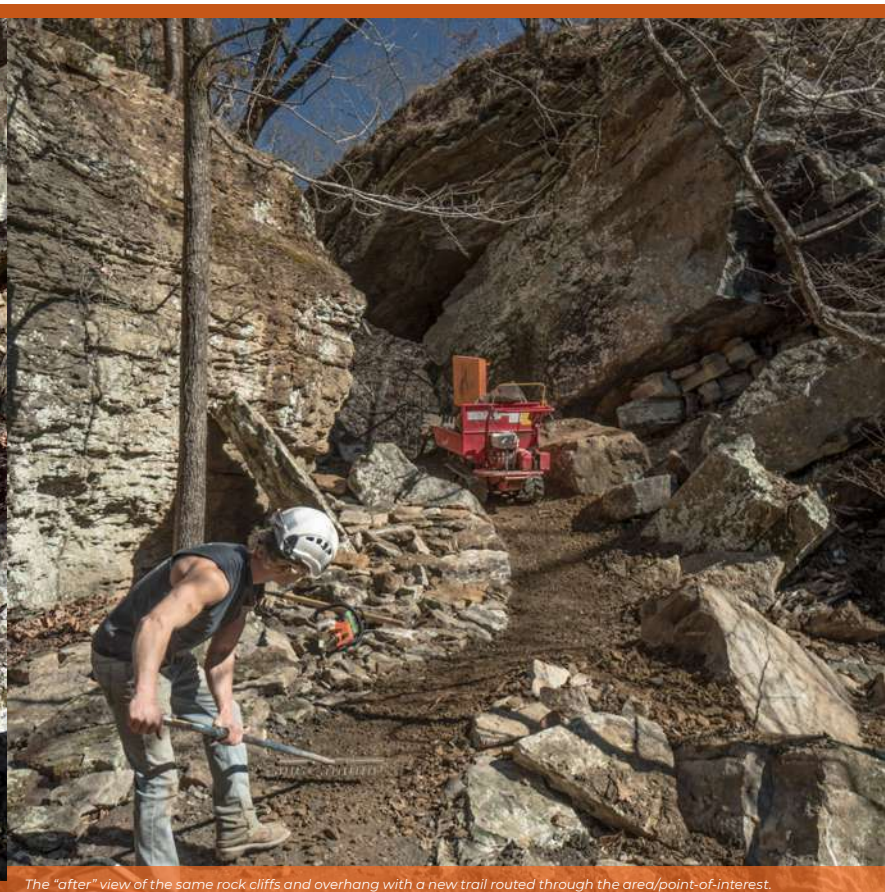
EXISTING ACCESS TRAILS - Access trails such as ATV trails, whether formal or informal, are useful in navigating around the property when scouting, for construction mobilization, and for emergency response access when the trail network is open.

SOILS - Soil information is helpful for understanding what types of trails can be created, the construction approach needed, and what conditions might be encountered during construction. Soil databases can be used as a starting point, but accuracy can vary widely, especially in mountainous terrain. Site visits are still required and test digs may also be necessary. One source for high-level soil data is the Web Soil Survey (WSS), produced by the National Cooperative Soil Survey, which is operated by the USDA Natural Resources Conservation Service (NRCS).

SENSITIVE AREAS - Sensitive areas related to plant biology, wildlife habitat, archeological sites, or cultural concerns identified by resource specialists and land managers often need to be avoided during trail development. Knowing about the resources and where they are located is essential for trail planning. Understandably, this information is not always readily available, or is even secretly guarded, to keep the public out of areas that may be sensitive to human interaction. Not all sensitive areas need to be avoided, and in some cases, land managers may want users to be able to experience these sensitive areas, as long as access is managed in a way that will not damage the habitat.

POINTS OF INTEREST - There is a good chance the land manager already knows what places on the property are special, so it is always good to ask for this up front. However, it is still up to the trail planner to scout and identify places that will be special from a riding perspective but may not be readily apparent to a land manager that does not have a trail riding or building background.

The "before" view of a point-of-interest rock band. Photo by Eli Glesmann/Rock Solid



The "after" view of the same rock cliffs and overhang with a new trail routed through the area/point-of-interest. Photo by Eli Glesmann/Rock Solid

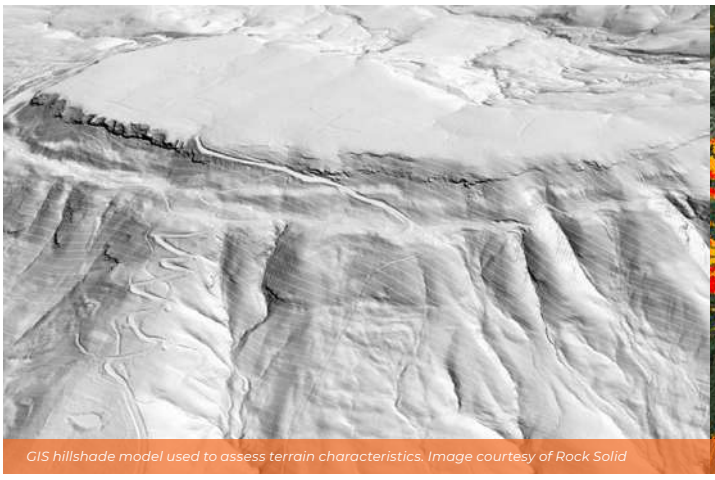
HYDROLOGY

- **Drainages -** Knowing where drainages and waterways are located, and whether they are ephemeral (seasonal or only flowing after rainfall), intermittent (no continuous flow), or perennial (continuously flowing) helps to determine crossing locations and construction methods. Crossing drainages typically involves either rock armoring or bridges, so understanding land manager guidance and federal direction related to this will help with planning, design, permitting, and cost-planning.
- **Wetlands -** Wetlands are low-lying areas that have three components present: water, specific soils, and wetland vegetation. Not only are wetlands not ideal for building trail, but there is federal guidance on what can and cannot be placed in a wetland. Crossings are possible in a variety of ways, all of which will require Army Corp of Engineers (ACOE) permitting.

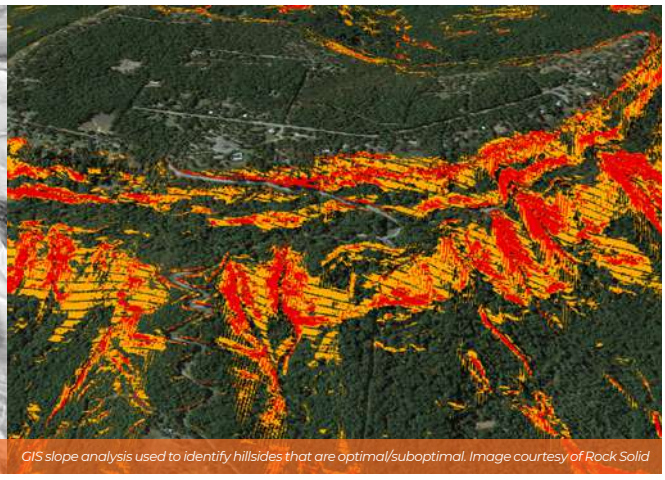
EXISTING INFRASTRUCTURE - Knowing what above-ground and below-ground infrastructure exists, and where it is located, is important for trail planning.

PLANNED DEVELOPMENT - What future developments—for buildings, roads, or trails—are planned for the property? This data overlay may not be publically available, but typically can be provided by the land owner. There may be entire swaths of the project site that are slated for development. Knowing future development plans before you start your trail project will help avoid having to completely rework a plan.

TERRAIN ANALYSIS - If Light Detection and Ranging (LiDAR) data or digital elevation models (DEM) are available, GIS consultants can create 3D models and data sets to show slope analysis and wetness studies. Being able to remotely rule out sections of property that are too steep, too flat, or too wet for optimal development can save valuable field time.



GIS hillshade model used to assess terrain characteristics. Image courtesy of Rock Solid

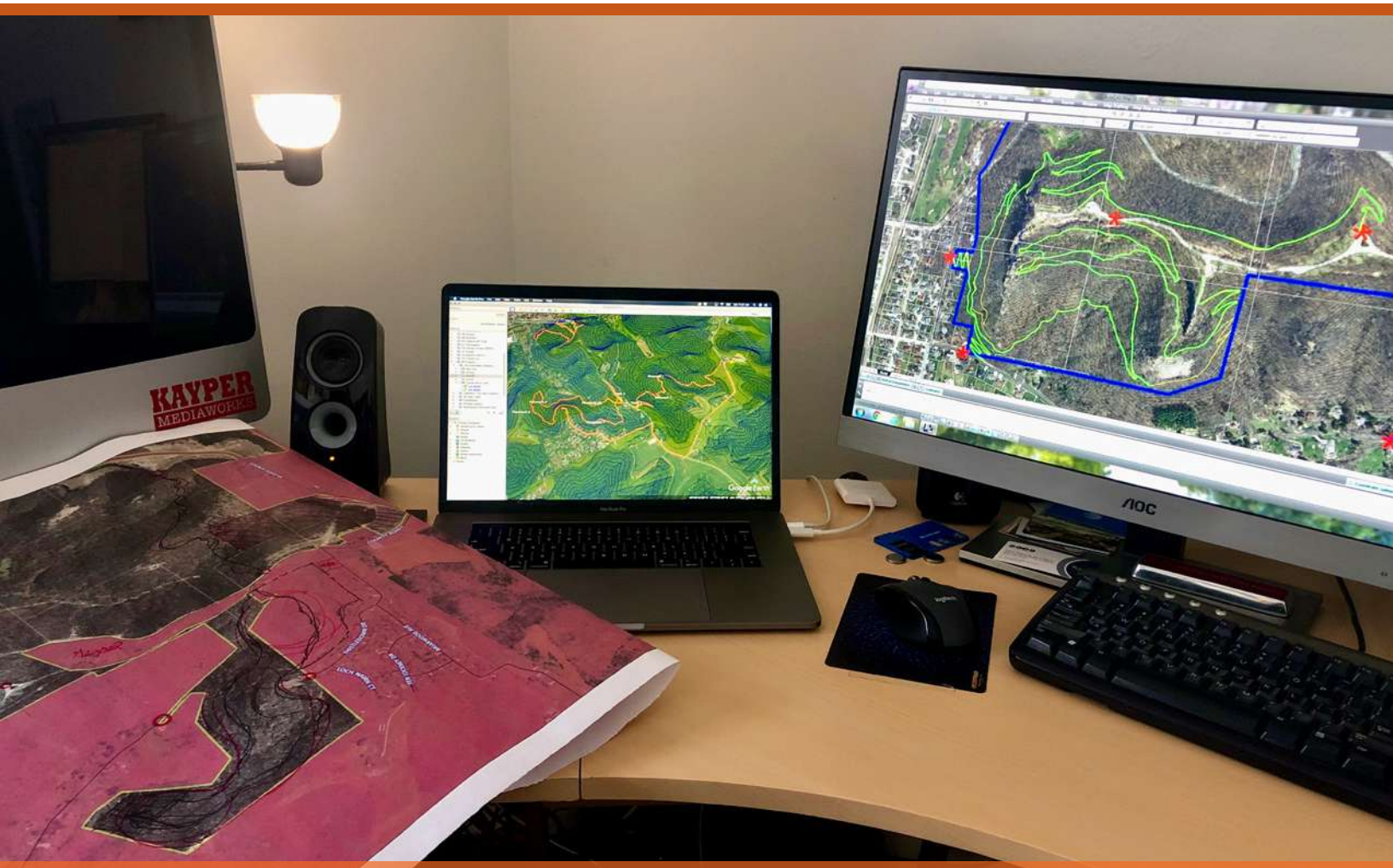


GIS slope analysis used to identify hillsides that are optimal/suboptimal. Image courtesy of Rock Solid

Once all site information has been obtained, the data can be viewed on a computer and manipulated to study the property. Individual data layers can be turned on and off to view and analyze the property and data from a myriad of perspectives.

Performing Desktop Analysis and Planning

Desktop analysis and planning consists of importing, viewing, and studying all the geospatial data gathered for the AOI. The primary goals of this activity are to become familiar with the characteristics of the property/AOI and identify which geospatial data to include on the base map that will be used during the site visit. This is also a good time for the trail planner to hold a virtual meeting with land manager personnel familiar with the property to identify and discuss known opportunities and constraints about the property.

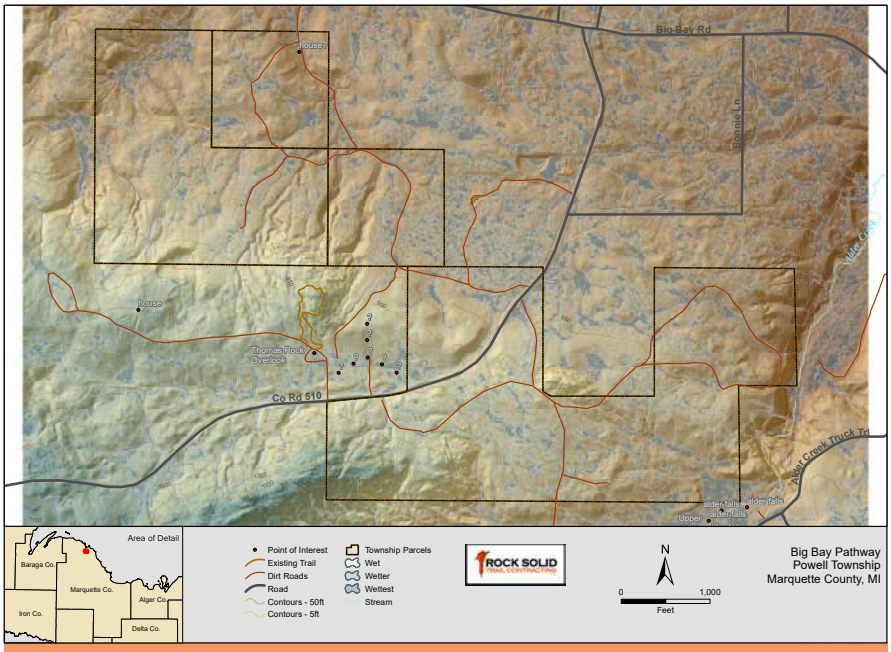


Desktop analysis and planning with GIS and AutoCAD. Photo by Repyak/IMBA

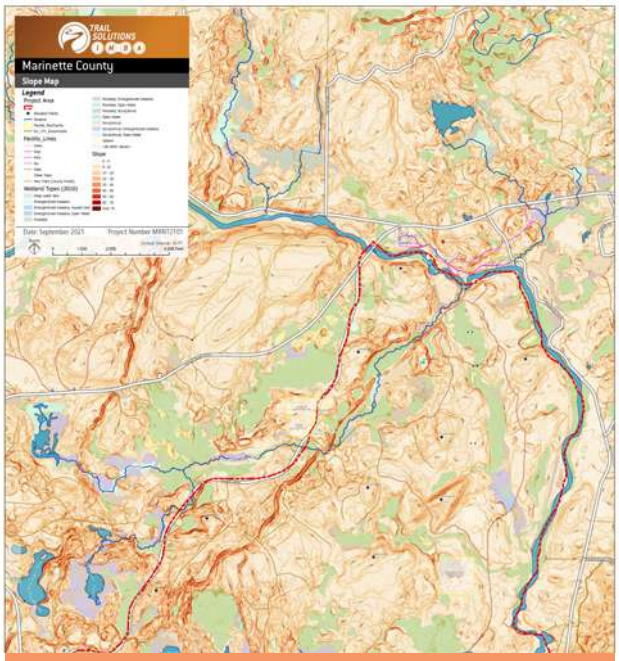
Creating an AOI Base Map

A base map typically includes an image of the project site along with key information to aid field navigation and planning, such as project boundaries, topographical contours, and existing infrastructure including roads and trails. Base maps are so critical and time-saving for initial site scouting that most professional trail planners require base maps prior to an initial site visit, especially for large sites. Multiple base maps can be created when different images or perspectives, such as aerial photos (also known as a satellite images), hillshade perspectives, or slope analysis perspectives are important. Having this kind of information available in the field as a geo-referenced PDF is invaluable.

Base maps are used throughout the entire trail development process and are beneficial to land managers, project stakeholders, professional clients' representatives, project managers, trail planners and trail building crews, and can be used as background data during public outreach efforts. An initial base map evolves from one phase to the next. For example, once a trails concept plan has been developed during the planning phase, the conceptual trail corridors can be added to the base map for use in the field during the design phase. When corridors have been flagged during the design phase, the base map is updated with field-designed trail corridors for use by construction crews during the build phase. Site observations and construction notes can also be added to the base map so that the build crews have instant access to the final trail design locations and relevant construction notes, all in one place.



AOI base map prepared for initial site visit. Map by Jon Schubbe/Rock Solid



Base map example. Image courtesy of IMBA Trail Solutions

Investigating Environmental Review and Permitting Requirements

During the assessment phase, the primary goal is to understand what the environmental review and permitting needs might be for the project, as well as the corresponding timelines that might influence the overall project timeline. It is at this point when you should determine who the appropriate point of contact will be; it is often a resource specialist on staff. This person will need the AOI base map to understand the location and boundaries of the project site.

During this phase, discuss the big picture process requirements with the environmental review process point of contact to understand what level of review might be necessary for the proposed project. It usually takes a certain amount of information about the proposed trail project such as location of the property, whether the trail will be multi-use or not, proposed construction techniques (machine-built, hand-built, or a hybrid), and potential width and mileage, in order to have a meaningful discussion. The goal is to have a high-level cursory discussion to understand the compliance process for that site, the project feasibility, what agencies might be involved, the timelines, potential permits, and what might be needed if the project is to move forward. Since planned trail corridors are not known yet, resource reviews at this phase are typically limited to general feedback about possible resource impacts within the boundaries of the AOI.

Generally, the applicable environmental and conservation laws and regulations define the environmental review process and who is responsible for ensuring compliance with those laws and regulations. Some land managers will lead the process entirely, handling resource reviews and obtaining any applicable permits. This is especially true on federal lands. However, at the state and local levels, it is common for trail professionals to procure permits and comply with environmental processes and best-management practices (BMPs). Regardless of the approach, land management agencies should maintain strict oversight of all compliance activities.

Planning for Initial Site Visit

Having a game plan is imperative, especially with larger properties that can take multiple days or weeks to scout. Depending on the size and accessibility of a site, the trail planner or planning team may have to scout by foot, bike, drone, motorcycle, all-terrain vehicle, 4-wheel drive truck, helicopter, or some combination thereof.

ATVs can be an effective scouting tool. Photo by Eli Glesmann/Rock Solid

Photo by Repyak/IMBA

While still in the office and before heading into the field, time can be invested in reviewing maps and site data, identifying access points and any existing roads and trails, areas of concern, and potential points of interest. Areas of concern could be, for example, steep ravines or cliff areas that might be problematic to cross, thus creating what are referred to as “pinch points” or “terrain traps” that can restrict trail corridor options.

Scouting Site and Collecting Field Notes and Geospatial Data

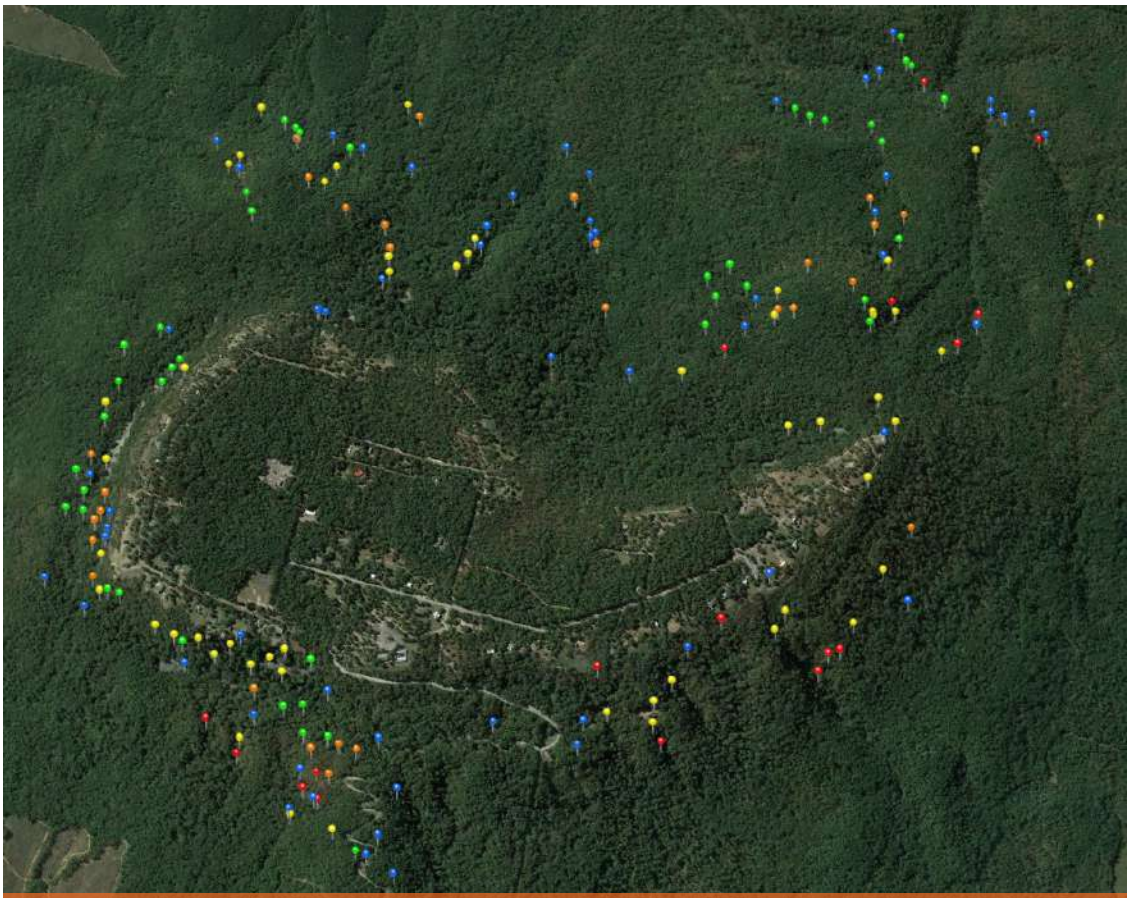
Having a visual of the positive and negative control points helps to rule out portions of a property and narrow down options. Due to the sheer volume of data points that can be captured, it is also helpful to have a color-coding scheme to make it easier to analyze the data.

Site scouting in the Wisconsin Northwoods, Marinette County. Photo courtesy of IMBA

- **SOILS -** Assess soil types (sand, silt, clay, rock) and if necessary, dig test pits to understand build opportunities and constraints.
- **SLOPES -** Assess hillside slopes to identify opportunities and constraints that influence trail planning or construction conditions.
- **ELEVATION -** Measure the amount of elevation and how usable it is to support the trail experience objectives.

- **SOLAR ASPECT (SHADE) -** Analyze the amount of sun versus shade and how desirable it is for soil conditions and user experience.
- **HYDROLOGY (WATER BODIES AND DRAINAGES) -** Identify water sources and drainages, as people like to recreate near bodies of water. Water sources and drainages can also constrain development due to the need to minimize crossings or how protected (riparian) areas may be off-limits for trail development.
- **ACCESS -** Locate opportunities for transporting crew, equipment, and materials into the property. This is important for understanding how long it may take crew members to arrive at their job sites each day, as well as how difficult or time-consuming it may be to transport job materials to work sites. It is also important to start identifying existing and potential access points for getting trail users into and out of the property.
- **PARKING -** Identify existing or nearby parking lots and their capacities, then identify additional areas for future parking lot development, if needed.
- **EXISTING TRAILS -** Assess existing trails to determine which trails are appropriate to retain and which should be shut down or improved. This will be important when planning the new trail corridors and determining if or how existing trails fit into the newly planned system.

An overarching goal when assessing a property is to identify sections that support trail types that will complement the natural terrain rather than work against it. Gathering data points for the items listed above is a critical step in working towards this goal.



Color-coded positive and negative control points captured in the field. Image courtesy of Rock Solid

Processing and Analyzing Field Data

Processing field data involves loading all field data gathered into mapping software and organizing by data layers and attributes. Having data points organized into logical groups makes it easier to apply the data in a variety of ways. Common groupings can include trail development zones, no-go zones, vistas and viewpoints, drainages, waterfalls, potential drainage crossings with bridges or armoring, and rock materials.

Analyzing field data helps to inform decisions about what sections of the property have conditions supporting different types of trail uses and what sections should not be used.

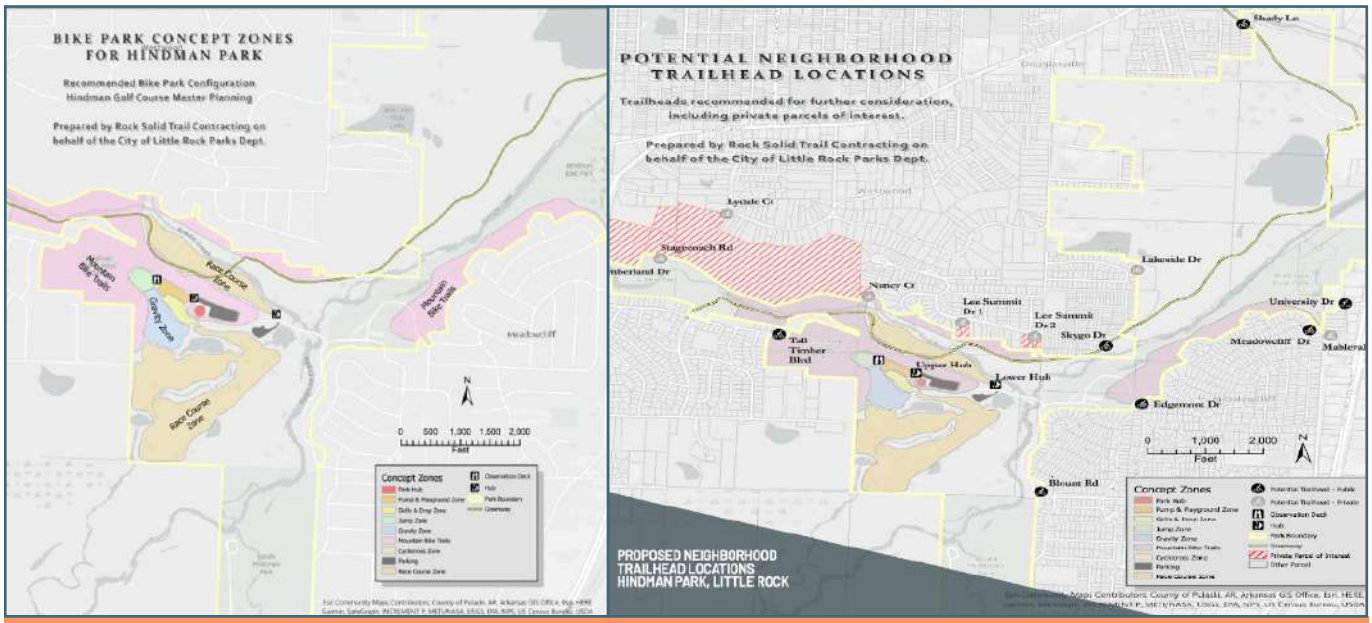
Some examples of typical property characteristics that may influence use zone selections include:

- **Rocky terrain -** ideal for technical trail ranging from intermediate to advanced difficulty levels
- **Steep, rocky terrain -** ideal for technical trail ranging from advanced to expert difficulty levels
- **Mellow hillsides with stable soils -** ideal for traditional or flowy singletrack ranging from beginner to intermediate difficulty levels. Stable soil compacts well, holds shape well, and resists erosive forces.
- **Moderate hillsides with stable soils -** ideal for wide, flowy gravity trail with large sculpted features such as berms, rollers, and jumps
- **Steep hillsides with stable soils -** ideal for traditional or flowy singletrack ranging from advanced to expert difficulty levels
- **Flat, low-lying or gentle sloped areas -** ideal for trailhead development accompanied by bike park amenities such as pump tracks, skills loops, drop zones, or jump lines
- **Wetlands -** not ideal for trail development; if a low-lying or wetland area must be used, raised tread construction solutions such as boardwalks or causeways must be considered

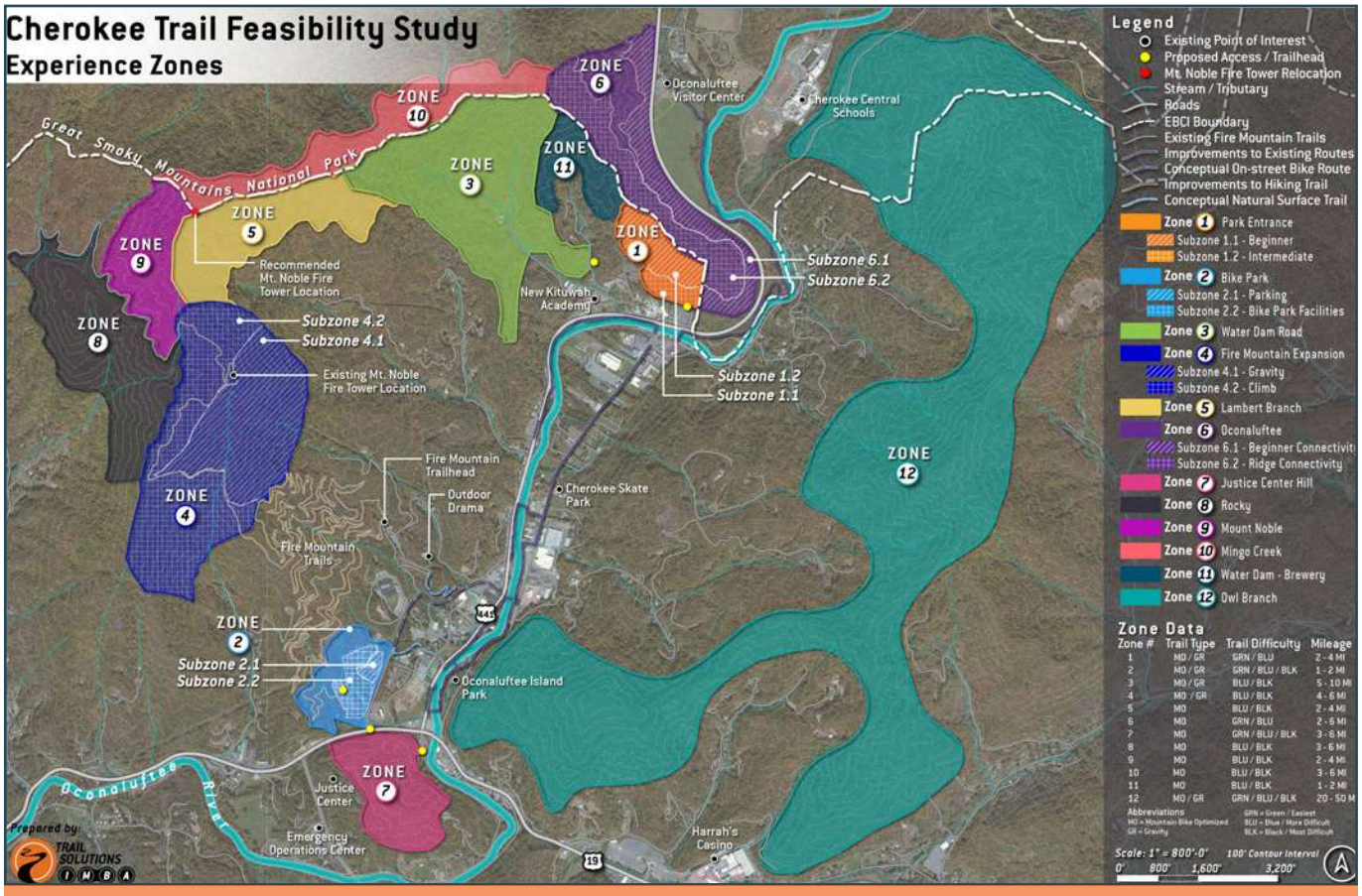
Findings are typically organized on a map using bubble diagrams and referred to as a "feasibility" or "suitability" map.

Creating a Feasibility Map Graphic

A feasibility map graphic combines the key site assessment and feasibility recommendations into an easy-to-read graphic that displays the various use/experience areas and key characteristics of each. Key characteristics may vary from project to project, but in general are usually grouped based on trail types and trail difficulty levels.



Site feasibility maps showing use/experience zones and potential trailhead locations. Maps by Jon Schubbe/Rock Solid



Potential trail development zones by experience types created for a large landscape trails concept plan in Cherokee, North Carolina. Map courtesy of IMBA Trail Solutions

Providing Cost Considerations for Future Phases

Since it is too early in the trail development process to provide cost opinions or cost estimates, industry averages (cost considerations) for trail consulting and trail construction services are provided so that agencies can begin to get an idea of approximate cost ranges for the various trail-related services. Cost considerations get more precise with each phase of the trail development process. They start with the assessment phase and move to cost opinions in the planning phase, then cost estimates in the design phase, and finally, actual pricing (either fixed or estimated)during the contracting phase when trail builders respond to proposal requests.

Budget Forecasting

Budget forecasting gets more precise moving through each phase of the trail development process.

- **Cost considerations (Assess) -** Trail planner provides general industry price ranges for the planning, design, and trail construction phases
- **Cost opinion (Plan) -** Trail planner provides a rough cost range for design services and trail construction based on the planning documents
- **Cost estimate (Design) -** Trail planner provides a refined cost estimate with contingency percentage for trail construction based on the design documents
- **Contract price (Build) -** Trail builder provides a fixed or estimated price for trail construction based on the design documents in the bid/proposal package

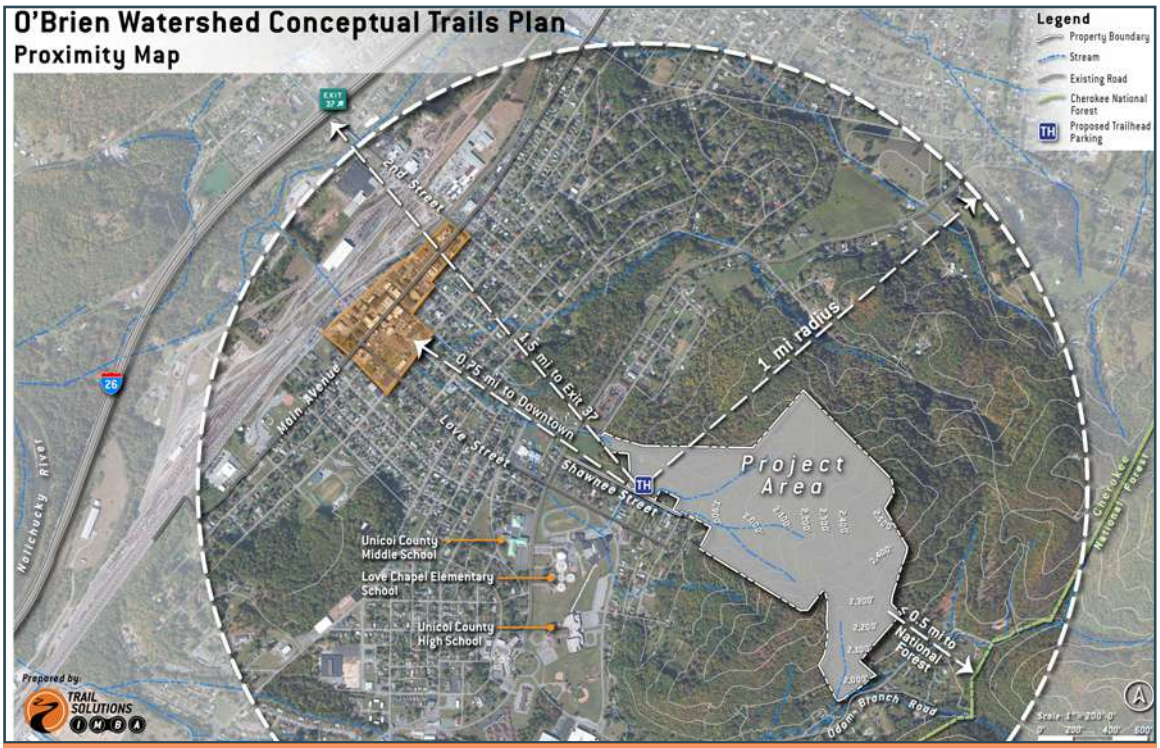
Creating a Site Assessment and Feasibility Report

The site assessment and feasibility report is a deliverable that contains property observations, project area analysis, relevant findings, trail development recommendations and suggested next steps.

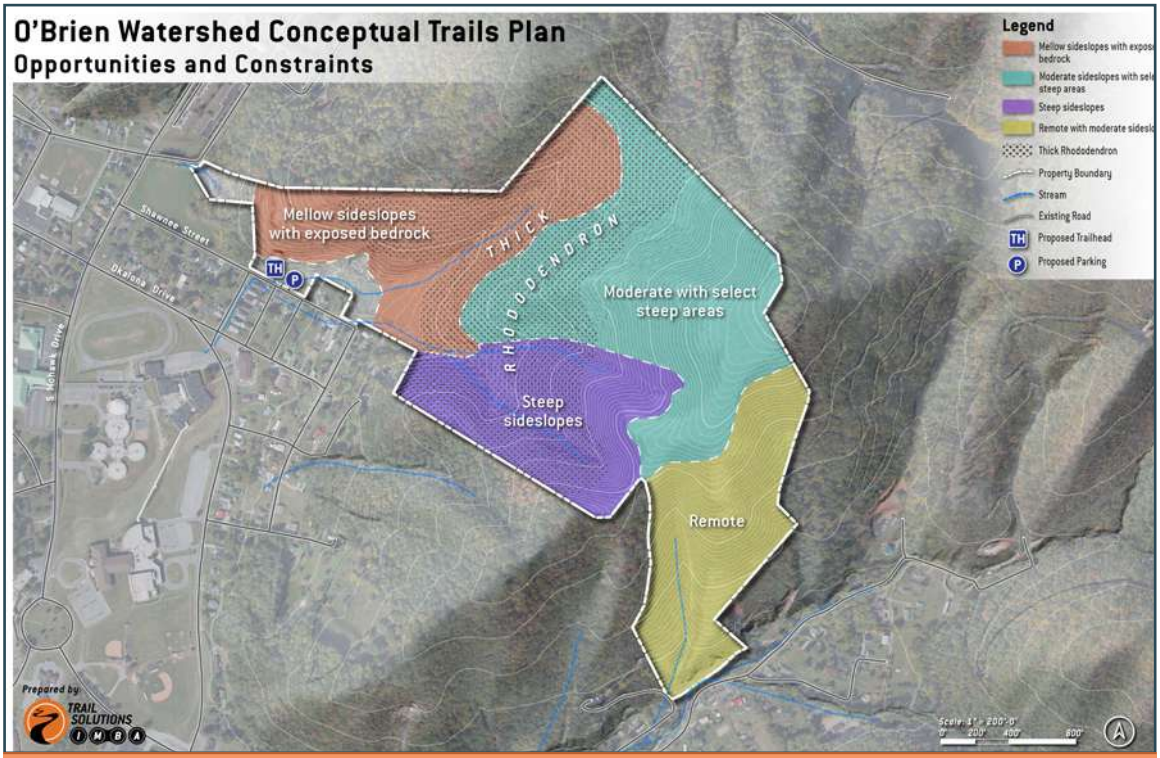
A typical report includes some or all of the following types of information:

- **Project overview**
- **Project location**
- **Project vision, goals, and objectives**
- **Environmental review and permitting outlook**
- **Existing conditions**
- **Findings and recommendations**
- **Feasibility map graphic**
- **Cost considerations**
- **Next steps**

Not all projects go through separate assessment and planning phases, producing a separate report for each phase. Unless a project site is extremely large (thousands of acres) or there are multiple sites to assess to narrow down site selection, most mountain bike trail projects typically combine the assessment and planning phases into one phase and produce a combined report that includes both assessment and planning activities.



