eMTB

LAND MANAGER HANDBOOK

peopleforbikes

ABOUT

PeopleForBikes

PeopleForBikes is an organization that aims to make riding better for everyone. By collaborating with millions of individual riders, businesses, community leaders, and elected officials, PeopleForBikes is uniting people to create a powerful, united voice for bicycling and its benefits.

Their work focuses on making every kind of bike ride better—whether it's a ride on trails, to the grocery store, or all the way across town. Why? Because when people ride bikes, great things happen for our bodies and our minds, as well as our local and global communities.

Bicycle Product Suppliers Association

The Bicycle Product Suppliers Association (BPSA) is an association of suppliers devoted to bicycles, parts, accessories, and services. The association leads industry initiatives in legal and governmental affairs and safety issues, is the premier resource for bicycle statistical data, and provides regular networking and educational forums for its members.

Bureau of Land Management

The Bureau of Land Management (BLM) may best be described as a small agency with a big mission: to sustain the health, diversity, and productivity of America's public lands for the use and enjoyment of present and future generations. It administers more public land—over 245 million surface acres—than any other federal agency in the United States. Most of this land is located in the 12 western states, including Alaska. The BLM also manages 700 million acres of subsurface mineral estate throughout the nation.

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INTRODUCTION

HOW TO USE THIS HANDBOOK

This handbook was developed in partnership with the bicycling industry and the U.S. Bureau of Land Management (BLM), in consultation with professional trail builders. It is intended to be a practical field resource for the planning, design, construction, maintenance, and management of electric mountain bike trails.

WHY

Electric mountain bikes, or eMTBs, first began appearing on trails as custom conversion kits containing after-market batteries and motors attached to mountain bikes. Over the past several years, the sale of production eMTBs has steadily grown, particularly in Europe. In general, the overall e-bike category in the U.S. has grown about 450% since 2013, with year-over-year growth averaging around 50%.

Because trails are both a desirable and a limited resource, the arrival of any new user group can incite perceived conflict for existing users and land managers. Questions about potential negative impacts such as crowding or the spread of invasive species are legitimate concerns that should be addressed in order to assess the compatibility of new uses with existing ones.

One of the main advocacy lessons learned from the explosive growth of mountain biking in the 1990s was that an influx of new users cannot be properly managed in an information vacuum. An improper understanding of the negative and positive impacts of a new use will lead to poor management decisions about protecting resources and promoting outdoor activity. The purpose of this handbook is, therefore, to share information and best management practices to reduce the negative impacts and enhance the positive impacts of eMTBs.

WHO

The primary audience for the information contained in this document is land managers. Whether you are a landscape architect for a local parks and recreation department or the recreation manager for a 200-mile trail network on federal lands, this book is intended to assist you.

Trail advocates and volunteer trail builders will also find relevant material in this handbook, particularly in the practical discussion of developing trails that are environmentally, socially, and fiscally sustainable.

WHAT

Impacts are inherently neutral; we assign value to them, deciding that they are either positive or negative. As with all other trail uses, eMTBs have the potential to create both negative impacts (such as trail erosion) and positive impacts (such as getting more people recreating). Minimizing the negative impacts and maximizing the positive impacts can only be done when there is a clear understanding of what experiences eMTB riders seek, how they interact with other users, and their physical impact on the natural environment.

WHERE

The diversity of landscapes, soils, habitats, and climates through which our nation's trails weave is nearly limitless, from the tundra of Alaska to the deserts of New Mexico and everything in between. It would not be possible to speak to each location's particular conditions, but there are themes that apply universally when considering developing sustainable trails and desirable user experiences for eMTB riders.

WHEN

The eMTB Land Manager Handbook is to be used throughout the life cycle of a trail, from early scoping meetings with stakeholders to ongoing tread maintenance.

CHAPTER 1
eMTBs

WHAT IS AN eMTB?

An eMTB is a bicycle with a small electric motor that is designed for the rigors of trail use. The presence of an electric motor, typically powered by a rechargeable battery and no more powerful than the motor of a hair dryer, separates it from a standard bicycle in that it is not solely human-powered.

Typically outfitted with mountain–bike specific technology such as disc brakes, suspension, and a wide gear range, eMTBs are functionally different from the large variety of electric bicycles (e-bikes) that are intended primarily for use on paved or improved surfaces, such as streets and bike paths. eMTBs do not include gas-powered bicycles, are quiet and emissions-free.

Two important technologies are relevant to the use and management of e-bikes, including eMTBs:

- *Pedal-assist eMTBs, also known as pedelec bikes or Class 1 eMTBs, only engage the electric motor when the rider pedals. This requires locomotion input from the rider, contrary to throttle-assist bicycles that can be activated without pedaling (Class 2 eMTBs).*
- *Governors cut power to the engine based on a predetermined top speed set by the manufacturer.*

CLASS 1–3 DEFINITIONS

American e-bike manufacturers created three categories of e-bikes, including eMTBs:

CLASS 1

A "Class 1 electric bicycle," or "low-speed pedal-assisted electric bicycle," is a bicycle equipped with a motor that provides assistance only when the rider is pedaling, and that ceases to provide assistance when the bicycle reaches the speed of 20 miles per hour.

CLASS 2

A "Class 2 electric bicycle," or "low-speed throttle-assisted electric bicycle," is a bicycle equipped with a motor that may be used exclusively to propel the bicycle, and that is not capable of providing assistance when the bicycle reaches the speed of 20 miles per hour.

CLASS 3

A "Class 3 electric bicycle," or "speed pedal–assisted electric bicycle," is a bicycle equipped with a motor that provides assistance only when the rider is pedaling, ceases to provide assistance when the bicycle reaches the speed of 28 miles per hour, and is equipped with a speedometer.

Most eMTBs from major manufacturers are Class 1 electric bikes that require riders to be pedaling for the motor to engage. In this handbook, eMTBs refer exclusively to Class 1 e-bikes.

WHAT DO eMTBers WANT?

Historically, the development of recreation trails focused on bringing people to important destinations or through unique landscapes. In urban areas, trails were developed to provide access to undeveloped areas. In almost all cases, there was little explicit consideration of the increasingly complex demand from users for specific experiences.

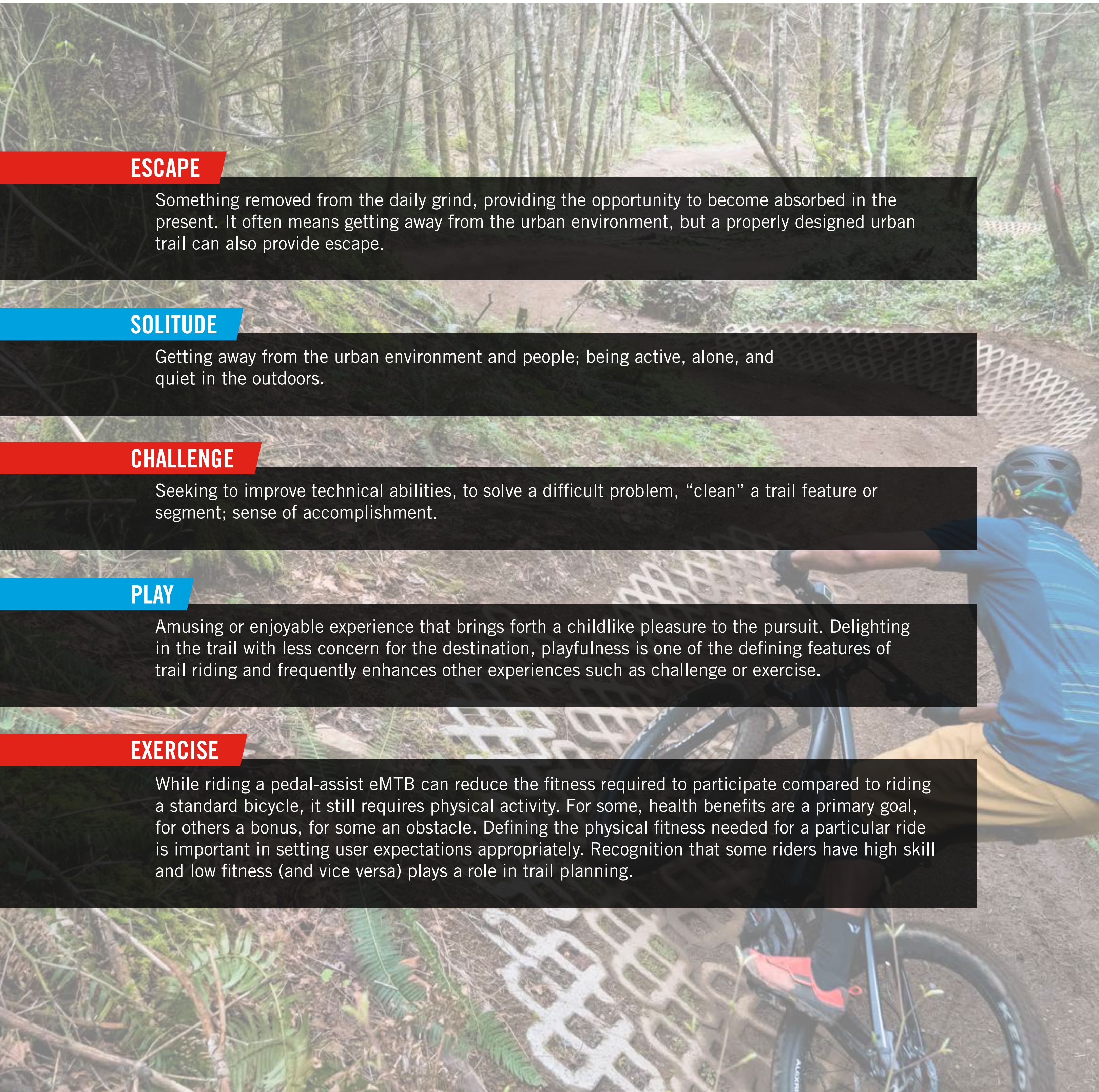
Current best practices for recreation trail development carefully consider both the mix of trail users (e.g., walkers, runners, equestrians, cyclists, ATV riders, etc.) and the desired experiences of each user group. Some people use the trail to experience solitude, while others want a physically or technically challenging outing. To further complicate matters, most users seek multiple experiences simultaneously.

