MADISON BICYCLE ADVENTURE TRAIL FEASIBILITY STUDY AND CONCEPT PLAN

MADISON, WISCONSIN

SUMMER 2021

Photo Credit Hansi Johnson

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ACKNOWLEDGMENTS

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TRAIL SOLUTIONS IMBA

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PROJECT BACKGROUND

Madison is known for its extensive hard surface bicycle infrastructure, but natural surface connections and singletrack networks close to neighborhoods are hard to come by. Natural surface trails, singletrack, and bike optimized park facilities encourage access for a range of trail users and riders from neighborhood children to the seasoned commuter, the occasional enthusiast to the serious athlete. Natural surface trail network development results in improved public health, equitable access, increased youth engagement, community building, and positive economic impacts.

Advocacy supporting the creation of off road trails for mountain biking in Madison and Dane County has been ongoing since the mid-1990s. As a result of those efforts Dane County began to work with the Wisconsin Off-Road Bicycle Association (WORBA), now known as Capital Off Road Pathfinders (CORP) to build mountain bike specific trails with initial singletrack trails being constructed at Badger Prairie County Park and CamRock County Park. Since the late 1990s numerous meetings have happened between City of Madison staff and CORP to discuss potential off road trails. For example...

- 2011 - Local bike advocates met with City staff and proposed trails at Elver Park
- 2017 - CORP/City formalized bicycle use of the trails at Quarry Park.
- 2017 - Student Advocacy Team at Leopold Elementary did a project which developed recommendations to get more children walking/biking. One recommendation was to develop a pump track/skills park for biking near Leopold Elementary.
- 2018 - Healthy Kids Collaborative of Dane County approached City Parks to discuss Leopold Park as a potential location for a pump track/skills park.
- City of Madison Parks Division, engaged the International Mountain Bicycling Association (IMBA) - Trail Solutions Program to complete a citywide feasibility study and planning exercise with goals of developing a connected network of natural surfaces and identifying locations for bike skills development features, bike parks, and bicycle playgrounds. City funding for this project was matched by IMBA's Trail Accelerator grant program. The concept of this network has been referred to as the ***Madison Bicycle Adventure Trail*** (MadBAT). The project analysis looked at existing City of Madison public lands and bike/pedestrian infrastructure, planned improvements to those lands and infrastructure, connectivity to adjacent county and municipal properties, and how these physical components interact with the wide range of demographics throughout Madison and the trail-based experiences riders (and non-riders alike) are interested in.

While the idea of a singletrack network has the general support of City staff, it is important to the land managers and elected officials that any trail-building efforts be thoughtfully planned and reviewed by all agencies involved. In order to build support with the public, elected officials and land managers, a planning document is needed to explain the many benefits of the trail system and how any one trail segment or riding area fits into a larger plan. This report creates a clear plan for the public and staff. It identifies areas where trails are appropriate and which types of trails and features are best suited for each site.

Madison Bicycle Adventure Trail Objectives

- Meet public desire for creation of off road recreational bike facilities located within Madison.
- Provide affordable opportunities for recreational experiences for all residents.
- Expand access to trail riding for underrepresented populations.
- Increase connectivity between parks to enhance access and meet the City's goal to increase sustainable transportation use.
- Increase funding and partnerships for development of the Madison Bicycle Adventure Trail Network.
- Meet the Parks Division mission to provide an exceptional system of safe, accessible, well-planned and maintained parks, facilities, public cemeteries, natural areas and public shorelines.

Fitness Culture and Outreach

Trails that are easily accessible for a wider number of residents would continue to grow ridership as Madison has a strong bicycle and fitness culture. The League of American Bicyclists awarded Madison a Platinum Bicycle Community designation, and People for Bikes rated Madison as the 6th best in its 2018 Places for Bikes rating. Madison is also well known as an active and fit city. Some highlights include:

- Ranked 4th fittest City in 2018 by American College of Sports Medicine Fitness Index
- Ranked Most Livable Mid-Sized City by AARP in 2106
- Fitbit Fittest City 2016
- Home of Ironman Wisconsin
- CrossFit Games Host 2018-2020
- USA Cycling Cyclocross National Championships in 2012-2013
- USA Cycling Amateur and Para Cycling Road National Championships in 2013-2014
- North American Unicycling Convention and Championships in 2015
- Home to bicycle industry leaders–Pacific Cycle, Saris, Planet Bike and just 20 miles away Trek Bikes

While this recreation and fitness culture exists throughout the Madison area, access to trails and bike optimized facilities is not available to all neighborhoods. This plan and project concepts have been presented to the public via webinars, media, and targeted outreach efforts. This document is intended to be the fundamental resource for advocates establishing access and Parks staff implementing specific projects outlined in the following pages.

Local and Regional Trail Facilities

Madison currently contains approximately one mile of official off road singletrack. However, within surrounding Dane County, there are approximately 50 miles of singletrack. Trails have been developed in parks at adjacent communities that include Maywood Park in Monona, Seminole and Quarry Ridge in Fitchburg, and in Middleton at Pleasant View and Blackhawk (a private ski club). More information on nearby trails can be found at ma dcitydirt.com

According to CORP data, the average rider travels over 10 miles to access a trailhead and that trip is most frequently taken in a motor vehicle. A network of trails located within Madison will drastically reduce the drive time required for most users to access a trail. By replacing car trips by bike trips or bus trips, our

urban trail network would help achieve a goal of the City of Madison's 2011 Sustainability Plan – to reduce vehicle miles traveled.

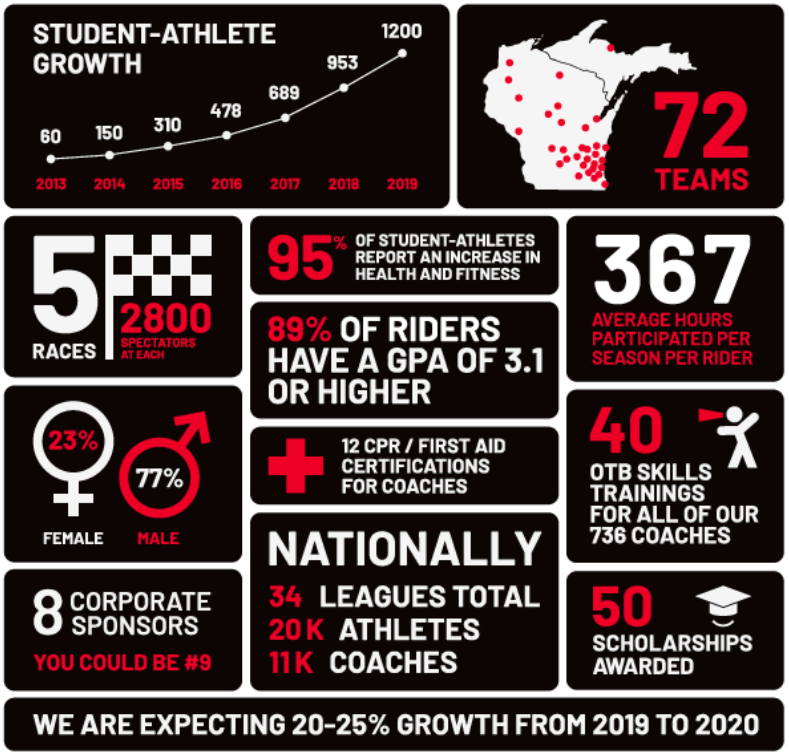
Many potential sites throughout have been discussed by City staff and residents for years, but a formal planning effort is needed to move trail construction forward.

National Interscholastic Cycling Association

Madison and Dane County is also home to a popular and rapidly growing high school mountain bike club scene. Founded in 2009, the National Interscholastic Cycling Association (NICA) develops interscholastic mountain biking programs for student-athletes across the United States. Currently, the Madison NICA teams have approximately 860 students and coaches and have been seeing more than 10% growth each of the last 10 years. While not an official Wisconsin Interscholastic Athletic Association sport, the number of school age kids in Madison rivals many popular traditional sports. Despite these large numbers, adequate practice facilities have not been developed. The current off road trail systems in the Madison area are becoming overwhelmed and the need for more trails and amenities is clear.

NICA develops mountain biking programs for student-athletes and coaches across the United States. Over 20,000 student-athletes in junior high and high-school participate in 34 state and regional leagues supported by over 11,000 volunteer coaches and 10,000 additional volunteers. And the numbers continue to grow. In the last ten years, student-athlete participation has averaged 48% annual growth, and coach participation has averaged 75% annual growth.

The league's mission is to build strong minds, bodies, character, and communities through cycling with the values of fun, inclusivity, equity, respect, and community. Unlike some youth programs, there are no benchwarmers, every athlete can participate, and the league offers a multitude of benefits: getting kids outside; promoting healthy lifestyles; exposing kids to cycling and outdoor advocacy; and providing social interaction, leadership opportunities, and life lessons such as self-awareness, discipline, success, failure, empathy, humility, and sportsmanship. In 2018, NICA launched GRiT (Girls Riding Together), a program focused on engaging more girls and women as student-athletes, volunteers and coaches; and updated their Teen Trail Corps advocacy program to promote stewardship of the trails. Some leagues include Elevate programs for student-athletes with mental and physical challenges. NICA is also helping to fuel more collegiate varsity cycling programs and clubs.



Healthy Kids Program

In 2017 Parks Division was approached by a group representing the Leopold Neighborhood on Madison's south side. These included representatives from Leopold School and UW Health's - Healthy Kids Program. At this meeting the group asked specifically for off road bike facilities in the neighborhood, specifically a pump track.

This was one of many requests received by Parks for such an amenity, this being the most organized and opening the discussion with Parks Leadership about the possibility of formally planning off road bike facilities.

Neighborhood Resource Team Request

As part of a 2017 presentation, the issue related to lack of appropriate spaces to recreate in the Leopold Neighborhood was raised. Leopold Neighborhood has a designated Neighborhood Resource Team (NRT) which helps find and fund

amenities in disadvantaged areas of the city. One point raised by this team was that kids in the area often receive free bikes through programs like Free Bikes 4 Kids, however there are few spaces to ride. As a result more than 80% of kids in the area have a bike, there is ample unused open space, but no appropriate or rewarding bike specific facilities.

This plan recognizes the vast amount of opportunity to provide recreation in cases like this throughout the city. Construction of a pump track will be underway at Leopold Park in 2021 as Madison's first purpose built off road bike amenity and already it has garnered a large amount of public feedback and anticipation from the community.

Capital Off Road Pathfinders Survey

In 2017 CORP conducted a survey of its members to determine the best course of action for the future off road bike optimized amenities in Madison.

The survey asked the following:

- What off-road bicycling facilities are missing in Dane County, including Madison?
- What facilities would you like to see added to the Madison Parks system?

The top 3 answers to both questions were:

- Flow Trails (sometimes also described as Singletrack)
- Skills areas for both mountain bike and cyclocross
- Pump Tracks

Members also provided a wide variety of comments and suggestions. Here are the 4 most common themes:

- The majority of those surveyed would prefer to ride less than 15 minutes to access a trail.
- Many indicated a lack of trails on the north and east sides of Madison.
- While there is some support for a large "bike park" for multiple disciplines, the majority of respondents want neighborhood trails (especially singletrack), perhaps a combination of linear dirt and existing paved surfaces forming a kind of "adventure trail" loop throughout the entire City. Some also suggested that portions of an "adventure trail" could be built along existing paved paths and incorporated into commutes to work or school.

The results of the survey were instrumental in forming the concept of this MadBAT plan. IMBA's Focus on "more trails close to home" is very fitting for this plan and resonates well with a majority of Madison residents. Thus it was decided the concept of an urban single track network was the best concept for an already highly developed urban environment such as Madison to pursue.

Park and Open Space Plan

The 2018-2023 Park and Open Space Plan (POSP) was adopted by the City of Madison Common Council in 2018. The purpose of the POSP is to serve as a long range planning guide for decisions made by City Boards and Commissions, City agencies and staff. It is a tool used to guide decisions for a variety of Park and Open Space issues such as city policies, park acquisitions, facility development, as well as park funding.

The POSP includes a goal of developing recreational bike facilities within parks and other public lands. This proposed community trails planning project, MadBAT, is one of the first steps toward achieving that goal.

Photo Credit Hansi Johnson

ABOUT IMBA TRAIL SOLUTIONS

IMBA Trail Solutions (TS) is the international leader in developing trails, with experience in over 500 projects in North America, Europe, and Asia. Our staff excels at planning, design, and construction of trail systems that provide high-quality experiences for local riders and destination visitors while simultaneously minimizing environmental impacts.

Trail Solutions is a fee-for-service based arm of the International Mountain Bicycling Association (IMBA), a 501(c)(3) nonprofit organization. IMBA's mission is to create, enhance, and protect great places to ride mountain bikes. Based in Boulder, Colorado, and with staff distributed across the country and the world, IMBA meets its goal to create great mountain bike experiences through its Trail Solutions program. Trail Solutions employs approximately twenty professional trail planners and builders. In addition to being industry professionals and exceptional mountain bike riders, Trail Solutions staff hold a broad base of applicable skills and knowledge from planning, landscape architecture, and environmental sciences to GIS systems, CAD, and graphic design.

Our wealth of experience has allowed us to develop the gold standard guidelines for the creation of both sustainable and enjoyable singletrack trails. These guidelines have influenced all major federal land management agencies and a large number of state and local parks departments. We pride ourselves on the positive experiences Trail Solutions has provided to the millions of active trail users around the world and on the economic independence that communities have achieved through the development of destination trail systems.