Assessment of project proximity to the community of Erwin, Tennessee. Map courtesy of IMBA Trail Solutions



Assessment of opportunities and constraints on the Erwin, Tennessee project site. Map courtesy of IMBA Trail Solutions

Chapter 9: Trail Development Process - Plan

The trail planning phase revolves around defining the conceptual trail corridors for the new, expanded, or improved trail system. The goal of this phase is to create an agreed upon concept plan. Since the concept plan is literally lines on a map, this is the time to perform multiple reviews amongst stakeholders to ensure all parties agree that the concept meets the project's vision and goals. Making changes to those lines on a map during the planning phase is far less costly and time consuming than re-flagging trail corridors out in the woods during the design phase.

The key activities of the planning phase are:

- **Review and refine project vision, goals, and objectives** defined during the assessment phase.
- **Continue engaging with the resource specialist** to understand natural and cultural resource concerns, discuss alternatives, and problem-solve issues as they arise.
- **Perform desktop-based analysis and planning** for the site visit.
- **Scout site and collect field notes and geospatial data** for planning the trail corridors.
- **Plan the conceptual trail corridors.**
- **Create an index of planned trails** (trail index).
- **Create a trails concept plan map graphic.**
- **Initiate environmental reviews and permitting process** (if needed).
- **Create cost opinions for design and construction.**
- **Create a trails concept plan report.**

Reviewing and Refining Project Vision, Goals, and Objectives

Even if the project vision, goals, and objectives were already defined during the assessment phase, it is important for the trail planner and land manager to review them to confirm if there have been any changes. Depending how much time has passed since the assessment phase, it could be valuable to hold another community/stakeholder input session to revalidate previous public input, get new input, and update the community on the status of the project.

Questions to review to determine if anything has changed since the assessment phase:

Have your vision, goals, and objectives for this project changed since the assessment phase?

Who and what are driving this project? Has this changed and do those changes impact the project?

Has your budget changed? Is the funding in place? Is there enough funding to construct the project all at once, or must the project be spread over phases?

Have new mountain bike trails been built in your community since the assessment phase?

> Maybe new trails were constructed nearby that duplicate some of your intended trail types; if so, now would be a good time to consider different trail types to avoid duplication with a competing trail system.

Has the desired mix of trail types, difficulty levels, and mileages changed?

Performing Desktop-Based Analysis and Planning for the Site Visit

The primary goals of this activity are to review the data and findings from the assessment and feasibility study, start considering possible corridor locations and connectivity, and identify additional geospatial data and notes to add to the base map to help direct ground scouting activities. Prior to site arrival it is wise for the trail planner to review the data and field approach with the land manager to identify and make any last-minute changes to the base map and planned field activities.

Scouting Site and Collecting Field Notes and Geospatial Data for Planning the Trail Corridors

For a concept plan to be a solid reflection of what the future trail layout could be, with realistic cost opinions and every potential gem on the property uncovered, you will want the trail planner to spend a sufficient amount of time on the ground getting to know the property. This is a key difference from the assessment phase. In the assessment phase (see page 99) the goal was to identify areas of the property that are suitable for different use types, whereas in the planning phase the goal is to create a conceptual plan of trail corridors. To do that, all key points of interest need to be identified to serve as decision criteria for planning the trail corridors. Here we are identifying what dots to connect when mapping out the trail corridors back at the office.

A property that is homogenous with long sightlines and minimal variation in terrain, elevation, and foliage, for example, will be easier to scout and typically require less exploration. A property that is non-homogenous with restricted sightlines and extensive variation will require a lot more ground scouting to identify routing constraints and uncover opportunities that can be pieced together to create a unique and diverse experience that explores the entirety of what the property has to offer.

The more diverse a property the more opportunity there is to create a truly unique and diverse trail experience. Some of the opportunities (control points) to look for on a property include:

- **Unique or majestic trees**
- **Visually appealing foliage**
- **Unique or beautiful plant life**
- **Interesting rock outcroppings or cliff walls**
- **Scenic overlook areas**
- **Dramatic terrain or landscapes**
- **Unique or interesting landforms**
- **Water elements such as creeks, rivers, or ponds**
- **Natural supplies of trail building materials, especially large rocks**
- **Elevation changes for climbing and descending opportunities**
- **Historical or archeological elements**

Control Points are locations or features that influence where a trail goes

Positive control points are locations we want users to go, such as scenic overlooks, waterfalls, bodies of water (lakes, rivers, ponds, creeks), unique terrain such as rock outcroppings or large boulders, historical sites, or majestic trees, to name a few. Positive control points can also be something as simple as a hillside with slopes and soils that are ideal build conditions, or items like parking lots, trailheads, or trail start and end points.

Negative control points are locations we do not want a trail to go, such as flat land, low-lying wet areas, wetlands, unbuildable slopes or terrain, sensitive habitats, sensitive archeological sites, and safety hazards.

A trail system is like a book, with each trail a chapter of the overall story. Like any good story, there are a variety of elements that come together to create a memorable experience. The qualities of a good book are not that different from the qualities of a good trail system.

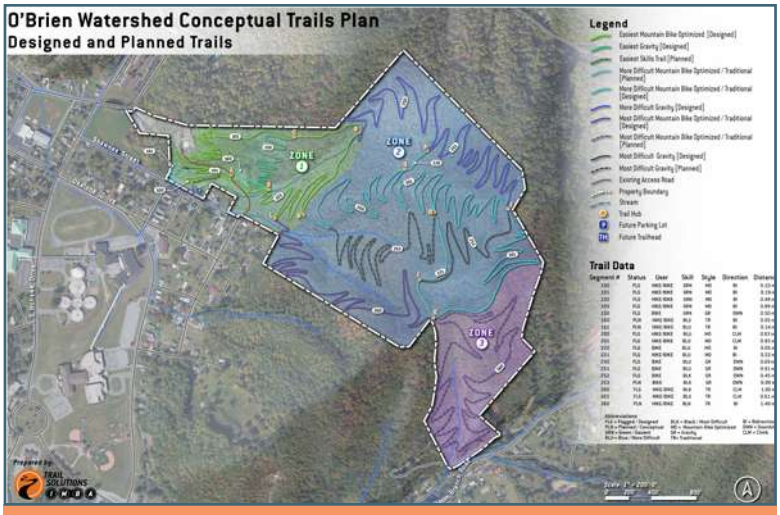
Goals for creating a good trail system include aiming for the following:

- **Strong dramatic content**
- **Variety in the rhythm and structure, as an array of trails that are homogenous become repetitive and lack character**
- **Creating believable, memorable characters by identify one or two spots in the trail system that will be iconic and imprinted in the minds of everyone who visits**
- **Making every line of "dialogue" count: every foot of trail should fit with the overall character of the system and not feel disjointed or out of place**
- **Creating conflict and tension: emotions such as anticipation, fear, excitement, and relief play a large role in creating memorable mountain biking experiences**

The more diverse a property, the more opportunity there is to create an experience that intertwines more of these principles together to create a unique and fulfilling experience. That is why, for a diverse property, it is important to identify and inventory the wide variety of characteristics that can be woven together to create an experience that goes beyond just the wheels on the ground. The better a trail planner knows a property, the better able they are to identify and highlight key areas or features of the property to include in the planned trail routes, getting the most out of the terrain and maximizing the eventual user experience.

Planning the Conceptual Trail Corridors

Now that all the site scouting data has been collected, it is time to start analyzing the data and connecting the dots, or in more professional terms, planning the trail corridors. A trail corridor defines the general path of a trail. It does not define the exact placement of every turn, wriggle, or feature in the trail. That level of detail is known as the trail alignment and is typically determined by the trail builder during construction. However, if certain trail segments are to be built by volunteers, then the best practice is for the trail professional to pin-flag the exact trail alignment (every turn and wriggle) during the design or build phase.



Conceptual trail corridors and designed trail alignments on the Erwin, Tennessee project site. Map courtesy of IMBA Trail Solutions

Trail corridors typically start off around 150- to 600-feet wide and get narrowed down during the design phase to around 50- to 150-feet wide. This is a balancing act because trail builders typically want as wide a corridor as possible for maximum flexibility and creativity during the build process, while resource specialists tend to want as narrow a corridor as possible to minimize the chance of disrupting any protected elements. The more narrow and restrictive the corridor, the more precise the corridor planning must be to ensure that the intended experiences match the final outcomes. This is just one of the many reasons why it is vital to have a highly qualified and experienced trail planner performing the work.

When planning trail corridors the primary elements being considered are:

ACCESS POINTS - Access points refer to how and where trail users are going to access the trail system. Access points can be parking lots, trailheads, neighborhood touch points, roads, or other trails.

PARKING - Parking is vital for users looking to visit a trail system that is not within riding distance. Estimating parking needs can be challenging. Some key criteria to consider are remoteness of the trail system, surrounding population density, ease of access, and attractiveness of the new trail system. If you are developing a world-class resource that is filling a void in the regional mountain bike landscape you can expect more parking demand than if you are developing a small, neighborhood trail system.

DENSITY - Trail density refers to how close trails are to each other. When you can see other trails and trail users, a sense of remoteness and escape can be lost. Creating trail sections and loops that are visually separated helps to maintain a sense of remoteness and escape that is sought by trail users.

GROUPING - Grouping relates to how trails are organized across the property so that riders of different skill levels and riding types can get to and from the experience zones of their choosing in the most efficient way possible, maximizing the amount of time spent riding versus time getting to where they want to ride. For example, grouping one-way gravity trails together is common so riders can descend, climb, repeat, to maximize time spent doing their activity of choice.

CONNECTIVITY - Connectivity refers to how the trails connect with each other (start and end points), as well as nearby trail networks and non-trail elements such as neighborhoods, access points, or other recreational amenities, to form a complete system.

CIRCULATION - Circulation refers to how trail users move through the trail system. Planning trail sections and loops that allow trail users to experience and move through all of the trails fluidly and without having to stop or repeat sections creates a sense of continuity that adds to the overall experience.

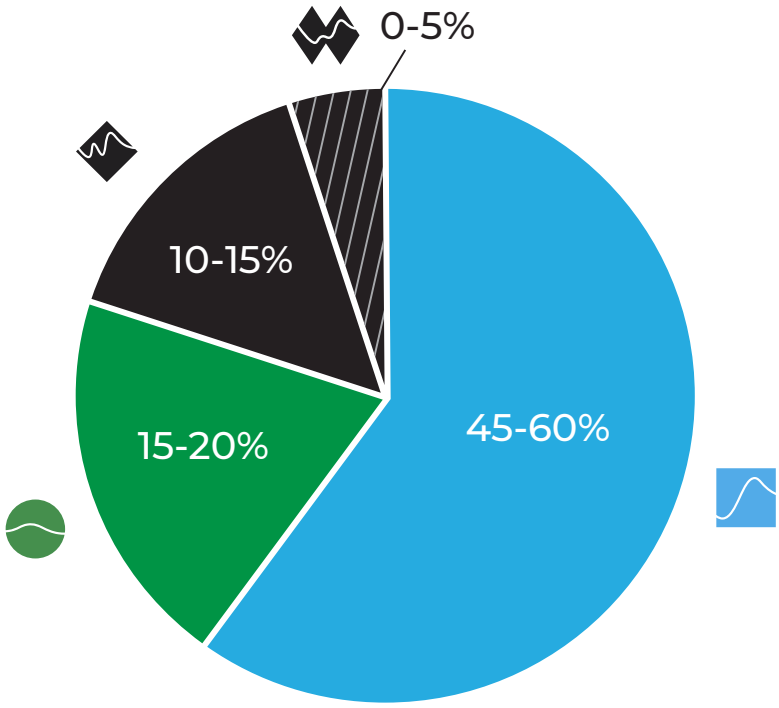
CAPACITY - Capacity relates to how many riders are expected to be in the system during peak periods and how that translates into how many riders a trail can support at one time. For example, a remote backcountry trail system will typically not experience the same kinds of capacity issues as an urban trail system, requiring fewer decisions about direction of travel and whether one-way trails should be considered. Too many riders on a trail segment at the same time can take away from the remote feel and increase the opportunity for trail conflict.

FLOW (INTERSECTIONS) - Flow is similar to circulation, but here the focus is on minimizing the number and frequency of intersections in a trail system so riders have fewer disruptions and fewer decisions to make. Every intersection creates a possibility of encountering another rider as well as a choice to make about which way to turn, disrupting the overall flow of the ride. Minimizing intersections helps to maximize the amount of time a rider can stay connected to the trail experience without disruptions.

BALANCE (TRAIL MIX) - Balance relates to the overall mix of trail types, difficulty levels, and mileages, attempting to provide a good balance for all the rider types and skill levels the trail system is trying to support. It is important to strive for a balanced mix so there is ample progression available for skill growth. For example, a trail system with two miles of beginner flowy trail, five miles of intermediate flowy trail, and three miles of advanced flowy trail has a good balance of skill levels served and mileages for each skill level. However, it has a poor balance, or lack of variety, of trail types since there are no traditional, technical, gravity, or jump trails represented.

- **Balanced does not necessarily mean equal. Similar to the downhill ski industry planning guidelines, an appropriate trail distribution across ability levels looks like a bell shaped curve.**

- **Achieving a balanced mix may mean looking beyond the individual trail system and considering the mix of trail types and difficulty levels across a region.**



- **Progressing as a rider from one difficulty level to the next can be stressful and intimidating. One way to help bridge this gap is to have a practice facility (skills park) at the trailhead with trail features varying in skill level from beginner through expert, so that people can see, experience, and practice their skill progression in a controlled environment before making the leap out on the trail. Another excellent way to bridge this gap out on the trail is to create optional, easier routes around TTFs so riders can pick and choose which challenges to accept. This also allows riders to keep riding, rather than having to dismount from their bike when encountering a trail feature they are not comfortable riding.**

USAGE DURATION - Usage duration refers to how long a trail user spends on a unique trail segment or loop, or in the trail system as a whole. A one-mile loop on a bike can go by rather quickly, whereas a five-mile loop creates a longer experience. Likewise, a five-mile trail system can go by very quickly for a rider, whereas a 25-mile trail system could take a half-day or the better part of an entire day depending on the terrain, skill level, and fitness of the rider.

TRAIL DIRECTION - Trail direction is either one-way or two-way, though in some instances you might see a blend, such as one-way for bikers and two-way for foot traffic. A two-way trail simply means that you can travel in either direction. Two-way trails are the norm for foot traffic trails, mainly because it is very easy for a person to simply step to the side if they encounter another hiker traveling in the opposite direction. This can become more challenging and disruptive to the user experience when you have a biker and hiker (or two bikers) encounter each other while traveling in the opposite direction.

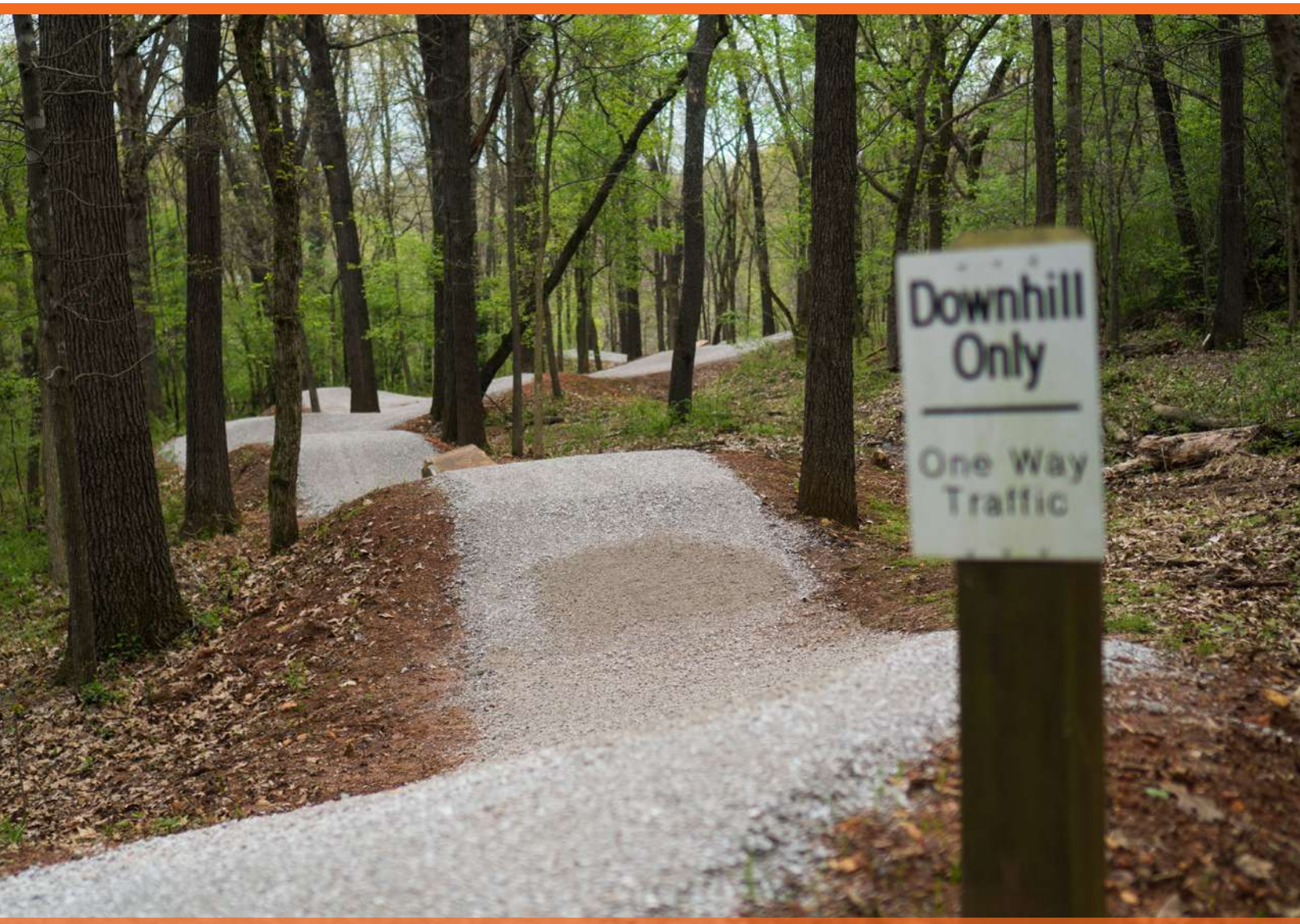


Photo by Eli Glesmann/Rock Solid

Differences Between Two-Way and One-Way Bike Trails:

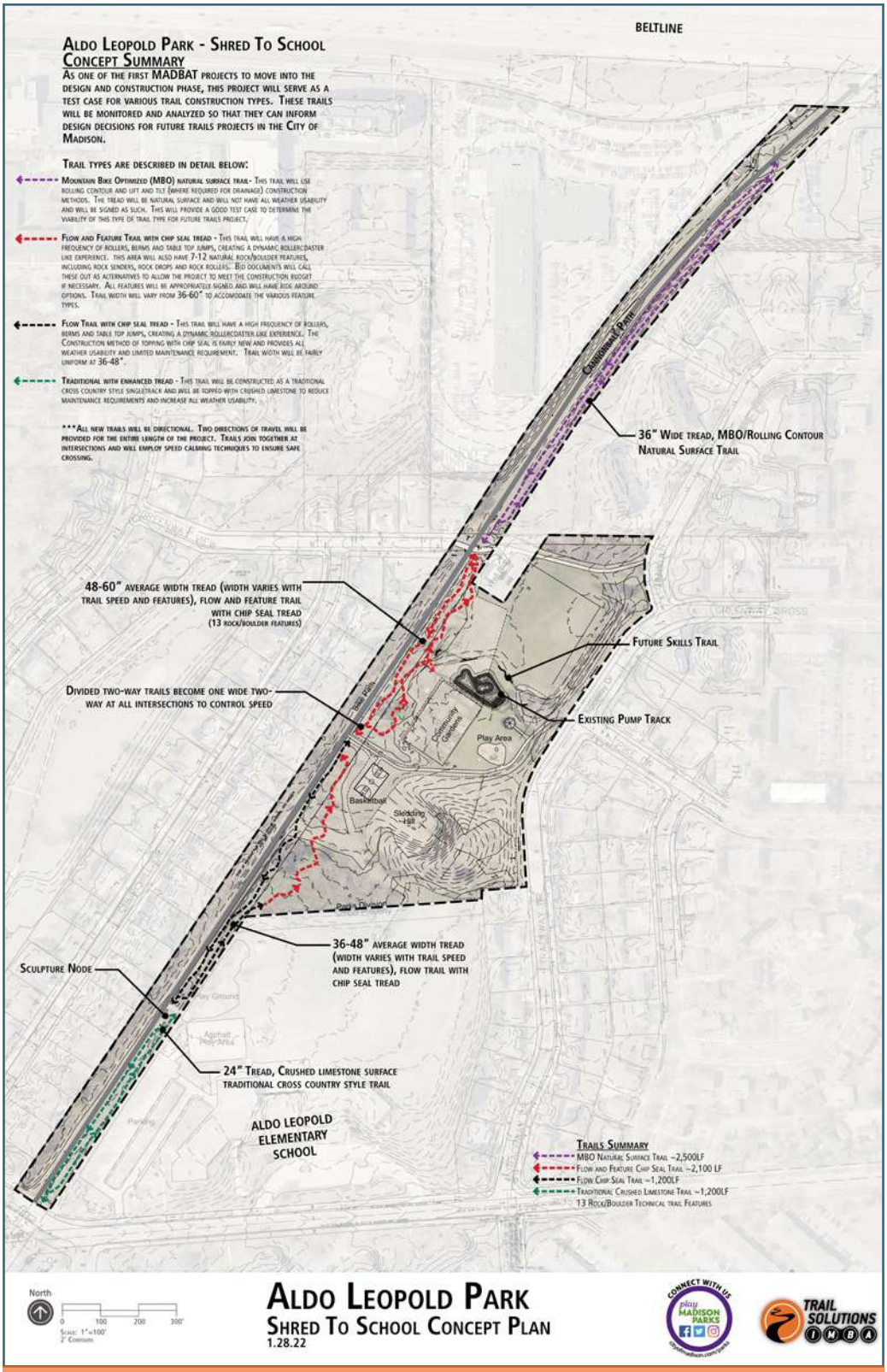
TWO-WAY

- **FLEXIBILITY -** Trail users have more flexibility in how they move through the trail system, allowing them to customize their trail experience.
- **CONNECTIVITY -** Two-way trails create more connectivity options.
- **QUANTITY -** Two-way trails provide double the mileage of a one-way trail. A 1-mile trail that can be ridden in both directions provides two miles of riding.
- **ECONOMICS -** Two-way trails allow more economical trail development, especially in a shared-use trail system.
- **DISRUPTIONS -** Riders traveling in opposite directions on the same trail create more interactions between trail users, which can lead to disruptions in the ride experience and potential for user conflict.
- **DECISIONS -** An intersection of two-way trails requires twice the number of route planning decisions when compared to an intersection of one-way trails. While offering more flexibility, having more decisions to make can also deter from the desire for minimal interruptions.
- **SIGNAGE -** Two-way trails require that signs at intersections have information on both sides. This may also require having multiple sign markers at an intersection (whereas one-way trails might only require one sign marker).

ONE-WAY

- **DESIGN -** A one-way mountain bike trail can be designed without compromise. (Designing a two-way mountain bike trail requires more complex design considerations such as how to slow down riders before a blind corner, how to reduce speeds to minimize consequences in a head-on collision, and how to blend trail features to work well in both directions.) If a trail is one-way, these considerations disappear, and bike-optimization can be maximized.
- **EXPERIENCE -** Because trail design does not have to be compromised, directional trail provides an increase in rider-optimized experience. Having one-way trails reduces the number of times a trail user needs to stop, possibly pull out a trail map, and make decisions about which way to travel.
- **ONCOMING TRAFFIC -** For one-way, bike-only trails, riders rarely have to stop or move off the trail for oncoming traffic, creating fewer disruptions to the trail experience.
- **ENCOUNTERS WITH OTHER USERS -** The amount of times a trail user encounters another user on the trail is reduced significantly since all riders are traveling in the same direction. This contributes to a more relaxed, serene experience. Densely populated urban centers with high volumes of trail users can benefit greatly from a one-way trail system. For a shared-use trail or system where riders only travel in one direction but foot traffic can travel in both directions, there are more encounters but more flexibility for foot traffic to move through the system.
- **QUANTITY -** The quantity of unique, rideable mileage is reduced by half with one-way trails. Directional trail provides an increase in optimized experience through fewer user interactions and more trail design options, which can be more valuable than length. Quantity does not always equal quality.

- **FLEXIBILITY -** Riders have less flexibility in how they move throughout the trail system.
- **MANAGEMENT -** Some land managers are hesitant to create one-way trails for bikers. This is changing as more land managers have personal experiences with well-planned, one-way bike trails.



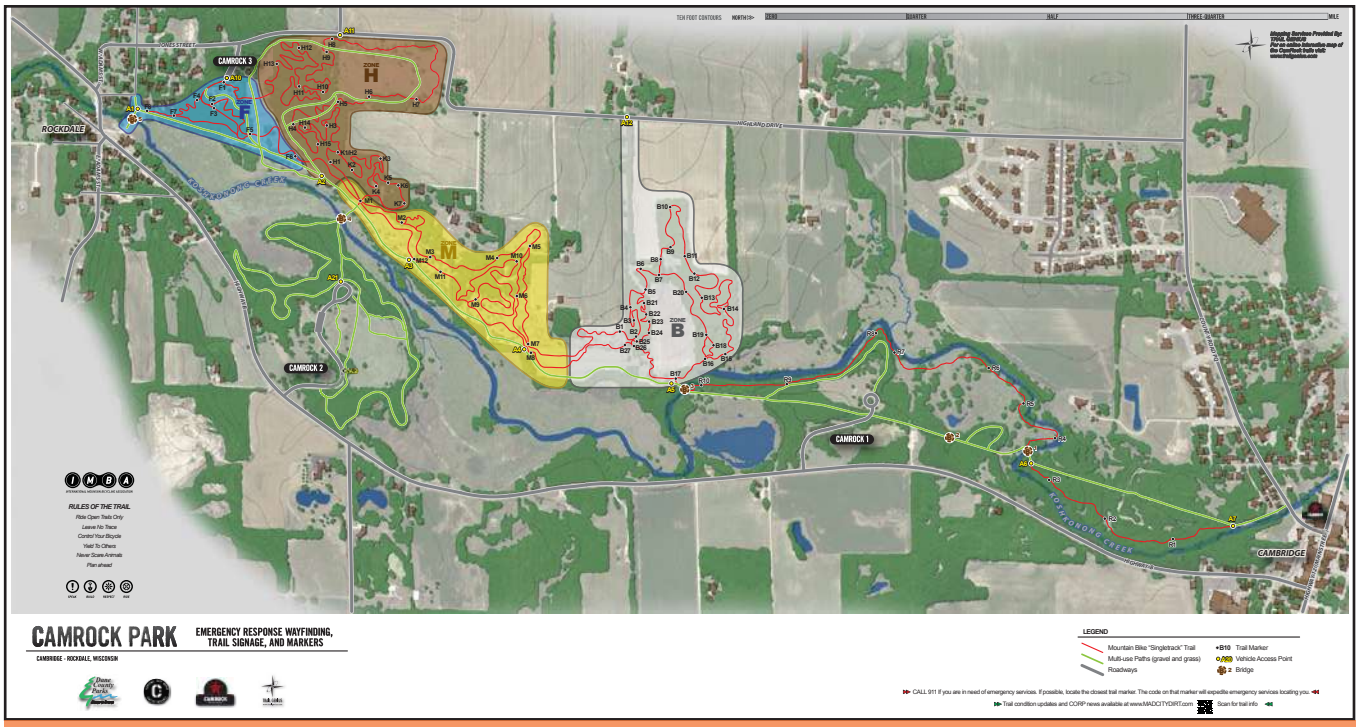
Concept plan graphic showing trail types and directionality for the "Shred to School" trail project in Madison, Wisconsin. Map courtesy of IMBA Trail Solutions

While it is rare for an entire trail system to consist of one-way bike trails, with the exception of possibly a lift-served gravity bike park, here are some key considerations for deciding if an individual trail should be one-way or two-way.

- **TRAIL TYPE -** Certain types of trail experiences are best-suited to being one-way for both enjoyment and safety. Gravity-dependent trail experiences, especially ones with jumps, are typically higher speed and should be one-way. Riders on jumps can not slow down, stop, or change direction mid-air. Having oncoming traffic in these situations can be very risky, even with long, clear sight lines.
- **VOLUME OF USE -** If you are planning a trail system in an urban area that you expect to receive frequent, high-volume use, one-way trails may be a good choice. Consider what sort of user volumes are expected during peak use periods, such as after school/work and on weekends. If you are developing a trail system in a remote area that will most likely receive limited use, then the need for one-way trails can be substantially reduced.
- **BUDGET -** If you do not have the budget to construct the quantity of mileage your community desires, then having two-way trails can provide more trail mileage for users to share. If you do have a sufficient budget, then you can consider an entirely one-way system or a combination of one-way and two-way trails.
- **EXPERIENCE -** If your focus is to provide an optimal riding experience, both in terms of playfulness with the terrain and reduced interaction with other users, then a one-way trail makes the most sense. Riding a two-way trail at speed requires a rider to be on their guard at all times in case another user is approaching. With a one-way trail, the rider can let their guard down, relax, and more thoroughly enjoy the experience knowing that there should not be anyone traveling in the opposite direction.

USER CONFLICT - User conflict happens when the experience of one trail user is negatively impacted by another trail user. Proper planning and consideration of the elements listed above can go a long way towards minimizing the opportunities for conflict. Creating one-way trails and offering separate, single-use experiences, such as a hiking-only trail, can help to balance user needs across an entire trail system. In dense urban areas with high traffic volumes, for example, one-way trails can substantially reduce the number of times trail users encounter one another, reducing opportunities for conflicts to arise.

EMERGENCY RESPONSE ACCESS - In addition to planning the riding trail corridors it is important to remember to plan the emergency response access corridors. This requires close coordination and planning with the land manager as they will have the most knowledge about existing routes and protocols, assuming any exist. Emergency access trails typically need to be wide enough to at least support off-road utility terrain vehicles (UTV) outfitted for emergency response activities. This is why it is important to have gathered geospatial data of all existing roads on a property during the assessment phase so these can be analyzed to determine if any existing roads can be leveraged, or if new emergency access trails will also need to be planned and built.



Access points and emergency wayfinding markers provided to local EMS at CamRock Park in Cambridge, Wisconsin. Map courtesy of IMBA Trail Solutions

Once all the trail corridors have been defined and connected, you have what is called a trails concept plan. The trails concept plan can then be reviewed for discussion and edits, potentially going through numerous versions before it meets the overall vision, goals, and objectives of the project.

Be aware that planned trail corridor lengths are typically around 10 percent shorter than final, built trail alignments due to the twists and turns that are not accounted for in corridor paths. For estimating mileages and construction costs it is important to add the 10 percent to corridor lengths to ensure mileage and cost estimates are as accurate as can be at this phase of the process.

CORRIDOR LENGTH VS. ALIGNMENT LENGTH

Planned trail corridors are typically around 10 percent shorter than built trail alignments so be sure when documenting trail lengths to add 10 percent to the corridor distance to ensure construction cost opinions are based on potential alignment lengths rather than actual corridor lengths.

Planned trail corridors are typically not flagged until the design phase unless resource specialists require flagged corridors to review instead of geospatial data. Most resource specialists can easily import the geospatial data for a trails concept plan into their computers and compare it against their known resource locations. This process allows initial corridor realignments to happen at the computer instead of in the field. If corridor-flagging is going to be required by a resource specialist during the planning phase, it is important to wait until a final concept plan has been agreed to before starting on the task as it is extremely labor-intensive and time-consuming, and you will want to minimize how many times it needs to be done. Also, depending on what is being reviewed, resource specialists can only walk flagged corridors during certain parts of the year due to weather conditions or when the resources in question may be visible or active. Due to these seasonality considerations, an on-the-ground resource review could potentially delay a project by up to a year or more.

Creating an Index of Planned Trails (Trail Index)

A trail index is a list of all the individual trail segments with key quantitative and qualitative characteristics defined for each trail. The goal of this list is to help describe the intended user experiences and capture quantities for producing design and construction cost opinions. The trail index is a fluid document, evolving as the project moves from conceptual planning to on-the-ground design and eventually to build-completion. It is standard to refine and add data and detail as the project becomes more defined.

Common trail index elements defined for each trail segment during the planning phase include:

USER OBJECTIVES - nature, escape, risk, fun, exercise, connectivity, etc.

TRAIL TYPE

- **Category -** bike-optimized, non-bike-optimized
- **Type -** traditional, flowy, technical, gravity, jump/slopestyle
- **Features -** rollers, berms, rock gardens, etc.

DIFFICULTY RATING AND SYMBOL - beginner (green circle), intermediate (blue square), advanced (black diamond), expert (double-black diamond)

RECOMMENDED USE

- **Shared-use -** allows multiple user groups such as bikers, hikers, and trail runners (sometimes referred to as multi-use)
- **Single-use -** only allows one user group, such as bike-only or hike-only
- **Prefered-use -** allows multiple user groups, but design is optimized for one specific user group

TRAIL DIRECTION - one-way, two-way; clockwise, counterclockwise; uphill, downhill; recommended direction. Examples:

- **One-way -** (counterclockwise)
- **Two-way -** (recommended direction is clockwise)
- **One-way -** (downhill-only)

TRAIL LENGTH - total length of the trail in feet or miles

TREAD WIDTH - average or typical width of the tread

AVERAGE GRADE - average percentage grade of the trail

SOIL TYPE - soil type(s) expected for this trail

TYPICAL FEATURE FREQUENCY - frequency of occurrence of typical trail features for this trail. Typical trail features include those that are considered a core element of the trail type. For example, rollers and berms are typical trail features on a flow trail, whereas technical rock features are typical trail features on a technical trail. This information helps convey the intended experience and is also useful in developing construction cost opinions. Examples:

- **Low -** Two to three trail features per 100 feet of trail
- **Medium -** Three to five trail features per 100 feet of trail
- **High -** Five to 10 trail features per 100 feet of trail

SPECIAL-FEATURE COUNT - The actual number of special features planned for this trail segment. This applies to unique features, typically using materials other than dirt, and not typical features such as rollers and berms. For example: "five technical rock features and six jumps." This level of description is extremely helpful for communicating intended user experience and preparing cost opinions. This count can easily be adjusted up or down during client communications to adjust intended user experience and cost opinions.

TRAIL NARRATIVE - a sentence or paragraph describing the intended trail experience. Examples:

- **Beginner flowy trail -** "A wide, mellow descent coming down the hillside. Tread width will be 48-inches wide with an average grade of four to five percent. Feature frequency will be high with a continuous linking of rollers and berms for a high level of engagement and a floaty, roller coaster-style experience."
- **Intermediate traditional trail -** "A somewhat narrow trail that meanders up and down the terrain for a broad mix of climbs and descents. Tread to be kept narrow (24-36-inches max) to minimize the look and appearance of a groomed trail. Trail to take advantage of natural rock as optional technical features, striving to maintain a natural, less-prescribed appearance and feel. Feature frequency to be low where terrain does not provide natural elements to work with, and high where terrain provides long stretches of natural rock bands to incorporate."
- **Advanced technical trail -** "A narrow, steep descent, traveling down the fall lines of exposed bedrock. Tread width will be as narrow as 12 inches with an average grade of 10 percent and recurring sections of 30- to 40-percent steep rock faces. The majority of the trail will be on exposed bedrock."

UNIT PRICE QUANTITIES - Known and estimated unit quantities can be included to help determine the cost opinion for each trail segment. Some of the most common fields included are:

- **Trail tread construction -** linear feet of trail to be constructed

- **Trail tread construction type -** standard bench cut, raised tread, or lift-n-tilt (a variation of raised-treat construction used in flat or shallow sloped areas where soil is excavated along the trail alignment to create positive drainages and a rolling contour trail experience)Lift-n-tilt is a variation of raised-tread construction
- **Trail tread capping -** linear feet of trail tread to be capped with additional tread material
- **Turn construction -** linear feet of turns/berms to be constructed
- **Armored drain crossings -** square feet of rockwork anticipated for rock armoring drain crossings
- **Rock retaining walls -** square face feet (SFF, and the total square footage calculated by multiplying the length by the height of the face of the retaining wall) of anticipated rockwork for rock retaining walls.
- **Rock features -** square feet of rockwork anticipated for rock-based TTFs
- **Boardwalk -** linear feet/square feet of woodwork anticipated for boardwalks
- **Bridges -** linear feet/square feet of woodwork anticipated for typical bridges

UNIT PRICE MULTIPLIERS - Other terrain factors not related to specific trail construction units can have an additional impact on overall pricing. Some typical terrain factors that can have an increased impact on costing include:

- **Rocky terrain**
- **Steep hillsides -** (60% grade or more)
- **Flat terrain -** (10% grade or less)
- **Dense vegetation -** (lots of tree clearing)

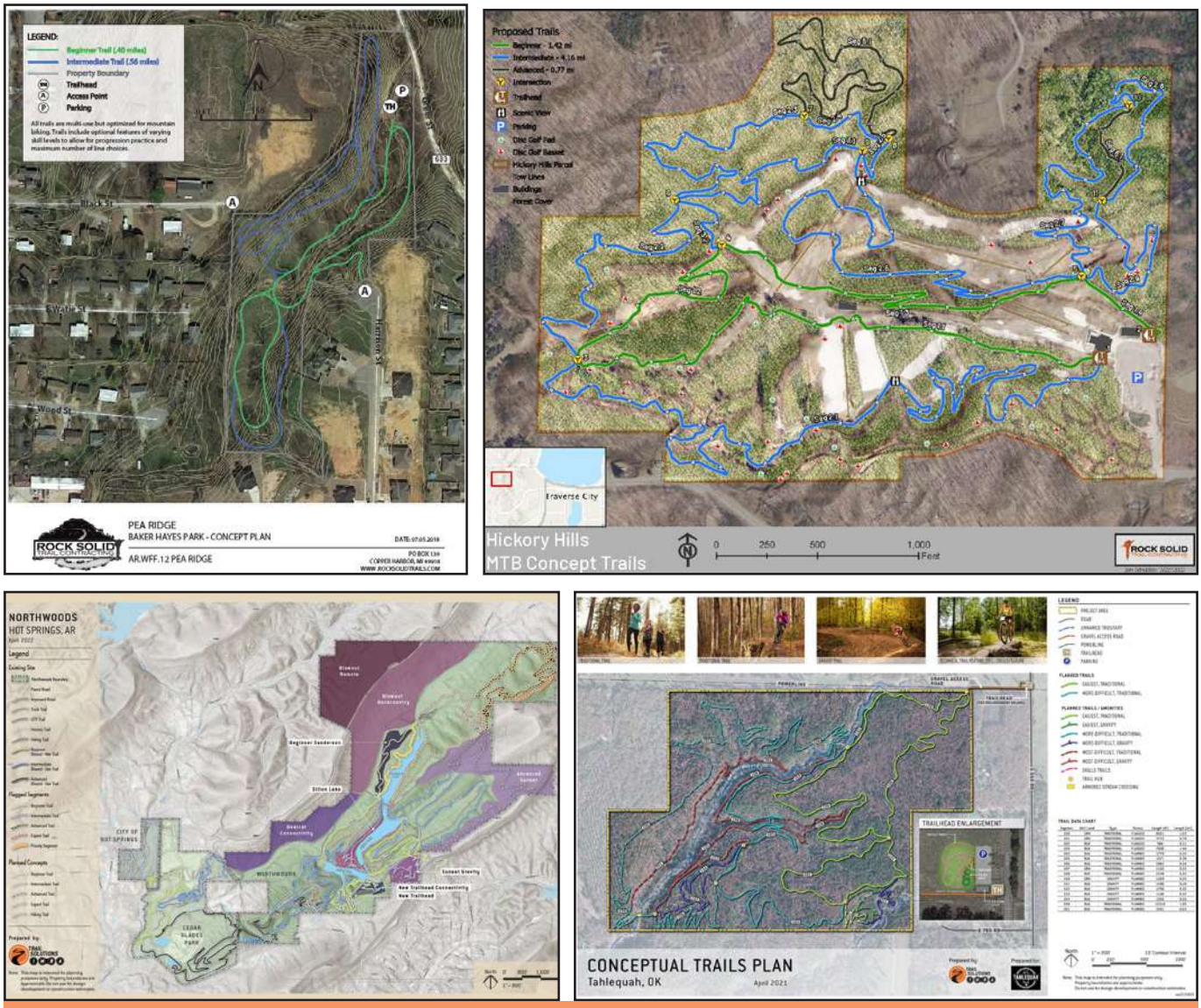
Segment	Difficulty	Direction	Use	Notes	Miles	Feet	Type	Style	Width	Avg Grade	TTF Qty	TTF Details
1	Beginner	1-way	shared	climb	0.64	3,379	Trad	flowy	5-6'	3%	5	mix of green & blue optional tech features - ledge ups, rock gardens (drains), rock overs
2	Beginner	2-way	shared	loop	1.14	6,019	Trad	flowy	5-6'	3%	20	same as 1
3	Beginner	1-way	bike	climb	0.18	950	Trad	flowy	5-6'	3%	1	
4	Beginner	1-way	bike	descent	1.50	7,920	Trad	flow-tech	3-4'	5%	8	rock over, rock gardens, ledges / drops, roller mounds
8	Beginner	2-way	shared	connector	0.12	634	Trad	flowy	5-6'	5%	0	
9	Beginner	2-way	shared	connector	0.14	739	Trad	flowy	5-6'	5%	0	
9b	Beginner	2-way	bike	climb	0.24	1,267	Trad	flowy	5-6'	3%	2	rock ledges, rock overs
5	Intermediate	1-way	bike	climb	0.10	528	Trad	flowy	2-3'	5%	2	rock ledges, rock overs
6	Intermediate	1-way	bike	descent	1.40	7,392	Trad	flow-tech	2-4'	7%	14	drops, rock gardens, jumps (optional)
7	Intermediate	2-way	bike	climb	0.30	1,584	Trad	flowy	2-3'	5%	2	rock ledges, rock overs
10	Advanced	1-way	bike	descent	2.04	10,771	Trad	flow-tech	1-3'	8%	20	drops, gardens, jumps (optional)
G1	Beginner	1-way	bike	descent	0.56	2,957	gravity	flowy	4-6'	5%	4	rollers, berms, roller mounds (jumpable), drops
G2	Intermediate	2-way	bike	descent	0.60	3,168	gravity	flowy	4-6'	7%	3	rollers, berms, tables, drops
G3	Advanced	1-way	bike	descent	0.43	2,270	gravity	flowy	3-6'	9%	3	rollers, berms, tables, drops
TOTALS					9.39	49,579					84	

Simplified example of a trail index. Image courtesy of Rock Solid

Which characteristics are included in the trail index may vary depending on what is known about the property and how much of the property has been seen. In addition, some of the characteristics listed above may not be defined until the design phase, though it is ideal to start planning for all of these.

