



Town of Blowing Rock

1036 Main Street ★ Post Office Box 47 ★ Blowing Rock, North Carolina

To: Scott Fogleman, Mayor Lawrence, and Members of Town Council
From: Nicole Norman, Finance Officer
Subject: Budget Amendment Ordinance to Account for Various Items
(Ordinance #2015-17)
Date: February 9, 2016

Enclosed please find a Budget Amendment Ordinance for the fiscal year 2016 for your consideration.

Section 1 (General Fund) allocates a portion of expected funds expected to exceed budget at the end of the year for Utility Franchise Tax as well as grant funds secured by the Blue Ridge Conservancy for the maintenance of Glen Burney Trail from the North Carolina Division of Parks and Recreation Recreational Trails Program.

Please let me know if you need further details on the proposed amendment.

**Fiscal Year 2016-17
Budget Amendment Ordinance 2015-17**

Be it ordained by the Town Council of the Town of Blowing Rock, North Carolina, that the following amendment be made to the annual budget ordinance for the fiscal year ending June 30, 2016:

Section 1. To amend the General Fund, the appropriations are to be changed as follows:

<u>Acct. No.</u>		<u>Current Appropriation</u>	<u>Decrease</u>	<u>Increase</u>	<u>Proposed Appropriation</u>
10-00-3400-335	Miscellaneous Income	\$ 20,000	\$ -	\$ 6,000	\$ 26,000
10-00-3300-337	Utility Franchise Tax	\$ 147,300	<u>\$ -</u>	<u>\$ 1,500</u> <u>\$ 7,500</u>	\$ 148,800

This will result in a net increase of \$7,500 in the appropriations of the General Fund. To allocate the revenue for the above, the following revenue will be increased. This revenue has been or will be received.

<u>Acct. No.</u>		<u>Current Appropriation</u>	<u>Decrease</u>	<u>Increase</u>	<u>Proposed Appropriation</u>
10-80-6100-251	Glen Burney Trail Maintenance	\$ -	<u>\$ -</u>	<u>\$ 7,500</u> <u>\$ 7,500</u>	\$ 7,500.00

Section 2. Copies of this budget amendment shall be furnished to the Clerk to the Town Council and to the Finance Officer for their implementation.

Adopted this 9th day of February, 2016.

Attested by:

JB Lawrence, Mayor

Sharon Greene, Town Clerk

Memo

To: Mayor JB Lawrence & Town Council
CC: Scott Fogleman
From: Parks & Recreation Director Jennifer Brown
Date: February 9, 2016
Re: Glen Burney Trail Maintenance Grant

Executive Summary

In 2013 the Blue Ridge Conservancy adopted the Glen Burney trail as one of their adopt-a-trail projects for their ASU chapter. They applied for a Recreational Trails Program through the North Carolina Division of Parks & Recreation in 2014 and in 2015 were awarded \$6,000. The grant requires a \$1,500 match for a total of \$7,500 to go towards addressing some major safety concerns along the trail. These safety concerns were addressed in a study provided by the Vermont Youth Conservation in conjunction with the Blue Ridge Conservancy (report is attached). We did receive another bid on just the major safety concerns which came in at \$15,000 from Jeremy Early Trailworks (see attached). The Blue Ridge Conservancy is also heading up fundraisers with community support to help raise the remaining \$7,500. This \$15,000 project would include building stairs, revegetating, and fencing certain areas along the trail.

Fiscal Impact

\$1,500 from the franchise tax. Franchise tax collections as a whole (includes utility franchise tax, telecommunication tax, and video programming tax) are currently running approximately 20% above budget, representing an estimated increase above budget expectations of \$47,000.

Staff Recommendation

Staff recommends that we cooperatively work with the Blue Ridge Conservancy to improve the immediate safety concerns on the Glen Burney Trail for the cost of \$1,500 with appropriations from the franchise tax and \$6,000 from the Recreational Trails Program grant. Once the fundraising from the community has been finalized, that amount will be donated to the Town and the project total, including the \$7,500 referenced above, will be used to execute an improvement project totaling \$15,000.



Jeremy Early
Trailworks, Inc.
1000 Hartford Ave.
Charlotte, NC 28209
704-582-9501
April 16, 2015
jeremyearlytrailworks@

Service Proposal for Jennifer Brown; Blowing Rock P&R: Glen Burney Trail

BREAKDOWN:

Services:

1) Wood staircase and subsequent check steps:

- Build wooden staircase, on steep pitch, along Glen Burney Trail; and re-vegetate area (plants TBD)
- Install seven check steps, using black locust as borders for steps, and back filling with gravel and dirt; install grade dips between steps, for drainage
- Line trail with “gargoyles”

2) Glen Burney Top Access Closure

- Remove existing base stone and picnic table from Falls area
- Re-vegetate area
- Build retaining wall (Length TBD) to close off old trail head

3) Overlook Access Trail and Fencing

- 20, large, rock steps; with “gargoyle” rocks to keep people on steps
- Install 100’ of fencing along staircase and overlook to keep people from venturing too far out on Falls

Time Frame: 4 weeks from start to completion

Total: \$15,000.00*

*Price includes all costs incurred by Jeremy Early Trailworks, Inc.

Signature: _____ Jeremy Early, owner

Date: 4/16/15

References:

- 1) Crawford Craige; Development Manager for Crescent Communities on Lake James;
ccraige@crescentcommunities.com; 828-260-7515

Built over 4 miles of natural surfaced trail throughout the *1780* and *Old Wildlife Club* communities on Lake James, near Marion, NC. We still maintain those trails, along with an additional 3 miles of logging roads. 2008-Present.

2) Joe Walker; Development Manager for Crescent Communities—*Springfield* and *Chapel Cove* communities, South Charlotte and Fort Mill, SC; jwalker@crescentcommunities.com; 980-321-5180

Built over 1.5 miles of natural surfaced trail at the *Springfield* community, in Fort Mill, SC, running through common open space on either side of the golf course. 8 bridges and boardwalks were built throughout the two trails, to allow for better access to users. Fall 2011-Spring 2012.

Built 1 mile of natural surfaced trail at the *Chapel Cove* community, on Lake Wylie, in Southwest Charlotte. Built two boardwalks, and a canoe rack for residents in *Chapel Cove*. Spring-Summer 2012.

3) Mike Leonard; National Executive Director of *The Conservation Fund*. Bethania, NC; mleonard@wcsr.com; 336-721-3721

We have worked with Mike on numerous projects across western NC, including over 2 miles of natural surfaced trail in Bethania; 5,000' of natural surfaced trail in Valle Crucis; 1 mile of natural surfaced trail going to the top of Little Table Rock #3, outside Spruce Pine, and 4,000' of natural surfaced trail on Saddle Mtn., outside Sparta. 2011-Present.

4) Travis Morehead; Community Coordinator with *The Carolina Thread Trail*. Charlotte, NC and surround counties; travis@carolinathreadtrail.org; 704-376-2556

We have worked with Travis, and Randy Gates, on numerous natural surfaced trail projects, for the Carolina Thread Trail organization. 1 mile of trail along the South Fork River, linking McAdenville to Lowell, NC, in Gaston County; 3,500' of trail in Bessemer City (Gaston County); 1 mile of trail, extending the Nation Ford Greenway in Fort Mill, SC. Built four wooden bridges throughout 2 miles of trail, on the Pharr Farm property, in Midland (Cabarrus County); 2010-2012

Glen Burney Trail Assessment and Management Plan Recommendations



**Prepared for the
Town of Blowing Rock, North Carolina**

by

**Keegan Tierney
Vermont Youth Conservation Corps
Operations Director**

January 2015

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Glen Burney Trail Overview

Location and General Description

The Glen Burney Trail is believed to date back to the late 1800's. The original land the trail was located on was donated to the town of Blowing Rock in 1906 by local school founder Emily Pridden.

The trail and associated parkland are bound by private property on the west and south and by private property and Globe Road on the east. Globe Road runs roughly parallel to the trail and is at its closest point to the trail at approximately the halfway point.

The Trail is accessed via Annie Cannon Park on Laurel Lane and is a short walk from Main St. in Blowing Rock. The trail proceeds downhill from Annie Cannon Park for 1.6 miles. It has a total elevation change of 600 feet. It is an "out and back" trail with no practical potential for a loop to be constructed and no current potential for connection to a second access point due to being landlocked by private landholders on all sides.

The trail's designated and managed use is pedestrian walking & hiking only. The town does not currently allow any other uses and does not plan to open the trail to other uses in the future. Given its general layout, accessibility, and average slope it holds little potential for other user types.

