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About IMBA Trail Solutions



IMBA Trail Solutions 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 preserve great mountain biking experiences. 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 division. 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, AutoCAD, 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 we have 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.

Approach

Through collaborative planning and a late summer 2019 site visit, IMBA Trail Solutions has crafted this master plan to define the opportunities and constraints in developing trails around Blue Marsh Lake (BML) on the existing Army Corps of Engineers (ACOE) property. To gain a comprehensive understanding of the area and the potential of the trail system, Trail Solutions assesses terrain, slopes, existing infrastructure, and ecology. Every detail is examined, from soil types, which can affect trail tread compaction and erosion potential, to anticipated user numbers and trailhead needs. Familiar with trail systems within the region and throughout the world, Trail Specialists gage which established practices can be used and which of the latest innovations can be applied during trail development and improvements. Trail Specialists ride similar trails in the region and understand the area's outdoor culture. They interview local stakeholders to learn from their expertise, balancing the interests of community members and land managers in designing the system.

1. Project Background

This trails master plan provides guidance and recommendations for development of natural surface multiuse trails and mountain bike trails, as well as bike specific facilities, within the ACOE property surrounding BML. This improved trail system will capitalize on the growing regional need for modern, purpose-built trails, specifically those that are optimized for mountain biking. It will serve the needs of the community by providing opportunities for a wide range of users to improve their physical health and experience the outdoors, as well as promote economic development through adventure tourism. This plan will also provide the groundwork for continue community efforts for IMBA Ride Center designation. This plan provides a framework to refurbish, repair, and reroute the existing trails to create a modern trail system that appeals to a wide range of visitors.

About Berks County

Berks County is a county in Pennsylvania with a population of 411,442. Located northwest of Philadelphia, the county boasts a large urban and suburban population while still retaining much of the agriculture of the Pennsylvania Dutch landscape. Berks County’s seat is Reading, the fifth largest city in Pennsylvania, with nearly a fifth of Berks County’s population. Reading is situated close to many large urban populations, including Philadelphia, PA (population 1.6 million, 1 hour southeast); New York, NY (population 8.6 million, 2.5 hours east); and Baltimore, MD (population 620,000, 2 hours south). Berks County has many parks and preserves with mountain biking trails. Mt. Penn, Neversink Mountain, French Creek State Park, and Coventry Woods are all popular regional trail systems. The majority of the existing trails for mountain biking in Berks County are traditional singletrack, often very rugged and primitive. Berks County has plentiful other recreational offerings, including rail trails such as Union Canal Towpath and Schuylkill River Trail.



About Blue Marsh Lake

Constructed from 1974 to 1979, Blue Marsh Lake is operated by the ACOE Philadelphia District and serves multiple purposes. BML is an impounded reservoir along the Tulpehocken Creek, about 4 miles north of Reading. The ACOE website reads, “While the main purpose of Blue Marsh was to provide flood control to part of the Schuylkill River Valley, over the years the lake has become a recreational hotspot.” The ACOE property includes 6,200 acres of land and 1,148 acres of water. BML’s recreational offerings include hunting, fishing, boating, and other lake-based activities. Recreational sites include picnic areas, a small beach, and boat launches. During the summer months, the water level is typically maintained at 290 feet above sea level, however over a year, the water



level can vary by 5 to 10 feet. ACOE notes, “Over the years, the park staff has increased outreach efforts and organizes volunteers for events that happen all year round. Three of the larger programs include Take Pride in Blue Marsh (April), Get Outdoors Day (June), and National Public Lands Day (September).”

BML is surrounded by an existing trail system, essentially one trail but in areas there are shortcuts or side loops. The Blue Marsh Trail (BMT) is used by hikers, runners, mountain bikers, and equestrians. The BMT circles the entire lake for the most part, in a nearly 32-mile loop. Additional trails bring the entire BMT system total to 36 miles. Much of the BMT utilizes old forest roads or current farm roads. BML has leased land to the Pennsylvania State Game Commission and area farmers who have established long-term agricultural fields. Many of these leases are expiring; however, it is anticipated many of the fields will be maintained to provide habitat diversity.

About Berks Area Mountain Biking Association

The organization responsible for driving this project is the Berks Area Mountain Biking Association (BAMBA). BAMBA was formed in 2012 as a chapter of IMBA. Recently, BAMBA established their own 501(c)(3) nonprofit organization. BAMBA has signed a memorandum of understanding (MOU) with the ACOE. The MOU lays the foundation for the partnership to develop a modern, high-quality trail system. BAMBA has identified problems with the present trail system and their vision for an updated system in an executive summary dated June 10, 2019. Both are included below:

PROBLEM STATEMENT:

An outdated trail design, erosion on the steep climbs, increased wet muddy segments, and lack of moderate loops has made this trail system less desirable among hikers and bikers. The 30-mile loop trail that encircles the lake is a major commitment in both time and endurance for even the most fit users. Recreational preferences have evolved with the increased popularity of mountain biking and hiking. Trail systems need to accommodate all skill levels and today’s leisure time limitations. The Blue Marsh Lake Trail is in need of accommodating these changing requirements, in order to continue to serve and attract these user groups.

VISION STATEMENT:

Update and enhance the Blue Marsh Lake Trail system using state of the art trail building techniques incorporating multiple moderate loops that originate at the existing access areas. Create an attractive, user friendly outdoor recreation and fitness circuit, for all skill levels, families, and adaptive riders, that encourages regular outdoor recreation and fitness.

2. Goals and Objectives

The goal of the following plan is to develop a progressive network of trails that offers beginner- to advanced-level mountain biking as well as foot traffic opportunities. The system will include traditional, bike-optimized, and gravity trails. Trails are planned for a variety of visitors. As trails are developed and mileage increases, visitation from residents, visitors, and regional trail users will increase. The majority of new trails will be bike-optimized with careful consideration for hikers and runners to be sure their needs will also be met. Design and construction will ensure quality multiuse trails.

This trails master plan is crafted to ensure trails and features will be designed and built in a sustainable manner and meet recreation, conservation, and education objectives. The trail system will create a progression of experiences and challenges as trail users explore the system in more depth with each visit. Individual segments will provide consistent and expected experiences. The design of the system will be similar to that of a well-planned ski trail system, with a collection of easier/green, more-difficult/blue, and most-difficult/black trails, appealing to a broad cross section of off-road bicyclists, from family-oriented entry-level riders to highly skilled enthusiasts. Providing progressive riding opportunities will help showcase modern trail design and construction, provide a wider variety of trail types within the region, and allow for responsible recreational use with minimal natural and historical resource impacts. The network should be enhanced by efficient way-finding signage and a variety of recreational amenities.

The objectives of the high-quality trails master plan are:

- Refurbish, repair, and reroute existing trails as needed to create a modern trail system that appeals to many visitors.
- Increase the availability of mountain bike-optimized trails in the region.
- Ensure a wide variety of difficulty levels are represented.
- Lay the groundwork for a successful trail system that appeals to a wide spectrum of visitors.
- Develop amenities that help riders build mountain biking skills and provide opportunities for progressive challenge and growth.
- Offer a network of trails that supports National Interscholastic Cycling Association (NICA) training and racing.
- Provide the quality and quantity of experiences in the system to create a regionally significant trail destination that merits a half- to full-day drive to the area.
- Create a trail system that is environmentally and socially sustainable, and that best highlights the natural beauty of the Pennsylvania landscape.
- Identify phases of implementation to offset financial burden, ensure high-quality trails are developed over time, increase the appeal of the trail system by providing new additions over time, and encourage repeat visits by the community and visitors.
- Provide detailed guidance for development of Phase 1 and general recommendations for future phases.

3. Existing Conditions

The state of Pennsylvania has a well-storied history of mountain biking and a rich trail culture. Reading in particular has over two decades of mountain bike culture and trail development. However, much of the local emphasis has been on legitimizing unplanned or social trails and creating partnerships.

Trail development is a natural pillar of improving and expanding recreation. The Berks area currently has no purpose-built mountain bike trails. Mountain biking across the state is similar to riding in the Berks area: raw, rugged, and primitive. Historically, the majority of mountain biking has been on “rake and ride” trails. At BML, the community now has the opportunity to create modern, high-quality mountain bike trails that will attract locals and visitors. The terrain surrounding BML has adequate elevation and varying slopes, like much of southeast PA.

The existing recreational opportunities at Blue Marsh Lake are focused around day-use and water-based activities such as fishing and boating. The new trails will add considerable access to the woodlands surrounding the lake for activities such as mountain biking, trail running, hiking, walking, and exploration. The trails are also anticipated to promote park use during shoulder seasons (spring and fall) when attendance rates drop.

Most of the zones are similar to one another and typical of the forested region. Generally, slopes are very mellow, 10-30%, with localized steeper slopes up to 60% and rarely, up to 80%. Rock content is minimal, which is atypical for the region. Extensive agriculture field production has reduced the forest, which in turn has affected the local hydrology. Loss of canopy increases precipitation on the ground, causing more intense raindrop energy and greater runoff quantities. In addition, the lack of native trees results in flashier (quickly occurring) runoff events, and less time between rainfall and peak flows. Less tree cover also results in a higher groundwater table, and therefore more occurrence of wet areas and seeps. The soils are sandy loams, with gravel, cobble, and boulders mixed throughout. This means most trails will drain well but creating large earthen features will be more difficult due to low cohesive strength.

Soils

A Natural Resources Conservation Service (NRCS) web soil survey of the project site was collected and reviewed. The majority of the project site is composed of Berks-Weikert complex. Calvin-Klinesville channery silt loams and Duffield silt loams are also present in appreciable amounts on site. These soils are all similar. Generally, these soil complexes consist of shallow, well-drained material formed from shale, siltstone, and sandstone.



The soils are ideal for natural surface trails due to their hydraulic conductivity, or ability to drain moderately quickly. Restrictive layers (soil layers that slow water flow), typically shale type bedrock, can be found anywhere from 18 inches to 3 feet below ground surface in many areas. These layers, in general, do not adversely affect future trail drainage. Saturated soils are found near surface water most often, though agricultural field development has altered groundwater hydrology.

Silt loams tend to occur in low elevation areas, generally in the riparian zones of tributaries and BML. Channery material is typical of shale, siltstone, and sandstone derived soils. Channery describes thin, flat rock fragments in soil. In trail building, channery loams have been found to hold shape while draining fairly well, resulting in durable tread and allowing for greater mountain bike optimization.

Hydrology

The BML property is in the hydrologic unit code (HUC) watershed 020402030407 or Middle Tulpehocken Creek and HUC 020402030406 or Spring Creek. The Pennsylvania State Department of Environmental Protection designates BML as a warm water fish lake, and many of the tributaries to Blue Marsh are designated as trout stocking streams. None of the tributaries in the project site is designated as high quality or exceptional value.

All of the tributaries draining to BML appear to be Waters of the United States, and therefore will require Clean Water Act permitting to cross. Generally, streams are currently bridged. As noted above, groundwater hydrology appears altered mainly due to field creation. Discussions with stakeholders indicate many of these fields will remain actively managed for wildlife and habitat diversification. Where topography produces concentrated surface flow during precipitation events downstream of open fields, it is likely that above-normal saturation of soils will occur, even on forested sideslopes.



The trail plan accounts for the anticipated above-normal seepage issues where possible, but thoughtful trail design and quality trail construction will be required to ensure the trail meets its goals for a considerable timeframe. Trail planners also made efforts to minimize stream crossings and utilize existing crossings where possible.

Flora, Fauna, and Habitat

Preliminary research of critical habitat data provided by the United States Fish and Wildlife Service shows no documented critical habitat on the project site. Possible federally listed threatened or endangered species on the project site include the Indiana bat (*Myotis soldalis*), Northern long-eared bat (*Myotis septentrionalis*), and bog turtle (*Clemmys muhlenbergii*). A review of the Berks County Natural Heritage Inventory, dated 2014, shows no documented regulated species at the project site.

The project site is generally temperate eastern forest, the exception being numerous manmade fields. Tree variety is largely eastern hardwoods such as oaks, hickories, beeches, and maples. Native grapevine is abundant in areas, as well as select coniferous tree species. Invasive species include honeysuckle and multiflora rose, especially in areas near cultivated or previously cultivated fields and in the associated wetter areas. In general, the forest exhibits many characteristics of woods near urban areas. Thick undergrowth is prevalent, especially in the southern end of the parcel. The larger wooded tracts tend to have more appealing aesthetics. Steeper slopes, especially above BML, are especially open and inviting with less vegetation.





Blue Marsh Trail

The existing BMT is a well-used natural surface trail system. The majority of the trail was designed and constructed four decades ago, and ACOE staff have been maintaining it as is since. The main loop is nearly 29.5 miles, additional multiuse loops add nearly 3 miles, and four hiking designated trails total just over 3 miles. Horse bypasses are present, typically at bridge crossings. Surprisingly, the system only has four well-used social trails, totaling about 0.75 miles.

A brief analysis of the trail system was completed using geographic information system (GIS) software and general industry best practices. A full assessment of the existing trails was not within the scope of this project and was not completed. Trail Solutions made every effort to field verify desktop analysis and provide trail development guidance across the entire project site.

The existing main loop of the BMT system was found to deviate from ACOE property for 4% of its length. This trail segment runs off-property for just over 1 mile on PA State Game Lands. Currently, the PA State Game Commission is not receptive to trail alignment adjustments, and site constraints do not allow for locating the trail entirely on ACOE property. If possible, in the future trail reroutes to provide a more sustainable alignment and better experience are recommended.

Over 15% of the main multiuse loop follows steep, fall-line alignments. Fall-line is the path of least resistance for surface water flow, following the perpendicular path to contours. In many additional locations, the existing trails follow steep alignments that break sustainable trail guidelines, such as the “half rule,” which states that to mitigate erosion, trail alignment grades should be less than half the sideslope. Many of these steep, fall-line sections are exhibiting current erosion and maintenance issues, and others are highly likely to degrade in the near future.

Low, flat areas are typically near BML, in areas just above pool level that may seasonally flood or become saturated. These areas are often on flat to mellow slopes, with little sideslope where benchcut trails can be created. Drainage may be mitigated through fill in some places. ACOE appears to use gravel in many areas of BMT maintenance. These areas make up about 5.5% of the total main loop. Together with steep, fall-line sections; over 20% of the existing BMT main loop requires mitigation.

Existing BMT System		
Name	Length (ft)	Length (mi)
Main Hiking Trail	155695.59	29.49
Skidders Loop	12219.32	2.31
Stilling Basin to Water Rd Trail	3525.66	0.67
Horse Bypass	3977.95	0.75
Horse Bypass	595.11	0.11
Horse Bypass	2103.69	0.40
Foxtrot Hiking Loop	7756.58	1.47
Squirrel Run Nature Trail	2977.77	0.56
Great Oak Nature Trail	3664.55	0.69
Eyes Of The Eagle Sensory Trail	1900.17	0.36
Existing Social Trail	1084.17	0.21
Existing Social Trail	1198.75	0.23
Existing Social Trail	937.53	0.18
Existing Social Trail	800.74	0.15
Total Multi-Use Trail		
	171440.57	32.47
Total Hiking Only Trail		
	16299.06	3.09
Total Horse Bypass		
	6676.75	1.26
Total Social Trail		
	4021.20	0.76
Total BMT System		
	198437.57	37.58

Existing BMT Main Loop Analysis			
	Length (ft)	Length (mi)	Percentage (%)
Off Property Trail	6328.96	1.20	4.06%
Steep, Fall-Line Trail	23910.87	4.53	15.36%
Low, Flat Trail	8477.37	1.61	5.44%
Total BMT Main Loop			
	155695.59	29.49	100.00%

On-site review focused on evaluating computer aided assessments, and more importantly, assessing visitor experience and potential for new trail development. The following zone breakdown details existing conditions and opportunities for select zones of trail development. The zones, or areas, were determined through desktop and field observations. Zones identify potential trail development phases, with trails related through geographic location or similar experience goals. The zones do not identify all possible trail alignments, instead they focus on the most feasible trails.

The entire BMT trail system can be improved to facilitate a more positive visitor experience and protect natural resources, while lowering the maintenance burden on ACOE staff and volunteer partners. Areas not discussed in this report could benefit from further trail planning efforts, including a complete field assessment of existing trail conditions.

Note: IMBA Trail Solutions did not evaluate, by desktop or field analysis, the existing BMT or adjacent ACOE lands from mile marker 29 to mile marker 0 (from the ACOE Project Office to the Lower Stilling Basin Lot). Planning, design, and construction has been provided by others and is complete.



Zone 1: State Hill

Existing Conditions

- Mile Marker (MM) 1.5-4.0
- Boat launch, popular trailhead
- 400 acres
- 225 feet of useable elevation

Opportunities

- Disperse visitors through stacked loops
- Beginner friendly trails
- Gravity experiences
- Shuttle runs

Constraints

- Wet and flat areas
- Squirrel Run Nature Trail
- Neighboring private property
- Open fields

Zone 1: State Hill

This area is located in the southern portion of the property. Zone 1 extends east and west along the BMT to make use of the large wooded slopes nearby. This area has some of the largest contiguous forest on site. Sideslopes are generally 10-40%, with flatter ridgetops, and some drainages have closer to 60% slopes. The vegetation tends to be very thick, often close to roads, homes, and old agricultural fields.

This zone contains considerable elevation for BML, with the added bonus of a paved road from low to high points. The driveway for public access has an impressive view of BML. The viewing area is one of the highest points in the zone and on the property.

Zone 1 features a popular boat launch with ample parking facilities. The State Hill boat launch is just 4 miles from Reading. Near the boat launch is a picnic area with tables and trailhead parking. A restroom is also available, making Zone 1 one of the most complete and accessible trailheads at BML.

The BMT towards Zone 2 and the emergency spillway is characterized by steep, old road grades and low-lying wet areas. Heading west, the BMT begins a pattern of steep climbs and descents with some flatter areas, traversing and skirting many agricultural fields.



There is one existing bridge, just after the Squirrel Run Nature Trail.

During field review, Zone 1 was frequented by foot traffic, namely dog walkers and hikers. The proximity to population and ease of access to both Zones 1 and 2 make them the hot zone for trail visitors.

Zone 2: Stilling Basin

Zone 2, or Stilling Basin, extends from below the BML dam west to Zone 1. This section of the BMT has a few steep climbs and frequent flat sections. The section from the Stilling Basin parking lot to the crest of the dam is especially steep, and current maintenance may not be enough to prevent erosion impacts. Ample wooded sideslopes are available, mostly around the emergency spillway.