Creating a Trails Concept Plan Map Graphic

This visual representation of all the trail corridors being proposed is typically created using GIS or design software such as Google Earth, ESRI ArcGIS, AutoCAD, and Adobe Illustrator.



Trails concept plan map graphics for Baker Hayes Park (Pea Ridge, Arkansas), Hickory Hills (Traverse City, Michigan), Northwoods (Hot Springs, Arkansas), and Tahlequah, Oklahoma
Maps courtesy of Rock Solid (top) and IMBA Trail Solutions (bottom)

Initiating Environmental Reviews and Permitting Process

The plan phase is where starting the compliance process in the assess phase pays off. Establishing an environmental review point of contact in order to understand the basic local environmental review/compliance process as it applies to the proposed trail project is key—It allows you to know what level of project planning, especially around proposed trail corridors and construction techniques, is needed for the environmental review process to move forward. Engage the environmental review point of contact early and throughout the planning phase.

The compliance process must be complete before the project can break ground, so the planning and design phases are where any necessary alternatives to the original project concept are proposed in order to meet resource protection needs.

The planning and design phases are also when engineering controls might be determined necessary as well as any specific construction techniques or materials that might be needed to meet resource-protection needs. These need to be noted in the planning and design phase so that timelines and costs are accounted for in the contract and build phases.

If the compliance needs for the proposed trail project are complex, planning the trail corridor may become iterative if alternatives are needed. Any specialized information needed for the environmental review process, such as GIS information for proposed trail corridors, species inventories, natural/cultural resource mapping, monitoring or studies, need to be discussed and accounted for in timelines and budget.

Creating Cost Opinions for Design and Construction

A cost opinion is simply an opinion of probable costs for upcoming design and trail construction services. Since the design will not be completed at this stage, there has to be a wide variety of assumptions about how much work of each type may or may not come to fruition, making this a good time to discuss and set expectations regarding budgets. This is especially true with the quantities and types of specialty features that may be desired. For example, looking at the budget impact for increasing the quantity of technical rock features from 50 (1,500 sq. ft. of rockwork) to 100 (3,000 sq. ft. of rockwork) can be a good starting point for discussing desired experiences, and how those translate to increased costs. At this stage, it is common to include a range on the low and high ends of the cost opinions for each line item. These cost opinion ranges will be refined into cost estimates with contingency percentages during the design phase.

Cost opinions for design services can include line items such as:

- **Project management**
- **Trail corridor flagging**
- **Travel and lodging expenses**
- **Updating base maps, base map graphics, and the trail index**
- **Creating detailed design drawings and construction documents**
- **Creating a signage plan and sign index**
- **Calculating detailed construction cost estimates**
- **Creating a design report**

Cost opinions for construction services can include line items such as:

- **Permitting**
- **Project management**
- **Crew mobilization**
- **Trail tread construction**
- **Travel and lodging expenses (typically included in the trail tread construction linear foot price rather than listed separately)**
- **Turns construction**
- **Armored drain crossings**
- **Rock retaining walls**
- **Rock features**
- **Boardwalks**
- **Bridges**
- **Special-features construction**
- **Trail hubs construction**
- **Signage**

Cook County Mountain Bike Trails in Minnesota. Photo by Bryan Hansel Photography

Creating a Trails Concept Plan Report

The trails concept plan report is a deliverable that contains items covered during the planning phase and may also include relevant information gathered during the assessment phase. It is quite common for the assessment and planning activities to be performed under one contract with the findings and recommendations presented together in a trails concept plan report.

A typical report includes some or all of the following types of information:

- **Project overview**
- **Project location**
- **Project vision, goals and objectives**
- **Existing conditions**
- **Trails concept plan**
    - *Trails concept plan map graphic*
    - *Trail narratives by zone, trail groupings, or individual corridors*
    - *Trail Index*
    - *Points of interest*
    - *Access*
    - *Parking*
    - *Equipment, personnel, and materials logistics*
    - *Trailhead infrastructure and amenities*
    - *Signage*
- **Cost opinion**
- **Phasing**
- **Environmental review and permitting outlook**
- **Next steps**

Trail map signage at Redhead Mountain Bike Park in Chisholm, Minnesota. Photo by Chris Guibert/Rock Solid

Contents

Contents

Table of contents examples for trails concept plan reports. Images by Jake Carsten/Rock Solid

Chapter 10: Trail Development Process - Design

The design phase begins once the trail planning activities are complete. While the planning phase is primarily conceptual (zones and/or lines on a map), trail corridors are physically flagged during the design phase. The trail corridor flagging is based on field exercises that ground-truth the trails concept plan.

The key activities of the design phase are:

- **Review and refine project vision, goals, and objectives** updated during the planning phase.
- Continue engaging with the resource specialist to **move the environmental review process toward completion.**
- **Perform desktop-based analysis and planning** for the site visit.
- **Flag the trail corridors** and collect field notes and geospatial data related to final placement.
- **Identify equipment, material, and personnel logistics.**
- **Update the trails concept plan map graphic and trail index.**
- **Create detailed design drawings/construction documents** (if needed).
- **Finalize environmental review and permitting process** (if needed).
- **Create an emergency response plan.**
- **Create cost estimates for the build phase.**
- **Create a trails design report.**

Of the activities above, the primary focus is flagging the trail corridors, updating the trails concept plan map graphic and trail index, and creating cost estimates.

Flagging trail corridor and marking trail hubs at the Northwoods in Hot Springs, Arkansas. Photos by Chrisman/IMBA

Reviewing Project Vision, Goals, and Objectives

As time passes, vision, goals, and objectives can change, so it is important to review these and adjust accordingly.

Questions to ask before diving into the design phase:

Have your vision, goals, and objectives for the project changed since the planning phase?

Has your budget changed? Is the funding in place? Is there enough funding to construct the project all at once, or must the project be spread over phases?

Have new mountain bike trails been built in your community since the planning phase? If so, will this impact the desired trail mix?

Has the desired mix of trail types, difficulty levels, and mileages changed?

Performing Desktop-Based Analysis and Planning for the Site Visit

The primary goals of this activity are to review the data and findings from the assessment and planning phases, plan the logistics and personnel requirements to execute the field-design work, and identify additional geospatial data and notes to add to the base map to help direct on-the-ground corridor flagging. As always, communication and coordination between the trail planner and land manager are vital to ensure site visits go smoothly.

Flagging the Trail Corridors

Flagging the trail corridors is the essential activity of hanging ribbon (and/or placing pin flags) every 20 to 100 feet to physically define the corridor of a trail. The distance between flags is determined primarily by visibility;trail builders should be able to follow the flag line easily, even when vegetation is dense (such as during summer months). Well-placed ribbon/flagging is often referred to as “intervisible” ribbon or “intervisible” flagging. Corridor flagging acts as the “breadcrumbs” that the builders will follow during construction.

Flagging trail corridor, turns, and hubs in Marinette County, Wisconsin. Photos by Eli Glesmann/Rock Solid

Flagging trail corridors is performed using a clinometer to confirm grades and ensure the corridor placements support the user objectives and trail types defined during the planning phase. While trail corridor flagging may seem simple, a professional trail planner must consider all of the information gathered up to this point and attempt to create a corridor that:

- **Uses terrain suitable for the desired trail types**
- **Maintains desired average and maximum grades**
- **Connects key points of interest**
- **Incorporates unique terrain and features**
- **Connects to other trails.**

Visibility is critical when flagging trail corridors. The ideal time to flag in Minnesota, for example, is during the narrow windows of spring and fall when there are no leaves on the trees (known as the “leaf-off period”) and there is no snow on the ground. This provides maximum visibility of the terrain and ground. Flagging is possible in the summer months if a property does not have dense understory or brush, but summer flagging may require significantly more time if visibility and access are limited or restricted by vegetation. The final step is to capture GPS tracks of flagged corridors to document the final corridor placements and verify lengths.

Flagging the trail corridor is optimal after leaves have fallen for maximum visibility. Photo by Eli Glesmann/Rock Solid

If the trail corridors have not been flagged by a trail planning professional, it is strongly recommended to hire a professional to walk and review the flag lines and confirm grades before the start of resource reviews. This can help avoid accidental resource impacts or additional review periods if corridor changes are suggested by the trail planner. Seeking trail planner input early can also improve the quality of the finished product.

Lead machine operator following the flag line. Photo by Eli Glesmann/Rock Solid

COMMON PITFALL:

Failure to field verify a trail plan

A trail plan developed on a computer is only good for generalized property analysis and should never be relied upon as a "buildable" trail plan. Assessing a site by foot (ground-truthing) is critical for identifying opportunities and constraints that lead to a well-vetted trail plan. A trail corridor adjusted by even a couple grade percentage points can result in hundreds, if not thousands, of extra feet of trail needing to be built that would not have been accounted for during the budgeting process. The added trail costs could wreak havoc if the need for more trail is not determined before grants have been awarded or worse yet, the builders are already on the ground.

Identifying Equipment, Material, and Personnel Logistics

While not essential during the concept phase, identifying and understanding equipment, material, and personnel logistics are critical for estimating project costs during the design phase.

Some of the key logistical considerations are:

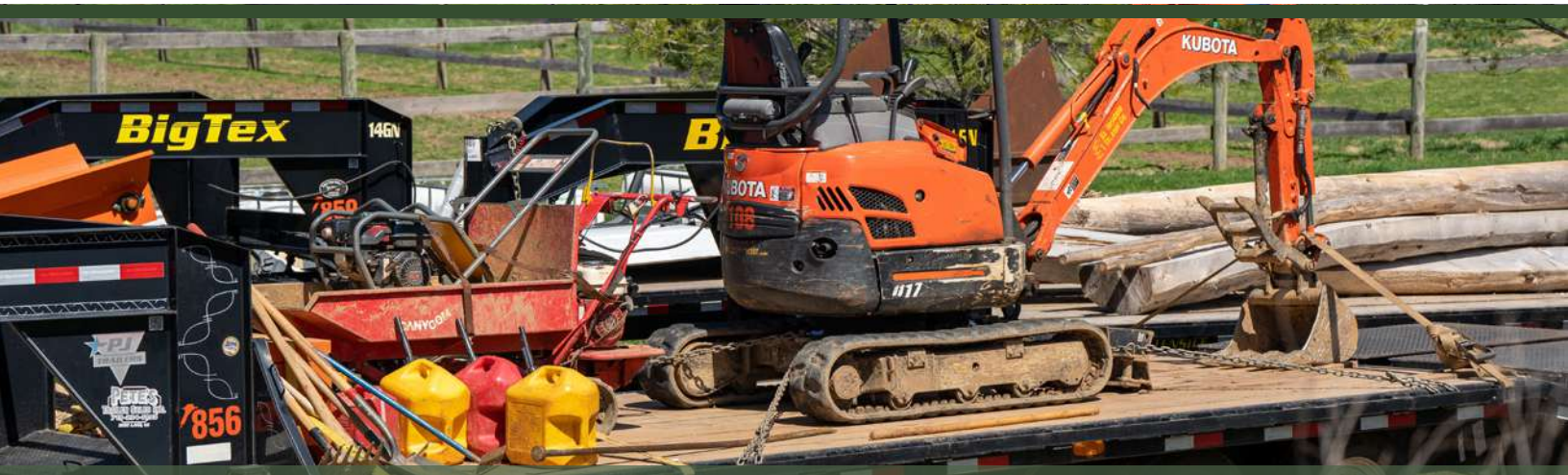
- **STAGING, STORAGE AND ACCESS/EXIT POINTS FOR EQUIPMENT -** Build crews will need to get machinery into and out of the various build areas and will need to know where they are allowed to drop off machines that will need to be driven into the sites. They will also need to know where they can store trailers and other vehicles during the build phase. Exit points are also vital so that crews do not have to backtrack over newly constructed tread or bushwhack across long and potentially inhospitable sections of raw terrain.

- **STAGING AND ACCESS POINTS FOR MATERIALS -** If imported materials such as dirt, rock, or lumber are to be used, drop locations for material storage and access need to be identified. Build crews will want materials staged as close as possible to where they are to be used, so numerous drop sites might be required to optimize material transport times. Staging materials as close as possible to their final destination will also help keep overall project costs as low as possible.

- **ACCESS POINTS FOR CREWS -** Build crews will typically travel to job sites by truck and then hike into the job site for that day. Thus, it is important to identify locations for build crews to park company vehicles on a daily basis. Multiple locations are typically needed to access the site with the shortest hike-in possible, especially since crews often need to carry heavy items such as containers full of fuel.

- **LOCATIONS WHERE SITE-SOURCED MATERIALS CAN BE HARVESTED -** Materials for tread capping, feature construction, and rock armoring are quite often harvested on-site close to the area of need, assuming the raw materials are available in the surrounding environment. When defining the corridor width along the flag line (which can be disturbed during construction), keep in mind that the smaller the corridor, the less access build crews will have to native material. Work with the trail planner to identify a realistic build corridor that will provide optimal access to native site materials. Ideally, the trail planner will have routed trail corridors through or near areas with needed materials. Since this is not always possible, site exploration for additional needed materials is quite common. This is a bit of a balancing act, though, because the larger the corridor, the more territory the resource specialists will have to analyze for potential conflicts.

Once gathered, all equipment, material, and personnel logistical information should be included in the final design report as well as the future bid package that will be sent out to trail building firms. Having this information available in the bid package makes it much easier for trail building firms to estimate equipment, material, and personnel transport times to provide a more accurate bid.

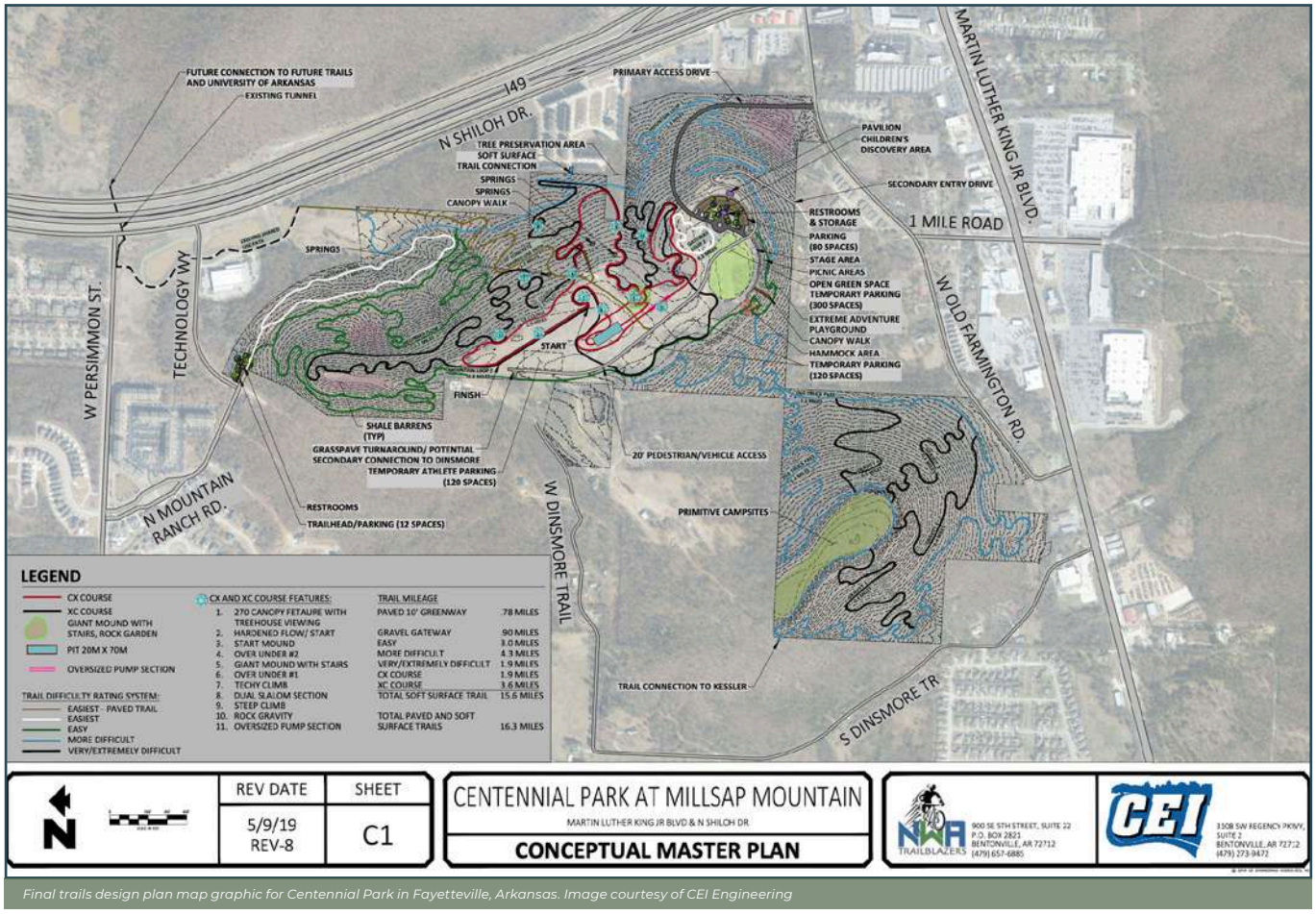


Trailer and equipment ready to be transported to a job site. Photo by Eli Glesmann/Rock Solid

Equipment storage at Rock Solid headquarters in Bentonville, Arkansas. Photo by Eli Glesmann/Rock Solid

Updating the Trails Concept Plan Map Graphic and Trail Index

Once the flagged corridor data is loaded into the computer, the trails concept plan-corridors from the planning phase are replaced with the field-designed corridors. Once the trails corridor design is complete, the trail index fields and trail narratives are reviewed and updated. An accurate trail index is vital for determining cost estimates and communicating expectations about intended trail experiences.



Final trails design plan map graphic for Centennial Park in Fayetteville, Arkansas. Image courtesy of CEI Engineering

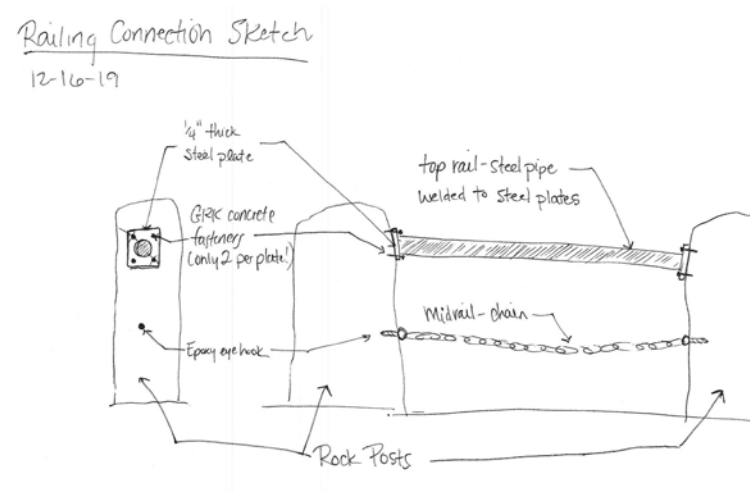
Creating Detailed Design Drawings/Construction Documents

Historically, mountain bike trail projects have not included the types of deliverables you find in traditional construction projects. Many projects used to be executed with just a trail map, flagged corridors, and descriptions of the trail types and difficulty levels. But as trails are being constructed in municipalities and nearby urban locations, detailed design drawings, construction documents, grading permits, and stormwater pollution prevention plans are becoming required more often by city officials and typically need to be accompanied by a professional engineer's stamp. Custom-designed elements such as boardwalks, bridges, or other TTFs may also require detailed design drawings or engineer-stamped construction documents. As the professional trail industry has matured, the trend has been moving towards more formal design documents to support permitting requirements and help ensure that desired trail experiences are met.

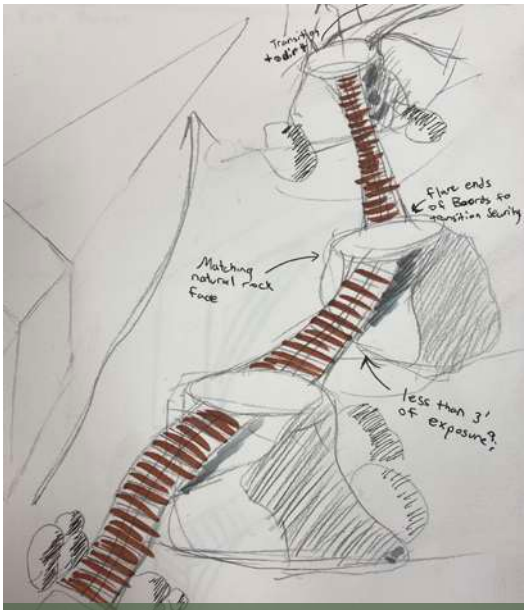
Detailed design drawings also make the bidding process more efficient and effective for all parties. Not having detailed design drawings and corresponding specifications for special features can substantially slow the process due to all the questions bidders must ask to clarify feature designs, specified materials, and desired construction methods. If questions are not asked and/or these items are not defined, bidders must guess or make assumptions that may or may not be accurate. In these cases, bid amounts can vary dramatically due to lack of information and padding of bids to allow for unknowns.

Types of design documents:

- **LOCATION MAP -** a map showing the location of the project site in its surrounding context
- **SITE PLAN -** a plan-view graphic showing the layout of the key project elements such as trail corridors, bike amenities, trailheads, and parking lots
- **CONCEPT SKETCHES OR 3D SKETCHUP MODELS -** freehand or digital renderings used to explore initial ideas for designs quickly and simply; not intended to be accurate or definitive; merely used for exploring and communicating design principles and aesthetic concepts. Common for trail features, boardwalks, and small bridges.

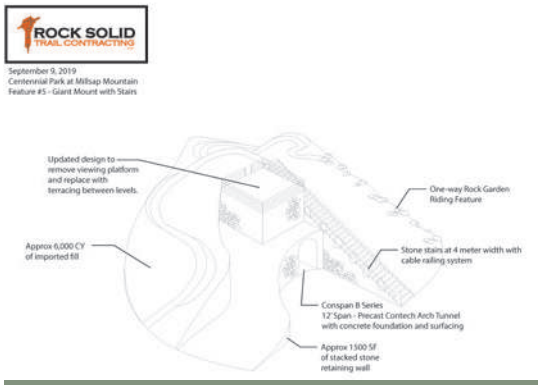


Design development sketch of a railing solution. Sketch by Andy Flietstra/Rock Solid



Conceptual design sketch of a TTF. Sketch by Kyle McGurk/Rock Solid

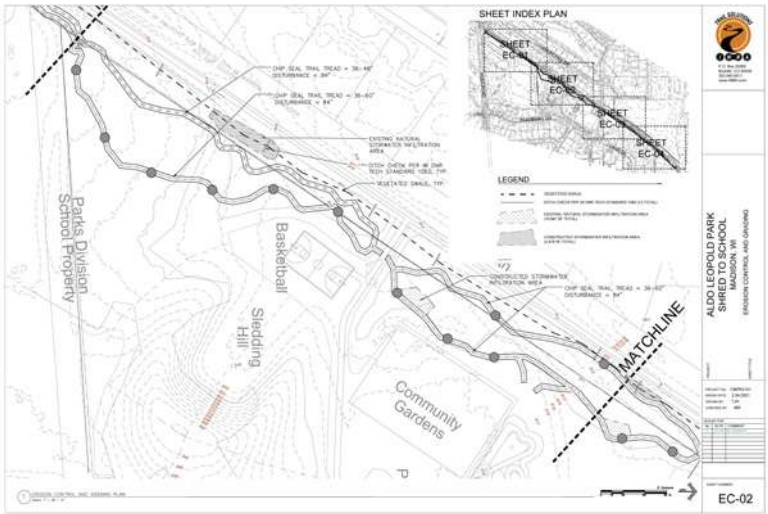
Design development sketch overlaid onto a site image. Sketch by Bill Kobs/Rock Solid

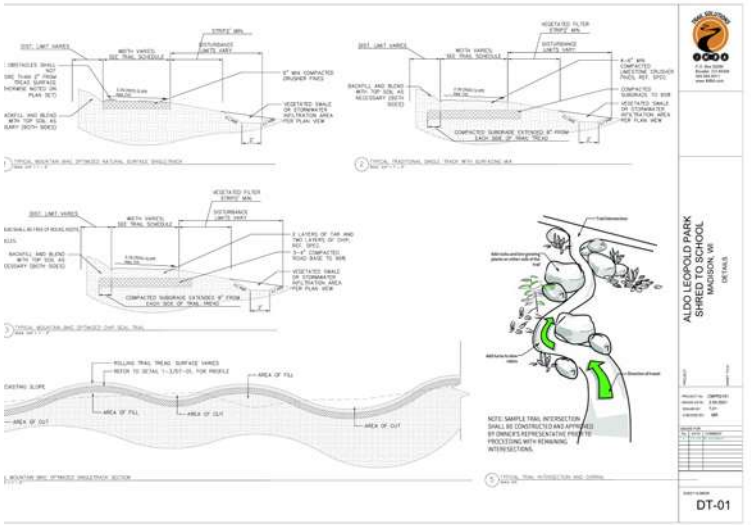


Schematic design drawing. Drawing by Alice Torvinen/Rock Solid

- **CONSTRUCTION DOCUMENTS -** graphical information displayed to scale and dimension that can be used to construct, fabricate, assemble, or install trail, trail features, special structures, signs, or kiosks. Typically created by architects and/or engineers.

A sheet from a set of construction documents. Photo by Eli Glesmann/Rock Solid





Construction Documents for the "Shred to School" trail project in Madison Wisconsin. Images courtesy of IMBA Trail Solutions

- **SIGNAGE PLAN AND INDEX -** a plan showing the placement of each sign marker throughout the trail system along with an index identifying the required details for each sign. A signage plan may also include logo/branding development and graphic standards for signage design.

Signage Plan

	Post Materials				Decals															
	Support Post	Sign Post	Dual Sided Marker	Anchor Barb	Corp of Eng	Trail Name (Not Mandatory)	Green Circle	Blue Square	No Motos	No Horses	Right Arrow	Left Arrow	Ahead Arrow	Rt+Lt Arrow	NW Arrow	NE Arrow	Point of Interest	Parking	Miles
	CSP-72-03		CIB-66-03	ANCBARU	RSS203		378E	374MD	RSS065S	RSS064SL	RSS102	RSS101	RSS103	RSS100	RSS327	RSS340	RSS080	RSS034	
			17.35	2.25	$8 (sheet-6)	see note*	2.01 ea	2.01 ea	$8 (sheet-6)	$8 (sheet-6)	$8 (sheet-6)	$8 (sheet-6)	$8 (sheet-6)	$8 (sheet-6)	$8 (sheet-6)	$8 (sheet-6)	$8 (sheet-6)	$8 (sheet-6)	see note*
s1a-f			1	1	1	1	1		1	1									
s1a-b					1													1	
s1b-f			1	1	1	1	1							1					1
s1b-b					1	1	1							1				1	1
s2-f			1	1	1		1	1				1	1						1
s2-b					1		1	1			1								1
s3-f			1	1	1		1				1		1				1	1	1
s3-b					1		1					1	1				1	1	
s4-f			1	1	1		1						1						
s4-b					1		1						1						
s5-f			1	1	1		1	1				1	1						1
s5-b					1		1	1			1		1						1
s6-f			1	1	1		1							1					1
s6-b					1		1							1			1	1	1
s7-f			1	1	1	1	1		1	1									1
s7-b					1													1	
s8-f			1	1	1	1	1		1	1				1					1
s8-b					1		1							1			1	1	
TOTALS (EA)			9	9	18	5	16	4	3	3	3	3	7	6	0	0	4	7	11
TOTALS (Decals)																			90
Sheets (6ea)					4				1	1	1	1	2	2			1	2	15

Sample signage plan index. Image courtesy of Rock Solid

Finalizing Environmental Review and Permitting Process

During the design phase, the primary goal is to incorporate any previous resource review findings into the design of the trail corridors. Once the trail corridors are flagged and agreed upon, resource specialists can be contacted and surveys of the flagged corridors can be requested. Be sure to contact the resource specialists well in advance of the scheduled design phase to try to ensure resource reviews can occur soon after the trail corridors are flagged.

Resource reviews may require adjustments to the flagged corridors. If so, trail corridors need to be adjusted in the field and resource specialists notified of changes. Whether or not the adjusted corridors need to be rewalked or reviewed again is at the discretion of the permitting agencies. Resource reviews can easily extend into the contracting phase, but must be complete with permits issued prior to the start of construction.

Creating an Emergency Response Plan

As with any outdoor activity, injuries will happen, so it is important to have a plan for how to respond. Though emergency access trails and routes should have already been identified during the planning phase, and then flagged during the design phase for any new access trails to be built, it is still necessary to have an operational plan for how emergency responses will be handled. While the planning, design, and construction of emergency access roads falls within the area of expertise of professional trail contracting firms, the creation of emergency response plans is typically handled internally by the land management agency or designated outside contractors. However, since it is such a critical element of trail management activities, here is some high-level information to help you get started.

An emergency response plan identifies personnel, equipment, infrastructure, and processes to support potential extractions.

Some of the key items to consider and address for an emergency response plan include:

- **EMERGENCY ACCESS POINTS -** need to be identified, signed, and numbered
- **EMERGENCY ACCESS ROADS/ROUTES -** need to be identified
- **EQUIPMENT AND SUPPLIES -** emergency extraction vehicles, rescue equipment, and medical supplies should be on-hand

All-terrain emergency response vehicle. Photo by Jake Carsten/Rock Solid

- **EMERGENCY RESPONSE PERSONNEL -** needs to be identified. Will emergency response personnel be volunteers, staff members, or municipal response teams? If staff members or volunteers will be utilized, who will be responsible for finding, hiring, and training team members?
- **COORDINATION WITH LOCAL EMERGENCY MEDICAL SERVICES (EMS) -** coordinate with local EMS for a site visit so they can examine the property and determine appropriate access points, map extraction routes, and make notes for emergency calls.
- **EMERGENCY RESPONSE MAP -** create an emergency response map with access points, extraction routes, and extraction information.
- **RECORD KEEPING -** tracking all emergency response actions is critical for both reporting and analysis to help identify areas of the trail system that might have recurring problems needing to be addressed.

Poor placement of high risk trails in hard-to-reach areas of a property can also contribute substantially to management challenges. Work closely with trail planning personnel during the assessment and planning phases to ensure these types of considerations are addressed early in the process.

Creating Cost Estimates for the Build Phase

With an updated trail index and detailed drawings of special trail features or structures, cost opinions evolve into cost estimates to reflect the new and updated information. Contingency percentages are added to line item costs to help anticipate potential overages. Contingency percentages are based on levels of confidence, work done to date, and known/unknown variables that may impact final costs.

Creating a Trails Design Report

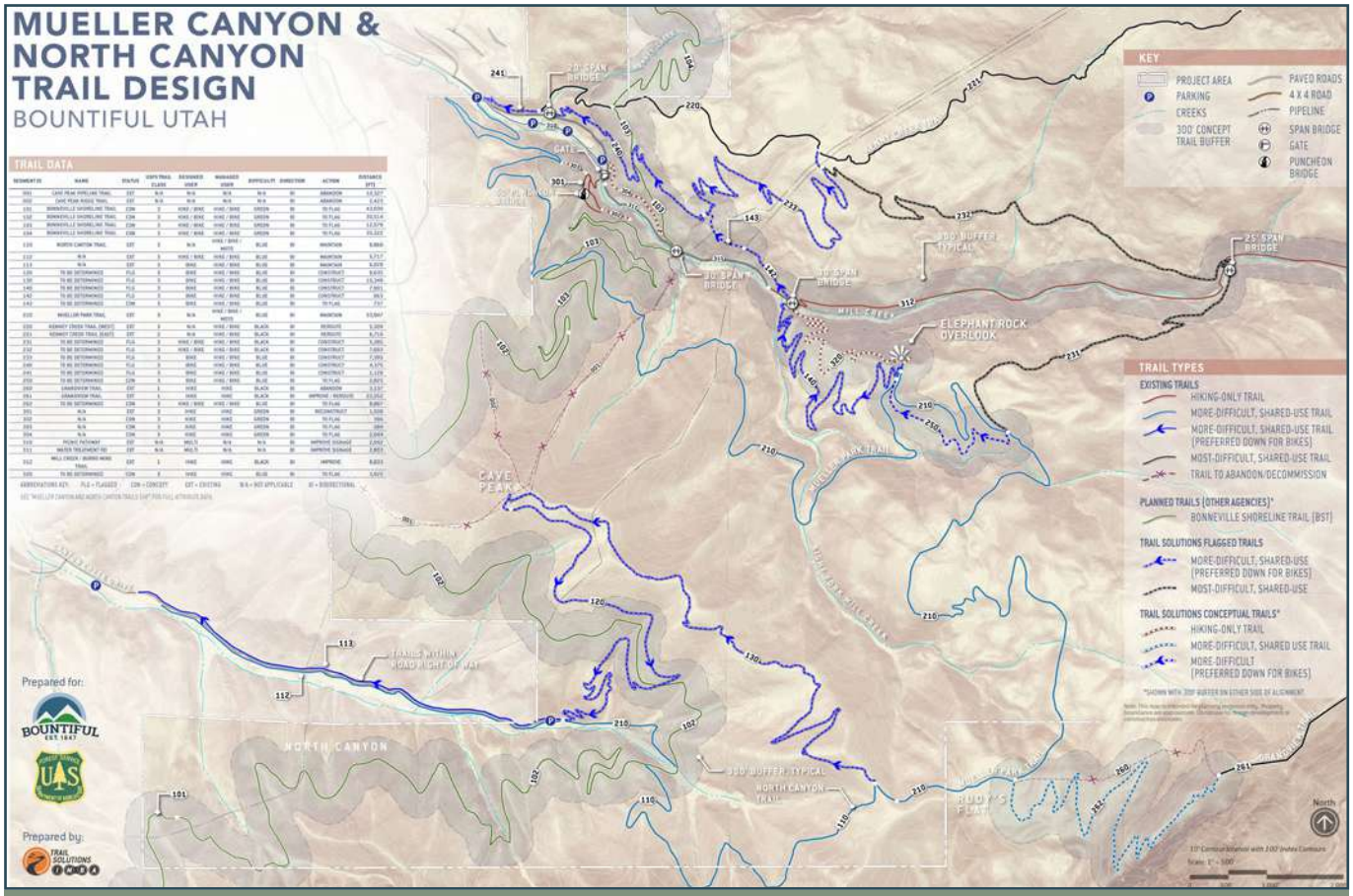
The trails design report (sometimes called a “design brief”) expands on the previously created trails concept plan report with an updated trails design map graphic, trail index, additional design drawings (if applicable), cost estimates, and any new updates regarding environmental review and permitting.

A typical trails design report includes the following types of information:

- **Project Background**
  - *Scope of work*
  - *Existing conditions*
  - *Project goals*
- **Design Methodology and Approach**
  - *Trail narratives*
  - *Trails design map graphic*
  - *Trail index*
- **Implementation**
  - **Phasing priorities**
  - **Environmental review and permitting outlook**
  - **General construction guidelines**
  - **Equipment, material, and personnel logistics**
- **Cost estimates**
- **Next steps**

There are a number of additional design items that may be included in the trails design report, especially if the trail planning firm was contracted to create them. If the trail planning firm was not contracted to create the following types of items, it is still vital that the agency create them in-house or through another qualified contractor:

- **Detailed design drawings/construction documents**
- **Signage plan**
- **Emergency response plan**



Trails design map graphic for Phase One trail development above Bountiful, Utah. Map courtesy of IMBA Trail Solutions

Chapter 11: Trail Development Process - Contract

To ensure a fair and equitable construction contracting process, public agencies must adhere to specific procurement rules that can vary depending on the funding source. While contracting does occur in the assessment, planning, and design phases, those professional service contracts are typically not subject to the same rigor as construction contracts.