IMBA TRAIL LABS AND TRAIL ACCELERATOR GRANT

Trail Labs are in-depth workshops designed to catalyze the next generation of great places to ride mountain bikes. Attendees learn what it takes to create a model trail community and return home with the knowledge and guidance for how to make it happen. Trail Labs are two-day intensive workshops during which IMBA staff, trail industry experts and local stakeholders lead participants through the recipe for a model community trail system: planning, design, building, activation, promotion and measuring success. Attendees also get a firsthand look at components of an intentional and diverse mountain bike trails community.

City of Madison Parks Division has had four staff attend the IMBA Trail Labs in 2018 and 2019. Attendees included Corey Stelljes- Project Engineer, Ann Friewald- Planning and Development Manager, Lisa Laschinger- Assistant Superintendent, and Greg Genin- Director of Operations

To grow the quantity and quality of mountain bike trail communities, IMBA has identified the need to accelerate the pace of trail building. **Trail Accelerator Grants** (TAG) provide a jump-start to communities that have the interest and political support to develop trail systems but need assistance to get projects up and running. A TAG award provides professional trail planning and consultation services to launch a community's trail development efforts, which can often leverage additional investment from local, regional, and national partners.

In late 2019, the City of Madison was awarded TAG matching funds to engage IMBA TS to create this planning document.

Photo Credit Tracey Toler

MadBAT TAG Meeting

BENEFITS OF MOUNTAIN BIKING

Health & Wellness

Access to trails encourages outdoor experiences which result in positive impacts on health, wellness, and Community.

There is a wealth of recent studies showing the positive impacts of "More Trails Close to Home", which is IMBA's focus. In general, these studies show that increased access and proximity of trails to neighborhoods increase the amount of time residents spend outside and the amount of exercise they get in a week. This increase results in improved health, both physical and mental. Additionally, in a 2011 study, the American Heart Association found that with each $1 of trail construction directly results in $3 of medical cost savings.

The process of trail planning, construction, and use is a catalyst for community building on many levels. Neighborhoods rally around public infrastructure improvement, trails connect residents to nearby gathering spaces and businesses, trail-based events attract nearby residents plus city wide citizens, and trail beautification art projects and even trail maintenance days bring the community together in a positive manner. Opponents sometimes say "trails bring crime to our neighborhoods" and, while trails are not absent of crime, studies show that they discourage illegal activities rather than increase them.

Youth Engagement & Equitable Access

Trails in proximity to neighborhoods, schools, public gathering spaces, and business districts are a driver of youth engagement, equitable access, activities that embrace inclusion, and new trail users.

Equity is one of four "Guiding Lenses" in the City of Madison's 2018-2023 Park and Open Space Plan. As stated in the plan, "A focus on equity is imperative to achieving the Parks Division's vision of providing parks to all Madison residents. The Parks Division recognizes that thoroughly understanding the population it serves is the first step towards developing an inclusive parks system." In addition to developing park and trail infrastructure close to neighborhoods, trail use education and programming eases the barrier to entry when new trail users feel welcome and encouraged to engage in trail-based activities. Programming examples include; Madison Free Bikes 4 Kids program which delivers bikes to families who are not able to buy bikes on their own, Bike Madison's Safe Bicycling For Children school and summer camp based programming, Black Girls Do Bike and Bell Joy Ride that organizes women only rides.

Youth Benefits, The Next generation of Madison Bicyclists

While organizations like NICA are thriving, there is also concern regionally and nationally about fewer children engaging in lifelong healthy activities like bike riding.

Between 2014 and 2018, the number of children between 6 and 17 who rode their bikes more than 25 times per year — either neighborhood rides or competition and fitness cycling — fell by more than 1 million, according to the Sports & Fitness Industry Association, per the Washington Post. Other research has found bike riding among kids has dropped almost 20 percent since 2007, per Bicycle Retailer and Industry News.

It seems when given the opportunity with safe and fun off road bike infrastructure, kids become enthusiastic riders. With Madison being committed to fighting greenhouse gas emissions and supporting bicycling as green transportation infrastructure, it's critical to support and develop the next generation of riders. Amenities in the MadBAT plan can be used as transportation, but they are first and foremost, recreation amenities and are important because they make riding fun.

Trail Opportunities for Madison NICA Teams

Create trail opportunities for student athlete training, team practices, and potentially a race venue. NICA, the National Interscholastic Cycling Association, has grown in popularity over the past 5 years in a manner that the number of student athletes, coaches, and families that now ride together is overwhelming the current trail capacity surrounding Madison. For the upcoming 2021 season there are 4 NICA teams (East, Memorial, West Composite, Blackhawk/Middleton, and East) that use existing trail systems (Seminole, Quarry Ridge, Blackhawk) and informal training venues set up in nearby parks. These teams have 560 student athletes and 300 associated coaches that are in need of training venues close to their home schools and neighborhood.

Beyond the many benefits for student-athletes, NICA leagues provide significant economic stimulus to their communities. As participation grows, so does the demand for trails and bike amenities. Teams need trails for training and racing. NICA racecourses require 4- to 6-mile loops of combined singletrack and double track with 300–600 feet of climbing per lap. Throughout the country, communities are building NICA racecourses from scratch or modifying existing trails. Along with the trails, the racecourses require venues that can accommodate, in some cases, thousands of spectators and participants who generate business in lodging, travel, restaurants, bikes stores, and other retail sales and services. This economic activity can support jobs, provide sustainable growth in rural communities, and produce tax revenue. The bottom line: growth in NICA leagues doesn't seem to show any signs of slowing down, and that means an abundance of benefits for individuals and communities.

Economic Growth

Trail connectivity and quality outdoor recreation contribute to economic growth.

A well-designed natural surface trail system can stimulate economic growth by increasing activity within the local population as well as attracting visitors from outside. Trails generate business in retail sales and services, support jobs, provide sustainable growth in communities, and produce tax revenue. Access to trails also correlates to a higher quality of life, thus making the community more desirable and capable of attracting new businesses and workers to an area.

Communities throughout North America are looking at increasing bicycling tourism as a sustainable, renewable source of economic development. A bike experience-based destination is one that attracts tourists to an area for the benefits of the trails; provides visitors with all of the amenities needed to compliment, ease, and enhance their visit; and in turn creates word of mouth about the community that will draw new and repeat visits.

A CITY-WIDE SYSTEM PLAN

Ideally, in the coming years MadBAT will be seen as another layer of trails that connect Madison's residents to a city-wide system of trails that provide transportation corridors, a fun commuting option, a range of recreation experiences for pedestrians and bikers, venues for NICA athletes, and a driver of trail based economic impacts for outdoor recreation businesses and by out of town visitation.

MadBAT is meant to integrate seamlessly into existing public lands and be a leading request to be incorporated into future public land acquisitions and residential developments.

Types of Bike Optimized Trails and Facilities

The types of bike trails and facilities considered in this feasibility study are explained below. These narratives are meant to provide a brief description of the experience created by each type of amenity, the intended user, construction considerations, and approximate ranges of construction costs. The construction costs reflect the cost of retaining a professional trail builder and are provided for financial planning purposes only. The cost ranges do not include planning, design, and permitting needed to develop the facilities, typically estimated at 10-20% of construction costs.

Trail Types

Modern trail systems use specific trail types as a way of managing users and providing them with the best possible visitor experience. Extensive planning and design can be dedicated to the goal of maximizing a visitor's trail experience while simultaneously balancing the demands of physical, environmental and social sustainability. Various types of trails and trail planning strategies are explained below.

Note: since the focus of this project is natural surface trails, mountain bike trails, and bike optimized facilities; hard surface multi-use paths and commuter paths are not detailed in this section.

Traditional Shared Use Singletrack

These trails can serve walkers, hikers, runners, cyclists, and equestrians. They are constructed and maintained according to sustainable trail construction practices and employ techniques that minimize user conflict. As all user types travel these routes, care should be taken to avoid obstacles such as jumps, rollers, or water bars which may lead to an undesirable trail experience for an allowed user type. Turns are constructed sustainably but are not cambered like bike-optimized turns that improve cornering traction. Keeping trail grades within certain ranges ensures both a positive trail experience for users and proper stormwater drainage with minimized erosion. Depending on soil conditions, these trails may need surface hardening techniques to provide a durable four-season trail.

- Approximate Construction Costs: $30,000-$60,000 per mile

Mountain Bike Optimized Singletrack / Flow Trails

These trails are purpose-built to optimize the experience of riding a mountain bike. The trails can either be unidirectional or bidirectional depending on the type of trail, preferred circulation of users, and management decisions. This type of trail is constructed with features such as rock gardens, berms, grade reversals, cambered turns (typically wider than turns on traditional singletrack trails), and modest jumps. These trails should make use of gravitational forces and, where possible, be managed to enhance trail flow for descending riders. These trails may need surface hardening to provide a durable four-season trail. They should be designed for a range of users from beginner to advanced skill levels. Optional advanced features can be located along the side of the trail to provide challenges for intermediate and advanced riders. This allows many skill levels to experience the full trail mileage, while providing for skill progression within a smaller trail footprint.

- Approximate Construction Costs: $50,000-$100,000 per mile

A relatively new trend in this style of trail construction is adding a layer of "chip seal" as a finished trail surface. The texture mimics a coarse natural riding surface that allows riders to enjoy the trail during inclement weather.

- Approximate Construction Costs: $115,000-$220,000 per mile depending on trail width.

Mountain Bike Skills Trail

These are trails that have been specially designed for mountain bikers to develop the skills necessary for enjoying more challenging trails. This type of trail is built with different routes and features for a range of skill levels, allowing users to progress their skills with repetition and experience over time. Beginner riders and kids are especially fond of this type of purpose- built bike facility. They are typically constructed on nearly flat or gently sloping terrain and take up relatively little space. Features may include rocks, bridges, drops, rollers, and more. Typically, installed features include a mix of prefabricated structures and those built on-site with locally sourced materials.

- Approximate Construction Costs:
- $8-$12/linear foot for trail surface
- $1,500 - $5,000 for prefabricated features

Bike Optimized "Bike Park" Components

The features explained to this point are designed and optimized for linear bike-based experiences. A bike park uses linear trails for connections while combining a selection of the following features to create an amenity that appeals to a wide range of riders and ability levels. The type and scale of features is dependent on the community interest, ridership needs, goals of the project, the site's opportunities and constraints, and available funding. Bike parks range from small parks at 1-2 acres, medium sized parks of 5-15 acres in size, to larger parks over 15 acres. Bike parks serve local, regional, and destination ridership by offering a hub of activity to the cycling community by providing progressive facilities that are designed for riders to build skills and confidence while promoting a healthy, active lifestyle.

Tot Track and Bicycle Playground

A tot track is designed for smaller bicycles and beginner ability level users. The track consists of reduced-sized rollers as well as low-angle bermed turns that can accommodate balance bicycles as well as regular bikes with short wheelbases. These are essentially small versions of pump tracks, both of which can be constructed with dirt or hardened surfaces. Asphalt is the recommended surface material for tot tracks. Asphalt is more expensive to install, but greatly reduces maintenance costs. Most importantly, asphalt provides a consistent high-quality experience for the users.

Bicycle playgrounds incorporate play features such as prefabricated structures, rocks, berms, tunnels and other challenges to create a fun loop for children to practice skills and improve bike handling. The bicycle playground can range in size and configuration to best fit the site and desired features.

- Approximate Construction Cost: $10-$25 per square foot

Pump Track and Pump Parks

A pump track is designed to encourage cyclists of all skill levels improve their riding skills in a manner that is fun and repetitive. Pump Tracks are typically a bidirectional closed circuit or series of closed circuits made up of rollers and berms. Pump parks have an open design with a larger area of hard surfaces that allow users to create their own multidirectional routes through the rollers, berms, and jump features. A pump park will foster more organic and creative riding that stimulates both novice and skilled riders. Riding these facilities is an extremely anaerobic activity, so it is recommended that suitable seating and shade structures be installed for users to rest between sessions. Like the tot track, pump tracks and pump parks are recommended to have asphalt surfaces. With an asphalt surface, the track will allow users to enjoy year-round.

- Approximate Construction Costs: $15-25/square foot

Skills Development Features

Skills features can be made out of natural root resistant wood and/or stone. Pre-fabricated steel structures with wood decking are common also. Skills features include: skinny's, ladder bridges, rolling ramps, kinked boardwalks. Widths vary from 10" to 48" wide, heights range from 6" off the ground to 6' off the ground.

- Approximate Construction Costs: $2,500-25,000/feature

Progressive Drop Zone

"Drops" are advanced features that can be experienced along backcountry trails and in urban settings. Progressive Drop Zones are designed to allow riders to "session" (repeatedly loop) drops that increase incrementally from 12" off the ground to as much as 6' off the ground or more. Design of approaches to drops and landing zones need to be built by a trail industry professional who can not only build the features, but also ride them.

- Approximate Construction Costs: $10,000-25,000

Freeride and Slopestyle Trails

Typically found in a Resort Bike Park setting, these highly bike optimized trails incorporate gravity features like jumps, hips, cannons, camel backs, step ups, step downs. It is now becoming a common feature at destination bike parks. The trail can be up to 8' to 10' wide along average trail grades of 7-8%. Comfortable length can range from 1,000' to 4,000'. These can be designed and constructed for intermediate to expert riders with built-in skills progression.