Accepted trail construction guidelines, while providing best practices to reduce erosion, do not consider how the trail will feel for the user. Is solitude promoted by taking people to undeveloped areas? If the trail is intended to physically challenge users, does it do so at the expense of other users seeking a playful experience?

TYPICAL DESIRED EXPERIENCES FOR eMTBers

Planning trails for eMTBers requires an understanding of the typical trail experiences that they seek. In general, they are:

COMPARED TO OTHER TRAIL USERS



ESCAPE

Something removed from the daily grind, providing the opportunity to become absorbed in the present. It often means getting away from the urban environment, but a properly designed urban trail can also provide escape.

SOLITUDE

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

CHALLENGE

Seeking to improve technical abilities, to solve a difficult problem, “clean” a trail feature or segment; sense of accomplishment.

PLAY

Amusing or enjoyable experience that brings forth a childlike pleasure to the pursuit. Delighting in the trail with less concern for the destination, playfulness is one of the defining features of trail riding and frequently enhances other experiences such as challenge or exercise.

EXERCISE

While riding a pedal-assist eMTB can reduce the fitness required to participate compared to riding a standard bicycle, it still requires physical activity. For some, health benefits are a primary goal, for others a bonus, 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 high skill and low fitness (and vice versa) plays a role in trail planning.

COMPARED TO OTHER TRAIL USERS

In general, eMTBers are similar to other trail users, both motorized and nonmotorized, in that they seek a variety of experiences. They like to be outdoors on trails, sometimes for exercise, sometimes for fun, and sometimes for challenge. As with all users, the desired experience will vary by location as well as temporally. For example, during the weekend, users may seek escape in a backcountry setting, but during the week, a 30-minute outing after work is focused primarily on exercise.

eMTBers are more similar to other wheeled users in that they are better able to take advantage of the fun and efficiency provided by their bikes. This can separate them from pedestrians and equestrians who are unable to take advantage of the playfulnes provided by the use of wheels.

COMPARED TO MOUNTAIN BIKERS

All of the desired experiences listed for eMTBers are also high on the list for mountain bikers. eMTBs will typically allow any given user to go further because of the assist, but that does not change the desired experience.

MORE INFORMATION

For more information on trail experiences, refer to ***Guidelines to a Quality Trail Experience*** by the ***Bureau of Land Management*** and the ***International Mountain Bicycling Association*** (http://gqte.imba.com).

CHAPTER 2

SUSTAINABLE TRAILS

WHY SUSTAINABLE TRAILS?

A trail is a facility that allows the public to access and interpret landscapes while concentrating impacts to a defined corridor. A trail is considered sustainable when it allows users to enjoy an area with minimal impact to natural and cultural resources and requires only modest maintenance. When a trail fails to provide desired outcomes, the resulting impacts can be crowding, conflict, and the creation of unauthorized trails, so a truly sustainable trail must also align with desired user experiences.

Over the past several decades, the concept of sustainable trails has been refined. It is generally accepted by land managers and trail users that sustainable trails are necessary, and the reasons for this are both valid and obvious: poorly built and maintained trails are expensive to manage, result in environmental damage, and are wildly inconsistent in the experience they provide for users.

THE THREE FACETS OF TRAIL SUSTAINABILITY

ENVIRONMENTAL

When considering whether or not a trail is sustainable, a primary question to be answered is, "Will the trail provide resource protection?" As stewards of the natural environment, we have a responsibility to preserve landscapes, flora, and fauna for the enjoyment of future generations and the intrinsic benefit of natural habitats. Several resources exist to assist with the development of environmentally sustainable trails (see appendices).

SOCIAL

In the past, most discussions of trail sustainability focused on environmental sustainability and ignored social sustainability. This can be seen in the number of trails that are overcrowded, have less use than planned, or were created by users.

Each trail user seeks a specific experience. Because trails are open to the public, this means that different users seeking different experiences are on the same trail at the same time. Failure to consider or provide for a range of desired experiences leads to complaints of crowding and displacement. As problematic but more difficult to see is the latent demand for trails that don't exist. How many more people would be more active if there was a trail that met their needs?

Allowed uses factor into social sustainability. Trails that are open to a wide variety of user types will obviously provide the greatest good for the least amount of infrastructure. However, this may conflict irrevocably with desired user experiences; people will have a hard time finding solitude if everyone is crammed into the same space. Trail use configurations include:

SINGLE-USE

Single-use trails allow only one use type, such as mountain biking or hiking. Advantages include:

- Targeted user experience. With only one user type, it is possible to fine-tune the desired experience. For example, a trail specifically designed for technical challenge on a dirt bike would not need to consider whether hikers or equestrians could safely navigate it.
- Dispersal of users. Popular recreation areas with crowded trail systems can use single-use trails to best accommodate heavier traffic near the trailhead or at popular destinations, reducing conflict until people disperse into the system.

MULTI-USE

Multi-use trails allow two or more user groups to access a trail, such as hikers and equestrians. Multi-use trails are the most popular type of trails, although the user mix varies greatly. Advantages include:

- Best accommodates the needs of the broadest array of users.
- Helps to build a trail community. Visitors are encouraged to cooperate in order

to preserve and protect a common resource, and encountering other types of users on a trail helps to establish mutual respect and inspire courtesy.
- Cost- and resource-efficient, taking advantage of available space and trail mileage. This results in fewer miles than would be necessary to accommodate trails for individual user groups.
- Supports the most visitors. Trails that lead to specific major destinations, such as waterfalls and scenic vistas, should be considered for shared use, since most visitors will be drawn to the point of interest regardless of their mode. Likewise, trails that serve as major travel corridors can be more efficient when shared.

PREFERRED-USE
Preferred-use trails allow two or more user types to access a trail, but are designed to primarily accommodate the experience of only one of them. Advantages include:
- Allows multiple users, but targets a specific experience. This broadly spreads the benefit of access, but allows the design to provide a desired experience. Trail runners and cyclists, for example, may enjoy the same trail with minimal conflict, but bike-specific features can be added for the cyclists.

ECONOMIC
Economic unsustainability is often shown passively in poorly maintained trails or when users create their own trails because funding does not exist to develop new opportunities. Given the limited resources of land management agencies, the economic sustainability of an existing or proposed trail must be addressed.

This is not to say that a trail should not be maintained or created if it costs money. In some cases, the lack of available land or the desire to provide a unique experience, such as access to a viewpoint, may warrant the above-and-beyond costs that are incurred. Clearly, though, the resources to properly build and maintain a trail must be in place for any infrastructure to be considered sustainable.

SUSTAINABLE TRAILS FOR eMTBs
Given the above information, what makes a sustainable eMTB trail?

ENVIRONMENTAL
An environmentally sustainable eMTB trail has minimal and acceptable impact to the natural environment. It follows accepted trail development guidelines such as those developed by the International Mountain Bicycling Association (IMBA) to create a physical tread that minimizes erosion utilizing such principles as the Half Rule, grade reversals, and maximum trail grade.

IMBA performed a study sponsored by the Bicycle Product Suppliers Association (BPSA) to identify impacts of eMTBs on bike-optimized trails in the Pacific Northwest bio-region (see Chapter 5). Based on this study, the BPSA has developed best management practices (BMPs) to reduce eMTB impacts to trails. These BMPs, discussed in more detail in Chapter 5, should also be followed to create sustainable trails.

SOCIAL
Allowing eMTBs improves the social sustainability of a trail by increasing the number of users who can access it. This, of course, must be balanced with increased use. More than just access, however, a trail system should provide the experiences that are desired by the eMTB community, including some mix of multi-, single-, and preferred-use singletrack for the following experiences:

- Escape
- Solitude
- Challenge
- Play
- Exercise

ECONOMIC
To be economically sustainable, the land management agency, with the support of the trails community, must be able to bear the cost of developing and maintaining a trail system in a reasonable condition. That condition should be, at a minimum, that it continues to be both environmentally and socially sustainable given the above definitions. This can be provided through departmental expenditures, grants, volunteer labor, donations, and other sources.

CHAPTER 3

TRAIL PLANNING AND DESIGN

OVERVIEW

The decision of where and how to incorporate eMTBs into a trail system rests in the hands of the land management agency with input from trail-user stakeholders. While each agency has its own rules and regulations, the general process follows best practices for any public land use decision.

ASSESSMENT/ PLANNING → **DESIGN** → **CONSTRUCTION** → **MAINTENANCE/ MANAGEMENT**

The positive and negative impacts from eMTBs are distinct from other trail uses. While trail impacts are known and have been researched for activities such as hiking and mountain biking, they are not as well understood for eMTBs given the sport's shorter history. The following information is intended to assist land managers and advocates in decision-making.