In particular, the build phase can be challenging for land managers unfamiliar with mountain bike trail construction projects because of the wide variation of pricing approaches by contractors due to a lack of industry standards for pricing the various elements involved. This section will help clarify what contracts generally entail.

The key activities of the contracting phase are:

- **Determine contracting methods available** to your entity and decide which is best suited for the specific project.
- **Create a bid/proposal package** that includes project description and quantities, trails design map, trail index, design drawings/construction documents, unit price sheet, and business requirements.
- **Solicit bids/proposals** by advertising the bid package for trail builders to review and respond.
- **Review bid/proposal submissions** to select the contractor best-suited for the project.
- **Award the contract** to the selected trail builder and start the negotiations necessary to execute the contract.

Determining Contracting Method

The primary construction contracting methods available are: direct contract, design-build, design-bid-build, and specific to Minnesota, the Cooperative Purchasing Venture program. Contracting methods available or required may vary by agency and funding source. Check with your contracting department to determine what methods are available.

DIRECT CONTRACT

A direct contract simply is negotiated and signed directly with a contractor without having to adhere to a public bid process. Direct contracting is typically not allowed for public agencies unless the contracted dollar value is below a predetermined threshold, and even then, a direct contract may not be an option due to the types of services being requested. The dollar amounts for trail construction contracts typically exceed maximum dollar thresholds and need to be put out for public bid. Direct contracting for trail consulting services such as assessment, planning, and design are often handled with a direct contract since these are subject to different public bid rules than construction projects. However, there may still be a dollar-value threshold for professional services contracts that, when exceeded, require the project to be sent out for public bid.

DESIGN-BID-BUILD CONTRACT

The most typical contracting method, design-bid-build uses separate contracting phases for the assess-plan-design and construction activities. All of the assessment-planning-design deliverables are used to create a formal bid package that is put out to public bid for construction. This process takes longer than design-build and is more expensive, since the design documents need to be done to a high level of detail to ensure the bid package is sufficient for contractors to submit accurate bids. For a build contract that is advertised for competitive bid, it is essential to include detailed design drawings and/or construction documents for all typical and special features with build and material specifications. A thorough bid package with a clear vision, detailed design documents, and specific build unit quantities reduces the odds of trail contractors interpreting the bid package differently from one another, helping to ensure ”apples-to-apples” bids for the client to review.

DESIGN-BUILD CONTRACT

Unlike the design-bid-build contract where the design and build phases are contracted separately, the design-build contract combines the design tasks and construction activities into one contract. This shortens the development timeline and adds the benefit of a seamless transition from design to build since the same contractor teams are involved in each phase. And, since the design is not being sent out for other trail contractors to bid on, this reduces the need to have highly detailed design documents that are required for a design-bid-build contract. However, initial feasibility and planning must take place prior to the design-build contract to develop a general vision, realistic trail mileages, trail types and narratives, special features, and realistic budgets.

Design-build contracts are more common on smaller trail projects or larger projects where high-level planning has already been performed and the funding source allows for design-build. Design-build contracts can also be effective when a land manager knows what they want, a high degree of creative freedom is desired during the build process, or if a land manager has extensive experience and trust working with specific contractors. Make sure to check with your procurement office since not all municipalities allow design-build contracts.

Minnesota Cooperative Purchasing Venture (CPV)

The **CPV program** allows eligible entities (state agencies and CPV members) to order/purchase directly from pre-approved trail building contractors without advertising for public bids or obtaining multiple bids. This saves significant time and allows entities to hire their contractor of choice. (Note that the number of trail building contractors on the approved list is small compared to the number of contractors available nationally.) Fixed price, hourly crew rates and cost-plus markup percentages for materials and supplies are pre-negotiated between the state procurement office and trail building contractors. As a result, individual entities do not need to negotiate pricing when using a pre-approved contractor.

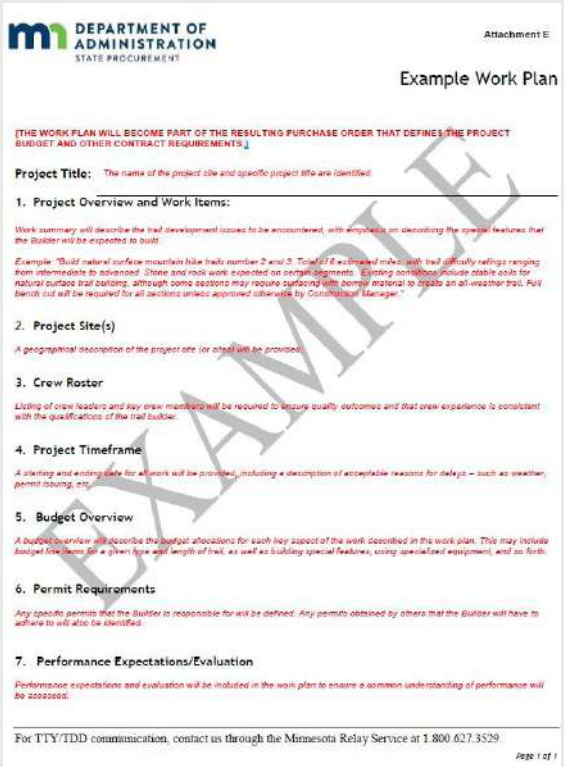
While the CPV program language focuses on trail construction, ordering agencies can also purchase site assessment, planning, and design services from trail contractors that offer these services. For trail contractors who offer turnkey services, utilizing the same contractor can shorten time frames and reduce the risks associated with transitions from one contractor to another.

Ordering agencies are highly encouraged to utilize an experienced construction manager (state-authorized representative who manages the projects for the state agency or CPV members) or client representative (professional trail contractor) to:

- **Provide assess-plan-design services for complex trail projects.**
- **Provide on-site project management to ensure the design intent and expectations are understood.**
- **Lead regular construction meetings.**
- **Sign off that crew members match the approved crew roster on the project's work plan.**
- **Receive daily progress reports and track daily/hourly crew activities.**
- **Provide continuous assessment of crew's work progress and performance to ensure production rates meet the hourly/daily rates paid and quality of trail construction matches expectations.**
- **Provide owner's approval and final acceptance of the work.**

The following outlines the primary steps for purchasing from a pre-approved trail contractor:

1. **Prepare work plan –** The purchasing entity prepares a work plan and any drawings necessary to support the project. The work plan details labor and material quantities and tasks to be performed by the trail contractor at a specific site/location. Costs and work schedules may be established from any written estimates or verbal discussions with the trail contractor.
2. **Review and negotiate work plan –** The trail contractor reviews and negotiates changes to the work plan, then the final work plan becomes part of the resulting purchase order.
3. **Create purchase order –** The purchasing entity creates and submits the purchase order and a "Notice to Proceed" letter to the trail contractor. Purchase orders may be amended by change orders.
4. **Invoice for work performed –** The trail contractor invoices for completed work.



DEPARTMENT OF ADMINISTRATION
STATE PROCUREMENT

Attachment E

Example Work Plan

[THE WORK PLAN WILL BECOME PART OF THE RESULTING PURCHASE ORDER THAT DEFINES THE PROJECT BUDGET AND OTHER CONTRACT REQUIREMENTS.]

Project Title: *The name of the project site and specific project title are identified.*

1. Project Overview and Work Items:

Work summary will describe the trail development issues to be encountered, with emphasis on describing the special features that the Builder will be expected to build.

Example: "Build natural surface mountain bike trails number 2 and 3. Total of 6 estimated miles, with trail difficulty ratings ranging from intermediate to advanced. Stone and rock work expected on certain segments. Existing conditions include stable soils for natural surface trail building, although some sections may require surfacing with borrow material to create an all-weather trail. Full bench cut will be required for all sections unless approved otherwise by Construction Manager."

2. Project Site(s)

A geographical description of the project site (or sites) will be provided.

3. Crew Roster

Listing of crew leaders and key crew members will be required to ensure quality outcomes and that crew experience is consistent with the qualifications of the trail builder.

4. Project Timeframe

A starting and ending date for all work will be provided, including a description of acceptable reasons for delays – such as weather, permit issuing, etc.

5. Budget Overview

A budget overview will describe the budget allocations for each key aspect of the work described in the work plan. This may include budget line items for a given type and length of trail, as well as building special features, using specialized equipment, and so forth.

6. Permit Requirements

Any specific permits that the Builder is responsible for will be defined. Any permits obtained by others that the Builder will have to adhere to will also be identified.

7. Performance Expectations/Evaluation

Performance expectations and evaluation will be included in the work plan to ensure a common understanding of performance will be assessed.

For TTY/TDD communication, contact us through the Minnesota Relay Service at 1.800.627.3529.

Page 1 of 1

Example work plan for Minnesota CPV program. Image courtesy of the State of Minnesota

For more details about the CVP program, please visit the Minnesota Office of State Procurement Cooperative Purchasing Opportunities website.

Working out trail building contracts eventually leads to moments like this. Redhead Mountain Bike Park in Chisholm, Minnesota. Photo by Chris Guibert/Rock Solid

Determining Pricing Method

Due to the wide variation in the ways a trail project can be executed on the ground, determining a fair and simple pricing method has always been a challenge for the trail building industry. Plus, it is extremely rare for the exact build length to be set prior to the start of a project due to the fact that it is the trail builder who makes the final decisions on the actual trail alignment (actual twists and turns) during construction. The cost (and time) to pin-flag or note exact placement of every twist and turn of a trail adds unnecessary cost to the project, especially since pin-flagging does not allow the trail builder any flexibility or creativity regarding site specific line placement. Flexibility with line placement within the corridor is critical since conditions below the ground are not fully known until construction starts.

Historically, the four most common pricing methods have been **linear footage**, **fixed price**, **unit price**, and **time and materials**. The following explains each while providing examples using the same goal of constructing five miles (26,400 linear feet) of trail for each method.

LINEAR FOOTAGE

One of the most common pricing approaches, this method involves pricing a trail segment based on a set price per linear foot of constructed trail. Ideally, trail segments of different trail types should be priced separately. Pricing trail construction solely on price per linear foot is simple, but can also be quite vague, especially if there is not a detailed trail index describing trail characteristics for each trail segment.

In addition, pricing per linear foot can encourage trail builders to focus more on daily production and less on quality trail and rider experience. Building TTFs and rockwork is much slower than typical tread construction. Slowing down to armor a drain or add an engaging TTF will not be in the financial interest of the trail builder unless this detail has been incorporated into the price per foot. This is why it is essential to have detailed descriptions of each trail segment with expectations regarding types and quantities of features to ensure that both the estimated price and intended rider experience are met.

> **Linear footage pricing example -** Construct five miles (26,400 linear feet) of traditional singletrack at $X.XX per linear foot

FIXED PRICE

From a budget perspective, a fixed price model works well for the land manager because it locks in the overall cost of the project and places production risk on the trail builder. However, as with linear footage pricing, a fixed price model incentivizes the trail builder to focus on daily production rather than quality of the build and rider experience. If the trail builder finishes the project under budget, then there is a financial reward in terms of additional profit. If the trail builder goes over budget, then there is a financial punishment in terms of reduced profit. On a fixed price project, it is easy to get caught up in the mental trap of being hyper focused on daily production, making production the primary objective rather than focusing on the build quality.

Fixed price also requires builders to add cost contingencies to the budget to account for potential unknowns. Delays due to weather, changing terrain conditions, or unknown underground constraints can all contribute to a project taking longer than planned. All of this has to be factored into pricing to help ensure a job meets the trail builder's profit goals. For all the reasons above, fixed price projects tend to be better for smaller projects with well-defined scope.

> **Fixed price example -** Construct five miles (26,400 linear feet) of traditional singletrack for a fixed price of $XXX,XXX

UNIT PRICE

The unit price model is the most transparent, fair, and effective for both the land manager and trail builder. However, it can be the most complex. Unit pricing ensures that trail builders are being compensated for the specific types of work being performed. This lessens the pressure of daily production goals for the trail builder and allows them to focus on doing what is best for the trail, instead of what will make the most money. Trail builders still need to execute each unit price item within their own internal estimated time frames.

Unit pricing creates the most viable option for true "apples-to-apples" comparison when it comes to reviewing bid responses, since all trail builders are bidding on the same units of work and estimated quantities. However, to utilize a unit pricing model, estimates on the quantities of all the various types of work that are to be performed must be reliable. This takes more time during the design phase, but it pays dividends during the contracting phase when trying to compare bids, as well as during the construction phase if decisions need to be made about adding, subtracting, or modifying unit quantities as the trails are being constructed.

Unit price example - Construct five miles (26,400 linear feet) of traditional singletrack based on the following estimated quantities:

- **Tread construction (Type A) - 18,500 linear feet at $X.XX per linear foot**
- **Tread construction (Type B) - 5,200 linear feet at $X.XX per linear foot**
- **Turn construction (Type A) - 1,000 linear feet at $XX.XX per linear foot**
- **Turn construction (Type B) - 800 linear feet at $XX.XX per linear foot**
- **Rockwork w/imported materials (TTFs) - 1,200 square feet at $XX.XX per linear foot**
- **Rockwork w/native materials (drain armoring) - 2,160 square feet at $XX.XX per linear foot**

TIME AND MATERIALS

Time and materials pricing has not been as common as linear footage pricing, but it has been more common in recent years as a result of the previously mentioned challenges that can occur with linear footage pricing and fixed pricing; those challenges are more related to poorly defined trail projects than the pricing models themselves. Time and materials pricing works especially well for projects that have less detail in the planning and design deliverables, or that have a lot of potential risk in terms of challenging terrain or complex features that are out of the norm for trail builders and difficult to define within a detailed timeline and budget.

Time and materials pricing can also be applied to projects focused on improving trail, evolving existing trails, or where the trail builder has a limited number of days or weeks available to work. In these cases, time and materials pricing allows the trail builder to accomplish as much quality work as possible within the available time window.

Time and materials pricing example - Construct five miles (26,400 linear feet) of traditional singletrack based on a daily crew rate of $X,XXX per day plus cost of materials purchased

- **Example: Crew estimates the work to take 66 days at a daily crew rate of $X,XXX for a total of $XXX,XXX plus cost of materials purchased.**
- **Conversely, if the land manager has a fixed budget of $XXX,XXX based on a daily crew rate of $X,XXX, it is simple to calculate how many days of work can be performed within the fixed budget.**

The common denominator for any of the pricing methods to work well is for a trail project to be purposefully planned and designed, with a descriptive trail index and reliable unit quantity estimates. Regardless of which pricing model is used, it is always important to know the unit price types and quantities for accurately estimating the time and costs to complete a project.

If the project is a design-build contract, it is still vital for the land manager and trail builder to collaborate on the trail plan and design to produce a thorough trail index prior to construction. This helps to ensure all parties have the same expectations regarding the build, and have a document to refer back to if questions or concerns arise during the build.

Pricing and Estimating Considerations

Estimating budgets for professional trail construction projects can be a challenge, especially in cases where the lead time between design and construction are years apart. Even without a large lead time between phases, pricing and estimating is difficult due to the highly variable nature of the desired experience. A variety of other factors influence pricing from one project to the next, such as availability of contractors, pricing of local lodging, resource analysis, permitting, approvals, remoteness of the project site, availability of local materials, and cost of supplies. Despite the challenges, estimating construction costs is essential for budget forecasting, grant writing, and construction schedule planning, all of which need to be addressed prior to creating a proposal package and soliciting bids.

The best method for understanding current price ranges is to contact a professional trail planner or builder in your region either by searching the PTBA directory or by an online search for local trail builders. When pricing, here are some typical questions a trail builder will ask about your project.

Do you have a trails concept plan? Who developed it?

How many miles of trail are there? Are they flagged? Who flagged them?

What type of experience are you wanting for each trail (trail types)?

How wide are each of the trails?

Do you want typical trail features? What types and how many do you want for each trail?

Do you want special trail features? What types and how many do you want for each trail? How many of these will there be on each trail? What do you want them constructed of, wood, steel, dirt, or rock? Do you have a list of these special features? Do you have detailed design drawings of these special features?

What is the terrain like where these trails will be located? Is it steep, flat, rocky, hilly? How steep? How rocky? Is the terrain open and clear or are there lots of trees or brush? Are the trees mature with a tall canopy and lots of space between them or are the trees young and very close together? (Terrain that is wide open with mellow side slopes, stable soils, and no trees to navigate or cut is going to be less expensive to build in than terrain that has steep side slopes, rocky soils, and lots of trees to navigate or cut.)

What are the soils like where these trails will be located? Is it sandy, loamy, rocky?

What does it take to access the project site? How much time will the build crew have to spend each day mobilizing into the project site?

Do these trails need to be signed? If yes, what types of signs will you want to use? How many of these signs are needed and where do they need to be placed? Are these signs to be made of wood, Carsonite, metal? Are these stock sign designs or custom? If custom, do you have designs already or will I need to come up with designs to be approved?

A trail builder needs to know the answers to these questions to best understand how much work and what types of work will be involved to provide an accurate pricing bid.

Turnkey construction typically includes all the elements necessary to deliver a completed trail, though special features such as bridges, boardwalks, and trail hubs are typically not included in those price ranges. There is a lot of variability in the industry in terms of what is included in a "turnkey" price structure, so it is essential to create bid packages that adequately address all pricing elements. Some of the key individual pricing elements to include in bid packages are listed below.

CORRIDOR CLEARING - cutting/clearing trees, understory, and other brush that is in the path of the designed trail. Corridor clearing is typically included in the tread construction price but can be listed separately if needed.

TREAD CONSTRUCTION - earthwork that includes cutting and finishing the tread as well as any integrated dirt features such as rollers and berms. With all else being equal, a 6-foot-wide trail can take twice as long to construct as a 3-foot-wide trail since there is at least twice as much dirt or more to excavate and disperse, as well as twice as much tread surface to finish. For this reason, trails of different widths and types should be priced separately.

Tread construction in Cedar City, Utah. Photo courtesy of IMBA

ROCKWORK - including armoring drains and construction of retaining walls and TTFs. Rockwork is a special skill set that takes much more time per linear foot when compared to typical tread construction. For example, a single build crew can build 200-400 linear feet of tread construction per day in typical conditions. Whereas it might take a single crew half a day to more than a full day to build a 50-foot-long rock garden, depending on where the rock is sourced and how intricate it is to place and secure all the rocks. This is why rockwork quantities need to be called out separately and priced differently. Rockwork is typically priced by the square foot (or per face foot for retaining walls) instead of by the linear foot since rockwork can be of varying widths.

Small retaining wall with culvert. Photo by Eli Glesmann/Rock Solid

Intricate retaining wall at Devil's Den State Park in Winslow, Arkansas. Photo by Eli Glesmann/Rock Solid

Construction of an extreme retaining wall was necessary to build the trail down a cliff wall. Photo by Hansi Johnson

WOODWORK - includes building boardwalks, bridges, railings, TTFs, and trail-related elements such as signs, kiosks, and seating areas. Woodwork is also a special skill set that, like rockwork, is much slower per linear foot when compared to typical tread construction. Woodwork can be billed by the feature type, linear foot, or square foot. If priced by the linear foot, wood features that are different widths need to be listed separately on the price sheet since two boardwalks of identical specifications aside from width would not be the same price per linear foot.

STEELWORK - includes building boardwalks, bridges, railings, and TTFs. Again, a much slower activity per linear foot when compared to typical tread construction.

MATERIALS - includes any types of products that are specified in the design-construction documents and need to be purchased to execute the job. Materials can include items such as rock and imported soil of a specific composition, culverts, and stormwater BMPs, to name a few.

SIGNAGE (AT TRAILHEAD AND ON TRAIL) - Signage costs and options vary widely from off-the-shelf products or custom fabricated. Composite signs, typically made of fiberglass, are one of the most commonly used off-the-shelf types of sign materials for trail construction projects. Custom signs typically utilize wood or steel, therefore vary in cost depending on specified materials and intricacy of design.

Custom trail signage at Tioga Recreation Area in Cohasset, Minnesota. Photo by Ryan Taylor Visual

SPECIAL FEATURES - one-off features such as trail hubs or unique start hills are more conducive to being priced using “each” instead of by linear foot or square foot. These types of special features need to have detailed design drawings and specifications for a trail builder to accurately price, unless the work is being performed as part of a design-build contract where the land manager and trail contractors work together to come up with a design that fits within the desired budget range.

Special finish zone feature for the UCI World Cup MTB race course at Centennial Park in Fayetteville, Arkansas. Photo by Eli Glesmann/Rock Solid

CONSTRUCTION METRICS - Construction metrics are intended to help estimate production potential of trail construction crews, estimate construction timelines, and monitor construction progress. Estimating construction timelines is a prerequisite to determining realistic project start and end dates for inclusion in a bid/proposal package. Crew sizes and daily production rates are the primary variables in determining construction metrics.

Trail construction crews typically consist of two to five staff. Below are examples of how crews are typically structured:

- **Two-Person Crew: 1 machine operator, 1 hand finisher**
- **Three-Person Crew: 1 machine operator, 2 hand finishers**
- **Four-Person Crew: 2 machine operators, 2 hand finishers**
- **Five-Person Crew: 2 machine operators, 3 hand finishers**

The most common crew configuration across the industry is a three-person crew. Crew configurations directly relate to how much daily production can be typically expected. Once you know the daily rate for a crew and expected daily production, production costs and timelines can be projected and extrapolated for multiple crews. The key variables are: **production footage** (daily or total), **duration** (quantity of work days), and **cost** (daily crew cost or total cost). If two of the three variables are known, the third can be calculated.

Three-person crew at Walden's Ridge Park in Chattanooga, Tennessee. Photo by Chrisman/IMBA

For example, one mile (5,280 linear feet) of trail to build where the trail builder estimates 250 linear feet per day of production for one crew, it will take approximately 22 work days to build (5,280 linear feet to build/250 linear feet per day production). Remember to factor in weekends when forecasting start and completion dates, as 22 work days is four weeks and two days, not three weeks and one day.

Here are the basic forumulas:

- **Daily production footage x quantity of work days = total production footage**
- **Quantity of work days x daily crew cost = total cost**
- **Total cost/quantity of work days = daily crew cost**
- **Total production footage/daily production footage = quantity of work days**

If the number of estimated crew work days starts to exceed your planned construction window, then you will need to start planning for additional crews. For example, if you need 10 miles (52,800 linear feet) of trail built and the builder estimates 250 linear feet per day of production, this amounts to 43 weeks, significantly longer than a typical 16-week summer build window like that of Northern Minnesota. A couple of calculations (43 weeks/three crews = 15 weeks per crew) tell us that three crews are needed to complete the build within the 16-week build window.

Daily crew production will vary depending on many factors:

- **Crew size**
- **Crew experience level**
- **Hillside slopes –** Steeper terrain requires more excavation; the slope sweet spot for trail crews is between 20-30% as this allows trail grades in the 10-15% range that will not break the half rule and require the least amount of soil excavated to build to those grades. Since extended trail sections rarely exceed 10% grade, any hillside slope above 30% creates more work to achieve the same result.
- **Hillside soils –** Consistent, loamy soil is much easier and faster to build in than a similar side slope that is littered with rocks or bedrock.
- **Hillside vegetation –** Clear, open terrain with no trees or dense brush is much easier and faster to build on than a hillside with lots of trees or dense brush.
- **Remoteness –** If a project crew has to hike an hour into and out of the job site each day, this will have a direct impact on daily production.
- **Trail type –** All other conditions being equal, a typical 3-foot-wide cross-country trail is easier and faster to build than a downhill flow trail, for example.
- **TTF types and quantities**

While the above list is not exhaustive, it highlights the primary factors influencing daily production. How much can a typical trail crew construct on a daily basis? The short answer is, it depends.

Typical trail crew construction metrics are:

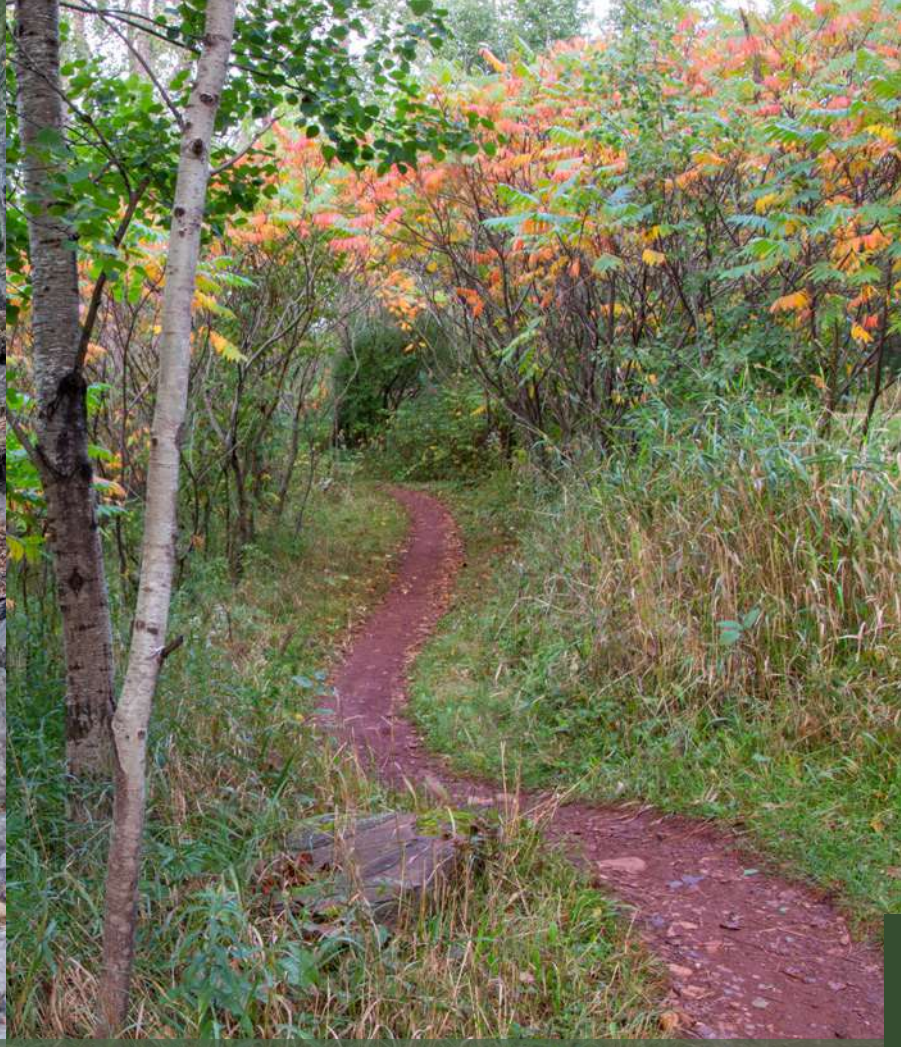
- **Three-person crew: 50 to 500 linear feet per day**
- **Five-person crew: 75 to 800 linear feet per day**

Why are the ranges so broad? For all the reasons listed above. For example, building in rocky terrain where the vast majority of tread surface is intended to be armored can limit production to 50 linear feet or less per day. Building on moderate sloped hillsides with consistent soils with no rock armoring or TTFs to construct can speed up production rapidly, with highly skilled crews hitting 500-800 linear feet per day. This second scenario is not very common, as the ends of the ranges are still considered extremes.

The Orange Crush trail at Redhead Mountain Bike Park (Chisholm, Minnesota) and Joe's Diner trail at Split Rock Wilds (Beaver Bay, Minnesota) are good examples of trails that were in the 50-75 linear feet-per-day range.

Orange Crush trail at Redhead Mountain Bike Park in Chisholm, Minnesota. Photo by Chris Guibert/Rock Solid

Joe's Diner trail at Split Rock Wilds in Beaver Bay, Minnesota. Photo by Chris Guibert/Rock Solid



Drag Line - North trail at Cuyuna Country State Recreation Area in Crosby, Minnesota. Photo by Steve Hausmann

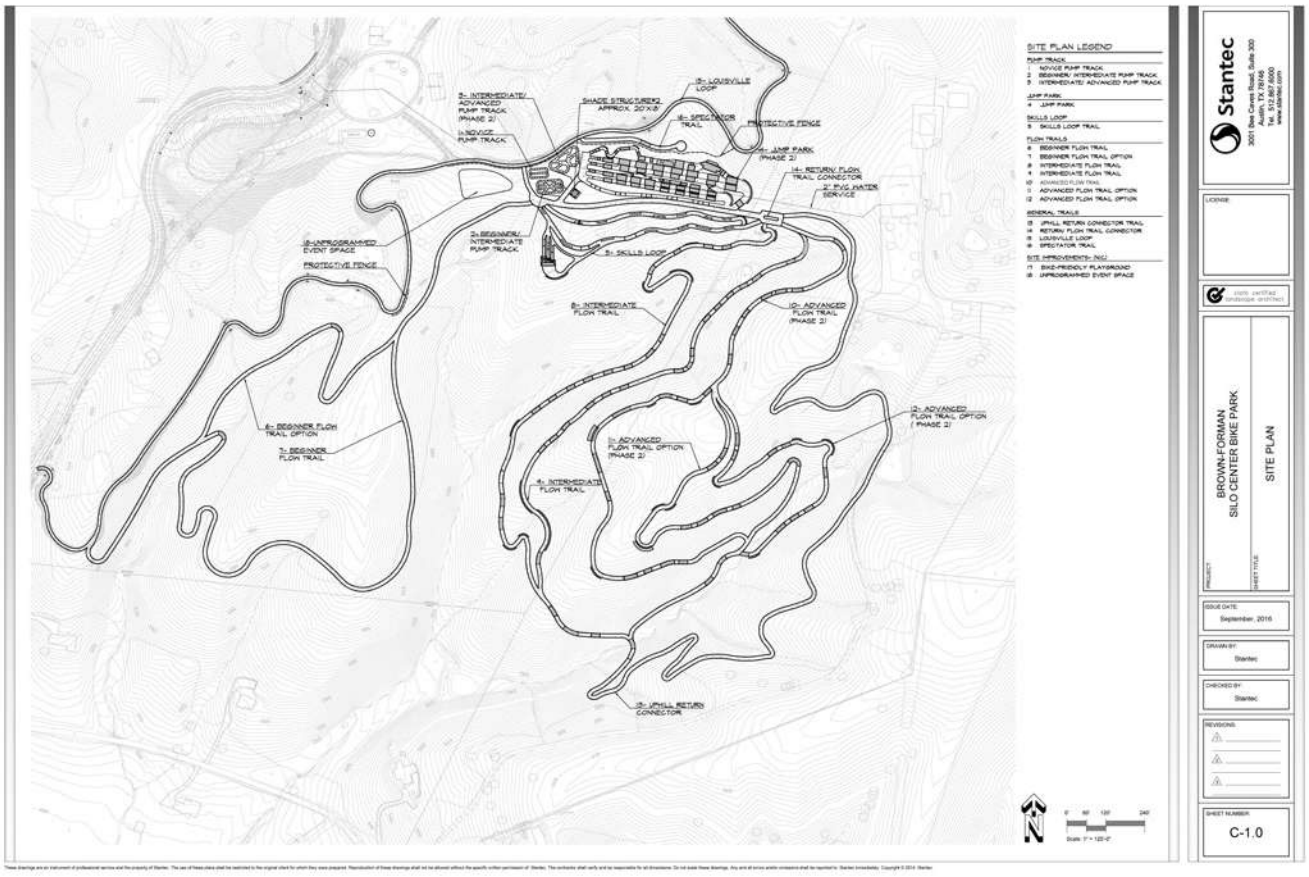
The Valley West trail at Mission Creek (Duluth, Minnesota) and Drag Line - North trail at Cuyuna Country State Recreation Area (Crosby, Minnesota) are good examples of trails that were in the 500-800 linear feet-per-day range.

The above ranges are good starting points for discussing key factors influencing daily production. In general, in typical conditions, building typical mountain bike trails, most crews can build (and finish) **200 to 400 linear feet of trail per day**. Multiplying this range by the number of workdays in a month results in the general estimating guideline of **one mile per crew per month**. One mile per crew per month is a solid metric for planning general trail building (not including engineered bridges or unique, special features). That said, one mile can be built in less time or take significantly longer depending on the trail type and build conditions, as well as unknowns such as weather and conditions below ground.

"One mile per crew per month." *— Tony Boone, Principal at Tony Boone Trails and COO of Timberline Trailcraft*

Creating a Bid/Proposal Package

A bid/proposal package, typically referred to as a request for bid (RFB) or request for proposal (RFP), can be as simple as a one-paragraph project overview with a list of build quantities, or as elaborate as a 100-page (or more) legal document with a full set of engineer-stamped construction documents. The extent of the bid package will depend on what contracting method is selected, what types of planning and design documents have been produced, and what contracting rules and regulations apply. This guide will focus solely on the elements that are unique or critical to mountain bike trail construction projects.



Site plan included in a bid package. Image courtesy of Stantec

Trail Project Summary

Bid packages can become very lengthy and therefore, time consuming for the reader. Do yourself, and your trail contractors a favor and include a summary of the project description (with quantities), project timeline, and business requirements at the very beginning of a bid package so that a trail builder can quickly and easily decide if this is a contract they can pursue.

PROJECT DESCRIPTION WITH QUANTITIES - A good project description can help a trail builder know quickly if the project is appropriate for their experience and skill set. If possible, include high-level quantities in the description so the contractor does not need to dig for the pricing worksheet buried elsewhere in the package.

- **Example:** Construct a new 10.5-mile, bike-optimized trail system consisting of a mix of beginner through advanced singletrack, flowy gravity trail, technical gravity trail, and gravity jump lines. Construction to include: approximately 3,000 square feet of technical rockwork, one 20-foot wooden bridge, design and installation of custom signage, and one 10,000-square foot gravel parking lot. Contractor responsible for providing all personnel, equipment, transportation, lodging, trail construction materials, and trail signage materials.

PROJECT TIMELINE - Trail builders book out six to 12 months or more, so knowing the deadlines for a bid response, project start, and project completion date helps a trail builder quickly determine if they have the availability to pursue a bid. Key timeline elements include:

- **Pre-bid meeting date and if it is a required meeting**
- **Pre-bid questions deadline**
- **Bid submission deadline**
- **Project start date or start window***
- **Project completion deadline**

Reminder: Because the environmental review process must be completed and all necessary permits in place prior to the start of construction, be sure to account for this when scheduling the project start date. Not having the environmental review complete or the necessary permits in place when the trail building crews arrive can create major disruptions in cost, schedule, and logistics.

BUSINESS REQUIREMENTS - A lot of smaller firms in the mountain bike trail contracting industry may not actively carry workers compensation coverage, be able to obtain high bonding limits, or have the administrative support staff to deal with time-consuming activities related to prevailing wage jobs. Trail builders also may not have contractors' licenses for multiple states. Knowing the business requirements upfront helps a trail builder quickly determine if they are eligible to bid on a project. For land managers reaching out to specific trail building firms, these are also good questions to ask early in the process to ensure the builder meets the requirements. If they do not, they should be given ample time to fulfill the requirements. This is by no means an exhaustive list, but here are some of the key business requirements that should be listed, if applicable:

- **Insurance –** can be automotive, equipment, general liability, and errors and omissions, to name a few.
- **Bonding –** typically payment and performance bonds. A payment bond ensures all subcontractors get paid so that the project owner is not left with subcontractor liens, while a performance bond guarantees the work will be completed if the trail builder fails to complete the work.
- **Contractor licensing –** can be as simple as filling out a form and paying a fee in some states, while other states can require contractors to register their business with the state, attend courses, pass exams, submit proof of insurance, and provide references and photos of work, among other things.
- **Prevailing wage –** projects that are subject to prevailing wage have established hourly pay rates (by trade) and special rules that contractors must conform to when paying employees; there are also specific payroll reports that must be completed and submitted regularly to ensure compliance on the part of the contractor.
- **Workers compensation –** a form of insurance providing wage replacement and medical benefits to employees injured on the job.
- **Federal Department of Transportation (DOT) registration –** Companies that operate commercial vehicles that exceed certain weight thresholds and are used to transport passengers or haul cargo in interstate commerce must be registered with the Federal Motor Carrier Safety Administration (FMCSA) and have a USDOT number.

It is important to note that there are a lot of smaller, qualified trail builders that will not meet all of the business requirements listed above. Making all of these mandatory will substantially lessen the pool of available talent, typically leaving only the largest contractors. As a land manager, it will be important to find a balance that will not unnecessarily exclude smaller, qualified contractors to create the largest possible bidding pool.

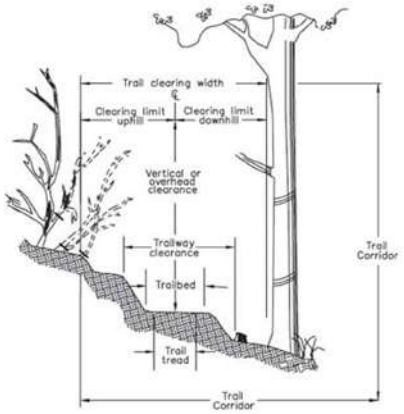
ADDITIONAL TRAIL-SPECIFIC INCLUSIONS - In addition to the project summary, timeline, and business requirements included at the start of the bid package, it is essential to have the trails design map graphic, trail index, construction typicals, design drawings/construction documents, and unit price sheet included in the bid package. These five items help ensure all contractors are bidding on the same items and with similar expectations of quantities and quality.

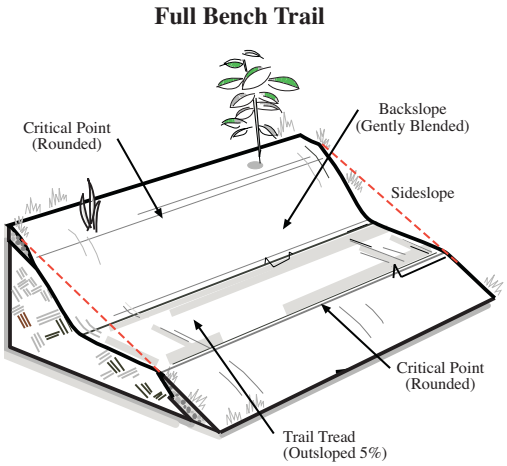
TRAILS DESIGN MAP GRAPHIC - Include the following versions that are developed during the design phase:

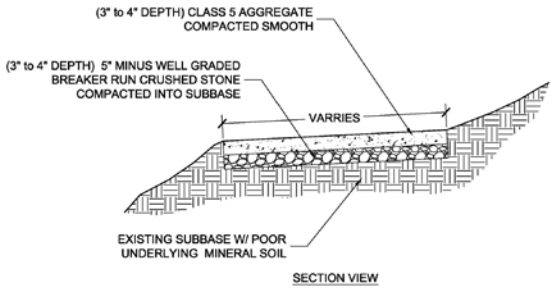
- **Trails design map image at a small file size for quick and easy viewing.**
- **Link to a downloadable high-resolution trails design map image in the form of a geo-referenced PDF. This can be the base map used when inspecting the property prior to preparing a bid/ proposal response.**
- **GIS data with the pertinent trail plan information for viewing in GoogleEarth or ArcGIS.**

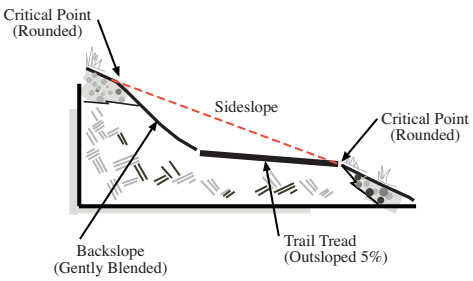
TRAIL INDEX - the final trail index listing the key trail characteristics necessary for how the final product should look and ride, paying special attention to trail types and trail features.