- Approximate Construction Costs: $12-$25/linear foot

Dirt Jumps and Progressive Jump Lines

Riders looking to practice jump skills in a low-consequence environment enjoy bike parks and dirt jumps. These consist of beginner to advanced, skill progression-oriented features through a mix of dirt jumps, berms, and prefabricated "slopestyle" features. These facilities are optimized for mountain bike and BMX riders of all levels. Dirt jumps provide a great workout, and an excellent practice area for building solid bike jumping skills.

Dirt jumps consist of features ranging in height from 3 to 6 feet, spaced to maximize a rider's ability to flow from one jump to the next without having to pedal. Dirt jump areas are designed with a start hill that provides enough gravity to propel riders into the jump lines. They are designed to be ridden in one direction, eliminating potential cross traffic conflicts. Dirt jumps require soil with a high percentage of clay (60-70%) that compacts very hard, minimizing rolling resistance while standing up to heavy use and high shear forces.

- Approximate Construction Costs: $10-$15/linear foot

NICA Training and Racing Facilities

NICA, the National Interscholastic Cycling Association, develops mountain biking programs for student-athletes and coaches across the United States. Over 19,000 student-athletes in junior high and high-school participate in 31 state and regional leagues supported by over 9,000 volunteer coaches and 10,000 additional volunteers. Participant numbers continue to grow. In the last ten years, student-athlete participation has averaged 48% annual growth, and coach participation has averaged 75% annual growth.

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The Madison area is in need of skills development areas and training trails for local NICA teams. The MadBAT plan sets the foundation for NICA projects within neighborhood and destination sized properties. The focus should be on skills and training rather than developing a race venue in Madison since there are venue locations in and around Dane County.

Experience Zones and Preferred-Use Trails

Experience zones and preferred-use trails are showing up in trail systems around the world. Experience zones divide management areas into special- use zones designed around specific activities: one zone may be preferred for mountain biking and another for accessible, interpretive trails. Implementation of such zones can provide a variety of visitor experiences and recreational opportunities that reduce conflict between differing user groups while providing sustainable, long-lasting trails.

Single use challenges the notion that all trails must be all things to all people. In this case, land managers designate certain trails as "preferred" for certain activities. For example, a trail that is single use for mountain bikers might be designed to be fast and flowing through open terrain, with swooping turns and dips. Hiking-preferred trails, meanwhile, may be more about travel efficiency with stairs, tight switchbacks, short distances, or other qualities that would be less attractive to bikers and equestrians. Visitors will be drawn to routes that match their desired experience.

Each trail system should, of course, include a variety of trails. One way to include numerous types of trails is to have shared-use trails at the beginning of the network near parking lots, with preferred-use trails branching off farther along. The number of trails designated for each mode of travel should be based on the habits and needs of the user groups being managed.

PROJECT APPROACH

Public lands for MadBAT

The City of Madison has over 5,740 acres of public lands managed by Parks and Engineering Divisions. Within that acreage there are 270 public parks ranging from beaches to prairies, and conservation properties to sports complexes. Parks Staff established a clear baseline for identifying public lands to be assessed...

> All Parks and Engineering properties with the exception of those listed as Conservation properties were considered at the beginning of this exercise.

It is also important to note that University of Wisconsin - Madison properties were not included in the study area of this project.

Desktop Analysis

To kick off this feasibility and planning exercise, IMBA TS worked with City and County Staff to gather geospatial data to create the working base map with existing bike-ped infrastructure, demographic information, municipal boundaries, and resource overlays. This database and mapping was used for inventorying public lands within Madison, existing and planned trails/greenways, demographics of surrounding neighborhoods, proximity to public gathering spaces and schools. Analysis of the data layers showed the project team gaps in trail connectivity, neighborhoods with public land access or lack of access, underserved areas absent of trail experiences, underutilized properties, and opportunities for bike optimized experiences.

Identification of MadBAT Opportunities

IMBA TS met with Parks Staff and CORP representatives over a series of meetings to review the working base map and discuss the opportunities and constraints observed during the desktop analysis. Initial opportunities were separated into two categories; Linear Singletrack Trail Connections and Bike Optimized Park Facilities.

Linear Singletrack Trail Connections

As mentioned earlier there are over 75 miles of hard surface trails throughout Madison. While this is a comprehensive trail network that serves commuter and recreation based users, there are gaps where natural surface singletracks can connect and greenways where singletrack trails can add trail experiences for pedestrians and cyclists.

For example, there are sections along the Southwest Commuter Trail where the City Property is wide enough to create a natural surface trail that offers mountain bike experiences for nearby neighborhoods and NICA athletes. Another instance would be a natural singletrack connection through the East Badger Mill Creek Greenway that makes a connection between the on road bike path on Hammersly south to Pilgrim Park and beyond.

Arbor Hills Greenway is an appropriate corridor for Linear Single Track Connections

Bike Optimized Park Facilities

Parks in Madison range in size and recreational offerings. Many are fully programmed and others have underutilized open spaces. The project team identified parks with direct connections to existing trails, parks near schools, and parks where potential singletrack connections mentioned above will create connectivity. Parks that have spaces appropriate for bike optimized facilities range in size from a half acre to 180 acres. These can be categorized in three park sizes;

Reindahl park adjacent to bike path offers space for bike optimized facilities

Pocket Park 0.25-1.0 acres

Where a small area or activity station along a linear trail, within an existing park, or stand alone feature can be developed. A facility like this can be for one ability level or a progressive range of ability levels.

An example of this park size would be Thut Park on the Southside of Madison North of the Beltline and West of W. Broadway. There are two spaces within the park that are under an acre where a series of skills development features could be placed and linked by a simple natural surface trail.

Neighborhood Park 1.0-15 acres

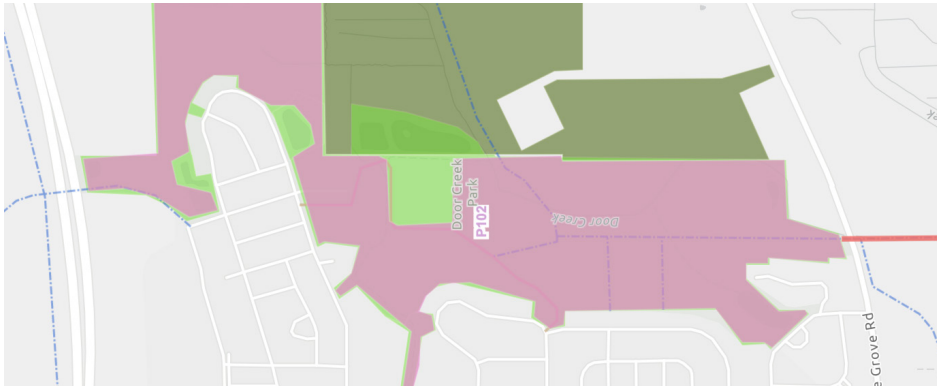
Utilizing an existing park property or future park by creating a series/grouping of bike optimized features or purpose built bike park focusing on experiences for all ability levels.

Mineral Point Park, adjacent to James Madison Memorial High School, has an eight acre space allowing for a natural surface trail around the park perimeter connecting skills development features and a bicycle playground.

Regional Destination over 15 acres

Parks of this size allow for a large bike park providing a wide assortment of trail experiences and bike park features for all ability levels.

Door Creek Park, between Milwaukee Street and Cottage Grove Road, has the potential to support bike optimized facilities that would be considered a destination for nearby neighborhoods, the greater Madison area, and quite possibly out of town visitors. Experiences could include singletrack trails, pump tracks, and skills development features.



Site Analysis and Ground Truth MadBAT Opportunities

The project team initially identified approximately 40 linear connections and 90 park properties during the first meetings. GIS data and site analysis helped the project team assess the feasibility of developing those linear connections and bike optimized park features.

Topographic information showed where slopes are appropriate for pump tracks and skills features. The presence of hillsides help with determining styles of trails to be developed and if there will be water drainage away from trails and features.

Wetland and soils data helped determine potential areas of development if park sites are hydrologically constrained or unable to support facility construction.

Proximity to existing/future hard surface trails and proximity to schools determined the hierarchy of property development potential. All identified properties that are within a quarter mile of trails and/or a quarter mile of schools are a higher priority than those not. The GIS analysis reduced the list of linear connections to 40 and park properties down to 80 properties.

To further assess the feasibility of the potential connections and bike park development, IMBA TS staff ground truthed each location during the Spring of 2020. TS staff took photos and notes on the physical landscape, property conditions, adjacent properties and neighborhoods, delineating the potential development areas, and listing the potential trail types and bike optimized facilities that would be appropriate for each property. The site visits added and removed a handful of connections and park properties from the lists resulting in the identification of 37 linear connections and 77 park properties.

Draft MadBAT Plan Development

The initial meetings, desktop based opportunity gathering, GIS analysis, and site visits all contributed to a draft MadBAT Plan interactive map and the list of potential Linear Singletrack Trail Connections and Bike Optimized Park Facilities. This draft was reviewed by Parks Staff where another eight trail connections and nine park properties were added. A second draft of the MadBAT Plan was shared with Park Division Leadership, Planning Division, City Engineering, Parks Operations, Traffic Engineering, and Stormwater Utility. Comments and feedback were collected by parks staff and the draft plan was updated to include two more trail connections and eleven additional park properties.

Draft MadBAT Plan External Feedback

Externally CORP and IMBA helped develop the plan. Input and support was offered by others during the planning process such as UW Healthy Kids Cooperative, NICA, City of Fitchburg, and Madison Area Sports Commission.

Internal and external partners reviewed draft copies of the MadBAT plan, offered comments and suggestions, and those comments and revisions were incorporated in the final version.

Parks Division held a series of 3 public informational meetings during the MadBAT plan development. Outreach for the network was done through a combination of social media, traditional media, Parks Division Blog, targeted outreach to neighborhood associations, outreach to Alders, CORP, and Parks release.

News of the network spread quickly and a story was published October 5th, 2020 in the Wisconsin State Journal in advance of the public meetings. The story was named as one of the "5 Favorite Stories of 2020" by Wisconsin State Journal writer Chris Hubbuch.

Public Informational meetings were held by Parks Staff and our IMBA consultant on October 13th, 15t, and 28th. The meetings were held via Zoom due to the ongoing COVID protocols. Approximately 150 people registered as attendees. It's estimated that approximately half of these actively participated in the meetings, asking questions and offering support. The responses were overwhelmingly positive and many people asked how to become further involved in order to move individual sites to construction. Parks also set up an email account for residents unable to attend meetings to review a draft plan created through an ArcGIS storymap online. To date that email address has received 138 messages of almost unanimous support.

Quarry Cove park was assessed by foot and drone views.

MADBAT RECOMMENDATIONS

Refer to the MadBAT online map viewer to view plan recommendations in more detail and zoom into neighborhood level connections.

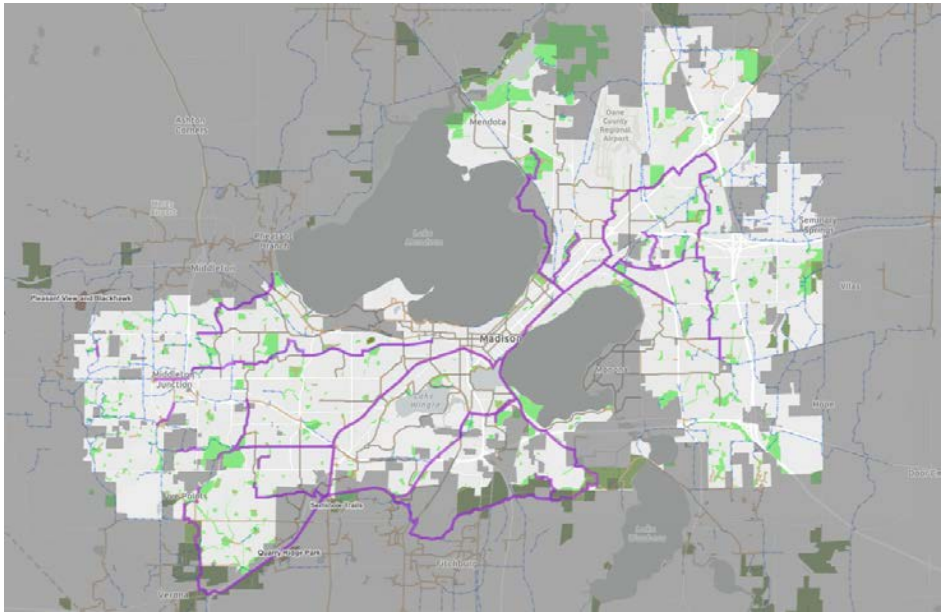
Connections

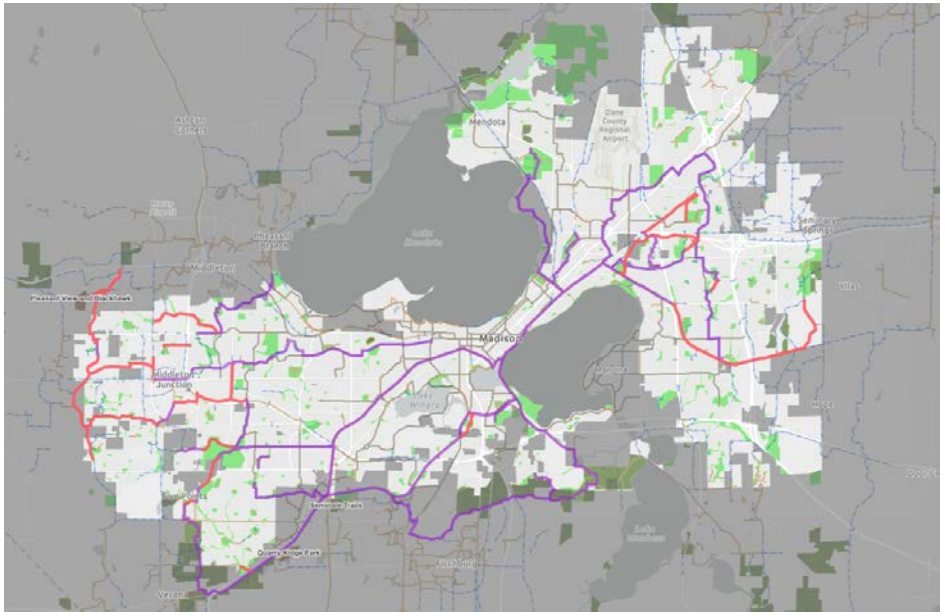
Existing Paths and Bike Lanes

The backbone of MadBAT is the existing bike infrastructure that allows for ease of access from the outer reaches of Madison into the downtown core, as shown as purple lines on the map below. 72.5 miles of the existing Paths and bike lanes will connect directly to planned natural surface trails or have corridors that are currently wide enough to accommodate parallel natural surface trails as an alternative experience to the existing hard surface path.