An effective framework for managing recreational trail users is benefits-based management, predicated on identifying outcomes (benefits) that improve conditions or prevent worsening conditions. While there is a range of benefits for trail users, the most direct ones are social, physiological, and psychological. Frequently, multiple benefits can be achieved at once. For example, a trail runner may join a group event (increased socialization and support) for a challenging run (improved cardiovascular health for better physiological health) along a backcountry route (psychological relief from living in the built environment).

Not surprisingly, the benefits identified for trail users generally and mountain bikers specifically are similar to those for eMTB riders, since eMTB riders recreate on trails in open spaces similar to mountain bikers.

THE BENEFITS OF eMTB RIDING INCLUDE:

Improved physical health
(reduced risk of heart disease and diabetes, weight loss, increased muscle mass)

Improved physiological health
(less stress, feeling of accomplishment)

Increased socialization
(more positive social interactions, spending time with friends and family)

eMTBs PROVIDE BENEFITS TO PEOPLE WHO WOULD OTHERWISE FIND IT DIFFICULT TO RECREATE ON TRAILS. BECAUSE MOUNTAIN BIKING CAN BE PHYSICALLY CHALLENGING, IT REDUCES THE NUMBER OF PEOPLE WHO CAN PARTICIPATE IN IT. eMTBs REMOVE SOME OF THE BARRIER, ALLOWING PEOPLE WHO MAY NOT HAVE THE STRENGTH OR STAMINA TO ENJOY THE GREAT OUTDOORS. PEOPLE ALSO RECEIVE THE SOCIAL BENEFIT OF MULTI-GENERATIONAL OUTINGS WHERE CHILDREN AND SENIORS CAN KEEP PACE WITH RIDERS IN THEIR PHYSICAL PRIME.

BENEFITS CAN BE ACHIEVED BY PROVIDING THE EXPERIENCES DESIRED BY eMTB RIDERS. AS IDENTIFIED IN CHAPTER 2, THESE INCLUDE:

ESCAPE: Something that takes the rider away from the daily grind, allowing them to get lost in the experience of riding. Often this means getting away from the urban environment, but an intense, engaging urban trail system can also provide this feeling.

CHALLENGE: Seeking to improve technical abilities, solve a difficult problem, or "cleaning" a trail feature or segment. Enhancing bike-handling skills provides a sense of accomplishment.

PLAY: An amusing or enjoyable experience, and one of the intrinsic reasons people ride trails. Frequently the primary motivation for an outing; fun doesn't have to be sacrificed for challenge or exercise.

EXERCISE: Physical exertion for the purpose of increased health. For some this is a primary goal, for others a bonus, for some an obstacle. Riding even an easy trail on a Class 1 eMTB requires cardiovascular fitness and upper and lower body strength. Some riders have high skill and low fitness, or vice versa.

SOLITUDE: Getting away from the urban environment and people; being alone or in a small group in the outdoors.

ASSESSMENT/ PLANNING

The first step is to determine if eMTBs are allowed based on the land management regulations. Reviewing land use and planning documents will help determine the appropriate uses within a given area or on a specific trail. If the rules allow eMTB use then proceed; if not, then a determination or regulatory change may be necessary before eMTBs can access the trails.

The step in creating eMTB trails is similar to that for any trail development: determining the existing conditions. How much land is available? Are there existing trails, and, if so, what is their condition? Geography, soils, vegetation, land use designations, sensitive habitat, property ownership, and numerous other factors will influence where new trails can go and where new uses such as eMTBs can be added to existing trails.

While much of the information can be obtained through land databases, the environmental sustainability of any existing trails will need to be determined. Guidelines developed by IMBA in its book *Trail Solutions: IMBA's Guide to Building Sweet Singletrack* can be used to determine if a trail is going to be continually prone to erosion or if it can be maintained with acceptable levels of effort.

In addition to environmental sustainability, existing trails should be assessed for the experiences they provide. Most trails developed organically: they were routed in a way that efficiently provided access between an origin and a destination. Frequently they followed old roadbeds or primitive routes. Even trails that have been meticulously planned and designed rely more on sustainable trail alignment principles than on providing specific experiences.

Assessing existing experiences is often an overlooked step. If eMTB routes are already available, do they focus on play or on exercise? If a trail is to be opened to eMTBs, is it rocky and challenging or is it hidden from surrounding development so that escape is the predominant sensation? This information provides valuable direction for subsequent actions in the development process.

The eMTB experiences will typically be similar to the MTB experiences that are provided. For example, if an existing trail open to MTBs provides for play and escape, the trail is likely to provide a similar experience for eMTB riders. The critical differences are outlined in the following chart.

EXPERIENCE	eMTB VS. MTB
ESCAPE	No major difference.
CHALLENGE	The power assist provided by an eMTB can make some technical sections easier, particularly on a flat or climbing trail. Conversely, descending trails, especially those with opportunities to put the bike in the air, are more difficult given the added weight of an eMTB.
PLAY	No major difference.
EXERCISE	Generally speaking, a rider will find most trails to be less physically challenging on an eMTB. However, for some people, mountain biking is inaccessible because of the physical effort; eMTBs allow them to ride a trail they otherwise could not. For this cohort, the trails are still physically challenging, just not as much as they would be on an MTB.
SOLITUDE	No major difference.

The desired experiences are further refined by assessing the difficulty level of the trail for cyclists. No guidelines exist for rating the difficulty of eMTB trails, but IMBA provides this information for MTBs. Given the similarity between the two activities, it is reasonable to use IMBA's guidelines.

IMBA TRAIL DIFFICULTY RATING SYSTEM

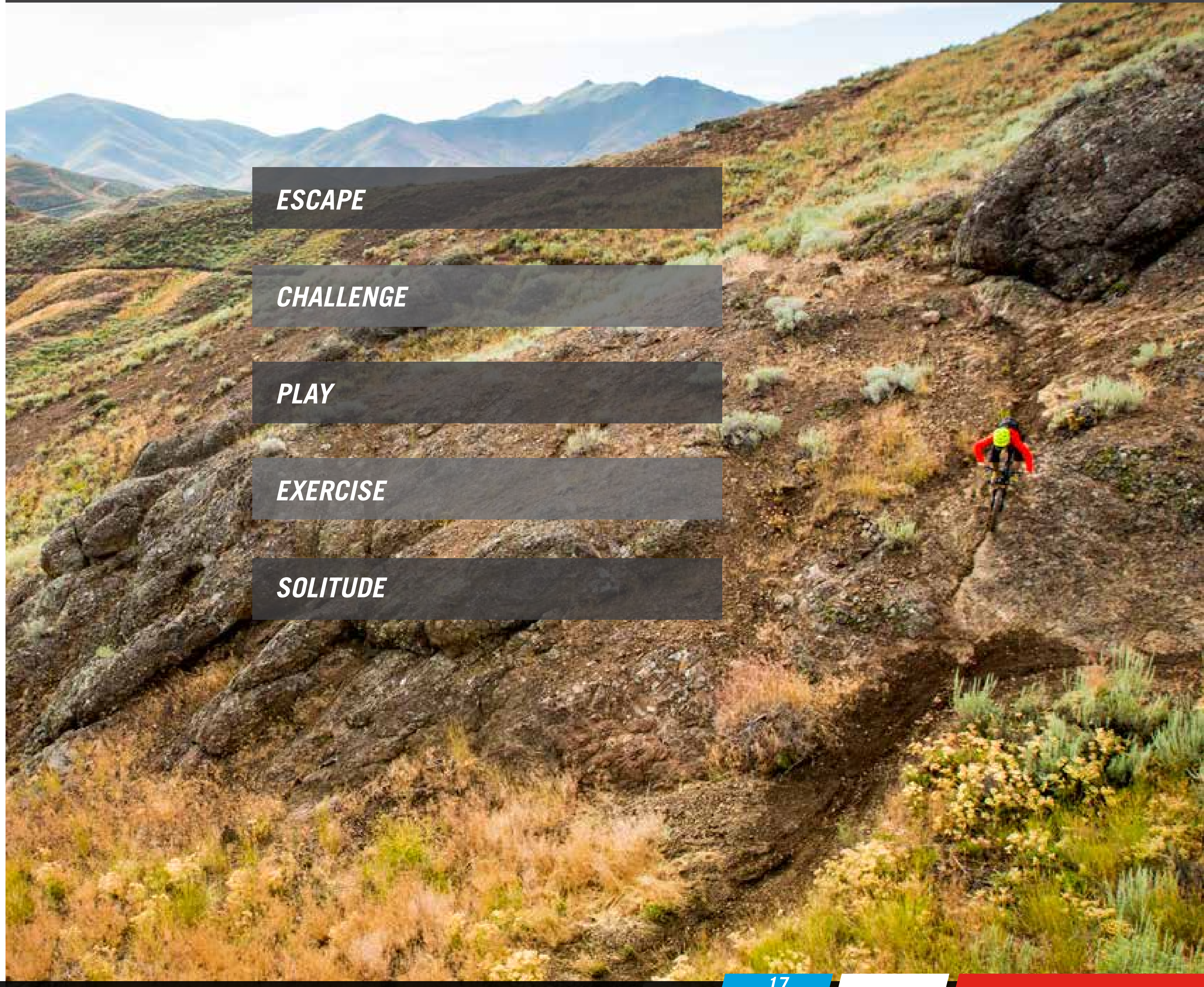
	Easiest White Circle	**Easy** Green Circle	**More Difficult** Blue Circle	**Very Difficult** Black Diamond	**Extremely Difficult** Dbl Black Diamond
Trail Width	72" or more	36" or more	24" or more	12" or more	6" or more
Trail Surface	Hardened or surfaced	Firm and stable	Mostly stable with some variability	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" tall or less Avoidable obstacles may be present Unavoidable bridges 36" or wider	Unavoidable obstacles 15" tall or less Avoidable obstacles may be present Unavoidable bridges 24" or wider TTFs 2' high or less, width of deck is less than 1/2 the height Short sections may exceed criteria	Unavoidable obstacles 15" tall or less Avoidable obstacles may be present May include loose rocks Unavoidable bridges 24" or wider TTFs 4' high or less, width of deck is less than 1/2 the height Short sections may exceed criteria	Unavoidable obstacles 15" tall or less Avoidable obstacles may be present May include loose rocks Unavoidable bridges 24" or narrower TTFs 4' high or less, width of deck is unpredictable Many sections may exceed criteria

TRAIL EXPERIENCE EVALUATIONS

The following process describes how to assess the range of eMTB experiences available within a given trail system or on a single trail. While data such as trail length and grade are objective, the experience that the trail provides is subjective, making it difficult to describe. Regardless, this is an important step in establishing a meaningful understanding of the existing conditions.