CONSTRUCTION TYPICALS - drawings of the most common trail elements or techniques that are used repeatedly throughout a trail system, such as rolling contour trail, the half rule, full-bench trail, trail corridor clearing limits, rock armoring, rock retaining walls, berms, switchberms (insloped switchbacks), wooden boardwalks, rock-armored drain crossings, trail capping, trail closure technique, and sign post installation. These should be included in a bid package even if there are no other specialty design drawings or construction documents.









Construction typicals for trail corridor clearing limits, flagstone paving, full-bench trail, and trail capping. Illustrations courtesy of IMBA and City of Duluth

DETAILED DESIGN DRAWINGS/CONSTRUCTION DOCUMENTS - detailed design drawings or construction document sets for typical and special trail features or structures, along with specifications on build technique and materials requirements. These are critical to ensure apples-to-apples bids.

COMMON PITFALL:

Poor descriptions of trail types and features

Trail types and features need to be thoroughly defined in terms of the type of trail, type of feature, size of feature, materials to be used, and the quantity of features desired for each trail segment. Without this specificity it is incredibly challenging for builders to provide accurate pricing in bid responses to ensure the desired trail experience and build budgets can be met.

UNIT PRICE SHEET - the unit price sheet is where contractors fill in their bid prices for each line item of biddable work. The unit price sheet is essential so that all contractors bid on the same line items and quantities. The more vague the line item pricing descriptions, the more challenging it will be for contractors to bid as they will have to make more assumptions. Typically, the more assumptions a contractor makes, the more they will have to pad their bid to account for lack of clarity in the bid package and unit price sheet.

A clear and detailed unit price sheet is worth the effort involved because it will allow more bidders to submit accurate bids and provide comparisons when reviewing bid responses. In many ways, building a trail system is like building a house as there are different specialty trades required to execute a house build. To get an accurate forecast of the cost to build the house, a builder or general contractor will need bids from the various trades, such as electrical, plumbing, carpentry, etc. While building a trail system typically does not require as many trade specialties as does building a home, a variety of elements still need to be listed separately in order to ensure there are clear expectations on the type and quantities of work involved. In general, these are things like trail types, custom wooden structures, rockwork, culverts, feature types, feature frequency, etc.

Here is a poor example of a line item from a unit price sheet. For this example, assume there is not a detailed trail index included in the bid sheet, which is, unfortunately, a common occurrence.

Poor example of a unit price sheet line item:

Build a five-mile intermediate-level single track trail. Price: _____

Why is this a poor example? By pricing the build as a bulk item and not by linear foot, it is not clear what the price would be for each foot of trail above or below the 5-mile mark, and whether or not the contractor would be compensated for any footage that exceeds the 5-mile mark. (It is extremely rare for planned footage to exactly match constructed footage.)

When a contractor reads a vague description like the example above, they may have the following questions:

- **What type of trail is the customer expecting, traditional, flowy, technical?**
- **What types of special features are they expecting, if any?**
- **What type of soil is there?**
- **How steep or shallow is the terrain?**
- **Are there natural materials available on-site for rockwork?**
- **What is access to the work site like?**

If these items are addressed in the trail index and supporting information obtained during the design phase, and included in the bid package, then the contractor will have sufficient information to make a pricing bid. If these items are not addressed, then, as a land manager, you can expect to either receive a lot of questions from your bidders during the pre-bid question period (and possibly have to scramble to find answers), or to receive fewer bids because contractors chose not to spend the time necessary to help a potential client sort out an incomplete bid package.

Most trail builders are extremely busy, and time spent responding to public bids is a hard cost in terms of time, travel, and personnel. As a result, most contractors will prioritize work they pursue based on how well the job is planned and how time consuming it will be to pursue this work. As a land manager, providing well-planned jobs with clear quality and quantity expectations will help establish your entity as a solid partner that quality trail builders will seek out and strive towards developing a long-term relationship.

Good examples of unit price sheet line items:

- **Build a five-mile, one-way, intermediate-level singletrack trail that is primarily flowy in nature, with descents optimizing flow characteristics through the use of berms, rollers, and jumps. See attached trail Index for additional trail characteristics and details.**

  Price per linear foot: _____

- **Construct 10 rock features of approximately 1,000 square feet. See attached trail index for the list and descriptions of feature types.**

  Price per square foot of rockwork: _____

- **Armor 30 drain crossings of approximately 1,200 square feet. See attached design drawing for typical drain armored section.**

  Price per square foot of rockwork: _____

- **Construct 100 linear feet of four-foot wide wooden boardwalk. See attached design drawing for specifications.**

  Price per linear foot of four-foot wide wooden boardwalk: _____

- **Construct 30 linear feet of six-foot wide wooden bridge with handrails. See attached design drawing for specifications.**

  Price per linear foot of six-foot wide wooden bridge with handrails: _____

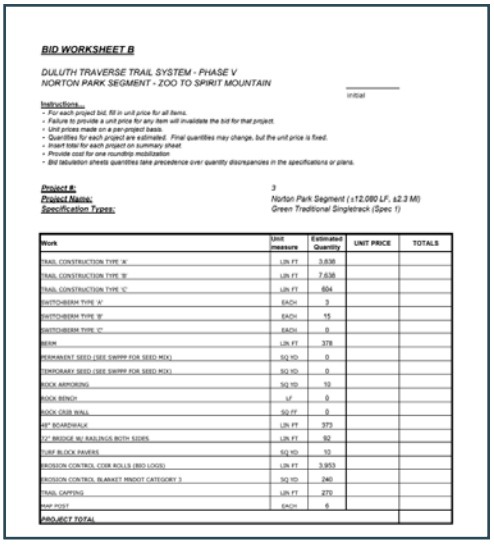
- **Construct one trail hub that includes rock benches and a 30-foot diameter gathering area for riders to congregate. See attached hand drawing.**

  Price for one trail hub: _____

What does the trail builder now know about the build expectations that were not outlined in the poor example? They know that the intended experience is a flow-style trail with 10 rock features throughout. They also know the land manager has planned for at least 30 drain crossings that need to be armored to help with drainage during expected rain events to minimize trail closures and repairs. They also know that the trail will probably be crossing a low-lying or wetland area since there is a special need for a boardwalk section, and that there is a ravine crossing where a bridge is needed. Last but not least, it is also known there is a desire for a trail hub at the start of the trail to bring riders together and initiate the experience.

This level of granularity goes a long way towards helping the contractor develop an accurate bid with a high level of confidence that their crew(s) can not only meet the desired outcome for the client, but also feel comfortable that they can meet their target profit levels without having to overly pad the bid to account for unknowns.

Item No.	Spec. Ref.	Description	Pay Unit	Est. Quantity	Unit Price	Amount Bid
1	312500	Inspect & Maintain Erosion Control as per MPCA General Storm Water Permit	L.S.	1	$	$
2	1.151B	Mobilization	L.S.	1	$	$
3	312500	Erosion Control Blanket, Category 4 Wood Fiber w/Natural Netting	S.Y.	4,000	$	$
4	312500	Sediment Control Log, Type D – Wood Chip, 8" Diameter	L.F.	1,010	$	$
5	322000	Type A Trail, 36" Wide Tread	L.F.	5,935	$	$
6	322000	Type B Trail, 36" Wide Tread	L.F.	10,980	$	$
7	322000	Type A Trail, 48" Wide Tread	L.F.	850	$	$
8	322000	Type B Trail, 48" Wide Tread	L.F.	250	$	$
9	322000	Berm Turn	L.F.	350	$	$
10	322000	Rolling Crown Switchback	EA	1	$	$
11	323000	HDPE Culvert, 15" Dia.	L.F.	45	$	$
12	323223	Salvaged Stone Retaining Wall	S.F.	300	$	$
13	322000	Aggregate Tread Capping, 3' Wide x 3" Thick	L.F.	7,500	$	$
14	322000	Relocate Wood Boardwalk	L.S.	1	$	$
15	323223	Trail Obliteration	L.F.	3,350	$	$
16	329200	Native Seed & Cover Crop	AC	5.0	$	$
17	329200	Weed Free Straw Mulch	AC	4.2	$	$



BID WORKSHEET B

DULUTH TRAVERSE TRAIL SYSTEM - PHASE V
NORTON PARK SEGMENT - ZOO TO SPIRIT MOUNTAIN

Initial

Instructions...
- For each project bid, fill in unit price for all items.
- Failure to provide a unit price for any item will invalidate the bid for that project.
- Unit prices made on a per-project basis.
- Quantities for each project are estimated. Final quantities may change, but the unit price is fixed.
- Insert total for each project on summary sheet.
- Provide cost for one roundtrip mobilization.
- Bid tabulation sheets quantities take precedence over quantity discrepancies in the specifications or plans.

Project #: 3
Project Name: Norton Park Segment (±12,080 LF, ±2.3 MI)
Specification Types: Green Traditional Singletrack (Spec 1)

Work	Unit measure	Estimated Quantity	UNIT PRICE	TOTALS
TRAIL CONSTRUCTION TYPE 'A'	LIN FT	3,838		
TRAIL CONSTRUCTION TYPE 'B'	LIN FT	7,638		
TRAIL CONSTRUCTION TYPE 'C'	LIN FT	604		
SWITCHBERM TYPE 'A'	EACH	3		
SWITCHBERM TYPE 'B'	EACH	15		
SWITCHBERM TYPE 'C'	EACH	0		
BERM	LIN FT	378		
PERMANENT SEED (SEE SWPPP FOR SEED MIX)	SQ YD	0		
TEMPORARY SEED (SEE SWPPP FOR SEED MIX)	SQ YD	0		
ROCK ARMORING	SQ YD	10		
ROCK BENCH	LF	0		
ROCK CRIB WALL	SQ FT	0		
48" BOARDWALK	LIN FT	373		
72" BRIDGE W/ RAILINGS BOTH SIDES	LIN FT	92		
TURF BLOCK PAVERS	SQ YD	10		
EROSION CONTROL COIR ROLLS (BIO LOGS)	LIN FT	3,953		
EROSION CONTROL BLANKET PINDOT CATEGORY 3	SQ YD	240		
TRAIL CAPPING	LIN FT	270		
MAP POST	EACH	6		
PROJECT TOTAL				

Unit price sheet examples. Images courtesy of Minnesota DNR (left) and City of Duluth (right)

The combination of a trails design map graphic, thorough trail index, detailed design-construction drawings and specifications, and a detailed unit price sheet work together to provide a solid foundation for a trail builder to develop accurate pricing for a project.

COMMON PITFALL:

Insufficient proposal content

A Request for Proposal (RFP) without a trails design plan, trail index, detailed design drawings/construction documents, and well-written unit price sheet can lead to wide variations of bid prices and increased odds that the final product will not match the desired trail experiences.

Trail Builder Qualifications

It is critical to review trail builder qualifications in your decision process of who to hire. Though the industry is seeing more experienced trail builders, more often than one would think, an excavation company or a pipe-laying company bids on trail work because they have the equipment and availability, but rarely have the appropriate skill set. Anyone who has been responsible for contracting projects where a bid was won by an inexperienced or unqualified firm is well-aware of the chain of disappointing events that can occur.

Including a good set of contractor qualifications in the bid package can help land managers exclude unqualified bidders, effectively evaluate the strengths and weaknesses of each qualified bidder, and help to determine which contractor has the niche skill sets required for a specific job.

In cases where bids are scored, different valuations can be assigned to each item depending on the contractors' responses. Though not an exhaustive list, typical trail builder qualifications that will be included in packages are:

PTBA MEMBERSHIP

Is the trail builder a member of the Professional Trail Builders Association (PTBA)? If yes, what date was their membership approved?

Note: It is recommended to not make PTBA membership a mandatory requirement as there are highly reputable firms such as IMBA Trail Solutions (nonprofits are not allowed to be PTBA members) and numerous smaller firms that have the skill and experience to build quality trail experiences.

TRAIL TYPE EXPERIENCE

Does the company have experience constructing the required trail types identified in the bid package? If yes, the company should provide the following for each trail type:

- **Trail names**
- **Trail locations**
- **Trailforks trail links (if available)**
- **Names of operators/crew members experienced in constructing the trail types and specialty types**
- **Number of years experience each operator/crew member has in constructing the trail types and specialty types**
- **Number of miles each operator has built for the specific trail types**
- **Photos of typical tread, typical features, and any special features constructed**

SPECIALTY-TYPE EXPERIENCE

Does the builder have experience constructing the specialty feature types (masonry/rockwork, woodwork, metal fabrication, dirt jumps) identified in the bid package? If yes, they should provide the following for each specialty type:

- **Names of crew members experienced in constructing each of the specialty types**
- **Number of years experience each crew member has constructing the specialty types**
- **Quantity of specialty features each crew member has built for each specialty type**
    - **Examples** – *rockwork: 5,000 square feet of rockwork, 35 rock gardens, 20 rock drops, 10 rock-overs/roll downs, 1,000 square face-feet of retaining wall, five trail hubs, seven specialty features*
    - **Examples** – *woodwork: 2,000 linear feet of boardwalk, 35 skinnies, 15 10-foot or shorter bridges, two 20-foot bridges, 15 specialty features*
    - **Examples** – *metal fabrication: 1,000 linear feet of metal bridges, 20 metal bridges 10-feet or shorter, one 50-foot bridge, seven metal frame jumps, three specialty features*
    - **Examples** – *dirt jumps: 15 jump lines/45 jumps, 30% beginner/60% intermediate/10% advanced/0% expert, 30 tabletops/five hip jumps/five step-ups/five step-downs*
- **Photos of specialty types constructed**

CLIENT REFERENCES

Bidding companies should provide three references for work performed that is similar to this project. They should include the full name, company name, job role (at the time of the job), email address, and cell phone number for each reference. Ideally, references will be people who have direct knowledge and experience working with the bidding firm during the construction process.

TEAM MEMBERS

Bidding companies should provide the names, qualifications, and years of experience (in the roles identified) of the team members that will be performing the following roles:

- **Project Manager –** The person responsible for contract management and administration and overall project delivery.
- **Project Foreman –** The on-site person responsible for execution of all project construction.
- **Machine Operators –** The lead machine operators for each crew.

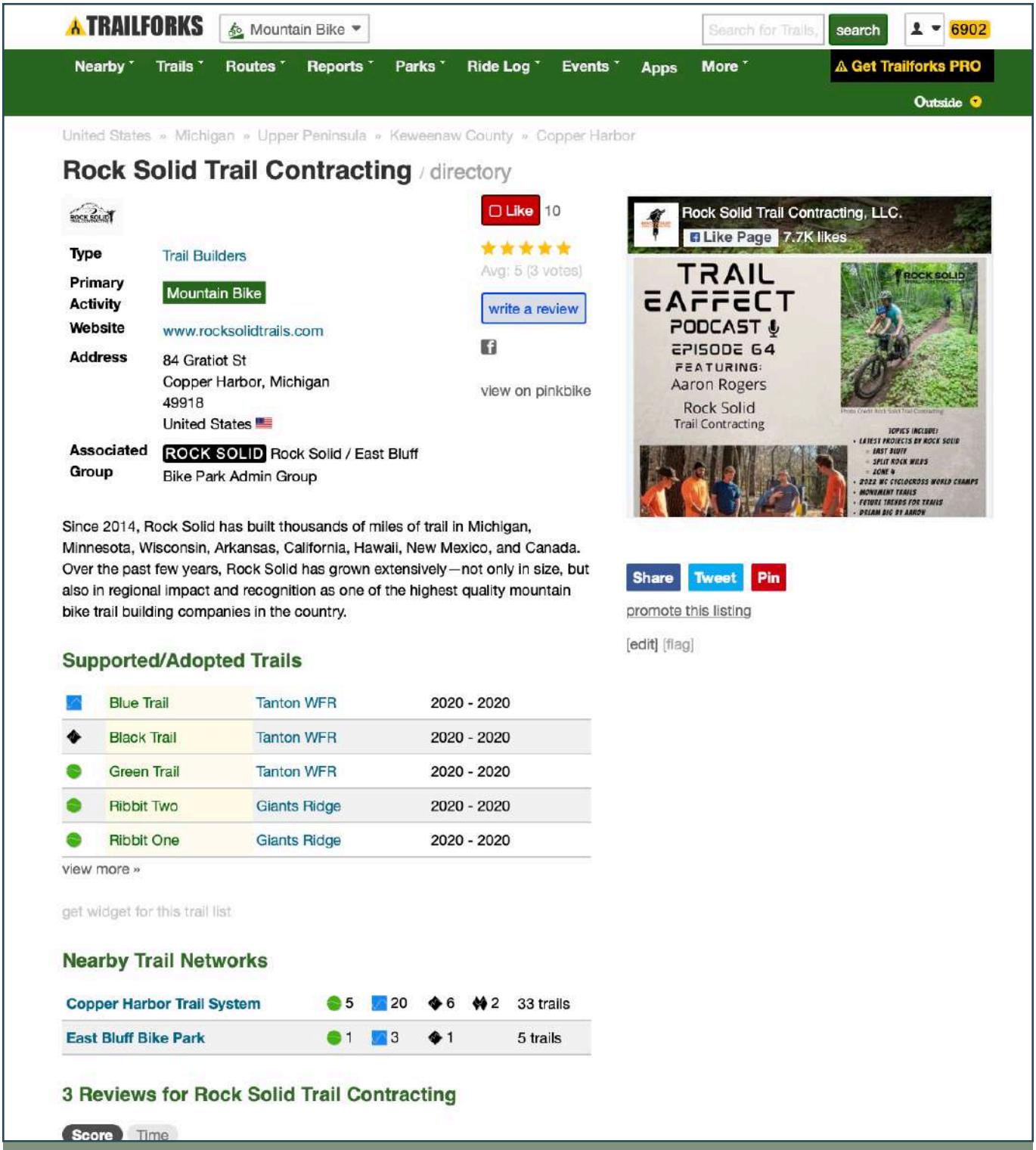
The qualifications above can help substantially in comparing and qualifying trail construction contractors. Keep in mind, however, that identifying key team members 12 to 18 months in advance can be challenging due to employee turnover and potential scheduling changes. A trail building company who can not identify their crew should not be ruled out unless a specific resource is critical to a type of construction and the company has no other qualified personnel to take over that person's role.

An alternative to incorporating contractor qualifications in a bid package is to have potential contractors complete a **Request for Qualifications (RFQ)** prior to releasing an RFB/RFP. This is an excellent method for developing a list of prequalified contractors and then only inviting the prequalified contractors to submit a RFB/RFP response. This can substantially speed up the review process by reducing the responses to only those of prequalified contractors.

COMMON PITFALL:

Not vetting contractors well enough

The trail building industry relies heavily on the apprenticeship method which can vary from builder to builder, putting more responsibility on the land manager to vet and qualify trail contractors. Despite having a professional association, there is not currently a licensing or certification path for teaching and testing the most common trail planning and trail building techniques to ensure a common standard of knowledge and execution.



Trailforks trail builder page for Rock Solid. Image from trailforks.com

TRAILFORKS TRAIL BUILDER DIRECTORY: The Trailforks application allows trail builders to list their firm as the builder of individual trails or trail systems, allowing users to search for trails constructed by specific builders. The application also allows users to write reviews of the trail building firms. This can be a good source for researching the work of trail builders or to find trails built by specific builders in your region.

Before and after tread construction in Lander, Wyoming. Photo by Adam Buck/Pathfinder Trail Building

Flowy bike-optimized singletrack trail in Tofte, Minnesota. Photo courtesy of Rock Solid

Rock berm under construction on the Boo Boo trail at Slaughter Pen in Bentonville, Arkansas Photo by Kyle Copeland/Rock Solid

Completed rock berm on Rock Solid at Coler Bike Preserve in Bentonville, Arkansas. Photo by Hansi Johnson

Armored S-berm at Welch Village in Welch, Minnesota. Photo by Adam Buck/Pathfinder Trail Building

Rock drill prep for using feathers and wedges to split rock. Photos by Eli Glesmann/Rock Solid

Lots of detailed hand work goes into making rock puzzles secure, stable, and fun. Photos by Chris Guibert/Rock Solid

Using the rock saw to cut and shape rock at Centennial Park in Fayetteville, Arkansas. Photo by Eli Glesmann/Rock Solid

Before and after rock tread construction at Sinks Canyon in Lander, Wyoming. Photos by Adam Buck/Pathfinder Trail Building

Before, during, and after rock tread construction at Cacapon State Park, West Virginia. Photos courtesy of IMBA

Portable chainsaw mill for planing logs in the field. Photos by Chad Landowski/Traction Trailworx

Ripping black locust trees for log-ride features in Munising, Michigan. Photos by Chad Landowski/Traction Trailworx LLC

Building a custom wood-stone trail feature at HandCut Hollow in Bentonville, Arkansas. Photo by Eli Glesmann/Rock Solid

Completed custom wood-stone trail feature at HandCut Hollow in Bentonville, Arkansas. Photos by Eli Glesmann/Rock Solid

Fabricating a custom steel trail feature in the wild at Coler Mountain Bike Preserve in Bentonville, Arkansas. Photo by Eli Glesmann/Rock Solid

COMMON PITFALL:

Selecting an unqualified trail builder

Selecting a trail builder without expertise in the desired trail types and features you have planned can result in a myriad of issues such as trail types and features not meeting expectations, poor construction techniques leading to erosion and maintenance issues, or having to hire another contractor to come back and fix mistakes.

Soliciting Bids/Proposals

Soliciting bids requires publishing the bid package so contractors can bid on the project. Where you publish can vary depending on whether the solicitation is for a public or private bid. The public bid process typically has strict rules that need to be followed to ensure a fair and equitable process. The private bid process is less formal and can be as simple as sending emails containing the bid package to known contractors asking for a response by a certain date. For bid solicitation rules, contact your agency's contracting department.

For trail construction bids, it is recommended to solicit bids at least 12 months in advance, and ideally 18 months in advance of your intended start date. Since quality trail builders routinely have their schedules booked six to 12 months or more in advance, the biggest pool of potential candidates will be available to you if you solicit bids 12 to 18 months prior to the project start date.

COMMON PITFALL:

Poor timing of proposal solicitation

An RFP released too late in the process may receive few or no responses because all qualified trail builders are already booked for the desired build season, leading to delays of up to a year or more depending on the length of your build season. Due to the shortage of qualified trail builders, trail construction RFPs should be released one year or more in advance to ensure the largest possible pool of qualified bidders.

Reviewing Bids/Proposals

Reviewing bid responses involves a lot more than just looking at price; this is why low-price bid selection is not recommended for trail construction projects. The two most common methods for selecting a bid response are lowest price and best value. Low-price bid selection is exactly what it implies, that the lowest price bid is selected, regardless of other criteria. Low-price bid selection may work well for buying widgets or highly standardized services, but a trail construction project is far from either.

A best-value bid is where the selection can be based on qualitative factors and the overall perceived value of the contractor's experience and price. Though not allowed by all municipalities, this allows the bid solicitor to select the company they feel has the best qualifications for their job, even if the price is higher than other respondents. Recalling the trail builder qualification criteria discussed earlier in this section, the following are reminders of why selecting a low-price bid is potentially disastrous. If the answer is "No" to any of these questions, it is better to avoid the low-price bid:

1. **Does the trail builder have experience building the types of trails requested?**
2. **Do the machine operators identified for the project have experience building the types of trails requested?**
3. **Has the trail builder performed work for your entity in the past? If so, did that project meet quality, timeline, and price expectations?**

If you have no option but to use the low-price bid method, it is essential to establish robust contract requirements to weed out unqualified builders. Being armed with the trail builder qualifications discussed earlier, as well as the option of using an RFQ to develop a list of prequalified bidders, can help to provide the confidence needed in having to choose the lowest bidder for your project.

Here is some sage advice from a couple of Minnesota land managers that have extensive experience hiring and managing professional trail contractors.

"As for selecting trail contractors we weigh heavily the quality/performance of past work and often take site visits to see the work and evaluate it prior to selecting a contractor. We also ask the contractors to have PTBA (Professional Trail Builders Association) membership in good standing or similar experience. We always ask for and call references." — Jim Shoberg, Senior Parks Planner and Landscape Architect for the City of Duluth

"Trail contractor evaluations can be tough for a land manager to decipher. It is good to also chat with the local representatives about their experience (scope, schedule, budget) with specific builders and understand the contractor's preferred style of trail construction. Trail building crews from the same contractor can have their own specialties and knowing who the primary excavator (crew lead) operator is can help the land manager make a more confident selection." — Trent Luger, Senior Landscape Architect, Minnesota DNR

Establishing trust and building long-term relationships with trail contractors can substantially reduce the stress levels and decision paralysis that are common when hiring a new contractor. As important as it is for trail contractors to work to earn a land manager's business and trust, it is equally important for land managers to do the same. It is not uncommon for quality trail building firms to have multiple contracts from which to choose from. A land manager that is easy to work with and has a track record of being responsive and fair can play a large role in the trail contractor's decision process.

Awarding the Contract

Awarding the contract is the activity of executing a contract once a trail builder has been selected. An award does not necessarily have to go to just one trail building firm. Depending on the size, timeline, and technical expertise required on a project, contracting with multiple vendors can make a lot of sense to ensure a sufficient number of crews with appropriate skill sets are staffed to meet the quantity (trail mileage), quality (trail experience), and timing requirements (project deadline). There are very few trail contracting firms that have the sheer number of crews necessary to complete a 10- or 20-mile trail system in a single summer season, for example.

Minnesota is a prevailing-wage state, which means that there is a minimum hourly wage that employers must pay certain workers on projects where state dollars are used to fund the construction. Certified prevailing wage rates are set by the Minnesota Department of Labor and Industry (DLI) for each county. However, each governing jurisdiction may have a different agreement with the local labor union and whatever is in that agreement must be followed.

There is a high probability of working with out-of-state firms not familiar with prevailing-wage rates. Be sure to provide prevailing-wage rate information to potential trail builders so they have the proper labor code rates of pay for accurately pricing their services. Trail builders that have not worked on a prevailing-wage contract may need support as they get up-to-speed on the requirements. However, time invested in helping trail builders meet and adhere to Minnesota contracting requirements is a win-win for the entire state, as it helps to create a larger pool of qualified trail builders for all agencies in the state.

Chapter 12: Trail Development Process - Build

The build phase begins once the trail planning and design activities are complete, though you will begin planning for construction long before. Since trail building techniques are covered extensively in other publications such as IMBA Trail Solutions, this section will focus primarily on the build phase as it relates to the role of the land manager rather than specific construction techniques.

The key activities of the build phase are:

- **Schedule the work.**
- **Kick off the project.**
- **Monitor the progress.**
- **Close the contract.**

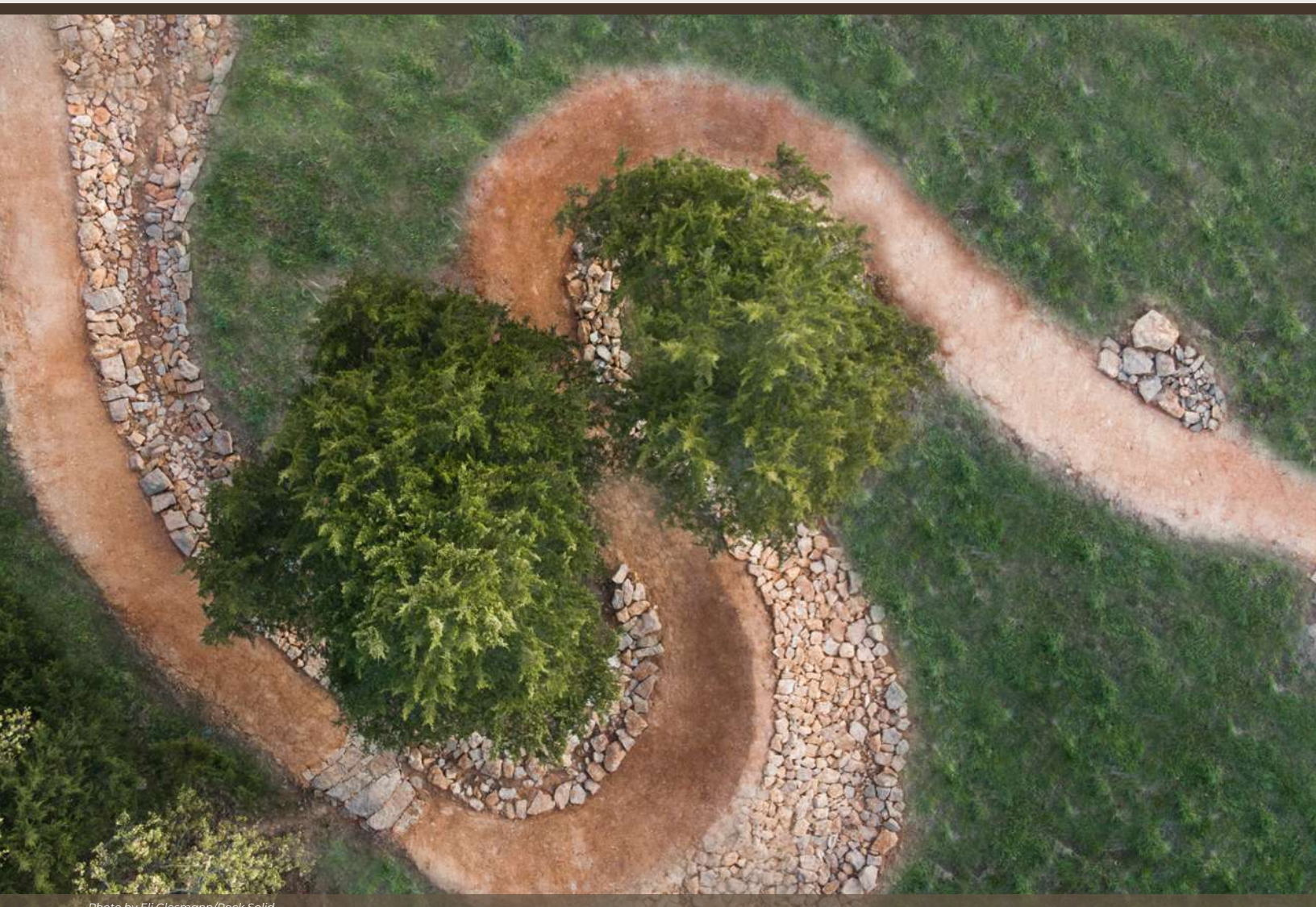


Photo by Eli Glesmann/Rock Solid

Excavator work at Arapahoe Basin, Colorado. Photo courtesy of IMBA

Scheduling Work

Scheduling should begin as soon as a contract is signed or awarded. Work with the trail builder to determine planned start and completion dates, though "no-later-than" start and completion dates should have already been identified in the bid package. Since weather and crew availability can impact planned start dates, ongoing communication with the trail contracting firm is vital. Weather conditions that happen prior to a project can have a domino effect and can cause delays for crews on prior work, which can also push out project start dates.

Photo by Chris Guibert/Rock Solid

Depending on the location where work is being performed, lodging can be a challenge, especially if the project is in a highly visited tourist destination where lodging can be scarce and/or incredibly expensive. It is worthwhile to bring this type of information up during the bid process so contractors are aware of potential scheduling challenges and above-normal lodging expenses.

This is also a good time to review all the equipment, material, and personnel logistics in preparation for the arrival of build crews. As you will remember from the design phase chapter, the key logistical considerations are:

- **Staging, storage, and access/exit points for equipment**
- **Staging and access points for materials**
- **Access points for crews**
- **Locations where site-sourced materials can be harvested**

Last but not least, be sure all necessary regulatory approvals and/or permits are in place prior to the arrival of crews. Nothing creates havoc like finding out on arrival day that portions of a property or segments of trail can not be started due to pending approvals, especially if those areas or trail segments are vital access points for equipment, materials, or personnel. Changes Required in such situations are likely to result in contractual change orders and increased costs to compensate the trail building firm for increased project build times. No one wins in this situation, as costs increase for land managers while work schedules for crews, typically planned well in advance, get pushed out and have a ripple effect, potentially delaying project start times for other customers.

Trail closure signage during construction. Photo courtesy of IMBA

Kicking Off the Project

Before trail building crews start work, it is vital for the land manager, project owner, and trail contracting firm to hold a kick-off meeting to ensure everyone is on the same page. The key items to review and discuss are:

- **Introductions, job roles, and reporting channels. It is essential to establish one primary point of contact between the land manager and trail builder to ensure continuity of communications.**
- **Project scope, project location, project boundaries.**
- **Planned start and end dates.**
- **Rules and protocols while working on the project site, such as:**
    - *Days and times when crews are/aren't allowed to work*
    - *Where trailers and work vehicles can/can't be stored*
    - *Where job materials can/can't be stored*
    - *Where crews can/can't park on a daily basis going to job site*
    - *Where crews can/can't utilize restroom facilities*
    - *Emergency situation protocols*

- **Resource concerns such as sensitive areas and how crews can/can't interact with those areas, what types of environmental controls (erosion control materials or techniques) are expected to be used, and what types of environmental protocols (monitoring and reporting) may be required to comply with environmental protections and permit requirements defined during the environmental review process.**
- **A plan to walk the flag lines so all crew members get a feeling for the overall project, the terrain, and client expectations for trail types and features. This may be the first time some or any of the crew members have visited the site as it is not uncommon for only the trail planners to have been to the site prior to construction crews arriving.**
- **Additional time for questions and answers.**

The kick-off meeting is typically the first time a lot of the project personnel will be meeting, so this is a good time to get to know each other a little bit and start building a positive and productive relationship. A positive tone in a kick-off meeting can go a long way towards establishing a positive project from day one.

Trail builders should frequently flow-check work by riding new sections. Photo by Eli Glesmann/Rock Solid

Monitoring Progress

Whether it is someone from your staff or a professional client representative, an independent party not involved in the trail build needs to continually walk and/or ride completed work to provide requested corrections as a "punch list" to the trail builder. If possible, this would be done daily. If not, it should be done weekly at a minimum. It is best to have more frequent site visits on the front end of a project to become familiar with the contractor's progress and quality of work. Even if the trail builder has been contracted on past projects of yours, one of the crews on the project may be new to the company.

Therefore it is always good to review and provide feedback early and often to catch issues before the crews progress too far past the problem. For trail building crews, mobilizing back to a section of trail from even a week or two prior can be time-consuming and cost-prohibitive. Work with the trail builder to develop a review schedule that works for everyone.

> ***Reminder:*** Natural and cultural resource concerns must also be monitored with any required inspections or submissions related to resource protection and mitigation defined by permits and be performed and submitted within required timelines. Periodically review agreed-upon decisions resulting from environmental review processes with the approval/permitting point of contact to ensure all requirements are indeed met when it comes to any engineering controls or special construction protocols for particular sections of trail.

COMMON PITFALL:

Failure to monitor construction progress

Failure to monitor construction progress and quality can lead to rework, project delays, and budget overruns.

Trail bridge under construction at Split Rock Wilds in Beaver Bay, Minnesota. Photo by Andy Flietstra/Rock Solid

Machine operators and hand crew making the magic happen. Photo by Eli Glesmann/Rock Solid

In addition to monitoring quality of work, it is important to monitor the quantity of work completed to understand if the project is on track to meet the construction timeline outlined in the contract. Measuring linear footage of tread construction with a measuring wheel is the most straightforward way to do this, as the trail builder will be doing the same. This also serves as a good way to double-check invoice quantities and build trust in the process.

Monitoring Unit Price Quantities

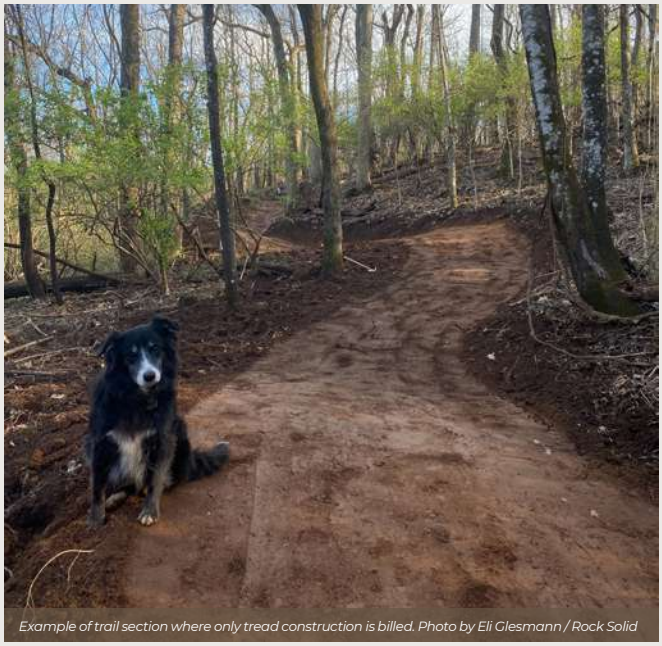
Billing for linear footage, fixed price, and time and materials pricing methods are straight-forward and require minimal measurements and calculations. Linear footage pricing applies a per-foot price to every foot of trail type constructed, regardless of what types or quantities of wood, rock, steel, or dirt features are constructed. Unit pricing, on the other hand, applies separate prices for each unit type and requires more measurements and billing calculations. It is important to verify the different unit price quantities constructed or at least spot-check items to ensure your measurements and the contractors are in alignment.

Some additional unit price distinctions to consider are:

TREAD CONSTRUCTION - differentiates price per unit for tread construction, berms, and jumps. Tread construction is priced by linear foot and has separate pricing for each trail type and width. Berms are also priced by linear foot but have separate pricing for different sizes/heights (small, medium, large). Jumps are typically priced by each and can also have separate pricing for different sizes.

ROCKWORK - differentiates price per unit for rock armoring, retaining walls, and whether native (on-site) or imported (purchased) rock is used. Rock armoring is priced by the square foot whereas retaining walls are priced by the square face foot (wall length multiplied by wall height). When billing for work, trail builders should only bill for rock-armored tread and dirt tread construction for the same section of trail if there are two constructed and finished riding lines (alternate lines).