A popular social trail leads from the BML dam to the Water Road fisherman’s lot on the Tulpehocken Creek. This 0.6-mile segment of singletrack is some of the local riding community’s favorite, and some of the most fun seen during the site visit. The hillsides above this trail have slopes from 10-40%, making ideal locations for trails. There are some maintained fields in this zone, which create constraints to trail planning and are typically a root cause of thick undergrowth in the nearby forest.

Like Zone 1, Zone 2 is very popular with visitors. The actual Lower Stilling Basin parking lot is very popular with fisherman. The area to the east of Zone 2 was not analyzed by IMBA Trail Solutions.



Zone 2: Stilling Basin

Existing Conditions

- MM 0-1.5
- Popular trailhead, fishing access
- 150 acres
- 175 feet of useable elevation

Opportunities

- Reduce maintenance cost and improve visitor experience on steep sections
- Beginner friendly trails
- Disperse visitors through stacked loops

Constraints

- Wet and flat areas
- Dam, emergency spillway, and dry dam
- Neighboring private property
- Open fields

Zone 3: North Church

Existing Conditions

- MM 14.25-15.25, MM 16.25-18.0
- Less visited zone, mainly equestrian and mountain bike use
- Very steep sideslopes, some exposed bedrock
- 125 acres
- 275 feet of useable elevation

Opportunities

- Steep slopes allow for exposed, narrow singletrack experience
- Intermediate and advanced mountain bike-optimized singletrack
- Create more loop experiences in this remote setting

Constraints

- Wet drainages
- Open fields

Zone 3: North Church

The North Church Zone is at the far northern end of the property. This zone comprises all the land to the north of Old Church Road and on the western side of BML. The eastern side of BML is often flat, with copious fields and narrow corridors with the State Route 183 boundary; providing little feasible opportunity for trail improvement or development.

The popular access point for this section of the BMT is the Old Church parking lot. This trailhead has a portable toilet, ample picnic areas, and passive boat launches. It is a quiet area and tends to see fewer visitors than Zones 1 and 2. Anecdotally, there is more equestrian use in this zone, which appears plausible due to fewer visitor interactions.

This zone could support numerous parallel singletrack corridors on steep sideslopes. Often the BMT is on the top, flat area of a ridge or following the fall line down to drainages. Realigning these segments would create more sustainable and enjoyable trails. Appealing forested sections of Zone 3 offer scenic views of BML and interesting exposure along precipitous slopes. The North Church Zone has some of the most concentrated areas of slopes over 60% on the entire project site.

Near the northern end of this zone, the BMT co-locates with an existing road, and passes through some of the only exposed rock on the whole site. This area has potential for interesting trail features. The BMT often skirts agricultural fields, as typical of the property, there is little forest where new trails can be created. Two major drainages exist and pose some challenges for trail development. There are some connections through these difficult areas which are vital for trail experience.



Zone 4: Seven Mile Hill

This large zone is only smaller than Zone 1 and is centered on the famous Seven Mile Hill climb. Improvements planned to the existing BMT nearby will extend the zone. The primary importance of this zone is the large wooded hill it contains. Slopes on the majority of the hill are around 30%, making ideal landscape for gravity trail development.

The large forested sections are vital to providing quality, sustainable singletrack and allow for more diverse trail types than other tighter zones. The forest here is similar to the rest of the woods at the project site, with thicker underbrush in drainages and near field edges.

An abundance of existing farm roads in the area allow for loop rides and runs by visitors, often coming from the State Hill boat launch or Upper Stilling lot, Zones 1 and 2 respectively. Zone 4 is also served by the Justa Road and Highland Road parking lots. These two lots are used less due to amenities and distance from the population, but provide quicker access to this zone. The anecdotal use patterns discussed with riders indicate the need for loop diversification within the BMT, but also point out the popularity of loops formed using this zone. The large wooded slopes will allow for more loop creation, further utilizing the trailhead amenities in Zone 1 and 2 and



possibly creating more use for the Justa Road and Highland Road parking lots.

Where the BMT is hemmed in by fields, few trail additions are planned. Zone 3 mainly includes the large hill and smaller forested slopes. This zone is just north of Zone 1 and south of Zone 6.

Zone 4: Seven Mile Hill

Existing Conditions

- MM 4.5-9.5
- Some of the largest forested tracts at BML
- 325 acres
- 225 feet of useable elevation

Opportunities

- Intermediate and advanced gravity singletrack hub
- More loop experiences for longer and more varied outings

Constraints

- Wet drainages
- Open fields

Zone 5: Day-Use Area

This small zone was identified and researched primarily to create more trail opportunities around the major parking facilities. The Day-Use Area Zone encompasses the available trail development terrain round the Dry Brooks boat launch and day-use area. The zone, the epicenter of use during the summer months, provides the vast majority of parking at BML.

For the most part, this zone is not conducive to trail development. Major restrictions include the property line, developed lawn areas, and existing hiking-only nature trails. The Great Oak Nature Trail and Eyes of the Eagle Sensory Trail both occupy the largest wooded areas near the day-use area. Where available, the landscape is often mellow slopes and typical thickly vegetated forest, which add difficulties for trail design and construction.



Zone 5: Day-Use Area

Existing Conditions

- MM 26.5-28.5
- Largest parking and infrastructure areas
- 100 acres
- 80 feet of useable elevation

Opportunities

- Small singletrack connections
- Beginner friendly trails
- Skills development trails

Constraints

- Great Oak Nature Trail and Eyes of the Eagle Sensory Trail
- Maintained lawn and existing infrastructure
- Property lines

Zone 6: Skinners

Existing Conditions

- MM 10.5-12.75
- Wooded sideslopes and lakeside access
- 225 acres
- 150 feet of useable elevation

Opportunities

- Intermediate mountain bike optimized singletrack
- Create more loop experiences for longer and more varied outings

Constraints

- Wet drainages
- Open fields
- Property lines

Zone 6: Skinners

This small zone covers the existing Skinners Loop that diverges off of the BMT as well as the BMT south towards Zone 4. The Skinners Zone contains ample opportunity to bring visitors closer to the lake. The zone is very linear, essentially encompassing the forested sections along the BMT. With the tight corridor between the BML, agricultural fields, and property lines; there is little developable area. Many of the wooded slopes offer good chances to incorporate singletrack alternatives to the BMT, further diversifying loop opportunities. Most of the slopes are below 40%, but the actual peninsula which Skinners Loop traverses has slopes over 60% on the northern side, presenting more unique chances to provide narrow contour singletrack.

Zone 7: 24-Mile Marker

Zone 7 is centered around the 24-mile marker on the BMT. This short zone consists of two linear miles of the BMT along which wooded slopes allow for trail development. The slopes are all under 40%, allowing for efficient and sustainable trail construction. This zone was identified and evaluated to provide some singletrack alternatives on the eastern side of BML. Much of the eastern side of the property is undevelopable, but Zone 7 presents a few chances for additional trails, which will allow for loops and diverse trail experiences.

Zone 7: 24-Mile Marker

Existing Conditions

- MM 23.5-25.5
- Wooded sideslopes and lakeside access
- 100 acres
- 75 feet of useable elevation

Opportunities

- Intermediate mountain bike-optimized singletrack
- More loop experiences for longer and more varied outings

Constraints

- Wet drainages
- Open fields
- Property lines



4. Permitting

There are a wide variety of regulatory requirements for construction projects, including trail construction. Obtaining construction permits ensures we follow the local, state, and federal laws; and that we are good stewards of the land. People seek trails for all kinds of reasons, but chief amongst the majority of visitors is the desire to enjoy nature. Mass disturbance, erosion, and sedimentation not only impact our environment, water quality, and flora and fauna; they are unsightly and if not mitigated, will create an area which visitors no longer want to visit. This section provides a brief breakdown of anticipated permitting needs for the BML trails project. It is important to note, some permits require the entire project to be evaluated and not simply the phase that will be immediately implemented. Exact permitting needs should be researched and developed during design, this section serves as an overview of potential permitting needs for this project.

Clean Water Act, Sections 401 and 404

Section 404 of the Clean Water Act (CWA) establishes a program to regulate the discharge of dredged or fill material into Waters of the United States, such as streams, rivers, and wetlands. There are currently no planned new crossings of the Waters of the United States.

The filing of an application with the ACOE starts both the 404 permit and the 401 certification processes. CWA Section 401 requires state water quality certifications prior to the issuance of federal permits (404) to ensure that proposed projects will not violate state water quality standards. The decision to issue a Section 401 water quality certification rests with the Pennsylvania Department of Environmental Protection (DEP). There is no planned construction within any Waters of the United States, therefore, a 401 Water Quality Certification is typically issued along with the 404 permit. ADEQ has determined that projects not involving Extraordinary Resource Waters have minimum long-term impact on waters of the state.

The general conditions for issuance of a Section 404 Permit include:

- Water Quality Certification; A 401 water quality certification from DEP must be obtained prior to obtaining a 404 permit and beginning construction.
- Maintenance; Any authorized fill shall be of correct material, properly maintained, including maintenance to ensure public safety.
- Erosion and Sedimentation Controls; Appropriate erosion and sedimentation controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills must be permanently stabilized at the earliest practicable date.

CWA permitting and review are conducted by the local ACOE district. For this project, the Philadelphia ACOE district is responsible for overseeing and granting permits.



Clean Water Act, Section 402

Construction stormwater management is managed through the National Pollutant Discharge Elimination System (NPDES) permit program, authorized by Section 402 of the Clean Water Act. NPDES permits are issued by DEP in agreement with the U.S. Environmental Protection Agency. The purpose of NPDES permits in light of construction is to control the discharge of unmanaged stormwater associated with earth disturbance into streams, rivers, and other waterways. 25 Pa. Code Chapter 102 requires a permit from DEP for construction disturbance over 1 acre. The general permit is PAG-02 NPDES General Permit for Stormwater Discharges Associated with Construction Activities.

DEP issues permits for construction-related NPDES through a general state permit. The applicant must submit a notice of intent (NOI) to DEP for approval under the general permit. The major components of a construction general permit (CGP) are:

- Erosion and Sediment (E&S) Control Plan
- Pennsylvania Natural Heritage Program (PNHP) Search
- Post Construction Stormwater Management (PCSM) Plan
- Thermal Impact Analysis
- Antidegradation Analysis

A PCSM Plan is required under 25 Pa. Code § 102.8(g) and includes the following regulatory standards:

- Do not increase the post-development total runoff volume for all storms equal to or less than the two year/24-hour event.
- Existing (pre-development) non-forested pervious areas must be considered meadow in good condition or its equivalent.
- Twenty (20) percent of existing impervious area to be disturbed must be considered meadow in good condition or better

Future phases should be submitted in accordance with the most recent version of the Permit Guidelines for Phased NPDES Stormwater Discharges Associated with Construction Activity Permits. The seal of a licensed professional (professional engineer, land surveyor, geologist, or landscape architect) licensed to practice in the Commonwealth of Pennsylvania is required on erosion and sediment control plans and post construction stormwater management plans for engineered structural BMP calculations and specifications. It is not anticipated that engineered structural BMPs will be required for trail development.

National Environmental Policy Act

All trails within the master plan are on ACOE property. Because this is a federal agency, all construction on site will require prior environmental and cultural review per the National Environmental Policy Act (NEPA). NEPA review is required regardless of the degree of construction. Some of the planned construction could conceivably be considered minor trail maintenance or rerouting and be reviewed as a Categorical Exclusion. New trail development may require a complete Environmental Assessment, or potentially, an Environmental Impact Statement. Specialists will review flagged corridors, typically 100-200 feet wide, for threatened and endangered species, historical and cultural artifacts and sites, and other potential resource impacts. These reviews should be scheduled as trails are designed, prior to construction. Reviews are typically time sensitive, and therefore should only be conducted on trails expected to go to construction within one year.

Utility Location

It is against state law to excavate or grade without a utility location. Many of the trails and zones within this report are found near existing roads and infrastructure, with potentially buried utility lines. It is extremely important that contractors notify the applicable organizations in a timely fashion for utility location services.



5. Trails Master Plan

The recommendations within this report are the culmination of desktop analysis, field work, stakeholder meetings, and professional expertise. The recommendations are focused on:

1. Providing progressive mountain bike opportunities to the local population.
2. Allowing for the effective development of the area as a mountain bike tourist destination.
3. Ensuring trail access for hikers, runners, and equestrians.

The recommendations include development in multiple zones. The master plan identifies these zones and discusses the existing conditions and proposed trail development. All trail recommendations are planned corridors and not field designed alignments.

The recommendations and cost opinions in this report reflect the conceptual nature associated with planned trails. As plans are further developed into detailed design, it may be concluded that they are not suitable for construction. Flagged trail alignments will allow the develop of more exact construction cost estimates.

It is recommended that the design and construction be completed in phases, both to reduce financial burden and to increase the appeal of the trail system by providing new additions over time.

It is recommended that field design and construction management be provided by one qualified professional. It is vital to the success of a project of this size and complexity, that the management of multiple construction teams be provided by one management organization. One qualified professional organization providing the design will ensure a cohesive and complete design package. A piecemeal approach to design and construction may not result in the intended experiences and goals. Development cost opinions can be found in Appendix A.

Note: the existing BMT must remain open in its entirety for access by hikers, mountain bikers, and equestrians. Traditional trail types are planned as sustainable reroutes to steep sections of the BMT that are currently causing, or likely to cause, natural resource impacts and poor visitor experience.

Definitions

Below is a table of terms and definitions used throughout the master plan. The type and difficulty level definitions are simplified from the “Blue Marsh Lake Trail Guidelines by Difficulty Level” provided in Appendix A. To facilitate discussion and implementation, potential trail alignments are named as segments. Segments represent potential trail corridors and are not field flagged trails. Segment numbering helps identify key information. Three digits were used in segment numbering. The first digit reflects the zone in which the segment is found The second digit reflects the trail type, with 0, 1, and 2 indicating a mountain bike-optimized trail; 3 indicating traditional singletrack; 5 indicating gravity trail; and 9 indicating an existing social trail not



identified by ACOE. The third digit is a simple counter, going up as trail segments of specific types in specific zones increase. For examples, Segment 151 is located in Zone 1 and is a gravity trail, and Segment 590 is in Zone 5 and is an existing social trail.

Terms		
Type	Traditional	Traditional singletrack trails are planned, designed, and constructed for multiuse. Typically these trails are reroutes of steep, fall-line existing trails. Traditional singletrack should match the intended difficulty level. Traditional singletrack does not include bike-optimized features or tread. Traditional trails are bidirectional.
	Mountain bike-optimized	Mountain bike-optimized singletrack trails are planned, designed, and constructed for hikers and bikers, with mountain bikers being the preferred user. Mountain bike-optimized trails maximize the fun and efficiency of riding a bike. The majority of the trail contains an appropriate density of bike-specific features intended to provide riders with enjoyment, challenge, and diversity. Mountain bike-optimized trails are bidirectional.
	Gravity	Gravity trails are planned, designed, and constructed for mountain bikers only. All gravity trails are downhill directional. Gravity trails are highly purpose built for mountain bikers and take full advantage of the potential energy of gravity. Gravity trails typically descend steadily and employ many features and styles to appeal to riders looking for new and exciting experiences while growing their skills.
Difficulty Level	Easiest	Typically firm and stable tread surface with average grades of 5% or less and maximum grades not exceeding 15%. Unavoidable obstacles should be under 2" in height.
	More Difficult	Mostly stable tread surface with average grades of 8% or less and maximum grades not exceeding 20%. Unavoidable obstacles should be under 8" in height.
	Most Difficult	Variable tread surface, sometimes loose with average grades of 10% or less and maximum grades not exceeding 40%. Unavoidable obstacles should be under 15" in height.
Intended Users	Multiuse	Hikers, bikers, and equestrians. Multiuse trails are all traditional in type and are typically reroutes of steep, fall-line sections of the trails.
	Hikers & Bikers	Hikers and bikers only, no equestrians. These trails are all mountain bike-optimized, and contain a high density of bike-specific features which are not appropriate for equestrian use.
	MTB	Mountain bikers only. These trails are all gravity type and downhill directional. The design and construction make full use of gravity and highly tune the trail for bike-specific use, creating a single user trail.



Zone 1: State Hill

Experience Goals

- Sustainable mountain bike-optimized singletrack
- Varying trail options from a popular trailhead
- Stacked loops for visitor dispersion and diverse trail outings
- “Sessionable” gravity trail progression

Trail Distances

- ~13 miles

Intended Uses

- Mountain biking
- Adaptive MTB
- Hiking
- Trail running
- Equestrians

Planned Trail Types

- Bike-optimized
- Gravity

Anticipated Skill Levels

- Easiest
- More difficult

Zone 1: State Hill

Zone 1 is the largest zone and a main nexus of trail activity at the project site. Due to the large forested areas, ample slopes, and over 200 feet in useable elevation, the State Hill zone has the most planned miles of all the zones. This high mileage will likely necessitate multiple phases, discussed later in *Recommended Phasing*.

Out of almost 13 miles, 0.5 miles are planned as multiuse trails, 10.5 miles as mountain bike-optimized trails, and 2 miles as gravity trails. The experience goals of Zone 1 include providing multiple mountain bike-optimized loops for new riders and beginners, while also providing more challenge for enthusiasts where possible.

Due to the popularity of this area, planned trail segments made use of the existing BMT to create stacked loops. Additionally, the large forested slopes allow for completely new loops for hikers and bikers. The 0.5 miles of multiuse trail open to equestrians includes two short reroutes around steep, fall-line sections of the BMT.

Zone 1 presents one of the most unique and exciting opportunities at the site: shuttle runs. The entrance to the State Hill boat launch accesses the ACOE property at a high point with excellent views of BML. The road descends to the parking and boat launch, where the BMT crosses the infrastructure. The hillside below the scenic view drops to the trailhead parking, an ideal setup for gravity trails and shuttle runs. Zone 1 builds on this progressive mountain bike plan by providing a second gravity hub with a more-difficult trail to help riders progress their skills. A shuttle cannot be used on the second hub. Riders must pedal to the top, but the trail will provide quick and easy access to high-quality, bike-only descents.

Segment 100 (easiest, mountain bike-optimized)

Segment 100 is just over a mile in length and essentially parallels the existing BMT to the south, or uphill side, from the State Hill boat launch to the dry dam where Zone 2 begins. Segment 100 departs the existing BMT about 350 feet from the State Hill boat launch eastern entrance, after planned Segments 101 and 110 meet at the BMT.

The BMT has several steep grades and at times traverses low-lying flat areas which can be wet. Segment 100 follows the contour of the hillside and rolls along, connecting to the BMT three times where the BMT hits a high point before finally intersecting and terminating where the property lines constrain the



available terrain. This layout creates multiple loop opportunities for hikers and bikers. Additionally, the gravity trail Segment 150 and the more-difficult singletrack Segment 102 intersect with Segment 100 at the far western and eastern ends respectively.

