Krusch Nature Preserve Assessment and Planning Project

Cambridge, Vermont



Submitted to:

Justin Marsh, Chair of the Town of Cambridge Conservation Commission
Bob Heiser of The Vermont Land Trust
Sally Laughlin of Cambridge, VT

Prepared by:

Erin Amadon, Trail Planner and Builder

TOWN 4 TRAIL SERVICES LLC

Providing access to the natural world through trails

Professional TrailBuilders ASSOCIATION

Krusch Nature Preserve Assessment and Planning Project
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Krusch Nature Preserve Summary

Introduction

In 2019, Town 4 Trail Services, LLC, was asked to design an approximately 1-mile trail pending a Town vote to accept this property as the Krusch Nature Preserve. The Krusch Nature Preserve also provides access to the Cambridge Pines, a Vermont State property with significantly large white pines and hemlock on the 22-acre property. Upon approval, in 2020, Town 4 Trail Services, LLC explored this unique property combining the existing trail alignment with new recommendations to create a sustainable trail through the Preserve.

Trail Improvement Overview

Trail layout and design principles have changed significantly in the past 10 to 15 years. As is typical in New England's history of trail design, it was less about sustainability and more about getting to the top of the mountain as fast as possible or as close to the water as possible. As use increases along these trails, the soil is compacted, and it becomes more difficult to drain water off the trail. These factors, combined with the alignment, can lead to gullying of the trail tread. The gully traps water which increases the carrying capacity as it flows downslope, creating more significant erosion, root exposure, and damage to the environment.

This document includes trail assessment and planning services following the principles of sustainable layout and design focusing on creating a positive user experience, sustainable grades, following the half rule, constructing an outsloped treadway, incorporating frequent grade reversals, making provisions for sheet flow, building with an erosion-resistant material, and something that is low maintenance.

Below I have outlined the design and construction of the 3,891-linear foot Krusch Nature Preserve trail. All sections of this document work together to provide detailed information on the layout of the trail and the construction guidelines for each linear foot of the treadway.

Work Log Methodology

The trail construction worklog focused on gathering accurate information so that it can be used to generate construction quantities and approximate location. Once construction begins, the true nature of construction needs become evident and may vary from the worklog, causing the potential for modification of the work needed.

Upon completion of the approved concept flag line, the process of creating the trail construction work logs begins. The work log was completed using a variety of tools. A measuring wheel was used to document each linear foot of the proposed improvements. That data was then entered into an iPad spreadsheet allowing for ease of calculating work item quantities. Photographs were taken with the iPad or iPhone and entered into the same spreadsheet for reference. Additional tools, such as a 200-foot tape measure and a 25-foot tape measure, were also used to get accurate measurements for quantity of trail structures.

The worklog provides a way for the reader to walk the proposed trail alignments and reference the improvement recommendations. The worklog sets reference points along the trail, and there may be a 5 to a 10-foot discrepancy between the worklog and the individual who is operating the measuring wheel. The variances should be expected because of human nature and the forever changing dynamics of the forest.

Project Quantities

The table below summarizes the total number of the construction items required for construction of the Krusch Nature Preserve. The table below provides quantities that should be used for construction estimates.

SUMMARY

Item	Unit	Quantity	Description
Corridor Clearing	Linear Feet	2,982	Clearing limits.
Side Hill Bench Cut	Linear Feet	809	Excavated treadway.
Light Bench Cut	Linear Feet	759	Tread definition.
Grade Dip	Total	10	Low area for drainage.
Crush & Fill	Cubic Yards	0.88	Fill for depressions in treadway.
Bog Bridging	Linear Feet	297	Elevate the treadway.
Stepping Stones	Linear Feet	9	Elevate the treadway.
Bridge with Guardrail	Linear Feet	30, 37	2 Bridges at listed lengths.
Total length: 3,891 linear feet			

Trail Construction Specifications Overview

The following trail construction specification categories used in the work logs are listed and defined below.

Corridor Clearing

The trail corridor is defined as the edge of the clearing limits of vegetation for an equal distance on either side of the trail treadway. Determining the dimension of corridor clearing is directly tied to the user group and trail type. In general, the corridor is cleared an additional width of 1-foot to 2-foot either side of the trail tread. The corridor should be a minimum of 6 feet wide and 10 to 12 feet in height to accommodate boats.

Side Hill Bench Cut

A full bench cut is created by excavating across the hillside to create the desired trail tread. Excavate the entire treadway down to compacted mineral soil at the desired width, grade, and with a 2%-5% out slope treadway. The minimum tread width should be 2-linear feet.

Light Side Hill Bench Cut

Similar to a side hill bench cut, the light side hill bench cut is constructed when the side slope is not significant for a full bench cut. Define the treadway to the desired width, grade, and with a 2%-5% out sloped treadway.

Grade Reversal & Grade dip

Frequent grade reversals are an essential aspect of sustainable trail layout and design. A grade reversal is created when the running grade of the trail either increases or decreases, levels off creating a low area in which the water can drain off the trail, and then either the running grade increases or decreases. Simply stated, a grade reversal is a change in elevation with a low area in which water can drain off the trail. Grade reversals should be installed as frequently as possible based on soil types and running grade. Rolling grade dips serve the same purpose as a grade reversal, but grade dips are installed into existing trails.

Crush and Fill

Use crush, fist-size stones or smaller, to fill depressions in order to elevate the treadway. Top the crush with 6-inches of mineral soil and compact in lifts to an outsloped treadway.

Bog Bridging

Typical bog bridging construction requires a wooden sill set on the ground and two wooden stringers set and secured on sills. Typically bog bridging does not span more than 8 feet per section. This distance may vary based on the material

used for construction. The cost estimate, for a professional contractor, in this document includes using cedar bog bridge material using 4 linear foot helical anchors to secure the bog bridging.

Stepping Stones

Stepping stones elevate the treadway, providing dry footing and allow soils surrounding the stepping stones to stabilize, eventually leading to revegetation of the surrounding soil. As stepping stones are typically set in wet, muddy areas, they should be large stones so that the mass of the stone aides in the stabilization of the treadway and should not move.

Trail Bridge

The two bridge designs that I would recommend are from the United State Forest Service (USFS) and a from the company E.T. Techtonics. I would recommend you seek out other bridge designs given the nature of this project, from engineers that can provide you with stamped drawings.

The USFS Sawn Timber Bridge design can be found in the Trail Construction Specifications section of this document. The USFS Bridge Booklet that can also be found by following this link: USFS Trail Bridge Plans.

The second bridge design recommendation would be a E.T. Techtonics Fiberglass Bridges. Please find more information by following this link: E.T. Techtonics. I believe this is a good option, given the benefits of a PE stamped drawings and calculations, ease of installation, and the design. I have included a couple of pictures of bridges I have installed when I was working with another Professional Trail Contractor in the Trail Construction Specifications section of this document.

If you decide not to use one of the two recommended above bridge designs, I recommend that you contact a structural engineer in Vermont. I would recommend that you contact Jeremy Krohn at (802) 671-5752. He lives in Southern Vermont and has many connections in the trail world.

General recommendation

In general, all hazard trees that are leaning into or along the trail should be removed. I do not recommend removing all dead trees because they provide essential wildlife habitat. However, for this report, hazard trees are any tree that is dead or dying leaning toward the trail or a trail structure. Removing hazards trees is especially important near gathering spaces such as trail junctions or observation areas. Ultimately, the client will have to make a judgment call on what constitutes a hazard or excessive risk to your property and the public.

Construction Recommendation

With some oversight, I believe trail volunteers and/or a youth conservation crew can complete the following tasks: corridor clearing (except for hazard tree removal), sidehill benching, stepping stones, crush, and bog bridging.

Cost Estimate

I recommend using either a Vermont Youth Conservation Corps Crew or a NorthWoods Conservation Corps Crew to help with the construction of corridor clearing (except for hazard tree removal), sidehill benching, stepping stones, crush, and bog bridging. The typical crew cost for a Vermont Youth Conservation Corps (VYCC) crew consisting of two crew leaders and six members is $7,300 per week. VYCC has started doing a smaller crew that consists of 4 adults (usually made up of leader) and typically costs $3,600.00 a week. I have reached out to VYCC and NorthWoods for additional information on costs and how long they think it would take their crews to complete the work. I will pass along the information when I receive it.

The cost estimate for a professional trail builder to complete the above-recommended scope of work, excluding the two bridges is approximately **$32,865.00** and would take approximately 1 month to construct. **This cost estimate does not**

include the two bridges at 30 linear feet and 37 linear feet. This estimate does include material, labor, equipment rental, housing, contingency, and overhead. You will need to decide on the bridge design before you can estimate the cost to construct the bridge, which may include engineering cost.

I did submit a request for quote for two ET Techtonics Fiberglass Bridges at 30-linear feet and 37-linear feet. You can find those quotes in this document in the Trail Specification Section under Trail Spec 5.4 Fiberglass Bridge. Please keep in mind these estimates do not include the cost of the abutments and labor to put the bridges together.

Workshop Cost Estimate

Town 4 Trail Services, LLC will provide one instructor for a minimum of 6 participants to a maximum of 10 participants, limited personal protective equipment (extra safety glasses & gloves), and hand tools for a two-day workshop on Sustainable Trail Construction. The total estimated cost of this workshop including instructor time, mileage, and overhead is **$1,188.00.**

Conclusion

Research has given us advanced information that connecting and understanding the connection to the natural world plays a large part in increasing our overall wellness. With this, organizations have seen a drastic increase in use and are presented with challenges to accommodate this use. Additionally, trail layout and design principles have developed drastically since these trails were first designed. Investing in the completion of these recommended trail improvements will enhance the visitor's experience while protecting the natural resource of the Krusch Nature Preserve.