STEP 1:

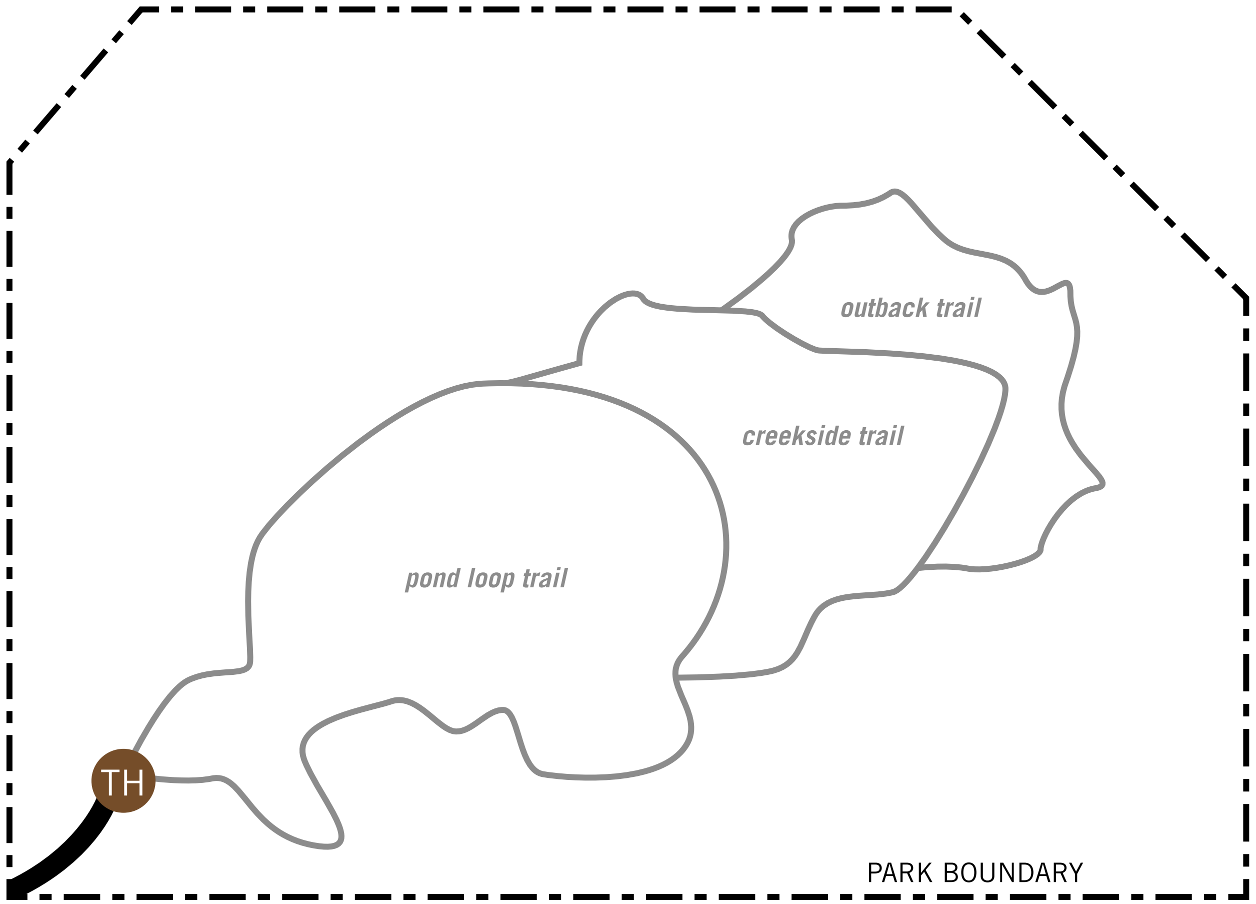
Review and understand the experiences listed previously.



STEP 2:

Plan your field review by assembling maps, identifying the trails to be assessed, and determining the most efficient route to take. In addition to your normal field gear, bring preprinted trail assessment worksheets (see Chapter 5).

FOREST GROVE TRAIL SYSTEM



STEP 3:

Ride the trails with either an MTB or, preferably, an eMTB. After you've completed each trail (or if your trail is long, each distinct trail segment), fill out the assessment worksheet. Remember, it should be about your experience and what you felt on the ride, not what you think it should be or what you think someone else might experience.

If you are not confident in your riding ability or if you want to get a broader range of opinions, you can designate surrogates to ride the existing trails and report back to you. Using experienced MTB or eMTB riders will make for better reporting. Everyone should use the same assessment worksheet and complete it in detail immediately after riding a trail.

FOREST GROVE TRAIL SYSTEM: TRAIL ASSESSMENT

TRAIL NAME	STATUS	LENGTH	DIFFICULTY	DIRECTIONALITY	USES	PRIMARY EXPERIENCE
Pond Loop	*Existing*	*4.0 Miles*	●	*Bi-Directional*	*Hike, Bike*	*Play*

Description: Most of the visitors to the park use this trail to start/end their hike, run, or ride as they access the other trails in the network. The trail is relatively smooth and flat, with good sightlines. Average trail width is 40".

TRAIL NAME	STATUS	LENGTH	DIFFICULTY	DIRECTIONALITY	USES	PRIMARY EXPERIENCE
Creekside	*Existing*	*2.5 Miles*	■	*Bi-Directional*	*Hike, Bike*	*Escape*

Description: The most popular trail in the park with enthusiast cyclists and trail runners. A tighter, twistier trail with frequent grade reversals and short ascents/descents. Speeds are moderate based on the texture of the tread and frequent direction changes. Average trail width is 30".

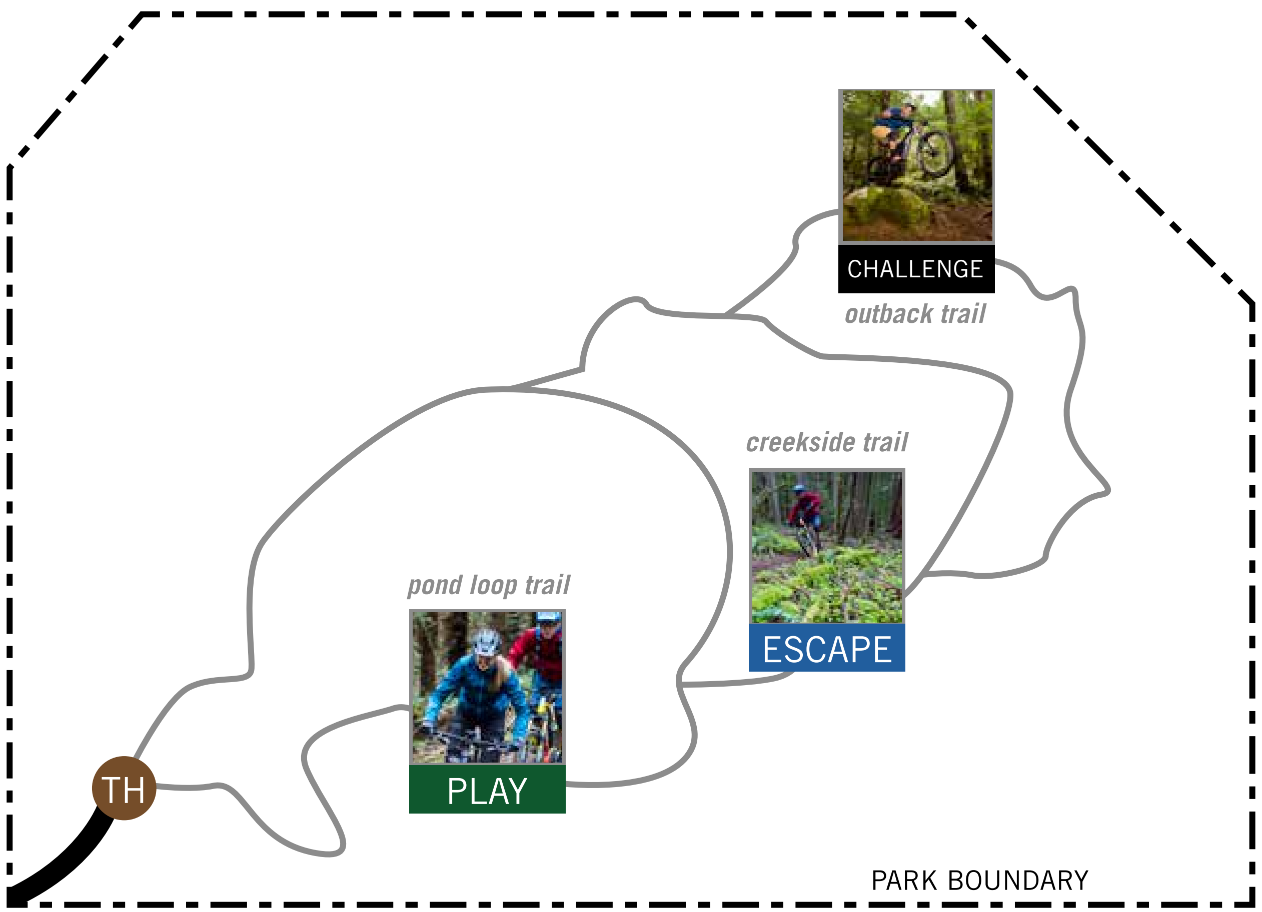
TRAIL NAME	STATUS	LENGTH	DIFFICULTY	DIRECTIONALITY	USES	PRIMARY EXPERIENCE
Outback	*Existing*	*1.0 Mile*	◆	*Directional*	*Hike, Bike*	*Challenge*