Care should be taken with design and signage to ensure only foot and wheel traffic. The trail should provide a fun and flowy rolling contour experience for riders, providing a hook to encourage more riding. The trail should also be designed and constructed for adaptive MTB use.

Proposed Zone 1 Trails					
Segment	Type	Length (ft)	Length (mi)	Difficulty Level	Intended Users
100	Mountain bike-optimized	6219.52	1.18	Easiest	Hikers & Bikers
101	Mountain bike-optimized	9595.41	1.82	Easiest	Hikers & Bikers
102	Mountain bike-optimized	3378.42	0.64	More Difficult	Hikers & Bikers
103	Mountain bike-optimized	5471.42	1.04	Easiest	Hikers & Bikers
104	Mountain bike-optimized	6463.10	1.22	Easiest	Hikers & Bikers
105	Mountain bike-optimized	5043.43	0.96	More Difficult	Hikers & Bikers
106	Mountain bike-optimized	818.73	0.16	Easiest	Hikers & Bikers
107	Mountain bike-optimized	5355.24	1.01	More Difficult	Hikers & Bikers
108	Mountain bike-optimized	5895.95	1.12	More Difficult	Hikers & Bikers
109	Mountain bike-optimized	5722.85	1.08	More Difficult	Hikers & Bikers
110	Mountain bike-optimized	493.37	0.09	Easiest	Hikers & Bikers
130	Traditional	1410.27	0.27	More Difficult	Multiuse
131	Traditional	1256.18	0.24	More Difficult	Multiuse
150	Gravity	3654.57	0.69	Easiest	MTB
151	Gravity	3749.81	0.71	Easiest	MTB
152	Gravity	3482.71	0.66	More Difficult	MTB
Total (mi)		12.88	100%		
Total Traditional (mi)		0.51	4%		
Total Mountain bike-optimized (mi)		10.31	80%		
Total Gravity (mi)		2.06	16%		
Total Easiest (mi)		6.91	54%		
Total More Difficult (mi)		5.97	46%		

Segment 101 (easiest, mountain bike-optimized)

This short, almost 2-mile loop climbs from the State Hill boat launch BMT eastern entrance, where Segment 112 connects to the trail, to the scenic overlook and loops back down to the western BMT entrance.

Segment 101 provides climbing access to Segment 150, the gravity trail from the scenic overlook, and to an additional singletrack loop for walkers, runners, and riders. At the scenic overlook, the more-difficult singletrack Segment 102 allows a large loop with Segment 100. The trail should also be designed and constructed for adaptive MTB use.

Segment 102 (more difficult, mountain bike-optimized)

Segment 102 is a short connector on some of the steeper slopes below the scenic view. This singletrack offers diversity on the small slope that makes up the eastern side of Zone 1. Care should be taken to provide an intermediate experience differing from Segments 100 and 101, to add progression and diversity. Where feasible, design should ensure a minimum 150-foot buffer from the Squirrel Run Nature Trail. The trail should also be designed and constructed for adaptive MTB use.

Segment 103 (easiest, mountain bike-optimized)

Together with Segments 102, 104, and part of the BMT, Segment 103 creates an approximately 3-mile mountain bike-optimized, easiest loop. This is a huge accomplishment for Zone 1, allowing continuous singletrack loops especially aimed at new riders. The loop would help set the stage for future riders.

Segment 103 traverses the upper property line, intersecting with the gravity hub for Segments 151 and 152, before connecting into Segment 104 near an old forest road. The trail should be a rolling contour style ideal for mountain bikers and should also be designed and constructed for adaptive MTB use.

Segment 104 (easiest, mountain bike-optimized)

From the western end of Segment 103, Segment 104 heads north, downhill, towards the BMT and BML. The trail roughly parallels the existing forest road. This road intersects the BMT near the bridge crossing just west of Squirrel Run Nature Trail and ends at a gated private driveway off Brownsville Road. Segment 104 should tie into the BMT just to the east of the existing road and BMT bridge. Prior to the BMT intersection, Segment 151, an easiest gravity trail, will tie into Segment 104. Segment 105 creates a small loop and two intersections off of 104. Careful design at all intersections is necessary to maintain buffers from the Squirrel Run Nature Trail and control user speeds and ensure best trail management practices. The trail should roll along the contour while gradually changing elevation and should also be designed and constructed for adaptive MTB use.



Segment 105 (more difficult, mountain bike-optimized)

To provide challenge and diversity close to the trailhead, Segment 105 is nearly a mile of more-difficult singletrack planned as a loop off of Segment 104. This singletrack will have more elevation change and provide an optional loop for the larger 102-103-104 loop. This will create appeal for enthusiast riders and help new riders progress. This trail also allows runners and hikers to vary their outings, creating multiple unique loops for different trail experiences. Segment 105 should be specifically designed to provide the next level of difficulty to riders from Segment 104. It should be designed and constructed for adaptive MTB use.

Segment 106 (easiest, mountain bike-optimized)

Segment 106 is a short connector to the existing social trail, Segment 190. Segment 106 connects 190 to the BMT, forming a very small loop close to the parking areas of State Hill boat launch. In addition to improvements on 190, Segment 106 allows for an introductory riding experience and provides meaningful connectivity while varying the general options within the trail system. Segment 106 should be designed and constructed for adaptive MTB use.

Segment 107 (more difficult, mountain bike-optimized)

Segments 103 and 104 meet near the existing road described above, which parallels a stream from the existing BMT bridge near mile marker 3 to the property line. Segment 107 starts at this 103/104 intersection and crosses the existing road near the upper portions of the ACOE property. The slopes above the stream are thick with vegetation and often wet where the forest has been converted to fields. This short section may require a boardwalk or

extensive rock armoring. After crossing the headwall area, Segment 107 traverses the steep slopes to the west of the stream. These slopes create an ideal canvas for more-difficult singletrack design and construction. Segment 107 creates larger loop experiences and skill level variety near the State Hill boat launch. The trail intersects Segment 130 and should be a rolling contour trail designed and constructed for adaptive MTB use.

Segment 108 (more difficult, mountain bike-optimized)

This segment is a mountain bike-optimized option to avoid the steep existing BMT. It provides loop options and skill level diversity. Segment 108 should be a rolling contour trail designed and constructed for adaptive MTB use.

Segment 109 (more difficult, mountain bike-optimized)

Like Segment 108, this segment provides loop options and avoids steep sections of the BMT. Segment 109 contours along the lower slopes after the first bridge west of State Hill boat launch, eventually tying back into the BMT at a similar elevation. Segment 109 should be a rolling contour trail designed and constructed for adaptive MTB use.

Segment 110 (more difficult, mountain bike-optimized)

Segment 110 is a short connection from the east side of Zone 1. This short singletrack connection keeps trail visitors who park at the State Hill trailhead off the road and provides direct access to trails and the woods. This trail should be designed and constructed for adaptive MTB use.

Segment 130 (more difficult, traditional)

Segment 130 is intended as a reroute around a very steep section of the BMT. This trail makes use of the wooded slopes and more gradually traverses its way to the top of the hill. This segment should be constructed as traditional singletrack that allows for hiking, biking, and equestrian use. This segment helps mitigate potential resource impacts such as erosion and sedimentation, from the existing trail. After construction of the new trail, it is advised the existing BMT be discontinued and decommissioned. Segment 130 should be designed and constructed for adaptive MTB use.



Segment 131 (more difficult, traditional)

Like Segment 130, this is a short reroute of the existing BMT where a steep section is prone to erosion and provides a less than desirable experience. This short singletrack should be designed and constructed for hikers, bikers, adaptive MTB, and equestrians.

Segment 150 (easiest, gravity)

From the scenic view and the intersection of Segments 101 and 102, this segment drops back to the trailhead by connecting into 100. This almost 0.75-mile trail provides the only shuttle opportunity at BML and a great introduction to bike-specific gravity trails. This trail should be properly designed and constructed to provide a high-quality, modern bike descent for standard and adaptive MTB use.

Segment 151 (easiest, gravity)

From the gravity hub on Segment 103, this easiest gravity descent is longer than Segment 150 by a touch, and provides yet more introduction to gravity riding for the region. Along with 150, Segment 151 creates a great outdoor playground for children and adults alike, where they can practice skills and have fun while exercising. Segment 151 should also be designed and constructed for adaptive MTB use.

Segment 152 (more difficult, gravity)

Segment 152 provides the next level of progression to the planned gravity trails in Zone 1. This trail pushes grades steeper and should have a higher density of bike-specific features. Segment 152 will allow for interesting gravity sessions at Zone 1, progression and learning for all riders, and something new for more traditional mountain bikers. The trail should be appropriate for adaptive MTB use.

Segment 190 (existing social)

Segment 190 is the longer of the two social trails at the State Hill boat launch. Together with 191, these trails provide fishing access and singletrack alternatives to the BMT. With improvement, these trails could be adopted as system trails. It is recommended that Segment 190 be improved to meet easiest-level trail guidelines, creating a loop with Segment 106. This trail should also be designed and improved for adaptive MTB use.

Segment 191 (existing social)

This social trail should be improved to provide more-difficult mountain bike-optimized singletrack options close to the trailhead. With Segment 190, this creates new loops for riders and hikers, further improving the attraction of the State Hill boat launch area for trail visitation.





Zone 2: Stilling Basin

Zone 2 presents opportunities for small loops and added connectivity. Together with Zone 1, this development zone will create over 15 miles of new trail close to population centers. This means more people are likely to enjoy the outdoors, engage in stewardship, and participate in healthy activities.

Zone 2 is characterized by the emergency spillway and dam, which create unique constraints to trail design and construction. Providing a few easiest and more-difficult singletrack options will help spread users out in the dense area of BML. Additionally, some resource impacts were addressed through a short reroute from the Lower Stilling Basin lot.

Segment 200 (easiest, mountain bike-optimized)

This 0.75-mile connector provides mountain bike-optimized alternatives to the BMT as it passes the BML dam. Segment 200 picks up from Segment 230, the traditional singletrack recommended to reroute the steepest portion of the BMT. Segment 200 should roll along the contours as it heads to a viewpoint over the emergency spillway and BML. This segment should be designed and constructed for adaptive MTB use.

Segment 201 (easiest, mountain bike-optimized)

After the emergency spillway, the BMT climbs steeply away from BML. To provide more views and access to the lake and more appropriate grades, Segment 201 traverses the contour as it climbs to the intersection with BMT and Segments 202 and 203 at the dry dam prior to Zone 1.

Segment 202 (more difficult, mountain bike-optimized)

From the existing Stilling Basin to Water Road trail, just south of the emergency spillway, Segment 202 climbs steadily to the height of land before descending to the Segment 201-203-BMT intersection. This segment will provide diversity through skill difficulty, help disperse visitors, and offer more loop and trail opportunities. This trail should be designed and constructed for adaptive MTB use.

Segment 203 (more difficult, mountain bike-optimized)

Segment 203 provides trail connectivity between the Water Road lot and the dry dam BMT-201-202 intersection. This allows users to stay on singletrack and keep off Water Road. Segment 204 connects Segments 202 and 203, to create an internal loop and allow for different trail choices by visitors. This trail should be designed and constructed for adaptive MTB use.

Zone 2: Stilling Basin

Experience Goals

- Sustainable mountain bike-optimized singletrack
- Stacked loops for visitor dispersion and diverse trail outings
- Varying trail options from a popular trailhead

Trail Distances

- ~3 miles

Intended Uses

- Mountain biking
- Hiking
- Trail running
- Equestrians

Planned Trail Types

- Bike-optimized

Anticipated Skill Levels

- Easiest
- More difficult



Segment 204 (more difficult, mountain bike-optimized)

Segment 204 connects Segments 202 and 203 across a wooded hillside. This provides additional dispersion for trail visitors and more-difficult singletrack to appeal to enthusiast riders and help new riders progress. This trail should be designed and constructed for adaptive MTB use.

Segment 230 (easiest, traditional)

A short reroute of the steep BMT where it leaves the Lower Stilling Basin lot. The current trail shows active erosion, and a climb with more gradual grades and a contour alignment will help mitigate resource impacts while providing a more enjoyable experience to users. This short segment should be designed and constructed for hikers, bikers, equestrians, and adaptive MTB users. Where it connects back to the BMT, Segment 200 departs and provides a mountain bike-optimized singletrack option for bikers and hikers.

Proposed Zone 2 Trails					
Segment	Type	Length (ft)	Length (mi)	Difficulty Level	Intended Users
200	Mountain bike-optimized	4000.63	0.76	Easiest	Hikers & Bikers
201	Mountain bike-optimized	2638.65	0.50	Easiest	Hikers & Bikers
202	Mountain bike-optimized	4135.49	0.78	More Difficult	Hikers & Bikers
203	Mountain bike-optimized	1629.39	0.31	More Difficult	Hikers & Bikers
204	Mountain bike-optimized	1152.79	0.22	More Difficult	Hikers & Bikers
230	Traditional	1185.53	0.22	Easiest	Multiuse
Total (mi)		2.79	100%		
Total Traditional (mi)		0.22	8%		
Total Mountain bike-optimized (mi)		2.57	92%		
Total Easiest (mi)		1.26	45%		
Total More Difficult (mi)		1.31	47%		

Segment 290 (existing social)

This short loop connects each end of the dry dam with Water Road in the middle. Segment 203 will likely result in less use of this social trail, as 203 provides an entire trail connection from the Stilling Basin to the Zone 1. This social trail should be improved to meet more-difficult, traditional trail guidelines. There are some erosion issues that should be addressed.

Stilling Basin to Water Road Trail (existing social)

This existing trail is recognized by the ACOE. The trail currently departs the BMT just after the Lower Stilling Basin lot and heads south to a fishing lot on Water Road. This is a great piece of existing singletrack that is popular with mountain bikers and hikers. The current alignment coincides with future water main

construction plans. Currently, the intent is to restore the trail after the water line is installed. It is recommended that this trail, or a similar trail connecting the same intersections, be improved and developed as a more-difficult, traditional trail.



Zone 3: North Church

Experience Goals

- Sustainable mountain bike-optimized singletrack
- Stacked loops for visitor dispersion and diverse trail outings
- Exposed, narrow, rugged, advanced singletrack

Trail Distances

- ~5 miles

Intended Uses

- Mountain biking
- Hiking
- Trail running
- Equestrians

Planned Trail Types

- Bike-optimized

Anticipated Skill Levels

- More difficult
- Most difficult

Zone 3: North Church

North Church provides some of the best terrain to develop advanced trails, typically steep slopes. The far northern end also has exposed bedrock, allowing for technical, narrow singletrack. The more remote feel of Zone 3 plays nicely with planned trails, which typically bypass steep or flat portions of the BMT for sideslopes and BML views. Some of the planned segments mitigate the worst erosion damage and should be traditional style trails appropriate for equestrians.

Segment 300 (more difficult, mountain bike-optimized)

The very beginning of Segment 300 could be developed separately, as a traditional singletrack open to equestrians, as it provides a sustainable alternative to a steep section of the BMT. The first approximately 300 feet of Segment 300 reroute a piece of eroding BMT directly north of Old Church Road. The remainder of Segment 300 parallels the BMT on the sideslopes. The BMT quickly gains the ridge and follows the relatively flat top; whereas, Segment 300 is located just over the knuckle to create optimal mountain bike-optimized rolling contour trail. This segment should be appropriate for adaptive MTB use.

Segment 301 (more difficult, mountain bike-optimized)

Around mile 16.5 of the BMT, Segment 301 creates a loop off the BMT by utilizing the steeper sideslopes towards BML. This segment is very similar to Segment 300 in style and intent. The trail should be mountain bike-optimized rolling contour trail appropriate for adaptive MTB use.

Segment 302 (most difficult, mountain bike-optimized)

Segment 302 provides a loop opportunity for rides in Zone 3 by developing trail in a small wooded drainage. This bypasses much of the open field riding and short fall-line sections of the BMT. This trail should be a rolling contour trail appropriate for adaptive MTB use.

Segment 303 (most difficult, mountain bike-optimized)

Segment 303 departs Old Church Road where Segment 300 is planned. Segment 303 is intended for advanced riders, utilizing the steep sideslopes above BML and below Segment 300. This singletrack should be narrow and rugged in character.



Segment 304 (most difficult, mountain bike-optimized)

Like Segment 303, Segment 304 makes use of the steep sideslopes above BML at the northern end of the project site. This trail should be narrow and rugged, providing a most-difficult level experience in a rather remote part of the property.

Proposed Zone 3 Trails					
Segment	Type	Length (ft)	Length (mi)	Difficulty Level	Intended Users
300	Mountain bike-optimized	4020.94	0.76	More Difficult	Hikers & Bikers
301	Mountain bike-optimized	1026.10	0.19	More Difficult	Hikers & Bikers
302	Mountain bike-optimized	2234.20	0.42	More Difficult	Hikers & Bikers
303	Mountain bike-optimized	3904.74	0.74	Most Difficult	Hikers & Bikers
304	Mountain bike-optimized	3197.45	0.61	Most Difficult	Hikers & Bikers
305	Mountain bike-optimized	675.94	0.13	More Difficult	Hikers & Bikers
306	Mountain bike-optimized	2355.26	0.45	Most Difficult	Hikers & Bikers
307	Mountain bike-optimized	3564.64	0.68	Most Difficult	Hikers & Bikers
330	Traditional	1790.59	0.34	More Difficult	Multiuse
331	Traditional	1399.25	0.27	More Difficult	Multiuse
332	Traditional	3324.47	0.63	More Difficult	Multiuse
Total (mi)		5.21	100%		
Total Traditional (mi)		1.23	24%		
Total Mountain bike-optimized (mi)		3.97	76%		
Total More Difficult (mi)		2.74	53%		
Total Most Difficult (mi)		2.47	47%		

Segment 330 (more difficult, traditional)

Segment 307 ties into Segment 330 where they meet the BMT. This section of BMT to the west, and below Segment 330 is steep and eroding. To provide a more positive visitor experience and reduce resource impacts, a traditional singletrack designed and constructed for multiuse including equestrian and adaptive MTB is recommended. This segment would use the sideslopes to provide a more sustainable alignment along the contour. Segment 330 ties into the existing bridge, which will remain, and then runs to Segment 331 on the western side of the drainage.

Segment 305 (more difficult, mountain bike-optimized)

Segment 305 is a short bypass of a steep section of the BMT. Segment 305 uses the sideslopes to provide a rolling contour experience. This trail should be mountain bike-optimized and appropriate for adaptive MTB use.

Segment 306 (most difficult, mountain bike-optimized)

This segment is almost 0.5 miles of trail intended to be some of the most rugged at BML. This segment traverse steep slopes with exposed bedrock. Design and construction should make ample use of this resource to provide a truly advanced, rugged trail experience.