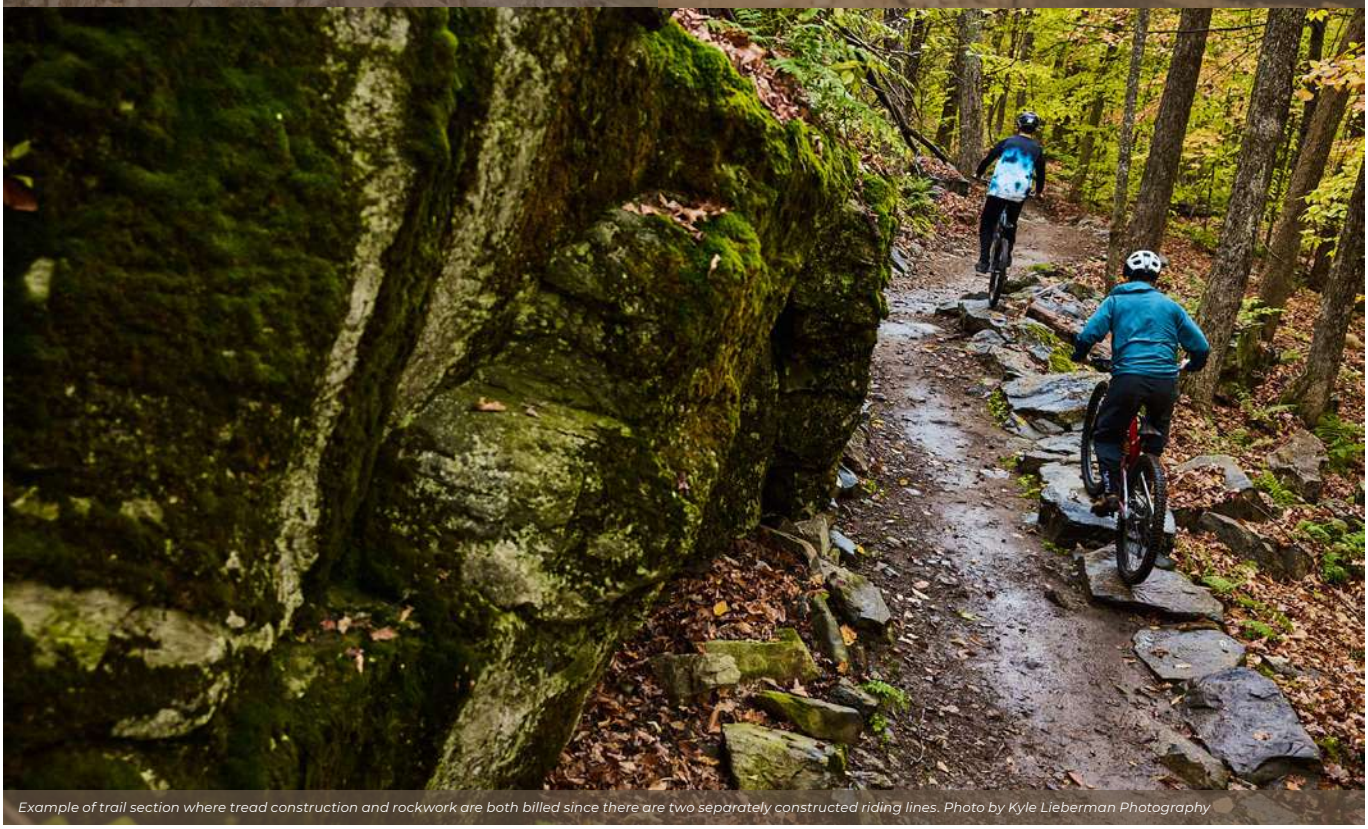
WOODWORK/STEELWORK - differentiates price per unit for boardwalks and bridges based on length or square footage. If based on length, separate prices need to be defined for different widths. As with rockwork, trail builders should only bill for both the wooden/steel structure and dirt tread construction for the same section of trail if there are two constructed riding lines.



Example of trail section where only tread construction is billed. Photo by Eli Glesmann / Rock Solid

Example of trail section where only rockwork is billed since the rockwork is the only riding line. Photo by Chris Guibert/Rock Solid.

Measuring production quantities for invoice billing. Photo by Eli Glesmann/Rock Solid



Example of trail section where tread construction and rockwork are both billed since there are two separately constructed riding lines. Photo by Kyle Lieberman Photography

The key to accurate unit price invoicing is to consistently measure each unit price type the same way. Berms, for example, will produce different quantities when measured from the bottom, the top, or along the riding line. Unit pricing requires a bit more effort than the other pricing methods, but it is the most precise and transparent for estimating and setting expectations about build quantities and user experience.

Closing the Contract

Perform a final walk-through and create a punch list of items for the trail builder to complete. Upon satisfactory completion, document successful fulfillment of trail builder responsibilities and approve release of the final invoice and retainage (if applicable). This is also a good time to capture GPS tracks of each trail segment as these are essential for developing accurate trail maps. Last, but definitely not least, be sure to fulfill and finalize all resource-protection protocols and permit requirements to ensure full compliance with the environmental review process to the satisfaction of the land manager.

> ***NOTE:*** **Retainage** refers to when a project owner withholds a portion of invoice proceeds (usually 10 percent) and then releases those funds once the project has met all completion criteria.

Trail building at Arapahoe Basin ski area in Dillon, Colorado. Photo by Chrisman/IMBA

Chapter 13: Trail Development Process - Promote

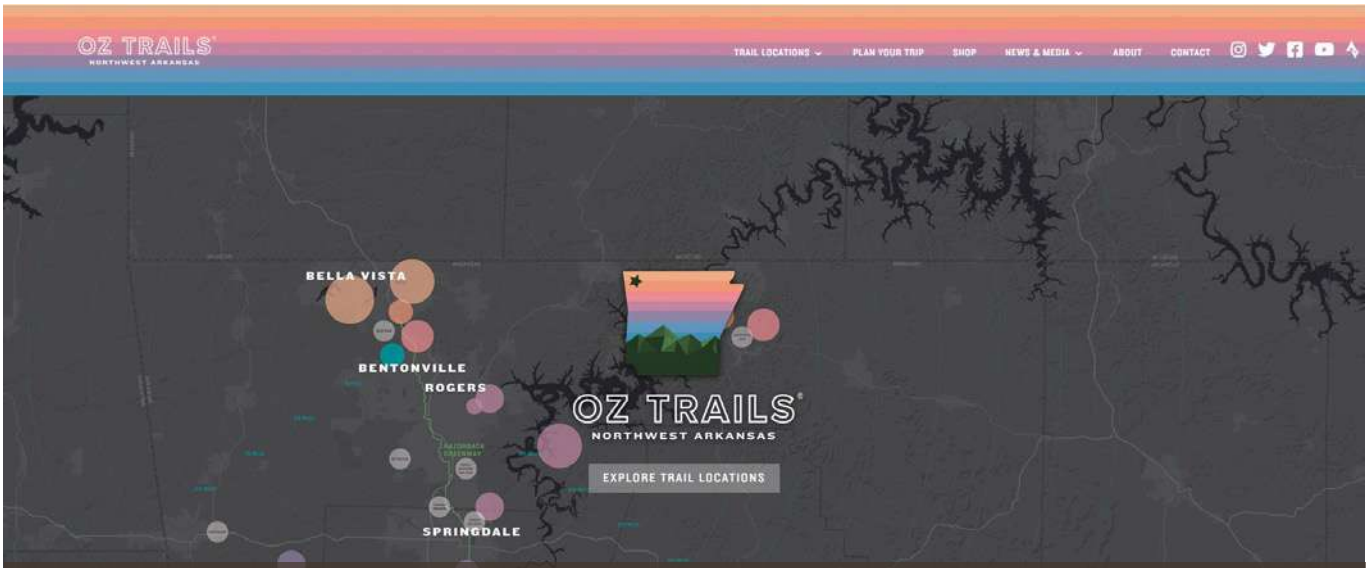
The promotion and marketing of the trail system should begin in conjunction with the planning phase; early user engagement builds excitement and anticipation. Marketing and promoting the trail system once the trails are complete is equally important and may be done with help from a number of agencies. Promotion should extend beyond just the physical trails and carry over to trail-based programming for activities such as general events, themed events, races, skill clinics, or any type of community gathering where the trails are the infrastructure that make the programming possible. In addition, tracking and monitoring the success of a new trail system can provide key data for justifying past and future trail investments.

The key activities of the promotion phase are:

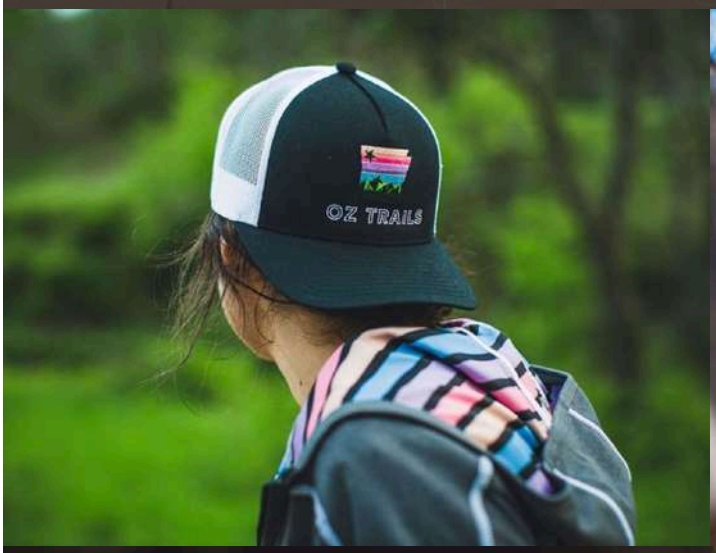
- **Develop community branding.**
- **Document progress with photos and video.**
- **Identify internal and external promotion channels.**
- **Create and publish content.**
- **Create and publish trail maps** (MTB Project/Trailforks).
- **Host a grand-opening event.**
- **Create trail-related programming.**
- **Track and monitor progress.**

Developing Community Branding

Even if your community has no existing trail systems, think beyond the creation of the first trail system and consider developing a community-wide brand that can represent all future trail systems and trail-related programming in your area. Having a community-wide brand from the outset can help target marketing and promotion activities for all future trail projects. This is something that Bentonville, Arkansas has done quite successfully with their OZ Trails brand and new tagline, 'The mountain bike capital of the world.' OZ Trails has become the brand that represents all mountain bike trail systems in the Northwest Arkansas corridor, providing a single communication point for system-wide communications and conversations.



Community branding to showcase the multi-purpose trail development in Northwest Arkansas. Image from oztrails.com



Community branding carried over into events, logistics, trail infrastructure, and merchandise help create a unifying experience for visitors and locals alike. Photos courtesy of OZ Trails

Documenting progress

Gain user engagement early in the project and document the progression of the trail development phases with photos, videos, and stories. Parlay the images and video into media attention by providing them to local and regional media outlets with key messages to make story writing easier. Or, better yet, hire a professional writer, photographer, or videographer that specializes in the mountain bike industry to capture and write content to tell the story. Content creators who specialize in the mountain bike industry will usually already have a user following as well as knowledge of specialty channels to recommend for content distribution.

Photo courtesy of OZ Trails

Identifying Internal and External Promotional Channels

Internal channels are promotional avenues within your own agency, whereas external channels are any promotional avenues outside of your agency. Promotional channels can be formal, such as local newspapers or television stations, or informal, such as mountain bike clubs or local bike shops. In addition to print publications and television, some of the most commonly used platforms for promotion are websites, blogs, YouTube, Facebook, Instagram, and Twitter.

Promotional channels to consider include:

LOCAL AND REGIONAL MOUNTAIN BIKE CLUBS - Local mountain bike clubs are usually filled with passionate advocates and avid promoters of mountain bike trail projects. IMBA-affiliated mountain bike clubs can be located using the IMBA website directory. At the time of printing, clubs are active in the following Minnesota areas:

- **Biwabik and Chisholm – Iron Range Off-Road Cyclists (IROC)**
- **Deerwood – Cuyuna Lakes Mountain Bike Crew (CLMTB)**
- **Detroit Lakes – Lakes Area Mountain Bike Alliance & Trails (LAMBAT)**
- **Duluth – Cyclists of Gitchee Gumee Shores (COGGS)**
- **Grand Marais – Superior Cycling Association (SCA)**
- **Grand Rapids – Grand Rapids and Itasca Mountain Bicycling Association (GRIMBA)**
- **Mankato – Mankato Area Mountain Bikers (MAMB)**
- **Winona – Winona Area Mountain Bikers (WAMB)**

LOCAL AND REGIONAL BIKE SHOPS - Bike shops have a vested interest in promoting new trails. More trails usually translates to more riders which in turn translates to more bike sales and repair work.

LOCAL AND REGIONAL PROMOTIONAL AGENCIES - Local and regional promotional agencies exist for the purpose of promoting state attractions. Involve promotional agencies early in the trail development process to leverage their knowledge, experience, and understanding of local and regional promotional timelines. Promotional agencies include:

- **Destination marketing organizations**
- **State tourism bureaus**
- **Regional tourism marketing organizations**
- **Chambers of Commerce, local as well as regional**

Photo courtesy of OZ Trails

LOCAL AND REGIONAL NEWSPAPERS AND TELEVISION STATIONS - Local news outlets are often seeking new stories and content to cover.

NATIONAL MOUNTAIN BIKE MEDIA COMPANIES - Obtaining coverage at the national level can be more challenging without a compelling story or content. Mountain bike media companies produce content such as mountain bike news, bike reviews, professional rider interviews, riding destination editorials, and event coverage, and are always looking for great stories to tell. Platforms used include print publications, websites, YouTube channels, and social media channels of Facebook, Instagram, and Twitter. Having compelling content (and quality trail experiences) is key to getting coverage at the national level. Some of the more popular producers of mountain bike content include:

- **International Mountain Bike Association (IMBA)**
- **Mountain Bike Action magazine**
- **Freehub magazine**
- **Vital MTB**
- **Pinkbike**

Of all the channels listed above, local bike clubs and bike shops can easily have the quickest and largest impact, and often with the least amount of cost or effort, as both are directly connected to the local trail users and have a vested interest in promoting new trail developments.

Creating and Publishing Content

The goal of promotional content is to build awareness and excitement about the project. Content can range from something as simple as amateur photos and a few key facts to a professionally produced video.

The most common types of promotional content for mountain bike trail projects include:

PHOTOS - having high-quality photos can not be stressed enough. Show a variety of content such as people at an event, riders riding a trail, new construction in progress, or families having fun, for example. It is also important to show photos of a variety of ages, gender, race, and skill levels so that everyone can identify with the photo. Photos of people smiling show that they are having fun.

Photo courtesy of OZ Trails

PRESS RELEASES AND MEDIA ADVISORIES - provide information for each phase of the project to build awareness and excitement and include facts, photos, videos and testimonials, and quotes from a variety of interested parties. For photos, videos, and interviews, be sure to include a variety of all ages and skill levels to showcase that the experience is not exclusive to advanced riders.

ARTICLES, BLOGS - write or commission articles to tell a story that goes beyond the facts and figures of the completion of each phase.

Example - The Making of Standing Boy: Part 1: **https://www.imba.com/blog/making-standing-boy-part-i**

PROMOTIONAL VIDEOS - shoot or commission promotional videos to elevate the story beyond just text and photos.

Example – Ely, Nevada is mountain biking's next boom town: **https://www.youtube.com/watch?v=5i7oZsuI-wk**

Storytelling can be an especially effective way to create interest in a project. Human-interest stories related to the trail systems can also be told in addition to the stories focusing on facts and figures. Some of the local promotional channels can also be sources of valuable content.

Some content sources to consider:

- **The facts –** The who, what, when, where, why, and how of the project.
- **Local riders –** Local riders are also active members of the community. Find out why they ride and what they love about the local trails and trail community. Or, ask them what they do for a living, what groups they are involved with, and possibly, what activities they do to support local trails. Maybe they donate money or provide products or services to help maintain or promote the trails.
- **Community groups –** Consider interviewing community groups involved in the project to showcase their contributions.
- **Local mountain bike clubs –** Find out what services the local bike club is performing that can provide promotional stories, such as fundraising, corridor-clearing, trail construction, or event-hosting.
- **Sponsors –** If there are local business partners helping to fund the project, consider interviewing the owner or representatives to find out why this project is important to them and how they feel it brings value to the community.
- **Trail contractors –** Consider interviewing the various professional trail contractors involved in the project. Trail planners, GIS professionals, and trail builders may each have a unique perspective on the project based on their area of expertise, uncovering interesting and engaging content.
- **Agency personnel –** Consider interviewing personnel from the various agencies involved in the project. Each agency and job role will have different perspectives, whether regulatory, financial, environmental, or human interest.

Creating quality content can be time-consuming and require strong writing, photography, and videography skills. Check to see if these skill sets exist within your agency or community. If not, consider hiring professionals if budget is available. And remember, it is important that promotional material feature riders of all ages, gender, race, and skill levels.

New trail announcement in Little Rock, Arkansas. Photo by Garrett Hubbard courtesy of Arkansas State Parks

Creating and Publishing Trail Maps

Trail maps play a critical role in the quality of a trail user's experience. Trail maps are used in both paper and digital format, so both types should be created and distributed. While most people do have smartphones, technology has its limitations and downsides. Phone service may be limited, making access impossible. Batteries die. And one of the top reasons people use trails is to disconnect from technology.

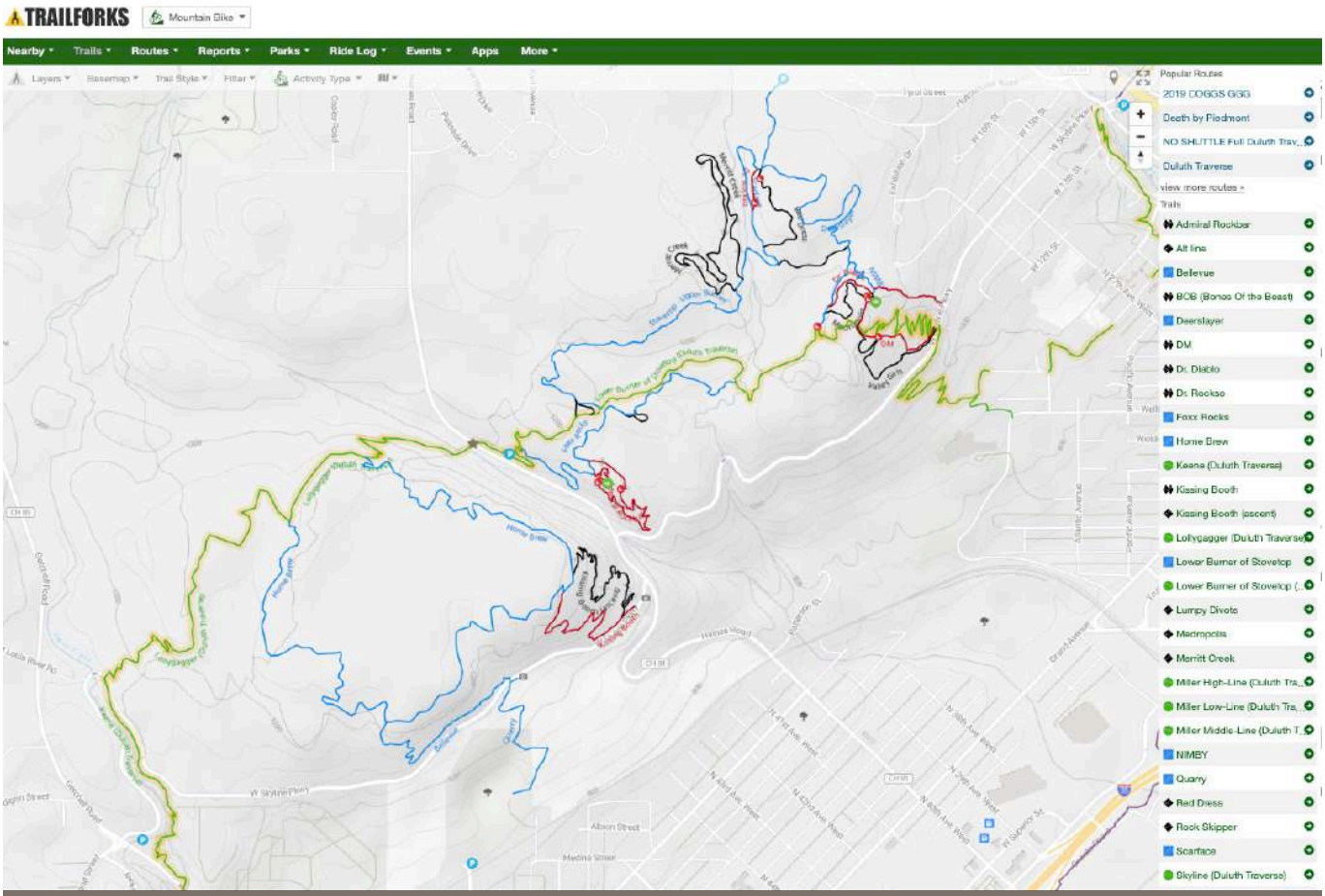
Printed maps can be easier to read than a digital map on a small screen since the map may be viewed better on a larger format. Plus, paper maps fold up neatly and can be easily stored in a pant or shirt pocket. Paper maps are typically made available at local bike shops, trailheads, and promotional agencies.

Digital maps can provide more information than paper maps and also allow users to zoom into different parts of a map for more detail. Digital maps also do not have to be printed, physically distributed, or restocked when supplies run low. A geo-referenced digital map adds the capability for location tracking through GPS service which does not require cell service. A geo-referenced map allows a user to see where they are located in the trail system, reducing navigation anxiety and risk of getting lost. Lost trail users create a hazard to themselves and all agency personnel called in to locate or extract the lost user.

MTB Project and Trailforks are the two most widely used mountain bike trail map applications for on-trail navigation. Both applications are available in Apple and Android format and provide geo-referenced trail data overlaid on high quality base map imagery with location tracking that does not require cell phone coverage. Riders are able to search nationally, by state, by region, or just by proximity to see what trails are nearby, effectively turning both apps into excellent promotional channels. Trailforks has the added advantage of a data-rich environment with tools to help inventory, maintain, promote, and showcase trail networks. Every mountain bike trail system should have trail maps on one, or ideally, both of these applications.

TRAILFORKS

MTB PROJECT



Trail map navigation on the Trailforks website. Image from trailforks.com

Hosting a Grand Opening Event

Hosting a grand opening event at the trail system provides a promotional opportunity to create excitement and provide recognition to organizations and key personnel that have contributed to the success of the project. Invite local dignitaries, planners, sponsors, contributors, and potential contributors. Also invite local mountain bike clubs, local bike shop staff, and park staff. Promote the event through channels well in advance of the event. Plan to capture photos and videos at the event to further promote the trails.

And do not forget the three T's of a successful event: toilets, tickets, and trash. A poorly planned or executed event can quickly turn ugly if toilets and trash are left off the plan, giving attendees a negative experience.

Creating Trail-Related Programming

In addition to an initial grand opening event, working with outside partners to organize events, races, skills clinics, and/or kids camps, can be a great way to further integrate your trail system into the local community.

Building a solid library of programming takes time, but doing so is essential to further community engagement and get the most value out of the trails. The trails form the foundation of the community asset, but the programming and events are what create the actual sense of community. This is where community partnerships can come in handy. Reach out to local bike clubs, bike shops, youth groups, hospitals and medical agencies, or other community groups that may have a vested interest in developing programs to support their user groups. Remember, solid programming is key to making sure the money you have just spent as a community has the largest possible impact.

Planning for spectator access and viewing stations is vital for race venues. UCI World Cup MTB course at Centennial Park in Fayetteville, Arkansas. Photo by Eli Glesmann/Rock Solid

Tracking and Monitoring Success

Part of good marketing is having good data. It is wise to measure and monitor the success of your trail projects as this will help provide justification for past and future investments. One simple method for obtaining objective data is through the use of trail counters. For a property that has existing trails, installing counters six to 12 months or more in advance of a new trail project will help you develop baseline data to compare against once the new trails are open. And if your project has multiple phases, tracking user data will help you compare the growth of trail use over the various phases. This applies to trail-related programming as well, since trail counters will help you track the spikes in users during events as well as the overall increases in use that programming brings to a trail system.

Having all of this data is excellent for justifying past investments, but more importantly, it can be used to show quantitatively verifiable and objective data of the impact a new trail system has on a property. This data also creates the opportunity for analysis of the investment made versus the community and social impact achieved. In addition, future potential trail development projects can leverage this data when building a case for the approval of a new project, rather than relying solely on anecdotal evidence. A small investment in data tracking made early in the trail development process can pay off handsomely for a community in the long run.

Promotion should be a recurring activity. Plan to keep promotional channels current with trail updates, trail conditions, photos and videos, articles, and new programming events. How much you are able to invest in promotion will depend heavily on the resources available to you and your department. Finding ways to leverage resources with other departments can be a great way to share the load. When push comes to shove, however, ultimately the best promotion is a well-designed and well-constructed trail system. Word of a new and exciting trail system has a way of getting spread like wildfire through the mountain bike community, so if you have to focus your limited resources somewhere, design and construction should always be the first priority.

Riding in Vermont. Photo by Jacob Shapiro

Chapter 14: Trail Development Process - Maintain

Maintenance begins once the trail construction activities are complete, though planning for maintenance should begin long before then. As the saying goes, "Everyone likes to cut ribbons, but nobody likes to pick up trash." Keeping a trail system clean and well-maintained is critical to the ongoing success of a trail system, but there is a lot more to maintenance than simply picking up trash. If trail users are continuously battling braking bumps and getting repeatedly whipped in the face by vegetative overgrowth, they will seek out another system that is better-maintained. Dirt erodes and nature is always working hard to take back what has been built, so the trail maintenance phase is never-ending.

The key activities of the maintenance phase are:

- **Develop an operations and maintenance plan.**
  - Budget
  - Personnel
  - Types of activities
  - Tools and personal protective equipment (PPE)
  - Safety protocols
  - Equipment
  - Scheduling work
  - Tracking work (maintenance reporting process)
  - Trail closure guidelines
- **Acquire equipment and tools.**
- **Hire and train staff (contractors, staff, volunteers).**
- **Perform and document maintenance and repairs.**

Developing an Operations and Maintenance Plan

Planning for maintenance is commonly overlooked when planning a trail system. Quite often, maintenance plans develop as a by-product of a lack of forward thinking combined with negative feedback from trail users. Fortunately, this is something that can be funded and planned for with straightforward strategies and tactics.

An operations and maintenance plan should address the following items:

BUDGET

Budget is listed first since it will directly influence what can or cannot be selected from the rest of the list below. Discussions about operations and maintenance budgets should be happening as early as the Assess phase, and be continually reinforced through the Plan and Design phases. A recommended maintenance budget is typically 3-10% of the initial construction cost spent annually. For example, if the trail system cost $1,000,000 to plan, design, and build, a suggested annual maintenance budget would be in the $30,000-$100,000 range. There are a lot of factors that can influence this figure, but this is a good starting point.

PERSONNEL

Just as when deciding between utilizing volunteers or professionals to build your trails, weighing the pros and cons (*see page 20*) for both comes into play when deciding on how to tackle ongoing maintenance. Budget will play a large factor here, but the primary options are:

- **PROFESSIONAL CONTRACTORS** - Professional trail building firms can be hired on an as-needed basis or under an annual maintenance contract. Hiring on an as-needed basis can be challenging since firms may or may not be already booked when you need them. Having a maintenance contract ensures that the professional firm will have the work scheduled and staffed—just be sure to identify and agree to planned maintenance items as well as the process and potential timelines for responding to unplanned work. Having these discussions up front can help to avoid misunderstandings and ensure all parties have the same expectations.

- **STAFF** - Hiring employees to execute maintenance needs can be a very cost-effective option in comparison to hiring professional contractors. In addition, having permanent staff makes it possible to quickly respond to issues as they arise, and provides a permanent set of eyes on the property to hopefully stay ahead of issues before they become bigger issues. Having dedicated staff also creates a good opportunity for ongoing public engagement and an informal (or formal) feedback loop for hearing what the community does and does not like about the trail system because of the potential interactions between on-site staff and trail users.

  Keep in mind that staff will need to be properly trained. With staff turnover, training will need to happen again. If trail maintenance expertise does not exist within your agency, professional trail contractors can often be hired to train staff. If staff are hired prior to the completion of trail construction, it is worth checking with the trail building firm to request staff training prior to them leaving the job site. It is best to plan well in advance and include this request in the build proposal so that time and money are accounted for in the overall project cost and schedule.

- **VOLUNTEERS** - Volunteers can be a great asset to a community trail system. Many trail systems around the country are currently maintained by local volunteer organizations. Volunteers are very cost-effective and provide a good avenue for establishing a sense of pride and ownership of the trail system. Volunteers typically need lots of direction; be sure to have appropriate staff to help guide and oversee volunteer activities. In communities with large, successful trail volunteer organizations, the majority of maintenance can be delegated to the volunteer group, as long as there is a solid history of performance and a desire of the volunteer group to shoulder that type of responsibility. In communities with small or no volunteer organizations, capacity and lack of expertise can be an issue until a larger, better-trained organization is developed.

  Regardless, it is highly recommended to establish a formal, signed contract or agreement between the agency and volunteer group. The agreement should define the roles and responsibilities of all parties mentioned in the agreement, as well as define approved activities and limits of each group in the defined relationship. Most agencies require volunteer groups to carry liability insurance, so this must also be addressed. Between the agreement and the liability insurance, acceptable and unacceptable activities should be defined. For example, it is often forbidden for volunteer groups to operate tools such as chainsaws or motorized equipment like excavators and skid steers. This is not always the case, but these are the kinds of situations that need to be discussed and decided upon when forming a formal relationship.

  Just like with hired staff, a plan to train and retrain volunteers on an ongoing basis needs to be in place. This is especially important with volunteers since there is typically significantly more turnover with volunteers than with staff members.

TYPES OF MAINTENANCE ACTIVITIES

Identifying and understanding the types of maintenance activities that will be needed to properly maintain the trails is essential in order to communicate expectations to maintenance personnel during training and on an ongoing basis. It is also ideal to distinguish between maintenance activities and repair activities. Maintenance involves ongoing activities related to weather and use events. Repairs are larger projects such as rebuilding a failed feature or rerouting a section of trail that was poorly planned, placed, or executed. Repairs typically need to be planned and often might be beyond the scope or skill set of volunteers. Typical maintenance activities include:

- **CLEARING TRAIL CORRIDOR** - This consists of cutting back vegetation, limbs, and branches that have grown into the riding path and encroach on the riding experience. This is an ongoing need; frequency will depend on the amount of rainfall and types of vegetation.

- **MAINTAINING BACKSLOPE** - Rocks and soil from the backslope (the hillside just above the trail tread) can be displaced due to rain and other weather events. Raking out backslopes to be smooth and free of holes is important to restore the capability for water to sheet-flow down them. Holes and other disruptions in the backslope can cause water to pool and/or channel, creating ruts in the backslope and channeling water across the tread, leaving indentations and ruts.

Hand crew finishing back slope at Tannery Knobs Bike Park in Johnson City, Tennessee. Photo by Robert King.

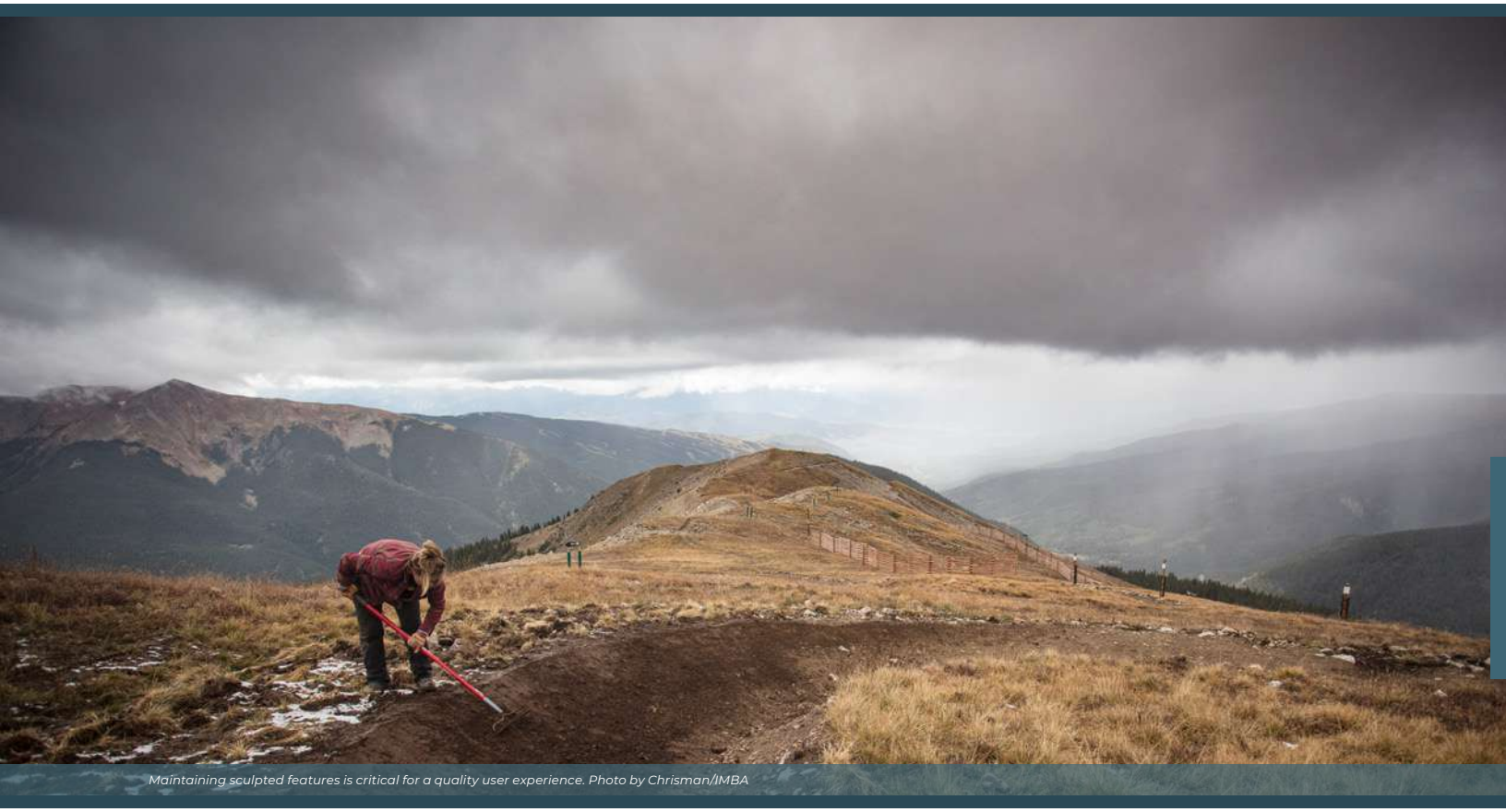
- **MAINTAINING TREAD** - Maintaining tread involves restoring the shape of the riding surface if it is damaged by debris, water flow, users, or other elements. Here are some common examples of how tread needs to be maintained:

  - ***Restoring outslope*** - Restoring outslope is a common tread maintenance item that involves knocking down berms that have built up on the downhill edge of a trail, trapping water and channeling it down the trail, rather than letting water flow across the trail. This practice is often referred to as “deberming.”
  - **Clearing drains** - Clearing drains consists of raking out soil buildup in the drain basins that occur at every grade reversal in the trail. During rain events, soil is carried down the tread to the drain (grade reversal). It is quite common for soil to be deposited by the water at the drain due to the change in direction of the water. As soil builds up in the drain, water flow is blocked and can create puddles and pooling. These drains need to be raked out to restore the outslope and allow water to continue off the trail and down the hillside.
  - ***Fixing ruts*** - If trails are ridden after rain events prior to the trail being allowed to fully dry out, tires can leave indentations (ruts) in the tread. These ruts can seriously disrupt a positive user experience and thus need to be raked out and returned to a smooth riding surface.
  - ***Removing debris from the trail*** - Rain, wind, and snow events can cause debris to fall onto the trail riding surface, including entire trees. All debris should be removed from the trail riding surface to minimize the chance of riders colliding with debris. Since most parks have minimal maintenance staff, it is ideal to have an easy way for riders to report downed trees or other maintenance items directly to park staff. Signage at a trailhead with reporting instructions creates an opportunity for extra eyes to help keep up with trail maintenance needs.

- ***Removing fallen leaves from the trail*** - This is a debated topic in some communities. In general, leaves should be removed from the trail tread due to the tendency for dead leaves to create a slippery and potentially dangerous situation. It can be very hard to steer or brake when riding on top of dead leaves. Backpack blowers are a great way to clear dead leaves from the trail riding surface. However, care must be taken not to aim the blowers too close to the tread surface as the power of the blowers can remove soil and rocks from the tread surface, creating additional unwanted problems. One exception to the need to remove leaves from the trail tread is during freeze/thaw conditions when they act as a protective layer to the sensitive tread during thaw periods.

Blowing fall leaves off the trail. Photo by Eli Glesmann/Rock Solid

- ***Maintaining sculpted features*** - Features such as rollers, berms, and jumps can see heavy erosion due to rider shearing forces and are also more susceptible to erosion due to gravity (steep berm faces and jump faces, for example). Maintaining these types of features typically involves raking the dirt surfaces to restore the original shape or curve in an attempt to keep the riding experience optimal. Feature shaping is typically performed with stiff rakes and flat-head shovels. It is ideal for there to be some moisture in the soil when working on sculpted features so that the shape of the feature can be worked and compacted.

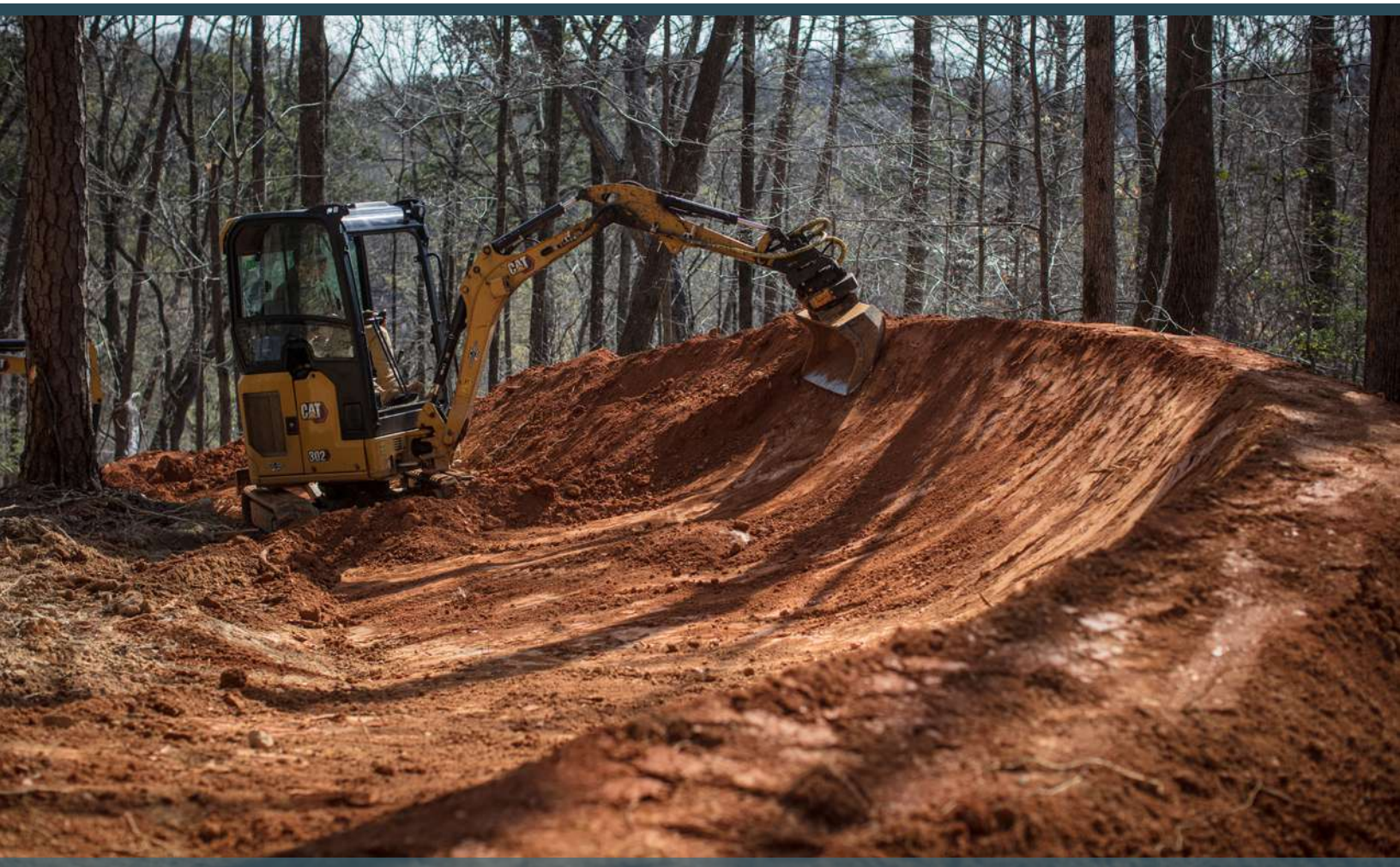


Maintaining sculpted features is critical for a quality user experience. Photo by Chrisman/IMBA

REPAIRS

As mentioned earlier, repairs are more involved than typical maintenance items. If trail construction is still within the warranty period, it is recommended to consult with the trail builder to see if a repair item falls under warranty work. Typical repair activities include:

- **REPAIRING ROCK ARMORING OR RETAINING WALLS -** Rock armoring for drains, technical features, and retaining walls can shift over time, especially if the original work did not utilize large armoring stones as anchors.
- **REROUTING DAMAGED TRAIL -** Although poor planning and grade management can be the cause for a trail to need to be rerouted, other natural factors can come into play. If a trail was built during a dry season, for example, it could be that seeps appear during the wet season, wreaking havoc on the trail in terms of water damage or chronic wet sections. In this case, armoring or rerouting trouble sections can be a useful way to repair a trail section.
- **REPAIRING OR REBUILDING FEATURES -** Dirt features that go too long without maintenance can erode to the point where they need to be rebuilt, requiring sourcing of new dirt, and stacking and packing the dirt to rebuild a feature. Wooden features can also erode over time to the point that wood planks crack or break, requiring replacement.

