

# Arms Grant Property Trail System

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## Trail Maintenance Management Plan and Inventory

**Prepared by Sinuosity, LLC**

**For the City of Burlington Department of Parks & Recreation**

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The unique Urban Wild of Arms Park contains approximately 3.5 miles of trail serving various user types in a unique natural setting within the New North End of Burlington, VT. Maintaining and reconstructing the trails to a standard of safety and durability throughout the trail system will enable park visitors to continue their enjoyment of the natural habitats and rare species near the trails, while mitigating trailside and wetland resource damage.

# Table of Contents

1. <u>Executive Summary</u> .....	
Management Plan Highlights .....	
2. <u>Introduction</u> .....	
2.1 Arms Grant Property Description .....	
2.2 Natural Resources of Arms Grant Property .....	
2.3 Trail System .....	
2.4 Trail Users .....	
2.5 Current Access Points and Parking .....	
2.6 Parking and Access Recommendations .....	
3. <u>Trail Management Plan</u> .....	
3.1 Need for a plan .....	
3.2 Purpose of the Plan .....	
3.3 Planning Team and Process .....	
4. <u>Purpose and Goals</u> .....	
4.1 Purpose of Trail System .....	
4.2 Trail System Goals .....	
5. <u>Trail Standards and Classification</u> .....	
6. <u>Trail Inventory (Map)</u> .....	
6.1 X-Country Course .....	
6.2 Church Spur Trail .....	
6.3 Bike Boardwalk .....	
6.4 High Point Region .....	
6.5 Outlook Spur .....	
6.6 Northern Singletrack .....	
6.7 Buckthorn Loop .....	
6.8 Hiker Trail .....	
6.9 East Side Singletrack .....	
6.10 North Avenue Entrance .....	
6.11 Rock Point Access Trail .....	
6.12 Bike Path Access Spur .....	
6.13 Elks Access Spur .....	
7. <u>Maintenance and Management Recommended Schedule</u> .....	
7.1 Annual Maintenance .....	
7.2 Maintenance and Reconstruction Schedule Summary .....	

7.2 Costs and Partnerships .....	
7.4 Partnerships and Stakeholders.....	
8. <u>Summary of Recommendations</u> .....	
9. <u>Appendix</u> .....	
9.1 Maps .....	
9.2 Photographs of Current Trail Conditions.....	
9.3 Recommended Trail Structure Photo Examples.....	
9.3 References .....	
9.4 USFS Class Matrix .....	

## **1. Executive Summary**

The Arms Property Trail System totals approximately 3.5 miles of existing trails located primarily on the Arms Grant Property as well as adjacent properties in the New North End. Current trail users include walkers, hikers, trail and cross country runners, various levels of mountain bikers and x-country skiers. Populations accessing the trails include local residents, Burlington High School x-country running and skiing teams and classes, visitors to Rock Point and its ropes course/camp, Church members, bikers traveling from further neighborhoods or accessing the bike path, as well as those who drive from further and park at the Elks Club.

The trails in this system range in difficulty from Easy to Expert, providing both a more manicured and rustic experience through varied terrain. The area of Arms Grant Property is a designed Urban Wild and is home to unique natural communities, low lying vernal pools and seeps, as well as calcium rich exposed bedrock lending a unique character to the landscape providing habitat for the seven rare plant species that have been documented on this property.

Current trail use levels range from heavy on the main x-country loop to low on some of the less developed trails. While there have been some improvements made to the trails more recently, there are many areas where trails are widening, difficult to follow, eroding or otherwise less safe and durable than is desired. By bringing the trails up to a standard of safety and durability, closing un-needed trails, and providing re-routes that will be more durable and sustainable, the trail system and surrounding habitats can be further appreciated and protected for future generations.

## **2. Introduction**

### 2.1 Arms Grant Property Description

Arms Grant Property is a 30.5 acre property located in the New North End of Burlington, VT. It is bordered by North Ave, The Episcopal Diocese, Burlington High School, numerous residential sites, the Elks Club and North Avenue Alliance Church. The trails encompassed by the Arms Grant Trail System originate from and travel through all of the adjacent lands, including some residences. The property itself has been under ownership of the City of Burlington since 1962, though the date of construction of the trails is currently unknown. It was designated as an Urban Wild according to the Burlington Conservation Legacy Program in 2002.

### 2.2 Natural Resources of Arms Property Trail System Area

The landscape of the Arms Property Trail System Area is characterized by a mixture of gently sloping to moderately sloping terrain scattered with areas of calcium rich exposed bedrock interspersed with vernal pools, seeps and shrub swamps. The vegetation is diverse due to the calcium contributed from the local bedrock. Natural Communities documented on the Arms Grant Property include Mesic maple-ash-hickory-oak forest and Transition hardwoods limestone forest with patches of Hemlock, Beech, and White Pine. Seven rare plants were found on the Arms Property in 2002 and documented and locations recorded in the Arms Grant Property Inventory, Assessment & Management Plan, 2003. This forest, along with contiguous lands of Lone Rock Point forest provide for a variety of local wildlife habitat for a range of reptiles, amphibians, mammals and birds. None of these species are considered rare or threatened but they are uncommon in adjacent urban areas of Burlington City Limits.

### 2.3 Trail System

The Arms Property Trail System includes approximately 3.5 miles of trail and is located primarily on the Arms Grant Property. Some sections of trail extend onto parcels owned by Burlington High School, the Episcopal Diocese, and the Elks Lodge. Trail class currently ranges from Class 3 (Developed) to Class 1 (Minimally Developed). Many, if not all, of the trails are user created and were generally user maintained until more recent minor improvements by Burlington City Park trail staff.

### 2.4 Trail Users

Cross Country Running/Skiing- These activities occur mainly by the Burlington High School teams who use this area for both racing and training. The use is contained to the Class 3 trail sections (see Appendix for course map).

Hiking/Walking- User created paths from nearby neighborhoods to the Trail System indicate a fair amount of residential foot traffic. User created trails accessing the high point of the property (which overlaps the Rock Point and Arms Property) are primarily for foot travel and are currently in Class 1 and Class 2, though many sections of the Class 3 trail may be used for access to this high point feature.

Students and Classes also use the Arms Property Trails System to access resources used to support class related educational opportunities. Among these are access to a ropes course located on the Rock Point property, currently accessible on a spur trail from both the Class 3 loop and the Bike Path.

Bikers- The Arms Property Trail System provides an opportunity to fulfill the growing recreational needs of the local mountain bike community. Informal trails on the Arms Property Trail System have been built and used by mountain bikers for almost two decades. The Arms Property Trail System allows for a variety of mountain biking opportunities at different skill levels, from beginner to intermediate and advanced.

### 2.5 Current access points and parking

Though there is no designated parking area on the Arms Park Property, the Arms Property Trail System can be accessed from all directions. There is a designed Trail Parking Area on the Episcopal Diocese Rock Point Property to the south, though the only trail leading from this parking to the Arms Property Trail System is in disrepair and is recommended for closure unless it can be brought up to a safe and durable standard. Parking may be possible at the Burlington High School, though it is limited. Additional unofficial parking is available at the Elks Lodge to the North, which is dependent on concurrent events.

There are currently numerous northwesterly access points connecting adjacent residences to the park via the Elks Lodge Property, which also links to the only westerly access to the Arms Park Trail System via the bike path.

There are currently five southeasterly access points from Burlington High School. The main access point for the general public to the east is the North Avenue entrance. Other smaller spur trails provide access from residences to the Northeast of the Arms Property Trail System.

### 2.6 Access and parking recommendations

Though unofficial parking is available at the Elks Lodge, use is contingent on event schedule and available spots. As most trail users enter the park from the Bike Path and the eastern entrances, it is recommended that entrance kiosks with trail use and educational information be installed to support the efforts taken through the implementation of this plan. Additionally, the Burlington High School would provide an optimal site for a small designated parking area to support the use of the Arms Property Trail System.

As mentioned previously, the southern Rock Point access to the Arms Park Trail System is recommended for closure unless the trail can be brought up to standard. Challenges of this section are the long term maintenance needs of the trail and difficulty in trail location due to local topography and drainage (see trail map and inventory for details). Additionally, the most southerly access point from the Burlington High School is recommended for closure due to redundancy and severe erosion.

### **3. Trail Management Plan**

#### 3.1 Need for a Plan

The Arms Property Trail System appears to have been informally created by users and minimal trail improvements have been made to manage the diverse user groups. Many trail users have created their own trails as they felt a need for greater recreational opportunities. Without clearly designated, sustainably built and maintained trails, the trails will continue to erode or widen, potentially harming threatened and protected species found on the property. Continued erosion can adversely affect nearby wetlands as well as the safety and user experience of those who visit the Arms Property Trail System.

Along with the need for a comprehensive plan and its implementation to mitigate areas of trail degradation, there is a need for user groups and adjacent landowners to collaborate with Burlington City Parks and Recreation in the management of this trail system. Because of the nature of the current shared property ownership, the future of the trail system is reliant upon this cooperation.