Wheel Reading	Reference point	Work Comments	Photo #	Photo
0	North Side of the proposed parking lot.	Follow the existing woods road.	1	2-inch DBH birch on the left.
31	Two lead yellow birch on the left.	Install a grade dip.		
91	17-inch DBH pine and 10-inch DBH yellow birch off the trail on the right.	Install a grade dip.	2	Log on the left.
142	Moss covered log on the ground to the right.	Install a grade dip.	3	Pine across the treadway.
183	Pine across the treadway.	Continue following existing woods road.	4	Snag on the right.
243	20-inch pine the left.	Install a grade dip.	5	3 lead maple on the left.
289	Three lead maple on the left.	Install grade dip.		
331	Pine snag on the left.	Install a grade dip.		
370	10-inch DBH maple on the right.	Continue following the existing woods road.	6	Broken maple on the left.
471	Junction with the field.	Close old road to the right (use plantings, brush, post, or fencing). Begin mowing to define treadway.		
515	19-inches downhill from the crest of the hill.	Install a grade dip.		
534	Crest of the hill.	Continue mowing to define the treadway.	7	View into the field.

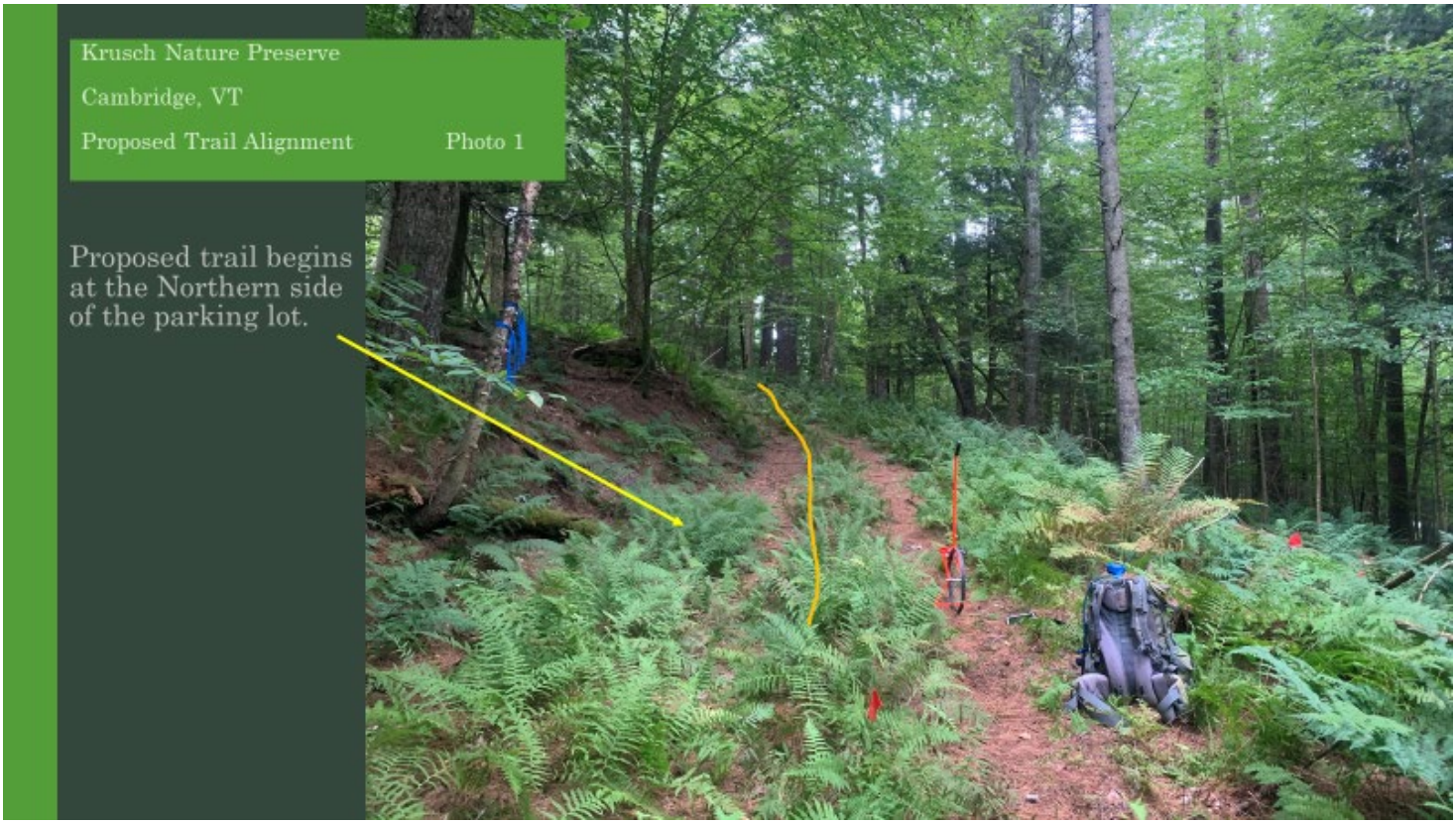
Wheel Reading	Reference point	Work Comments	Photo #	Photo
707	Small hawthorne on the right.	Continue mowing to define the treadway.	8	View of the field and woods edge.
909	Leave the field and enter the woods.	End mowing. Begin 2,982 linear feet of corridor clearing. Crush and fill for 10 linear feet at yellow birch to protect the roots.	9	Yellow birch on the left.
956	Large stump on the left.	Begin 82 linear feet of side hill benching.	10	Trail sweeps to the left.
999	10-inch DBH fir on the left.	Install a grade reversal.		
1016	Snag in the center of the treadway.	Continue side hill benching.	11	Side hill to the first bridge site.
1038	Terrain levels out.	End side hill benching.		
1058	17-inch DBH yellow birch on the left.	Begin 30 linear foot bridge with guardrails.	12	Bridge site.
1088	8-inch DBH yellow birch in the center of treadway.	End bridge. Remove yellow birch.		
1106	6-inch DBH yellow birch on the right.	Begin 75 linear feet of side hill benching.	13	Across the side slope.
1181	6-inch DBH maple in the center of the treadway.	End side hill benching. Begin 120 linear feet of light benching. Remove maple.	14	Short section of fall line trail.
1224	3-inch DBH hemlock on the right.	Install a grade reversal.		
1270	View of yellow birch that grew on an old stump and sign on the right.	Continue light benching.	15	Snag on the left.
1301	Hemlock snag on the left.	End light benching. Begin 51 linear feet of side hill benching.		

Wheel Reading	Reference point	Work Comments	Photo #	Photo
1330	Depression in the treadway with steep terrain.	Continue side Hill benching, while pulling mineral soil into the depression.	16	Snag in center of the treadway.
1352	Snag on the right.	End side hill benching. Begin 118 linear feet of light benching.		
1392	Yellow birch roots on the right.	Remove maple.	17	Yellow birch roots on the right.
1470	Gateway between three pines and one hemlock.	End light benching. Begin 145 linear feet of side hill benching.	18	Dead pine in the center of the treadway.
1532	16-inch maple on the right.	Remove pine.		
1584	3-inch DBH hemlock in the center of the treadway.	Remove pine. Continue to side hill benching.	19	Pine log across the treadway.
1615	Two lead white pine on the left.	End side hill benching. Begin 104 linear feet of light benching.	20	Mushroom on the hemlock to the right.
1719	Intersection with existing trail.	End light benching. Remove small clump of hemlocks on the left.	21	Small clump of hemlocks on the left.
1759	Intersection with existing woods road.	Clean right side of culvert. Close old road to the left (plantings, brush, post, or fence).	22	Culvert.
1880	Leave the existing woods road. Trail curves to the left thru the ferns.	Begin 175 linear feet of light benching. Potential junction for a loop trail in the future.	23	Road continues to the right.
1963	Three lead yellow birch on the right.	Continue light benching.	24	Snag in center of the treadway.
2055	18-inch DBH white pine on the right.	End light benching. Begin 64 linear feet of side hill benching.	25	Two lead yellow birch on the right.
2119	17-inch DBH hemlock on the right.	End side hill benching. Begin 13 linear feet of light benching.	26	Yellow birch at stepping stone location on the right.

Wheel Reading	Reference point	Work Comments	Photo #	Photo
2132	Edge of a drainage.	End light side hill benching. Begin 9 linear feet of stepping stones.		
2141	Edge of a drainage.	End stepping stones. Begin 198 linear feet of light benching.		
2244	4-inch DBH birch on the left.		27	Yellow birch on the right.
2304	Lookout over the ravine.	Continue light benching.	28	Trail sweeps to the right.
2339	Junction with open area along the ridge.	End light benching.	29	Short section of fall line.
2364	Stump on the left.	Install a grade dip.		
2399	Two lead yellow birch on the right.	Install a grade dip.		
2483	Low area between two ridges.	Begin 54 linear feet of side hill benching.	30	Dead hemlock on the right.
2516	1-inch DBH striped maple on the right.	Install a grade reversal.		
2537	8-inch DBH hemlock on the right.	End side hill benching. Begin 31 linear feet of light benching thru the ridge.	31	Large stump on the right.
2568	7-inch DBH yellow birch on the right.	End light benching. Begin 284 linear feet of side hill benching.	32	Log across the treadway.
2625	16-inch DBH hemlock on the right.	Continue side hill benching.	33	Trail curves to the left.
2696	16-inch DBH maple on the right.	Continue side hill benching curving the trail to the left.	34	Three stumps in foreground.

Wheel Reading	Reference point	Work Comments	Photo #	Photo
2771	Stump on the left.	Continue side hill benching.	35	Stump on the left.
2804	Grade reversal.	Continue side hill benching. Begin steep side slope. Save mineral soil for fill at junction with trail to waterfall.	36	Steep side slope.
2852	Steep terrain.	End Benching. Begin 2 linear feet of crush and fill to reduce grade.		
2854	Junction with existing trail to water fall.	End crush and fill.	37	Trail curves to the right.
2895	Junction with existing woods road.	Install a grade dip.	38	Trail follows the brook to the left.
2947	Dragon Brook sign on the left.		39	Trail curves to the right and then to the left.
3159	24-inch DBH pine on the right.	Continue following the existing woods road.	40	Large pine on the right.
3324	5-inch hemlock leaning over the treadway.	Continue following the existing woods road.	41	Hemlock leaning over the treadway.
3459	8-inch DBH cherries on the left and the right.	Leave the existing woods road. Begin 18 linear feet of side hill benching.	42	Trail sweeps to the left.
3477	6-inch DBH hemlock in center of treadway.	End side hill benching. Remove hemlock.		
3487	Pine snag on the left.	Begin 37 linear foot bridge with guardrails.	43	Second bridge site.
3524	5-inch hemlock on the right.	End bridge. Begin 297 linear feet of bog bridging.		
3517	Pine snag on the left.	Continue bog bridging.	44	Through the ferns.