Geology and Topography

The geologic structure that forms the Blue Ridge Mountains are characterized by the layers of metamorphic rock bands that were folded through geologic up-thrusting and in many areas are characterized by alternating light and dark bands characteristic of the minerals present in each layer. The town of Blowing Rock is located primarily on a layer of Gneiss formation which was named after the town by the US Geological Survey. Blowing Rock Gneiss tends to work easily and can be split into slabs along planes within the rock. It also crushes easily which makes it appropriate material for trail construction and maintenance.

The New Year's Creek descends steeply from the town of Blowing Rock. The creek has eroded a deep and steep sided valley into the bed rock. The terrain has a cross slope upwards of 60% in some areas limiting access to on-site materials and eliminating potential for re-routing the trail to reduce the prevailing grades within acceptable levels. The trail has been cut into hillside, also known as the cross slope, in most areas. The cross-slope grade allows for a cut of up to 36" in most areas without uphill reinforcement to retain the soil. However, short sections exist where a maximum tread width of only 18" is possible without uphill soil retention.

Trail Slope

The trail has an overall average grade of 18.4%. This provides a skewed view of the general prevailing grades encountered along different segments of the trail which are more accurately

reflected by breaking the trail into natural grade breaks as measured by their corresponding distances. This is summarize below and provides a clearer picture of prevailing grades:

- 0 to 0.25 miles - average grade of 5%
- 0.25 miles to 0.85 miles - average grade of 18%
- 0.85 miles to 1.0 miles - average grade of 33%
- 1.0 miles to 1.6 miles (end) - average grade of 15%

Within each of these segments there are short runs of steeper grades with a maximum measured grade of the established trail running at 38%. Additionally between the Glen Burney Falls and the Glen Marie Falls there are numerous areas where the established trail has been abandoned or is no longer recognizable by trail users. In these areas users are following no real established trail and proceeding downhill at grades over 50%.

The Falls

The trail descends from the Park to three pristine and scenic waterfalls, the Cascades, the Glen Burney Falls and the Glen Marie falls. The Cascades, as the name implies is a series of drops and pools. The trail accesses the Cascades directly at the top of the series of falls. The trail runs immediately adjacent to the edge of the river and then proceeds back away from the river via a stone staircase. Glen Burney and Glen Marie falls are carved from the bedrock proceeding gently downward over a domed shape bedrock outcropping. The dome shape causes the falls to appear approachable and gentle; however, as the water proceeds downstream, the bedrock quickly progress from a gently rolling dome to a vertical edge above the pools 40' below. The trail approaches both sets of falls from above, leading trail users out to an area where the falls have just started their descent over the dome. Due to the easy access to the falls area, their location a short distance off the trail, and the physical structure of the falls, a situation is created where casual hikers may perceive a lower level of risk than is present at the site. Low perceived risk has caused several people to inadvertently fall or be swept over the falls and has resulted in one known fatality. Both falls are easily accessed from the trail at their base as well as their top.

Trail popularity, information, access

Upon a quick internet search, information on the Glen Burney Trail can be found on numerous websites. Some information is very basic and provides only direction, while other sites provide long and detailed descriptions of the trail and information about the various attractions to be found. Examples are given below.

Blowing Rock Town Wikipedia page mentions the falls:

http://en.wikipedia.org/wiki/Blowing_Rock,_North_Carolina#History

Blowing Rock Town website/trail map:

<http://www.blowingrock.com/documents/glen%20burney.pdf>

Visit NC website: <http://www.visitnc.com/listing/glen-burney-trail-annie-cannon-gardens>

“The 1.5 mile foot trail begins in the Annie Cannon Gardens, and descends some 800 feet and provides breathtaking vistas of two waterfalls, the Glen Burney (45’) and the Glen Mary (55’). Enjoy an inviting two-hour out-and-back hike into a virgin Appalachian hardwood forest with spectacular cascades. Fairly strenuous. Please heed all posted signs along trail.”

Boone, North Carolina tourism website: <http://www.exploreboone.com/outdoors/hiking/glen-burney-trail/>

“Keep heading down, and at 1.2 miles, turn right to a picnic table (a great spot for lunch!) and to an observation deck beyond with wonderful views above the slippery shimmering slab of Glen Burney Falls. Do not climb over this barrier-people have died falling from the cataract. Plentiful signs warn hikers to stay behind the rail.”

Trip Advisor: http://www.tripadvisor.com/Attraction_Review-g48966-d3535076-Reviews-Glen_Burney_Trail-Blowing_Rock_North_Carolina.html

Other websites:

- http://www.northcarolinawaterfalls.info/waterfall/1003/Glen_Burney_Falls
- <http://blueridgencguide.com/2011/03/17/hiking-trails-glen-burney-trail-blowing-rock/>
- <http://www.tommangan.net/twoheeldrive/index.php/2011/06/06/glen-burney-trail-in-blowing-rock/>
- <http://www.hikewnc.info/trailheads/annie-cannon-park/map>

Project Background

The town of Blowing Rock recognized the need for a professional trail assessment in order to decide how best to address the degradation of the Glen Burney Trail. Over time numerous aspects of the trail have developed safety concerns, including:

- access to the ruins
- narrow stretches of tread in areas with steep drops
- unsafe user created trails where the walking surface is undefined or difficult to navigate
- unusually steep sections
- easy access to dangerous viewpoints of the falls

The town reached out to the Conservation Trust for North Carolina and the Vermont Youth Conservation Corps (VYCC) with an interest in learning more about the process to address these concerns through trail maintenance and capital improvements. After an initial assessment of the condition of the trail it was decided that a full consulting visit would be necessary to document the trail’s current conditions, provide maintenance and improvement recommendations, and build accurate cost estimates for completion of the work.

The VYCC contracted with the town to complete the assessment work during the winter of 2014/2015. A site visit was conducted in January of 2015 by the VYCC Operations Director to complete trail assessment data gathering. The following report is broken out as follows:

- *The Process:* Upon arrival in Blowing Rock a meeting was conducted to determine the town's goals for this assessment and gauge what their subsequent follow up actions might be. This section summarizes what was learned in that meeting. This information is based on conversations between the Town of Blowing Rock as represented by Town Manager, Scott Fogleman, and Recreation Assistant Director, Erin Kegley and the VYCC Operations Director, Keegan Tierney. Jan Pender of Conservation Trust for North Carolina's (CTNC's) North Carolina Youth Conservation Corps (NCYCC) program and Rob McCorkindale of the Blue Ridge Conservancy were present at the meeting as well.
- *Trail Management Fundamentals (TMF):* The TMF section of this report is meant to provide background information and a structural framework for the Trail Management authority, in this case the Town of Blowing Rock, to make future management decisions for the Glen Burney Trail. The TMF is adopted from various sources with primary reference to the Trail Management Objectives process and training designed by the US Forest Service in cooperation with other federal agencies. This process is understood nationwide by most large trail management organizations and is used to create a consistent way of talking about trails. It provides information on what a trail can be expected to look like, what the expected user groups are and guides the long term management decisions.
- *Current Conditions – Glen Burney Trail:* The current conditions are those conditions as documented during the January 2015 site visits. Current conditions include a photo documented trail survey, descriptive review of trail segments, and a prioritized list of projects as encountered on the trail.
- *Recommended Upgrades:* The recommended upgrades build upon the prioritized list of projects from the current conditions section. Upgrades are described for each prioritized project. In areas where more than one option exist for solving a problem they are outlined as the recommended upgrade and the alternate upgrade with reasoning behind these designations. Upgrades become the decision point of the town of Blowing Rock based on it decided Trail Management Objectives. The recommended Upgrades are summarized in budget format as an Appendix C of this document.

Note: If upon review of this report this information is inaccurate, misinterpreted, or otherwise incorrect please feel free to contact the VYCC to discuss the changes needed and this report will be modified to accurately represent the town's needs and goals.

The Process

The town has recognized the value and potential risks associated with serving as the management authority and steward of the Glen Burney Trail. The trail serves as a valuable public asset as well as a tourist resource and amenity to the Historic Downtown. The town has recognized that the trail has historically gotten little regular maintenance or attention from town parks or public works staff. They anticipate that this will continue to be the case as regular budgeted funds are limited and staff has minimal experience or time to focus on advanced trail maintenance to address trail maintenance and upgrades over time. As a result, the town is interested in completing trail upgrades that will require little annual labor and funding to maintain. It is understood that this level of construction will require a higher up-front investment that will pay for itself over time in lower maintenance costs and higher user enjoyment/safety. In addition, the minimal trail maintenance required following this initial investment should be readily available through a partnership with the Blue Ridge Conservancy (BRC) working with volunteer groups from Appalachian State University (ASU). This report will outline key maintenance items which should be attended to on an ongoing basis. Managing the partnership between the town, the BRC, and ASU will be up to those three partners. The town has also recognized that long-term maintenance will likely be aided by the technical resources that the North Carolina Youth Conservation Corps can bring to bear.