Segment 307 (most difficult, mountain bike-optimized)

Segment 307 provides a most-difficult loop option below Segment 301. Like other segments in Zone 3, this advanced singletrack parallels an intermediate trail on the lower, steeper sideslopes above BML. This trail should provide a rugged mountain bike-optimized experience.

Segment 331 (more difficult, traditional)

Segment 331 climbs the hill opposite Segment 330, to provide a similar sideslope contour trail. Turns help reduce grades and create a more enjoyable trail for all. This trail is planned as traditional because the BMT is eroding and use of the existing trail should be reduced.

Segment 332 (more difficult, traditional)

Segment 332 picks up where Segment 331 ties into the BMT. Segment 332 runs along the contour, above Segment 304, on the mellower sideslopes. This trail parallels the BMT higher up, where it rides the flat ridgetop after climbing steeply along the fall line. This trail should be traditional as it will likely provide a better connection across the system for all users. Equestrians are likely to appreciate the more sustainable and maintainable grades and this in turn reduces resource impacts.





Zone 4: Seven Mile Hill

Seven Mile Hill provides a great canvas to develop a hub of gravity trails. Zone 4 contains four gravity runs, though careful design may allow for an additional one or two full- to half-length runs. The famous hill which gives this zone its name is one of the largest wooded hills on site. The distance from the major trailheads of Zone 1 and 2 make this a potentially better site for modern bike-only descents. Seven Mile Hill is close enough (~3 miles from State Hill boat launch) to provide easy access, while far enough to disperse this user type.

Additionally, the existing parking at Justa and Highland Roads may be improved to allow better access for riders solely seeking gravity experiences. On top of gravity trail development, Zone 4 contains numerous mountain bike-optimized routes which provide for loop options and ride diversity. These many segments make use of wooded slopes to create modern contour trails. Together this makes Zone 4 the second highest in terms of planned trail miles.

Segment 400 (more difficult, mountain bike-optimized)

Past mile marker 4 and Segment 131, this optional loop will dip off of the existing BMT to use the sideslopes below. This will help create a bench cut contour trail, optimal for riders but also providing walkers and runners with options. This segment stays in the woods, skirting the existing fields, and providing a more enjoyable trail experience. This segment should be designed and constructed for adaptive MTB use.

Segment 401 (more difficult, mountain bike-optimized)

Around mile marker 5, the BMT follows a drainage towards BML. Segment 401 skirts the loss of elevation and the associated Seven Mile Hill climb, by running along the contour of the wooded slopes. Segment 401 ties back into the BMT near mile 7.25, before the BMT dives steeply down another drainage towards BML. This segment provides excellent loop opportunities and more direct access to the future gravity trails on top of the hill. This trail should be mountain bike-optimized singletrack along the contour, designed and built for adaptive MTB use.

Segment 402 (more difficult, mountain bike-optimized)

Nearly 1.4 miles in length, this is one of the longer segments planned at BML. Segment 402 diverts from the BMT before it begins the Seven Mile Hill climb, instead staying on the contour and wrapping above BML until it reconnects with the BMT. This provides an easy alternative to the steep climb and uneventful descent of the current BMT, giving the rider a bike-optimized contour trail. Segment 402 ends where Segment 406 begins, making a four-way

Zone 4: Seven Mile Hill

Experience Goals

- Sustainable mountain bike-optimized singletrack
- Stacked loops for visitor dispersion and diverse trail outings
- Sessionable gravity trail progression

Trail Distances

- ~8 miles

Intended Uses

- Mountain biking
- Hiking
- Trail running
- Equestrians

Planned Trail Types

- Bike-optimized
- Gravity

Anticipated Skill Levels

- More difficult
- Most difficult



intersection with the BMT. Segment 405 also connects to 402 midway through, providing another way to ascend to the top of the hill. Gravity Segment 452 also ends on 402. This segment will provide excellent loop variety within the system and should be appropriate for adaptive MTB use.

Segment 403 (more difficult, mountain bike-optimized)

Segment 403 is a short loop off the BMT which provides direct access to the highest point in Zone 4 and the future gravity hub for Segments 450 and 451. Additionally, gravity Segments 452 and 453 descend from the northern terminus back to Segment 402. Segment 404 creates an inner loop, essentially bypassing a steeper section of the BMT. This trail will provide bidirectional loop variety for riders, walkers, runners, and adaptive MTB.

Segment 404 (more difficult, mountain bike-optimized)

Segment 404 creates an inner loop to Segment 403, providing a mountain bike-optimized bidirectional alternative to the wider and steeper BMT. This trail should be appropriate for adaptive MTB use.

Segment 405 (more difficult, mountain bike-optimized)

Segment 405 drops from the intersections of BMT, 401, 403, and 407 down a drainage to Segment 402. It provides a wider variety of loop options and a more enjoyable and maintainable singletrack experience compared to the BMT. This trail should be designed and constructed for adaptive MTB use.

Segment 406 (more difficult, mountain bike-optimized)

Similar in length to Segment 402, this long mountain bike-optimized rolling contour trail provides great loop options and bypasses long stretches of the wider BMT and a handful of steep sections. The trail does connect to the BMT at one point, about midway, to add variety. The character of the segment is similar throughout, with the southern end running along steeper slopes. The trail should be appropriate for adaptive MTB use.

Proposed Zone 4 Trails					
Segment	Type	Length (ft)	Length (mi)	Difficulty Level	Intended Users
400	Mountain bike-optimized	2694.62	0.51	More Difficult	Hikers & Bikers
401	Mountain bike-optimized	2938.54	0.56	More Difficult	Hikers & Bikers
402	Mountain bike-optimized	7273.38	1.38	More Difficult	Hikers & Bikers
403	Mountain bike-optimized	3595.52	0.68	More Difficult	Hikers & Bikers
404	Mountain bike-optimized	1059.83	0.20	More Difficult	Hikers & Bikers
405	Mountain bike-optimized	1464.97	0.28	More Difficult	Hikers & Bikers
406	Mountain bike-optimized	7202.90	1.36	More Difficult	Hikers & Bikers
407	Mountain bike-optimized	4382.29	0.83	More Difficult	Hikers & Bikers
450	Gravity	3032.55	0.57	More Difficult	MTB
451	Gravity	2900.70	0.55	Most Difficult	MTB
452	Gravity	2901.54	0.55	More Difficult	MTB
453	Gravity	2020.90	0.38	Most Difficult	MTB
Total (mi)		7.47		100%	
Total Mountain bike-optimized (mi)		5.80		78%	
Total Gravity (mi)		1.67		22%	
Total More Difficult (mi)		6.92		93%	
Total Most Difficult (mi)		0.55		7%	

Segment 407 (more difficult, mountain bike-optimized)

This trail is part of the major nexus of planned mountain bike-optimized trails in Zone 4. Together with Segments 401, 403, and 405; Segment 407 creates a large diversity of loop options for trail visitors. This segment skirts the BMT in a similar fashion to Segment 405. 407 climbs into the wooded drainage before descending back to the BMT, offering great singletrack alternatives. The trail should be appropriate for adaptive MTB use.

Segment 450 (more difficult, gravity)

The longest gravity run in Zone 4, just over 0.5 miles, Segment 450 drops from the height of land down to the BMT near mile marker 6. Segment 451 leaves from the same hub and intersects 450 before it ties into the BMT. The mellow wooded slopes mean design and construction should make full use of the continuous descent by incorporating a high density of bike-specific dirt features. The planned trail has many turns to create a great flowing experience unique at BML. The trail should be appropriate for adaptive MTB use.

Segment 451 (most difficult, gravity)

One of two most-difficult gravity trails at BML, this longer, advanced option leaves the height of land with Segment 450 and merges back into it before 450 ties into the BMT at mile marker 6. This trail should have more and larger dirt features than 450, providing appropriate skill progression and a bigger flow experience than 450, possibly the only one of its kind in the region.

Segment 452 (more difficult, gravity)

The BMT cuts off opportunities for gravity runs to the west of the height of land, so a second gravity hub is planned on the existing BMT where Segments 403 and 404 bypass the BMT. Segment 452 should be similar to Segment 450, providing an intermediate-level descent for riders. The trail should strive to provide a different experience than 450, to add diversity to the gravity trails in Zone 4. Segment 453 is a most-difficult option off 452, diverging and merging to make use of steeper slopes and provide progression in the gravity trails. Segment 452 ties back into Segment 402, and special care should be used in design and construction to ensure a socially sustainable intersection which mitigates user conflicts (such as excess speed from gravity riders). The trail should be appropriate for adaptive MTB use.



Segment 453 (most difficult, gravity)

Similar to Segment 451, this is the more advanced option off the west gravity hub in Zone 4. Segment 453 provides the chance to create more diversity in the gravity runs of BML and allow for riders to seamlessly progress their skills.



Zone 5: Day-Use Area

The Dry Brooks day-use area is by far the largest trailhead at BML. The summer months tend to fill the parking lots with lake visitors, so trail development is most needed for shoulder season visitors. The existing hiking-only trails prevent widespread trail development and result in only a few planned segments. The segments were planned as beginner and intermediate level connections, providing vital access to the BMT and short loop options for users. Care was taken in planning to ensure new trails are located a minimum 100 feet from existing hiking trails, except where infeasible.

Segment 500 (easiest, mountain bike-optimized)

This longer easiest, mountain bike-optimized singletrack provides a connection from the BMT to the lower reaches of the day-use area. This trail parallels the entrance road in the woods using rolling contour design. Careful design should be employed to control user speeds and provide an introductory singletrack experience. The trail should be designed and built for adaptive MTB use.

Segment 501 (easiest, mountain bike-optimized)

Segment 501 is a short connection on the upland slopes between Segment 500 and the boat launch. This also connects to Segment 503. The trail should be designed and built for adaptive MTB use.

Segment 502 (easiest, mountain bike-optimized)

This segment is a short connection from the BMT before it crosses the access road above the Great Oak Nature Trail to the day-use parking area. This segment ties into the upper parking lot at the opposite end of Segments 501 and 503. The trail should be designed and built for adaptive MTB use.

Segment 503 (easiest, mountain bike-optimized)

Connecting the upland Segment 502 to the lower elevations of the day-use area, this trail makes use of the wooded slopes and maintains the 100-foot buffer from the Eyes of the Eagle Sensory Trail. The trail should be designed and built for adaptive MTB use.

Zone 5: Day-Use Area

Experience Goals

- Sustainable mountain bike-optimized singletrack
- Stacked loops for visitor dispersion and diverse trail outings
- Beginner friendly trail to showcase mountain biking to day-use visitors

Trail Distances

- ~2 miles

Intended Uses

- Mountain biking
- Hiking
- Trail running
- Equestrians

Planned Trail Types

- Bike-optimized

Anticipated Skill Levels

- Easiest
- More difficult



Proposed Zone 5 Trails					
Segment	Type	Length (ft)	Length (mi)	Difficulty Level	Intended Users
500	Mountain bike-optimized	1838.71	0.35	Easiest	Hikers & Bikers
501	Mountain bike-optimized	1550.45	0.29	Easiest	Hikers & Bikers
502	Mountain bike-optimized	1820.61	0.34	Easiest	Hikers & Bikers
503	Mountain bike-optimized	1807.76	0.34	Easiest	Hikers & Bikers
504	Mountain bike-optimized	1997.15	0.38	More Difficult	Hikers & Bikers
505	Mountain bike-optimized	2014.00	0.38	Easiest	Hikers & Bikers
506	Mountain bike-optimized	2949.29	0.56	More Difficult	Hikers & Bikers
Total (mi)		2.65		100%	
Total Mountain bike-optimized (mi)		2.65		100%	
Total Easiest (mi)		1.71		65%	
Total More Difficult (mi)		0.94		35%	

Segment 504 (easiest, mountain bike-optimized)

Wrapping around the northern ridge that goes out to the dam, this trail departs from the small field near the camp host site and entrance, providing the uphill climb for gravity experience on Segment 205. This trail could support short out-and-back hikes but only provide loop opportunity to bikes. This climb should be mellow and use gentle grades and wide turns. It should be well separated from the roads and camp host site.

Segment 505 (easiest, mountain bike-optimized)

This short connector will provide singletrack access from the end of the dry dam to Segments 590 and 503. This provides much needed trail connectivity, versus the steep doubletrack that is currently used. Segment 505 should

be developed as an easiest trail to ensure good loop options in the day-use area for new riders and kids.

Segment 506 (more difficult, mountain bike-optimized)

This short connector will provide singletrack access from 502 to 500/501/BMT. This bypasses a steep hill climb and descent on State Game Commission property around mile marker 28. To keep the trail entirely on ACOE property, careful design will be required around the property corner pinch near the entrance road and the tight corridor between the road and property line as it descends towards the lake. Some of the road may need to be incorporated, or permission and clearance from the State Game Commission granted to use some of their wooded areas.

Segment 590 (existing social)

This short lakeside social trail connects the Dry Brooks boat launch to the Dry Brooks day-use area. This trail is very popular and provides lake access and better trail experiences than the BMT. This trail should be further developed, which may include short relocations or armoring due to seasonal wet areas, to provide a true easiest mountain bike-optimized singletrack.



Zone 6: Skinners

Proposed Zone 6 Trails					
Segment	Type	Length (ft)	Length (mi)	Difficulty Level	Intended Users
600	Mountain bike-optimized	7102.47	1.35	More Difficult	Hikers & Bikers
601	Mountain bike-optimized	3671.62	0.70	More Difficult	Hikers & Bikers
602	Mountain bike-optimized	5776.96	1.09	More Difficult	Hikers & Bikers
603	Mountain bike-optimized	5825.65	1.10	Most Difficult	Hikers & Bikers
Total (mi)		4.24	100%		
Total Mountain bike-optimized (mi)		4.24	100%		
Total More Difficult (mi)		3.13	74%		
Total Most Difficult (mi)		1.10	26%		

The Skinners Zone lies between Zones 3 and 4, where the Skinners loop peninsula offers steep slopes

and wooded areas for mountain bike-optimized singletrack development. The planned routes provide alternative loop options for hikers and bikers, while also skipping some of the steep, fall-line sections of the BMT. Zone 6 utilizes the existing bridge crossing, but segments will often divert from the BMT to provide forested trail experiences.

Segment 600 (more difficult, mountain bike-optimized)

A long, nearly 1.4-mile, segment on the opposite side of the small cove from Segment 406, this trail provides similar experiences to 406, namely, a forested rolling contour trail with more gradual climbs and descents than the BMT. This mountain bike-optimized singletrack should be appropriate for adaptive MTB use.

Segment 601 (more difficult, mountain bike-optimized)

Segment 601 skirts a steep section of BMT, using the sideslopes to drop to the existing drainage crossing. This trail should be appropriate for adaptive MTB use.

Segment 602 (more difficult, mountain bike-optimized)

Like Segment 601, this segment skips steeper sections of the BMT in favor of the wooded sideslopes, creating a rolling contour option that adds diversity and sustainability to the system. The trail should be designed and built for adaptive MTB use.

Zone 6: Skinners

Experience Goals

- Sustainable mountain bike-optimized singletrack
- Stacked loops for visitor dispersion and diverse trail outings
- Remote and rugged singletrack
- Exposed terrain

Trail Distances

- ~4 miles

Intended Uses

- Mountain biking
- Hiking
- Trail running
- Equestrians

Planned Trail Types

- Bike-optimized

Anticipated Skill Levels

- More difficult
- Most difficult



Segment 603 (most-difficult, mountain bike-optimized)

The steep northern slopes of the Skinners loop peninsula make a great canvas for a most-difficult mountain bike-optimized singletrack. Reminiscent of the Zone 3 advanced trails, this segment will add diversity and options to the larger trail system. It should be a rugged piece of trail making use of the exposure and lake views to create a truly most-difficult mountain-bike optimized trail.

Zone 7: 24-Mile Marker

A small zone on the east side of BML, this area is highly constrained between property lines, roads, and agricultural field allowing space for only two segments. The segments were planned to provide alternatives to the BMT, allowing for more dispersion of trail visitors and more sustainable trails.

Segment 700 (most difficult, mountain bike-optimized)

Just prior to mile marker 24 and where the BMT uses Route 183 to cross BML, Segment 700 provides a more-difficult mountain bike-optimized singletrack option. The segment crosses the BMT once, as it makes use of the forested sideslopes by running along the contours. The trail should be designed and built for adaptive MTB use.

Segment 701 (most difficult, mountain bike-optimized)

Segment 701 is after mile marker 24 and Route 183, but similar to Segment 700, provides a more-difficult mountain bike-optimized singletrack option. The trail should be designed and built for adaptive MTB use.

Zone 7: 24-Mile Marker

Experience Goals

- Sustainable mountain bike-optimized singletrack
- Stacked loops for visitor dispersion and diverse trail outings
- Exposed, narrow, rugged, advanced singletrack

Trail Distances

- ~4 miles

Intended Uses

- Mountain biking
- Hiking
- Trail running
- Equestrians

Planned Trail Types

- Bike-optimized

Anticipated Skill Levels

- More difficult

Proposed Zone 7 Trails					
Segment	Type	Length (ft)	Length (mi)	Difficulty Level	Intended Users
700	Mountain bike-optimized	2769.45	0.52	More Difficult	Hikers & Bikers
701	Mountain bike-optimized	3551.36	0.67	More Difficult	Hikers & Bikers
Total (mi)		1.20		100%	
Total Mountain bike-optimized (mi)		1.20		100%	
Total More Difficult (mi)		1.20		100%	

Recommended Phasing

To allow for long-term financial health, as well as match the community's growing mountain bike needs, BML trail development should be phased. Design and construction should occur as needed, and design should predate construction by no more than one year. Design and construction can be done in conjunction where the trails would benefit from a design-build style development due to site limitations or the complex techniques used in building advanced trails, such as gravity trails. It is strongly recommended that one qualified mountain bike trail designer provide the trail design. A piecemeal approach to design will likely result in drastically varying trail quality and could negatively affect the goals of the project. Before construction can occur, design must be completed. Design should include as much trail as is feasible to build in the next one to two years. Flagging and reviews can become outdated over time, while this may inspire breaking design into very small pieces, the more trail designed, the better the trails and system will work and meet the goals of the project. The more design completed at once the more it will work together without issues, piecemeal design may not account for future trail development and restrict opportunities or even eliminate them. For this project, design makes the most sense by zone if not all at once.

Generally, the zone order is comparative with the phasing recommendations, with Zones 1, 2, and 3 being a higher priority than Zones 6 and 7. Many of the phases can be broken down into smaller, manageable projects, such as Phase 1a, 1b, etc. The phasing outline below is an outline of recommended trail development, typically giving guidance for trail design prior to construction. Costs are related to the degree of confidence and detail in a design. This master plan does not include ground truthing for every corridor nor does this master plan lay out the exact designed alignments of trails. Therefore, construction cost opinions can vary 25-50% due to limited data. Project and zone cost opinions can be found in Appendix B.