Description: On this trail runners were observed passing cyclists, indicating how technically challenging it is. Rocks, tight turns, and a narrow corridor keep speeds in check. The slightly descending grade of the trail allows riders to take advantage of momentum through the endless rock gardens, and the one-way traffic reduces head-on interactions. Average trail width is 24".

STEP 4:

Compile the assessments by placing the results into a table or onto a map. This will help you and others understand the experiences and skill levels that could be provided to eMTBs, creating a baseline for the next step in the trail development process.

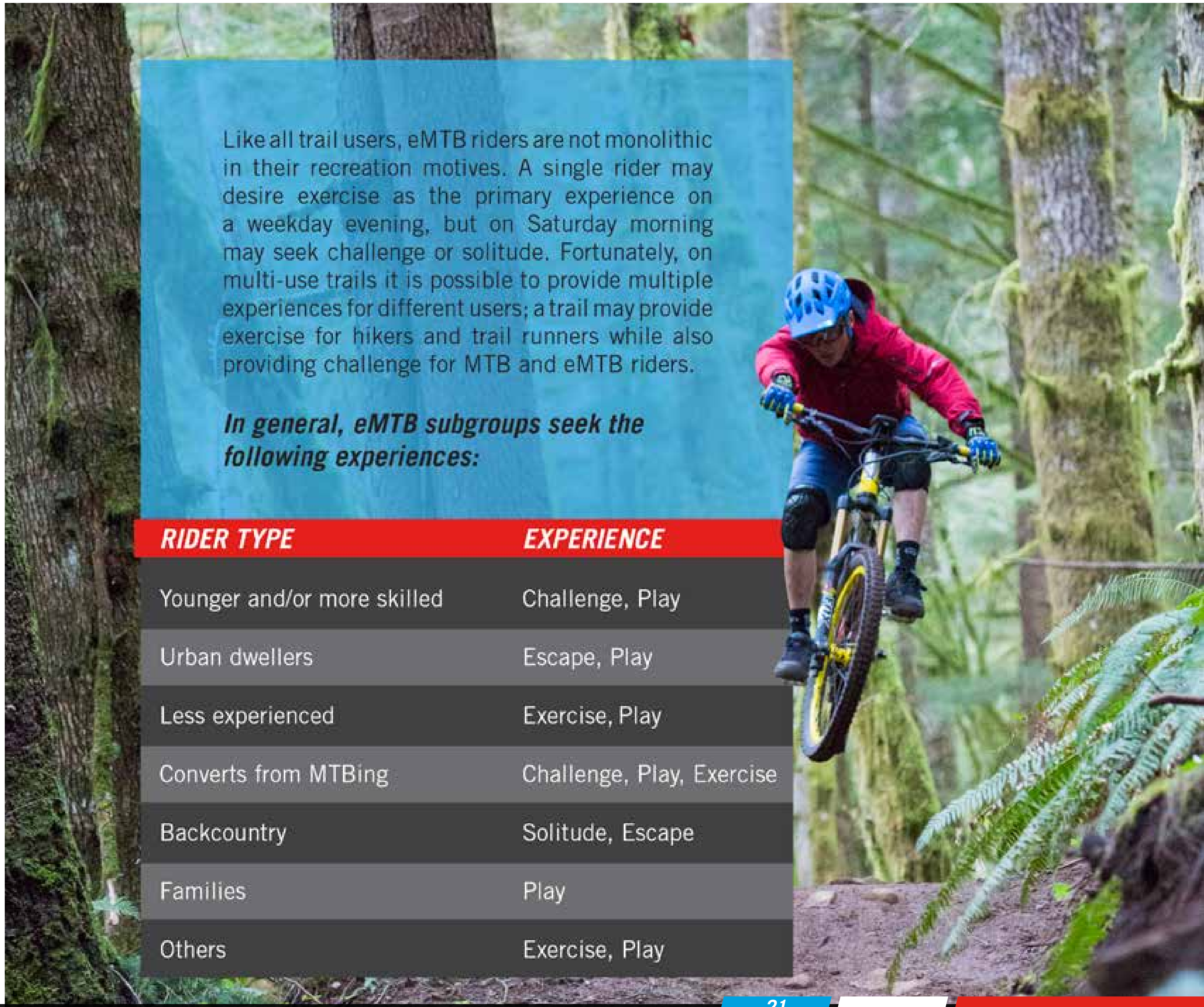
FOREST GROVE TRAIL SYSTEM



Once the assessment has been completed, it is time to start planning for the future. This process will answer two important questions:

- ***What eMTB experiences are desired by the riding community?***
- ***Given the terrain, existing trails, and other opportunities/constraints, can those eMTB experiences be reasonably provided?***

Determining the answer to the first question requires a combination of professional judgment and stakeholder involvement. This can be provided with your knowledge as a land manager, through research, and by outreach to trail users.



Like all trail users, eMTB riders are not monolithic in their recreation motives. A single rider may desire exercise as the primary experience on a weekday evening, but on Saturday morning may seek challenge or solitude. Fortunately, on multi-use trails it is possible to provide multiple experiences for different users; a trail may provide exercise for hikers and trail runners while also providing challenge for MTB and eMTB riders.

In general, eMTB subgroups seek the following experiences:

RIDER TYPE	EXPERIENCE
Younger and/or more skilled	Challenge, Play
Urban dwellers	Escape, Play
Less experienced	Exercise, Play
Converts from MTBing	Challenge, Play, Exercise
Backcountry	Solitude, Escape
Families	Play
Others	Exercise, Play

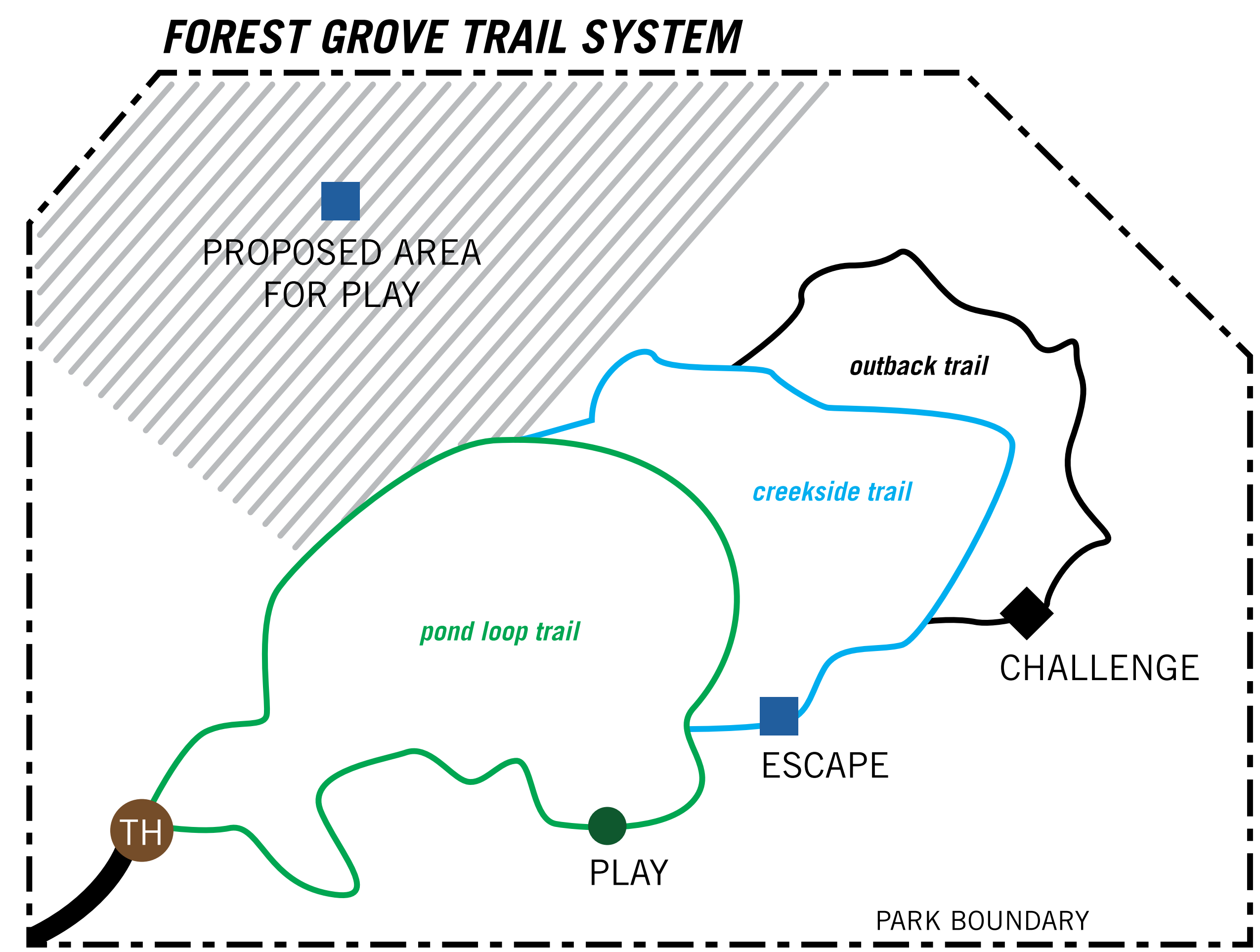
Of course, a trail system cannot be all things to all users, so it is important to select one or two eMTB experiences for each trail that are likely the same experiences for MTBs to maximize efficiencies.