One option for this trail in regard to resolving the safety issues present is to close the trail entirely and not provide developed access to the waterfalls – sometimes referred to as “the no-build” alternative. The town could choose this option to limit its exposure to risk associated with guiding people to the waterfalls via an established trail. This option is not explored further in this report because of the expressed desire by the town to provide the Glen Burney Trail as a focal point for town residents and tourists who seek a local, accessible, outdoor experience. Their hope is that this trail is a feature that draws people to Blowing Rock and the Blue Ridge Mountains, and not just an occasionally used casual trail. To this end this report makes recommendations that would accommodate the largest swath of trail users and considers safety from the perspective of that wide swath of user types. This includes families with small children, users who may not fall into the fitness category of your “typical” hiker, older adults, groups such as camp and recreation groups, and users with varying physical capabilities.

The town has prioritized safety as their top concern and wishes that safety issues rank as the highest priorities within this report. This will be taken into consideration and will be broken down in more detail within the prioritized list of projects later in this report.

Trail Management Fundamentals¹

Under the leadership of the US Forest Service, numerous federal government agencies have adopted a system of Trail Management Objectives that allow trail management agencies to have a common classification and management system - in essence creating a common language for talking about trail management. This report summarizes these trail management objectives as succinctly as possible to provide a framework to make management recommendations. The four key components of the Trail Management Objectives system are Trail Type, Trail Class, Trail Uses (managed & allowed), and Design Parameters.

Trail Type

The assignment of a 'type' of trail categorizes a trail at its most basic level. There are three common types of trails: Terra (land-based), Water, and Snow.

Terra Trail: The predominant foundation of the trail is ground (as opposed to snow or water); and that is designed and managed to accommodate ground-based trail use.

Snow Trail: The predominant foundation of the trail is snow (as opposed to ground or water); and that is designed and managed to accommodate snow-based trail use.

Water Trail: The predominant foundation of the trail is water (as opposed to ground or snow); and that is designed and managed to accommodate trail use by water craft. There may be ground-based Portage segments of Water Trails.¹

A trail system may contain all three types but every trail or trail segment will only be assigned one trail type. The Glen Burney Trail should be considered as a Terra Trail for sustainable design purposes. Although the trail may occasionally have snow on its surface Snow Trails are defined as such when it is only used in the winter time and summer time use is not permitted.

Trail Class

Trail Class and trail classification is where the real decision making happens in regard to what a specific trail or trail system will look like. Classification is the prescribed scale of trail development, representing the intended design and management standards of the trail. The assignment of a trail class will dictate whether a trail looks and feels like a remote back-country experience (i.e. the Appalachian Trail) versus amore developed trail (i.e. a community bike path). Trail class is assigned on a numerical scale ranging from one to five as follows:

- Trail Class 1: Minimal/Undeveloped Trail
- Trail Class 2: Simple/Minor Development Trail
- Trail Class 3: Developed/Improved Trail
- Trail Class 4: Highly Developed Trail

¹ This section has been adapted from the USFS Trail Fundamentals Training Materials found as referenced in the bibliography as 'USFS Staff'

- Trail Class 5: Fully Developed Trail

Trail classifications are made based on the tread development, user flow, natural obstacles, constructed features (i.e. bridge, boardwalks, turnpike, etc.), signage and way finding, and user experience. A trail class should be thought of as the 'typical' section of trail and should also align with the managed objective of the trail. This creates a direct relationship to the Managed Use/Designed Use component of the Trail Management Objectives described below and each is intimately related to the other. One cannot be considered without the other.

Managed Use/Designed Use

Managed Use is a set of trail uses that are allowed on any given trail segment or trail system. A trail may be managed for many sets of uses. Managed uses of a trail or trail system are determined by a trail management group/organization/agency, in this case the Town of Blowing Rock, as part of their trail management plan. Managed use is based on a number of factors:

1. Promoting types of use that align with Blowing Rock's land management philosophies and discouraging uses which do not.
2. Consideration of the natural communities present and their ability to support a specific type of trail use.
3. The design and layout of the trail system in regard to user group needs.

Managed uses encourage a specific type of trail use while discouraging/disallowing others. There can be numerous types of uses that are managed on a trail system.

There is only one **Designed Use** for any given trail/trail segment. The designed use is the allowed use type that will dictate the construction parameters for any segment of trail. While there can be many managed uses there can ultimately only be one set of parameters a trail can be designed for. In typical cases, the designed use is determined to be the managed use which requires the highest level of trail development (i.e. a trail that will be used by bicyclists will have larger line-of-sight clearings, not vertical structures like steps, and larger radius turns).

Upon determination of a designed use a trail class should be chosen from the *Trail Class* list above. This will dictate the level of trail development necessary. The designed use may consider a managed use and class concurrently when comparing one managed use to another. For example a trail with a designed use for biking and managed use for horses may consider enlarging the trail corridor to accommodate a class 3 ski/snowshoe trail while at the same time constructing the trail tread to accommodate a class 4 biking trail.

Design Parameters

Once a class and designed use designation is assigned to a specific trail the trail manager must set a standard for the *Design Parameters*. Design parameters consist of a matrix of design criteria that correspond with a trail's designed use and class designation. For example a

“hiker/pedestrian” as a designed use will have a tread width range that varies from 0-12” up to 36-72” for Class 1 and Class 5 respectively. A full set of Interagency Design Parameters is included as Appendix B to this document and is recommended as a guide to use in the Glen Burney Trail management decision making process. The Design Parameters for a trail can be easily thought of as the level of trail ‘development’ on each section of trail.

Sustainable Trail Design Basics

The term ‘sustainable’ has a wide breadth of applications and meanings to various groups of people. In the world of trail and trail design “sustainability of natural surface trail corridors” is defined as the characteristic of a travel surface to support currently planned and future uses with minimal impact to the natural systems of the area. Sustainable trails have negligible soil loss or movement while allowing the naturally occurring plant systems to inhabit the area, recognizing required pruning and eventual removal of certain plants over time. Sustainable trails will not adversely affect the naturally occurring fauna. Sustainable trail design will accommodate existing and future uses while only allowing appropriate uses. The sustainable trail will allow appropriate uses, require little rerouting, and minimal have maintenance over extended periods of time.” (Duffy)

There are many considerations to take into account when designing a new trail to make it sustainable. For existing trail systems these elements are applied to trails that may be in conflict with sustainable design parameters. In some cases this can result in the need for a system wide reconstruction. In more moderate cases a trail can be brought up to existing sustainable standards with minor upgrades. The Glen Burney trail falls into the former category with much of the trail needed re-construction or upgrades to meet sustainable standards.

Designing sustainable trails takes a heavy focus on layout of the trail system in relation to slope. Slope is a measure of elevation gain/loss over a horizontal distance of travel. Put simply in numbers if you travel 100’ and you lose 15’ in elevation your trail is running at a 15% slope. An easy shorthand rule to remember the basic rules of slope on a trail system can be summed up in intervals of five. When teaching new trail workers these principles it is outlined as the “Rule of 5’s”. There are three basic rules that make up this system:

The 5% rule

Trails should have an out slope of no more than 5%. Out slope is the grade of the trail tread (walking surface) from the uphill edge of the trail to the downhill edge of the trail. This creates a trail that sheds water while remaining comfortable to walk on without the feeling of potentially twisting your ankle or having your feet slip out from under oneself.

The 10% rule

In new construction the maximum average grade of a typical trail should be no more than 10%. Average grade accounts for the total trail grade accounting for short steep sections and section of longer lesser grade. This creates a trail that is comfortable to walk for most people without

needing to take frequent rest breaks. It also is a good average for the typical slope most soils can support without increasing concerns about erosion.

The 15% rule

Any time a trail exceeds 15% grade it necessitates structures being installed to prevent erosion. These structures could include stairs, steps, water bars, and other hardening techniques.