Notes:

- *Cost opinion tables are for natural surface trail and mountain bike zone development only. They do not include parking lots, roads, bike paths, trailhead improvements, etc.*
- *Cost opinion tables include estimated permitting and signage costs for planning purposes only. Detailed signage and permitting costs will be developed during design. These costs may be outside the scope and funding of BAMBA.*
- *Traditional type trails recommended as sustainable reroutes to the existing BMT and open to equestrians may be outside the funding and project scope of BAMBA.*

Phase 1: 2020 to 2021

Phase 1 will set the stage for the continued development of a robust mountain bike trail system at BML. Phase 1 should focus on Zones 1, 2, and 5. Zone 5: Day-Use Area is the priority in this phase, with just under 2 miles of trails. Segments 500, 501, 502, 503, and 505 should be constructed together to create a cohesive mountain bike experience in the day-use area. At the same time, Segment 590 should be improved for visitor access and experience.

Segments 100, 130, and 131 provide connectivity and reroutes of unsustainable sections of the BMT. Segment 100 will immediately provide a mountain bike-optimized singletrack that also serves the many walkers and runners by creating small links in a chain with the BMT. Segments 130 and 131 address fall-line sections of the BMT and provide a more sustainable trail for multiuse.



Segments 101, 103, and 104 must be constructed prior to gravity trails 150, 151, and 152. The mountain bike-optimized singletrack segments will help disperse all visitors better. The gravity trails should be developed one at a time, to create buzz and excitement from the riding community as each new gravity trail is brought online. Segments 106, 190, and 191 should be developed in conjunction and represent an easy win with minimal construction and maintenance.

Segments 107, 108, and 109 are more-difficult mountain bike-optimized singletrack that provide a variety of loop options with the BMT. These segments should be developed last. As with the gravity trails, developing one trail at a time helps keep excitement for the project high. These segments could be built as other zones are being developed. Segment 110 is meant to provide a seamless singletrack experience for everyone, and as a short trail tying to the parking lot is not crucial but should not be forgotten.

Zone 2 expands upon connectivity and diversity close to population centers. Segment 230 would provide great benefits right away, by replacing the very steep BMT with user-friendly multiuse singletrack. Segments 200 and 201 should also be considered early on in Phase 1, as they create more diversity and loops for visitors to explore and spread out on.

Depending on the timing of the water main construction and Stilling Basin to Water Road trail reconstruction, Segment 202 would provide immediate access back to the BMT. Segment 203 is a high second priority as well because it creates a better connection from Water Road to the dry dam. Segment 204 provides variety and could be developed last in this zone.

Phase 2: 2022

Phase 2 should primarily fill in the missing links of Zones 1, 2, and 5. Zone 3 should be the priority as it increases trail diversity and visitor dispersion. Phase 2 should begin with Segment 300 or 303, which are very close to the most popular trailhead at the northern end of BML and would have the highest impact through easy access and quickly allowing visitors to disperse or create loops, which is not currently possible from the Old Church lot. Segment 303 is a most-difficult trail and would be the first advanced trail in the project, which would bolster continued support from enthusiast riders. Along the same lines, Segment 307 creates a great advanced loop opportunity. Segment 304 provides a similar parallel option as 303. These trails, 303, 307, 304, all make great sense as primary Phase 2 objectives.

Segments 330, 331, and 332 are all multiuse trails and should be developed after the advanced singletrack is complete. These will provide equestrians and riders with more sustainable routes and a few loop options as well. The anticipated results are further visitor dispersion and more appeal to the community, further creating support and enlarging the partner and volunteer base.

Phase 3: 2023

Phase 3 begins development in Zone 4: Seven Mile Hill. This will create more gravity trails, likely activating the Justa and Highland Road parking lots more. Segment 402 would have some of the largest impacts, with nearly 1.5 miles of mountain bike-optimized trail that circumvents the famous hill climb and gives riders and walkers a less demanding experience near BML.



Segment 401, 405, and 407 create numerous options for riders and hikers; making them a perfect second priority. Segment 400 helps create a more sustainable bike-optimized singletrack and should come early in Phase 3. After more extensive loops and options are created, work should focus on the gravity hub. This includes Segments 403, 450, and 451. These would create some new longer descents for riders and include the first most-difficult gravity trail at BML.

Segments 452 and 453 can be added soon after to give more gravity options. Lastly, Segment 406 should be completed, giving a long singletrack option with 402 to visitors, and creating fantastic big loops and options for mountain bikers.

Phase 4: 2024

Phase 4 is the completion of the planned trails at BML. This phase includes the remaining trails in Zones 6 and 7. Zone 6: Skinner should be the first priority. Segment 603 provides the final most-difficult trail and will likely be a big hit with the community. Adding Segments 600, 601, and 602 creates awesome mountain bike-optimized loops and options. This essentially completes the most important mountain bike-optimized singletrack trails around BML. Lastly, Segments 700 and 701 in the 28 Mile-Marker Zone should be designed and built. This will provide some diversity for riders, helping draw some visitors to the eastern side of BML and creating more incentive for people to do complete loops of the lake.

Bridges and Boardwalks

The ACOE currently manages many bridges throughout the BMT. These features require additional maintenance and risk management. Currently all recommendations within the trails master plan has all trails utilizing existing bridges. These features require more maintenance and management, but their benefits can outweigh the issues. Bridges and boardwalks should be regularly inspected for wear and tear as well as defects. New trail bridge and boardwalk construction should follow known guidelines, such as the United States Forest Service guidelines.

State Game Lands

Due to prior design, some of the existing BMT is located on State Game Lands (SGL). These areas abut many of the BML property lines. It is understood the State Game Commission is not interested in further trail development at this time, and relocating the current trail off SGL is infeasible in many locations. It is recommended the ACOE and partners continue to work collaboratively with the State Game Commission on managing the BMT. In the future, it may be advisable to assess the SGL for sustainable trail relocations and potentially further trail development.

Increased Visitation and Best Management Practices

As trails are developed, it is anticipated visitation will also increase. While this is generally positive, it will undoubtedly create new issues, namely, parking and higher traffic on the roads. With more people on foot and bikes traveling the ACOE roads to get to access points and trailheads, drivers will need to travel slower and more carefully, especially as many of these recommendations are aimed at getting kids on bikes. Crosswalks and associated signage will

likely be required at some locations to reduce risk to trail visitors, especially in Zone 5, the day-use area. Improving signage at entrances to warn drivers of increased pedestrian and bicycle usage will be helpful. Enforcement of speed limits and good driving habits may also be required. Parking is likely sufficient for increased trail visitors, especially at the day-use area. The State Hill boat launch and Stilling Basin lots may require additional car parking over time. The trails have been planned and designed to promote dispersion, so visitors are spread across multiple zones. More parking may be required as usage increases, especially if trail visitors are taking up trailer spaces at boat launches.

Programming

The recommendations within this report, if followed, will create many miles of trails at BML. To fully activate and create a community around outdoor recreation and mountain biking, certain programming is necessary. The Phase 1 trails create ideal loops and diversity for a variety of riders, including high-school racers. The Pennsylvania Interscholastic Cycling League (PICL) has a strong presence in the area, and the Phase 1 trails would give them a great training venue. The trails at BML are sure to be an excellent venue for practicing. Phase 1 when fully completed will make a big splash both in mileage and diversity of trails. By Phase 3, many miles and types of trails will be present, creating a regional draw for riders. Events and programming could help keep visitation numbers high in the shoulder seasons.

Beyond high-school racing, many other programs can activate the community. The new mountain bike-optimized singletrack and gravity trails are sure to appeal to many riders, especially children. This could lead to further bike development within the community, such as BMX racing or a bike park. These attractions, specifically the diversity of trails, make ideal locations for instruction and clinics for children. Phase 1 includes enough mileage and gravity trails to host a wide variety of events. After school or summer programs would be a great way to build skills and confidence for those kids who don't want to race or compete.

Additionally, the trails and infrastructure make great sites for other events and clinics. Mountain bike skills clinics are increasingly popular, with a whole subindustry created around them. Women's-only and mixed gender skills clinics are often put on by traveling instructors, and facilities like those planned at BML make great venues for these events. These could help draw visitors during shoulder seasons, while ultimately getting more people on bikes and comfortable riding on trails. Lastly, riding or running races and other events such as bike festivals are very possible and encouraged once the trail system is developed. Hosting a race regularly can attract visitors year after year, especially if the event is well organized and consistent.

Regional Destination

Mountain biking and trail use is ever changing and quickly progressing. The Blue Marsh project has the potential to be a regionally significant mountain biking destination. Many of the area trails do not provide a high-quality trail experience, and the vast majority are traditional singletrack or even double track and forest road. The Allegripis trails are some of the closest modern, mountain bike-optimized trails. If done correctly, this project is sure to impact the local and regional mountain bike scenes. The Berks area is striving to become a Silver Level IMBA Ride Center, and many of the trails required for this designation are planned within this project. What is a destination today, may not be one in the next decade. However, there are some underlying qualities which help support riding destinations and draw visitors for trail use.

- **Trail Lengths** Generally, people like to enjoy trails for at least as long as they traveled to visit them. To draw tourists from a day's drive to stay overnight, at least two full days of riding must be available. This likely means 20-40 miles minimum of high-quality singletrack.
- **Trail Diversity** Visitors, especially mountain bikers, enjoy diversity and quality. By following this trails master plan, a diverse offering of trail types and lengths will be available at BML.
- **Destination Best Practices** The Berks area has a very strong bike culture and amenities ideal for visitors, from plentiful eating and drinking establishments, some very close to BML, to the numerous hotels and lodging options. Reading and the surrounding communities incorporate many best practices mountain bikers like to see in a destination.



Summary

Blue Marsh Lake has a very high potential to create a regional trails destination and an amazing community trail system. Meeting these goals rests on the ability to implement high-quality trails. This master plan is the foundation for that high-quality work. Qualified and talented trail designers and construction managers should be contracted to ensure this project meets its full potential. The largest impediment to success is poor quality design, construction, and management. Contractors must have the ability to manage a large trails project. We strongly suggest the stakeholders find one designer/construction manager for the remainder of the project.

Blue Marsh Lake has the potential to offer a wide array of trail experiences, and the landscape is conducive to many trail types. The existing Blue Marsh Trail circles the lake and provides an ideal backbone for a modern and widespread trail system. This traditional trail offers riders, walkers, and equestrians access to many of the proposed zones and, along with the planned trails, will create immense loop and trail variety. While the majority of development will be mountain bike-optimized singletrack trails, there is room for modern gravity lines and traditional multiuse trails to provide more sustainable routes and reduce resource impacts from the existing trail. Progression would be widely available, and this master plan spells out a thoughtful approach to implementation that encourages the growth of riders and the community.

The opportunity to create venues for school race training, children's programming, and adult events and clinics is huge and will only mean a more successful project and stronger community. BAMBA's goals include getting more people outside and active on the trails. Building a robust trail system close to town will help achieve those goals. The existing infrastructure of the Army Corps of Engineers, with many trailheads and day-use areas, provides a fantastic starting point and helps ensure funding is spent on trails instead of trailhead improvements. The trails are also likely to increase visitation to the lake, helping create more shoulder season use and giving new life to areas like North Church and Justa Road.

With 35.88 miles master planned, and 37.58 miles of existing trail; Blue Marsh Lake could have enough trail mileage and diversity to create a huge resource for the surrounding communities and region. The project has the potential to be an enormous success and be a flagship for modern trail system development and management. The continued partnership of organizations like BAMBA and the Army Corps of Engineers will help drive this project and create a trail system that is enjoyable for all visitors.



Figure 1: Project Area Development Zones

Figure 2: Zones 1 & 2

Figure 3: Zone 3

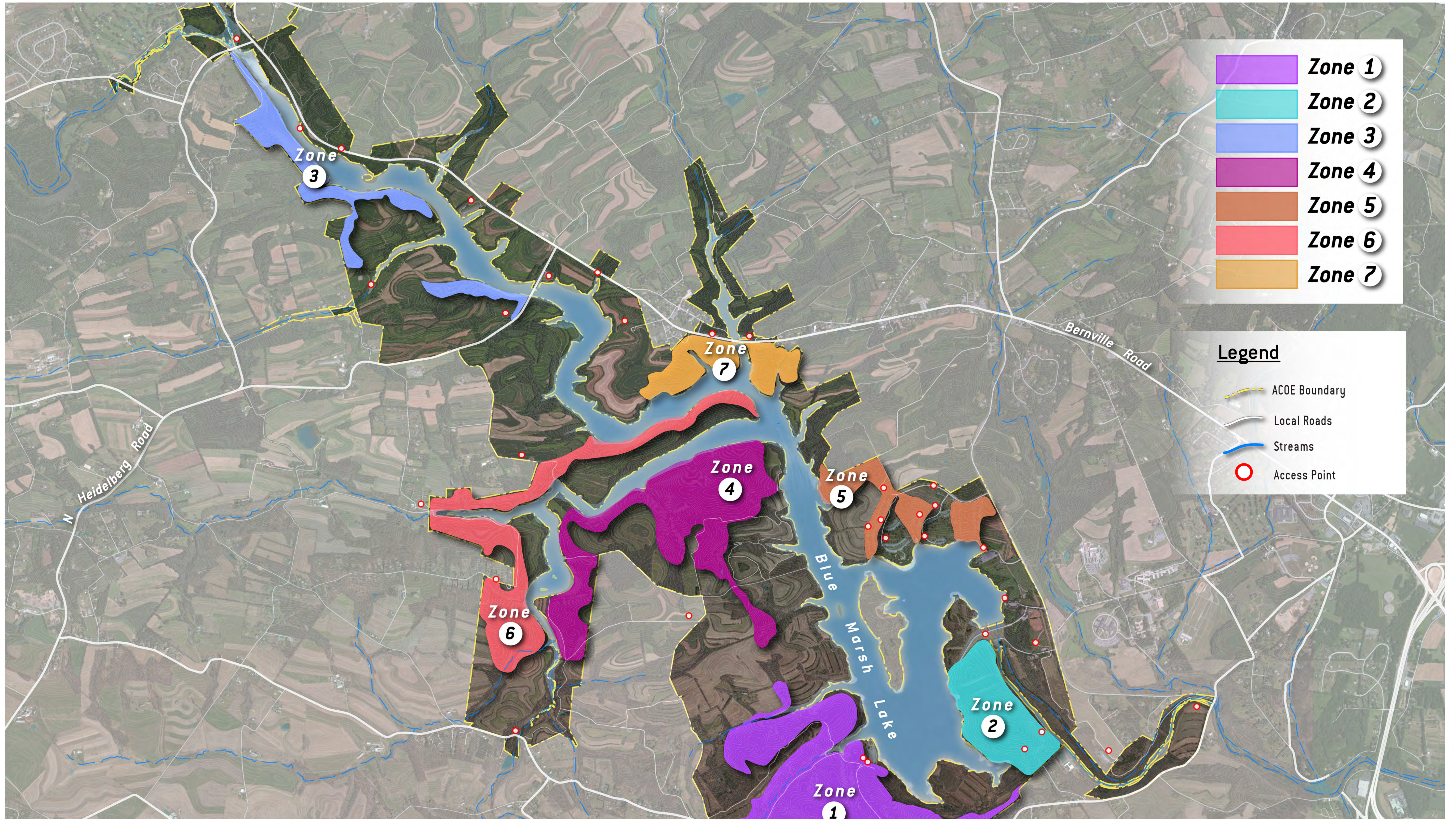
Figure 4: Zones 4 & 6

Figure 5: Zones 5 & 7

Appendix A: Trail Guidelines by Difficulty Level

Appendix B: Cost Opinion Tables

Appendix C: Proposed Trails Table



Blue Marsh Lake: Trails Master Plan

Project Area Development Zones



0' 1,500' 3,000' 6,000'



Blue Marsh Lake: Trails Master Plan

Zones 1 & 2

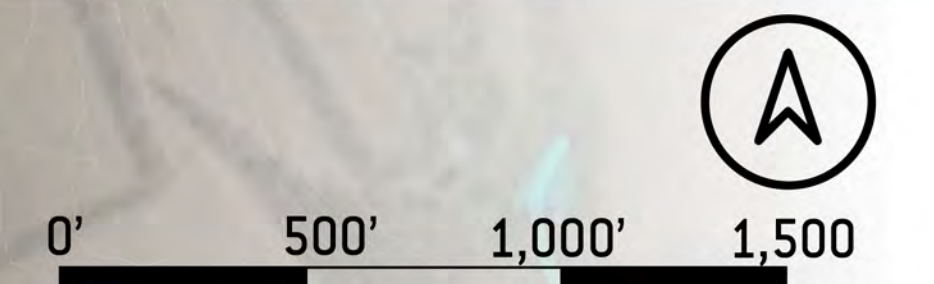
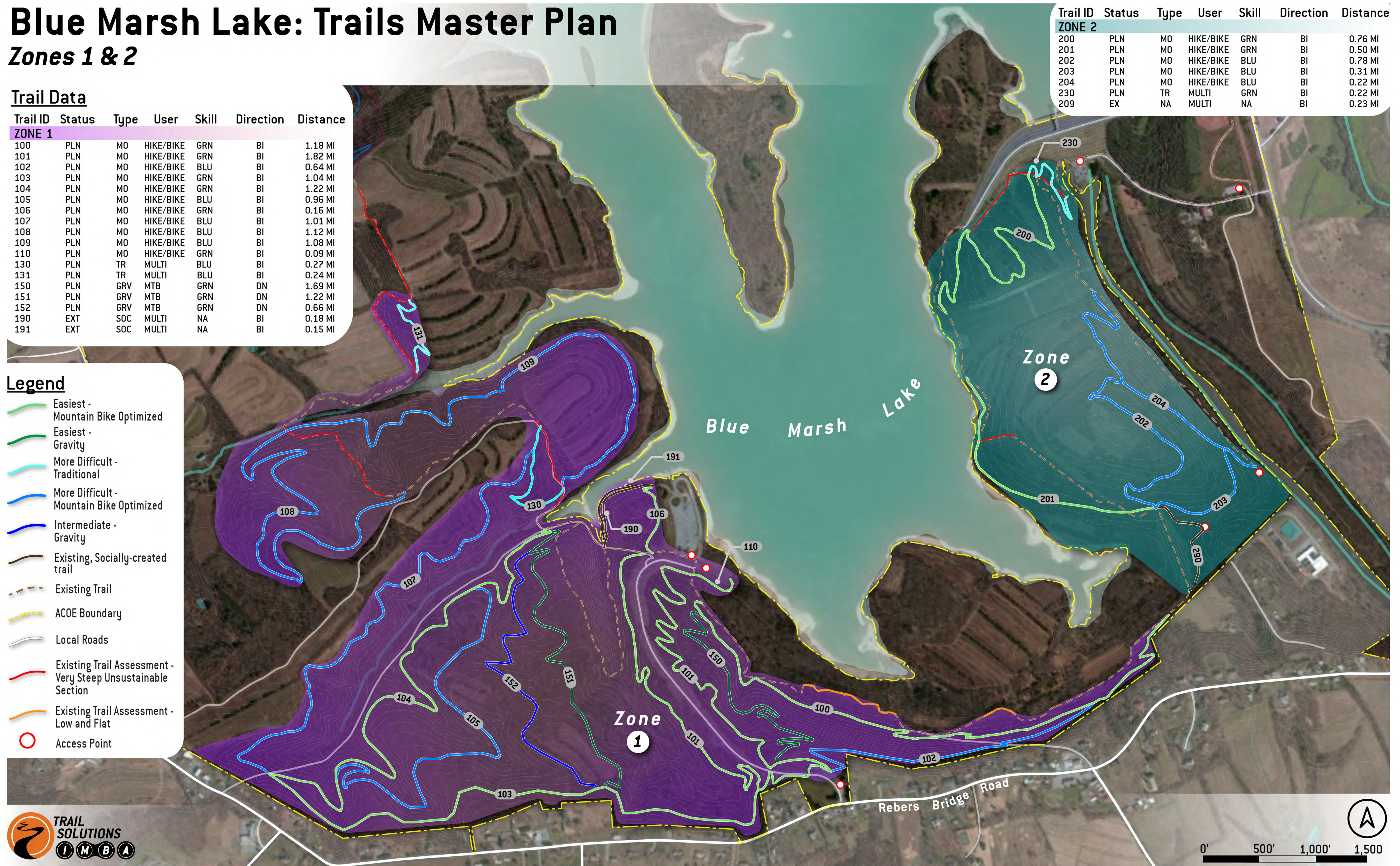
Trail Data