#### 3.2 Purpose of the Plan

The primary purpose of this Trail Maintenance Management Plan is create a comprehensive inventory of existing trails and their conditions and to create a 5 year plan of recommended improvements to bring each trail up to a standard of safety and sustainability. Other goals of the plan include identification of current trail users and their recreational and safety needs. These recommendations must also be balanced with the protection of the sensitive and rare species throughout the natural area.

#### 3.3 Planning Team and Process

This plan was created by Brooke Scatchard and Mariah Keagy of Sinuosity, LLC. Brooke specializes in GIS mapping and mountain bike trail construction, layout and design. Mariah's specialties encompass a broad range of multi-use, non-motorized and pedestrian recreation management practices. This plan was completed in coordination with the Burlington Parks and Recreation Land Steward, Dan Cahill.

The trail system was systematically assessed over the course of three field days. Data was collected for: current class, recommended target class, existing structures, areas of needed trail improvement (based on user safety), existing and potential erosion (based on user group, use of trail, trail slope and substrate), trail widening, and trail redundancies. A range of recommendations for trail improvements were made and assigned a priority.

This data was collected in coordination with GPS data points to allow for the creation of GIS maps to clearly indicate the location of all data sites on their corresponding trail section. These maps and associated data will assist land managers in the implementation of maintenance and trail improvement projects according to the recommended 5 year maintenance and reconstruction schedule included in this Plan. Costs for labor and supplies are included for each recommended improvement and incorporated in both the maintenance and improvement schedules and the trail inventory for each section.

## 4. Purpose and Goals

The mission of the Burlington Parks and Recreation Department is to enhance quality of life of all the citizens of Burlington and for the visitors to our community in the following ways:

- By acquiring, developing and maintaining a system of parks which offers a broad spectrum of built facilities and open spaces.

Urban Wilds apply to Burlington City properties which “provide habitat for rare and endangered plant and animal communities, wetlands and other riparian systems, floodplain, unique geological and hydrological features, important wildlife habitat and travel corridors, areas important for scientific research and education, scenic vistas, trails, passive recreation, sustainable forest communities, and cultural features.” (insert reference)

### 4.1 Purpose of Trail System

The Arms Property Trail System currently provides a variety of recreational opportunities to the nearby Burlington High School and Rock Point School students, nearby residents, and occasional bike path users looking for a less developed recreational experience. Arms Property Trail System currently provides a range of trail sections providing recreational opportunities for cross-country running and skiing, and trails serving a range of hiking and mountain biking difficulty. Currently many of the existing Class 1 and Class 2 trails are user created, thus indicating a clear need for additional designed recreational opportunities in the area.

Although creating safe and sustainable recreation opportunities for residents of Burlington is a goal of the Arms Property Trail System, it is also designated as an Urban Wild. According to this designation, the area is to be managed to preserve the features that make the land unique and to provide recreation that is compatible with the sensitivity of the land and its conservation. A well managed trail system will protect this unique habitat while also providing opportunities for safe recreational enjoyment of these same unique features.

### 4.2 Trail System Goals

The goals of the Arms Property Trail System are to provide a variety of safe recreational opportunities to Burlington residents that are in keeping with the Urban Wilds land conservation designation. If the trails within the Arms Property Trail System are brought up to maintenance standards on an annual maintenance schedule, while consistently making trail improvements to areas of disrepair, the trail system can continue to support the current trail users without threatening to have adverse effects on the local wetlands and rare species scattered throughout the property. Future management of the Arms Property Trail System may serve to support niches of recreational opportunities which are less afforded in other Burlington City Parks, such as quiet areas where the dominant visual and auditory experience is of the surrounding natural space.



## **5. Trail Standards and Classification**

The trail standards adopted for this property are those used by the USFS within the Trail Management Objectives, with consideration to the user group, current class and desired target class for the user group on each section of trail. Classes are determined by the USFS Trail Condition Assessment Survey Matrix. Classes range from 1-5, with one being minimally developed and 5 being fully developed.

Factors considered in the rating of the TMO are slope, protrusions and obstacles within the tread way, width of tread way and trail structures, corridor, and surface material. If one section of trail is rated in a lower class, the entire trail falls into that class. Class stipulations for these variables change with the designed use for the trail.

The Arms Property Trails System currently contains sections of trail ranging from Class 1 to Class 4 for the designed uses of pedestrian, x-country skiing, and bicycle travel. No trail is consistently Class 4 or Class 1. The goal of implementing this Trail Maintenance Management Plan is to bring all trails up to safe and durable standards and generally in a Class which supports the desired use. In most cases, the trails will be Class 2 or Class 3, with short alternate sections of bike/hike trails which may fall into the Class 1 due to height of protrusions in the tread way. Please see the Appendix for reference.

Additional standards used within the classifications of the Arms Property Trails System are the ratings of Easy, Moderate, Advanced, and Expert where applicable. This rating system is very user friendly and has been added for ease of implementation of the Trail Maintenance Management Plan. For additional references on trail maintenance, reconstruction and design please see references in the Appendix.

## 6. Trail Inventory

### **6.1 X-C Course**

*Current Class for Designed Use*

*Pedestrian: 3*

*Bicycle: 4*

*X-Country Ski: 2 (un-groomed)*

***Targeted Designed Use: Pedestrian, Bicycle, X-Country Ski***

***Recommended Target Class***

***Pedestrian: 3***

***Bicycle: 4***

***X-Country Ski: 3 (un-groomed)***

Summary of Current Use: The X-C Course is under current seasonal use by the BHS as part of their training and competition X-C running course (see map in appendix). It is also used as an easier route by hikers and bikers, providing access westerly to the bike path. Winter use includes x-country skiing.

Current Status: The current trail corridor averages 10 feet, with few areas of lesser width. There are currently 5 existing bridges with many other low lying muddy areas where the trail has significantly widened or braided. On higher ground there are areas of exposed bedrock and roots minimally protruding into the tread way (4”), with one larger protrusion of 16”. Both Upper Parking lot access points from BHS onto this trail are eroded and gullying, losing significant material downslope.

Summary of Recommended Improvements: Boardwalks and importing tread material to raise the tread will mitigate the current trail widening in wet and muddy areas along with two short reroutes to more sustainable terrain and the instillation of drainage, where possible. Sections of exposed bedrock with occasional protruding rock and roots can be graded with fill to even out the tread way and bring the trail to a continual Class 3 status. To reduce the erosion to the upper BHS parking lot entrances to this trail, drainage features can be installed and paired with closing the more southerly entrance to concentrate use on the more stable route.

Priority: Due to its heavy use many of the trail, improvements needed on this trail should be considered a high priority within the trail system. Of these improvements, the highest priority on this trail consist of a large muddy section in need of bridging (uphill from the junction to the Rock Point Trail) and the eroding section of trail at the bottom of the slope from the upper BHS parking lot entrance.

## **6.2 Church Spur Trail**

### *Current Class for Designed Use*

*Pedestrian: 3*

*Bicycle: 4*

*X-Country Ski: 3 (un-groomed)*

***Targeted Designed Use: Pedestrian, Bicycle, X-Country Ski***

### ***Recommended Target Class***

***Pedestrian: 3***

***Bicycle: 4***

***X-Country Ski: 3 (un-groomed)***

Summary of Current Use: Primarily hiking traffic. This trail serves as a spur trail to connect to the Arms Property Trail System. Use appears generally low.

Current Status: The trail entrance nearest the church has been unsuccessfully resurfaced with wood chips and plastic tarp in areas surrounding a well-built bridge. The remainder of the trail is low lying with muddy sections.

Summary of recommended improvements: 137 feet of surfacing is needed to raise and harden the tread, reducing muddy sections and creating a stable tread way. Removal of the excess tarp is recommended where it is exposed.

Priority: Improvements to the trail are generally low within the trail system due to the use levels of the trail.

## **6.3 Boardwalk**

### *Current Class for Designed Use*

*Pedestrian: 2*

*Bicycle: 2*

***Targeted Designed Use: Pedestrian, Bicycle (Intermediate)***

### ***Recommended Target Class***

***Pedestrian: 2***

***Bicycle: 2***

Summary of Current Use: This section of trail appears to be used by an equal number of foot travelers and bikers with moderate to low use. This trail provides opportunities for an intermediate/beginner leveled loop.

Current Status: This section of trail contains large sections of widening and low lying muddy areas, totaling 208 feet in length. (See photo)

Summary of recommended improvements: 208 feet of boardwalk would bring this trail up to standard and mitigate current trail widening. It is recommended that constructed boardwalk is in keeping with an Intermediate (Class 2) trail experience.

Priority: Trail improvements on this trail are considered of moderate priority (year 2 of the maintenance and improvement plan) since the trail is quickly widening due to the wet and muddy trail conditions. These improvements will bring the entire trail to a Class 2 standard.