Connections Using Planned/Future Public Land Projects

City of Madison staff provided insights related to future public land projects that are in planning stages or have been identified as feasible corridors, shown as orange lines below, for future development. These alignments, 26.9 miles, will add another layer of connectivity as they are implemented. Many of which will have wide enough greenspaces for parallel natural surface trail options.





Natural Surface Linear Connections and Parallel Trails

These trails are what MadBAT is all about, a potential 32 miles of singletrack trails on public lands (shown as magenta lines below). Natural material trails that can range from native soil trail tread, to imported soil compositions that shape well and compact into a firm and stable surface, to crushed stone trails with the potential to create a "chip seal" texture for high traffic areas where all weather resiliency is needed. As trail designs are developed, they can take on a form of the three trail types mentioned earlier; traditional shared use singletrack, bike optimized singletrack / flow trails, and mountain bike skills trails. In future development plans the combination of these may be referred to as Singletrack Sidewalks or Shred to School Trails.

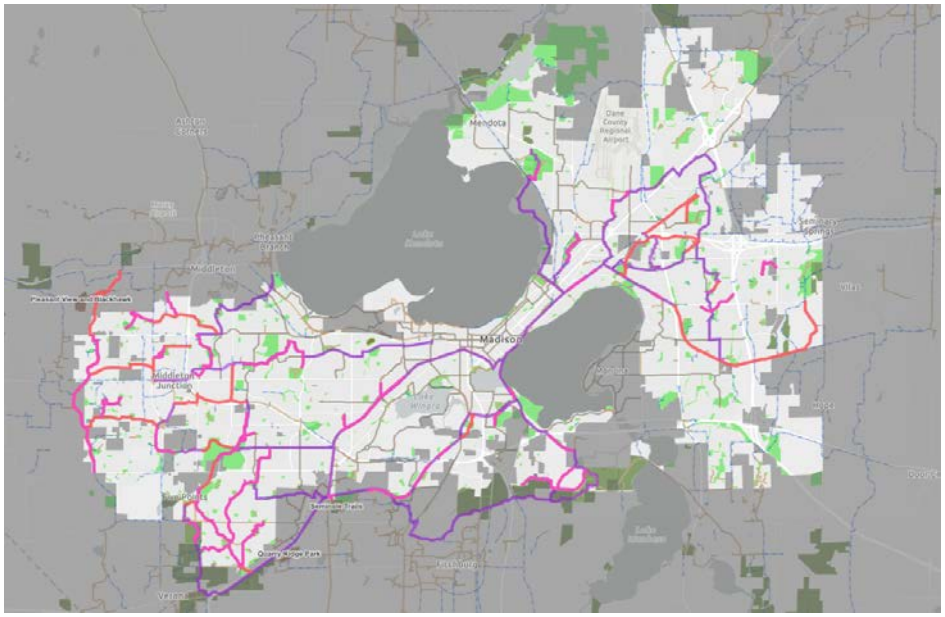
Bike Optimized Facilities

The recreation experiences supported by the linear connections mentioned above are further enhanced by the bike optimized destinations throughout the MadBAT system. These destinations will range from pocket parks with a couple skills development features; to neighborhood parks with pump tracks, skills loops, and perimeter trails; to regional bike parks that engage riders of all ages and ability levels from Madison and will draw destination visitors.

Eight pocket parks including; Glen Oak Hills, Odana Hills East, Sauk Creek, Tillotson, and Waunona are small in size but have available spaces for impactful bike skills development features that are tucked into neighborhoods resulting in access to new and exciting recreational opportunities for families.

Parks ranging in size from 1 to 15 acres have the potential to offer many different bike optimized and trail based experiences. The project team identified 72 properties in this study that would be feasible to develop an array of MadBAT components. Not all 72 will be developed, but all are appropriate locations for projects that gain neighborhood support and rise in priority.

The Madison area can support two to three relatively large bike parks compared to the size of the neighborhood parks. These would be in parks over 15 acres and offer a host of MadBAT components from pump tracks and skills development features to a network of trails for all ability levels and different trail types. A few parks standout from the list of 15; Aldo Leopold, Door Creek, Elver, Hill Creek, Northstar, and Walnut Grove.



A complete list of parks, their acreages, and potential MadBAT components is listed in the following Appendix.

How sites and priorities will be decided going forward

Parks Division is committed to developing the MadBAT system through public engagement and input. Sites given priority for development may share some of the following qualities:

- Serve a new need or desire for trails and facilities in the area
- Close to schools or neighborhoods
- Accessible from existing paved bike path network or MadBAT natural surface trail connections
- Increases connectivity to other trails or paths
- Can build built in conjunction with other construction projects to save costs
- Are free from significant objections from user groups or neighborhoods
- Have an accessible funding source or private donation allocated to the project

PRIORITY MADBAT PROJECTS

As the project team created the MadBAT Plan and received public comment, five properties rose above others in terms of priority due to location, visibility, neighborhood desire, potential funding, and opportunity to be pilot projects setting the stage for future developments. Each property has different characteristics that lend to unique experience and are also located across Madison from east to west north to south.

Aldo Leopold Park

ID #207d and P207

Adjacent to the Cannonball Path and north of Aldo Leopold School, 17 acre Aldo Leopold Park has a balance of developed activities, flexible open spaces, and underutilized zones. Prior public outreach showed that there is a demand for bike based recreation in that neighborhood. With that in mind, a "temporary" ⅛mile trail was created at the park during the summer of 2020. A range of ridership was observed and even covered by local media and the REI Journal.

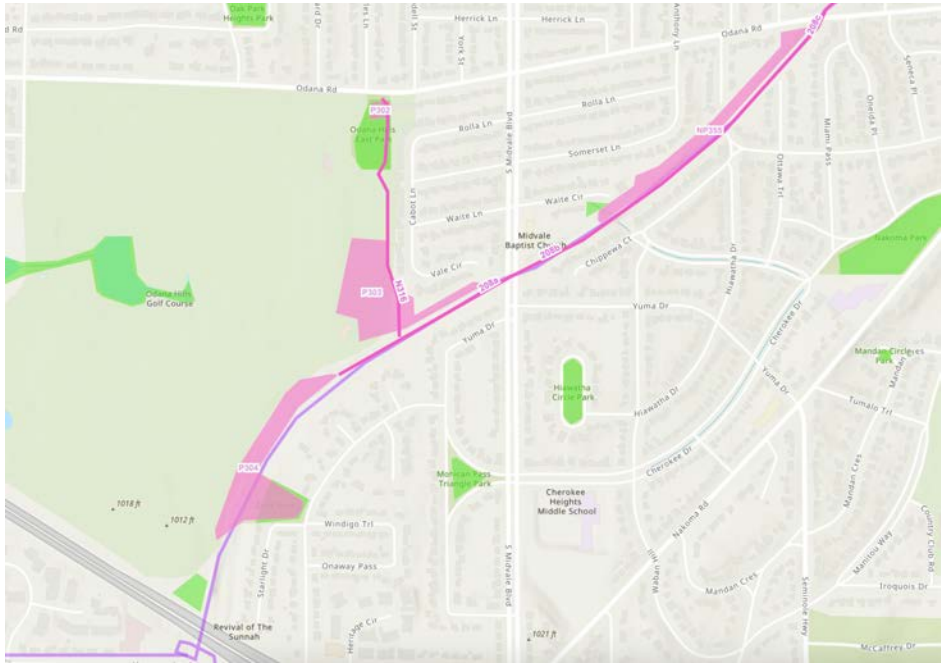
Since then, the Madison Parks Division has engaged Progressive Bike Ramps and VeloSolutions to construct an asphalt pump track at Aldo Leopold park in late summer or early fall of 2021. This will be phase 1 of what is envisioned as a comprehensive bike optimized recreation facility. As funding and support continue, additional phases will be implemented in coming years with the "Shred to School" and skills development trails next in line for implementation.

Aldo Leopold Bike Park Schematic Design

Southwest Commuter - Beltline north to Odana Road

ID #208a, 208b, P303, P305, NP355

Currently the Southwest Commuter Trail corridor north of the Beltline to Odana Road has a handful of social trails that have been built without permission from the Parks Division. The corridor north/northwest and park land identified at Odana Hills GC Woods all have characteristics that are appropriate for trail based recreation improvements. The corridor is wide enough to construct a series of professionally built trails with skills development features.



Southwest Commuter - Beltline north to Odana Road

Sycamore Park

ID #P126 AND P127

Located just west of N. Thompson Drive on the east side of Madison, Sycamore Park is known for its fenced dog park and adjacent open spaces. With 20 vertical feet of relief, natural surface trails can be designed to offer gentle flow that introduces riders to bike handling (steering and braking) in a manner that can be separate from other trail uses. Segments of trail can be laid out that provide experiences for beginners, intermediates, and advanced riders while also being connected to the hard surface trail that bisects the park that allows for ease of connectivity to/from the surrounding neighborhood.

Sycamore Park

Walnut Grove Park

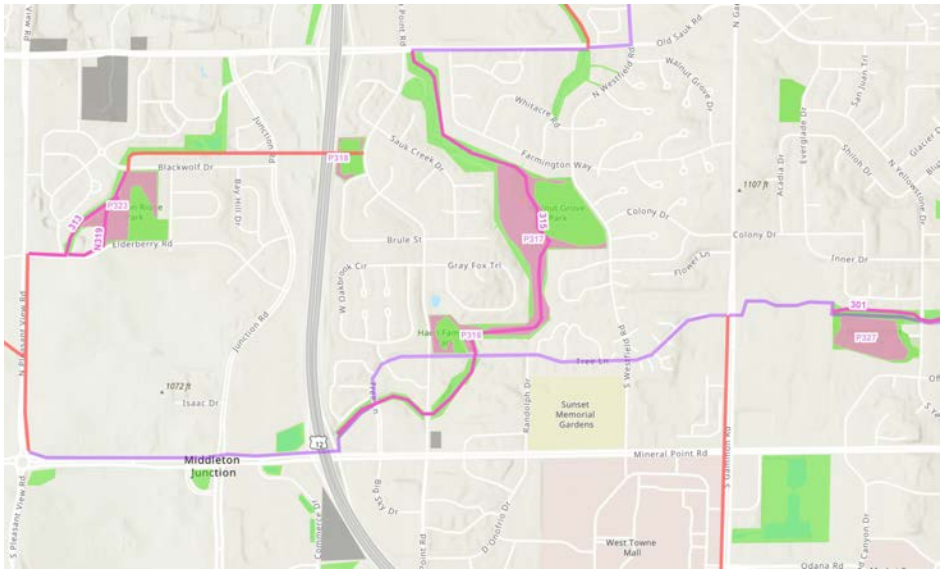
ID #315, P316, and P317

Two opportunities have good potential at Walnut Grove Park, north of Mineral Point Road and east of the Beltline. First, there is the Park with spaces on its periphery appropriate for singletrack trails and skills development features. Secondly, portions of the east Mendota-Pheasant Branch Greenway are located between Old Sauk Road and Mineral Point Road. This greenway will be undergoing a stormwater mitigation project making way for the potential of natural surface trail connectivity. Combining these properties along with nearby Haen Family Park, a trail based facility can offer many experiences for riders and pedestrians alike.

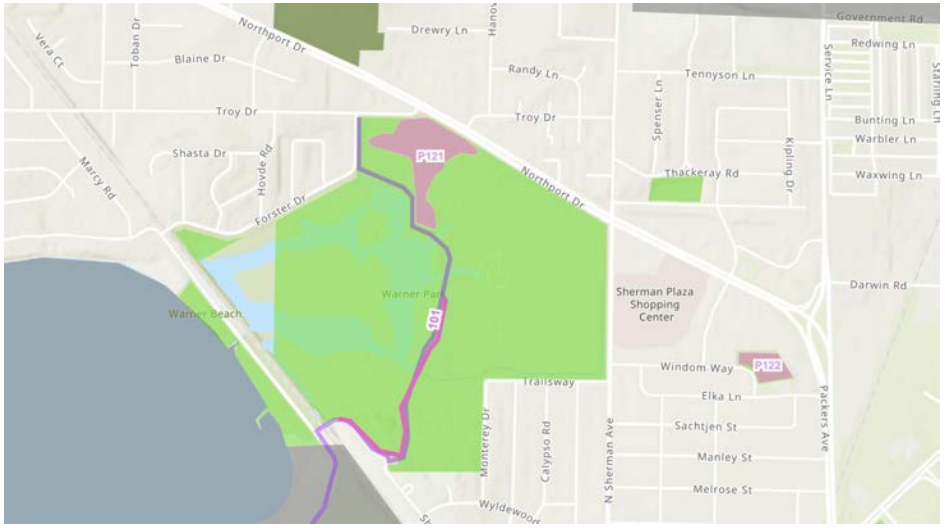
Warner Park

ID #101 and P121

The northside of Madison is underserved when it comes to trail connectivity and bike based recreation. At Warner Park, with the community center and flexible open spaces, a pump track facility and series of skills development features would provide an experience that is currently not accessible from adjacent neighborhoods. These types of facilities can be developed in a compact space allowing for circulation around them and limited impact to existing uses. With that said, the potential for this to be a highly utilized facility, a study should be done to determine the reasonable size that will meet the perceived demand.