All of the above mentioned rules are approximations and there may be a shift of plus or minus three percent in either direction based on the type of soils being worked with, the local climate (particularly precipitation type, frequency & intensity), user group variations, vegetative, and other factors. However, as a general guiding principle these rules have proven effective tools for helping manage existing trail systems toward a sustainable design. One caveat to the 10% rule and the 15% rule that must be mentioned here is another design principle that is known as the **½ rule**. **The ½ rule states that no trail should exceed ½ of the average cross slope of the terrain.** Therefore if a trail is being built on terrain with a cross slope of 10% no section of the trail should exceed 5%, thus the half rule supersedes the rule of 5's.

These basic sustainable trail design considerations have been taken into account throughout the analysis of the Glen Burney Trail and have led to many of the recommendations in this document. Although the rules are not explicitly stated in each case they are the foundation for the recommendations present.

Glen Burney Trail Current Conditions

Trail Survey

The following trail survey was conducted in January 2015. The intention was to photo document immediate maintenance needs and examples of frequently occurring maintenance issues. These photographs provide context for the overall management plan but do not serve as photo-documentation for every individual problem on the trail. Following the photo log are numerous examples of potential solutions to these common trail deferred maintenance issues. Each solution is provided with the Original photo and recommended fixes. In some cases a third photo is included that highlights the issue at hand to help extract three dimensional understanding from a two dimensional photograph.



Example 1 – Failing culvert

The culvert needs to be re-surfaced over to protect the culvert and eliminate a user slip hazard. Additionally the inlet to the culvert needs to be cleaned of organic matter and a clear path of flow maintained for water running into it.



Example 2 – Indistinct tread

Exposed tripping hazard and rough ground has pushed trail users downhill causing tread creep



Example 3 – User based re-route

The user created re-route around this fallen tree has led to a short steep section of trail with loose soils and high erosion.



Example 4 – Failed stone stairs

Stone stairs constructed without any control structures have allowed trail users to bypass the stairs on the downhill edge leading to trail widening and erosion



Example 5 – Tread constriction

Roots and rough terrain have pushed users to the outside edge of the established tread and narrowed the tread to 10" in some locations



Example 6 – Drainage problems

Tread compaction have caused a berm to form on the downhill edge of the tread causing water to run down the trail, eroding tread material and further exacerbating the problem



Example 7 – Failed stone structures

Stone stairs and other stone structures have failed in numerous locations due to use of undersized material in the original construction



Example 8 - Erosion

Similar to example 6 erosion of the tread has caused the trail to become the path of least resistance causing a self-exacerbating problem. In numerous areas this is due solely to the fact that the trail violates the rules of 5s and/or the half rule



Example 9 – Original tread lost

The original tread location likely ran over the top of this stone. In a number of areas massive erosion has led to indistinct tread and former structures serving as obstacles to push people off the trail.



Example 10 – Compaction and Erosion on step up/down

Bottom steps need to be reinforced with stone or other hardening materials. When not reinforced micro erosion causes the step distance to increase over time until it is too large and users defer around the step leading to tread creep.



Example 11 - scouring

Here is an example of an area where the trail has lost a critical mass of soil through constant erosion over time. This scouring leaves a rough corridor that users seek a route around. 14



Sloughing and pinching

Steep banks down-slope from the trail are high risk areas for erosion. In numerous spots downhill stabilization will be necessary to retain the trail tread.

Trail Design Recommendations

Type/Class Designation Recommendations

The Glen Burney Trail is a Terra Trail with earthen tread-ways.

Hiking Class 3 Trail

The Glen Burney Trail currently falls into the Hiking Class 2 & Class 3 categories. The trail consist primarily of native tread materials with regularly occurring areas of erosion and degradation that have led to substantial obstructions and hazards such as roots, gullies, and boulders in the trail tread. The trail tread has an average width of 18-24 inches. The cleared corridor ranges from 24-74 inches wide with a cleared height of 96 inches.

The trail should be upgraded and problem areas address to bring it entirely into Class 3 type trail. Consideration could be taken to bring the initial 0.25 miles of trail into Class 4 or 5 depending on the management goals. The option exists to create a universally accessible trail for the first 0.25 miles. If this was desired, attention must be paid to signage and control structures to indicate the end of the universally accessible section of trail.

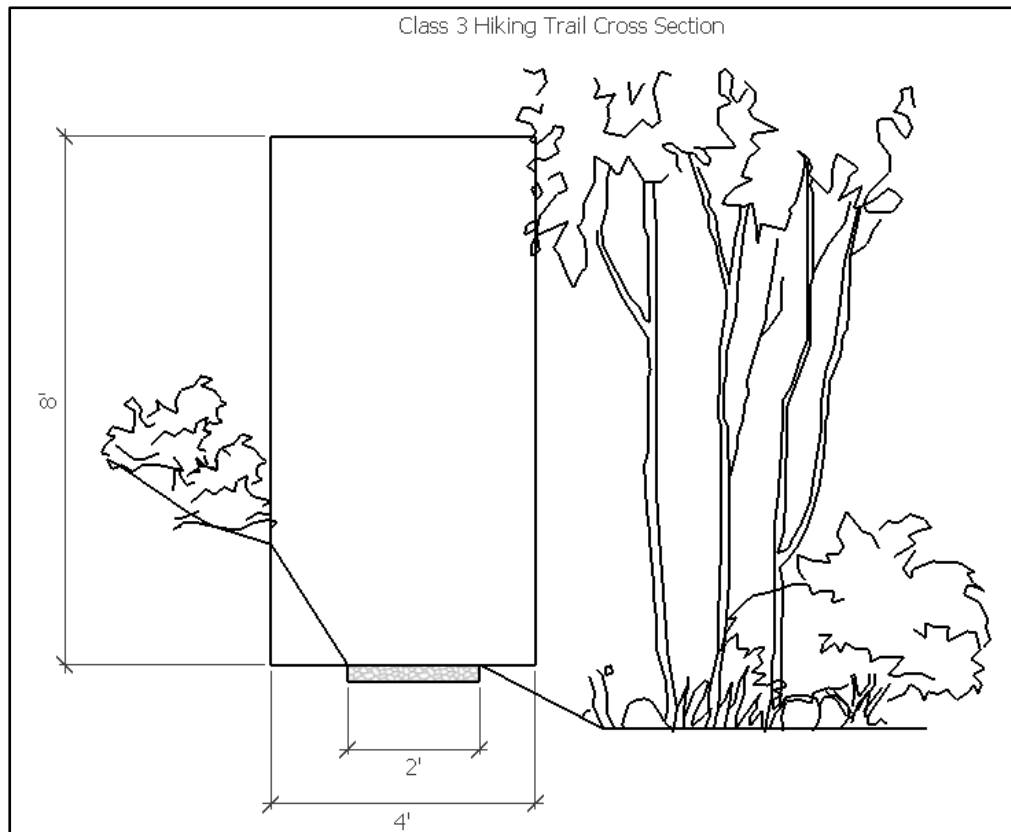


Illustration: K. Tierney

Restoration/Enhancements Required To Meet Trail Class Recommendations

Box Steps

Box steps are simple wood construction steps that prevent erosion and allow water infiltration into the surrounding soils, thus preventing water from gaining volume and running down the trail. For longevity box steps should be constructed of pressure treated or naturally rot resistant timber such as Black Locust or Osage Orange. Steps should be pinned together and into the ground with ½" rebar.



Tread Restoration

The Glen Burney Trail should be upgraded in all areas to a minimum level of Class 3 trail. In numerous areas this will mean widening the trail tread (likely restoring it to its original width). Widening can most easily be accomplished by benching into the upslope and thus cutting the trail further into the hill. In some locations, as highlighted below, it will be more beneficial to elevate the tread. Primary reasons to elevate the tread are, lack of adequate cross-slope to compete additional benching, to protect exposed roots, and to elevate the tread out of wet areas.



Drainage Corrections



The entire Glen Burney Trail needs drainage corrections. Causes of channelization are numerous as outlined in the photo-log above. The solution in all areas is to provide frequent and appropriately sized structures to remove water from the trail.



In this example we see the original photograph, a photograph highlighting the problem, and the problem solved by cutting through the berm on the downhill edge of the trail.



Other examples of possible solutions include water bars, check steps with drainage swales, stone armored crossings, French drains, and ditches.

Check Steps



As mentioned above check steps will be a common and necessary solution to drainage and grade problems on the Glen Burney Trail. In this example water has eroded and channelized the trail. Installation of check steps a backfilling the tread will restore the trail to an acceptable grade and provide an enjoyable user experience. One key element not pictured here that will be required at various points along the trail is control elements, commonly called 'gargoyles', to keep people on the trail and the stairs.