#### **6.4 High Point Region**

*Current Class for Designed Use*

*Pedestrian: 2*

*Bicycle: 2*

***Targeted Designed Use: Pedestrian, Bicycle (Moderate/Advanced)***

***Recommended Target Class***

***Pedestrian: 3***

***Bicycle: 2 (with advanced options)***

Summary of Current Use: Use of trails varies from moderate to very low on some sections of trail.

Current Status: This area is currently overcrowded with redundant, hard to follow trails, some of which encroach on areas containing rare and sensitive vegetation. Many of these redundant user created trails are steep and eroded. Short sections of trail are rugged with protruding rock, lacking drainage, or steep and eroding.

Summary of Recommended improvements: Redundant trails in areas that are eroding or nearby known sensitive plants are recommended for closure (see map). Selective closures and improvements will still provide for varied levels of recreational opportunities in the area. One section of re-route (376 feet) is recommended, with two additional shorter reroutes (60 feet and 33 feet). These new sections, combined with rock tread work to cover exposed ledge will bringing this section of trail up to a consistent Class 2/3 status. Drainage installation will also prevent future erosion.

Priority: The re-routes in this section and trail closures are highest priority due to the current erosion of thin soils and presence of rare plant species. Other work in this region is a lower priority due to relative stability of the tread way.

## **6.5 Outlook Spur**

*Current Class for Designed Use*

*Pedestrian: 1*

*Bicycle: 1*

***Targeted Designed Use: Pedestrian***

***Recommended Target Class***

***Pedestrian: 3***

Summary of Current Use: Use of this trail is low to moderate, though more popular with pedestrians as it reaches the high point of the property with a view of Lake Champlain.

Current Status: This area is currently overcrowded with redundant, hard to follow steep and eroding trails. Route finding is difficult in some of these sections.

Summary of Recommended improvements: It is recommended that redundant trails are closed in this area, maintaining one short hiking loop to continue access to the view and high point. Current erosion can be mitigated with the installation of two short sections of wooden check/box steps, totaling 23 steps.

Priority: Due to the amount of erosion in the area, the trail closures are a high priority. The remaining spur trail step installation is a lower priority considering the relatively low use this trail receives.

## **6.6 Northern Singletrack**

*Current Class for Designed Use*

*Pedestrian: 2*

*Bicycle: 1*

***Targeted Designed Use: Pedestrian, Bicycle (Advanced)***

***Recommended Target Class***

***Pedestrian: 2***

***Bicycle: 1 (Advanced)***

Summary of Current Use: Low to moderate bike use, low pedestrian use.

Current Status: This trail is a favorite among advanced bikers because sections of exposed rock create challenges which are less frequent in other areas of the trail system. While this section of trail was user created for challenge, sections of the trail remain to be brought to a safe and stable standard. Short sections of current trail structures are in disrepair, while others are widening due to undefined sections of challenging trail surface, most of which is rugged exposed ledge. Sections of erosion are occurring in a few areas, the longest at the beginning and end of the trail.

Summary of Recommended improvements: Improvements to this trail should be designed to improve the sustainability while retaining the challenging character that is sought by its users. Re-routes are needed on the east and west ends of this trail and total over 250 feet (approximate) with adjacent trail closures of 90 and 20 feet. Exact location of western reroute is undetermined due to an inability to lay out a new trail without the most current data on nearby rare plant species. Cribbing and reconstruction of the tread in short sections will stabilize tread creep that when matched with repairs of existing trail structures will provide a more stable route and mitigate trailside impacts.

Priority: Both reroutes at the ends of this section are highest priority due to the level of erosion. The remainder of the trail improvements are also a high priority to ensure the protection of rare plant species from the threats of tread widening and the continued safety of the trail users.

## **6.7 Buckthorn Loop**

*Current Class for Designed Use*

*Pedestrian: 2*

*Bicycle: 1*

***Targeted Designed Use: Pedestrian***

***Recommended Target Class***

***Pedestrian: 2***

***Bicycle: 2 (Moderate)***

Summary of Current Use: Trail use on this section is moderate to low.

Current Status: This short double-loop section is generally sustainable with the exception of two section of low lying trail, totaling 90 feet. One current section contains challenging exposed bedrock which is inconsistent with the remainder of the Class 2 trail.

Summary of Recommended improvements: Fill can be imported to raise the tread on the low lying section, with the construction of a short re-route (100 feet) to provide a less advanced bike/pedestrian option around the exposed bedrock.

Priority: The work on this section is a higher priority since this trail can be included in intermediately leveled loops created south of the beginner x-country trail.

## **6.8 Hiker trail**

*Current Class for Designed Use*

*Pedestrian: 2*

***Targeted Designed Use: Pedestrian***

***Recommended Target Class***

***Pedestrian: 2***

Summary of Current Use: Trail use on this section is low. It appears to be used primarily by local residents for hiking and dog walking.

Current Status: This short section of trail is currently lightly used primarily by pedestrian traffic due to the slope of the trail in the entry and exit from a low lying wet area. The low area is currently a wet crossing filled in with rotting dead and down wood to allow passage. The wet area is identified as a seep.

Summary of Recommended improvements: In order to bring the trail up to a durable and stable status an 18 foot bridge would need to be installed over the wet crossing. If trail use remains low and it is limited to pedestrian traffic, the steeper slopes will remain relatively stable for some time, but will need erosion control measures with any increased usage.

Priority: This section of trail is low priority due to its low use levels and proximity to the X-C course.

## **6.9 East Side Singletrack**

### *Current Class for Designed Use*

*Pedestrian: 2*

*Bicycle: 1 (Expert)*

***Targeted Designed Use: Pedestrian, Bicycle (Advanced)***

### ***Recommended Target Class***

***Pedestrian: 2***

***Bicycle: 1***

Summary of Current Use: This trail is accessed via North Avenue Entrance. The upper loops of this trail appear to be primarily used by advanced mountain bikers and those looking for a less built and more natural trail experience.

Current Status: The upper loops are expert to intermediate bike/pedestrian trails with some existing trail structures in disrepair and other overly challenging sections which create potential safety concerns.

Summary of Recommended improvements: Sections of the upper loop can be graded using local rock to reduce some of the overly rugged features. Local rock can also be used to repair current trail structures to a safe and durable status.

Priority: The tread on the upper loops is stable with little to no trailside damage thereby making these improvements a lower priority.

## **6.10 North Avenue Entrance**

### *Current Class for Designed Use*

*Pedestrian: 3*

*Bicycle: 1 (Advanced)*

***Targeted Designed Use: Pedestrian, Bicycle***

### ***Recommended Target Class***

***Pedestrian: 3***

***Bicycle: 2 (Moderate)***

Summary of Current Use: This trail provides access from the north via North Avenue. It is used by regularly by nearby residents for both bike and pedestrian access, though there is no parking near this access point.

Current Status: The northern access point is currently a blind entrance onto North Ave after a straight down hill, putting runners and bikers at a fast pace onto a sidewalk and busy street. Sections of this trail are steep with more minor erosion. An existing small ledge drop is currently being used by bikers and lacks appropriate signage to warn trail users of its existence.

Summary of Recommended improvements: Short sections of reroute (60 feet) at both the entrance of the trail and on the hill approaching the entrance will reduce erosion as well



as provide a safer and slower entry point onto North Avenue. Installation of a small sign and more advanced filter feature at the top of the drop will warn unsuspecting downhill travelers and lead them towards the safer route to the right.

Priority: The safety improvements to this well used section of trail are highest priority.

#### **6.11 Rock Point Access Trail**

*Current Class for Designed Use*

*Pedestrian: 2*

***Targeted Designed Use: Pedestrian***

***Recommended Target Class***

***Pedestrian: 2***

Summary of Current Use: This trail is used by bikers and pedestrians with low use levels. It is also used to gain access to the Rock Point ropes course and camp. It provides access to the Arms Property Trail System from the parking lot at Rock Point.

Current Status: These trails all travel through low lying, continuously wet areas. There are currently sections of bog bridging in various levels of disrepair along the section with deep ruts by bike tires indicate small amounts of bike traffic. The area is considered a Class 2 wetland and would require permitting for repairs and upgrades to the trails.

Summary of Recommended improvements: In order to bring this trail up to standard and to reduce current impacts (trail widening and vegetation trampling) bog bridges would have to be replaced and installed along the entire section of trail. Due to the wetland impacts and cost of materials it is recommended this section of trail is closed, unless access to Rock Point Property is desired. If access is to be maintained, it will require approximately 2040 feet of bog bridges, some requiring cribbing where the substrate is too soft for single sill logs.

Priority: Considering the location of the trail in a designated wetland, if this trail is to be retained, these improvements must be a very high priority.

## **6.12 Bike Path Access Spur**

### *Current Class for Designed Use*

*Pedestrian: 3*

*Bicycle: 2*

*X-Country: 3 (un-groomed)*

### ***Targeted Designed Use: Pedestrian, Bicycle, X-Country***

### ***Recommended Target Class***

***Pedestrian: 4***

***Bicycle: 4***

***X-Country: 3 (un-groomed)***

Summary of Current Use: Current use on this trail is high. It connects loop 1 and 2 part of the Burlington High School X-Country course and is the only western access to the Arms Park Trail System.