Ideally, the result of this work will be a list identifying the desired eMTB experiences, and their relative difficulty level, that will be provided for eMTB riders in your community.

DESIRED EXPERIENCE	DIFFICULTY LEVEL
Play	■ More Difficult
Challenge	◆ Very Difficult
Escape	● Easy

Once you have completed the above step, it is time to answer the second question: Given the conditions, can these experiences be provided? It is possible that the situation precludes the reasonable provision of a desired experience. If your park is 10 acres and bordered on two sides by an interstate freeway, it is going to be difficult for people to experience escape. Conversely, if your construction standards require that all trails be six feet wide and surfaced with crushed stone, exercise will prevail over challenge.

At this point, you should have an understanding of your existing landscape and trails (if any), desired eMTB experiences, and whether you can reasonably provide those experiences. Capturing this information in a map or table and including short comments is helpful for guiding the subsequent design work.



DESIGN

NEW TRAIL DESIGN

The design phase is where the ideals of the desired experiences are influenced by the opportunities and constraints of the available land to give life to what people want from their eMTB excursion.

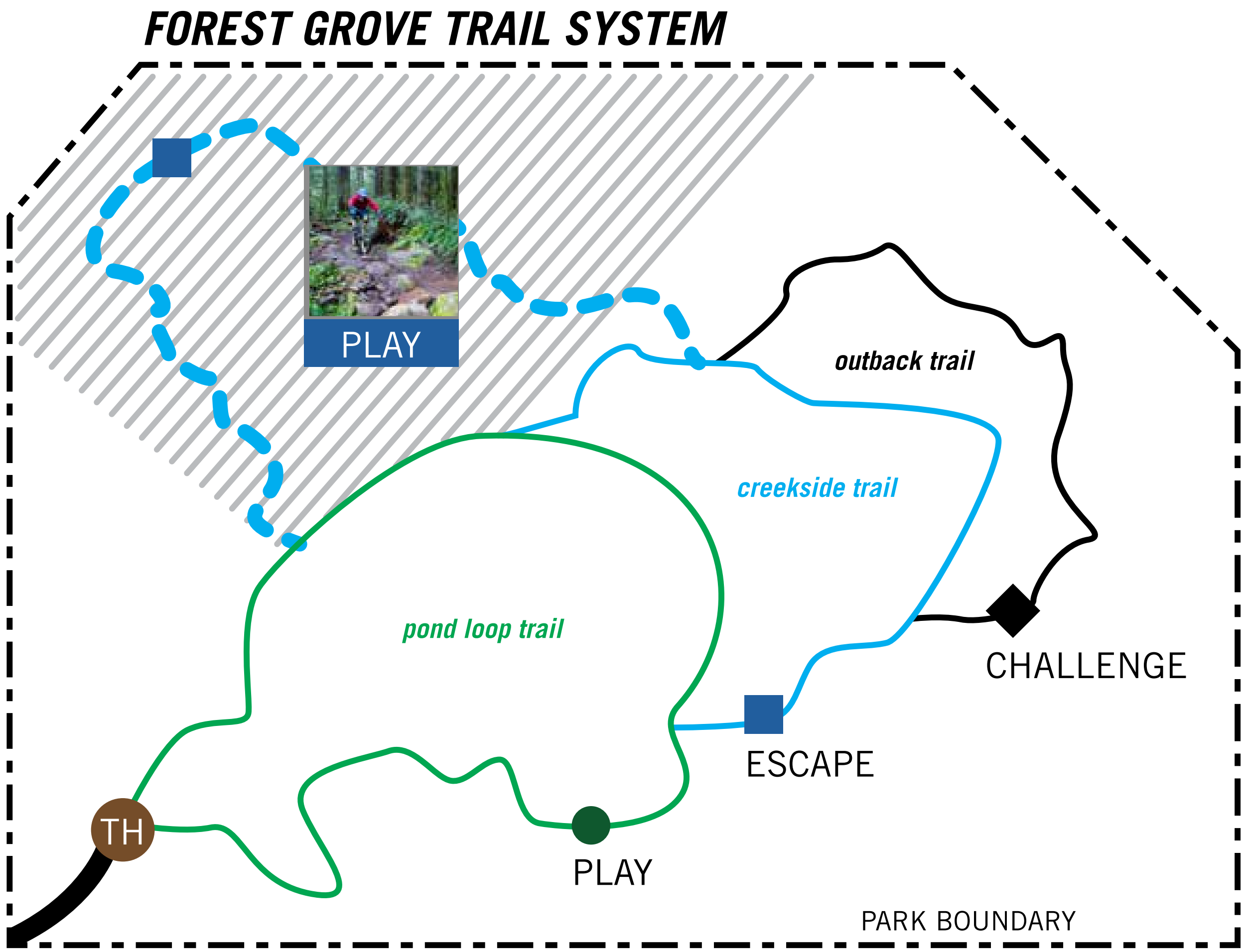
If your assessment and planning work indicated that local eMTB riders desire a fun, intermediate-level experience, you can identify a location for a new trail that will meet this need. Using the map data you assembled earlier, search for the types of landscapes (e.g., moderate side slopes, easy access) that best support this experience.

Once you have identified an area, begin designing the potential trail alignment using accepted design guidelines such as those detailed by IMBA in their books (see Chapter 5). These guidelines can be amended slightly to take advantage of the unique attributes of bikes generally and eMTBs specifically.

Designating descending-direction trails open only to MTBs and eMTBs is a good way to mitigate user conflicts by providing a highly valued riding experience and removing head-on interactions. This concept can be applied to trails open to eMTBs to reduce the potential conflict created by increased uphill travel speeds.

When cyclists have a directional trail open only to their use, there are fewer user interactions because the speed differential is low. In particular, any speed differential afforded by an eMTB will be minimized.

Use your map to sketch alignments that conform to sustainable trail guidelines as well as meet the criteria you previously identified for experience and difficulty level.