Wheel Reading	Reference point	Work Comments	Photo #	Photo
3553	Honeysuckle on the right.	Continue bog bridging.	45	
3682	Dead pine across the treadway.	Continue bog bridging.	46	Large cottonwood on the right.
3751	Junction with existing trail.	Continue bog bridging.	47	Ferns. The trail sweeps to the left.
3795	Seasonal flow.	Continue bog bridging. Span seasonal flow.	48	Seasonal flow.
3802	End seasonal flow.			
3821	Hemlock snag on the right.	End bog bridging.		
3855	Existing trail curves to the left.	Begin 36 linear feet of side hill bench cut.	49	Boundary photo.
3884	Grade reversal.			
3891	Boundary.	End corridor clearing. End side hill bench cut. End worklog		


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 1
Proposed trail begins at the Northern side of the parking lot.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 2
Install a grade dip.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 3

Install a grade dip.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 4

Continue following old woods road.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 5
Install a grade dip.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 6
Continue following old woods road.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 7

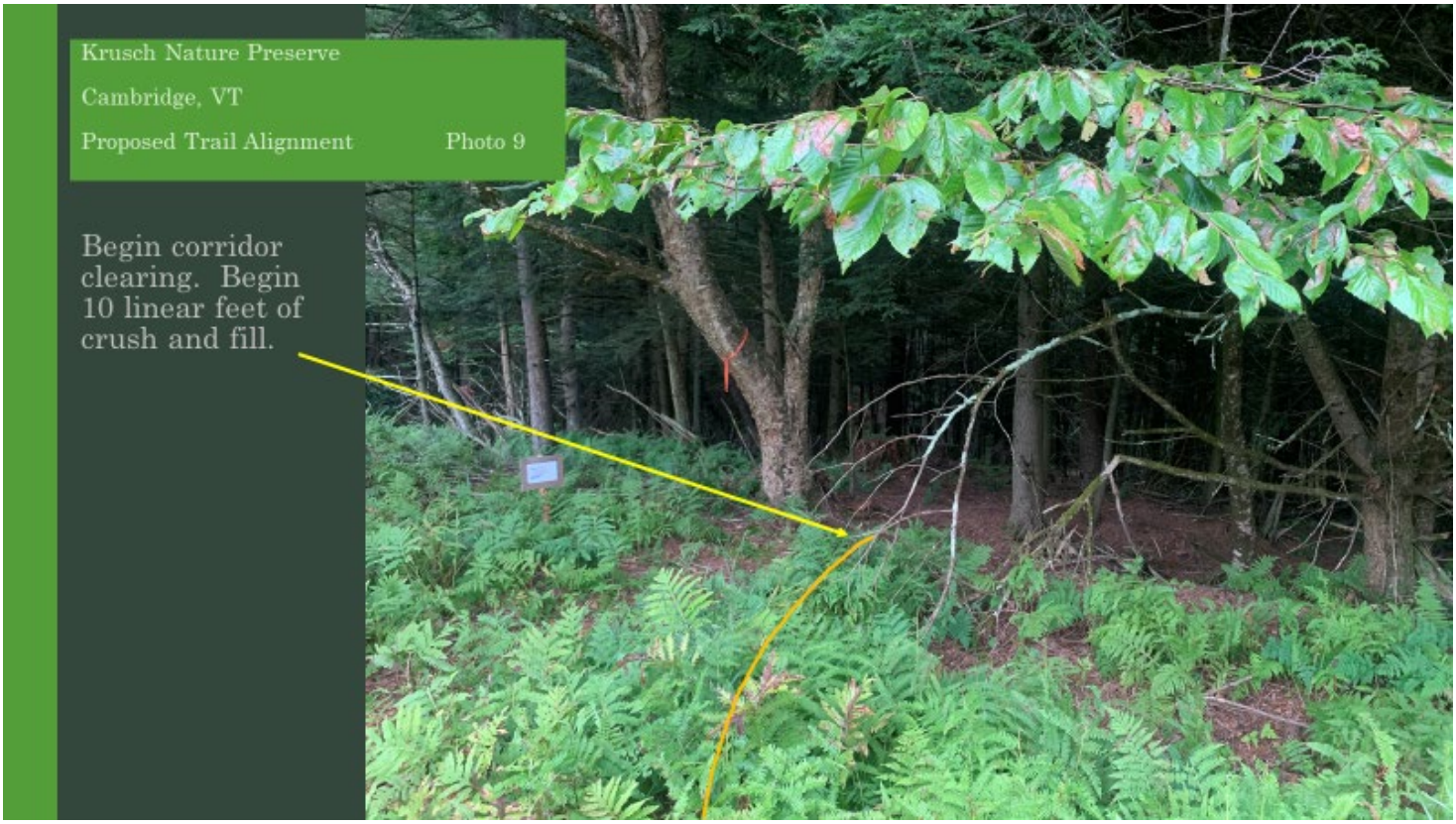
Mow through the field to define the treadway.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 8

Continue mowing through the field to define the treadway.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 9
Begin corridor clearing. Begin 10 linear feet of crush and fill.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 10
Side hill benching.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 11
Bridge location.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 12
Bridge with guardrails.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 13

Side hill benching.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 14

Light benching.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 15

Continue light benching.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 16

Side hill benching.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 17

Continue light benching.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 18

Side hill benching.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 19

Continue side hill benching.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 20

Light benching.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 21
Junction with existing woods road.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 22
Follow existing woods road.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 23

Light benching.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 24

Continue light benching.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 25

Side hill benching.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 26

Stepping stones.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 27

Trail sweeps out for view into the ravine.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 28

Light benching.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 29
Grade dip.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 30
Side hill benching

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 31

Light benching through the ridge.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 32

Side hill benching.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 33

Continue side hill benching.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 34

Continue side hill benching.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 35
Continue side hill benching.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 36
Grade reversal.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 37
Crush and fill to reduce grade at trail junction.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 38
Junction with existing woods road.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 39

Proposed trail follows Dragon Brook.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 40

Continue following existing woods road.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 41

Continue following existing woods road.

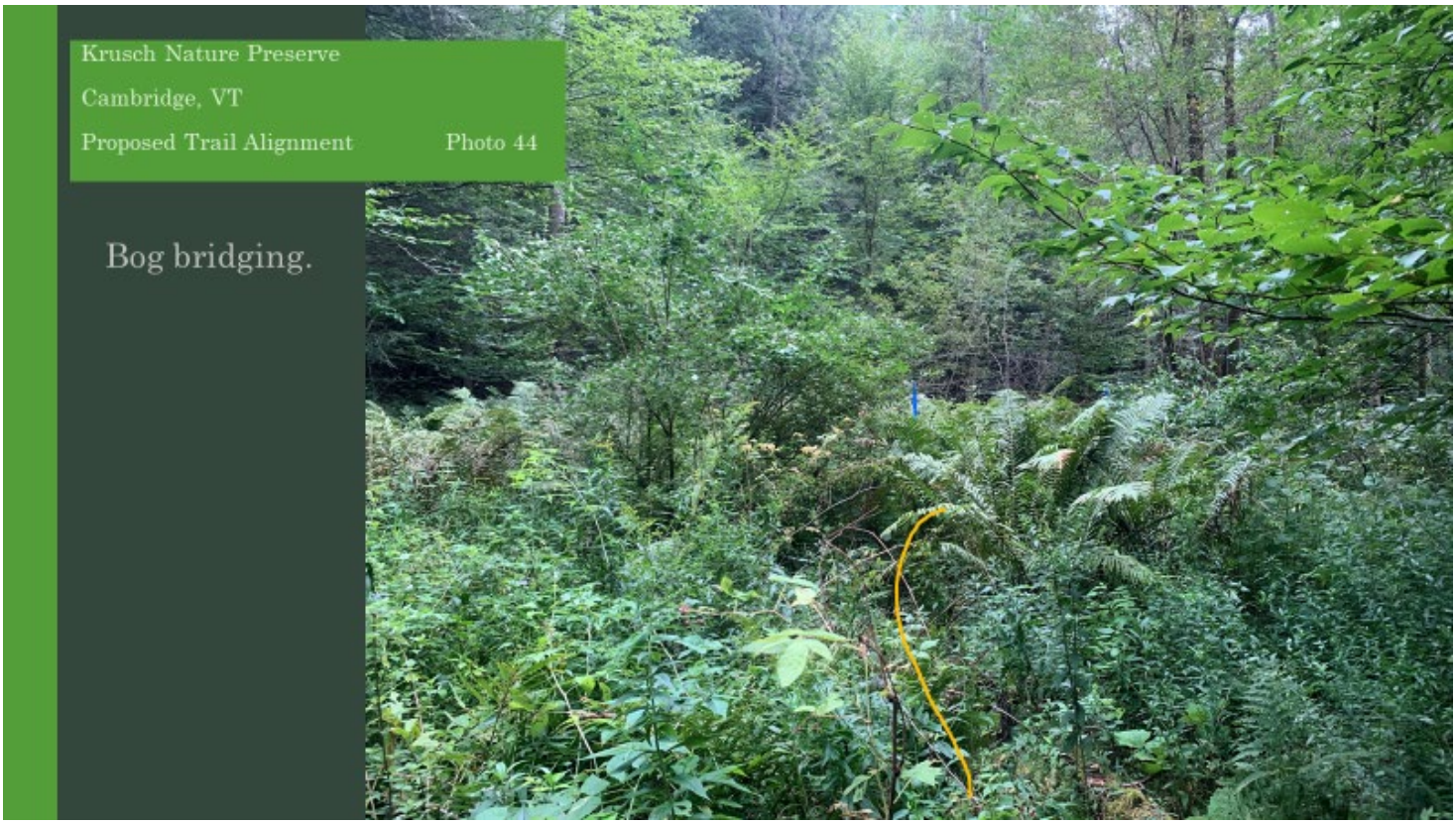
Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 42

Trail leaves existing woods road and sweeps to the left.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 43
Bridge.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 44
Bog bridging.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 45

Continue bog bridging.

Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment Photo 46

Continue bog bridging.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 47

Continue bog bridging.

Krusch Nature Preserve

Cambridge, VT

Proposed Trail Alignment Photo 48

Span seasonal flow with center of bog bridging.


Krusch Nature Preserve
Cambridge, VT
Proposed Trail Alignment
Photo 49
End Worklog.
An additional 174 linear feet of side hill benching is recommended to reach level ground on State Property.

TRAIL CONSTRUCTION SPECIFICATION **1.1 Corridor Clearing**

The trail corridor is defined as the edge of the clearing limits of vegetation for an equal distance on either side of the trail treadway. Determining the dimension of corridor clearing is directly tied to user group and trail type. In general, the corridor is cleared an additional width of 1-foot to 2-foot either side of the trail tread.

Specifications:

- Corridor width: 6 feet
- Corridor height: 10 feet to 12 feet

Judgment should be made when removing vegetation within the trail corridor as not all vegetation needs to be removed. The clearing of the corridor should frame the trail tread and is explicitly done to create a positive user experience.

Tree branches and limbs which impede the trail corridor should be removed at the branch collar. Caution and proper pruning methods should be used so that no cuts or tears are made while using pruning tools.

Trees and shrubs that must be removed can be cut off at knee height (for leverage) and later dugout to remove the stumps. Trees that are within the corridor, but not growing in the treadway, may be cut flush with the ground.

All brush should be removed from the corridor and disposed of out of sight of the trail treadway. The cut ends should face away from the trail treadway to reduce visibility.

Experienced sawyers should remove hazard trees that are leaning toward the trail corridor, but outside of the corridor. When using a chainsaw, vegetable-based bar and chain oil is recommended to limited the impact upon the resource.

Example:

TRAIL CONSTRUCTION SPECIFICATION **2.1 Grade Reversal & Grade Dip**

Frequent grade reversals are an essential aspect of sustainable trail layout and design. A grade reversal is created when the running grade of the trail either increases or decreases, levels off creating a low area in which the water can drain off the trail, and then either the running grade increases or decreases. Simply stated a grade reversal is a change in elevation with a low area in which water can drain off the trail. If water is trapped on the trail, the carrying capacity will increase, creating more significant erosion. Grade reversals should be installed as frequently as possible based on soil types and running grade.

Grade dips serve the same purpose as a grade reversal, but grade dips are installed into existing trails.

A grade reversal is installed during the benching phase of excavation and is constructed by excavating across the hillside to create the desired trail tread. Excavate the entire treadway down to compacted mineral soil at the desired width, grade, and with a 2%-5% outslope treadway.

Specifications:

- Tread width: 2-feet
- Outsloped treadway at 2% to 5%

All materials should be saved and used for specific applications; this includes the leaf litter, organic duff layer, and excess mineral soil.

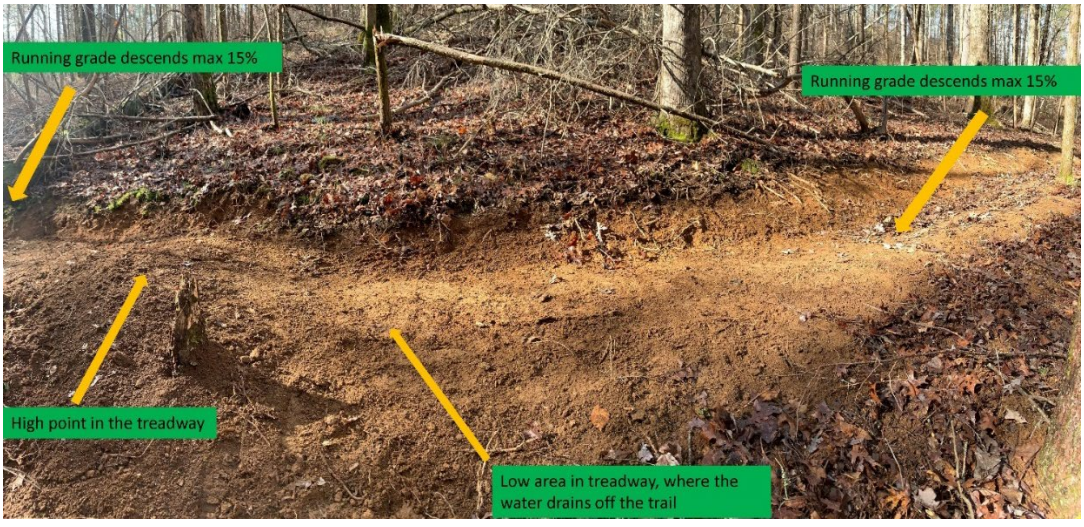
Leaf litter should be removed equally from the centerline of the tread and be saved for use later. Leaf litter provides a source of seed material and can be used for revegetation aesthetics after the treadway is constructed.

The organic material should be removed within the full bench cut area and stockpiled for use later. Be careful not to impede water flow by creating piles, berms, or windrows along the trail during construction.

Upon the removal of the leaf litter and organic material, excavate to the necessary depth for full bench construction. Excess mineral soil should be stockpiled for use later.

Roots should cut cleanly and not torn, as this will help the root compartmentalize. Roots cut during construction should be hidden from view and spread into the woods. Any stones found during excavation can be used for stone cribbing or crushed for backfill.

Example:



TRAIL CONSTRUCTION SPECIFICATION **4.1 Full Bench Cut**

A Full bench cut is created by excavating across the hillside to create the desired trail tread. Excavate the entire treadway down to compacted mineral soil at the desired width, grade, and with a 2%-5% outslope treadway.

Specifications:

- Tread width: 2-feet
- Outsloped treadway at 2% to 5%

All materials should be saved and used for specific applications; this includes the leaf litter, organic duff layer, and excess mineral soil.

Leaf litter should be removed equally from the centerline of the tread and be saved for use later. Leaf litter provides a source of seed material and can be used for revegetation aesthetics after the treadway is constructed.

The organic material should be removed within the full bench cut area and stockpiled for use later. Be careful not to impede water flow by creating piles, berms, or windrows along the trail during construction.

Upon the removal of the leaf litter and organic material, excavate to the necessary depth for full bench construction. The back slope of the bench cut should not exceed the angle of repose, roughly a 45-degree angle from the hinge point of the treadway. Excess mineral soil should be stockpiled for use later.

Roots should be cut cleanly and not torn, as this will help the root compartmentalize. Roots cut during construction should be hidden from view and spread into the woods.

Any stones found during excavation can be used for stone cribbing or crushed for backfill.

Examples:

TRAIL CONSTRUCTION SPECIFICATION **4.2 Stepping Stones**

Stepping stones are used for pedestrian-only trails where the terrain is flat, and there is no way to drain the water off the tread surface. Stepping stones elevate the treadway, providing dry footing and allow soils surrounding the stepping stones to stabilize, eventually leading to revegetation of the surrounding soil. As stepping stones are typically set in wet, muddy areas, they should be large stones so that the mass of the stone aides in the stabilization of the treadway and should not move.

Specifications:

- Tread width: 2-feet
- Space between stones should not exceed 12-inches

Unlike most other trail structures stepping stones do not require excavation down to solid mineral soil before construction can begin. This is because stepping stones are typically set in wet, muddy areas where the organic layer can be quite deep. However, this doesn't mean you can lay the stone on top of the ground and call it good. You should still remove as much organic material as possible to create a hole to set the stepping stone in.

Leaf litter should be removed equally from the centerline of the tread and be saved for use later. Leaf litter provides a source of seed material and can be used for revegetation aesthetics after the treadway is constructed.

The organic material should be removed at tread width and dispersed into the woods. Be careful not to impede water flow by creating piles, berms, or windrows along the trail during construction.

Roots should be cut cleanly and not torn, as this will help the root compartmentalize. Roots cut during construction should be hidden from view and spread into the woods.

Once you have removed the leaf litter and the majority of the organic material, excavate the appropriately sized hole for your first stone. Set the flattest side up to provide a level stepping surface. The stepping stone should be set so that it is elevated above the surrounding terrain enough to keep water and mud from the tread surface, but not too high as to present an additional safety hazard. The stepping stone needs to be set solid so that it does not move side to side. Continue setting stepping stones in this manner, spacing the stones no further than 12-inches apart. A good rule of thumb is to space the stones 6-inches to 9-inches apart as this can accommodate a wide variety of users and still allow water to flow between the stones.

Examples on the following page.

Examples:


Large stones set creating a stable and easily traversed treadway
Stepping stones located in Seal Harbor, ME


Stabilized soil and new vegetation growth.
Stepping stones on the Long Trail in VT

TRAIL CONSTRUCTION SPECIFICATION **4.8 Bog Bridges**

Bog Bridges are used for pedestrian-only trails where the terrain is flat, and there is no way to drain the water off the tread surface. Bog bridging elevates the treadway, providing dry footing and allow soils surrounding the structure to stabilize, eventually leading to revegetation of the surrounding soil. As bog bridges are typically set in wet, muddy areas, they consist of a section of wooden planks set across base logs, placed end to end down the trail.

Specifications:

- Tread width: 6-inches (one plank) to 12-inches wide (2 planks)

Rot-resistant wood is preferred for bog bridges, typically Northern White Cedar, Locust, White Oak (planks), Hemlock, or Pressure Treated Lumber. The type of wood will determine the required dimensions for construction to avoid premature breakage. Generally speaking, you do not want the plank to flex more than approximately 1-inch with a 200-pound person.