Current Status: This very short spur is currently severely eroded and gullying up to 4 feet deep in sections. It is a fall line trail with loose, sandy substrate which is eroding and depositing material onto the bike path.

Summary of Recommended Improvements: If it is desired to decrease traffic through the Arms Park Trail System, a more sustainable reroute may be possible to the north of the current alignment. The angle of the intersection with the bike path could be changed in this way to slow trail users down before merging onto the more popular Bike Path. However, if access to the Arms Park Trail System from the Bike Path is to be encouraged with the installation of a sign and the possibility for trail improvements to the Elks Access Spur (to provide a direct East/West corridor to connect to Ethan Allen), the tread should be hardened with imported material.

Priority: This section of trail is a high priority due to the levels of use and the degree of active erosion.

### **6. 13 Elks Lodge Access Spur**

*Current Class for Designed Use*

*Pedestrian: 3*

*Bicycle: 3*

***Targeted Designed Use: Pedestrian, Bicycle***

***Recommended Target Class***

***Pedestrian: 3***

***Bicycle: 3***

Summary of Current Use: This spur appears to be a former lightly used road bed which travels through the Elks Property and intersects the X-C course and Bike Path Access Spur.

Current Status: This trail is currently mostly all both safe and durable.

Summary of Recommended Improvements: None are currently recommended on this trail section.

Priority: This trail is a lower priority as it is currently relatively durable for the amount of current use.

## 7. Maintenance and Management Recommended Schedule

### 7.1 Annual Maintenance

Every trail requires annual maintenance. A well-built trail system, up to standard for the current use requires still requires at least one annual maintenance patrol in which blow downs are cleared and drainages are cleared of leaf litter and sediment. Additional general maintenance tasks may include light brushing out of trail corridors as well as the closing of new or old bootleg trails using dead and down brush and leaf litter. Ideally the trails are monitored and patrolled for light maintenance needs throughout their popular use seasons, especially after larger wind or rain events. With timely light maintenance, long term trail degradation can be avoided in areas as trail users look for alternative routes around down trees and route find, causing undue vegetation trampling and trail widening.

### 7.2 Maintenance and Reconstruction Schedule Summary (By Year)

PLEASE REFER TO ENTIRE SCHEDULE IN APPENDIX- 9.5

**Year 1-** The majority of the recommended work to be done in the first year is on the X-C Course working to mitigate the worst areas of erosion and trail widening on this heavily used trail. Proposed work to fix these areas of concern varies from reroutes to boardwalks or surfacing with imported crushed stone fill. Any other areas of greater safety concern and excessive erosion are also scheduled for this year. The remainder of the work this year is in closing redundant trails to allow for re-vegetation and reparation to the affected areas as soon as possible. Most of this work will bring the beginner trails up to a more safe and durable standard.

Labor Hours	Labor Cost	Materials Cost	Equip. Cost	Total Cost
349.5	\$12,233	\$3,570	\$1,687	\$17,490

**Year 2-** Work recommended for the second year of scheduled maintenance and reconstruction is mainly focused on the X-C Course, Northern Singletrack and Boardwalk trails. The work includes installations of drainages which both fix current trail issues as well as providing preventive measures to maintain current trail sections in durable and safe conditions. Much of the remainder of the work is focused on brining a more advanced recreation option up to safe and durable standards on the Northern Singletrack, while mitigating the extensive trail widening on the Boardwalk trail (see photo in appendix).

Labor Hours	Labor Cost	Materials Cost	Equip. Cost	Total Cost
279.7	\$9,789	\$4,159	\$2,028	\$15,976

**Year 3-** Year three recommended work mainly focuses on the X-C Course, East Side Singletrack, and mitigating the steep and eroding slopes leading to the High Point. The continuation of the X-C Course improvements will raise additional sections of the tread, creating a more uniform surface and reducing larger protrusions to expand the potential for x-country skiing when the winters allow. Improvements on the East Side Singletrack will increase the safe and durable recreation potential for advanced hikers, runners and bikers while reducing the potential for future trail widening on these trails.

Labor Hours	Labor Cost	Materials Cost	Equip. Cost	Total Cost
100.9	\$3,533	\$1,822	\$2,340	\$7,694

**Year 4-** Year four improvements primarily continue the X-C Course re-surfacing in areas where the current surface protrusions are causing trail widening and creating possible safety hazards for beginner trail users.

Labor Hours	Labor Cost	Materials Cost	Equip. Cost	Total Cost
44.0	\$1,540	\$940	\$841	\$3,320

**Year 5-** Year five recommended improvements are relatively few as the area trails have been minimally improved since their creation and the majority of the areas of concern will continue to degrade quickly over the next few years. Aside from any work listed in years 1-4, the recommended work for year 5 involves a foot bridge on a less popular hiking-only trail as well as a section of advanced mountain bike trail which could be made more uniform to reduce potential trail widening, though none currently exists.

Labor Hours	Labor Cost	Materials Cost	Equip. Cost	Total Cost
13.6	\$476	\$375	\$30	\$879

Note:

While it may not be possible to follow the recommended schedule for years 1-4 for funding or other reasons, it is advised to follow the recommended schedule as closely as possible for the sustainability of the trails and safety of the users.

### 7.3 Costs and Options

**Labor-** As noted on the Maintenance and Reconstruction Schedule, labor cost and time estimates are currently based on a typical hourly rate of a contracted trail specialist. While use of volunteer labor is recommended for certain projects, others require more skills and training to be constructed efficiently, effectively and to safety and durability specifications.

**Materials-**Material costs may vary. Cost estimates are given at current costs from local suppliers. Each material was chosen for its ability to be both durable and cost effective and all are standard industry building materials.

Rock Point Access Trail- As mentioned in the inventory, unless access to Rock Point is a priority, it is not recommended to include this trail in the Arms Property Trail System due to the sensitivity of the area and the costs of improvements.

#### 7.4 Partnerships and Stakeholders

Current stakeholders and potential partners in the Arms Property Trail System include all adjacent property owners to Arms Grant Property (BHS, Rock Point, Elks Club, North Avenue Alliance Church, and nearby residents). Currently BHS performs light maintenance on the x-country course, which they use heavily. Other possible future partners in trail maintenance and reconstruction projects and possible sources of volunteer labor include the Fellowship of the Wheel mountain bike club and Burlington High School.

## **8. Summary of Recommendations**

The approximately 3.5 miles of trail included in the Arms Property Trail System accommodate a variety of trail users and allow recreational opportunities on the Arms Grant and adjacent properties. The Arms Grant Property is designated an Urban Wild, which expands the values of the management from recreation to conservation of the unique resources also present in the landscape. In order to allow for continued recreation without undue negative impacts on the unique species and features located within the region of the Arms Property Trail System, various trail improvements have been recommended based on the conservation of the resource and the safety and enjoyment of trail users. The aim of these improvements is to create a safe, sustainable and enjoyable trail system through which a variety of trail users can travel.

Most of the current trail conditions in need of mitigation include areas of erosion, muddy areas with active and increasing widening, trailside vegetation trampling, and areas where safety is a concern due to disrepair or incomplete trail construction. Improvements have been prioritized, taking account the amount of trail use, the sensitivity of the trailside area affected, and sensitivity to accommodating a variety of user groups for a variety of trail experiences.