Walnut Grove Park



Warner Park

NICA TEAMS

As mentioned a few times earlier in this document, NICA teams are growing significantly year after year, overwhelming existing trail facilities, therefore showing a demand for skills development and training facilities. Many of the pocket parks and neighborhood parks listed will fulfill the need for skills development experiences, there is also a need for trail mileage where student athletes can improve fitness, gain understanding of the endurance required in mountain bike racing, and have a venue of trails to learn about land stewardship via trail maintenance. Large parks that have acreage appropriate to support one to six miles of trail is what NICA teams are identifying as desirable locations. The MadBAT project team along with CORP are exploring locations where trail offerings will meet the future demand, located in underserved zones, and have neighborhood support. Door Creek Park and Hill Creek Park are two properties being discussed along with others of similar size.

Hill Creek Park

CONTINUED ENGAGEMENT AND REVIEW PROCESS

Community Outreach and Visioning

The MadBAT plan reflects identified suitable locations for trail connections and bike facilities. The proposed locations work in tandem with existing recreational amenities and are located based upon the assessment of opportunities, constraints, nearby supporting infrastructure, and community amenities. This Concept Plan acts as a guiding document at this point in the implementation process. In order to move forward to build these bike facilities, a site specific understanding of each parks' and surrounding neighborhood goals and coordination with any future plans is necessary to integrate the conceptual facilities into the properties. Public outreach will continue to gather input on plans as they are developed. This outreach is paramount to ensure residents are engaged during this process. This will generate excitement and support for the plans, create a stewardship base of future trail users, and foster a sense of ownership and pride of the bike facilities. In addition to reaching out to residents, communication with CORP, NICA, and other user groups will help build an understanding of the interests and concerns while creating relationships.

Since many of the bike facilities presented in this study would be a new type of recreational amenity to the area, the facilities and their benefits may be unfamiliar to residents, stakeholders, and community leaders. Continued education, through community meetings, field trips to trails and bike facilities, and demonstration projects will help residents understand the potential of these facilities and generate support for future projects.

While the scope of this feasibility study focused on public lands within Madison, other opportunities for bike optimized facilities may exist in adjacent municipalities. Projects are already known to be under development in Middleton, Fitchburg, and Monona. Coordination between individual municipalities, Dane County, and Madison will be helpful to identify other sites of interest and create a unified vision for bike amenity development when appropriate.

IMPLEMENTATION

Design Development of Trail Connections and Bike Facilities

This MadBAT document outlines the feasibility of properties to be developed into facilities meeting the demand for bike based exercise and recreation. The next step is to continue with planning at a site specific level that is further refined based upon community input and coordination with future park plans, design development with detailed site plans should be created to guide the development of the bike facilities. The site plans should clearly indicate the type of desired features and trail types. Parks with multiple bike facility plans may require a master plan with phasing recommendations. Project cost and timeline projections should be identified and provided with the masterplans.

After the design development is complete, development of construction plans with specifications and details is necessary to guide and communicate the construction. Based upon the facility type and conditions, permitting plan sets may be necessary. For the development of all trails and bike facilities, IMBA TS recommends using a professional trail designer/builder to field flag the trail alignments, construct the trails or bike facilities, and provide training for staff and volunteers. The construction of the pump track and other asphalt features will require specialized construction cres to create the high quality facilities Madison residents will expect.

Natural Surface Trail Development Considerations

Follow Sustainable Trail Construction Guidelines

In general terms, the design and construction of singletrack trail routes should follow sustainable trail construction guidelines. A summary of these guidelines is provided in the document appendix.

A sustainable trail balances many elements. It has little impact on the environment; resists erosion through proper design, construction, and maintenance; and blends with the surrounding area. A sustainable trail also appeals to and serves a variety of users, adding an important element of recreation to the community. It is designed to provide enjoyable and challenging experiences for users by managing their expectations and their use effectively. Following sustainable trail design and construction guidelines allows for high-quality trail and education experiences for users while protecting the land's sensitive resources. For additional trail design, construction, and maintenance techniques, refer to Trail Solutions: IMBA's Guide to Building Sweet Singletrack. These guidelines are appropriate for any pedestrian and biking trail.

Surface Material

Trails surfaced with native materials are able to provide maintainable and durable tread if sustainable trail guidelines are followed. The key surfacing issues to manage will be:

- Maintaining surface compaction
- Damage to tread by use in wet conditions
- Vegetation growing in tread from lack of maintenance, an aggressive growing season, and/or lack of use
- Poor native soil at a particular site (expansive clay, sand, and silt)

Areas with poor soils may need to rely on imported materials. Generally, this would be a crushed aggregate that includes a mix of other soil types depending on the particular conditions in a given location.

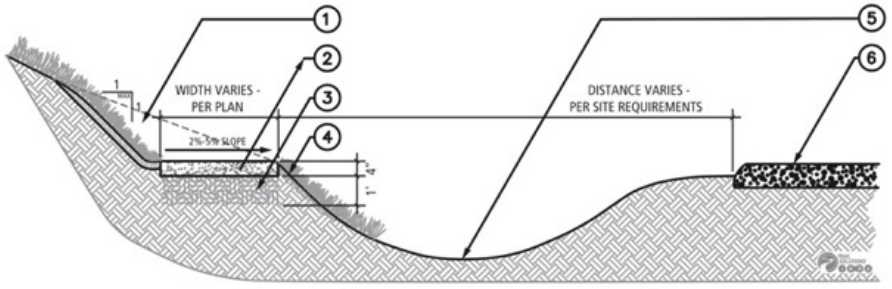
Drainage Considerations

Most drainage challenges will be overcome by following sustainable trail construction guidelines, but some specific considerations exist for the MadBAT implementation. The construction of singletrack will primarily be in the right of way areas near existing hard surface paths. This area (which we will refer to as the trail corridor) is usually engineered during the pathway construction process to manage runoff of water from the pathway or adjacent roadways. This means that large volumes of water will often be flowing from the nearby surfaces and across the natural surface trails built parallel to them. Care must be taken to ensure that this flow of water runs in a laminar and sheet flow fashion across the tread. Narrow drains which focus water and create higher volume and flow must be avoided. The tread surface must be compacted and possess an outslope grade of no more than 5 percent.

Obstructions and Risks

With the trail corridor paralleling pathways, there are a number of obstructions and associated risks which will require both site-specific solutions and the development of general guidelines. Potential obstructions may be:

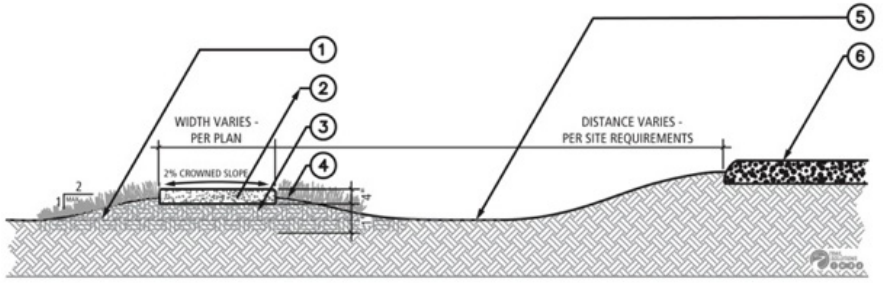
- Utility poles and guy wires – accident risks to trail users, excavation of trail near base



① EXISTING ROAD BANK GRADE
② TRAIL SURFACING MATERIAL PER SITE REQUIREMENTS
③ COMPACTED NATIVE FILL MATERIAL
④ REVEGETATE ALL DISTURBED AREAS
⑤ DITCH - TRAIL SURFACE MUST BE HIGHER THAN MAX WATER LEVEL
⑥ ROAD SURFACE

A TRAIL SECTION - SINGLETRACK SIDEWALK, CUT & FILL

ESTIMATED UNIT COST RANGE - $4.75 to $10.00 Per Linear Foot



① EXISTING GRADE
② TRAIL SURFACING MATERIAL PER SITE REQUIREMENTS
③ COMPACTED BALLAST STONE & CLEAN NATIVE FILL
④ REVEGETATE ALL DISTURBED AREAS
⑤ LOWEST GRADE
⑥ ROAD SURFACE

B TRAIL SECTION - SINGLETRACK SIDEWALK, ELEVATED

ESTIMATED UNIT COST RANGE - $8.00 to $16.00 Per Linear Foot

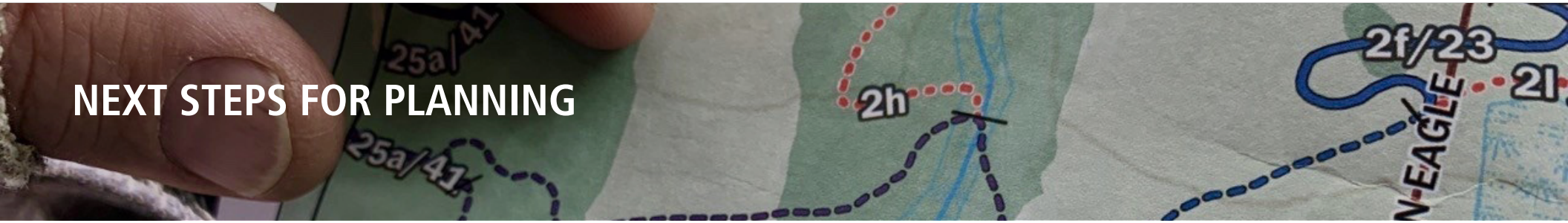
- Culvert pipe ends – accident risks to trail users, excavation of trail near culvert ends, moist soils create drainage issues
- Waterway crossings – accident risks to trail users, soft or eroded trail tread requiring built structures for crossings
- Fences – accident risks to trail users, excavation of trail near post bases
- Vegetation – accident risks to trail users due to visibility challenges, removal of larger trees to create access for trail
- Pathway signs – accident risks to trail users, excavation of trail near base
- Vehicles – drivers of vehicles and trail users may not understand who has the right of way at intersections of roadways and singletrack trails
- Wet soils – inability to create compact natural surface tread
- Buried utilities – trail closures during utility work, hazards during construction of trails

Liability

As the bike facilities would introduce a new type of recreation with newn liability concerns to municipalities, an assessment and clear understanding of recreation protections, laws, and precedents is necessary to ease concerns and create a plan to mitigate risk. In Madison bike facilities are covered under Wisconsin's Recreational Immunity Law in the same manner as other park facilities such as playgrounds, sport courts, and paved paths. During site specific planning legal advice from the City Attorney's office will be sought to ensure all liability concerns are understood and create a plan to mitigate risk. Warnings of the inherent risk of mountain biking should be clearly provided on park signage and should be reviewed by a legal professional.

Funding

The availability of funding for the bike facilities will vary among municipalities. Planning for these amenities in yearly recreational budgets will begin the process of designating funds for bike facility projects. Some municipalities employ a voter-approved recreational and trails sales tax to generate funding specifically for recreation improvements. In addition, a range of federal, state, and local grants are available that support trail development and recreational amenities. Coordinating with local organizations with allied interests may offer financial support and increase the base of supporters.



NEXT STEPS FOR PLANNING

Operations and Maintenance Plan

The purpose of an Operations and Maintenance (O&M) Plan is to provide the Parks Division with guidelines and tools for day-to-day maintenance and weekly/monthly/annual inspections. The goal of the document is to ensure a consistent experience for trail and facility users. Successful operations will rely on a regular program of inspection and maintenance of the trails, tracks, and associated facilities. This document will not only ensure a quality recreational experience for the trail user, but is also an essential ingredient of a risk management plan for the City of Madison. Sufficient staff/volunteer/contractor hours and resources must be devoted to a regular maintenance schedule in order to meet these goals. Trail maintenance is an important program that is related to trail safety, quality of user experience, attractiveness, and image. The city risks liability for accidents, if maintenance is ignored or negligently executed.

O&M Plans cover topics on inspections, signage, trail/facility building materials, tools, maintenance frequency, risk management, incident/accident reporting, and emergency response.