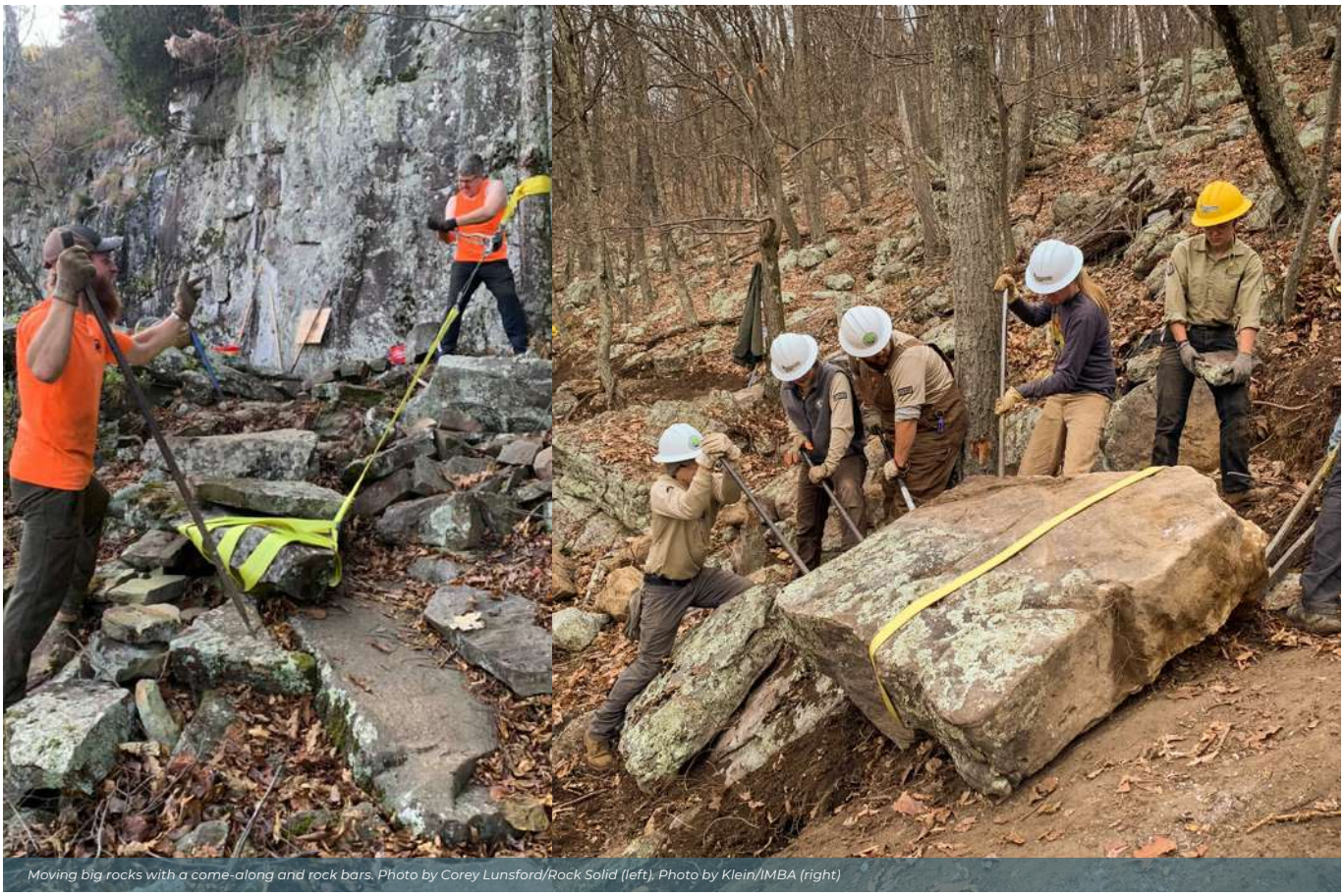


Rebuilding large features with equipment can be beneficial if logistically feasible. Photo by Chrisman/IMBA

TOOLS AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

Common maintenance tools and PPE that will need to be acquired include, but are not limited to:

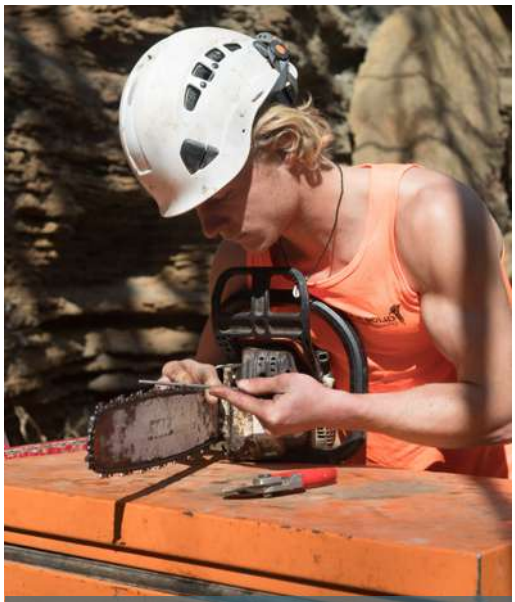
- **Trail hoes**
- **McLeods**
- **Pick mattocks**
- **Pickaxes**
- **Stiff rakes**
- **Axes**
- **Small hand saws (fixed-handle or folding)**
- **Sledgehammers**
- **Rock hammers**
- **Wheelbarrows**
- **Buckets**
- **Rock slings**
- **Rock bars**
- **Griphoist/come-along**



Moving big rocks with a come-along and rock bars. Photo by Corey Lunsford/Rock Solid (left). Photo by Klein/IMBA (right)

- **Chainsaws**

  Chainsaws are critical items in every build crew's toolset, though volunteers are rarely allowed to use chainsaws, and for good reason. Chainsaws are extremely dangerous and only those who have successfully completed a chainsaw certification course and use the proper PPE, which include eye/ear protection, chainsaw chaps, gloves, and reinforced footwear should be able to use them. In addition to specific PPE, a chainsaw kit should also include items such as wedges, a feller's ax, fuel/oil, and a chain-sharpening kit.



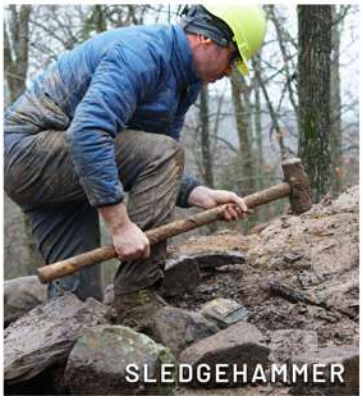
Sharpening blades on the chainsaw chain. Photo by Eli Glesmann/Rock Solid

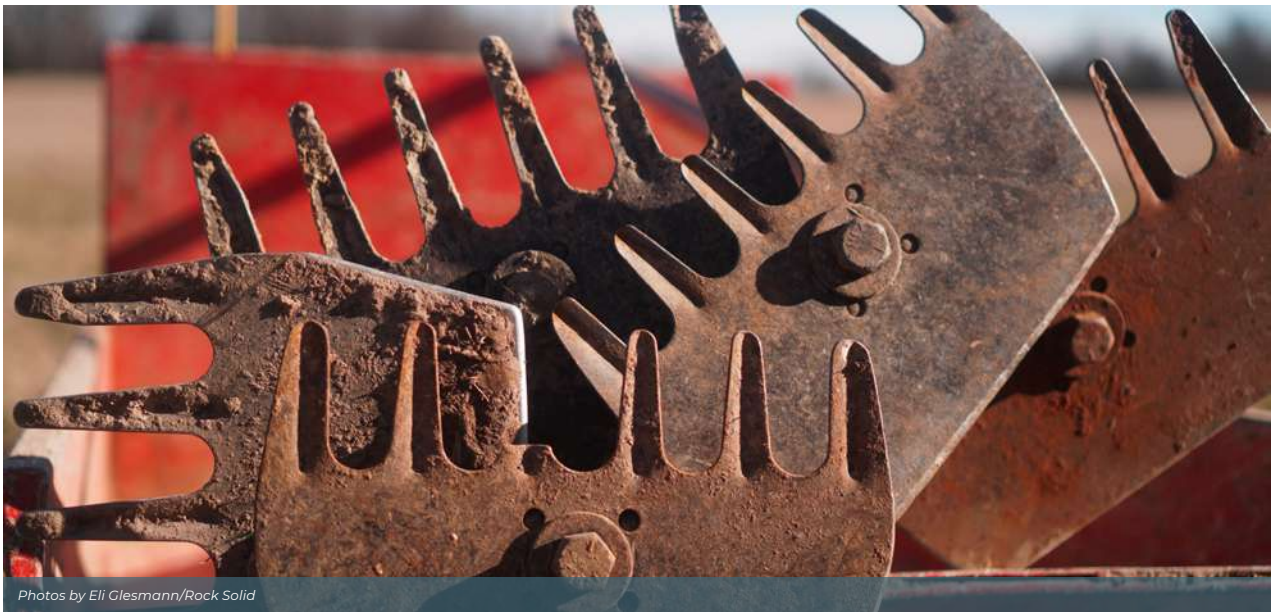
- **Jackhammers**

  Jackhammers can be stand-alone or attachments to excavators. They are used for breaking up and shaping rock.

Photo by Eli Glesmann/Rock Solid

- **Protective eyewear**
- **Gloves**
- **Insect repellant**
- **Poison ivy and oak creams**
- **Tick repellant (Deet and Permethrin, for example)**
- **First aid kits**





Photos by Eli Glesmann/Rock Solid

SAFETY PROTOCOLS

It is imperative to create safety protocols for handling and use of tools. An accident report form will need to be created for the inevitable event when someone thinks that juggling axes will impress their coworkers, or when someone wades shirtless into a sea of poison ivy (pro tip: workers should never be shirtless). To help nip that kind of nonsense in the bud, start volunteer workdays with a safety meeting to show how tools should be carried and used in the presence of others. This is also a good practice to develop with employees and contractors. Common safety meeting topics include, but are not limited to:

- **TOOL TRAINING** - Maintenance crew should be taught the proper technique for using each type of tool. When using tools that require swinging motions, tools should never be used when someone else is within reach of the tool's radius when being swung. This radius is known as the "circle of death." The phrase is utilized to remind crew members to constantly be aware of who is around them at all times and on all sides. Tool training should happen whether crew members are brand new or highly seasoned. This provides consistency and ensures all crew members get the same training and understand what is expected in your particular environment.
- **TOOL TRANSPORT** - Tools should be carried in workers' hands and down at their sides on the downhill side of the trail. Carrying tools on the downhill side of a trail lessens the probability that a worker will fall onto the tool if they slip and fall. Tools should not be carried on the shoulders. Tools carried on the shoulder are at eye-level with other workers in front of or behind the person carrying the tool. They are also prone to go flying if a person trips and falls. Also, a person should not carry more tools than can comfortably be carried in their hands. And, when walking into job sites, workers should allow ample space of 10 feet or so between each other to avoid bumping into each other or the tools being carried.
- **PASSING** - When passing someone who is working on a trail, workers should always announce themselves and wait for the person to acknowledge them, stop swinging, and provide verbal approval that it is okay to pass.
- **SAFETY GEAR** - Workers should have gloves, safety glasses, sturdy boots or shoes (no flip-flops or other open-toed shoes) and water at a minimum. Depending on site requirements, hard hats may be required as well. At least one person should have a first aid kit and a way to call for help. Protective creams such as sun block, insect repellant, and poison oak/ivy treatments are also recommended. Tick repellant is also highly recommended in areas and seasons prone to ticks.
- **ACCIDENT REPORTING** - Identify who injuries should be reported to and how injuries will be documented. Also identify the process that will be used in case an evacuation is necessary, including the name and contact information for emergency response units and the name and location of the nearest hospital.

EQUIPMENT

Equipment use is typically restricted to professional contractors and staff due to liability concerns. Typical equipment utilized by professional contractors and highly trained staff include, but is not limited to:

- **MINI EXCAVATORS** - Mini excavators are probably the most common equipment of choice for most professional trail builders. Mini excavators offer the most flexibility in terms of moving and shaping dirt.

Mini excavator. Photo by Chrisman/IMBA

- **MINI SKID STEERS -** Mini skid steers are also a very common equipment choice for professional trail builders. Mini skid steers can move more dirt more quickly than mini excavators, but do not have as much flexibility in terms of digging and shaping features.

Stand-on mini skid steer. Photo by Chris Guibert/Rock Solid

- **TRACKED CARRIERS -** Tracked carriers are like mini walk-behind dump trucks used for moving dirt and equipment around the job sites.

Walk-behind tracked carrier. Photo by Eli Glesmann/Rock Solid

Large tracked carrier. Photo by Eli Glesmann/Rock Solid

- **PLATE COMPACTORS** - Plate compactors are vital for compacting tread surfaces.

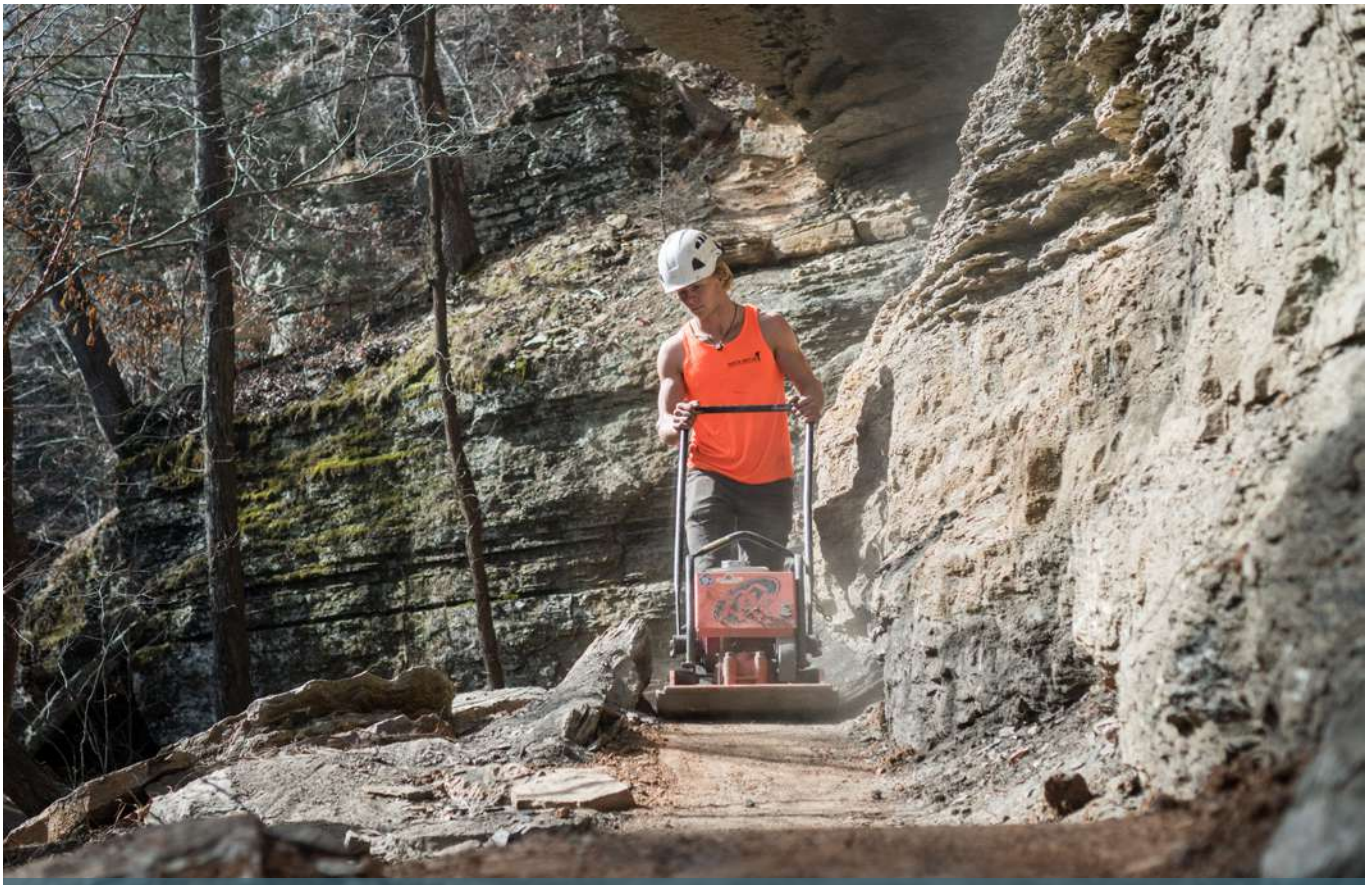


Plate compactor. Photo by Eli Glesmann/Rock Solid

- **TRUCKS AND TRAILERS** - Equipment needs to be moved around the trail system and occasionally taken in for repairs and maintenance.

Photo by Eli Glesmann/Rock Solid

SCHEDULING WORK

If using volunteer groups to support maintenance, a system for scheduling and announcing volunteer workdays will need to be developed. Social media pages can be a great (and free) resource for managing these events. It is becoming more and more common for trail systems to have separate Facebook pages for general information, volunteer workdays, and trail conditions, so that users can subscribe only to the pages that interest them.

TRACKING WORK

It is vital to have a process for tracking maintenance and repair work. Developing a trail inspection checklist, tracker, and schedule should be a top priority. A trail inspection tracker can be as simple as logging the date, type of work performed and where, and the names and contact information of the people who performed the work. Lawsuits are a reality. Having thorough documentation showing a history of recurring maintenance and repair activities is an important part of a good lawsuit defense. Not having good maintenance and repair records can lead to a perception of negligence when determining the level of fault. For volunteer workdays, it is also highly recommended to have a liability waiver form and a sign-in sheet for attendees.

TRAIL CLOSURE GUIDE

Riding trail when it is too wet can wreak havoc on the tread surface, exacerbating maintenance needs and requiring more frequent and longer trail closures. Thus, it is vital to establish a process for when and how to close and reopen trails to avoid or minimize these problems. Soil types also play a large role, as sandy soils can actually ride better when wet. Also, if some trails dry faster than others, it could be possible to open some of the trails while keeping others that need more time to dry closed.

An example of a trail closure decision tree. Image courtesy of Arkansas Parks and Recreation Foundation

Some of the key items to consider for a trail closure guide are:

- ***What situations will warrant a trail or trail system closure?***
  - Trails are too wet to ride without causing damage to the tread surface
  - High wind advisory that may cause large branches or trees to fall, posing a danger to trail users
  - Trail cleanup period following a high wind situation, allowing time for large trees, debris, and branches to be removed from trails
  - Flash-flood warnings that may cause creeks and streams to rise rapidly and pose a danger to trail users
  - Active construction or intrusive maintenance that would make it unsafe for trail users or inefficient for trail workers due to frequent interruptions
  - Spring melt freeze/thaw cycles where the trail tread is fragile as the winter frost comes from the ground. Riders who endure long winters are anxious to get out and ride as weather warms up, so user education and closures will help reduce spring-time impacts.

- ***How will trail users be notified when the trail system is closed? How about when it is reopened?***
  Having an active social media channel and robust signage at the trailhead and all entry points are good ways to provide timely updates.

- ***Will there be a way to physically close access to the trails?***
  This is more difficult if there are a lot of trailheads. Physical gates can be a good method, but keep in mind that someone would need to be available to physically open and close these gates every time there is a closure. A lot of trail systems have no physical barriers and rely on good judgment and peer education of the trail user community.

- ***Will there be signage at trailheads to educate trail users when not to use the trails and why?***
  Having educational and closure signage at each trailhead is the best practice to follow.

ACQUIRING EQUIPMENT AND TOOLS

This part may seem somewhat self-explanatory, as the tools and equipment identified during development of a maintenance strategy will need to be purchased for performing maintenance, but there are a few additional things to keep in mind:

- **STORAGE** - Where will tools be stored?
- **ACCESS** - Who will have access to the tools and how will access be controlled? Will tools need to be signed out? If so, what is the process for signing tools out?
- **TRANSPORT** - How will tools be transported from storage to the work site and back?
- **INVENTORY** - How will tools be tracked and counted? Which tools should be tracked and counted as inventory rather than just being considered supplies?
- **MAINTENANCE** - How will the maintenance tools be maintained? Yes, maintenance tools need to be maintained. For most trail tools, this typically means sharpening of the blade edges so that tools cut well and require less physical effort to use. Want to keep volunteers and staff happy? Make sure all tools stay nice and sharp. Have sharpening tools on-hand and institute a sharpening process after each maintenance session. Angle grinders are effective at sharpening most blade heads and can be kept in the tool storage, while sharpening files can be easily carried into job sites and used as needed throughout the day.
- **REPLACEMENT** - Tools wear out and break. Who will be responsible for replacing tools? What is the process for inspecting tools for damage or excess wear and approving the purchase and replacement?

HIRING AND TRAINING STAFF

This part may also seem self-explanatory but having a good hiring and onboarding process is essential to a smooth operation. Hiring will vary depending on whether contractors, employees, or volunteers are being utilized. A good place to start for an onboarding process is the maintenance strategy as it identifies information that will be essential for workers to execute their job roles.

IMBA Trail Solutions and Youth Conservation Corps working together at Cacapon State Park, West Virginia. Photo by Daddio/IMBA

TRAIL MAINTENANCE RESOURCES

We chose not to go into extensive detail in this guide on trail maintenance techniques as there are other good sources for this information. Sources for detailed information on trail maintenance techniques include:

- ***Trail Solutions: IMBA's Guide to Building Sweet Singletrack***
- **Arkansas Parks and Recreation Foundation maintenance documents. To obtain the documents listed below, please send an email to Arkansas Parks and Recreation Foundation.**
  - Natural Surface Trail Field Guide To Maintenance –Ten-page guide to aid in the training and communication of trail maintenance techniques and expectations with staff and volunteers.
  - Maintenance How-To – A one-page volunteer cheat sheet

Founded in 2017, the Arkansas Parks and Recreation Foundation (APRF) has extensive experience contracting with mountain bike trail professionals, managing over eight million in expenditures (trails, architecture, amenities) since inception. APRF has developed five new trail systems, building 82 miles of world-class mountain bike trail in the process. And more relevant to this section, APRF is responsible for managing trail maintenance on over 150 miles of trail (including an IMBA EPIC), so they know a thing or two about the challenges land managers can face with the contracting and maintenance phases.

Photo by Chris Guibert/Arkansas Parks and Recreation Foundation

Chapter 15: Trail Development Process - Evolve

The evolution phase is optional. However, not evolving or improving trails over time creates a scenario where trail use can diminish as riders seek out more relevant, modern trail systems. Strategic evolution can be planned to roll-out over time to spread out budgetary needs and to create a sense of constant improvements.

The key activities of the evolution phase are:

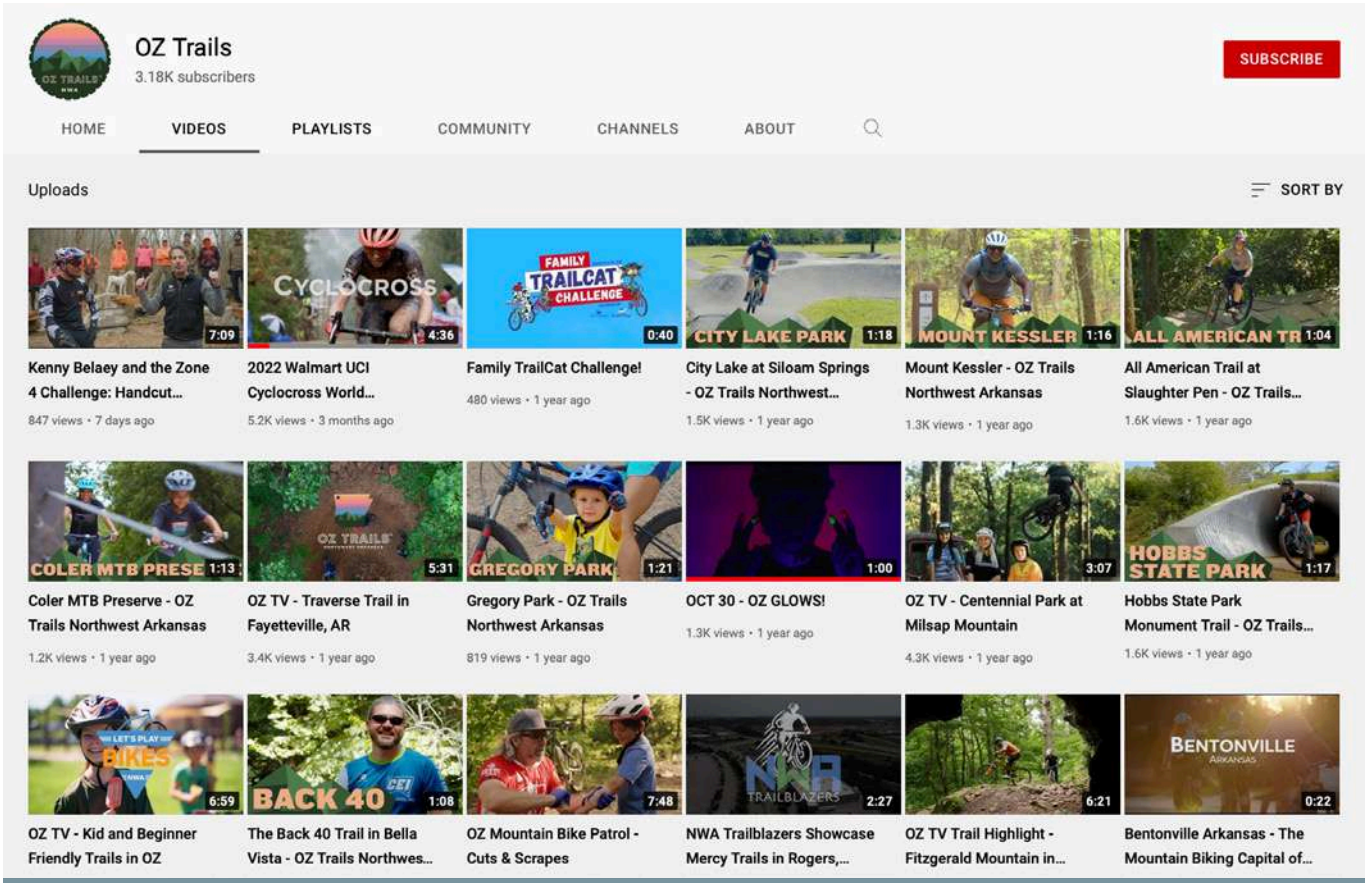
- **Obtain community input.**
- **Identify trails to be evolved or added.**
- **Plan and design trails to be evolved or added.**
- **Contract and build the trails.**
- **Promote, promote, promote!**

A rough guideline for evolving a trail system is to target improvements within at least five to 10 years, but ideally sooner. Improvements do not have to mean doing a complete system rebuild all at once, which would be prohibitive on numerous levels. Rolling in improvements on a regular, more frequent basis can keep riders engaged and excited. Some key methods to evolve a trail system over time include:

Some key methods to evolve a trail system over time include:

- **Improve or rebuild an individual trail, trail section, or trail feature that has grown stale, is not well-liked or has chronic maintenance issues.**
- **Build a new trail to expand mileage and create a riding experience that is new or unique to the trail system.**
- **Build a new single-use (bike-only, hike-only) or directional trail to evolve the system and address any user conflict issues.**
- **Build bike-optimized amenities such as a pump track, jump line, or skills development area.**

OZ Trails of Arkansas has done an excellent job of continually evolving trails and promoting the upgrades through extensive video and photo content. In addition to featuring new and rebuilt trails, OZ Trails also features instructional content and human interest stories related to their trails promotion and evolution activities, providing a feature-rich experience of content through their Facebook, Instagram, and YouTube pages.



OZ Trails YouTube channel featuring trail promotion and evolution activities. Image from oztrails.com

Photo by Eric Arce Photography

Chapter 16: Summary

If there is one thing that will last from your work, it is the value of trails. They are a beloved asset to your community that will generate health and economic benefits for years to come. They provide a critical place for people to unplug, get outdoors, and have fun. As trail users introduce their children to the joy of trails, they pass these values on to the next generation. Your efforts today will pay off long into the future, and the trails community that forms will thank you.

While it is easy to get lost in the details, pulling back to a high level can help to regain focus and clarity. Remember the following basics:

1

ASSESS

Assess the available land and terrain to determine if the site or sites are feasible for trail development.

2

PLAN

Conceptually plan the trail corridors.

3

DESIGN

Flag the trail corridors and create detailed design drawings and construction documents.

4

CONTRACT

Contract with a trail builder for the build.

5

BUILD

Build the trails.

6

PROMOTE

Promote the trails so people learn about them and can find them.

7

MAINTAIN

Maintain the trails to keep the conditions and user experience optimal.

8

EVOLVE

Evolve the trails to keep people engaged and coming back.

Simple, right? Definitely not. But, hopefully this guide has been and will continue to be just that—a guide that helps steer you toward successful trails.

Summit reward at Split Rock Wilds in Beaver Bay, Minnesota. Photo by Chris Guibert/Rock Solid

End of primary content

Appendix to follow

Quick Reference Guide (Trail Development Process)

High-Level Process

1	2	3	4	5	6	7	8
ASSESS	**PLAN**	**DESIGN**	**CONTRACT**	**BUILD**	**PROMOTE**	**MAINTAIN**	**EVOLVE**
identify properties & assess sites for trail development feasibility.	conceptually plan the trail corridors.	flag the trail corridors and create detail design drawings and construction documents.	contract with a trail builder for the build.	build the trails.	promote the trails so people hear about them and can find them.	maintain the trails to keep the conditions and user experience optimal.	evolve the trails to keep people engaged and coming back.

Detailed Process – *Key Stages of Each Phase*

1) ASSESS

1. Define project vision, goals, objectives
2. Identify property for trail development
3. Obtain geospatial data for area of interest (AOI)
4. Perform desktop analysis and planning
5. Create an AOI base map
6. Investigate environmental review and permitting requirements
7. Plan for initial site visit
8. Scout site and collect field notes and geospatial data
9. Process and analyze field data
10. Create a feasibility map graphic
11. Provide cost considerations for future phases
12. Create site assessment and feasibility report

2) PLAN

1. Review/refine project vision, goals, objectives
2. Continue engaging with resource specialist
3. Perform desktop-based analysis and planning
4. Scout site and collect field notes and geospatial data
5. Plan the conceptual trail corridors
6. Create an index of planned trails (trail index)
7. Create a trails concept plan map graphic
8. Initiate environmental reviews and permitting process (if needed)
9. Create cost opinions for design and construction
10. Create a trails concept plan report

3) DESIGN

1. Review/refine project vision, goals, objectives
2. Move the environmental review process toward completion
3. Perform desktop-based analysis and planning
4. Flag the trail corridors and collect field notes and geospatial data
5. Identify equipment, material, and personnel logistics
6. Update the trails concept plan map graphic and trail index
7. Create detailed design drawings/construction documents (if needed)
8. Finalize environmental review and permitting process (if needed)
9. Create an emergency response plan
10. Create cost estimates for the build phase
11. Create a trails design report

4) CONTRACT

1. Determine contracting method
   - Direct contract
   - Design-build
   - Design-bid-build
2. Create bid/proposal package
   - Project overview
   - Trails design map graphic
   - Trail index
   - Detailed design drawings and construction documents
   - Unit price bid sheet with quantities
3. Solicit bids/proposals
   - Make the bid package available to trail builders to review and respond
4. Review bid/proposal submissions
   - Evaluate bid package responses to select the contractor best suited for the project
5. Award contract
   - Notify selected trail builder
   - Execute contract
   - Ensure contracting requirements are met

5) BUILD

1. Schedule work
   - Confirm regulatory approvals and permits are in place
2. Kick off project
   - Introductions and job roles
   - Project scope and timeline
   - Project site rules
   - Resource concerns
   - Equipment, material, and personnel logistics
   - Trail types and intended experiences
   - Walk flag lines
3. Monitor progress
   - Daily or weekly at a minimum
   - Verify unit quantities invoiced
4. Close contract
   - Final walk-through and punch list

6) PROMOTE

1. Develop community branding
2. Document progress with photos and video
3. Identify internal and external promotion channels
4. Create and publish content
5. Create and publish trail maps (MTB Project / Trailforks)
6. Host a grand opening event
7. Create trail-related programming
8. Track and monitor progress

7) MAINTAIN

1. Develop an operations and maintenance plan
   - Budget
   - Personnel
   - Types of activities
   - Tools and personal protective equipment (PPE)
   - Safety protocols
   - Equipment
   - Scheduling work
   - Tracking work (maintenance reporting process)
   - Trail closure guidelines
2. Acquire equipment and tools
3. Hire and train staff (Contractors, staff, volunteers)
4. Perform and document maintenance and repairs

8) EVOLVE

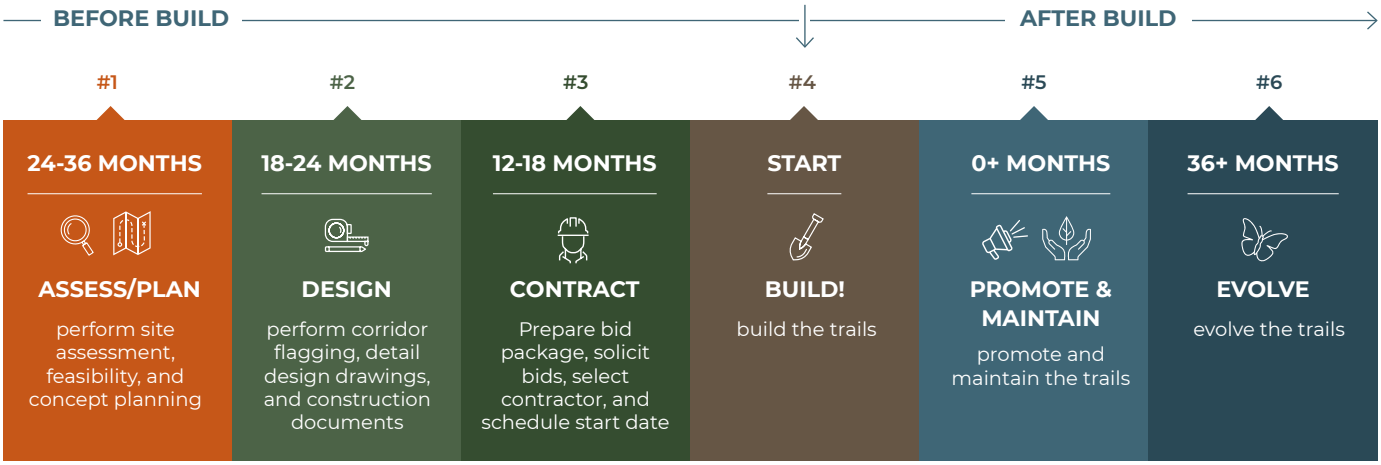
1. Obtain community input
2. Identify trails to be evolved or added
3. Plan and design trails to be evolved or added
4. Execute environmental reviews and permitting process
5. Contract and build the trails
6. Promote, promote, promote!

APPENDIX B

Trail Development Timeline

The timeline for a trail development project can easily span two years or more for even a single phase of construction.

Ideally, a request for proposal should be put out for bid at least a year in advance of the desired start date for construction. Trail building firms fill up their schedules quickly, often booking work six months to a year or more in advance. Putting a contract out for bid less than six months before a desired start date can substantially reduce the number of firms that bid on a project, sometimes having no bidders at all. **A good guideline to follow when planning timelines for trail development is:**



While there are an infinite number of timeline scenarios, below are two different timeline examples to help understand and plan for a successful trail development process.

#1 An *optimal* project timeline

This timeline is considered optimal because it puts the build schedule approximately one year after the contract phase.

1. Fall, 2024 – Assess and Plan
2. Spring, 2025 – Design
3. Summer, 2025 – Contract
4. Summer, 2026 – Build

#2 An *aggressive* project timeline

This timeline is considered aggressive because the bid package goes out for bid only three to six months prior to the desired construction start. This short timeline can substantially reduce the number of qualified trail contractors available to bid on the project.

1. Spring, 2024 – Assess and Plan
2. Fall, 2024 – Design
3. Winter, 2024-2025 – Contract
4. Summer, 2025 – Build

This does not mean a qualified contractor cannot be found last minute, but the odds are not good. The first two project timeline examples only reflect one build phase, whereas larger projects may have two or three or more phases. For larger projects with multiple phases and a goal of executing a build phase each successive summer build season, there will need to be overlapping schedules. Below is a timeline example for a project with three build phases.

#3 A *three build phase* project timeline

1. Spring, 2024 – Assess and Plan (phase 1-3)
2. Fall, 2024 – Design (phase 1)
3. Spring, 2025 – Contract (phase 1)
4. Fall, 2025 – Design (phase 2)
5. Spring, 2026 – Contract (phase 2)
6. Summer, 2026 – Build (phase 1)
7. Fall, 2026 – Design (phase 3)
8. Spring, 2027 – Contract (phase 3)
9. Summer, 2027 – Build (phase 2)
10. Summer, 2028 – Build (phase 3)

All of the examples above assume the projects go through a competitive bid process. They also assume the assess, plan, and design phases have not been condensed into one season, which is possible depending on the size of the project. Development timelines can also be reduced if an agency is allowed to use design-build or direct contracts. Working with the same trail contractor throughout an entire project can develop efficiencies that help to reduce workloads and stress levels. The first time through the process is always the hardest. Lessons will be learned, and relationships formed that help agency personnel gain confidence and proficiency managing the trail development process.

APPENDIX C

All-Weather Trails

The term "all-weather trail" refers to a trail that has been surfaced with materials to improve rideability when wet. Normal soil that has a blend of loam and clay contents are the optimal tread material for building trail and riding trail. However, these natural soil types need to dry before being ridden to avoid damage. In climates where rain or snow is common, this can be especially problematic, causing frequent and disruptive closures, or creating extensive maintenance needs if closures are not managed properly.

Trail can be surfaced with a variety of materials that are resistant to this kind of damage. All-weather tread surfacing solutions can include crushed rock, rubber, chip-seal, asphalt, or concrete. There are a variety of pros and cons to each which will be covered here in more detail.