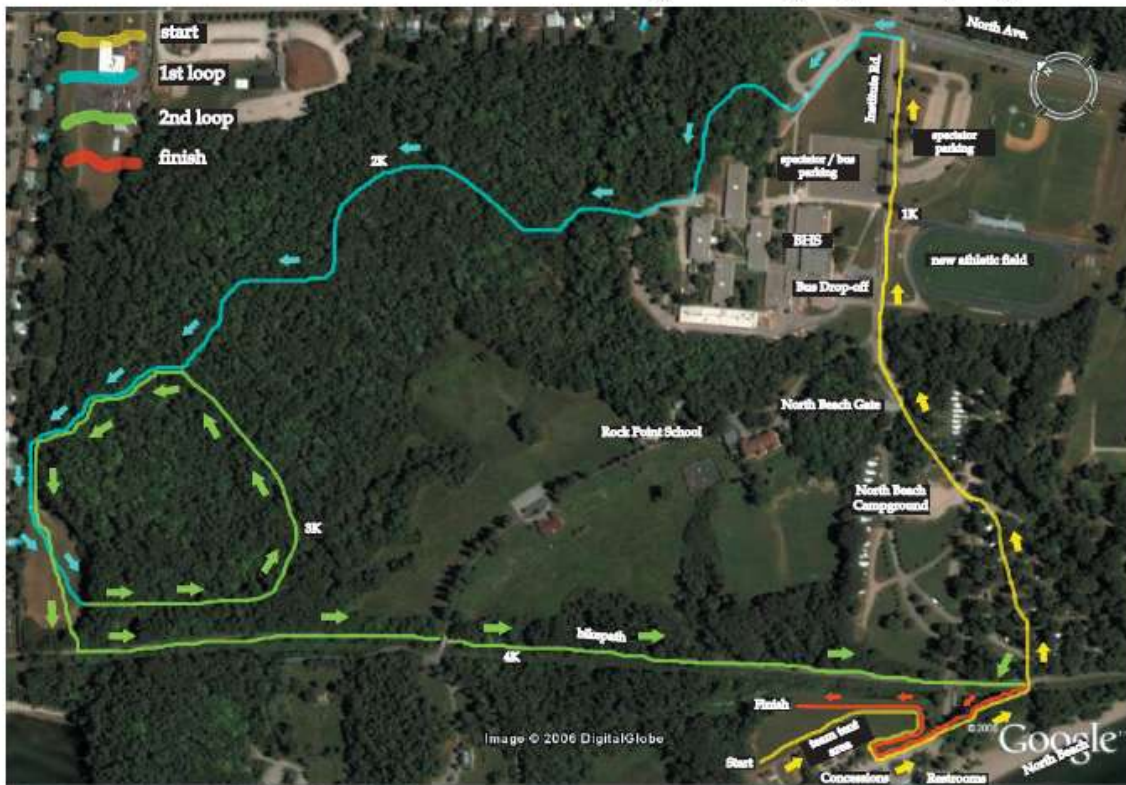
Recommended improvements consist mainly of: 1) raising low lying areas with either boardwalk or imported crushed stone fill material, 2) mitigating erosion by re-routing steep alignments onto terrain with a less steep slope, 3) installing drainage to prevent further future erosion, 4) creating more consistent tread ways with imported crushed stone fill for the beginner trail user or skier, 5) increasing safety on expert bike trails to allow for advanced and moderate experiences, 6) and closing redundant trails to allow for natural re-vegetation and increased protection of rare or sensitive species in these areas.

## 9. Appendix

### 9.1 BHS X-C Course Map

#### Burlington High School 5K High School Cross Country Course

- course terrain features grass, asphalt, concrete (sidewalk) and dirt trail
- start, finish, team areas, restrooms and concessions (BHS Invite only) at North Beach
- bus drop-off at Burlington High School
- all spectator and bus parking is at Burlington High School lots



## 9.2 Photographs of Current Trail Conditions



X-C Course: Steep muddy area, boardwalk and re-route proposed





X-Country Course: Tread creep on a wide section of exposed ledge, crushed stone surfacing with retaining rock cribbing are proposed



Boardwalk Trail: Low lying muddy section, boardwalk proposed



### 9.3 Recommended Trail Structure Photo Examples

#### **BOARDWALKS**





## **BRIDGES**



## **BOG BRIDGES (Puncheons)**

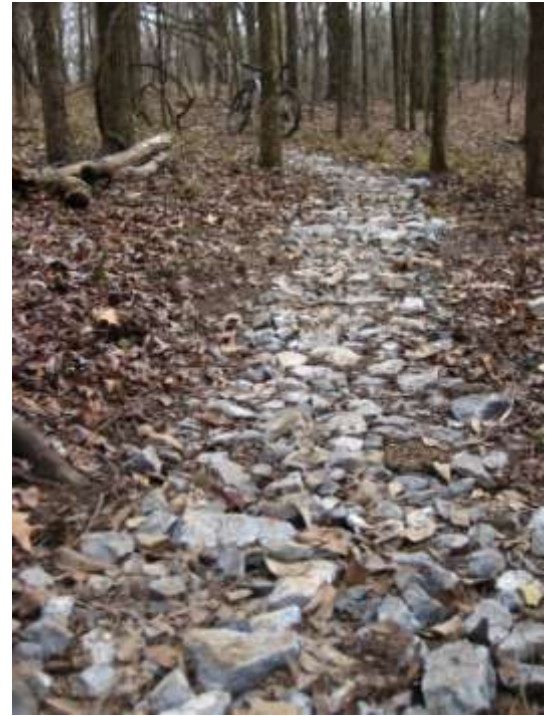


## WOODEN STAIRS





## ROCK ARMORED TREAD



## IMPORTED FILL



#### 9.4 References

Birkby, Robert C. *Lightly on the Land: The Student Conservation Association Trail-Building and Maintenance Manual*. Seattle, WA: The Mountaineers, 2005. ISBN 0-89886-848-3. 344 pp. Available at 800-553-4453.

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Staff of AMC's Trails Department. *AMC's Complete Guide to Trail Building & Maintenance: Proven techniques, safety guidelines, equipment tips, 4<sup>th</sup> ed.* Boston, MA: Appalachian Mountain Club Books, 2008. ISBN 978-1-934028-16-2.

Steinholz, Robert T.; Vachowski, Brian. "Wetland Trail Design and Construction 2007 Edition." 0723 2804. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center, 2007. 90 p. Available at <http://www.fhwa.dot.gov/environment/rectrails/trailpub.htm>.



## 9.5 Maintenance and Reconstruction Schedule (5 year)

### YEAR 1

ID	Trail Name	Length	Problem	Solution	Labor Hours	Labor Cost	Material Cost	Equip. Cost	Total Cost
698.0	X-C Course	107	heavily eroded 3-4 ft gully	realign or reconstruct with machine	6.1	\$214		\$214	\$428
698.0	X-C Course	107	heavily eroded 3-4 ft gully	fill with crushed stone	13.8	\$483	\$268	\$535	\$1,286
701.0	X-C Course	80	wetland	new boardwalk	45.6	\$1,596	\$1,200		\$2,796
703.0	X-C Course	65	low areas with poor drainage	fill with crushed stone	8.4	\$293	\$228	\$358	\$878
723.0	X-C Course	110	grassy wetland	new boardwalk	62.7	\$2,195	\$1,650		\$3,845
725.0	X-C Course	10	needs drainage	add drainage to the south	1.0	\$35			\$35
726.0	X-C Course	65	eroding imported crushed stone	machine grade with drain at top	3.7	\$130		\$130	\$260
728.0	X-C Course	22	needs drainage	rolling grade dip drainage	2.2	\$77			\$77
730.0	X-C Course	45	encroaching buckthorn	widen corridor clearing	1.1	\$39			\$39
733.0	X-C Course	18	narrow intersection	bench corner junction and widen tread	2.0	\$70			\$70
736.0	X-C Course	20	needs drainage	RGD knick with retaining at drain	2.0	\$70			\$70
738.0	North Ave Entrance	10	blind drop off	add rock tread filter feature before drop	5.0	\$175			\$175
745.0	East Side Trails	5	leaning trees	corridor clearing, remove leaning trees	0.1	\$4			\$4
767.0	Buckthorn Loop	40	muddy area	fill with crushed stone	5.2	\$181	\$100	\$200	\$481
770.0	Buckthorn Loop	50	wet organic soil	fill with crushed stone	6.5	\$226	\$125	\$250	\$601
801.0	High Point Main	15	too much outslope	benching near tree	2.0	\$70			\$70
	High Point Main	376	fall line trail	re-route	75.2	\$2,632			\$2,632
	High Point Main	34	trail goes through a depression	re-route to the west	6.8	\$238			\$238
	X-C Course	78	fall line trail	re-route to the east	15.6	\$546			\$546
	X-C Course	163	fall line trail	re-route to the west	32.6	\$1,141			\$1,141
	Buckthorn Loop	99	exposed ledge	re-route easier alternative to the east	19.8	\$693			\$693
	North Ave Entrance	33	blind intersection with N. Ave	re-route to the north	6.6	\$231			\$231
	Redundant Trails	2555	too many trails	close trails	25.6	\$894			\$894
	<b>Year 1 Total</b>				<b>349.5</b>	<b>\$12,233</b>	<b>\$3,570</b>	<b>\$1,687</b>	<b>\$17,490</b>

\*Labor Cost Estimates based on typical experienced trail contractor rate of \$35/hr