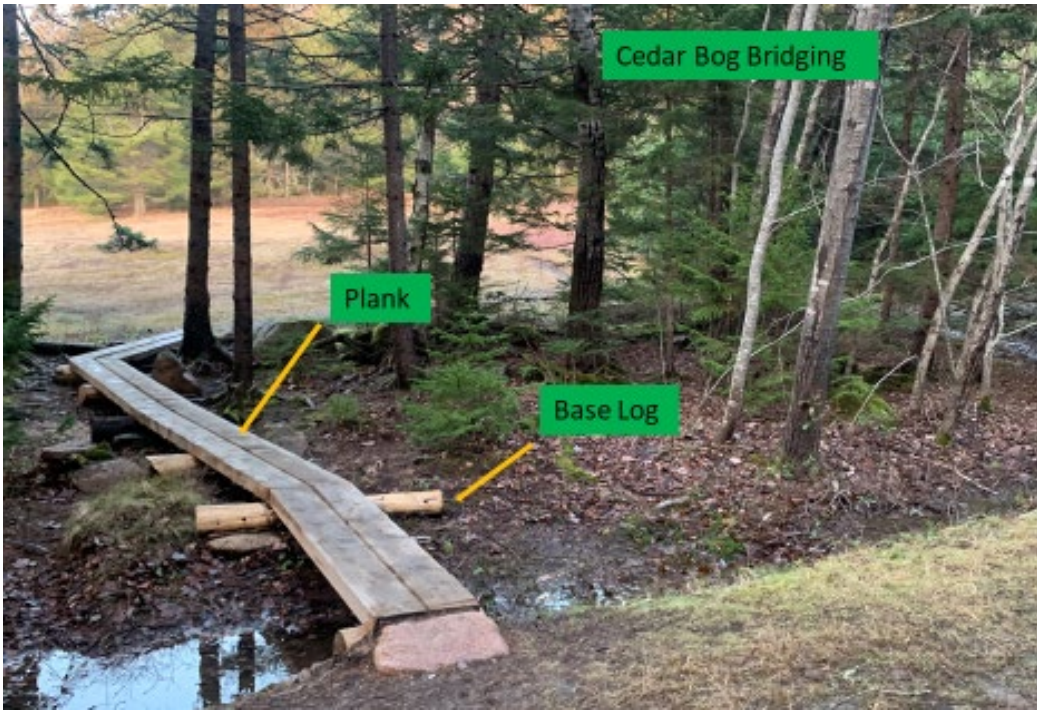
Cedar planking should be a minimum of 4-inches thick, 6-inches wide, and span only 8-linear feet. Bridges should not be spaced more than a maximum of 1 ½-inches apart. Base logs should be 4-inches to 6-inches thick and a minimum of 2 ½-feet long. Base logs that are smaller than this may not provide enough floatation in wet soils and may split when spikes are driven through the planks.

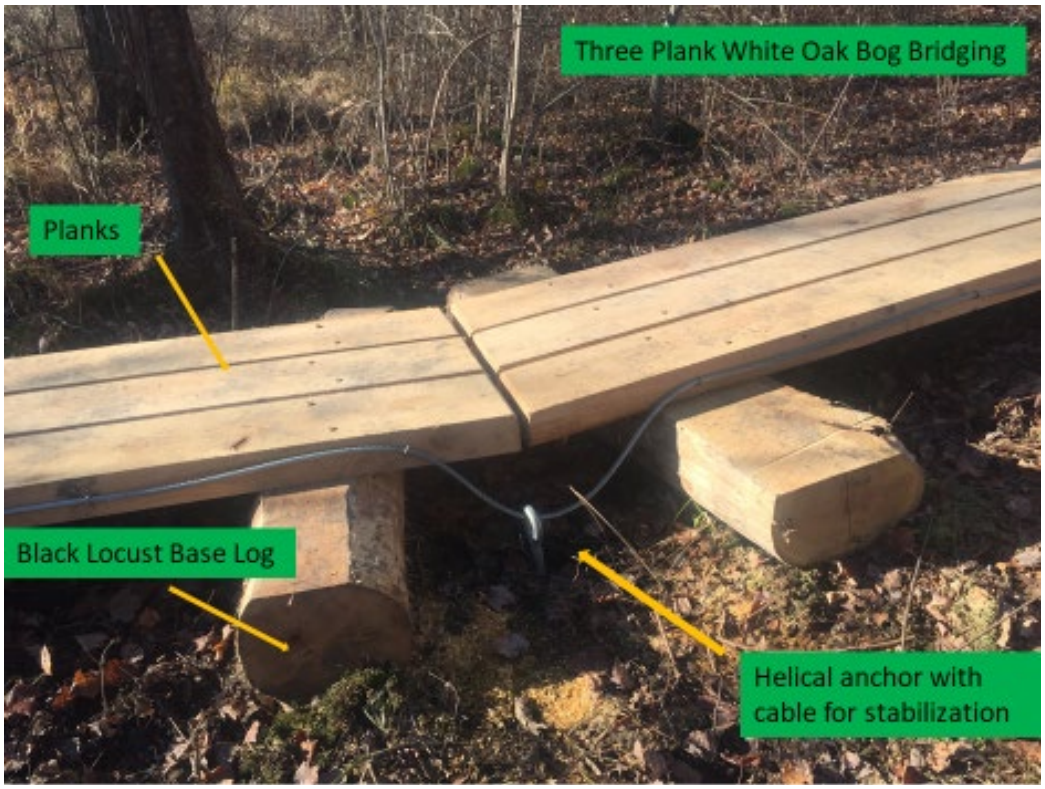
Determine the location of any small drainage channels and deep mud holes. Span these locations with the center of the bog bridging and then layout the remaining sections of bog bridging. Be sure to end the bog bridging well beyond the wet area onto higher ground because hikers will have a greater impact stepping off the structure. You can use smaller logs at the entrance and exits of the structure to have a smoother transition. Bridges should be constructed as completed units, and planks should be spiked to base logs. The distance from the center of the spike to the end of the plank should not exceed 8-inches.

The organic material should be removed at the base log location dispersed into the woods. Be careful not to impede water flow by creating piles, berms, or windrows along the trail during construction. Any roots should be cut cleanly and not torn, as this will help the root compartmentalize. Roots cut during construction should be hidden from view and spread into the woods.

Examples on the following page.

Examples:


Cedar Bog Bridging
Plank
Base Log


Three Plank White Oak Bog Bridging
Planks
Black Locust Base Log
Helical anchor with cable for stabilization

TRAIL CONSTRUCTION SPECIFICATION **5.3 USFS SAWN TIMBER BRIDGE**

U.S. Department of Agriculture Forest Service, Standard Trail Plan: Sawn Timber Bridge

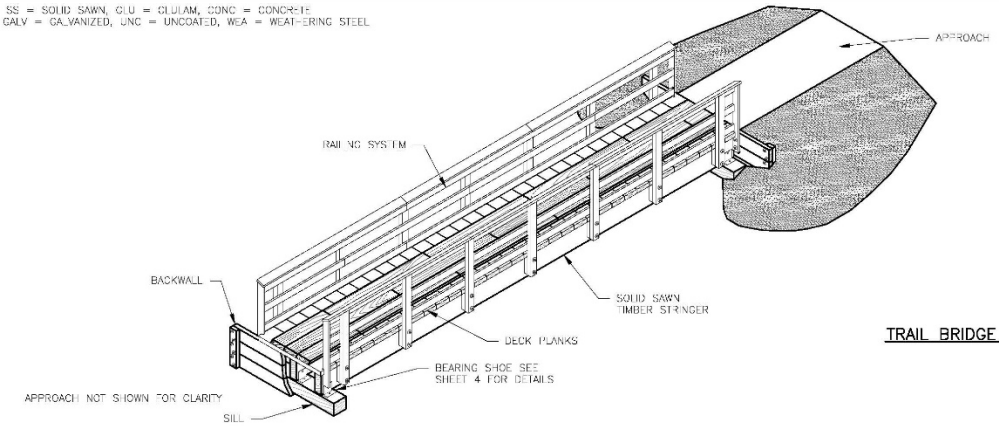
The bridge design can also be found at: https://www.fs.usda.gov/managing-land/trails/trail-management-tools/trailplans

								STRINGERS					DECK			BACKWALL					
STRUCTURE NUMBER	TRAIL NO.	BRIDGE LOCATION	BRIDGE LENGTH OUT-TO-OUT	STRINGER SPAN C-C BRNG	BRIDGE CLEAR WIDTH	PEDESTRIAN LOAD	GROUND SNOW LOAD	SPECIES	NUMBER	MATERIAL SIZE	TREATMENT YES	TREATMENT NO	SPECIES	SIZE	TREATMENT	TYPE	SPECIES	SIZE	WIDTH	HEIGHT	TREATMENT

NA = NOT APPLICABLE

	RAILING SYSTEM/CURB						RUNNING PLANK					SILL			APPROACHES						HARDWARE	
STRUCTURE NUMBER	SPECIES	TYPE	HEIGHT	MATERIAL TYPE	TREATMENT YES	TREATMENT NO	SPECIES	SIZE	WIDTH	TREATMENT YES	TREATMENT NO	TYPE	SIZE	TREATMENT	LENGTH NEAR	LENGTH FAR	WIDTH	MATERIAL TYPE	MATERIAL DEPTH	GEO-SYNTHETIC TYPE	COATINGS	COMMENTS
X																						

ABUTMENT MATERIAL TYPE: SS = SOLID SAWN, GLU = GLULAM, CONC = CONCRETE
HARDWARE COATING TYPE: GALV = GALVANIZED, UNC = UNCOATED, WEA = WEATHERING STEEL