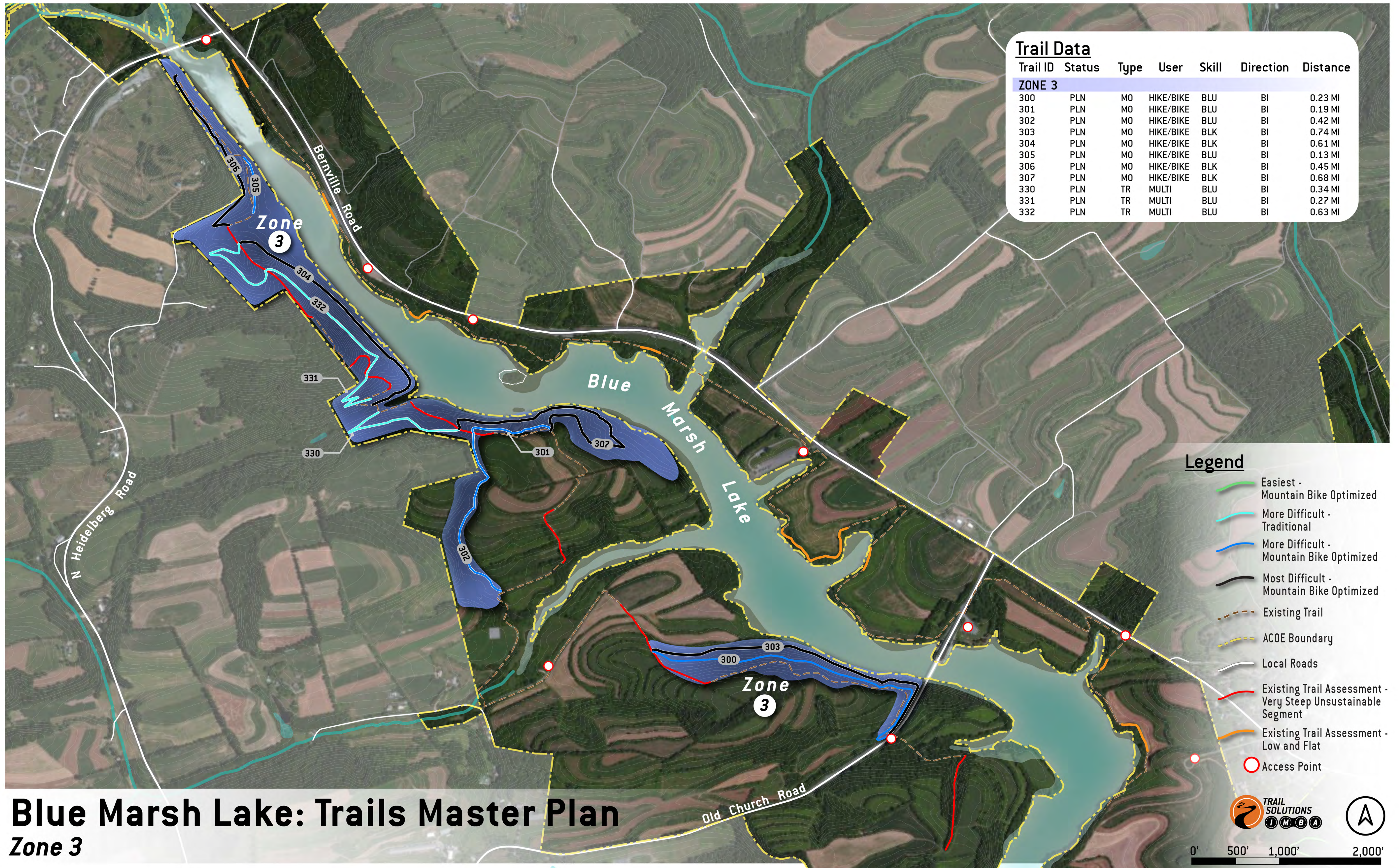
Trail ID	Status	Type	User	Skill	Direction	Distance
ZONE 1						
100	PLN	MO	HIKE/BIKE	GRN	BI	1.18 MI
101	PLN	MO	HIKE/BIKE	GRN	BI	1.82 MI
102	PLN	MO	HIKE/BIKE	BLU	BI	0.64 MI
103	PLN	MO	HIKE/BIKE	GRN	BI	1.04 MI
104	PLN	MO	HIKE/BIKE	GRN	BI	1.22 MI
105	PLN	MO	HIKE/BIKE	BLU	BI	0.96 MI
106	PLN	MO	HIKE/BIKE	GRN	BI	0.16 MI
107	PLN	MO	HIKE/BIKE	BLU	BI	1.01 MI
108	PLN	MO	HIKE/BIKE	BLU	BI	1.12 MI
109	PLN	MO	HIKE/BIKE	BLU	BI	1.08 MI
110	PLN	MO	HIKE/BIKE	GRN	BI	0.09 MI
130	PLN	TR	MULTI	BLU	BI	0.27 MI
131	PLN	TR	MULTI	BLU	BI	0.24 MI
150	PLN	GRV	MTB	GRN	DN	1.69 MI
151	PLN	GRV	MTB	GRN	DN	1.22 MI
152	PLN	GRV	MTB	GRN	DN	0.66 MI
190	EXT	SOC	MULTI	NA	BI	0.18 MI
191	EXT	SOC	MULTI	NA	BI	0.15 MI

Trail ID	Status	Type	User	Skill	Direction	Distance
ZONE 2						
200	PLN	MO	HIKE/BIKE	GRN	BI	0.76 MI
201	PLN	MO	HIKE/BIKE	GRN	BI	0.50 MI
202	PLN	MO	HIKE/BIKE	BLU	BI	0.78 MI
203	PLN	MO	HIKE/BIKE	BLU	BI	0.31 MI
204	PLN	MO	HIKE/BIKE	BLU	BI	0.22 MI
230	PLN	TR	MULTI	GRN	BI	0.22 MI
209	EX	NA	MULTI	NA	BI	0.23 MI

Legend

- Easiest - Mountain Bike Optimized
- Easiest - Gravity
- More Difficult - Traditional
- More Difficult - Mountain Bike Optimized
- Intermediate - Gravity
- Existing, Socially-created trail
- - - Existing Trail
- - - ACOE Boundary
- Local Roads
- Existing Trail Assessment - Very Steep Unsustainable Section
- Existing Trail Assessment - Low and Flat
- Access Point





Trail Data						
Trail ID	Status	Type	User	Skill	Direction	Distance
ZONE 3						
300	PLN	MO	HIKE/BIKE	BLU	BI	0.23 MI
301	PLN	MO	HIKE/BIKE	BLU	BI	0.19 MI
302	PLN	MO	HIKE/BIKE	BLU	BI	0.42 MI
303	PLN	MO	HIKE/BIKE	BLK	BI	0.74 MI
304	PLN	MO	HIKE/BIKE	BLK	BI	0.61 MI
305	PLN	MO	HIKE/BIKE	BLU	BI	0.13 MI
306	PLN	MO	HIKE/BIKE	BLK	BI	0.45 MI
307	PLN	MO	HIKE/BIKE	BLK	BI	0.68 MI
330	PLN	TR	MULTI	BLU	BI	0.34 MI
331	PLN	TR	MULTI	BLU	BI	0.27 MI
332	PLN	TR	MULTI	BLU	BI	0.63 MI

- Legend**
- Easiest - Mountain Bike Optimized
 - More Difficult - Traditional
 - More Difficult - Mountain Bike Optimized
 - Most Difficult - Mountain Bike Optimized
 - Existing Trail
 - ACOE Boundary
 - Local Roads
 - Existing Trail Assessment - Very Steep Unsustainable Segment
 - Existing Trail Assessment - Low and Flat
 - Access Point

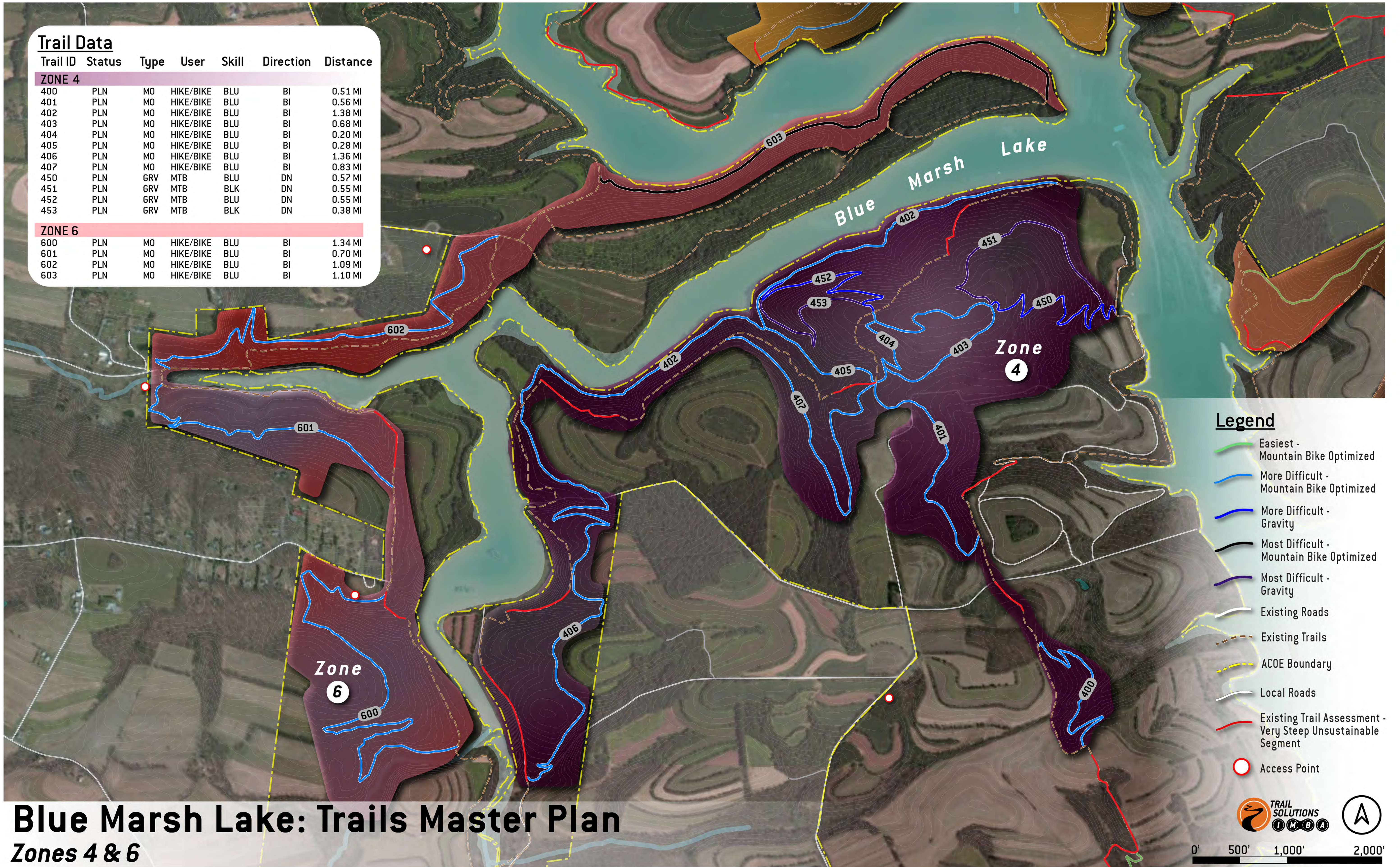
Blue Marsh Lake: Trails Master Plan

Zone 3

0' 500' 1,000' 2,000'

Trail Data

Trail ID	Status	Type	User	Skill	Direction	Distance
ZONE 4						
400	PLN	MO	HIKE/BIKE	BLU	BI	0.51 MI
401	PLN	MO	HIKE/BIKE	BLU	BI	0.56 MI
402	PLN	MO	HIKE/BIKE	BLU	BI	1.38 MI
403	PLN	MO	HIKE/BIKE	BLU	BI	0.68 MI
404	PLN	MO	HIKE/BIKE	BLU	BI	0.20 MI
405	PLN	MO	HIKE/BIKE	BLU	BI	0.28 MI
406	PLN	MO	HIKE/BIKE	BLU	BI	1.36 MI
407	PLN	MO	HIKE/BIKE	BLU	BI	0.83 MI
450	PLN	GRV	MTB	BLU	DN	0.57 MI
451	PLN	GRV	MTB	BLK	DN	0.55 MI
452	PLN	GRV	MTB	BLU	DN	0.55 MI
453	PLN	GRV	MTB	BLK	DN	0.38 MI
ZONE 6						
600	PLN	MO	HIKE/BIKE	BLU	BI	1.34 MI
601	PLN	MO	HIKE/BIKE	BLU	BI	0.70 MI
602	PLN	MO	HIKE/BIKE	BLU	BI	1.09 MI
603	PLN	MO	HIKE/BIKE	BLU	BI	1.10 MI

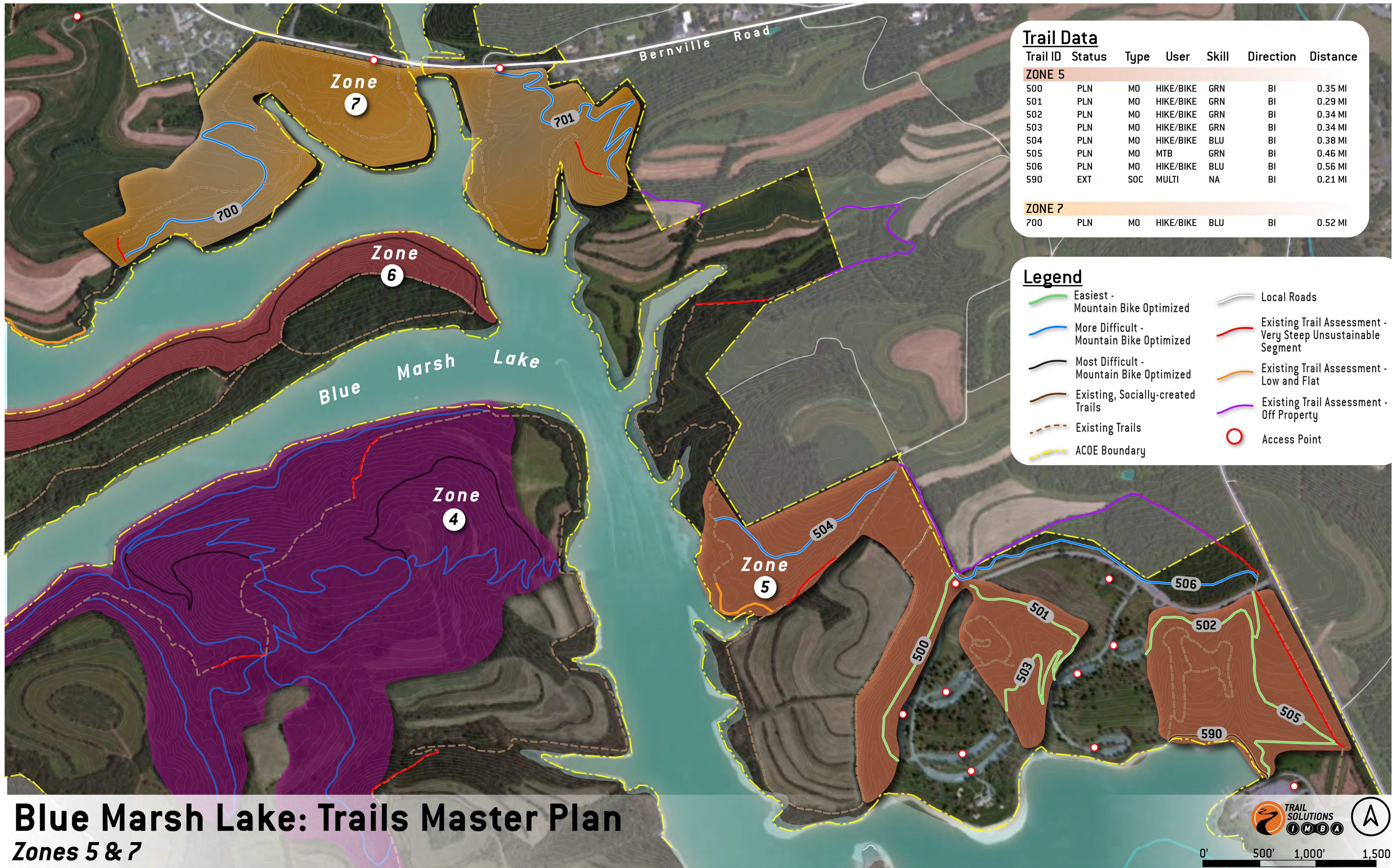


- ### Legend
- Easiest - Mountain Bike Optimized
 - More Difficult - Mountain Bike Optimized
 - More Difficult - Gravity
 - Most Difficult - Mountain Bike Optimized
 - Most Difficult - Gravity
 - Existing Roads
 - - - Existing Trails
 - - - ACOE Boundary
 - Local Roads
 - Existing Trail Assessment - Very Steep Unsustainable Segment
 - Access Point