Trails should be managed according to recommended ability level guidelines, trail type guidelines, and respective trail experience narratives. Design development will provide these detailed guidance documents. Maintenance is an ongoing cost and should be planned for. Typical annual maintenance budgets for traditional and mountain bike-optimized trails are 10%-15% of the installation cost, and freeride/jump trails can be closer to 20%-25% of the construction cost. Some of the annual maintenance for all trails can be performed by adequately managed and trained volunteers. These tasks will include corridor trimming, downed tree removal, general clean up (branches, leaf litter, etc.), and minor drainage work

Volunteer assisted maintenance and professional contractor based upkeep will be required. The frequency of this work will depend upon trail conditions, soil characteristics, weather patterns, and use. Typically for traditional shared use trails, vegetation management is needed 3-5 times per year with professional contractors maintaining structural issues will be required every few years that may involve small reroutes, major drainage work, or other large tasks. Freeride trails can be expected to need a professional touch more often as trails wear through weather and use. This will typically come in the form of rebuilding large dirt features and upgrading trails to provide slightly new experiences which help continue to draw destination riders, give locals something new, and help all riders progress in their skills. Increasingly, destination mountain bike trail systems are funding and hiring part- or full-time staff to provide maintenance to trail systems. Ensuring a quality, consistent riding experience is key to attracting visitors and keeping a local riding community satisfied and growing.

Maintenance Approach

As trail systems grow in both popularity and trail mileage, it will be important to continue providing access to the places and experiences people travel there for. Trail maintenance helps a trail system work well for its intended use consistently, over long periods of time. A well-maintained trail system generates return visits by people who enjoyed an earlier outing at the facility. Recreationists who find a good place to ride, hike, or run share those experiences with their friends and other like-minded people.

A rotating system of trail maintenance is an effective way to make sure that trails are consistently in good order. Under this system, the entire MadBAT system can be divided into zones, with one zone's trail maintenance needs addressed in one year. The next year, maintenance of the next sequential zone of trail is addressed, until the entire system is maintained. Each zone then receives major maintenance on consistent rotation.

Trail Maintenance Crew

Many communities and counties around the nation employ seasonal trail crews to protect, enhance, and maintain their trail investments. A seasonal trail crew can provide substantial maintenance on the existing trail system over the course of three to four months, while taking the burden off of volunteers.

Strengths to trail crew approach:

- Focused maintenance approach for MadBAT trails and facilities
- Ease the burden of maintenance and construction off of volunteers
- Potential to engage Youth Conservation Corps crews

Challenges to trail crew approach:

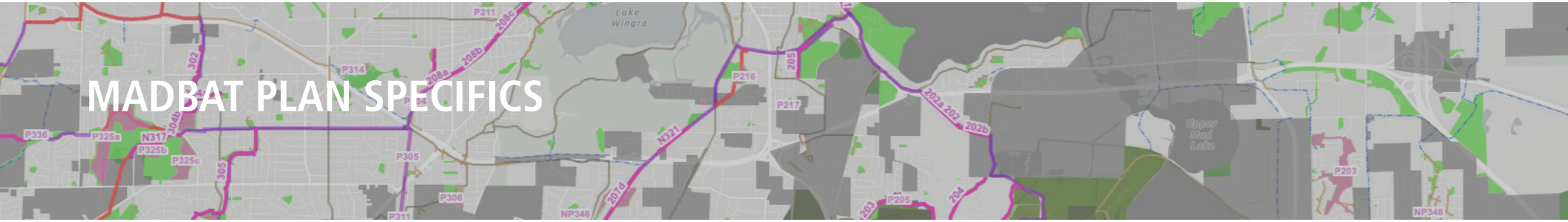
- Acquiring consistent funding
- Finding a nonprofit or municipal managing partner to oversee crews and receive funds
- Need for consistent management, grant writing, and project management

Parks Division and CORP Memorandum of Understanding

CORP will have a seat at the table as the O&M plan is being developed. In order for a partnership between the City of Madison and CORP an agreement that defines roles and responsibilities of all parties will need to be created and in place prior to the implementation of MadBAT trails and facilities. Discussions have begun related to this agreement and will be ongoing throughout 2021 and early 2022.

CONCLUSION

This plan outlines the potential of creating 32 miles of new natural surface trails and identifies 90 parks feasible for bike optimized facilities. Following implementation of the priority projects listed here, a strategic approach to developing additional trail and bike based opportunities will emphasize the long-term sustainability of trails, facilities, and the organizations that maintain them. Significant investments will need to be made, and the support of community members and city officials will be critical. As MadBAT is implemented it will become an outdoor recreation asset and transportation option for the entire city of Madison resulting in improved access to the outdoors for all Madison communities, healthy recreation based habits, youth engagement and community building around neighborhood amenities, sustainable activities, positive economic outcomes, and a series of experiences that bring visitors to the area.



MADBAT PLAN SPECIFICS

MadBAT Natural Surface Linear Connections and Parallel Trails

Segment ID	Name	Linear Feet	1/4 Mile From Schools	Potential Trail Opportunity
101	Warner Park	2,580		Singletrack trail adjacent to existing bike paths
104	Cap City - Dempsy Street reach	1,508	✓	Singletrack trail parallel to existing bike path
106	Eastwood Drive	2,499	✓	Singletrack trail parallel to existing bike path
108	Demetral Fields	4,368	✓	Singletrack trail parallel to existing bike path
201	Olin Park - west of Wingra Creek	1,637	✓	Singletrack trail parallel to existing bike path
202	Cap City Path	1,856		Singletrack trail parallel to existing bike path
203	Madison Metro Sewage District?	10,445		Singletrack trail on MMSD Property
204	Madison Metro Sewage District?	3,220		Singletrack trail on MMSD Property
205	Quann Park path	1,947	✓	Singletrack trail parallel to existing bike path
301	Garner Park to James Madison H.S.	11,239	✓	Singletrack trail within greenway spaces
302	Struck Street Greenway	1,439	✓	Singletrack trail within greenway spaces
303	West Bdger Mill Creek - Elver Park Greenway	1,955	✓	Singletrack trail within greenway spaces
305	East Badger Mill Creek Greenway	14,823	✓	Singletrack trail within greenway spaces
306	McKee Road to Cross Country Road	7,493	✓	Singletrack trail within greenway spaces
307	UBMC Regional West to Upper Badger Mill Creek South	12,226	✓	Singletrack trail within greenway spaces
308	Country Grove Park to Glacier Crossing Park	3,936	✓	Singletrack trail within greenway spaces
309	Valley View to Midtown Commons Park	4,775	✓	Singletrack trail within greenway spaces
310	Cardinal Glenn Park to Thousand Oaks Park	5,332	✓	Singletrack trail within greenway spaces
311	Burnt Sienna Drive Greenway	3,147		Singletrack trail within greenway spaces
312	North Blackhawk Pond Greenway	5,728		Singletrack trail within greenway spaces
313	Junction Ridge Park to North Pleasant View Road	1,920		Singletrack trail within greenway spaces
314	North Mendata - Pheasant Branch Greenway	3,383	✓	Singletrack trail within greenway spaces
315	Old Sauk Greenway	8,259		Singletrack trail within greenway spaces
102a	Starkweather Path	845		Partnership with Dane County for singletrack trail parallel to existing path
102b	Starkweather Path	2,328		Partnership with Dane County for singletrack trail parallel to existing path

MadBAT Natural Surface Linear Connections and Parallel Trails

Segment ID	Name	Linear Feet	1/4 Mile From Schools	Potential Trail Opportunity
202a	Cap City Trail	389		Singletrack trail parallel to existing bike path
202b	Cap City Trail	1,291		Singletrack trail parallel to existing bike path
207a	Cannonball to Roundabout to Seminole Trails	1,279		Singletrack trail parallel to existing bike path
207b	Cannonball	3,054		Singletrack trail parallel to existing bike path. Adjacent City of Fitchburg Property has good potential for parallel trails.
207c	Cannonball Along Knollwoood	2,333		Singletrack trail parallel to existing bike path
207d	Cannonball Beltline to Aldo Leopold Park	3,242		Singletrack trail parallel to existing bike path
208a	Southwest Commuter Odana GC to Midvale	1,358	✓	Singletrack trail parallel to existing bike path
208b	Southwest Commuter Odana GC to Odana Road	2,716	✓	Singletrack trail parallel to existing bike path
208c	Southwest Commuter WI DOT	2,133	✓	Singletrack trail parallel to existing bike path
208d	Southwest Commuter WI DOT Corridor	4,983		Singletrack trail parallel to existing bike path
304a	Chapel Hill Road Greenway	2,584	✓	Singletrack trail within greenway spaces
304b	Chapel Hill Road Greenway	1,082		Singletrack trail within greenway spaces
N316	Odana Hills East Park to SW Commuter	1,699	✓	Singletrack trail parallel to existing bike path
N317	Elver Park Path	2,970	✓	Singletrack trail parallel to existing bike path
N318	Heritage Heights Trail	729		Singletrack trail parallel to existing bike path
N319	Junction Ridge Park Option	1,232		Singletrack trail parallel to existing bike path
N320	CapCity Trail along St. Paul Ave	877	✓	Singletrack trail parallel to existing bike path
N321	Cannonball to Beltline	1,948		Singletrack trail parallel to existing bike path
N322	Rustic Drive Greenway	3,848		Singletrack trail within greenway spaces
N323	Starkweather-Olbrich Greenway	4,827	✓	Singletrack trail within greenway spaces
N324	IceAge Junction	3,669		Singletrack trail parallel to existing bike path
		167,131	Total Linear Feet	
		32	Total Miles	

MadBAT Bike Optimized Facilities

Park ID	Name	Acreage	1/4 Mile From Schools	Schools	1/4 Mile From Existing Bike Paths	1/4 Mile From Existing Bike Routes	1/4 File From Planned/Future Bike Paths	Potential Bike Optimized Components
P101	Northeast Park	184.2			✓		✓	Perimeter Trail, Singletrack Trails, Beginner Flow Trails, Bicycle Playground, Pumptrack, Skills Development Features
P102	Door Creek Park and Greenways Complex	148.7			✓		✓	Singletrack Trails, Pump Track, Skills Developoment Features. Mainly Single Track from parking lot thru woods to cottage grove road. Long range planning would be additional trails on Dane County Parks.
P103	Kennedy Park	19.7	✓	Kennedy Elementary School	✓	✓	✓	Perimeter Trail, Skills Development Features, Pumptrack
P104	Glacier Hill Park	7.7				✓	✓	Perimeter Trail, Flow Trails (along north side of park), Skills Development Features, maybe Bicycle Playground
P106	Honeysuckle Park and Greenways	7.7	✓	Toad Hill Children's House		✓	✓	Singletrack Trails, Skills Development Features, Bicycle Playground
P107	Hiestand Park	3.3	✓	Toad Hill Children's House	✓	✓	✓	Singletrack Trail(s) connecting to greenway, keeping a buffer from Disc Golf.
P109	Eastmorland Park	11.3	✓	Whitehorse/Schenk		✓	✓	Singletrack Trails adjacent to existing paths, Skills Development Features, Bicycle Playground
P110	Ontario Park	1.7	✓	St Dennis Convent, St Dennis School		✓	✓	Singletrack Trails adjacent to existing paths, Skills Development Features, Bicycle Playground
P111	Ring Street Greenway	1.5	✓	Whitehorse/Schenk	✓	✓	✓	Singletrack Trails adjacent to existing paths
P112	Dennett Drive Greenway	1.6	✓	Whitehorse/Schenk	✓	✓	✓	Singletrack Trails adjacent to existing paths, Skills Development Features
P116	Dixon Park	2.9						Singletrack Trails adjacent to existing paths, Skills Development Features, "Pocket" Pumptrack Park
P117	Wirth Court Park	1.6		Whitehorse/Schenk	✓	✓	✓	Skills Development Features, Bicycle Playground
P121	Warner Park	10.5			✓	✓	✓	Singletrack Trails adjacent to existing paths, Skills Development Features, Bicycle Playground, Pumptrack
P122	Windom Way Park	2.5				✓	✓	Bicycle Playground, Pumptrack
P123	Reindahl Park	23.1	✓	Discovery Year's Preschool	✓	✓	✓	Singletrack Trails adjacent to existing paths, Skills Development Features, Pumptrack Park
P124	Carpenter - Ridgeway Park	3.2				✓		"Pocket" Pumptrack Park, Skills Developoment Features, Opportunity to pull in rogue trails on MATC property
P125	Washington Manor Park and Greenways	4.3				✓		Singletrack Trails adjacent to existing paths, Skills Development Features, Bicycle Playground
P126	Sycamore Park - South	22.0			✓	✓	✓	Perimeter Trail, Singletrack Trails, Underutilized space could support trails and skills Development Features
P127	Sycamore Park - North	12.0			✓	✓	✓	Singletrack Trails replacing current rogue trail building
P201	Droster to GW to Orlando Park	43.8			✓	✓	✓	Singletrack Trails connecting Greenway and Park, Skills Development Features, Pumptrack, Bicycle Playground
P202	GE Property Past Quarry Operations	60.4					✓	Trail development potential on Dane County Parks Property, Long Range Planning Project
P203	Veterans Memorial Parkand GW Complex (includes Owl Creek Park)	61.6					✓	Singletrack Trails, Skills Development Features, Bicycle Playground
P205	Baxter Park	5.3						Perimeter Trail, Bicycle Playground, Pumptrack, Skills Development Features
P207	Aldo Leopold Park	17.1	✓	Wingra School	✓	✓	✓	Singletrack Trails adjacent to existing paths, Skills Development Features, Bicycle Playground, Pumptrack
P208	Knollwood Park and DCP potential	23.7						While Knollwood is a conservation park there are rogue trails with heavy use. Look to incorporate/improve existing trails and look at trail development potential on adjacent DCP property.
P209	Post Road Section Greenway	7.2	✓	Leopold School		✓	✓	Singletrack Trails, Skills Development Features
P210	Tillotson Park	1.0						Spur Trail with Skills Development Features
P211	Westmorland Park	7.1	✓	Midvale School		✓	✓	Pumptrack, Skills Development Features
P212	Quarry Park	15.3				✓	✓	Existing Trails Improvements
P213	Forest Hill Cemetery	12.1	✓	Wingra School		✓	✓	Perimeter Trail and Incorporate Rogue Trails
P215	Town of Madison Park Property	1.2			✓	✓	✓	Skills Development Features, Pumptrack, Bicycle Playground
P216	Bowman Park	6.8				✓	✓	Perimeter Trail, Skills Development Features
P217	Penn Park	6.7	✓	Child developement Inc		✓	✓	Perimeter Trail, Skills Development Features, Close to Boys and Girls Club
P218	Goodman Park	2.0	✓	Franklin School, Woodland Montessori		✓	✓	Skills Development Features, Small Pumptrack
P219	Olin Park - South of Lake Monona Shoreline	5.0	✓	Woodland Montessori		✓	✓	Singletrack Trails, Flow Trails, Skills Development Features
P220	Olin Park - North of Wingra Creek	2.9		Woodland Montessori		✓		Singletrack Trails
P221	Thut Park	0.5				✓	✓	Skills Development Features
P222	Thut Park	1.8				✓	✓	Skills Development Features
P223	Waunona Park	0.7				✓	✓	Skills Development Features, Pumptrack
P224	Waunona Park	0.5				✓	✓	Skills Development Features, Pumptrack
P225	Monona Park	7.3	✓	Monona Grove Union HS; Lafollette HS		✓	✓	Perimeter Trail, Skills Development Features
P301	Rennebohm Park	10.4				✓		Singletrack Trails adjacent to existing paths, Bicycle Playground, Pumptrack
P302	Odana Hills East Park	0.4						Pumptrack
P303	Odana Hills GC Woods	6.2			✓	✓		Singletrack Trails, Skills Development Features
P304	Odana Woods	6.0				✓	✓	Singletrack Trails adjacent to existing paths, Incorporate/improve existing rogue trails. Bicycle Playground on southeast lobe.
P305	WI DOT Corridor Hammersley to Verona Road	3.0	✓	Great Beginnings, Careing Shareing Children Center	✓	✓	✓	Singletrack Trails adjacent to existing paths
P306	Marlborough Park	12.1	✓	Careing Shareing Children Center	✓	✓	✓	Perimeter Trail, Flow Trails, Skills Development Features, Pumptrack, Bicycle Playground
P307	DCP Seminole Trails	24.9				✓	✓	Singletrack network improvements and additional Bike Park components
P308	Dawley Park	10.0				✓		Further investigation need to see if there are developable uplands