TRAIL BRIDGE W/RAILING SYSTEM

SHEET 1 OF 4

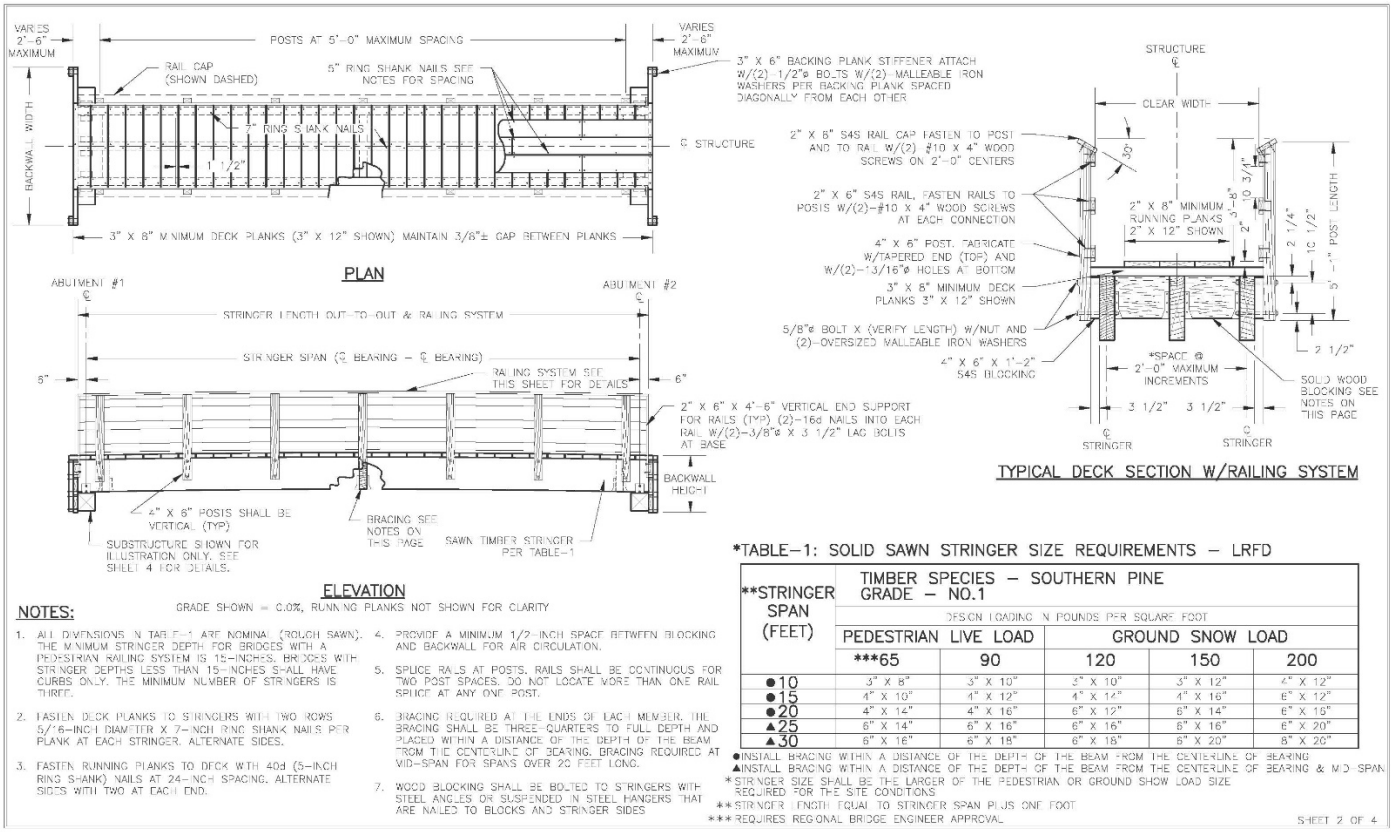
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE
STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME: SAWN TIMBER STRINGER TRAIL BRIDGE
SECTION: 962 - SAWN TIMBER TRAIL BRIDGE
TYPICAL ID: STS

REVISION DATE: NOT TO SCALE

DRAWING NO.: STD_962-10-01
SHEET OF



NOTES:

1. ALL DIMENSIONS IN TABLE-1 ARE NOMINAL (ROUGH SAWN). THE MINIMUM STRINGER DEPTH FOR BRIDGES WITH A PEDESTRIAN RAILING SYSTEM IS 15-INCHES. BRIDGES WITH STRINGER DEPTHS LESS THAN 15-INCHES SHALL HAVE CURBS ONLY. THE MINIMUM NUMBER OF STRINGERS IS THREE.
2. FASTEN DECK PLANKS TO STRINGERS WITH TWO ROWS 5/16-INCH DIAMETER X 7-INCH RING SHANK NAILS PER PLANK AT EACH STRINGER, ALTERNATE SIDES.
3. FASTEN RUNNING PLANKS TO DECK WITH 40d (5-INCH RING SHANK) NAILS AT 24-INCH SPACING, ALTERNATE SIDES WITH TWO AT EACH END.
4. PROVIDE A MINIMUM 1/2-INCH SPACE BETWEEN BLOCKING AND BACKWALL FOR AIR CIRCULATION.
5. SPLICE RAILS AT POSTS. RAILS SHALL BE CONTINUOUS FOR TWO POST SPACES. DO NOT LOCATE MORE THAN ONE RAIL SPLICE AT ANY ONE POST.
6. BRACING REQUIRED AT THE ENDS OF EACH MEMBER. THE BRACING SHALL BE THREE-QUARTERS TO FULL DEPTH AND PLACED WITHIN A DISTANCE OF THE DEPTH OF THE BEAM FROM THE CENTERLINE OF BEARING. BRACING REQUIRED AT MID-SPAN FOR SPANS OVER 20 FEET LONG.
7. WOOD BLOCKING SHALL BE BOLTED TO STRINGERS WITH STEEL ANGLES OR SUSPENDED IN STEEL HANGERS THAT ARE NAILED TO BLOCKS AND STRINGER SIDES

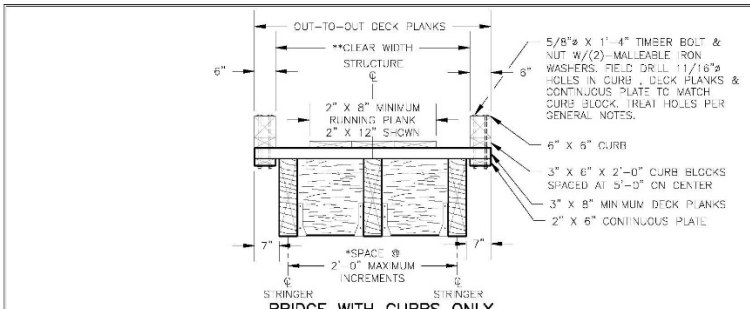
*TABLE-1: SOLID SAWN STRINGER SIZE REQUIREMENTS - LRFD

**STRINGER SPAN (FEET)	TIMBER SPECIES - SOUTHERN PINE GRADE - NO.1				
	DESIGN LOADING IN POUNDS PER SQUARE FOOT				
	PEDESTRIAN LIVE LOAD		GROUND SNOW LOAD		
	***65	90	120	150	200
●10	3" X 8"	3" X 10"	3" X 10"	3" X 12"	4" X 12"
●15	4" X 10"	4" X 12"	4" X 12"	4" X 16"	6" X 12"
●20	4" X 14"	4" X 16"	6" X 12"	6" X 14"	6" X 16"
▲25	6" X 14"	6" X 16"	6" X 16"	6" X 16"	6" X 20"
▲30	6" X 16"	6" X 18"	6" X 18"	6" X 20"	8" X 20"

●INSTALL BRACING WITHIN A DISTANCE OF THE DEPTH OF THE BEAM FROM THE CENTERLINE OF BEARING
▲INSTALL BRACING WITHIN A DISTANCE OF THE DEPTH OF THE BEAM FROM THE CENTERLINE OF BEARING & MID-SPAN
*STRINGER SIZE SHALL BE THE LARGER OF THE PEDESTRIAN OR GROUND SHOW LOAD SIZE REQUIRED FOR THE SITE CONDITIONS.
**STRINGER LENGTH EQUAL TO STRINGER SPAN PLUS ONE FOOT
***REQUIRES REGIONAL BRIDGE ENGINEER APPROVAL

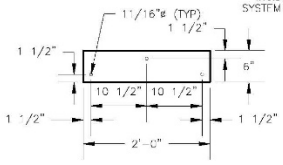
SHEET 2 OF 4

U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE **STANDARD TRAIL PLAN**	PROJECT NAME & LOCATION	DRAWING NAME **SAWN TIMBER STRINGER TRAIL BRIDGE**	REVISION DATE **NOT TO SCALE**	DRAWING NO. **STD_962-10-02b**
		SECTION **962 - SAWN TIMBER TRAIL BRIDGE** TYPICAL ID **STS**		SHEET OF

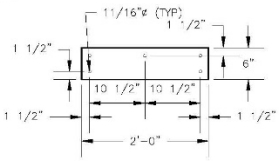


BRIDGE WITH CURBS ONLY
DECK SECTION W/STRINGERS @2'-0" O.C.

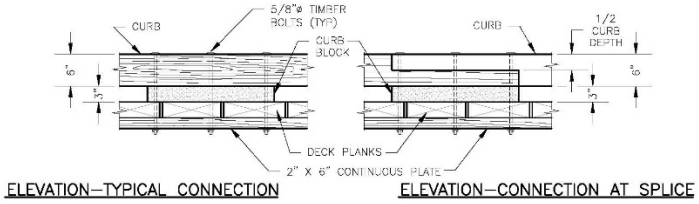
* MINIMUM NUMBER OF STRINGERS IS THREE
** INSIDE FACE TO INSIDE FACE OF RAILING SYSTEM



PLAN–CURB BLOCK



PLAN–CURB BLOCK AT SPLICE



ELEVATION–TYPICAL CONNECTION

ELEVATION–CONNECTION AT SPLICE

SOLID SAWN CURB CONNECTION DETAILS

GENERAL NOTES:

SPECIFICATIONS: MATERIALS AND CONSTRUCTION OF THIS STRUCTURE SHALL BE IN ACCORDANCE WITH THE STANDARD SPECIFICATION FOR CONSTRUCTION OF ROADS AND BRIDGES ON FEDERAL HIGHWAY PROJECTS (FP-03) AND STANDARD SPECIFICATIONS FOR CONSTRUCTION OF TRAILS AND TRAIL BRIDGES ON FEDERAL PROJECTS.

TIMBER & LUMBER: SOLID SAWN TIMBER MEMBERS SHALL CONFORM TO THE REQUIREMENTS OF THE GRADING RULES AGENCY FOR THE SPECIES, TYPE, AND GRADE SPECIFIED BELOW.