Sloughing



The Glen Burney Trail has numerous locations with very steep cross slopes. When the cross slope drops immediately off the trail tread with not shoulder it leads to sloughing of the downhill edge of the trail. This narrowed trail becomes a safety hazard for users, particularly in pinch-points such as this example where a large boulder resides on the uphill slope.

Tread Creep



Tread creep is prevalent in a number of locations along the trail but particularly bad from the top of the Glen Burney falls to the base of the Glen Marie falls. Creep originates with trail users avoiding some obstacle.

In the example provided here we see the original photograph with exposed soil on the far downhill edge of the trail corridor. In the second photo the brown cross-hatch represents the originally benched trail tread. Over time compaction and erosion led to root exposure and the tread slowly crept downhill through the red cross-hatch area.

The solution in this example would be to install downhill retention structure, in this case stone cribbing, and backfill the tread with native soil to re-establish and single, defined tread. The creep area would then be re-vegetated to allow the understory to re-grow.

Available Resources for Trail and Safety Upgrades

NCYCC Crews

The North Carolina Youth Conservation Corps (NCYCC) is a program developed in a partnership between the Conservation Trust for North Carolina and the Vermont Youth Conservation Corps (VYCC). The NCYCC employs North Carolina youth and young adults between the ages of 16 and 24 years old to complete high priority conservation and recreation projects around the state of North Carolina. NCYCC crews are led by skilled adult leaders who have a background in conservation work and group leadership. Crews complete trail maintenance and construction projects, invasive species management, habitat management, and recreational facility development projects during a 7-week summer season that corresponds with the high school and college summer break.

Technical Crews

The Vermont Youth Conservation Corps is an organization modeled after the Civilian Conservation Corps of the 1930's. The mission of the VYCC is to teach individuals to take personal responsibility for all their actions. This mission is met through VYCC's four core principles of leadership, conservation, teamwork, and education. Every year the VYCC fields 20 crews of 10 youth and young adults to complete projects around the state of Vermont and New York. The VYCC brings 30 years of trail building experience to this project.

This project specifically would be supported by VYCC Technical Crews. These crews are supported through a partnership with AmeriCorps that allows the VYCC to field crews for a 6-month time period running from June through November. Crew Members are typically 18-24 years in age and enter the program with a higher level of experience than a standard crew member. Crews are trained in chainsaw operation, complex back-country rigging systems, and mechanized equipment use.

Commercial Contractors

If the town of Blowing Rock chooses to pursue some of the recommendations below this project will have a specific need to hire a commercial fence and/or wall contractor for construction of barriers at the various viewpoints, dangerous slopes, and waterfall access points.

Determination of a contractor will depend on the barrier/control method desired for these various safety concerns. For the purposes of this report the barrier cost has been estimated at \$50/linear foot. This is a middle range between a chain-link fence at \$30 per linear foot and a stone wall at \$90 per square foot (or a minimum of \$90 per linear foot depending on wall height). The decision on type of barrier to use, local contracting costs, and added fees for the remote location of this project will affect the price estimate for commercially contracted labor.

Trail Upgrades (by trail segment)

Trailhead to Stairs

Close small side trail that proceeds downhill to New Year's Creek. The trail is unstable and directly on the creek bank. Remove wooden ramp/staircase. Restore three areas of in-sloped

trail with moisture issues by raising trail tread with imported gravel and grading with a 3%-5% out slope. Clean culvert inlet, raise tread to re-bury culvert, and ensure a clean out-flow. Install approximately 25 check stone steps.

NCYCC Crew Time: 2 weeks

Install a stacked stone staircase in the steep eroded are where the check steps terminate adjacent to a bench.

Technical Crew Time: 1 week

*Optional upgrade for consideration: Upgrade to universally accessible trail from the existing brick building housing septic line equipment. This would require installing a handicap only parking spot adjacent to the building. Upgrade would include installation of stone curbing and upgrading trail surface material to ½" minus crushed stone with stone dust mixed in to create a **firm and stable** trail tread. Firm and stable are terms with exacting definitions in the accessible community and set a standard for walking/rolling surfaces. A large and usually preventative limitation to accessible trails is trail grade. This would limit the potential to upgrade to accessible trail to the initial ¼ mile of the Glen Burney Trail. This upgrade is not outlined in the prioritized budget below. If the town considered this upgrade it could be estimated at \$18/lineal foot for materials, labor, and equipment expenses.*

Wood Staircase and Subsequent Check Steps

Install a wood stringer staircase on steep pitch shortly after the stone staircase above. Re-vegetate/naturalize the eroded slope with erosion fabric and plant material. Install approximately seven check steps running downhill toward ruins. Install grade dips between the end of check steps and the sharp left turn in trail to the retaining wall below.

NCYCC Crew: 1 week

Retaining Wall

Install pressure treated or naturally rot resistant wood retaining wall with "dead-man" anchors to ensure long-term wall stability.

NCYCC Crew: 1 week

The Ruins Switchback

Install commercial grade fencing (see options outlined below in this document) running from the beginning of the ruins to the switchback below. Install four check steps leading down switchback. Cut step into large downed log which is crossing trail.

NCYCC Crew: 1 week

Commercial Contractor: 150 linear feet of fencing

Base of Ruins to the Bridge

Brush back rhododendron to re-establish clear trail corridor as outlined in regular maintenance section below. Remove sloughing from uphill edge and de-berm tread leading toward the bridge. Re-route trail on uphill edge to prevent users from dropping down to river bed.

Optional; re-establish steps to river to provide stream access if desired.

NCYCC Crew: 2 weeks

The Bridge to the Road Wash

Replace 25' span with an engineered certified, 50' long, steel stringer bridge. Install to elevate bridge away from flood zone and create sustainable bridge approaches. Re-vegetate banks that currently drop down to 25' bridge. Complete minor tread improvements leading to and away from bridge.

Technical Crew: 2 weeks

Road Wash

Build downhill retention wall using large stone and backfill trail tread with imported gravel material. Improve cross drains in two sections to allow road drainage water to pass across trail where it currently runs down the trail.

Technical Crew: 2 weeks

Road Wash to the Cascades

Widen trail tread as possible along large boulder by installing downhill retention or elevating tread. Consider installing railings or other heavy duty type fencing to prevent falls in narrow section with steep drop-off.

NCYCC Crew: 2 weeks

Commercial Contractor: 50 feet of fencing

The Cascades

Constrain trail and define single tread by installing control features such as gargoyles, large woody debris, or constructed constrains such as wire handrails. Improve warning signage as described below.

NCYCC Crew: 1 week

Commercial Contractor: 45 feet of fencing

The Cascades to the Big Wash

Complete general tread improvements to prevent future erosion issues and enhance user experience.

NCYCC Crew: 0.5 weeks

Big Wash to Glen Burney Top Access

Pave and install cross drains at the big washout. Complete general tread improvements leading toward Glen Burney Falls.

NCYCC Crew: 0.5 weeks

Technical Crew: 2 weeks

Glen Burney Top Access Closure

Close top access to Glen Burney by pulling all paving stone, pulling picnic table, and building a

retaining wall along edge of trail to close existing descent to top-of-falls access. Plant new vegetation to encourage rapid re-growth of the understory at the top of Glen Burney Falls' area. Install short-term signage explaining closure and warning people to keep off newly established vegetation.

NCYCC Crew: 1 week

Overlook Access Trail and Fencing

Improve staircase to overlook viewpoint by installing large gauge 20 stone staircase. Install fencing along staircase and overlook to prevent people from going too far out on rocks

Technical Crew: 3 weeks

Commercial Contractor: 100 feet of fencing

Glen Burney Descent & Stone Stairs

Rebuild 15-20 stone stairs. Re-route and improve tread with three switchbacks. Re-vegetate eroded banks and social trails leading down the slope.

Technical Crew: 4 weeks

NCYCC Crew: 1 week

Glen Burney/Glen Marie Intersection to Top of Glen Marie

Install fencing at various fall-points. Complete general tread improvements.

Technical Crew: 4 weeks

Commercial Contractor: 150 feet of fencing

Glen Marie Descent

Install a series of stone staircases along Glen Marie descent for a total of approximately 120 stone stairs. Close goat paths and re-vegetate. Close trail from Glen Marie downhill

Technical Crew: 10 weeks

Commercial Contractor: 100 feet of fencing

Alternate Option: Install a series of wood platforms with staircases descending the bank. This option would result in slightly increased materials expenses but reduced labor expenses for a total section cost of \$74,195. This is not listed in the budget break-out below.