## YEAR 2

Point	Trail Name	Length	Problem	Solution	Labor Hours	Labor Cost	Material Cost	Equip. Cost	Total Cost
696.0	X-C Course	139	wet seep	define ditch, raise tread, retain fill	7.9	\$278		\$278	\$556
696.0	X-C Course	139	wet seep	define ditch, fill to raise tread, retain fill	17.9	\$628	\$487	\$765	\$1,879
699.0	X-C Course	100	exposed roots, braided trail	add fill to define tread	12.9	\$452	\$350	\$550	\$1,352
706.0	X-C Course	10	needs drainage	knick drainage	1.0	\$35			\$35
709.5	X-C Course	10	poor drainage	drain at top end of bridge	1.0	\$35			\$35
711.0	X-C Course	40	steep slope exposed ledge	add fill, must be hardened surface	5.2	\$181	\$140	\$220	\$541
712.0	X-C Course	15	needs drainage	Long constructed drain waterbar	1.5	\$53			\$53
729.0	X-C Course	45	steep	machine grading to reduce slope	2.6	\$90		\$90	\$180
731.0	X-C Course	25	needs drainage	two large knick drainages	2.5	\$88			\$88
732.0	X-C Course	15	needs drainage	knick drainage	1.5	\$53			\$53
735.0	North Ave Entrance	4	narrow tread, rock gap	widen ledge gap and remove 5" ash	2.0	\$70			\$70
750.0	Northern Singletrack	10	exposed ledge in tread	remove rocks and add alternate reroute	5.0	\$175			\$175
751.0	Northern Singletrack	20	exposed ledge in tread	rock fill with 15' cribbing 2' wide	10.0	\$350			\$350
751.0	Northern Singletrack	20	exposed ledge	rock fill with 15' cribbing 2' wide	2.6	\$90	\$50	\$100	\$240
753.0	Northern Singletrack	20	sharp corner on reroute	widen and inslope tread	10.0	\$350			\$350
755.0	Northern Singletrack	15	rocky side hill	build crib wall, fill with native dirt	7.5	\$263			\$263
756.0	Northern Singletrack	20	steep eroded trail	find reroute after consulting rare plant map	10.0	\$350			\$350
763.0	Boardwalk	30	wet area	boardwalk with 8' fill at ends	17.1	\$599	\$450		\$1,049
764.0	Boardwalk	130	wet area	new boardwalk	74.1	\$2,594	\$1,950		\$4,544
765.0	Boardwalk	5	wet dip	stone armor	2.5	\$88			\$88
765.0	Boardwalk	5	wet dip	fill with crushed stone	0.6	\$23	\$13	\$25	\$60
766.0	Boardwalk	48	seep	new boardwalk	27.4	\$958	\$720		\$1,678
790.0	High Point Connector	5	needs drainage	knick drainage	0.5	\$18			\$18
791.0	High Point Connector	5	needs drainage	knick drainage	0.5	\$18			\$18
792.0	High Point Connector	5	needs drainage	knick drainage	0.5	\$18			\$18
793.0	High Point Connector	12	exposed ledge	remove obstacle rocks, armor, crib, and fill	6.0	\$210			\$210
	Northern Singletrack	189	fall line trail	re-route to the west	37.8	\$1,323			\$1,323
	High Point Connector	58	exposed ledge	re-route easier alternative trail to the north	11.6	\$406			\$406
	<b>Year 2 Total</b>				<b>279.7</b>	<b>\$9,789</b>	<b>\$4,159</b>	<b>\$2,028</b>	<b>\$15,976</b>

\*Labor Cost Estimates based on typical experienced trail contractor rate of \$35/hr

### YEAR 3

Point	Trail Name	Length	Problem	Solution	Labor Hours	Labor Cost	Material Cost	Equip. Cost	Total Cost
700.0	X-C Course	75	low tread getting muddy	raise tread	9.7	\$339	\$263	\$413	\$1,014
703.5	X-C Course	28	low area	fill with crushed stone	3.6	\$126	\$98	\$154	\$378
704.0	X-C Course	20	low area	fill with crushed stone	2.6	\$90	\$70	\$110	\$270
705.0	X-C Course	10	existing bridge	replace fill material	1.3	\$45	\$35	\$55	\$135
707.0	X-C Course	10	existing bridge	replace and extend fill	1.3	\$45	\$35	\$55	\$135
708.0	X-C Course	70	low area between bridges	fill with crushed stone	9.0	\$316	\$245	\$385	\$946
710.0	X-C Course	25	low area	fill with crushed stone at junction	3.2	\$113	\$88	\$138	\$338
713.0	X-C Course	10	low ledge	fill with crushed stone	1.3	\$45	\$35	\$55	\$135
715.0	X-C Course	14	low area	fill with crushed stone	1.8	\$63	\$49	\$77	\$189
717.0	X-C Course	28	low area	fill with crushed stone and retain 6ft to bridge	3.6	\$126	\$98	\$154	\$378
740.0	East Side Trails	6	trail too narrow	repair rock tread bridge	3.0	\$105			\$105
741.0	East Side Trails	6	ledge depression	rock tread work and dirt fill	3.0	\$105			\$105
742.0	East Side Trails	5	loose rock	stabilize rocks in tread	2.5	\$88			\$88
743.0	East Side Trails	4	ledge step	rock ramp on tread	2.0	\$70			\$70
744.0	East Side Trails	8	outsloped turn	build rock and dirt insloped turn	4.0	\$140			\$140
748.0	N. Ave Neighborhood	10	rugged exposed ledge	rock tread ramp	5.0	\$175			\$175
748.0	N. Ave Neighborhood	12	rugged exposed ledge	reroute with rock fill	1.5	\$54	\$30	\$60	\$144
757.0	Church Spur	47	improper surfacing	remove tarp, fill with gravel from existing pile	6.1	\$212	\$118	\$235	\$565
759.0	Church Spur	90	low tread	fill with crushed stone	11.6	\$406	\$225	\$450	\$1,081
799.0	Outlook Spur	17	steep slope	wood steps with native dirt fill	13.6	\$476	\$238		\$714
800.0	Outlook Spur	14	steep slope	wood steps with native dirt fill	11.2	\$392	\$196		\$588
	<b>Year 3 Total</b>				<b>100.9</b>	<b>\$3,533</b>	<b>\$1,822</b>	<b>\$2,340</b>	<b>\$7,694</b>

\*Labor Cost Estimates based on typical experienced trail contractor rate of \$35/hr

## YEAR 4

Point	Trail Name	Length	Problem	Solution	Labor Hours	Labor Cost	Materials Cost	Equip. Cost	Total Cost
718.0	X-C Course	15	exposed roots	fill insloped turn with crushed stone	1.9	\$68	\$53	\$83	\$203
719.0	X-C Course	18	exposed ledge	fill with crushed stone and retain	2.3	\$81	\$63	\$99	\$243
720.0	X-C Course	16	exposed ledge	fill ramp onto ledge	2.1	\$72	\$56	\$88	\$216
721.0	X-C Course	32	exposed ledge corner	fill with crushed stone and retain	4.1	\$144	\$112	\$176	\$432
722.0	X-C Course	21	exposed ledge	fill between ridges	2.7	\$95	\$74	\$116	\$284
737.0	X-C Course	30	steep exposed ledge	possible wood steps with stone fill	24.0	\$840	\$420		\$1,260
737.0	X-C Course	30	steep exposed ledge	possible wood steps with stone fill	3.9	\$135	\$105	\$165	\$405
754.0	Northern Singletrack	23	low areas	fill with crushed stone or native dirt	3.0	\$104	\$58	\$115	\$276
	<b>Year 4 Total</b>				<b>44.0</b>	<b>\$1,540</b>	<b>\$940</b>	<b>\$841</b>	<b>\$3,320</b>

## YEAR 5

Point	Trail Name	Length	Problem	Solution	Labor Hours	Labor Cost	Materials Cost	Equip. Cost	Total Cost
741.0	East Side Trails	6	ledge depression	fill with crushed stone or native dirt	0.8	\$27	\$15	\$30	\$72
761.0	Hiker Trail	18	stream	new bridge	12.8	\$447	\$360		\$807
	<b>Year 5 Total</b>				<b>13.6</b>	<b>\$474</b>	<b>\$375</b>	<b>\$30</b>	<b>\$879</b>

## 5 YEAR TOTAL

	Labor Hours	Labor Cost	Materials Cost	Equip. Cost	Total Cost
<b>5 Year Total</b>	<b>787.7</b>	<b>\$27,569</b>	<b>\$10,865</b>	<b>\$6,925</b>	<b>\$45,359</b>

\*Labor Cost Estimates based on typical experienced trail contractor rate of \$35/hr

## 9.6 USFS Class Matrix



### Trail Class Matrix (FSH 2353.142, Exhibit 01)

Trail Classes are general categories reflecting trail development scale, arranged along a continuum. The Trail Class identified for a National Forest System (NFS) trail prescribes its development scale, representing its intended design and management standards.<sup>1</sup> Local deviations from any Trail Class descriptor may be established based on trail-specific conditions, topography, or other factors, provided that the deviations are consistent with the general intent of the applicable Trail Class.

Identify the appropriate Trail Class for each NFS trail or trail segment based on the management intent in the applicable land management plan, travel management decisions, trail-specific decisions, and other related direction. Apply the Trail Class that most closely reflects the management intent for the trail or trail segment, which may or may not reflect the current condition of the trail.