DECK PLANKS, CURBS, SILLS, & BACKING PLANKS
- COASTAL REGION DOUGLAS FIR-LARCH ROUGH SAWN NO.1 GRADE, GRADING RULES AGENCY – WWPA, WCLIB

RUNNING PLANKS
- COASTAL REGION DOUGLAS FIR-LARCH ROUGH SAWN NO.2 GRADE, GRADING RULES AGENCY – WWPA, WCLIB

RAILS & POSTS (SEE PROJECT CRITERIA)

UNTREATED
- REDWOOD, S4S, NO.1 GRADE GRADING RULES AGENCY – RIS
- WESTERN RED CEDAR, S4S, SELECT STRUCTURAL GRADE GRADING RULES AGENCY – WWPA, WCLIB

TREATED
- HEM-FIR/DOUGLAS FIR, S4S, NO.1 GRADE GRADING RULES AGENCY – WWPA, WCLIB

TREATMENT: SEE PROJECT CRITERIA FOR MEMBERS IDENTIFIED TO BE TREATED AND FOR TREATMENT TYPE. PRESERVATIVE TREATMENT SHALL BE IN ACCORDANCE WITH THE CURRENT AMERICAN WOOD PROTECTION ASSOCIATION (AWPA) SPECIFICATIONS USING THE TREATMENT MATERIALS LISTED BELOW. TREATMENT WILL COMPLY WITH THE REQUIREMENTS OF THE CURRENT EDITION OF WESTERN WOOD PRESERVERS INSTITUTE (WWPI) "BEST MANAGEMENT PRACTICES FOR THE USE OF TREATED WOOD IN AQUATIC ENVIRONMENTS".

STRINGERS, DECKING, RUNNING PLANKS, & RAILING SYSTEM, IF TREATED
- AWPA USE CATEGORY SYSTEM (U1) FOR USE CATEGORY 3B ABOVE GROUND-EXPOSED (UC3B)
- PENTACHLOROPHENOL IN LIGHT OIL (TYPE C SOLVENT)
- COPPER NAPHTHENATE (CuN) IN LIGHT OIL (TYPE C SOLVENT)

SILLS, BACKING PLANKS, CRIBS, & TIMBER WALLS, IF TREATED
- AWPA USE CATEGORY SYSTEM (U1) FOR USE CATEGORY 4B GROUND CONTACT HEAVY DUTY (UC4B)
- PENTACHLOROPHENOL IN HEAVY OIL (TYPE A SOLVENT)
- COPPER NAPHTHENATE (CuN) IN HEAVY OIL (TYPE A SOLVENT)

FIELD TREATMENT: COPPER NAPHTHENATE (2% SOLUTION) SHALL BE FURNISHED FOR FIELD TREATING OD WOOD. ALL ABRASIONS AND FIELD CUTS –APPROVED BY THE C.O.R.– SHALL BE CAREFULLY TRIMMED AND GIVEN THREE BRUSH COATS OF THE FIELD TREATMENT SOLUTION. WHERE APPROVED FIELD DRILLING OF BOLT OR NAIL HOLES IS REQUIRED, THE HOLES SHALL BE FILLED WITH PRESERVATIVE PRIOR TO INSERTING THE FASTENERS.

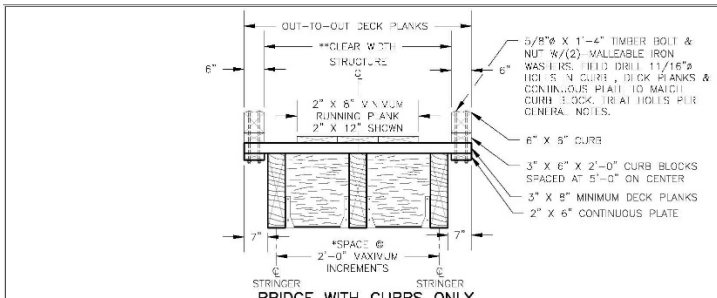
HARDWARE AND STRUCTURAL STEEL: SEE PROJECT DESIGN CRITERIA FOR STEEL HARDWARE FINISH. GALVANIZED OR UNFINISHED HARDWARE SHALL MEET THE REQUIREMENTS OF AASHTO M270, GRADE 36, WITH NUTS AND BOLTS CONFORMING TO ASTM A307, GRADE A. WEATHERING STEEL AND HARDWARE SHALL MEET THE REQUIREMENTS OF AASHTO M270, GRADE 50W, WITH BOLTS AND NUTS CONFORMING TO ASTM A325, TYPE 3. USE MALLEABLE IRON WASHERS AGAINST WOOD UNLESS OTHERWISE NOTED.

WHEN STRUCTURAL STEEL IS TO BE WELDED, THE WELDING PROCEDURE SHALL BE IN ACCORDANCE WITH AWS D1.1 AND SHALL BE SUITABLE FOR THE GRADE OF STEEL AND INTENDED USE OR SERVICE.

FABRICATION: SUBMIT SHOP DRAWINGS FOR ALL BRIDGE COMPONENTS (EXCEPT TIMBER RUNNING PLANKS). SHOW ALL DIMENSIONS AND FABRICATION DETAILS FOR ALL CUT OR BORED TIMBER. FIELD DRILLING OF HOLES SHALL NOT BE ALLOWED UNLESS OTHERWISE NOTED ON THE PLANS.

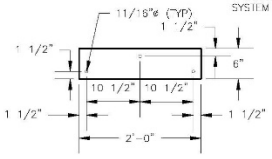
SHEET 3 OF 4

U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE **STANDARD TRAIL PLAN**	PROJECT NAME & LOCATION	DRAWING NAME **SAWN TIMBER STRINGER TRAIL BRIDGE**	REVISION DATE	DRAWING NO. **STD_962-10-03a**
		SECTION **962 - SAWN TIMBER TRAIL BRIDGE** TYPICAL ID **STS**	**NOT TO SCALE**	SHEET **X** OF

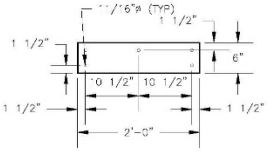


BRIDGE WITH CURBS ONLY
DECK SECTION W/STRINGERS @2'-0" O.C.

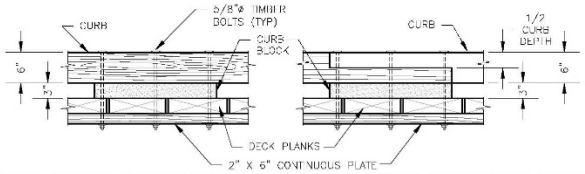
* MINIMUM NUMBER OF STRINGERS IS THREE
** INSIDE FACE TO INSIDE FACE OF RAILING SYSTEM



PLAN–CURB BLOCK



PLAN–CURB BLOCK AT SPLICE



ELEVATION–TYPICAL CONNECTION ELEVATION–CONNECTION AT SPLICE

SOLID SAWN CURB CONNECTION DETAILS

GENERAL NOTES:

SPECIFICATIONS: MATERIALS AND CONSTRUCTION OF THIS STRUCTURE SHALL BE IN ACCORDANCE WITH THE STANDARD SPECIFICATION FOR CONSTRUCTION OF ROADS AND BRIDGES ON FEDERAL HIGHWAY PROJECTS (FP-03) AND STANDARD SPECIFICATIONS FOR CONSTRUCTION OF TRAILS AND TRAIL BRIDGES ON FEDERAL PROJECTS.

TIMBER & LUMBER: SOLID SAWN TIMBER MEMBERS SHALL CONFORM TO THE REQUIREMENTS OF THE GRADING RULES AGENCY FOR THE SPECIES, TYPE, AND GRADE SPECIFIED BELOW.

DECK PLANKS, CURBS, SILLS, & BACKING PLANKS RUNNING PLANKS
- SOUTHERN PINE NO.2 GRADE GRADING RULES AGENCY – SPIB
- SOUTHERN PINE NO.2 GRADE GRADING RULES AGENCY – SPIB

RAILS & POSTS (SEE PROJECT CRITERIA)

UNTREATED
- BALDCYPRESS, S4S, NO.1 GRADE GRADING RULES AGENCY – SPIB
- WHITE OAK, S4S, SELECT STRUCTURAL GRADE GRADING RULES AGENCY – NELMA

TREATED
- SOUTHERN PINE, S4S, NO.1 GRADE GRADING RULES AGENCY – SPIB

TREATMENT: SEE PROJECT CRITERIA FOR MEMBERS IDENTIFIED TO BE TREATED AND FOR TREATMENT TYPE. PRESERVATIVE TREATMENT SHALL BE IN ACCORDANCE WITH THE CURRENT AMERICAN WOOD PROTECTION ASSOCIATION (AWPA) SPECIFICATIONS USING THE TREATMENT MATERIALS LISTED BELOW. TREATMENT WILL COMPLY WITH THE REQUIREMENTS OF THE CURRENT EDITION OF WESTERN WOOD PRESERVERS INSTITUTE (WWPI) "BEST MANAGEMENT PRACTICES FOR THE USE OF TREATED WOOD IN AQUATIC ENVIRONMENTS".

STRINGERS, DECKING, RUNNING PLANKS, & RAILING SYSTEM, IF TREATED
- AWPA USE CATEGORY SYSTEM (UC) FOR USE CATEGORY 3B ABOVE GROUND–EXPOSED (UC3B)
- PENTACHLOROPHENOL IN LIGHT OIL (TYPE C SOLVENT)
- COPPER NAPTHENATE (CuN) IN LIGHT OIL (TYPE C SOLVENT)

SILLS, BACKING PLANKS, CRIBS, & TIMBER WALLS, IF TREATED
- AWPA USE CATEGORY SYSTEM (UC) FOR USE CATEGORY 4B GROUND CONTACT–HEAVY DUTY (UC4B)
- PENTACHLOROPHENOL IN HEAVY OIL (TYPE A SOLVENT)
- COPPER NAPTHENATE (CuN) IN HEAVY OIL (TYPE A SOLVENT)

FIELD TREATMENT: COPPER NAPHTHENATE (2% SOLUTION) SHALL BE FURNISHED FOR FIELD TREATING OD WOOD. ALL ABRASIONS AND FIELD CUTS –APPROVED BY THE C.O.R.– SHALL BE CAREFULLY TRIMMED AND GIVEN THREE BRUSH COATS OF THE FIELD TREATMENT SOLUTION. WHERE APPROVED FIELD DRILLING OF BOLT OR NAIL HOLES IS REQUIRED, THE HOLES SHALL BE FILLED WITH PRESERVATIVE PRIOR TO INSERTING THE FASTENERS.