Blue Marsh Lake: Trails Master Plan

Zones 4 & 6

0' 500' 1,000' 2,000'



Trail Data

Trail ID	Status	Type	User	Skill	Direction	Distance
ZONE 5						
500	PLN	MO	HIKE/BIKE	GRN	BI	0.35 MI
501	PLN	MO	HIKE/BIKE	GRN	BI	0.29 MI
502	PLN	MO	HIKE/BIKE	GRN	BI	0.34 MI
503	PLN	MO	HIKE/BIKE	GRN	BI	0.34 MI
504	PLN	MO	HIKE/BIKE	BLU	BI	0.38 MI
505	PLN	MO	MTB	GRN	BI	0.46 MI
506	PLN	MO	HIKE/BIKE	BLU	BI	0.56 MI
590	EXT	SOC	MULTI	NA	BI	0.21 MI
ZONE 7						
700	PLN	MO	HIKE/BIKE	BLU	BI	0.52 MI

Legend

- Easiest - Mountain Bike Optimized
- More Difficult - Mountain Bike Optimized
- Most Difficult - Mountain Bike Optimized
- Existing, Socially-created Trails
- Existing Trails
- ACOE Boundary
- Local Roads
- Existing Trail Assessment - Very Steep Unsustainable Segment
- Existing Trail Assessment - Low and Flat
- Existing Trail Assessment - Off Property
- Access Point

Blue Marsh Lake: Trails Master Plan

Zones 5 & 7

0' 500' 1,000' 1,500'

Blue Marsh Lake Trail Guidelines by Difficulty Level			
<i>All values are approximate and should be used in aggregate to determine the appropriate skill level. Values do not apply to technical trail features (TTFs) such as jumps, rollers, drops, whoopdees, etc.</i>			
	Easiest (Green Circle)	More Difficult (Blue Square)	Most Difficult (Black Diamond)
Riding Surface (under typical conditions)	Firm tread, highly predictable traction	Mostly firm tread, predictable traction	Variably firm tread, mostly predictable traction
Average Trail Grade			
<i>Ascent</i>	1% to 5%	1% to 7%	1% to 10%
<i>Descent</i>	-1% to -7%	-1% to -12%	-1% to -20%
Maximum Segment Grade			
<i>Climbing (segment cannot exceed 50' in length)</i>	+10%	+15%	+25%
<i>Descending (segment cannot exceed 150')</i>	-10%	-20%	-40%
Turn diameter (min., >90 degrees)	16'	12'	8'
Height of unavoidable obstacles (max.)	2"	10"	20"
Tread cambering (excludes turns, TTFs)			
<i>Outslope (avg.)</i>	0% - 5%	0% - 5%	0% - 10%
<i>Outslope (max.)</i>	5%	10%	20%
<i>Inslope (avg.)</i>	0% - 5%	0% - 5%	0% - 10%
<i>Inslope (max.)</i>	10%	15%	20%
Clearing limits from constructed tread (greater above jumps)	3' horz., 8' vert.	2' horz., 10' vert.	1' horz., 12' vert.
Constructed Tread Width			
<i>0% - 5% sideslope</i>	12" - 24"	8" - 24"	6" - 18"
<i>6% - 25% sideslope</i>	16" - 36"	12" - 30"	8" - 24"
<i>26% - 50% sideslope</i>	24" - 42"	16" - 36"	12" - 30"
<i>51% - 75% sideslope</i>	Not recommended	30" - 48"	18" - 42"
<i>75+% sideslope</i>	Not recommended	Not recommended	36" - 48"

Blue Marsh Lake: Trails Master Plan



Proposed Blue Marsh Lake Trails Cost Opinion							
Zone	Total Linear Feet	Total Miles	Design Subtotal	Permitting Subtotal	Signage Subtotal	Construction Subtotal	Zone Total
1	68011	12.88	\$14,075.76	\$10,000.00	\$10,000.00	\$541,294.46	\$575,370.22
2	14742	2.79	\$3,054.17	\$5,000.00	\$6,250.00	\$103,475.73	\$117,779.89
3	27494	5.21	\$6,495.17	\$6,000.00	\$7,500.00	\$249,249.90	\$269,245.07
4	41468	7.85	\$9,517.70	\$8,000.00	\$7,500.00	\$422,496.56	\$447,514.26
5	14378	2.72	\$2,910.46	\$3,000.00	\$5,500.00	\$96,160.63	\$107,571.09
6	22377	4.24	\$5,195.95	\$5,000.00	\$2,500.00	\$190,664.91	\$203,360.85
7	6321	1.20	\$1,436.55	\$3,000.00	\$1,250.00	\$50,566.45	\$56,252.99
Totals							
	194790	36.89	\$42,685.75	\$40,000.00	\$40,500.00	\$1,653,908.63	\$1,777,094.38
10% Contingency			\$4,268.58	\$4,000.00	\$4,050.00	\$165,390.86	\$177,709.44
Grand Total							
			\$46,954.33	\$44,000.00	\$44,550.00	\$1,819,299.50	\$1,954,803.82

Cost opinion tables include estimated permitting and signage costs for planning purposes only. Detailed signage and permitting costs will be developed during design. These costs may be outside the scope and funding of BAMBA.

Blue Marsh Lake: Trails Master Plan



Zone 1: Blue Marsh Lake Trails Cost Opinion								
Segment	Type	Difficulty Level	Length (ft)	Design Cost per Mile	Design Subtotal	Construction Cost per Foot	Construction Subtotal	Segment Total
100	Mountain bike-optimized	Easiest	6219.52	\$1,000.00	\$1,177.94	\$6.00	\$37,317.11	\$38,495
101	Mountain bike-optimized	Easiest	9595.41	\$1,000.00	\$1,817.31	\$6.00	\$57,572.48	\$59,390
102	Mountain bike-optimized	More Difficult	3378.42	\$1,200.00	\$767.82	\$8.00	\$27,027.39	\$27,795
103	Mountain bike-optimized	Easiest	5471.42	\$1,000.00	\$1,036.25	\$6.00	\$32,828.52	\$33,865
104	Mountain bike-optimized	Easiest	6463.10	\$1,000.00	\$1,224.07	\$6.00	\$38,778.57	\$40,003
105	Mountain bike-optimized	More Difficult	5043.43	\$1,200.00	\$1,146.23	\$8.00	\$40,347.41	\$41,494
106	Mountain bike-optimized	Easiest	818.73	\$1,000.00	\$155.06	\$6.00	\$4,912.36	\$5,067
107	Mountain bike-optimized	More Difficult	5355.24	\$1,200.00	\$1,217.10	\$8.00	\$42,841.94	\$44,059
108	Mountain bike-optimized	More Difficult	5895.95	\$1,200.00	\$1,339.99	\$8.00	\$47,167.56	\$48,508
109	Mountain bike-optimized	More Difficult	5722.85	\$1,200.00	\$1,300.65	\$8.00	\$45,782.79	\$47,083
110	Mountain bike-optimized	Easiest	493.37	\$1,000.00	\$93.44	\$6.00	\$2,960.24	\$3,054
130	Traditional	More Difficult	1410.27	\$1,200.00	\$320.52	\$8.50	\$11,987.28	\$12,308
131	Traditional	More Difficult	1256.18	\$1,200.00	\$285.50	\$8.50	\$10,677.55	\$10,963
150	Gravity	Easiest	3654.57	\$1,000.00	\$692.15	\$12.00	\$43,854.89	\$44,547
151	Gravity	Easiest	3749.81	\$1,000.00	\$710.19	\$12.00	\$44,997.75	\$45,708
152	Gravity	More Difficult	3482.71	\$1,200.00	\$791.52	\$15.00	\$52,240.59	\$53,032
Zone Subtotal					\$14,075.76		\$541,294.46	\$555,370.22

Permitting	\$10,000.00
Signage Subtotal	\$10,000.00
Grand Total	\$575,370.22

Zone 2: Blue Marsh Lake Trails Cost Opinion								
Segment	Type	Difficulty Level	Length (ft)	Design Cost per Mile	Design Subtotal	Construction Cost per Foot	Construction Subtotal	Segment Total
200	Mountain bike-optimized	Easiest	4000.63	\$1,000.00	\$757.70	\$6.00	\$24,003.78	\$24,761
201	Mountain bike-optimized	Easiest	2638.65	\$1,000.00	\$499.74	\$6.00	\$15,831.88	\$16,332
202	Mountain bike-optimized	More Difficult	4135.49	\$1,200.00	\$939.88	\$8.00	\$33,083.89	\$34,024
203	Mountain bike-optimized	More Difficult	1629.39	\$1,200.00	\$370.32	\$8.00	\$13,035.14	\$13,405
204	Mountain bike-optimized	More Difficult	1152.79	\$1,200.00	\$262.00	\$8.00	\$9,222.31	\$9,484
230	Traditional	Easiest	1185.53	\$1,000.00	\$224.53	\$7.00	\$8,298.72	\$8,523
Zone Subtotal					\$3,054.17		\$103,475.73	\$106,529.89

Permitting	\$5,000.00
Signage Subtotal	\$6,250.00
Grand Total	\$117,779.89

Cost opinion tables include estimated permitting and signage costs for planning purposes only. Detailed signage and permitting costs will be developed during design. These costs may be outside the scope and funding of BAMBA.

Blue Marsh Lake: Trails Master Plan



Zone 3: Blue Marsh Lake Trails Cost Opinion								
Segment	Type	Difficulty Level	Length (ft)	Design Cost per Mile	Design Subtotal	Construction Cost per Foot	Construction Subtotal	Segment Total
300	Mountain bike-optimized	More Difficult	4020.94	\$1,200.00	\$913.85	\$8.00	\$32,167.54	\$33,081
301	Mountain bike-optimized	More Difficult	1026.10	\$1,200.00	\$233.20	\$8.00	\$8,208.78	\$8,442
302	Mountain bike-optimized	More Difficult	2234.20	\$1,200.00	\$507.77	\$8.00	\$17,873.56	\$18,381
303	Mountain bike-optimized	Most Difficult	3904.74	\$1,300.00	\$961.39	\$10.00	\$39,047.36	\$40,009
304	Mountain bike-optimized	Most Difficult	3197.45	\$1,300.00	\$787.25	\$10.00	\$31,974.50	\$32,762
305	Mountain bike-optimized	More Difficult	675.94	\$1,200.00	\$153.62	\$8.00	\$5,407.55	\$5,561
306	Mountain bike-optimized	Most Difficult	2355.26	\$1,300.00	\$579.89	\$10.00	\$23,552.57	\$24,132
307	Mountain bike-optimized	Most Difficult	3564.64	\$1,300.00	\$877.66	\$10.00	\$35,646.42	\$36,524
330	Traditional	More Difficult	1790.59	\$1,200.00	\$406.95	\$8.50	\$15,220.01	\$15,627
331	Traditional	More Difficult	1399.25	\$1,200.00	\$318.01	\$8.50	\$11,893.60	\$12,212
332	Traditional	More Difficult	3324.47	\$1,200.00	\$755.56	\$8.50	\$28,258.02	\$29,014
Zone Subtotal					\$6,495.17		\$249,249.90	\$255,745.07

Permitting	\$6,000.00
Signage Subtotal	\$7,500.00
Grand Total	\$269,245.07

Zone 4: Blue Marsh Lake Trails Cost Opinion								
Segment	Type	Difficulty Level	Length (ft)	Design Cost per Mile	Design Subtotal	Construction Cost per Foot	Construction Subtotal	Segment Total
400	Mountain bike-optimized	More Difficult	2694.62	\$1,200.00	\$612.41	\$8.00	\$21,556.93	\$22,169
401	Mountain bike-optimized	More Difficult	2938.54	\$1,200.00	\$667.85	\$8.00	\$23,508.30	\$24,176
402	Mountain bike-optimized	More Difficult	7273.38	\$1,200.00	\$1,653.04	\$8.00	\$58,187.07	\$59,840
403	Mountain bike-optimized	More Difficult	3595.52	\$1,200.00	\$817.16	\$8.00	\$28,764.17	\$29,581
404	Mountain bike-optimized	More Difficult	1059.83	\$1,200.00	\$240.87	\$8.00	\$8,478.67	\$8,720
405	Mountain bike-optimized	More Difficult	1464.97	\$1,200.00	\$332.95	\$8.00	\$11,719.76	\$12,053
406	Mountain bike-optimized	More Difficult	7202.90	\$1,200.00	\$1,637.02	\$8.00	\$57,623.19	\$59,260
407	Mountain bike-optimized	More Difficult	4382.29	\$1,200.00	\$995.98	\$8.00	\$35,058.33	\$36,054
450	Gravity	More Difficult	3032.55	\$1,200.00	\$689.22	\$15.00	\$45,488.22	\$46,177
451	Gravity	Most Difficult	2900.70	\$1,300.00	\$714.19	\$18.00	\$52,212.56	\$52,927
452	Gravity	More Difficult	2901.54	\$1,200.00	\$659.44	\$15.00	\$43,523.11	\$44,183
453	Gravity	Most Difficult	2020.90	\$1,300.00	\$497.57	\$18.00	\$36,376.24	\$36,874
Zone Subtotal					\$9,517.70		\$422,496.56	\$432,014.26

Permitting	\$8,000.00
Signage Subtotal	\$7,500.00
Grand Total	\$447,514.26

Cost opinion tables include estimated permitting and signage costs for planning purposes only. Detailed signage and permitting costs will be developed during design. These costs may be outside the scope and funding of BAMBA.

Zone 5: Blue Marsh Lake Trails Cost Opinion								
Segment	Type	Difficulty Level	Length (ft)	Design Cost per Mile	Design Subtotal	Construction Cost per Foot	Construction Subtotal	Segment Total
500	Mountain bike-optimized	Easiest	1838.71	\$1,000.00	\$348.24	\$6.00	\$11,032.26	\$11,381
501	Mountain bike-optimized	Easiest	1550.45	\$1,000.00	\$293.65	\$6.00	\$9,302.69	\$9,596
502	Mountain bike-optimized	Easiest	1820.61	\$1,000.00	\$344.81	\$6.00	\$10,923.67	\$11,268
503	Mountain bike-optimized	Easiest	1807.76	\$1,000.00	\$342.38	\$6.00	\$10,846.55	\$11,189
504	Mountain bike-optimized	More Difficult	1997.15	\$1,200.00	\$453.90	\$8.00	\$15,977.17	\$16,431
505	Mountain bike-optimized	Easiest	2414.00	\$1,000.00	\$457.20	\$6.00	\$14,483.99	\$14,941
506	Mountain bike-optimized	More Difficult	2949.29	\$1,200.00	\$670.29	\$8.00	\$23,594.30	\$24,265
Zone Subtotal					\$2,910.46		\$96,160.63	\$99,071.09

Permitting	\$3,000.00
Signage Subtotal	\$5,500.00
Grand Total	\$107,571.09

Zone 6: Blue Marsh Lake Trails Cost Opinion								
Segment	Type	Difficulty Level	Length (ft)	Design Cost per Mile	Design Subtotal	Construction Cost per Foot	Construction Subtotal	Segment Total
600	Mountain bike-optimized	More Difficult	7102.47	\$1,200.00	\$1,614.20	\$8.00	\$56,819.75	\$58,434
601	Mountain bike-optimized	More Difficult	3671.62	\$1,200.00	\$834.46	\$8.00	\$29,372.97	\$30,207
602	Mountain bike-optimized	More Difficult	5776.96	\$1,200.00	\$1,312.94	\$8.00	\$46,215.66	\$47,529
603	Mountain bike-optimized	Most Difficult	5825.65	\$1,300.00	\$1,434.35	\$10.00	\$58,256.52	\$59,691
Zone Subtotal					\$5,195.95		\$190,664.91	\$195,860.85

Permitting	\$5,000.00
Signage Subtotal	\$2,500.00
Grand Total	\$203,360.85

Zone 7: Blue Marsh Lake Trails Cost Opinion								
Segment	Type	Difficulty Level	Length (ft)	Design Cost per Mile	Design Subtotal	Construction Cost per Foot	Construction Subtotal	Segment Total
700	Mountain bike-optimized	More Difficult	2769.45	\$1,200.00	\$629.42	\$8.00	\$22,155.59	\$22,785
701	Mountain bike-optimized	More Difficult	3551.36	\$1,200.00	\$807.13	\$8.00	\$28,410.86	\$29,218
Zone Subtotal					\$1,436.55		\$50,566.45	\$52,002.99

Permitting	\$3,000.00
Signage Subtotal	\$1,250.00
Grand Total	\$56,252.99

Cost opinion tables include estimated permitting and signage costs for planning purposes only. Detailed signage and permitting costs will be developed during design. These costs may be outside the scope and funding of BAMBA.