Trail Attributes	Trail Class 1 Minimally Developed	Trail Class 2 Moderately Developed	Trail Class 3 Developed	Trail Class 4 Highly Developed	Trail Class 5 Fully Developed
<b>Tread &amp; Traffic Flow</b>	<ul style="list-style-type: none"> <li>♦ Tread intermittent and often indistinct.</li> <li>♦ May require route finding.</li> <li>♦ Single lane, with no allowances constructed for passing.</li> <li>♦ Predominantly native materials.</li> </ul>	<ul style="list-style-type: none"> <li>♦ Tread continuous and discernible, but narrow and rough.</li> <li>♦ Single lane, with minor allowances constructed for passing.</li> <li>♦ Typically native materials.</li> </ul>	<ul style="list-style-type: none"> <li>♦ Tread continuous and obvious.</li> <li>♦ Single lane, with allowances constructed for passing where required by traffic volume in places where there is no reasonable opportunity to pass.</li> <li>♦ Native or imported materials.</li> </ul>	<ul style="list-style-type: none"> <li>♦ Tread wide and relatively smooth, with few irregularities.</li> <li>♦ Single lane, with allowances constructed for passing where required by traffic volume in places where there is no reasonable opportunity to pass.</li> <li>♦ Double lane where traffic volume is high and passing is frequent.</li> <li>♦ Native or imported materials.</li> <li>♦ May be hardened.</li> </ul>	<ul style="list-style-type: none"> <li>♦ Tread wide, firm, stable, and generally uniform.</li> <li>♦ Single lane, with frequent turnouts where traffic volume is low to moderate.</li> <li>♦ Double lane where traffic volume is moderate to high.</li> <li>♦ Commonly hardened with asphalt or other imported material.</li> </ul>
<b>Obstacles</b>	<ul style="list-style-type: none"> <li>♦ Obstacles common, naturally occurring, often substantial, and intended to provide increased challenge.</li> <li>♦ Narrow passages; brush, steep grades, rocks and logs present.</li> </ul>	<ul style="list-style-type: none"> <li>♦ Obstacles may be common, substantial, and intended to provide increased challenge.</li> <li>♦ Blockages cleared to define route and protect resources.</li> <li>♦ Vegetation may encroach into trailway.</li> </ul>	<ul style="list-style-type: none"> <li>♦ Obstacles may be common, but not substantial or intended to provide challenge.</li> <li>♦ Vegetation cleared outside of trailway.</li> </ul>	<ul style="list-style-type: none"> <li>♦ Obstacles infrequent and insubstantial.</li> <li>♦ Vegetation cleared outside of trailway.</li> </ul>	<ul style="list-style-type: none"> <li>♦ Obstacles not present.</li> <li>♦ Grades typically &lt; 8%.</li> </ul>

10/16/2008

Trail Attributes	Trail Class 1 Minimally Developed	Trail Class 2 Moderately Developed	Trail Class 3 Developed	Trail Class 4 Highly Developed	Trail Class 5 Fully Developed
<b>Constructed Features &amp; Trail Elements</b>	<ul style="list-style-type: none"> <li>Structures minimal to non-existent.</li> <li>Drainage typically provided without structures.</li> <li>Natural fords.</li> <li>Typically no bridges.</li> </ul>	<ul style="list-style-type: none"> <li>Structures of limited size, scale, and quantity; typically constructed of native materials.</li> <li>Structures adequate to protect trail infrastructure and resources.</li> <li>Natural fords.</li> <li>Bridges as needed for resource protection and appropriate access.</li> </ul>	<ul style="list-style-type: none"> <li>Structures may be common and substantial; constructed of imported or native materials.</li> <li>Natural or constructed fords.</li> <li>Bridges as needed for resource protection and appropriate access.</li> </ul>	<ul style="list-style-type: none"> <li>Structures frequent and substantial; typically constructed of imported materials.</li> <li>Constructed or natural fords.</li> <li>Bridges as needed for resource protection and user convenience.</li> <li>Trails amenities may be present.</li> </ul>	<ul style="list-style-type: none"> <li>Structures frequent or continuous; typically constructed of imported materials.</li> <li>May include bridges, boardwalks, curbs, handrails, trails amenities, and similar features.</li> </ul>
<b>Signs<sup>2</sup></b>	<ul style="list-style-type: none"> <li>Route identification signing limited to junctions.</li> <li>Route markers present when trail location is not evident.</li> <li>Regulatory and resource protection signing infrequent.</li> <li>Destination signing, unless required, generally not present.</li> <li>Information and interpretive signing generally not present.</li> </ul>	<ul style="list-style-type: none"> <li>Route identification signing limited to junctions.</li> <li>Route markers present when trail location is not evident.</li> <li>Regulatory and resource protection signing infrequent.</li> <li>Destination signing typically infrequent outside wilderness areas; generally not present in wilderness areas.</li> <li>Information and interpretive signing uncommon.</li> </ul>	<ul style="list-style-type: none"> <li>Route identification signing at junctions and as needed for user reassurance.</li> <li>Route markers as needed for user reassurance.</li> <li>Regulatory and resource protection signing may be common.</li> <li>Destination signing likely outside wilderness areas; generally not present in wilderness areas.</li> <li>Information and interpretive signs may be present outside wilderness areas.</li> </ul>	<ul style="list-style-type: none"> <li>Route identification signing at junctions and as needed for user reassurance.</li> <li>Route markers as needed for user reassurance.</li> <li>Regulatory and resource protection signing common.</li> <li>Destination signing common outside wilderness areas; generally not present in wilderness areas.</li> <li>Information and interpretive signs may be common outside wilderness areas.</li> <li>Accessibility information likely displayed at trailhead.</li> </ul>	<ul style="list-style-type: none"> <li>Route identification signing at junctions and for user reassurance.</li> <li>Route markers as needed for user reassurance.</li> <li>Regulatory and resource protection signing common.</li> <li>Destination signing common.</li> <li>Information and interpretive signs common.</li> <li>Accessibility information likely displayed at trailhead.</li> </ul>
<b>Typical Recreation Environments &amp; Experience<sup>3</sup></b>	<ul style="list-style-type: none"> <li>Natural and unmodified.</li> <li>ROS: Typically Primitive to Roaded Natural.</li> <li>WROS: Typically Primitive to Semi-Primitive.</li> </ul>	<ul style="list-style-type: none"> <li>Natural and essentially unmodified.</li> <li>ROS: Typically Primitive to Roaded Natural.</li> <li>WROS: Typically Primitive to Semi-Primitive.</li> </ul>	<ul style="list-style-type: none"> <li>Natural and primarily unmodified.</li> <li>ROS: Typically Primitive to Roaded Natural.</li> <li>WROS: Typically Semi-Primitive to Transition.</li> </ul>	<ul style="list-style-type: none"> <li>May be modified.</li> <li>ROS: Typically Semi-Primitive to Rural.</li> <li>WROS: Typically Portal or Transition.</li> </ul>	<ul style="list-style-type: none"> <li>May be highly modified.</li> <li>Commonly associated with visitor centers or high-use recreation sites.</li> <li>ROS: Typically Roaded Natural to Urban.</li> <li>Generally not present in Wilderness areas.</li> </ul>

For National Quality Standards for Trails, Potential Appropriateness of Trail Classes for Managed Uses, Design Parameters, and other related guidance, refer to FSM 2353 and FSH 2309.18.

For standards and guidelines on the use of signs and posters on trails, refer to the Sign and Poster Guidelines for the Forest Service (EM-7100-15).

The Trail Class Matrix shows combinations of Trail Class and Recreation Opportunity Spectrum (ROS) or Wilderness Recreation Opportunity Spectrum (WROS) settings that commonly occur, although trails in all Trail Classes may and do occur in all settings. For guidance on the application of the ROS and WROS, refer to FSM 2310 and 2353 and FSH 2309.18.



## Design Parameters (FSH 2309.18, Section 23.11, Exhibit 01)

Design Parameters are technical guidelines for the survey, design, construction, maintenance, and assessment of National Forest System trails, based on their Designed Use and Trail Class and consistent with their management intent<sup>1</sup>. Local deviations from any Design Parameter may be established based on trail-specific conditions, topography, or other factors, provided that the deviations are consistent with the general intent of the applicable Trail Class.