MadBAT Bike Optimized Facilities

Park ID	Name	Acreage	1/4 Mile From Schools	Schools	1/4 Mile From Existing Bike Paths	1/4 Mile From Existing Bike Routes	1/4 File From Planned/Future Bike Paths	Potential Bike Optimized Components
P311	WI DOT Corridor near Allied Drive	4.4	✓	Great Beginnings	✓	✓	✓	Singletrack Trails adjacent to existing paths
P312	Huegel Park	8.3	✓	Huegel Elementary		✓	✓	Singletrack Trails, Flow Trails, Skills Development Features, Pumptrack, Bicycle Playground
P313	Maple Prairie Park	3.9			✓			Singletrack Trails, Skills Development Features
P314	Odana Hills East park	10.3	✓	Madison Montessori	✓	✓	✓	Perimeter Trail, Skills Dev Features, BPG
P315	Garner Park	14.7			✓	✓	✓	Singletrack Trails, Skills Development Features
P316	Haen Family Park	3.2				✓	✓	Perimeter Trail, Skills Development Features
P317	Walnut Grove Park	19.9				✓	✓	Perimeter Trail, Singletrack Trails, Bicycle Playground, Pumptrack, Skills Development Features
P318	Sauk Creek Park	0.9				✓	✓	Perimeter Trail, Skills Development Features
P319	Wexford Park	2.7			✓	✓		Good terrain for trails, but would need to be separate from the well done community developed interrpretive trails.
P320	Woodland Hills Park	10.5			✓	✓		Good terrain for trails, but would need to be separate from the well done community developed interrpretive trails.
P321	Swallowtail Park	1.4			✓		✓	Skills Development Features, Pumptrack, Bicycle Playground
P322	Blackhawk Park	7.8			✓		✓	Perimeter Trail, Skills Development Features, Pumptrack, Bicycle Playground
P323	Junction Ridge Park	8.2					✓	Singletrack Trails, Skills Development Features
P324	Hill Creek Park	71.0					✓	Community Wide Park Park with Singletrack Trails, Flow Trails, Bicycle Playground, Pumptrack, Skills Development Features
P325a	Elver Park	73.1	✓	Orchard Ridge Nursery School	✓	✓	✓	Singletrack Trails, Skills Development Features
P325b	Elver Park	13.8	✓	Wisconsin Youth Co	✓	✓	✓	Singletrack Trails, Flow Trails
P325c	Elver Park	32.5	✓	Wisconsin Youth Co	✓	✓	✓	Singletrack Trails, Flow Trails, Bicycle Playground, Pumptrack
P326	Marshall Park	12.7			✓	✓	✓	Singletrack Trails, Skills Development Features, Bicycle Playground
P327	Mineral Point Park	8.9	✓	Madison Metro; Memorial HS		✓	✓	Perimeter Trail, Skills Development Features, Bicycle Playground
P328	Greentree - Chapel Hills Park	12.9	✓	Orchard Ridge Nursery School	✓	✓	✓	Singletrack Trails, Skills Development Features
P329	Pilgrim Park	3.5			✓	✓		Singletrack Trails, Skills Development Features, Bicycle Playground
P330	Waltham Park	3.1			✓			Perimeter Trail, Flow Trails, Skills Development Features, Pumptrack, Bicycle Playground
P331	Country Grove Park	3.6	✓	Indigo Preschool; Chavez Elementary	✓			Singletrack Trails, Skills Development Features
P332	Apple Ridge Open Space	10.6			✓		✓	Singletrack Trails, Skills Development Features, Pumptrack, Bicycle Playground
P333	Nesbitt Open Space	2.4			✓		✓	Singletrack Trails, Skills Development Features
P334	Thousand Oaks Park	9.9					✓	Singletrack Trails, Skills Development Features
P335	Cardinal Glenn Park	1.7						Skills Development Features, Pumptrack, Bicycle Playground
P336	Midtown Commons Park	5.3			✓		✓	Perimeter Trail, Skills Development Features, Bicycle Playground
NP337	Manchester Park	10.5			✓		✓	Singletrack Trails, Skills Development Features, Pumptrack, Bicycle Playground
NP338	Glen Oak Hills Park	0.9			✓	✓	✓	Beginner Flow Trails, Skills Development Features
NP339	Brodner Park	2.7			✓	✓	✓	Singletrack Trails adjacent to existing paths, Skills Development Features, Bicycle Playground
NP340	CDA Property Allied Drive	0.4			✓	✓	✓	Skills Development Features
NP341	Elvehjem Park	3.5			✓	✓	✓	Skills Development Features, Bicycle Playground
NP342	Galaxy Park	2.5						Beginner Flow Trails, Bicycle Playground, Pumptrack, Skills Development Features
NP343	North Star Park	18.6					✓	Singletrack Trails, Skills Development Features, Pumptrack, Bicycle Playground
NP344	Quarry Cove Park	5.9			✓	✓		Singletrack Trails, Flow Trails, Skills Development Features
NP345	Arbor Hills	5.1	✓	Leopold School	✓			Perimeter Trail, Skills Development Features, Bicycle Playground
NP346	Kingswood Park	2.2			✓		✓	Perimeter Trail, Singletrack Trails, Skills Development Features, Bicycle Playground, Pumptrack
NP347	Kestrel Park	1.9					✓	Perimeter Trail, Skills Development Features, Bicycle Playground, Pumptrack
NP348	Secret Places Park	2.6			✓		✓	Singletrack Trails adjacent to existing paths, Skills Development Features, Bicycle Playground, Pumptrack
NP349	Woods Farm Park	3.3					✓	Perimeter Trail, Skills Development Features, Bicycle Playground, Pumptrack
NP350	Northland Manor Park	3.7				✓	✓	Singletrack Trails, Skills Development Features, Pumptrack, Bicycle Playground
NP351	Whitetail Ridge Park	3.2				✓	✓	Singletrack Trails, Skills Development Features, Pumptrack, Bicycle Playground
NP352	Acer Park	8.0					✓	Perimeter Trail, Skills Development Features
NP353	Acacia Ridge Park	10.2					✓	Perimeter Trail, Skills Development Features
NP354	Birchwood Park	4.2					✓	Perimeter Trail, Skills Development Features
NP355	SW Commuter	3.8	✓	Henry Thoreau School	✓	✓		Singletrack Trails, Skills Development Features, Pumptrack, Bicycle Playground
NP356	Kingston Onyx Park	2.9					✓	Perimeter Trail, Skills Development Features, Bicycle Playground, Pumptrack

APPENDIX A: PUBLIC ENGAGEMENT PROCESS AND OUTCOME

See Attached

APPENDIX B: GENERAL TRAIL PLANNING AND DESIGN GUIDELINES

The following are guidelines for the construction and maintenance of trails. The natural environment is dynamic and unpredictable. The nature of recreational trails and roads, the desired user experience, and the constant forces acting on natural surface trails and roads make strict standards untenable and undesirable. As such, the guidelines below are simply that: best management practices that should be followed within environmental constraints.

Trail System Design

Mountain Bike-Optimized Trails and Preferred Direction Trails

Mountain bike-optimized singletrack trails are designed and constructed to enhance trail experiences specifically for mountain bikers. Mountain bike-optimized trails might differ from traditional trails in several ways: enhanced tread shaping, directional or one-way travel, and the addition of man-made technical trail features (TTFs). Bicycles move differently along a trail than other modes of transportation. The movement of the wheel, the use of gravity and friction, the transfer of energy from the rider to the wheel

– these offer both opportunities and constraints for trails and trail features that may differ from those of other users.

Mountain bike-optimized and one-way trails that harness gravity are a growing area of interest for mountain bikers. These trails can be designed and built at any level, from beginner friendly flow trails to extremely difficult race-oriented downhill trails. Riders cherish the feeling of flight that a bicycle provides while coasting through a succession of bike-optimized features from top to bottom. A consistent trail is not necessarily a boring or easy trail (though it can be), it's one that is designed such that a preceding section of trail prepares users for the subsequent sections. This is a hallmark of flow trails and can be particularly important for beginner trails, as well as for higher speed trails with gravity features, such as jumps and drops.

As trail systems grow and become congested, one-way trails help to take the pressure off popular shared-use trails. Riders looking for speed, thrill, and challenge will have their own designated areas, and users travelling at slower speeds will have their own trails. Well-designed mountain bike- optimized singletrack and gravity singletrack are exciting for mountain bikers but are also designed to help manage risk and minimize user conflict.

Rolling Contour Design

Providing consistent climbs and extended descents is a design priority. Trails may contour gently up or down for consistent lengths to maximize climbs and descents. This is known as rolling contour design. All shared- use trails should be of rolling contour design to minimize impact and sedimentation in the watershed.

Stacked Loops

A stacked-loop system is a series of loops somewhat like links in a chain. The loops can vary in length and difficulty. In a stacked-loop system, the loops that are closest to the trailheads are more inviting to novice riders, and the loops further out cater to more advanced riders. This creates a progression of experiences and challenges as users explore the trails in more depth.

Progressive Hubs and Clusters

A trail system of hubs and clusters looks more like spokes radiating out from a central junction and intersecting at various points. A trailhead or major intersection is a hub. A cluster is a concentration of trails radiating out from the hub. Like a stacked loop system, hubs and clusters are designed with skill level progression in mind. Hubs and clusters give users more trail options for varying skill levels at each hub, allowing for skill level diversity. At many intersections, riders have the option to change trail difficulty or continue on the same difficulty level.

With progressive trail features, a mountain biker may become a better rider by gradually moving up in trail difficulty. This practice also spreads out visitors and helps reduce trail user conflict. This is also a proven risk management tool. Signage shows difficulty levels at every hub and wherever necessary in the trail system to help users choose trails based on their skill levels and desired experience. Giving riders the option to warm up before hitting more technical segments provides a level of safety in the system.

Loops and clusters are often favored over out-and-back routes because they offer variety. People love the adventure of starting down one path and returning to the same point by way of a different trail. With loops or clusters in a trail system, visitors can choose a short route, a combination of routes, or a long outer route.

Progressive design and construction also allow users of different levels to ride the trails in the same system, so families and groups can enjoy being together in one place and riders can find a trail that matches their skills and progress.

Trail Difficulty Rating System

In order for a trail system to provide the varied riding experiences and skill progression which trail users seek, the trails must be built to provide relatively specific challenges and riding characteristics. For the purposes of this conceptual trail plan, the difficulty rating system has been simplified into three levels:

- Easiest Trails, Green Lines (green circle) – For beginners, these trails have a smoother and wider tread, lower trail grades, and less exposure to fall risks.
- More Difficult, Blue Lines (blue square) – For intermediate riders, these trails can be steeper, more technically difficult, or longer.
- Very to Extremely Difficult Trails, Red Lines (black diamond or double black diamond) – For advanced riders, these trails offer a combination of difficult trail tread, technical features, and long distances for those looking for challenge and endurance-oriented experiences. Generally, they have significant exposure and have less predictable surfaces.