Signage and way-finding

The Glen Burney Trail is well marked by an entry kiosk, large welcoming trail name signs, and the Glen Burney Falls, Glen Marie Falls, and Cascades are all marked with nicely crafted wooden trail signs indicating a hiker's arrival at those locations.

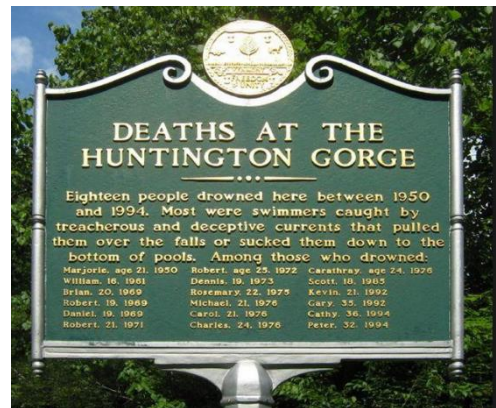
The kiosk in the parking area tells trail users of the basic regulations of trail use and warns them of the dangers of the falls. It also provides a basic trail map and supplemental information. The kiosk is well visible from the parking area but does not have to be passed by to access the Glen Burney Trail. It is recommended that the kiosk be moved in alignment with the trailhead or the trail-head access be moved to force people to walk past the kiosk.



The bulletin board section of the kiosk should also contain some enhanced permanent information about the trail that addresses the following items:

- While the hike in is relatively easy, it is a **strenuous** hike on the return trip
- Warning that this is an out and back trail only with no access to other exits
- Information about the general conditions and construction of the trail. This is particularly important as the first ¼ mile of trail are relatively flat and have a significant amount of imported materials
- A reminder to respect private land owners immediately adjacent to the trail

Additional consideration should be given to whether the town wants to further highlight the danger of the waterfalls. One example of a sign that warns users of the danger of a particular area is this example from the Huntington Gorge in Vermont. The state of Vermont has installed this sign to highlight the extreme dangers of this swimming area.



The trail name signs and individual falls signs are all nicely crafted and fitting to the aesthetic of the trail. At



the trailhead, the signs indicate variable routes users could follow.

These signs should all be re-oriented to direct users in only one

direction as per the trail closure recommendations described above.

Any signs with directional information pointing people toward the spur trail near the parking lot or to the top of the Glen Burney falls should be removed or re-crafted to ensure that they do not point people towards those locations.

In addition to the warning signage hanging from wire rope on the trail

side of the river, there is signage attached to trees across the river. All

trail closure and warning signage located at the falls should be placed in

the former trail corridor prior to arriving at the top of the falls. It

should be placed so trail users could not possibly pass by it without

seeing it. Using more pictorial based signage may also provide a clearer message to trail users who often do not read signs. Pictorial signage, if designed well, can be understood at a glance and by trail users whose English language reading skills may not be adequate to understand the text based warning signs at the trailhead.

The Glen Burney Trail does not have significant blazing/reassurance signage. Blazes or other trail markers provide trail users with occasional reassurance that they are on the right path. There are a number of accounts on hiking websites and blogs where users have identified challenges following the trail corridor. This was not found to be the case during the trail survey. For the users who are having difficulty finding the trail installation of simple and unobtrusive trail blazing is recommended. Some common types of trail blazes are pictured below.



By utilizing trail blazing and implementing the recommendations in this report to re-define the trail tread there should be no confusion about the direction the trail takes. This will also limit the number of people that inadvertently walk out to private property disturbing landowners because they lose the trail corridor.

Barriers and fall prevention

A variety of options exist for construction of barriers or other fall prevention structures that will provide additional risk awareness and safety to users of the Glen Burney Trail. Typical trail specifications call for fall protection on built structures (i.e. boardwalks, bridges, viewing platforms) when the gross fall height is 30" or more. Barriers typically are specified to be between 42" and 60" in height. Typical trail bridge barriers are constructed with openings that with a maximum gap width that would prevent a 4" sphere from passing through. Appendix D of this document provides a summary of the US Forest Service recommendations for trail bridge barrier (rail) systems.

On trail tread, barriers become a variable in the trail class matrix and liability standards of the trail management organization. While this report does not make any claim to advise on town assumed risk and liability from a legal perspective, it does provide the following options for consideration by the town in their approach to risk management on the Glen Burney Trail. The final decision lies with the town and should be made with access to legal counsel.

Stone Walls

Stone walls have been used in a variety of outdoor recreational settings as a barrier to high risk areas. Stone walls have been frequently used since the 1930's when the Civilian Conservation Corps built many of the nations developed state and national park sites. As a natural building material, stone is easily incorporated into the aesthetics of the trail setting. It's longevity as a building material is unsurpassed when constructed by an experienced mason. Stone can be dry stacked, wet stacked (i.e. built with mortar) or applied as a veneer to a substructure case of concrete or formed steel. The example here is a stone wall barrier at the Linville Gorge area.



Photo Credit: <https://blueridgeimpressions.wordpress.com/2012/08/13/linville-gorge-and->

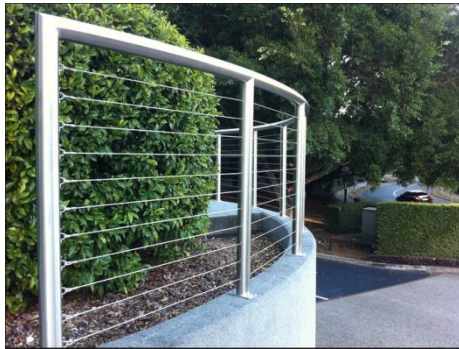


Photo Credit: <http://aaronatfencing.com.au/products/stainless->

Steel Fencing

Steel can be fabricated in virtually any shape and size desired. It is long lasting, especially stainless steel, and provides effective barrier and fall protection. These types of fences provide users to see through the barrier to enjoy the scenery beyond without the need to be taller than the barrier. This is an attractive option for barriers that may be higher than waist level for an average person or in areas where children are frequent users. Steel fences like the one shown here will require annual inspection to

ensure that their attachment points have not come loose and that slack has not developed in the wire rope due to stretching and climactic factors.

Wood Fencing

Wood comes in a variety of shapes and sizes including split rail, post and plank, post and dowel, and picket fences. The Glen Burney Trail currently has a split rail fence above the ruins and a plank fence serving as a visual barrier between the trail and a private residence. Wood is easy to install and provides flexibility in design and span. Depending on style it can also seamlessly blend into the natural landscape. Wood requires regular maintenance and inspection to ensure



Photo Credit: <http://ohiofencecompany.com/fence-product/wood/wood-split-rail-fence.html>

that it remains sound and safe. Wood provides the least longevity of the three options outlined.

Combination of Materials

In addition to the options outlined above materials can be combined together to form a barrier that enhances their functionality while providing meeting aesthetic, safety, and longevity needs of the town. Examples below include wood-and-steel and wood-and-stone.



Photo Credit: http://www.cityfencesa.com/farm_and_ranch_fences.asp



Photo Credit: <http://bookcoverings.com/linville-gorge-nc-map/>

Capital Improvements Budget

This capital budget for the Glen Burney Trail is a projection of total expenses to complete a full reconstruction of the Glen Burney Trail. It is broken out by priority area and includes all expenses described above. The alternate options outlined for specific trails stretches are not included here, as already stated above.