CRUSHED ROCK

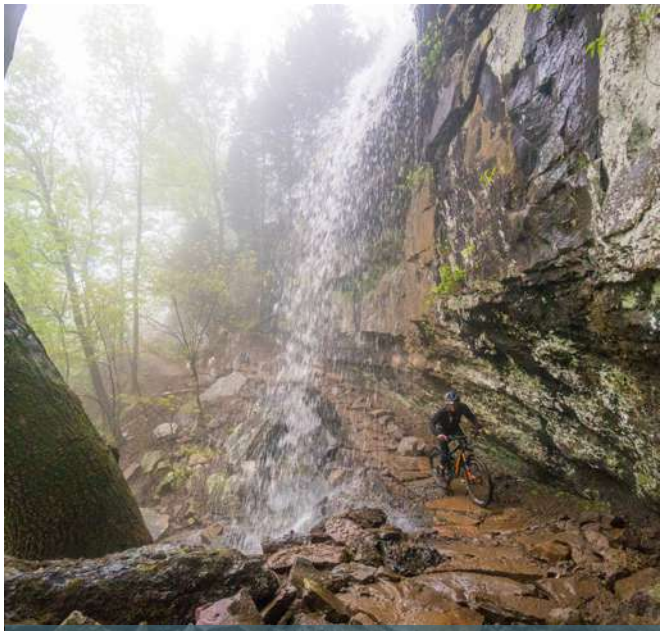
Crushed rock is probably the most common all-weather solution used in the mountain bike trail building industry. Crushed rock is imported and applied in 4- to 6-inch layers to create the final riding surface. Crushed rock installation typically consists of larger aggregates for the base and finer screenings/crusher fines for the finished riding surface. Crusher fines (also known as stone dust) comes from a process of screening out large stones and rock where the resulting material includes small crushed rock and the fines which contain the natural binders. Crusher fines can be compacted due to the retention of the inherent binders acting as cement, making them ideal for an all-weather surface that utilizes crushed rock.

Two of the key limiting factors of a crushed rock trail are cost and trail type. A crushed rock trail can cost two to three times as much as a normal mountain bike trail. The extra cost is due to the cost of purchasing the crushed rock, having it delivered, transporting it into the job site, and then applying and compacting the crushed rock. The other key limiting factor is trail type. Crushed rock trail ideally should not exceed grades of 8% as it is likely to become unbound and fall to the bottom edge of the trail, especially during heavy rainfalls. Once this process starts, it can be hard to combat. This limitation makes it difficult to apply crushed rock successfully on flowy trails where tall, steep berms and jump faces can easily exceed grades of 20% or more. As a result, crushed-rock, all-weather trails tend to appear mostly on beginner or intermediate trails that have very mellow grades and undulations.

Crushed rock trail in Copper Harbor, Michigan. Photo by Chris Guibert/Rock Solid

ROCK

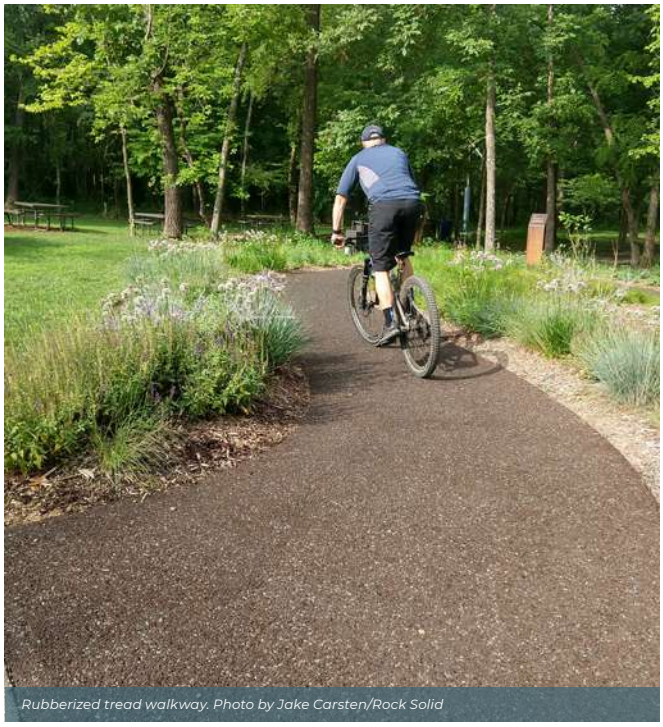
Trail tread that is armored with rock can withstand the elements and stand up to trail use over a long period of time. Rock armoring, if done properly, can be a permanent solution to wet conditions and erosion problems. Rock armoring trail tread is significantly more expensive than typical dirt tread construction, costing 10 times or more per linear foot. The age-old adage, "You can pay now or you can pay later" is true when pertaining to trail construction. Not armoring drains and other sections that will experience water flow will result in significantly more post-construction costs in terms of ongoing maintenance needs and more frequent trail closures, both of which create chronic management challenges. However, consider that rock installed in consistently wet locations can become very slippery and difficult to ride. Wet locations should be monitored for algae growth and dealt with before it causes concern.



Trail tread armored with large rock at Mount Nebo State Park in Dardanelle, Arkansas Photo by Eli Glesmann/Rock Solid

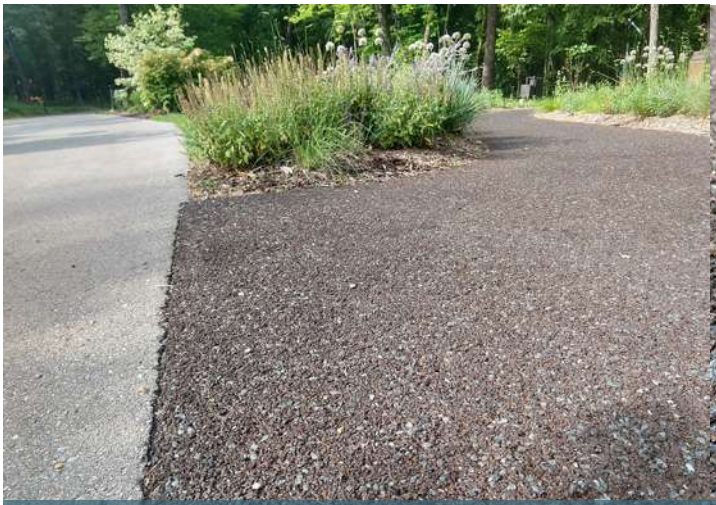
RUBBER

Rubberized trail tread typically consists of recycled shredded tires that are installed using glues or binders to keep the material together and create a consistent trail surface. Installation requires trenching, setting up forms, installing a subbase and edging, and then troweling the material into place. Rubberized tread applications can be pervious, allowing rain water to drain through the tread, which can be beneficial when installations need to avoid adding more impervious elements due to stormwater runoff requirements.



Rubberized tread walkway. Photo by Jake Carsten/Rock Solid

Rubberized trail tread is limited by the recommended maximum installation grade of 5%; vendors will not warranty work that falls outside this parameter. Much like crushed rock, this limits rubberized trail tread installations to beginner or intermediate trail tread that is predominantly flat and with minimal to no undulation. Another complication is the need to install forms to set the rubber material, meaning lumber materials need to be imported into and out of the woods. This adds to the installation time, complexity, and cost. For these reasons, rubberized trail tread has rarely been used on mountain bike trail systems. On the plus side, rubberized tread has excellent traction characteristics, drains extremely well, and is available in multiple color options. Rubberized trail tread is commonly used in playgrounds and sidewalk-style applications.



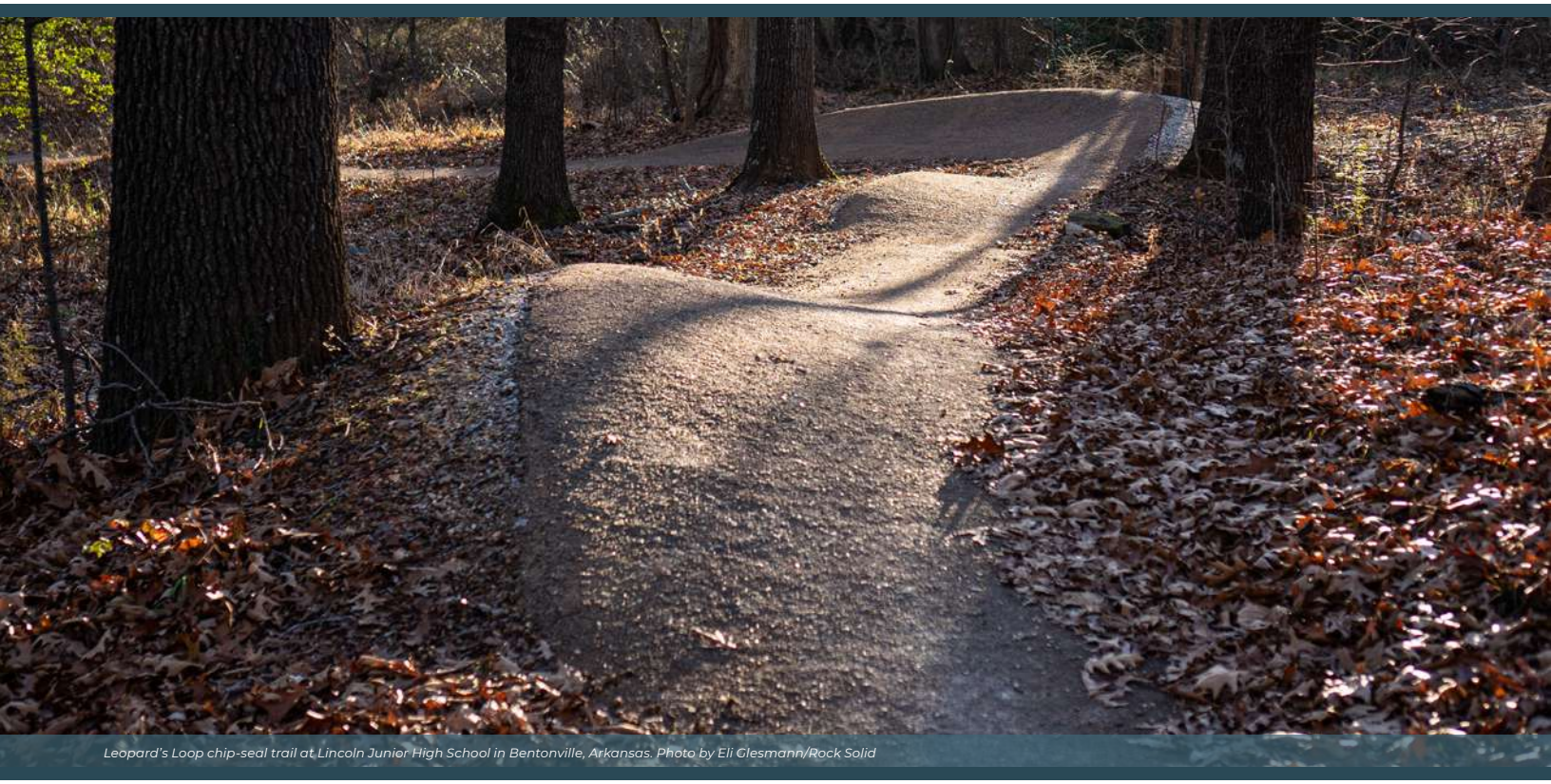
Seam where rubberized tread abuts asphalt. Photo by Jake Carsten/Rock Solid

Close-up of rubber tread mixed with small rock chips. Photo by Jake Carsten/Rock Solid

Rubberized tread installations can cost five to ten times as much as a typical 3'6"-wide natural surface mountain bike trail. Two popular brands of rubberized tread include Rubberway and KBI Flexi-Pave.

CHIP-SEAL

Chip-seal is a technology commonly used for rural roads and typically consists of a road base material with one or more layers of fine aggregates embedded in layers of liquid asphalt. While this method has not typically been used for mountain bike trails, Rock Solid Trail Contracting developed and evolved a variation of chip-seal technology with proven performance on a wide variety of trail applications and trail types, including flowy trails and jump trails.

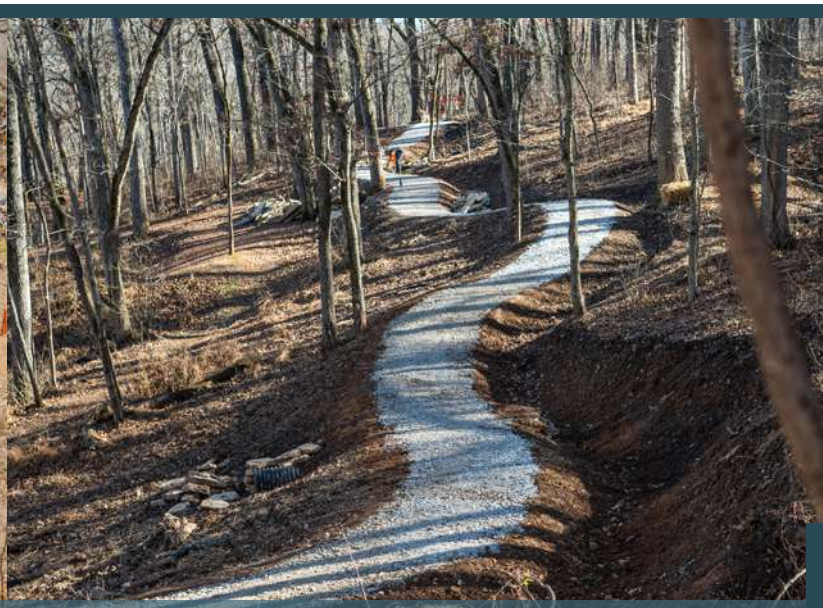


Leopard's Loop chip-seal trail at Lincoln Junior High School in Bentonville, Arkansas. Photo by Eli Glesmann/Rock Solid

Unrivaled all-weather performance on Leopard's Loop trail in Bentonville, Arkansas. Photo by Eli Glesmann/Rock Solid

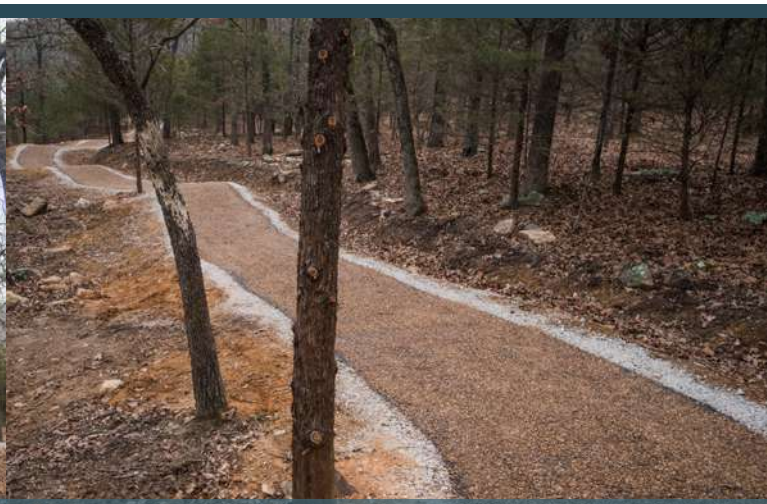
Rock Solid utilizes a layer of compacted road base on top of the initially cut and sculpted native soil followed by two or more layers of fine aggregates embedded in layers of liquid asphalt (oil/polymer mix). Rock Solid has experimented with numerous fine aggregates, selecting aggregates with a blend of traction and abrasion characteristics that minimize tire-wear and skin abrasions when riders crash. Since the first installation in 2020, seven chip-seal trail projects totaling five miles (130,000 sq. ft.) have been completed (as of December 2022).

Chip-seal climb trail under construction at Coler Mountain Bike Preserve in Bentonville, Arkansas Photo by Eli Glesmann/Rock Solid

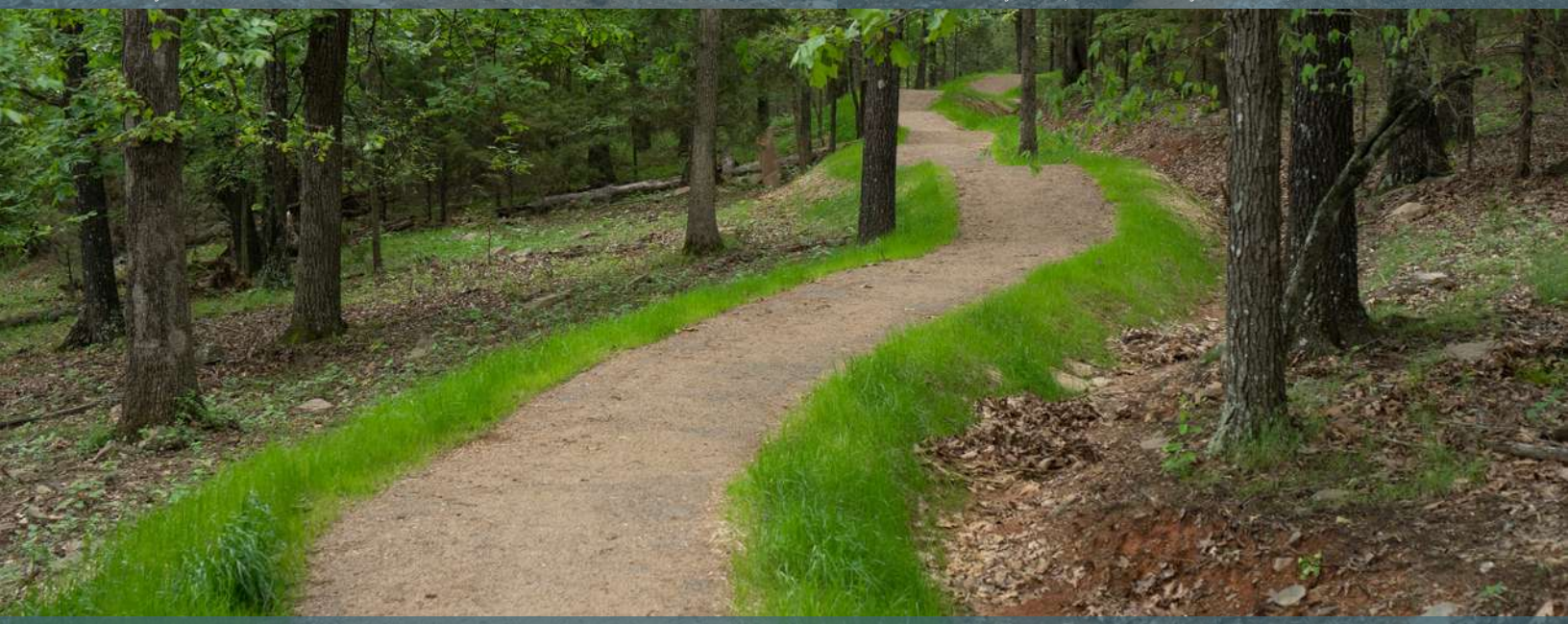


Chip-seal climb trail ready for top coats of liquid asphalt and fine aggregate at Coler Mountain Bike Preserve in Bentonville, Arkansas. Photo by Eli Glesmann/Rock Solid

Liquid asphalt and final aggregate coat being applied at Centennial Park in Fayetteville, Arkansas Photo by Eli Glesmann/Rock Solid



Freshly top-coated trail with liquid asphalt and small aggregate layers at Centennial Park in Fayetteville, Arkansas. Photo by Eli Glesmann/Rock Solid



After some time passes the chip-seal trail blends in well with the natural surroundings at Centennial Park in Fayetteville, Arkansas. Photo by Eli Glesmann/Rock Solid

Chip-seal trail tread solutions offer an unparalleled all-weather experience with the following benefits:

- **MINIMAL TREAD MAINTENANCE** - Rock Solid has chip-seal trails that have remained fairly unchanged after two years of year-round heavy use and a wide range of weather conditions including heavy rain and snow. If repairs are required due to a falling tree denting the surface or cracking from upheaval, the repair is usually as simple as spraying and coating a new liquid asphalt and aggregate layer on the damaged trail section.
- **DURABILITY** - Unlike other hard-surfaced trail options such as asphalt and concrete, chip-seal behaves like an elastic polymer, allowing it to naturally expand and contract with temperature fluctuations instead of cracking and forming potholes.
- **VERSATILITY AND EASE OF INSTALLATION** - Chip-seal machinery is smaller and easier to manage than asphalt or concrete trucks, making it easy to access difficult areas.

- **APPEARANCE** - Chip-seal trails utilize fine aggregates that blend into the surrounding natural environment, providing a much more natural aesthetic than asphalt or concrete would in a natural setting.
- **FULL SPECTRUM OF TRAIL TYPES** - Due to the ease of installation and the ability for chip-seal to be applied to steep berms and jump faces, chip-seal can be applied across the broad spectrum of different trail types and skill levels, though the optimal applications are for beginner trails, climbs, intermediate flow and pump track style trails from 0-10% grade with a tread width of three feet or more.

Excellent traction, even when wet at Leopard's Loop trail in Bentonville, Arkansas. Photo by Eli Glesmann/Rock Solid

Turnkey chip-seal trail installations include all labor and material and typically cost about four to five times as much as typical natural-surface mountain bike trail.

Dusk riding redefined: Choo Choo trail with glow-in-the-dark chip-seal surface at Slaughter Pen in Bentonville, Arkansas. Photo by Eli Glesmann/Rock Solid

ASPHALT AND CONCRETE

Asphalt and concrete have not typically been used for mountain bike trail applications, though concrete is occasionally used for TTF piers and bridge abutments. In these situations, concrete bags are typically brought in and mixed on-site. Asphalt and concrete do make sense for bike park applications such as pump tracks, jump lines, and skill loops that can otherwise require extensive maintenance needs when made from dirt.

Trail applications would need to be close to parking lots or areas easily accessible by large and very heavy asphalt or concrete delivery trucks, which is quite rare due to the typical length and remoteness of most trail installations. Asphalt and concrete, aside from not blending aesthetically within a natural environment, are impractical for trail applications in the woods due to the delivery methods (concrete and asphalt trucks), the remoteness of trail locations, the need for forms (concrete), and the short cure times. Asphalt and concrete can be made to look more natural, though, through the application of acrylic court surfaces like those seen on tennis courts.

A new chip-seal mountain bike trail adjacent to the Cannonball asphalt hike and bike path at Aldo Leopold Park in Madison, Wisconsin. Photo by Repyak/IMBA

APPENDIX D

Community Bike Park/Bicycle Playground Facilities

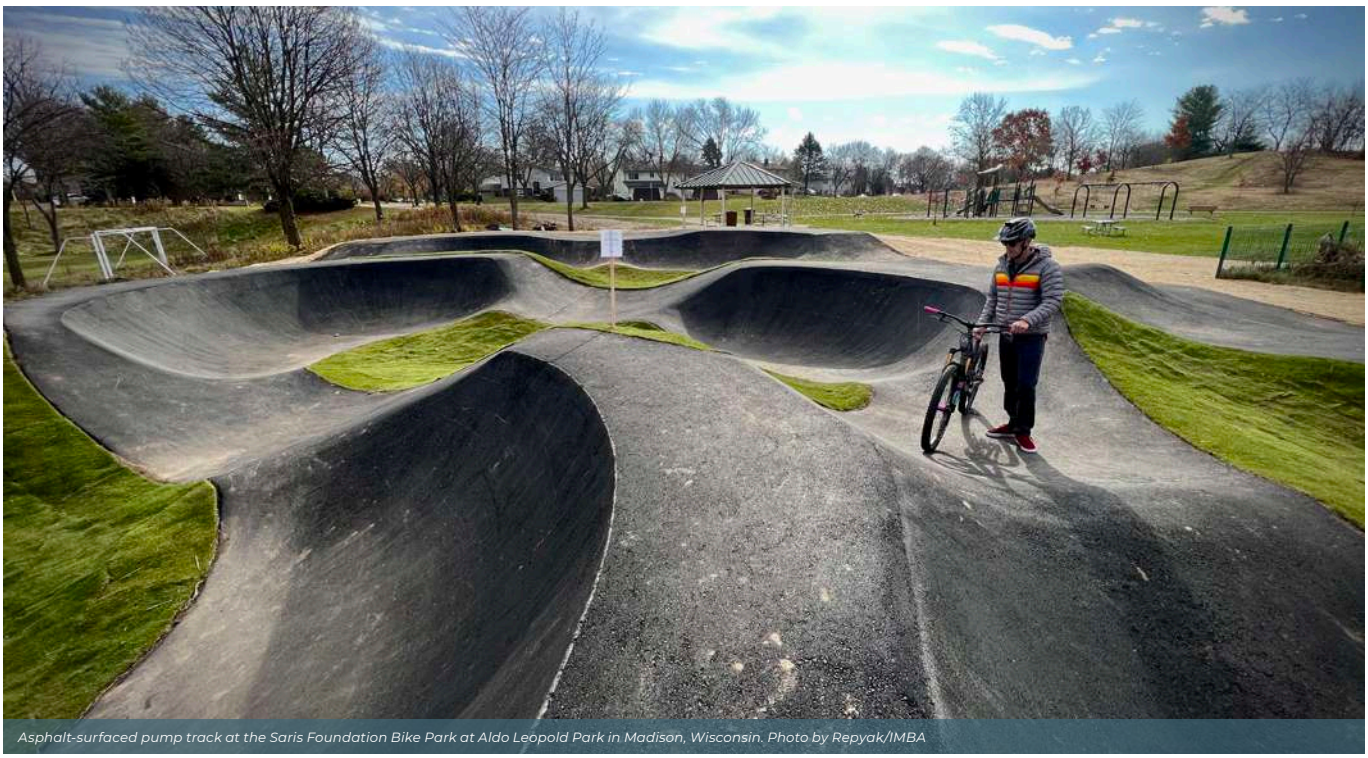
Community bike parks are an integral element of the mountain bike landscape and are more intensely designed than singletrack trails. They offer a small area where users can practice their skills, progress, and have fun in a well-managed manner. Bike parks are typically located in an existing park or similar area, but can also be located at trailheads of trail systems to create a complete offering of trails and practice areas at one site.

Site plan concept for Fire Mountain Bike Park in Cherokee, North Carolina. Image courtesy of IMBA Trail Solutions

Cleveland-Cliff's Bike Park situated in the Ohio & Erie Canal Reservation in Cleveland, Ohio. Photo courtesy of American Ramp Company

PUMP TRACK

A pump track is designed to help cyclists of all skill levels to improve their riding skills. Pump tracks are multidirectional and allow users to create their own routes through the rollers, berms, and jump features. A pump track will foster more organic and creative riding that stimulates both novice and skilled riders. Riding a pump track park is a physically demanding and an extremely anaerobic activity, so it is recommended that suitable staging/seating and shade structures be installed for users to rest between sessions.



Asphalt-surfaced pump track at the Saris Foundation Bike Park at Aldo Leopold Park in Madison, Wisconsin. Photo by Repyak/IMBA

Modular pump track in Oberstaufen, Germany. Photo by Hannah Bichay/Pumptrack.de

Asphalt pump track in Heubach, Germany. Photo by Alex Brunst/Pumptrack.de

Asphalt pump track in Jarvso, Sweden. Photo courtesy of Velosolutions

SKILLS AREA/SKILLS TRAILS/SKILLS LOOP

Users looking to progress their riding abilities in a low consequence environment can learn in a skills area. A skills area can consist of trail loops or trail sections that mimic real trail conditions but in a more controlled environment near a trailhead. Skills areas feature numerous optional stations where users can practice on features designed to teach specific skills. Features may include skinny bridges, rock gardens, rock-overs, climbing/descending ledges, drops, rollers, berms, jumps, and more. Features can be site-built or prefabricated, and ideally accommodate all skill levels (beginner through expert) for progressing bike handling skills. Aesthetics can be important, as is matching natural trail conditions; therefore, dirt, wood, and rocks are the most commonly used materials.

Natural surface and crushed stone skills trails with pre-fabricated trail features at the Iron Hills trails in Cedar City, Utah. Photo courtesy of IMBA

Surfaced skills trails with pre-fabricated trail features at Runway Bike Park in Springdale, Arkansas. Photo by Repyak/IMBA

Skills trails with rock and wood skinnies at Sylvan Hill Park in Wausau, Wisconsin. Photo by Gary Barden Design

TOT TRACK

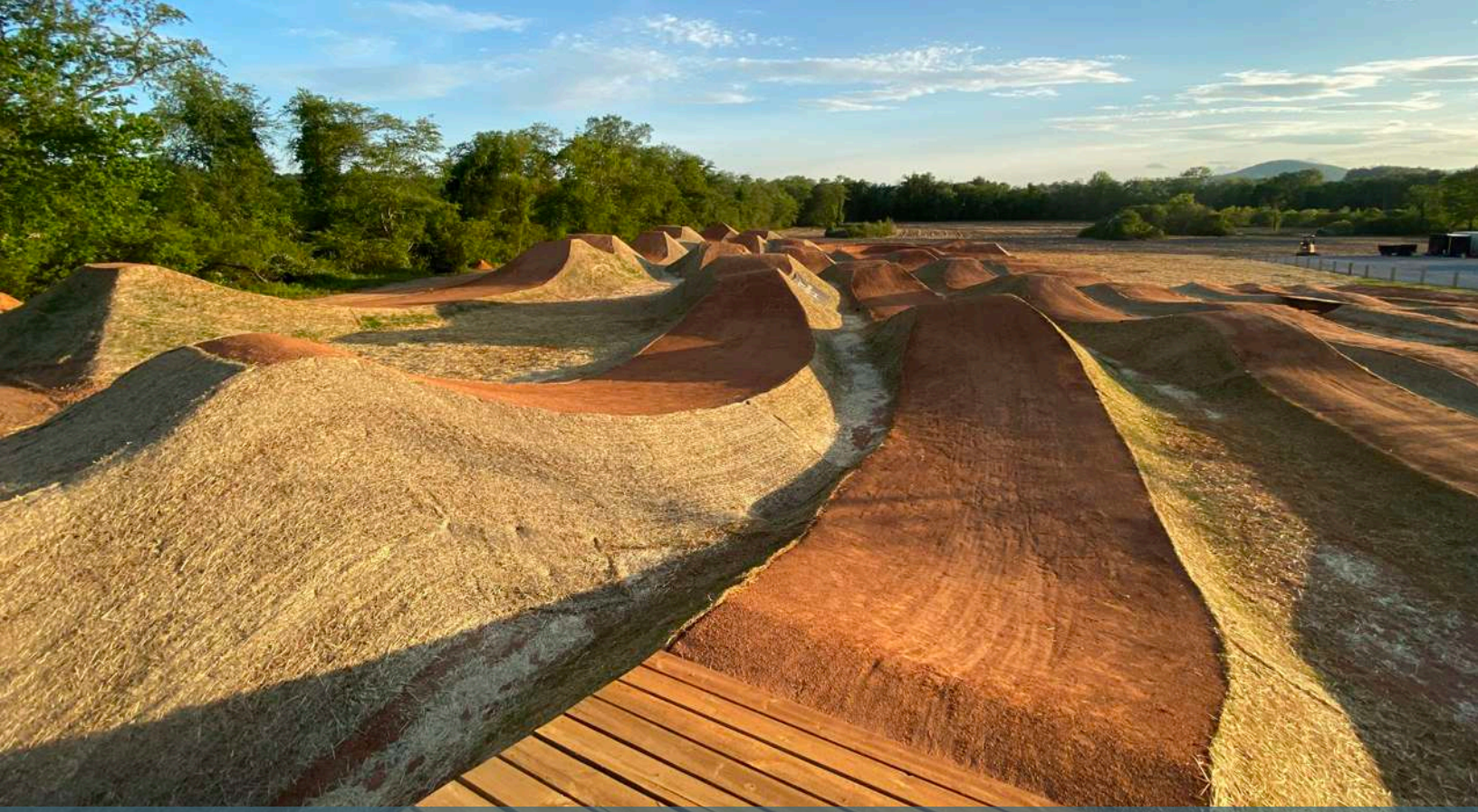
A tot track is designed for smaller bicycles and their users, typically toddler-aged. It features reduced-sized rollers as well as low-angle bermed turns, and can also incorporate reduced-sized technical features. It has features that can accommodate balance bicycles as well as regular bikes with short wheelbases. The tot track is designed for the least skilled of riders. Tot tracks are essentially smaller versions of pump tracks and skills loops. Like pump tracks and skills loops, tot tracks can be constructed from dirt or a hardened surface. Rubber, asphalt, concrete, and chip-seal are the recommended surface materials for tot tracks. Surfaced tot tracks are more expensive to install than dirt tracks, but greatly reduces maintenance costs and more importantly, provides a consistent high-quality experience for the users.

Beginner/tot skills area in Bentonville, Arkansas. Photo by Repyak/IMBA

Beginner/tot skills trail at Lakeside Bike Park in Buffalo, New York. Photo by Repyak/IMBA

JUMP LINES

Dirt jumps range in height, but are typically three- to six feet high, spaced to maximize a rider's ability to flow from one jump to the next without having to pedal. Dirt jump areas are designed so that the start hill is the highest elevation point and provides sufficient gravity to propel riders into the jump lines. Dirt jumps are incredibly fun, a great workout, and an excellent practice area for building solid bike jumping skills. These areas are designed to be ridden in one direction, eliminating potential conflicts. Dirt jumps require soil with a high percentage of clay (60-70%) that compacts very hard, minimizing rolling resistance and standing up to heavy use and high shearing forces. Installing engineered structures for the jump takeoffs substantially minimizes maintenance and improves the consistency of the user experience. Structures, such as ramps with lips, can be fabricated with steel, wood, and rock, or hardened with asphalt and at times with concrete. To further minimize maintenance, entire jump lines can also be made from chip-seal, asphalt, or concrete.

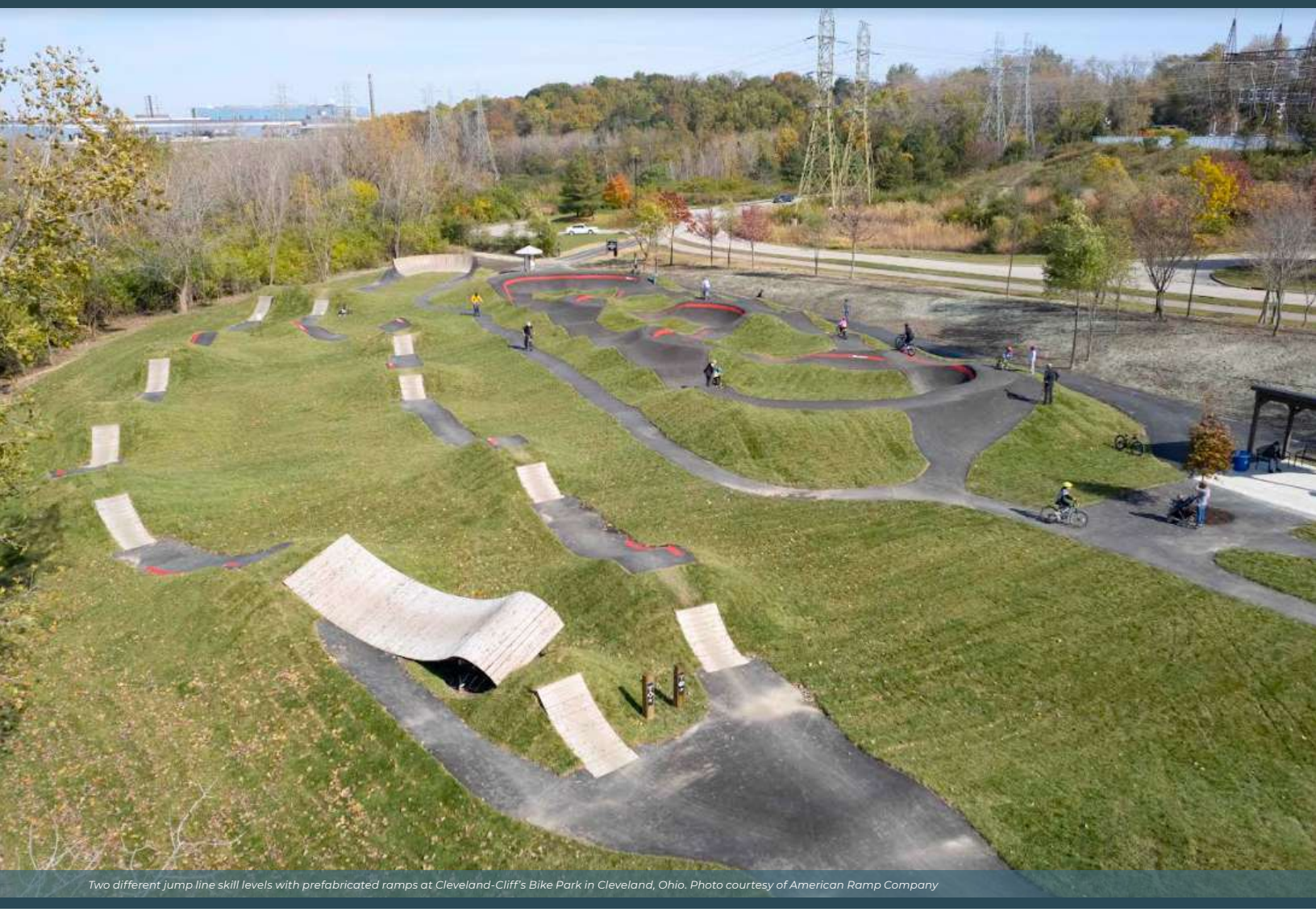


Progressive sets of dirt jump lines at Riveter in Fletcher, North Carolina. Photo courtesy of McGill Trail Fabrication

Dirt jump line at Riveter in Fletcher, North Carolina. Photo courtesy of McGill Trail Fabrication

Dirt jump line at Keystone Resort in Keystone, Colorado
Photo courtesy of McGill Trail Fabrication

Jump line with pre-fabricated jumps at Bijou Bike Park in South Lake Tahoe, California
Photo courtesy of American Ramp Company



Two different jump line skill levels with prefabricated ramps at Cleveland-Cliff's Bike Park in Cleveland, Ohio. Photo courtesy of American Ramp Company

Thank you for your commitment!

The Greater Minnesota Regional Parks and Trails Commission hopes you found our Mountain Bike Trail Development Guidelines to be helpful, insightful and inspiring as you strive to design and build your new trails.

The process of producing this guide was highly collaborative and evolved over time, building on the wisdom of its talented and innovative author, Jake Carsten. He recognized the potential to create much more than a manual to lead park/trail or land managers through the design-build process. The result is this comprehensive guide that covers the large and small details necessary to create world-class mountain bike trails.

Along with the dedicated experts at Rock Solid Trail Contracting and the International Mountain Bicycling Association (IMBA) who partnered with us on this unprecedented project, we thank you for your commitment to turning what's on these pages into beautiful and sustainable trails that will help people further enjoy the great outdoors for generations.

Mountain Bike Trail Development: Guidelines for Successfully Managing the Process

Author: Jake Carsten

Book Designer: Evolve Creative

Published by:

Greater Minnesota Regional Parks and Trails Commission (GMRPTC)

3601 Trinity Road

Duluth, MN 55811

218-310-2627

https://www.gmrptcommission.org/

Greater Minnesota Regional Parks and Trails Commission (GMRPTC) Disclaimer
The information contained in this and other GMRPTC documents is intended as a resource only and should not be interpreted as a standard, specification, or regulation. Deviation from the enclosed considerations may be dictated by the circumstances of each unique situation. Operations will vary from place to place on account of practical, operational, geographic, climatic, or other differences. Trail managers and bicycle groups should be aware that laws and requirements may vary according to jurisdiction, and that it is the responsibility of all parties to understand and adhere to local requirements. This information is not intended to constitute legal advice and should not be relied upon as a legal certainty. The publisher, editors, and contributors shall not be held responsible for any injuries resulting from the use of information contained in this book. Any individual in need of legal advice on any of the matters discussed in this book should consult an attorney.

Split Rock Wilds in Beaver Bay, Minnesota.
Photo by Paul Vincent Photography

GREATER MINNESOTA REGIONAL Parks and Trails COMMISSION

ROCK SOLID TRAIL CONTRACTING

IMBA
INTERNATIONAL MOUNTAIN BICYCLING ASSOCIATION

CLEAN WATER LAND & LEGACY AMENDMENT