This system was adapted from the International Trail Marking System used at ski areas throughout the world. Many trail networks use this type of system, most notably resort-based mountain biking trail networks. The system applies well to mountain bikers and is also applicable to other visitors such as hikers and equestrians. These ratings should be posted on trail signage and in all maps and descriptions. Following is a summary of criteria to be considered when implementing a trail rating system.

Tread Width

The average width of the active tread or beaten path of the trail.

Tread Surface

The material and stability of the tread surface is a determining factor in the difficulty of travel on the trail. Some descriptive terms include hardened (paved or surfaced), firm, stable, variable, widely variable, loose, and unpredictable.

Trail Grade (maximum and average)

Maximum grade is defined as the steepest section of trail that is more than approximately 10 feet in length and is measured in percent with a clinometer.

IMBA Trail Difficulty Rating System

	EASY GREEN CIRCLE	MORE DIFFICULT BLUE SQUARE	VERY DIFFICULT BLACK DIAMOND	EXTREMELY DIFFICULT DBL. BLACK DIAMOND
TRAIL WIDTH	36" (900 mm) or more	24" (600 mm) or more	12" (300 mm) or more	6" (150 mm) or more
TREAD SURFACE	Firm and stable	Mostly stable with some variability	Widely variable	Widely variable and unpredictable
AVERAGE TRAIL GRADE	Typically 5% or less	Typically 8% or less	Typically 12% or less	Typically 15% or less
MAXIMUM TRAIL GRADE	Max 15%	Max 15% or greater	Max 15% or greater	Max 15% or greater
NATURAL OBSTACLES AND TECHNICAL TRAIL FEATURES (TTF)	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

Average grade is the steepness of the trail over its entire length. Average grade can be calculated by taking the total elevation gain of the trail, divided by the total distance, multiplied by 100 to equal a percent grade.

Natural Obstacles and Technical Trail Features

Objects that add challenge by impeding travel. Examples of natural obstacles include rocks, roots, logs, holes, ledges, drop-offs. The height of each obstacle is measured from the tread surface to the top of the obstacle. If the obstacle is uneven in height, measure to the point over which it is most easily ridden. Technical trail features are objects that have been introduced to the trail to add technical challenges. Examples include rocks, logs, elevated bridges, teeter-totters, jumps, drop-offs. Both the height and the width of the technical trail feature are measured.

Trailheads

Well-placed trailheads and parking lots contribute to a successful trail system. Trailheads should be located in areas of lower elevation, as most trail users prefer outbound climbs with inbound descents back to the parking area. This also helps mitigate risk by allowing fatigued riders an easier route back to their starting point. This is especially true for mountain bikers, and necessary for families and beginners. Trailheads should offer information useful for the trail users, including trail maps, location information, emergency contact details, and volunteer information.

Sustainable Trails

A sustainable trail balances many elements and is designed to have little impact on the environment. Sustainable trails resist erosion through proper design, construction, and maintenance and blend with the surrounding area. A sustainable trail also appeals to and serves a variety of users over many years. It is designed to provide enjoyable and challenging experiences for visitors by managing their expectations effectively. Following sustainable trail design and construction guidelines allows for high-quality trail and education experiences for users while protecting the land's sensitive resources. For additional trail design, construction, and maintenance techniques, refer to Trail Solutions: IMBA's Guide to Building Sweet Singletrack.

Do not exceed the Half Rule

A trail's grade shouldn't exceed half the grade of the hillside or slope that the trail traverses. If the grade does exceed half the slope, it is considered a fall-line trail. Water will flow down a fall-line trail rather than run across it. Measure the slope with a clinometer, then be sure to keep the tread grade below half of that figure in order to ensure good drainage. For example, if you're building across a hillside with a slope of 20 percent, the trail-tread grade should not exceed 10 percent. There is an upper limit to this half rule: You must also apply knowledge about maximum sustainable grades. Very steep trails will erode even if their grade meets the half rule. For example, a trail with a grade of 24 percent that traverses a steep, 50-percent slope will be unsustainable even though it complies with the half rule.

Follow the Ten Percent Average Guideline

Generally, an average trail grade of 10 percent or less is most sustainable, average trail grade is the slope of the trail from one end to the other. Many trails will have short sections steeper than 10 percent, and some unique situations will allow average trail grades of more than 10 percent. A trail's average grade is calculated by dividing total elevation gain by total length, multiplied by 100 to convert to percent.

Do not exceed the Maximum Sustainable Grade

Maximum sustainable trail grade is typically about 15 percent; it is site-specific and fluctuates slightly based on several factors. The variables to be considered when setting your target maximum trail grade include:

- Half Rule
- Soil Type
- Rock
- Annual Rainfall Amount
- Grade Reversals
- Type of Users
- Number of Users
- Difficulty Level

Construct Grade Reversals

A grade reversal is just what it sounds like—a spot at which a climbing trail levels out and then changes direction, dropping subtly for 3 to 15 linear meters before rising again. This change in grade forces water to exit the trail at the low point of the grade reversal, before it can gain more volume, momentum, and erosive power. Grade reversals are known by several different terms, including grade dip, grade brake, drainage dip, and rolling dip.

Avoid The Fall Line

Fall-line trails usually follow the shortest route down a hill, the same path that water follows. The problem with fall-line trails is that they focus water down their length. The accelerating water strips the trail of soil, exposing roots, creating gullies, and scarring the environment.

Avoid Flat Areas

Flat terrain lures many trail builders with the initial ease of trail construction. However, if a trail is not located on a slope, it will become a muddy wet basin full of water. The trail tread must always be slightly higher than the ground on at least one side of it so that water can drain off properly.

Lift and Tilt

When flat terrain cannot be avoided, the "Lift and Tilt" technique may be necessary. When trails are placed through flat, slow-draining landscapes, the "Lift and Tilt" construction technique facilitates drainage that creates a long-lasting tread. This technique adds a "lift" of fill material to the trail tread, essentially lifting the tread in comparison to the adjacent surfaces by shaping the trail with rises and dips to facilitate drainage. These rises and dips are referred to as grade reversals. With the elevated and shaped tread, water drains off the tread surface rather than following down the trail. In the dip, the low point of the grade reversal, the trail is slightly outsloped and "tilted" to direct water off the trail. Grade reversals create mini-watersheds where water on the trail quickly flows to the lowest parts of the grade reversals and sheds off the trail tread.

In the absence of "Lift and Tilt" along flat terrain, water settles on the tread and remains for extended periods of time in clay and silty soils. During heavy rains, water is captured on the tread and flows down the trail. As water increases in volume and speed, erosive forces remove material from the tread, resulting in a cupped trail surface. This causes the trail tread to be lower than the surrounding landscape in which water follows the path of least resistance, settles into the tread, and continues to flow down the trail. This creates a continuous loop of eroding and cupped trails which hold, channel, and retain water.

Trail "Flow"

With good flow, the speed at which a rider travels on the trail should be fairly consistent, and the rider will not have to brake and accelerate frequently. Transitions between faster and slower speeds need to be gradual, with progressively increasing and decreasing turn radii and frequent uphill segments to reduce speed where needed. Steep downhill grades should not come right before tight turns. Adjusting the cross slope of the trail tread to match the flow also helps riders stay on the trail and allows higher speeds. Designing trails with flow in mind not only provides a high quality trail experience, it helps mitigate erosion issues from runoff and use.

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 providing information about the area. Signage also plays a critical role in managing risk and deploying emergency services.

Recommended signage for the trails should be simple, uncluttered, and obvious with 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. Because signs can intrude on the natural outdoor experience, too much signage can be unsightly. 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 location, 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 interpretive, 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 major intersections, informational signs provide details such as trail length and difficulty. These include signs that identify a trailhead from a road, signs at a trailhead kiosk, trail intersection signs, waymarks, difficulty rating signs, and trail length or elevation gain and loss signs.

Regulatory signs

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

Directional signs

Directional signs provide navigational information.

Warning signs

Often incorporating highly visible designs, these signs warn trail users of upcoming hazards or risks. These include visitor rules and regulations, allowed activities, road and trail intersections, and emergency signs.

Educational signs

Educational signs can provide a variety of information for trail users, such as guidelines for responsible recreation, descriptions of natural or cultural resources, trail etiquette, and bike skills.

APPENDIX C: BENEFITS OF MOUNTAIN BIKING TRAILS

Promoting Active and Healthy Lifestyles

The benefits of mountain biking may start on the trails, but they don't end there. Learning to ride a bike is a rite of passage. Bikes and the sport of mountain biking provide a multitude of opportunities to teach children valuable lessons that will carry into adulthood.

Obesity is at a high, while activity levels among Americans are plummeting. With its progressive nature and way of stimulating the senses, mountain biking is appealing, especially to youth, and provides an excellent form of recreation for reversing the trend toward poor health. Since riding a bike provides excellent cardio conditioning, improves strength and coordination, and burns several hundred calories an hour, it is an activity as appealing to parents as it is to kids.

The unstructured play that mountain biking provides inspires people to explore and appreciate the natural world, leading to positive associations with outdoor activities and exercise.

Mountain biking allows individuals to advance at their own pace, so kids looking for a challenge can have just as much fun as children who are more interested in exploring the scenery. Riding in nature provides an environment where children can work on their skills, have fun, and pedal their bikes without parents having to worry. Mountain biking is a cross- generational endeavor, accessible to all ages and levels of physical fitness. Going for a trail ride is an excellent way for parents to do more than support their children's activities, it's a way to share the experience. Every ride is an opportunity to create a healthy lifestyle and pass on lessons that are best learned through experience.

Several studies on physical activity have indicated that proximity to recreational facilities, such as trails, is a predictor for physical activity.

Simply put, if there are walking and biking trails nearby, then residents are more likely to use them and therefore be healthier. Physical health and exposure to nature also benefit mental health, reducing stress and increasing happiness. In addition, individual and community health translate to economic benefits by decreasing health care costs.

Contributing to Economic Growth

A well-designed trail system can stimulate economic growth by increasing activity within the local population as well as attracting visitors from outside. Trails can generate business in retail sales and services, support jobs, provide sustainable growth in rural communities, and produce tax revenue. Access to trails also correlates to a higher quality of life, thus making the community more desirable and capable of attracting new businesses and workers to an area.

IMBA assists local communities in increasing mountain bicycling tourism as a sustainable, renewable source of economic development. A mountain biking destination is one that attracts tourists to an area for the benefits of the mountain biking experience; provides visitors with all of the amenities needed to compliment, ease, and enhance their visit; and in turn creates word of mouth about the community that will draw new and repeat visits.

According to the Outdoor Industry Alliance, mountain bicyclists represent approximately 3.4% of the U.S. population, or nearly 10.6 million participants. IMBA's own research indicates that enthusiasts, who represent a portion of this overall number, travel extensively within a four- hour range and will typically devote one week per year specifically to travel to reach mountain bicycling destinations. Same-day visitors spend approximately $35 per day in local communities while destination visitors spend closer to $193 per day (due in part to lodging and increased meal purchases).

While mountain bicyclists are certainly willing to travel to ride, they will only do so if their destination contains a key ingredient: high-quality trails. These trails must be of a sufficient length and contain a variety of experiences, such as traditional singletrack, bike-optimized singletrack, bike parks, and shuttle options. The competition for these destination-quality locations is slowly increasing over time

A case study in Cable, Wisconsin, clearly illustrates how a community can benefit from offering a world-class bicycling experience. Construction of new bicycle trails in Cable resulted in:

- Increased property values.
- Increased spending on bicycle related goods.
- 35 jobs created annually, adding $523,000 to total employee compensation.
- Nearly $1.3 million impact related to spending from mountain bicyclists.

Fostering Community Pride and Identity

Involving community members in the planning, building, and maintaining of trails fosters community pride. In order to maintain sustainable trails, care of the trail system should be managed by local enthusiasts and rely on an organized membership base. Volunteering to help with trails provides an opportunity for area residents to connect with each other and with the terrain and land that

surround them. IMBA members donate nearly one million volunteer hours to trails throughout North America every year, making volunteerism a large part of mountain bike culture.

Trails and parks also provide informal opportunities for people to meet and interact with others in a natural setting. Connection to nature is paramount to maintaining the health of the environment and making the outdoors relevant and accessible to all. Trails serve a diverse population and cultivate unity and stewardship in the community. Trails can even revitalize blighted areas, for example, turning landfills into bike parks or gravel pits into trailheads.

Preserving Open Space

Trails make communities better places to live by preserving and creating open spaces for recreation. Greenways function as hands-on environmental classrooms for people of all ages, providing opportunities to enjoy nature close up. With its abundant plant life, open spaces can decrease pollution, protect water quality, and reduce soil erosion. Economic growth and property values are also tied to open space as buyers are generally willing to pay more for property located close to parks and open space. The recreation, health, economic, and environmental benefits of trails can contribute to an overall enhanced quality of life in nearby communities.

Encouraging Positive Recreation Use to Displace Negative Use

Without a plan, undeveloped areas are often haphazardly transformed by users creating unauthorized sites to suit their personal wants. Purposefully designing trail systems can help create diverse recreational opportunities, encourage safe use, and meet the needs of the entire community. Unauthorized trail building and dumping or other unacceptable activities can damage ecology, cause safety hazards, and leave behind debris that is both unsightly and illegal. The best way to encourage positive use is to displace negative use. A well-planned trail system can discourage and displace destructive activities with healthy recreational use that attracts visitors of all ages.