Glen Burney Trail Reconstruction Budget					
		Expense by Priority Ranking			
Trail Stretch	Description	Immediate Safety Concerns	Safety concerns	Trail Stability Upgrades	User Experience Upgrades
1	Trail Head to Stairs			\$23,400.00	
2	Wood Staircase and Subsequent Check Steps	\$7,250.00			
3	Retaining Wall		\$7,250.00		
4	The Ruins Switchback		\$14,500.00		
5	Base of Ruins to the Bridge				\$13,000.00
6	The Bridge to the Road Wash		\$28,000.00		
7	Road Wash			\$13,500.00	
8	Road Wash to the Cascades		\$15,500.00		
9	The Cascades		\$8,750.00		
10	The Cascades to the Big Wash				\$3,250.00
11	Big Wash to Glen Burney Top Access			\$16,250.00	
12	Glen Burney Top Access Closure	\$6,500.00			
13	Overlook Access Trail and Fencing	\$28,500.00			
14	Glen Burney Descent & Stone Stairs		\$30,000.00		
15	Glen Burney/Glen Marie Intersection to Top of Glen Marie		\$40,000.00		
16	Glen Marie Descent		\$99,250.00		
	Total by Priority	\$42,250.00	\$243,250.00	\$53,150.00	\$16,250.00
Total Project Cost					
			\$354,900.00		

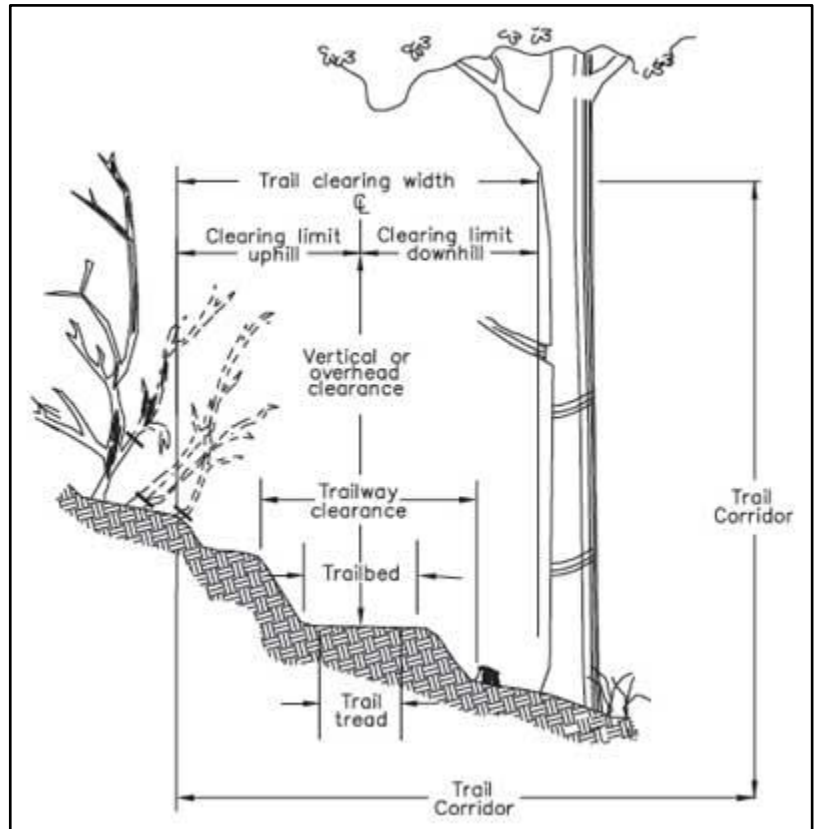
Preventative Maintenance

In an effort to reduce long-term maintenance costs, a regiment of regular preventative maintenance should be conducted on the trail system.

Semi-Annual Trail Sweeps

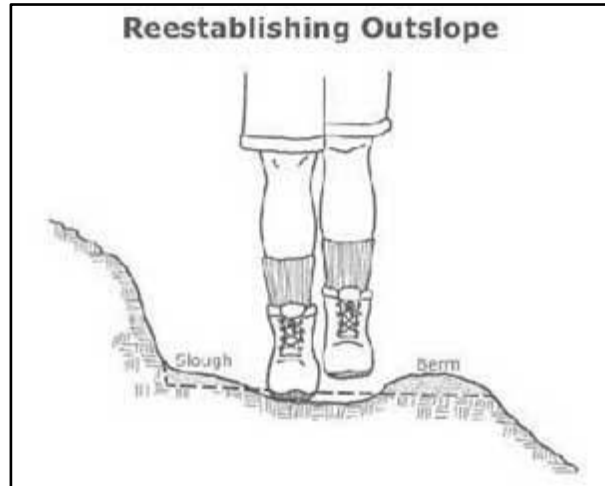
Semi-Annual trail sweeps should be conducted in the spring and the fall. A trail sweep is a moderately paced walk of the trail system to identify small issues that have cropped up over the winter and summer seasons. The following list and description of tasks details the baseline level of maintenance that should be conducted on trail sweeps:

Corridor Clearing - Each trail type and class has a designated trail corridor that should be established and maintained. To create a good mental picture, a corridor can be thought of as a tunnel through the undergrowth. Establishing a well defined and comfortable trail corridor is the first step in keeping users on the established trail. Annual maintenance on the trail corridor includes clipping any new growth extending into the corridor, pruning any branches that have bent into the corridor over time, trimming back shrubs and other low lying plants that are encroaching on the treadway, and regular mowing and/or brush hogging of grass paths and trails in open meadow areas where full sun access allows for quick vegetative growth.



Visual example of trail corridor and terminology (Hancock, 2007)

Annual Drainage Clean-outs - Trail drainage structures include culverts, water bars, grade dips, nicks, cross drains, and ditches among others. There are many names used in the trail world so the easiest way to think about drainage structures is to ask the question: *does this allow water to get off the trail?* If the answer is yes then it deserves annual maintenance. Annual drainage clean-outs should be completed in the autumn after leaf-fall. This will allow the trail system to be ready to handle the spring melt-off. All drainage structures should be fully cleared of leaves, sticks, rocks, and other debris that has made its way into the drainage over the course of the year. This allows a drainage structure to efficiently move water away from the trail tread. On sites with highly erodible soils a thin vegetative layer can be reapplied to a drainage structure to help prevent impact erosion during rain storms. This can be accomplished by sprinkling a thin layer of leaves over the cleared area.



Visual of slough and berm (Hesselbarth, 2007)

Tread Corrections – The trail tread-way is the main foundation of the trail and the focused impact point by trail users. This impact can cause subtle soil movement over time that can lead to major problems on a trail system. Two common impact problems that develop over time are trail creep and berm build-up. See images two and three. Annual tread maintenance should consist of removing the slough and berm that develop over time to maintain adequate cross trail drainage. When conducted on an annual basis this work can be completed with a light duty hand tool such as a McLeod, square shovel, or a garden hoe. Once a slough or berm has been allowed to establish heavier hand tools such as a pick mattock may be needed.



Visual of trail tread creep (Hesselbarth, 2007)

Undeveloped mechanized use tread can also suffer compaction over time. Since there is no developed tread there is not an opportunity to observe and remedy sloughing and berm development. The compaction evident on these trails will be that caused by the mechanized equipment or by trail users focusing their trail use in one specific area. This compaction is often indicated by a lack of vegetation and/or a channel in the trail. To remedy this type of compaction a trail segment should be closed and maintained with mechanized equipment. This can be accomplished by loosening the soil and replanting it with grass seed. To protect the trail it

must remain closed until the new vegetation is established.

Blow-down removal/Obstruction removal – Trail obstructions, most commonly blow-downs, must be removed on an annual basis. Obstructions cause trail users to divert off the trail tread, impede the flow of water off the trail, and can pose safety concerns. Obstructions should be removed from the trail tread as well as the downslope and drainages on a trail system. A down slope or drainage obstruction will quickly lead to backed up leaf and organic matter and water problems on the trail. Obstructions should be removed on an as needed basis. An annual walk-through of the trail system in the spring will allow most obstructions caused by winter snows to be addressed.

Trail Structure Inspections and Maintenance

Trail structures are categorized as the wood and steel built structures on the trail. They include bridges, puncheon, signage and way finding blazes, staircases, check steps, viewing platforms, and kiosks.

Structure Inspection, Cleaning, and Preventative Maintenance - All wood structures should have a detailed inspected every five years at minimum. Areas of wood/ground contact (i.e. bridge sills, puncheon sills, sign posts, check steps) should be inspected for rot. All wood structures that serve as trail tread (i.e. bridge decking, platforms, and puncheon) should be cleaned on a regular basis to prevent mold and mildew build-up that will make the structures slippery. Metal structures should be inspected for metal fatigue (i.e. cracks) and rust. Details on inspections techniques are as follows:

- **Rot Inspection** – Visual examination can sometimes indicate rot. Look for soft or wet appearance of the wood. Mushroom and other fungus are often indicators of internal rot. Moss growing on wood structures is an indicator of deteriorated wood. If any of these red flags is evident, the extent of the rot can be roughly determined using a tool such as a sharp knife, an awl, or a small flathead screw driver. Use the tool in two ways; scrape the surface using firm pressure toward the center of the structure. If wood peels away easily some surface rot and deterioration is present. In the areas that appear to have the most deterioration use the tool by pushing the metal tip into the wood. If the tool is able to penetrate the wood the replacement of the structure should be scheduled.
- **Wood Cleaning and Preservation** - Wooden tread, decking, and railing structures should be cleaned as necessary to prevent development of slippery surfaces. In shady areas this may be necessary annually while structures exposed to full sun may never need to be cleaned. Cleaning can be conducted with a wire brush and/or a stiff bristled plastic or organic brush. In environmentally sensitive areas cleaning with warm water is suitable. In areas that are resilient a mild bleach solution will help kill the mold and algae which cause slippery conditions. Wood structures should also be treated on a regular basis with a penetrating sealant. These come in oil and water based solutions. Structures should be weather sealed once every one to five years.