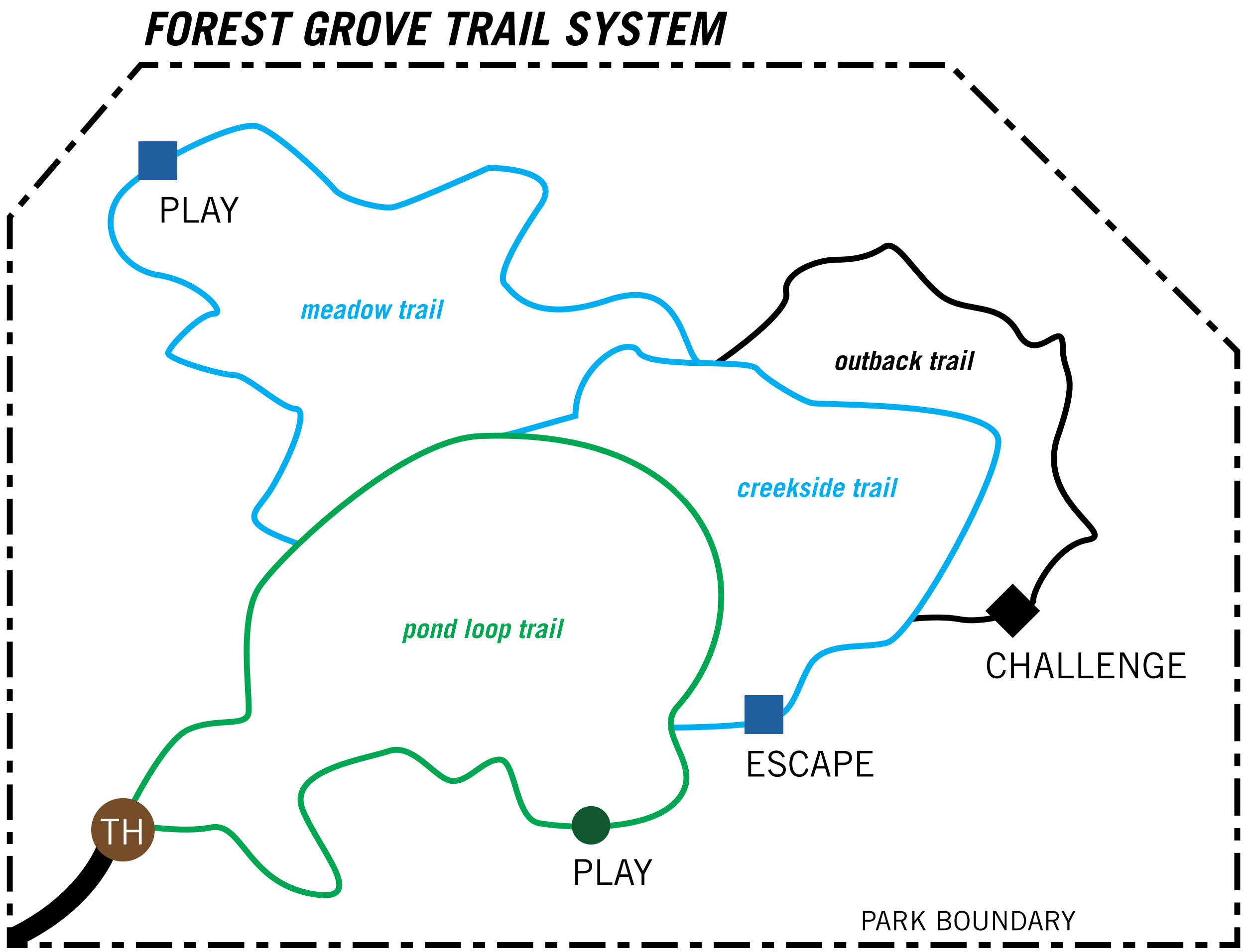


The conceptual alignment is then checked in the field using an inclinometer (or "clino") to verify the grades, with pin flags, ribbon flagging, or other markings used to identify the trail corridor. You may have to go back and forth along the alignment several times to adjust it to your liking.

Keep with you a copy of the desired trail experience characteristics that you developed in the assessment and planning stage so that you can refer to it regularly as you design the trail in the field. Take notes about how the trail should be constructed, referring to trail width, features, tread texture, and other criteria as this will be useful during the construction phase.

Once the alignment has been finalized, walk back through and capture the points with a GPS unit to accurately render them back onto the map.

When the points are inserted onto your map they will connect to form your final trail alignment.



What if you can't find a landscape that correlates to the desired experience? This does not mean the experience cannot be provided. It may mean, however, that it will be difficult to develop the right trail. If expert riders want a rocky, challenging trail but there is no rocky terrain in your park, the rocks can be imported, although this will certainly impact the budget. Identifying this in your design notes will help avoid unpleasant surprises when it comes time to build the trail.

USING EXISTING TRAILS

Assuming that eMTB use is an allowed use, you may not need or be able to create new trails but can instead open existing ones to eMTBs. This is likely the most efficient option, as new trail development can be time-consuming, costly, or have unacceptable impacts. In many parks, the trail network is already sufficiently dense that new trails would negatively affect natural resources, adjacent landowners, or staff management capacity.

This can be relatively straightforward if the existing system already has trails that match the desired eMTB experiences. If riders desire a challenging expert-level trail and you already have one in your inventory, the easiest solution would be to open the trail. Some minor improvements may be the most that is needed given the specific impacts of eMTBs.

DESCENDING TURNS

ASCENDING TURNS

If the existing trails are not matched to the desired experiences, more work will be required. This step should be undertaken carefully as such modifications may change the character of the trail for existing users. Working with stakeholders to understand use patterns will expose solutions such as employing a single-direction climb for eMTB riders that does not interfere with the use of the trail by existing users. Other times, narrowing the trail tread with chokes can increase the challenge and fun for riders while enhancing the escape feel for non-riders.

BUDGETING

At this point you should have enough information to create a rough implementation budget. You'll know approximately how much new trail you'll be building, how much existing trail you'll be retrofitting, and the relative ease (or difficulty) of your proposed endeavor. This can be done at a unit-price level to keep it simple.

FOREST GROVE TRAIL SYSTEM eMTB MODIFICATIONS

ITEM	*QUANTITY*	*UNIT*	*UNIT PRICE*	*TOTAL*
New trail construction	4,500	LF	$8	$33,750
Retrofit - rock armoring	100	SF	$15	$1,500
Retrofit - turn reconstruction	8	EACH	$600	$4,800
New signs	10	EACH	$50	$500

There are several ways to obtain approximate cost information:

- You may have recently undertaken similar work in your park, which will provide a baseline for labor, equipment, and materials costs.
- Other land managers in your region may have recently installed new trails or upgraded their existing ones.
- Professional trail builders work around the globe and have amassed considerable knowledge. Some will be happy to share regional cost information for the opportunity to know more about a potential future project. Members of the Professional Trail Builders Association (PTBA) can be reached at http://www.trailbuilders.org.

BACK TO THE DRAWING BOARD

What should you do if you cannot provide the experiences that are desired? Don't just fold up the process; circle back to the planning phase.

- If the primary experiences cannot be provided, perhaps secondary or tertiary experiences can be met; implementing at least some opportunity for eMTB riders is a good first step.
- It may be possible to provide the desired experience but not at the skill level that is preferred. For example, stakeholders may seek a solitude experience for advanced riders, but the terrain or existing trails are better suited for the same experience at an intermediate skill level.
- Now that you and the stakeholders have identified the desired trail experiences, are there other sites in your portfolio that are better matches? The planning work you have done to this point is too valuable to abandon and can help you hone in on better options.

These are acceptable solutions and are better than providing no trails at all. Using this process in an iterative manner creates the best trail possible and keeps the relevant stakeholders in the loop so that expectations can be met.

CHAPTER 4

TRAIL CONSTRUCTION AND MANAGEMENT

With a well-conceived design in hand you're ready to move to implementation. Whether you're creating a new trail, retrofitting an existing trail, or both, you should create a trail specification matrix for the proposed work. This matrix, which incorporates IMBA's Difficulty Rating System (see Chapter 5), finalizes the physical attributes of the trail that support the desired experiences. You will already have most of this information in your possession, so this is primarily a housekeeping exercise as you assemble your notes into one spot.

FOREST GROVE TRAIL SYSTEM - eMTB MODIFICATIONS

TRAIL NAME = Meadown Trail (new construction)
EXPERIENCE = Play
RATING = Blue Square (more difficult)

TRAIL CHARACTERISTICS/ FEATURE	*VALUE*	*NOTES*
Finished tread width	24" - 36"	
Clearance width	36"	Each side from edge of trail.
Clearance height	8'	
Outslope	0% - 7%	Avoid aggressive outsloping for purposes of drainage; use grade reversals instead.
Inslope	0% - 7%	Avoid aggressive insloping to avoid the sensation of a "flow trail."
Average grade, soil	7%	
Maximum grade, soil	15%	Maximum length of segment = 10'.
Grade reversal, frequency (trough to trough)	50'	Grade reversals should not make the trail feel hyperkinetic or resemble a pump track. Instead, the natural terrain should be surfed to take advantage of microtopography.
Turn radius	8' - 10'	"Switchberm" style turns with tighter radii and minimal berming necessary only to resist turning forces. Maximum berm height = 12". Backsides of berms must be filled at 1:2.
Maximum obstacle height	8"	Relief from surrounding typical soil-based tread.
Sightlines	100'	Continual clear sightlines are expected.

PROCUREMENT

The best trails are those that appear to be placed into the landscape, not on top of it. These trails celebrate the unyielding variations present in the natural environment and avoid the stifling sensation of uniformity, allowing the builder to display creativity and flexibility to create the best experience possible.

While this makes for memorable trails, it tends to confound the typical procurement process mandated for most government agencies. Fixed-price installation, measured against established construction standards, allows for the best quality at the lowest price when installing roads or plumbing fixtures; when used to bid trails, it typically leaves the contractor, the agency, and the trail users unsatisfied.

Some options are available to increase the likelihood of creating the trail experience that everyone in the process envisions.

- Mandated minimum experience requirements for bidders (e.g., 3–5 years in the industry working on similar trail projects) can keep unqualified contractors at bay. References from satisfied previous customers will help verify the purported expertise.

- Trail builders, especially those who create high-quality MTB or eMTB trails, can and should be considered “specialty contractors.” The ability to provide a fun, risk-managed adventure via sustainable singletrack requires unique skills, artistry, and the ability to translate experience-based criteria into a physical manifestation of dirt and rock. Your typical contractor will struggle with even the most basic trail project.

- Design-build contracts are ultimately the most cost-effective way to get a good trail, but most public-bid processes preclude this option. When this is not possible, using performance-based specifications combined with trail-specific construction specifications allows the contracting agency to ensure that what is built is not just a “trail-shaped object” but a piece of infrastructure that delivers the intended experience.

In all cases, the documentation created by following the steps in this handbook should be incorporated into the construction specifications for the project as they can provide specific contracting language and examples for the selected builder.

For more information, see Appendix 6 – Trail Contracting Guidelines in the Bureau of Land Management’s ***Guidelines for a Quality Trail Experience*** (http://gqte.imba.com).

In general, eMTB trail construction mimics that of mountain bike trail construction, which in turn hews closely to the guidelines for sustainable trail development regardless of user type. The basis for any eMTB trail construction is therefore the guidelines developed and proven by the trail-building community, in particular the resources from IMBA (See Chapter 5).