<b>Designed Use</b> <b>HIKER/PEDESTRIAN</b>		<b>Trail Class 1</b>	<b>Trail Class 2</b>	<b>Trail Class 3<sup>2</sup></b>	<b>Trail Class 4<sup>2</sup></b>	<b>Trail Class 5<sup>2</sup></b>
<b>Design Tread Width</b>	<b>Wilderness</b> (Single Lane)	0" – 12"	6" – 18"	12" – 24" Exception: may be 36" – 48" at steep side slopes	18" – 24" Exception: may be 36" – 48" at steep side slopes	Not applicable
	<b>Non-Wilderness</b> (Single Lane)	0" – 12"	6" – 18"	18" – 36"	24" – 60"	36" – 72"
	<b>Non-Wilderness</b> (Double Lane)	36"	36"	36" – 60"	48" – 72"	72" – 120"
	<b>Structures</b> (Minimum Width)	18"	18"	18"	36"	36"
<b>Design Surface<sup>3</sup></b>	<b>Type</b>	Native, ungraded May be continuously rough	Native, limited grading May be continuously rough	Native, with some on-site borrow or imported material where needed for stabilization and occasional grading Intermittently rough	Native with improved sections of borrow or imported material, and routine grading Minor roughness	Likely imported material, and routine grading Uniform, firm, and stable
	<b>Protrusions</b>	≤ 24" Likely common and continuous	≤ 6" May be common and continuous	≤ 3" May be common, not continuous	≤ 3" Uncommon, not continuous	No protrusions
	<b>Obstacles</b> (Maximum Height)	24"	14"	10"	8"	No obstacles
<b>Design Grade<sup>3</sup></b>	<b>Target Grade</b>	5% – 25%	5% – 18%	3% – 12%	2% – 10%	2% – 5%
	<b>Short Pitch Maximum</b>	40%	35%	25%	15%	5% FSTAG: 5% – 12% <sup>2</sup>
	<b>Maximum Pitch Density</b>	20% – 40% of trail	20% – 30% of trail	10% – 20% of trail	5% – 20% of trail	0% – 5% of trail

10/16/2008

Designed Use <b>HIKER/PEDESTRIAN</b>		<b>Trail Class 1</b>	<b>Trail Class 2</b>	<b>Trail Class 3 <sup>2</sup></b>	<b>Trail Class 4 <sup>2</sup></b>	<b>Trail Class 5 <sup>2</sup></b>
<b>Design Cross Slope</b>	<b>Target Cross Slope</b>	Natural side slope	5% – 20%	5% – 10%	3% – 7%	2% – 3% (or crowned)
	<b>Maximum Cross Slope</b>	Natural side slope	25%	15%	10%	3%
<b>Design Clearing</b>	<b>Height</b>	6'	6' – 7'	7' – 8'	8' – 10'	8' – 10'
	<b>Width</b>	≥ 24" Some vegetation may encroach into clearing area	24" – 48" Some light vegetation may encroach into clearing area	36" – 60"	48" – 72"	60" – 72"
	<b>Shoulder Clearance</b>	3" – 6"	6" – 12"	12" – 18"	12" – 18"	12" – 24"
<b>Design Turn</b>	<b>Radius</b>	No minimum	2' – 3'	3' – 6'	4' – 8'	6' – 8'

<sup>1</sup> For definitions of Design Parameter attributes (e.g., Design Tread Width and Short Pitch Maximum) see FSH 2309.18, section 05.

<sup>2</sup> Trail Classes 3, 4, and 5, in particular, have the potential to provide accessible passage. If assessing or designing trails for accessibility, refer to the Forest Service Trail Accessibility Guidelines (FSTAG) for more specific technical provisions and tolerances (FSM 2350).

<sup>3</sup> The determination of trail-specific Design Grade, Design Surface, and other Design Parameters should be based upon soils, hydrological conditions, use levels, erosion potential, and other factors contributing to surface stability and overall sustainability of the trail.





## Design Parameters (FSH 2309.18, Section 23.13, Exhibit 01)

Design Parameters are technical guidelines for the survey, design, construction, maintenance, and assessment of National Forest System trails, based on their Designed Use and Trail Class and consistent with their management intent<sup>1</sup>. Local deviations from any Design Parameter may be established based on trail-specific conditions, topography, or other factors, provided that the deviations are consistent with the general intent of the applicable Trail Class.

Designed Use <b>BICYCLE</b>		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Design Tread Width	Single Lane	6" – 12"	12" – 24"	18" – 36"	24" – 48"	36" – 60"
	Double Lane	36" – 48"	36" – 48"	36" – 48"	48" – 84"	72" – 120"
	Structures (Minimum Width)	18"	18"	36"	48"	60"
Design Surface <sup>2</sup>	Type	Native, ungraded May be continuously rough Sections of soft or unstable tread on grades < 5% may be common and continuous	Native, with limited grading May be continuously rough Sections of soft or unstable tread on grades < 5% may be common	Native, with some on-site borrow or imported material where needed for stabilization and occasional grading Intermittently rough Sections of soft or unstable tread on grades < 5% may be present, but not common	Native, with improved sections of borrow or imported materials and routine grading Stable, with minor roughness	Likely imported material and routine grading Uniform, firm, and stable
	Protrusions	≤ 24" Likely common and continuous	≤ 6" May be common and continuous	≤ 3" May be common, but not continuous	≤ 3" Uncommon and not continuous	No protrusions
	Obstacles (Maximum Height)	24"	12"	10"	8"	No obstacles
Design Grade <sup>2</sup>	Target Grade	5% – 20%	5% – 12%	3% – 10%	2% – 8%	2% – 5%
	Short Pitch Maximum	30% 50% on downhill segments only	25% 35% on downhill segments only	15%	10%	8%
	Maximum Pitch Density	20% – 30% of trail	10% – 30% of trail	10% – 20% of trail	5% – 10% of trail	0% – 5% of trail

10/16/2008

<b>Designed Use BICYCLE</b>		<b>Trail Class 1</b>	<b>Trail Class 2</b>	<b>Trail Class 3</b>	<b>Trail Class 4</b>	<b>Trail Class 5</b>
<b>Design Cross Slope</b>	<b>Target Cross Slope</b>	5% – 10%	5% – 8%	3% – 8%	3% – 5%	2% – 3%
	<b>Maximum Cross Slope</b>	10%	10%	8%	5%	5%
<b>Design Clearing</b>	<b>Height</b>	6'	6' – 8'	8'	8' - 9'	8' - 9'
	<b>Width</b>	24" – 36" Some vegetation may encroach into clearing area	36" – 48" Some light vegetation may encroach into clearing area	60" – 72"	72" – 96"	72" – 96"
	<b>Shoulder Clearance</b>	0' – 12"	6" – 12"	6" – 12"	6" – 18"	12" – 18"
<b>Design Turn</b>	<b>Radius</b>	2' – 3'	3' – 6'	4' – 8'	8' – 10'	8' - 12'

<sup>1</sup> For definitions of Design Parameter attributes (e.g., Design Tread Width and Short Pitch Maximum) see FSH 2309.18, section 05.

<sup>2</sup> The determination of trail-specific Design Grade, Design Surface, and other Design Parameters should be based upon soils, hydrological conditions, use levels, erosion potential, and other factors contributing to surface stability and overall sustainability of the trail.



## Design Parameters (FSH 2309.18, Section 23.31, Exhibit 01)

Design Parameters are technical guidelines for the survey, design, construction, maintenance, and assessment of National Forest System trails, based on their Designed Use and Trail Class and consistent with their management intent<sup>1</sup>. Local deviations from any Design Parameter may be established based on trail-specific conditions, topography, or other factors, provided that the deviations are consistent with the general intent of the applicable Trail Class.

Designed Use <b>CROSS-COUNTRY SKI</b>		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Design Groomed Width	Single Lane	Typically not designed or actively managed for cross-country skiing, allow use may be allowed	2' – 4' Typically not groomed	6' – 8' Or width of grooming equipment	8' – 10" Or width of grooming equipment	Typically not designed or actively managed for cross-country skiing, allow use may be allowed
	Double Lane		6' – 8'	8' – 12'	12' – 16'	
	Structures (Minimum Width)		36"	36"	36"	
Design Grooming and Surface <sup>2</sup>	Type		Generally no machine grooming	May receive occasional machine grooming for snow compaction and track setting	Regular machine grooming for snow compaction and track setting	
	Protrusions		No protrusions	No protrusions	No protrusions	
	Obstacles (Maximum Height)		12" Uncommon	8" Uncommon (no obstacles if machine groomed)	No obstacles	
Design Grade <sup>2</sup>	Target Grade		5% – 15%	2% – 10%	0% – 8%	
	Short Pitch Maximum		25%	20%	12%	
	Maximum Pitch Density		10% – 20% of trail	5% – 15% of trail	0% – 10% of trail	
Design Cross Slope	Target Cross Slope		0% – 10%	0% – 5%	0% – 5%	
	Maximum Cross Slope (For up to 50')		20%	15%	10%	

10/16/2008

Designed Use <b>CROSS-COUNTRY SKI</b>		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
<b>Design Clearing</b>	<b>Height</b> (Above normal maximum snow level)		6' – 8'	8' Or height of grooming equipment	8' – 10'	
	<b>Width</b>		24" – 60" Light vegetation may encroach into clearing area	72" – 120" Light vegetation may encroach into clearing area	96" – 168" Widen clearing at turns or if increased sight distance needed	
	<b>Shoulder Clearance</b>		0" – 6"	0" – 12"	0" – 24"	
<b>Design Turn</b>	<b>Radius</b>		8' – 10'	15' – 20' Or to accommodate grooming equipment	≥ 25'	

<sup>1</sup> For definitions of Design Parameter attributes (e.g., Design Tread Width and Short Pitch Maximum) see FSH 2309.18, section 05.

<sup>2</sup> The determination of trail-specific Design Grades, Design Surface, and other Design Parameters should be based upon soils, hydrological conditions, use levels, erosion potential and other factors contributing to surface stability and overall sustainability of the trail.