Proposed Blue Marsh Lake Trails					
Segment	Type	Length (ft)	Length (mi)	Difficulty Level	Intended Users
100	Mountain bike-optimized	6219.52	1.18	Easiest	Hikers & Bikers
101	Mountain bike-optimized	9595.41	1.82	Easiest	Hikers & Bikers
102	Mountain bike-optimized	3378.42	0.64	More Difficult	Hikers & Bikers
103	Mountain bike-optimized	5471.42	1.04	Easiest	Hikers & Bikers
104	Mountain bike-optimized	6463.10	1.22	Easiest	Hikers & Bikers
105	Mountain bike-optimized	5043.43	0.96	More Difficult	Hikers & Bikers
106	Mountain bike-optimized	818.73	0.16	Easiest	Hikers & Bikers
107	Mountain bike-optimized	5355.24	1.01	More Difficult	Hikers & Bikers
108	Mountain bike-optimized	5895.95	1.12	More Difficult	Hikers & Bikers
109	Mountain bike-optimized	5722.85	1.08	More Difficult	Hikers & Bikers
110	Mountain bike-optimized	493.37	0.09	Easiest	Hikers & Bikers
130	Traditional	1410.27	0.27	More Difficult	Multiuse
131	Traditional	1256.18	0.24	More Difficult	Multiuse
150	Gravity	3654.57	0.69	Easiest	MTB
151	Gravity	3749.81	0.71	Easiest	MTB
152	Gravity	3482.71	0.66	More Difficult	MTB
200	Mountain bike-optimized	4000.63	0.76	Easiest	Hikers & Bikers
201	Mountain bike-optimized	2638.65	0.50	Easiest	Hikers & Bikers
202	Mountain bike-optimized	4135.49	0.78	More Difficult	Hikers & Bikers
203	Mountain bike-optimized	1629.39	0.31	More Difficult	Hikers & Bikers
204	Mountain bike-optimized	1152.79	0.22	More Difficult	Hikers & Bikers
230	Traditional	1185.53	0.22	Easiest	Multiuse
300	Mountain bike-optimized	4020.94	0.76	More Difficult	Hikers & Bikers
301	Mountain bike-optimized	1026.10	0.19	More Difficult	Hikers & Bikers
302	Mountain bike-optimized	2234.20	0.42	More Difficult	Hikers & Bikers
303	Mountain bike-optimized	3904.74	0.74	Most Difficult	Hikers & Bikers
304	Mountain bike-optimized	3197.45	0.61	Most Difficult	Hikers & Bikers
305	Mountain bike-optimized	675.94	0.13	More Difficult	Hikers & Bikers
306	Mountain bike-optimized	2355.26	0.45	Most Difficult	Hikers & Bikers
307	Mountain bike-optimized	3564.64	0.68	Most Difficult	Hikers & Bikers
330	Traditional	1790.59	0.34	More Difficult	Multiuse
331	Traditional	1399.25	0.27	More Difficult	Multiuse
332	Traditional	3324.47	0.63	More Difficult	Multiuse
400	Mountain bike-optimized	2694.62	0.51	More Difficult	Hikers & Bikers
401	Mountain bike-optimized	2938.54	0.56	More Difficult	Hikers & Bikers
402	Mountain bike-optimized	7273.38	1.38	More Difficult	Hikers & Bikers
403	Mountain bike-optimized	3595.52	0.68	More Difficult	Hikers & Bikers
404	Mountain bike-optimized	1059.83	0.20	More Difficult	Hikers & Bikers
405	Mountain bike-optimized	1464.97	0.28	More Difficult	Hikers & Bikers
406	Mountain bike-optimized	7202.90	1.36	More Difficult	Hikers & Bikers
407	Mountain bike-optimized	4382.29	0.83	More Difficult	Hikers & Bikers
450	Gravity	3032.55	0.57	More Difficult	MTB
451	Gravity	2900.70	0.55	Most Difficult	MTB
452	Gravity	2901.54	0.55	More Difficult	MTB
453	Gravity	2020.90	0.38	Most Difficult	MTB
500	Mountain bike-optimized	1838.71	0.35	Easiest	Hikers & Bikers
501	Mountain bike-optimized	1550.45	0.29	Easiest	Hikers & Bikers
502	Mountain bike-optimized	1820.61	0.34	Easiest	Hikers & Bikers
503	Mountain bike-optimized	1807.76	0.34	Easiest	Hikers & Bikers
504	Mountain bike-optimized	1997.15	0.38	More Difficult	Hikers & Bikers
505	Mountain bike-optimized	2014.00	0.38	Easiest	Hikers & Bikers
506	Mountain bike-optimized	2949.29	0.56	More Difficult	Hikers & Bikers
600	Mountain bike-optimized	7102.47	1.35	More Difficult	Hikers & Bikers
601	Mountain bike-optimized	3671.62	0.70	More Difficult	Hikers & Bikers
602	Mountain bike-optimized	5776.96	1.09	More Difficult	Hikers & Bikers
603	Mountain bike-optimized	5825.65	1.10	Most Difficult	Hikers & Bikers
700	Mountain bike-optimized	2769.45	0.52	More Difficult	Hikers & Bikers
701	Mountain bike-optimized	3551.36	0.67	More Difficult	Hikers & Bikers
Total (mi)		36.82	100%		
Total Traditional (mi)		1.96	5%		
Total Mountain bike-optimized (mi)		30.74	83%		
Total Gravity (mi)		4.12	11%		
Total Easiest (mi)		10.10	27%		
Total More-Difficult (mi)		22.22	60%		
Total Most-Difficult (mi)		4.50	12%		

Appendix D: Present Day Mountain Bicycling

The sport of mountain biking has evolved radically since its recognized birth in the mid-1980s. Bicyclists began tinkering with fat tires to hybridize bicycles so that they could leave the paved roads to explore dirt roads and singletrack trails. Lower gearing, powerful brakes, and lightweight frames allowed riders to get further in a single backcountry outing than hikers or runners.

Mountain bikes and riders continue to evolve, with dozens of types of mountain bicycling alternatives. Purpose-built trails, bike parks, and amenities have improved to accommodate any skill level from beginner to expert. Until recently, mountain biking in Maine occurred on fairly traditional singletrack or dirt roads.

Today's riders are sophisticated, desiring every possible choice from taking young children on gently groomed trails to seeking intense experiences with higher consequences.

Not only has the pastime grown in popularity to meet the needs of enthusiast riders, but, it has widened in diversity to accommodate a wide variety of trail experiences. When the sport began, there was a strong emphasis on advanced riding. Trails were very difficult, and bikes were not kid friendly. Both issues have now been solved with the development of progressive, modern trail systems and bike park facilities.

In Arkansas, consumer spending on outdoor recreation contributes \$9.7 billion annually to the state economy. The Arkansas outdoor recreation economy also:

- Supports more than 96,000 direct jobs across the state.
- Generates more than \$2.5 billion in wages and salaries.
- Generates \$698 million in state and local taxes.

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

- Contributes \$133 billion annual contribution to the U.S. economy.
- Supports nearly 1.1 million jobs across the U.S.
- Produces \$53.1 billion annually in retail sales and services.

A [2018 economic impact study](#) released by the Walton Family Foundation describes in detail the \$137 million benefit from trails in Northwest Arkansas to the Arkansas economy in 2017, of which \$27 million came from tourism dollars.

Singletrack Trails

Singletrack trails are the bedrock of mountain biking. Singletrack differs from dirt roads and doubletrack mostly by trail width. Whereas the latter two routes allow users to travel side by side, singletrack is narrow enough to allow users to travel only in single file. Trails take on a wide variety of flavors from smooth and rolling to rough and rowdy. Trails are designed and constructed to meet certain experience goals, with some of the most important factors being intended user groups, directionality, and difficulty level.

Traditional Singletrack

These natural surface trails are most often multiuse, and typify what most people envision when they hear the word trail. Traditional singletrack trails should be constructed and maintained using techniques that minimize user conflict and maximize a natural surface texture and trail corridor, the area above and to the sides of the trail. This type of trail should be narrower than a flow trail, to reduce speed. These trails will see both bike and foot traffic, so care should be taken to avoid obstacles or features such as jumps, rollers, or water bars that might exclude some user types. Turns will be constructed sustainably but will not be cambered or bermed to optimize cornering traction for bikes.



Mountain Bike Trails

Mountain bike trails are optimized for mountain bike use while still providing an enjoyable experience for other user groups. Typically, pedestrians are the most common shared visitor type. Entire trails may be optimized for bike use, or particular segments, most often downhill portions, may be geared to riders and limited to travel in one direction. Bike-optimized features enrich the riding experience by adding fun and providing opportunities for riders to build their skills. Obstacles such as berms, rollers, wide turn radii, bridges, rock gardens, jumps, and drops are characteristic bike features. The feature density for mountain bike-optimized trails is higher than traditional singletrack but not quite as high as flow trails.

Flow Trails

Flow trails are purpose-built or modified singletrack trails, the majority of which contain a high density of specific features to enhance the riding experience and provide challenge. They harness gravity so that riders feel as though they are flowing through a succession of exhilarating features from top to bottom. These trails are directional, in order to promote optimal circulation patterns, maximize the visitor experience, and minimize user conflict. Flow trails do not have to compromise their downhill design by having to consider riders traveling in both directions.

These descending trails are designed to provide a “roller coaster” sensation to users by maximizing the efficiencies afforded by a bicycle and by counteracting forces that direct a user off of the trail. Berms and cambered tread surfaces, for example, promote traction, safety, sustainability, and enjoyment. These trails are never extreme, dangerous, or steep; challenge is provided by rewarding progressive skill development and incorporating features that can always be rolled but may be jumped. While a flow trail is singletrack, the tread surface itself should be wider in areas where it is anticipated that less-experienced visitors may need a greater margin of error.

The climbing trails that access flow trails are designed to provide a variety of optional technical climbing challenges while maximizing elevation gain and minimizing user exertion to allow riders to conserve energy for the descent.



Community Bike Park Facilities

Community bike parks are more intensely designed than singletrack trails. They offer a small area where users can practice their skills, progress, and have fun in a relatively well managed manner. Bike parks are typically located in an existing park or similar area.

Tot Track

A tot track is designed for smaller bicycles and users. It features reduced-sized rollers as well as low-angle bermed turns. It has features that can accommodate balance bicycles as well as regular bikes with short wheelbases. The tot track is designed for the least skilled of riders. This facility is recommended near the existing recreational facilities in City Park, directly next to the playground. Tot tracks are essentially smaller versions of pump parks, and like pump parks can be dirt or a hardened surface. Asphalt is the recommended surface material for this tot track. Asphalt is more expensive to install but greatly reduces maintenance costs and importantly, provides a consistent high-quality experience for the users.



Pump Park

A pump park (also known as pump track) is designed to help cyclists of all skill levels to improve their riding skills. Pump parks are multidirectional and allow users to create their own 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 a pump park is an extremely anaerobic activity, so it is recommended that suitable seating and shade structures be installed for users to rest between sessions. The pump park site is proposed near the jump line and parking lot one in Quarry Park. The pump park, like the tot track, is recommended to have an asphalt surface

Skills Area

Users looking to practice beginner to intermediate technical riding skills in a low- consequence environment can learn in a skills area. This trail zone can include numerous optional stations where users can practice on features designed to teach specific skills. Features may include skinny bridges, drops, rollers, and more. Typically, features are man-made, sometimes prefabricated. Locating a skills area along the proposed Terrapin Skin bike path could provide over 1,000 linear feet of skills development trail to all riders.



Dirt Jumps

Dirt jumps consist of tabletops 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 so that the start hill is the highest elevation point and provides sufficient gravity to propel riders into the jump lines. Dirt jumps are incredibly fun, a great workout, and an excellent practice area for building solid bike jumping skills. These areas are designed to be ridden in one direction, eliminating potential conflicts. Dirt jumps require soil with a high percentage of clay (60-70%) that compacts very hard, minimizing rolling resistance and standing up to heavy use and high shearing forces.

Installing engineered structures for the jump takeoffs substantially minimizes maintenance and improves the consistency of the user experience. Structures, such as ramps with lips, can be fabricated with steel and wood or hardened with asphalt and at times with concrete.



Technical Challenge Loop

Users looking to practice intermediate to advanced level technical riding skills in a low-consequence environment can utilize the technical challenge loop. This type of trail can feature numerous optional skill stations such as drops, jumps, rock gardens, and rollovers that directly challenge technical riding skills. Users can practice on natural and man-made features designed to teach advanced mountain bicycling skills. Typically, these features mimic the skills areas features but to a higher degree of difficulty. Aesthetics can be important, as is matching natural trail conditions, therefore dirt, wood, and rocks are the most commonly used materials. A rock skills loop is proposed surrounding the pump park in Quarry Park.



Lifted and Tilted Tread Type

Traditional rolling contour trails run along the side of a slope, perpendicular to the fall line. They are constructed with an outsloped tread to allow cross-slope drainage of runoff. However, not all proposed trail locations have enough sideslope for drainage, and frequent trail use may eradicate an outslope within a short time.

A new trail construction method, “lift and tilt,” is a way of raising the tread above the existing grade while simultaneously lowering the grade of areas off the trail that act as natural drains. This enhances tread drainage while increasing the fun factor for mountain bikers. Borrow basins are dug to harvest suitable mineral soil to lift and tilt the tread. Woody debris is used to replace the soil taken from the borrow basins, which are then masked and blended with organics to create natural-looking low points for drainage. This technique holds the rider on the trail while directing water off the tread into the basins.

This method can be implemented on any scale, using smaller machines to provide a singletrack feel or larger machines to create wide trails with a true bike park flow. Visitor numbers, rainfall, and soil type may require the use of culverts and sumps to keep trails rideable while providing drainage. The trail can have an increased emphasis on fun, flow, and airtime depending on the designated trail user.

For shared-use trails, which generally cater to beginning riders, the dial can be turned down with mellower grades, less undulation, and feature frequency. For advanced trails, the dirt features can be more dynamic with larger rollers and jumps, bigger drops, and steeper banked turns, giving riders play in the vertical plane. Flatter areas that may have been avoided in the past can now be designed to provide an exciting riding experience. The lift and tilt method is often used for pump tracks, flow trails, jump trails, and other bike-optimized amenities.



Appendix E: Benefits of Mountain Bicycling 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.

Appendix F: General Trail Planning and Design Guidelines

The following are guidelines for the construction and maintenance of future 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.

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.



Purpose-Built Singletrack Trails

Singletrack is defined as a dirt path narrower than double-track or fire road, usually 12 to 36 inches wide. Singletrack trails are not typically accessible by ATVs or other four-wheeled vehicles. Singletrack may be smooth or rocky, flat or steep, among many other attributes and building techniques.

Trails with grades that average between 3 – 10% and do not exceed half of the grade of the sideslope, or fall line, are easier to maintain. Keeping trail grades within certain ranges ensures both a positive trail experience for users and proper stormwater drainage with minimized erosion. Mountain bikers have become sophisticated, seeking purpose-built trails that offer a wide range of difficulty levels, terrain diversity, and genre types. Purpose-built trails are constructed with specific users in mind in order to optimize their experience with features and design.

Looking to the future, understanding what users may want and meeting their demands increases the sustainability of the trails and the overall trail system.

- Easier/Beginner (Green) trails have a smoother and wider tread, lower trail grades, and less exposure.
- More-Difficult/Intermediate (Blue) trails can be steeper, more technically difficult, or longer.
- Most-Difficult/Advanced (Black) trails offer a combination of difficult trail tread, technical features, and long distances for those looking for challenge and endurance-oriented experiences.
- Expert (Red) trails will be the most difficult and challenging in skill level.

The ridership within each category can be divided into the following groups: novice, intermediate, and advanced. Using a basic bell curve distribution, it can be assumed the majority of mountain bicyclists in any category and as a whole are intermediate riders. Beginner riders correspond with (Green) rated trails, intermediate riders with (Blue) rated trails, and Advanced riders with (Black) rated trails. More Advanced trails (Double Black) are typically required by a relatively small but very passionate contingent of ridership. A reasonable percentage of Double Black should be built as demand increases.

Stacked Loops

Stacked loops enable users to share many different levels of trail. In a stacked-loop system, the loops that are closest to the trailheads are more inviting to children, beginners, or families 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. The loop construction also allows users of all levels to ride the trails and improve their fitness and skill while enjoying the natural world.

Bidirectional trails can be ridden in either direction, thereby essentially doubling the trail options and allowing users to complete a loop and avoid an out-and-back route. Loops vastly increase the trail opportunities for beginner to expert mountain bikers, including families and groups.

Progressive Hubs and Clusters

All shared-use trails are created with skill level progression in mind. With progressive trail features, a mountain biker may become a better rider by gradually moving up in trail difficulty. It is proposed that this trail system offers features of varying skill levels so that riders may find a trail that matches their skills and progress.

Hubs and clusters give users more trail options for varying skill levels at each hub, allowing for skill level diversity. A trailhead or major trail intersection is usually a hub. A rider may start out on a beginner trail and then graduate on to a more difficult trail at the next hub. At many intersections, there is the option to change the trail difficulty or continue on the same difficulty level.

This practice spreads out visitors and helps reduce trail user conflict. Signage includes 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. A cluster is a concentration of trails with all levels of difficulty.

Providing consistent climbs and extended descents is a design priority. In most cases, the trails 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.

The most challenging trails and terrain will be further away from the proposed parking hubs, rewarding those willing to travel longer distances. This is also a proven risk management tool. Putting the difficult segments further out of reach of beginners, and giving riders time and distance to warm up before reaching those technical segments, provides a level of safety in the system.

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. 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. 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*. These guidelines are appropriate for any hike, bike, or equestrian trail.

Signage

The development of a mountain bike trail network requires the development of a comprehensive system of signs. Signs are the most important communication tool between land managers and trail users. A well-implemented and maintained signage system enhances the user experience by helping visitors navigate the trail network and 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, 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, guide users to destinations and key points of interest, and provide information on regulations and allowed uses. Signage can also be interpretative; helping visitors learn about responsible recreation and trail etiquette, learn about resource protection, and reduce risk and hazards.

Informational signs: Usually positioned at the trailhead and major intersections. Provide details such as trail length and difficulty. These include trailhead identification signs (from a road); signs at a trailhead kiosk with a complete map and description of all the nearby trails and facilities, local regulations, emergency contact information, and educational messages; trail intersection signs; waymarks; difficulty rating signs; and trail length or elevation gain and loss signs.

Regulatory signs: Delineate rules, such as prohibited activities, direction of travel, or other restrictions.

Directional signs: Provide navigational information.

Warning signs: Warn trail users of upcoming hazards or risks. These include visitor rules and regulations signs, allowed activities, road and trail intersections, and emergency signs.

Educational signs: Provide guidelines for responsible recreation and trail etiquette.

Interpretive signs: Describe natural or cultural resources. These include educational and responsible use signs.



Design Flagging

It is optimal to flag corridors just before the permitting review team is available to physically tour the flag line, so as not to lose flags from sunlight, wind, animals, humans, and other elements. Design and flagging costs will depend on conditions, accessibility, terrain, time of year, and other factors. For the Millinocket town trails, it is recommended a professional mountain bike trail designer be contracted to provide design as needed. Typically, a professional trail builder can complete 5-10 miles in a build season in the Millinocket area. Flagging should not outpace anticipated construction. Design should include design development documents to ensure the construction team creates the experience intended and does not ruin future opportunities.

Construction

Creating the proposed trail network of traditional singletrack trails, mountain bike-optimized trails, gravity trails, and bike park elements will guarantee a unique destination drawing riders from afar while giving local residents an exhilarating outdoor activity close to home. Construction should be provided by a combination of professionals and volunteers. Skilled mountain bike trail builders should work on the mountain bike-optimized and gravity trails. Volunteers can provide much of the preparation and finishing work between machine operators on the traditional singletrack trails, though volunteer involvement should occur during all construction. A phased plan of action will ensure continued enthusiasm for the Millinocket trails. Machines applicable to the landscape and style of trails include: mini-excavators, mini-skid steers, tracked haulers, and plate compactors. Currently, the KAT trail construction crew has the capability to build the traditional singletrack trails proposed within Millinocket. A qualified mountain bike trail builder is required to manage the work and ensure a high-quality riding experience. A good rule of thumb is: A builder can only build to their riding ability; if you can't ride it, you shouldn't build it.