USING FEATURES TO CREATE EXPERIENCES

The details of an eMTB trail come through in the features and characteristics that are used to provide the identified experiences. When implemented, these features create the experience that riders seek. This is the practical application of the step-by-step assessment, planning, and design work that you completed earlier; it is, to turn a phrase, where the knobby tires meet the dirt.

These features and characteristics apply whether you are building a new trail or retrofitting an existing one. The difference is whether you can implement them as part of the trail development or if they need to be done within an existing trail corridor. If the latter, your previous planning work should help you avoid implementing features that will negatively affect the experiences for existing users.

MANAGEMENT CONTROLS

In addition to influencing the rider experience, trail features can be integrated into the trail planning and design process as tools to accomplish a range of management objectives, such as controlling user speed or keeping people on the established trail. The following illustrations depict trail features that serve the dual purpose of providing for a distinct rider experience while simultaneously achieving important management objectives.

A backslope can be shaped to allow eMTBs to ride up onto it to increase play and challenge. Conversely, a steeper backslope will make a trail feel more narrow and will slow down users; however, this will also push users to the outside, and less stable, edge of the trail, so employ this technique only after careful consideration.

CORRAL/ANCHOR

OBJECTS USED TO DEFINE THE SIDES OF THE TRAIL TO REDUCE TRAIL WIDENING, CONTROL SPEED, PREVENT SHORTCUTTING, AND/OR EMPHASIZE UPCOMING TRAIL FEATURES.

OPTIONAL LINE

SHORT DETOURS OF DIFFERENT DIFFICULTY THAN THE MAIN ROUTE.

OPTIONAL LINES CAN BE EASIER TO ROUTE AROUND A TECHNICAL FEATURE ("RIDE AROUND") IF ON AN ADVANCED TRAIL. ON BEGINNER OR INTERMEDIATE TRAILS, THE OPTIONAL LINE CAN PROVIDE MORE CHALLENGE.

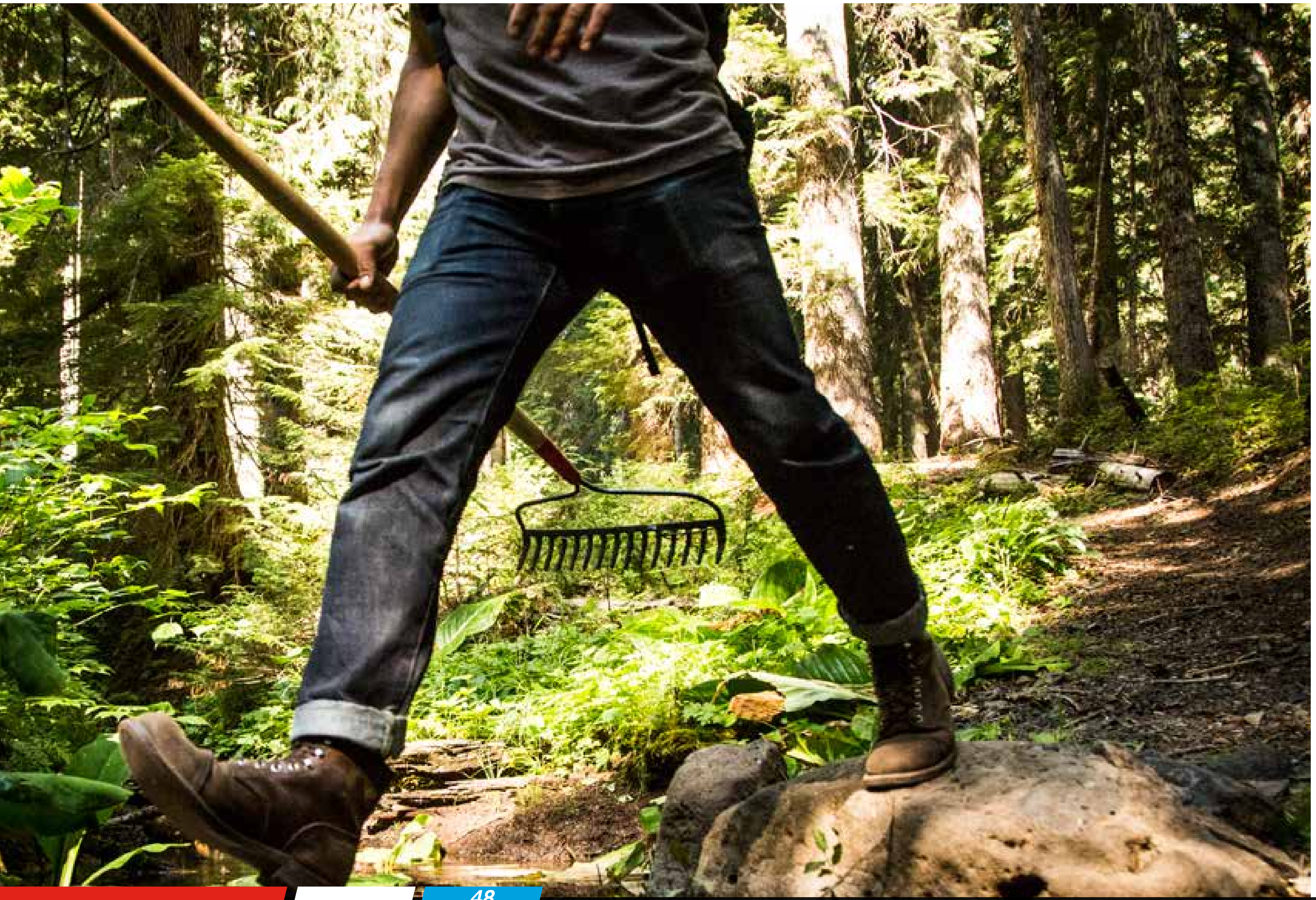
FILTER

A HIGH-SKILL, LOW-CONSEQUENCE OBSTACLE THAT DEMONSTRATES THE DIFFICULTY OF THE UPCOMING TRAIL OR FEATURE (AKA QUALIFIER OBSTACLE).

IMPLEMENTATION

Once you have decided on the features/characteristics that best match the desired experiences, you can note them in the specifications you are creating for the trail, copying the images from this document and attaching them directly to the trail specification matrix (see Chapter 5) that you created earlier. This information can be given to the people who will be implementing the project: your field staff, volunteers, or the trail contractor you select through the procurement process.

All of the previous work can quickly be undone, however, without proper trail-building knowledge. Constructing a new trail or updating an existing one is a task that requires working in a dynamic environment where risk management is paramount. Training your staff and volunteers, or selecting an experienced trail contactor, is the most important investment in time that you can make in the entire process. If you intend to use volunteers or internal staff to do the work, there are several good resources for acquiring or enhancing trail-building skills, starting with the books listed in Chapter 5. Another option is to hire a professional trail builder to do a workshop specific to your project, offering on-the-ground improvements while simultaneously training your staff and volunteers.



MAINTENANCE/ MANAGEMENT

If you've made it this far, congratulations! You've assessed your trails and terrain, met with stakeholders to identify opportunities and constraints, spent countless hours in the field, and then implemented the collective vision to provide great trail opportunities for a range of users. Your next step is to keep an eye on your trails and maintain them in good shape.

Because you used sustainable trail-building principles, your maintenance workload is greatly reduced; you'll spend most of your time doing routine activities such as cutting back vegetation and fixing wear and tear. You can then focus on ensuring that the trails provide the intended experiences by regularly assessing the trails, referring back to the trail specification matrix you developed at the beginning of this chapter to make sure any changes (either intentional or due to weather, use, or other land use practices such as habitat restoration) support the intended trail experiences.

To assist with this endeavor, you can regularly convene meetings with your trail users and stakeholders. Your partners may identify that a trail originally intended to provide solitude is now too popular and crowded. In this instance, solutions include providing other trails to draw users away from the solitude trail or reassigning the experience to something else (such as exercise) and creating a new solitude experience elsewhere.

Maintenance work should reinforce the identified experience of a trail. If the trail provides a technically challenging route for advanced eMTB riders, using coarsely textured rock armoring to fix trail damage would be the appropriate solution. Conversely, a trail that is intended to provide escape for beginner riders should eschew rock armoring and instead focus on simple tread work and vegetation management.

Over time, user desires change and new conditions influence your park. Going through the assessment and planning process every 5–7 years will help ensure that your trails remain relevant to your community. This, in turn, will keep your stakeholders engaged in a positive manner and allow them to express their support and thanks for having access to the experiences that they value from their public lands.

CHAPTER 5

ADDITIONAL INFORMATION

PeopleForBikes and the Bicycle Product Suppliers Association have created several resources to assist your efforts in creating and maintaining eMTB trails. These resources are available online at peopleforbikes.org/e-bikes.

- Model eMTB Regulations
- Sample Signs
- Studies and Research
- eMTB Maps and Rides
- eMTB Best Management Practices
- Trail Assessment Worksheet

Other organizations and land management agencies have created resources that inform current best practices for developing sustainable trails.

Trail Solutions: IMBA's Guide to Building Sweet Singletrack

Managing Mountain Biking: IMBA's Guide to Providing Great Riding

Guidelines for a Quality Trail Experience: An innovative approach to trail development that places a user's experience at the forefront of the process. Developed in partnership between the Bureau of Land Management and the International Mountain Bicycling Association, this graphics-rich book provides detailed, step-by-step actions for creating great mountain biking experiences.

Information Bulletin on Electric Mountain Bikes: Bureau of Land Management (https://www.blm.gov/policy/ib-2015-060)