- **Metal structure inspections** – Metal railings, bridges, sign posts, and other structural elements should be inspected for rust, cracks, or other obvious signs of deterioration. Surface rust should be treated and coated to prevent further rusting. In areas with rust, scrape away the loose scale with a stiff wire brush, sand the area with steel wool or 180 grit sand paper, wipe clean with mineral spirits, and paint with a matching exterior metal paint.

Signage and Way Finding Inspections - The trail system should be walked each spring to inspect all signage for deterioration, location, and cleanliness. Sight lines should be cleared to allow hikers to see signs from a distance. Any vegetation or tree branches should be pruned back. Signs should be cleaned of moss, mold, milder, and fungus to increase lifespan. All interpretive signage should be inspected annually, cleaned regularly, and re-finished prior to excess moisture or UV damage.

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Appendices

A. USFS Trail Class Matrix

B. USFS Trail Design Parameters

A. USFS Trail Class Matrix

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.¹ Local deviations from any Trail Class descriptor may be established based on trail-specific conditions, topography, or other factors, provided that the deviations do not undermine the general intent of the applicable Trail Class.

Identify the appropriate Trail Class for each National Forest System trail or trail segment based on the management intent in the applicable land management plan, travel management direction, trail-specific decisions, and other related direction. Apply the Trail Class that most closely matches 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
Tread & Traffic Flow	<ul style="list-style-type: none"> ♦ Tread intermittent and often indistinct ♦ May require route finding ♦ Single lane with no allowances constructed for passing ♦ Predominantly native materials 	<ul style="list-style-type: none"> ♦ Tread continuous and discernible, but narrow and rough ♦ Single lane with minor allowances constructed for passing ♦ Typically native materials 	<ul style="list-style-type: none"> ♦ Tread continuous and obvious ♦ Single lane, with allowances constructed for passing where required by traffic volumes in areas with no reasonable passing opportunities available ♦ Native or imported materials 	<ul style="list-style-type: none"> ♦ Tread wide and relatively smooth with few irregularities ♦ Single lane, with allowances constructed for passing where required by traffic volumes in areas with no reasonable passing opportunities available ♦ Double lane where traffic volumes are high and passing is frequent ♦ Native or imported materials ♦ May be hardened 	<ul style="list-style-type: none"> ♦ Tread wide, firm, stable, and generally uniform ♦ Single lane, with frequent turnouts where traffic volumes are low to moderate ♦ Double lane where traffic volumes are moderate to high ♦ Commonly hardened with asphalt or other imported material
Obstacles	<ul style="list-style-type: none"> ♦ Obstacles common, naturally occurring, often substantial and intended to provide increased challenge ♦ Narrow passages; brush, steep grades, rocks and logs present 	<ul style="list-style-type: none"> ♦ Obstacles may be common, substantial, and intended to provide increased challenge ♦ Blockages cleared to define route and protect resources ♦ Vegetation may encroach into trailway 	<ul style="list-style-type: none"> ♦ Obstacles may be common, but not substantial or intended to provide challenge ♦ Vegetation cleared outside of trailway 	<ul style="list-style-type: none"> ♦ Obstacles infrequent and insubstantial ♦ Vegetation cleared outside of trailway 	<ul style="list-style-type: none"> ♦ Obstacles not present ♦ Grades typically < 8%

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
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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
Constructed Features & Trail Elements	<ul style="list-style-type: none"> Structures minimal to non-existent Drainage typically accomplished without structures Natural fords Typically no bridges 	<ul style="list-style-type: none"> Structures of limited size, scale, and quantity; typically constructed of native materials Structures adequate to protect trail infrastructure and resources Natural fords Bridges as needed for resource protection and appropriate access 	<ul style="list-style-type: none"> Structures may be common and substantial; constructed of imported or native materials Natural or constructed fords Bridges as needed for resource protection and appropriate access 	<ul style="list-style-type: none"> Structures frequent and substantial; typically constructed of imported materials Constructed or natural fords Bridges as needed for resource protection and user convenience Trailside amenities may be present 	<ul style="list-style-type: none"> Structures frequent or continuous; typically constructed of imported materials May include bridges, boardwalks, curbs, handrails, trailside amenities, and similar features
Signs²	<ul style="list-style-type: none"> Route identification signing limited to junctions Route markers present when trail location is not evident Regulatory and resource protection signing infrequent Destination signing, unless required, generally not present Information and interpretive signing generally not present 	<ul style="list-style-type: none"> Route identification signing limited to junctions Route markers present when trail location is not evident Regulatory and resource protection signing infrequent Destination signing typically infrequent outside of wilderness; generally not present in wilderness Information and interpretive signing not common 	<ul style="list-style-type: none"> Route identification signing at junctions and as needed for user reassurance Route markers as needed for user reassurance Regulatory and resource protection signing may be common Destination signing likely outside of wilderness; generally not present in wilderness Information and interpretive signs may be present outside of wilderness 	<ul style="list-style-type: none"> Route identification signing at junctions and as needed for user reassurance Route markers as needed for user reassurance Regulatory and resource protection signing common Destination signing common outside of wilderness; generally not present in wilderness Information and interpretive signs may be common outside of wilderness Accessibility information likely displayed at trailhead 	<ul style="list-style-type: none"> Route identification signing at junctions and for user reassurance Route markers as needed for user reassurance Regulatory and resource protection signing common Destination signing common Information and interpretive signs common Accessibility information likely displayed at trailhead
Typical Recreation Environments & Experience³	<ul style="list-style-type: none"> Natural, unmodified ROS: Typically Primitive to Roaded Natural WROS: Typically Primitive to Semi-Primitive 	<ul style="list-style-type: none"> Natural, essentially unmodified ROS: Typically Primitive to Roaded Natural Typically WROS: Typically Primitive to Semi-Primitive 	<ul style="list-style-type: none"> Natural, primarily unmodified ROS: Typically Primitive to Roaded Natural WROS: Typically Semi-Primitive to Transition 	<ul style="list-style-type: none"> May be modified ROS: Typically Semi-Primitive to Rural Roaded Natural to Rural setting WROS: Typically Portal or Transition 	<ul style="list-style-type: none"> May be highly modified Commonly associated with visitor centers or high-use recreation sites ROS: Typically Roaded Natural to Urban Generally not present in Wilderness

¹ For National Quality Standards for Trails, Potential Appropriateness of Trail Classes for Managed Uses, Design Parameters, and other related guidance, refer to FSM 2353, FSH 2309.18, and other applicable agency references.

² For standards and guidelines for the use of signs and posters along trails, refer to the Sign and Poster Guidelines for the Forest Service (EM-7100-15).

³ The Trail Class Matrix shows the 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.

B. USFS Design Parameters

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 intent¹. 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 HIKER/PEDESTRIAN		Trail Class 1	Trail Class 2	Trail Class 3 ²	Trail Class 4 ²	Trail Class 5 ²
Design Tread Width	Wilderness (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
	Non-Wilderness (Single Lane)	0" – 12"	6" – 18"	18" – 36"	24" – 60"	36" – 72"
	Non-Wilderness (Double Lane)	36"	36"	36" – 60"	48" – 72"	72" – 120"
	Structures (Minimum Width)	18"	18"	18"	36"	36"
Design Surface ³	Type	Native, ungraded May be continuously rough	Native, limited grading May be continuously rough	Native with some onsite borrow or imported material where needed for stabilization, occasional grading Intermittently rough	Native with improved sections of borrow or imported material, routine grading Minor roughness	Likely imported material, routine grading Uniform, firm, and stable
	Protrusions	≤ 24" Likely common and continuous	≤ 6" May be common and continuous	≤ 3" May be common, not continuous	≤ 3" Uncommon, not continuous	No protrusions
	Obstacles (Maximum Height)	24"	14"	10"	8"	No obstacles
Design Grade ³	Target Grade	5% – 25%	5% – 18%	3% – 12%	2% – 10%	2% – 5%
	Short Pitch Maximum	40%	35%	25%	15%	5% FSTAG: 5% – 12% ²
	Maximum Pitch Density	20% – 40% of trail	20% – 30% of trail	10% – 20% of trail	5% – 20% of trail	0% – 5% of trail

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

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

² 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).

³ 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.