HARDWARE AND STRUCTURAL STEEL: SEE PROJECT DESIGN CRITERIA FOR STEEL HARDWARE FINISH. GALVANIZED OR UNFINISHED HARDWARE SHALL MEET THE REQUIREMENTS OF AASHTO M270, GRADE 36, WITH NUTS AND BOLTS CONFORMING TO ASTM A307, GRADE A. WEATHERING STEEL AND HARDWARE SHALL MEET THE REQUIREMENTS OF AASHTO M270, GRADE 50W, WITH NUTS AND BOLTS CONFORMING TO ASTM A325, TYPE 3. USE MALLEABLE IRON WASHERS AGAINST WOOD UNLESS OTHERWISE NOTED.

WHEN STRUCTURAL STEEL IS TO BE WELDED, THE WELDING PROCEDURE SHALL BE IN ACCORDANCE WITH AWS D1.1 AND SHALL BE SUITABLE FOR THE GRADE OF STEEL AND INTENDED USE OR SERVICE.

FABRICATION: SUBMIT SHOP DRAWINGS FOR ALL BRIDGE COMPONENTS (EXCEPT TIMBER RUNNING PLANKS). SHOW ALL DIMENSIONS AND FABRICATION DETAILS FOR ALL CUT OR BORED TIMBER. FIELD DRILLING OF HOLES SHALL NOT BE ALLOWED UNLESS OTHERWISE NOTED ON THE PLANS.

SHEET 3 OF 4

U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE **STANDARD TRAIL PLAN**	PROJECT NAME & LOCATION	DRAWING NAME **SAWN TIMBER STRINGER TRAIL BRIDGE** SECTION **962 - SAWN TIMBER TRAIL BRIDGE** TYPICAL ID **STS**	REVISION DATE **NOT TO SCALE**	DRAWING NO. **STD_962-10-03b** SHEET OF

TRAIL CONSTRUCTION SPECIFICATION **5.4 Fiberglass Bridge**

The bridge design recommendations are that of the E.T. Techtonics Fiberglass Bridges and Boardwalks. Please find more information here: E.T. Techtonics

Accessible bridge installed in Dalton, MA

Pedestrian bridge in Seekonk, MA

E.T. TECHTONICS
Fiberglass Bridges and Boardwalks
214 Industrial Lane, Alum Bank, PA 15521
814.839.4186 · Fax: 814.839.4276 · Toll free 888.CPI.PULL
CREATIVE PULTRUSIONS

9/28/2020
QUOTE # : 092820.1

Cambridge VT 30'x3'

Erin,

Thank you for your inquiry. I am pleased to submit the estimate for your fiberglass access solutions project. Please contact me if you have any questions or need further assistance.

Sincerely,

Brandon Weyant

E.T. Techtonics
A Creative Pultrusions, Inc. Product Line

Office: (814) 839-4186 Ext. 265
Mobile: (814) 289-1476
bweyant@pultrude.com

Design Approach: Allowable Stress Design (ASD)
Pedestrian Live Load: 85.0 PSF
Snow Load: 45.0 PSF
Wind Load: 30.0 PSF

(1) Fiberglass 30'-0'' long x 3'-0'' wide bridge	$	23,540.00
PE stamped drawings & calculations	$	2,400.00
Shipping Un-Assembled to Cambridge , Vermont	$	2,600.00
Sales Tax (if applicable)	$	-
Total	$	28,540.00*

*The total does not include any Federal, State, or Local taxes.
Notice: Shipping cost is an estimate and subject to change at time of order

Estimated Bridge Weight (Installed): 2,909 lbs (Material + Decking + Hardware)

The bridge will include the following:

- 1500 Series: Non-fire retardant
- Fiberglass Support Trusses w/ Diagonal
- 42'' high hand-railings
- Straight ends
- Standard top cap with solid-color paint coating
- Safety mid-rails (per ADA specifications, 3-3/4'' maximum spacing)
- Standard A307 hot-dipped galvanized steel hardware kit
- Standard Color: Olive Green
- Standard dead load camber design
- **3x12 P.T. Southern Yellow Pine Decking w/ Deck Screws**

Liability Statement

The calculations and recommendations set forth in this document are gratuitous in nature and are believed to be accurate. Creative Pultrusions, Inc., nor its employees assume any obligation or liability that may arise as a result of the use of the information placed forth in this document.

TERMS & CONDITIONS

Delivery: CPI will schedule bridge fabrication upon receipt of SIGNED Submittal CAD Drawings. To order a bridge, customer must send Purchase Order w/ 50% pre-payment (if required). Delivery lead-time (3-4 week, depending on backlog lead time can be subject to change) upon receipt of SIGNED drawings.

Notes:

- Payment terms: Parts – Net 30 days; Payment terms are based on approval of credit information supplied to Creative Pultrusions, Inc.
- A 3.5% service fee will apply for all payments made by Visa, Discover, and MasterCard.
- This quotation is firm for sixty (60) days. Prices are based on current material costs and are subject to change in the event price increases are incurred.
- Parts quoted are based on standard properties and tolerances as outlined in the Creative Pultrusion, Inc. Design Manual and Bridge Submittal Drawings at the time of order.
- Creative Pultrusions, Inc. shall warrant the structural integrity of all FRP materials, design, and workmanship for 15 years from the time of deliver.
- Delayed shipment for more than 30 days will be subject to additional charges, unless otherwise agreed upon.

IMPORTANT NOTICE TO CUSTOMER: This document is not an acceptance of any prior offer made by Customer. Rather, this document is an offer, acceptance of which is limited and subject to the terms of Seller's written sale agreement with Customer, or, if none, then Seller's Terms of Sale which are incorporated in full into this document and can be found [below/attached/on the reverse side hereof] and/or [Seller's website at www.creativepultrusions.com]. By accepting any performance by Seller, Customer agrees to be bound by the terms of this document and Seller's sale agreement with Customer, or, if none, then Seller's Terms of Sale. Contact Seller immediately if you do not have or cannot access Seller's Terms of Sale. If this document is a written confirmation of a verbal order by Customer, Customer agrees that the terms of this document control. Different or additional terms proposed by Customer are expressly rejected and shall not become a part of the contract between Customer and Seller.

E.T. TECHTONICS
Fiberglass Bridges and Boardwalks
214 Industrial Lane, Alum Bank, PA 15521
814.839.4186 · Fax: 814.839.4276 · Toll free 888.CPI.PULL
CREATIVE PULTRUSIONS

9/28/2020
QUOTE # : 092820.2

Cambridge VT 35'x3'

Erin,

Thank you for your inquiry. I am pleased to submit the estimate for your fiberglass access solutions project. Please contact me if you have any questions or need further assistance.

Sincerely,

Brandon Weyant

E.T. Techtonics
A Creative Pultrusions, Inc. Product Line

Office: (814) 839-4186 Ext. 265
Mobile: (814) 289-1476
bweyant@pultrude.com

Design Approach: Allowable Stress Design (ASD)
Pedestrian Live Load: 85.0 PSF
Snow Load: 45.0 PSF
Wind Load: 30.0 PSF

(1) Fiberglass 35'-0'' long x 3'-0'' wide bridge	$	27,700.00
PE stamped drawings & calculations	$	2,400.00
Shipping Un-Assembled to Cambridge , Vermont	$	2,600.00
Sales Tax (if applicable)	$	-
Total	$	32,700.00*

*The total does not include any Federal, State, or Local taxes.
Notice: Shipping cost is an estimate and subject to change at time of order

Estimated Bridge Weight (Installed): 3,426 lbs (Material + Decking + Hardware)

The bridge will include the following:

- 1500 Series: Non-fire retardant
- Fiberglass Support Trusses w/ Diagonal
- 42'' high hand-railings
- Straight ends
- Standard top cap with solid-color paint coating
- Safety mid-rails (per ADA specifications, 3-3/4'' maximum spacing)
- Standard A307 hot-dipped galvanized steel hardware kit
- Standard Color: Olive Green
- Standard dead load camber design
- **3x12 P.T. Southern Yellow Pine Decking w/ Deck Screws**

Liability Statement

The calculations and recommendations set forth in this document are gratuitous in nature and are believed to be accurate. Creative Pultrusions, Inc., nor its employees assume any obligation or liability that may arise as a result of the use of the information placed forth in this document.

TERMS & CONDITIONS

Delivery: CPI will schedule bridge fabrication upon receipt of SIGNED Submittal CAD Drawings. To order a bridge, customer must send Purchase Order w/ 50% pre-payment (if required). Delivery lead-time (3-4 week, depending on backlog lead time can be subject to change) upon receipt of SIGNED drawings.

Notes:

- Payment terms: Parts – Net 30 days; Payment terms are based on approval of credit information supplied to Creative Pultrusions, Inc.
- A 3.5% service fee will apply for all payments made by Visa, Discover, and MasterCard.
- This quotation is firm for sixty (60) days. Prices are based on current material costs and are subject to change in the event price increases are incurred.
- Parts quoted are based on standard properties and tolerances as outlined in the Creative Pultrusion, Inc. Design Manual and Bridge Submittal Drawings at the time of order.
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WORKS REFERENCED

Birchard, William Jr., & Robert Proudman. *Appalachian Trail: Design, Construction, and Maintenance*. Second Edition, Harpers Ferry, West Virginia: Appalachian Trail Conference, 2000.

Birkby, Robert C. *Lightly on the Land: The Student Conservation Association Trail Building and Maintenance Manual*. Seattle, WA: The Mountaineers, 2005.

Bureau of Parks & Lands Off-Road Vehicle Division. *Best Maintenance Practices: Maine Motorized Trail Construction and Maintenance Manual.* Augusta, ME: Maine Department of Conservation Parks & Lands Off-Road Vehicle Division, 2001.

International Mountain Bike Association. *Trail Solutions: IMBA's guide to building sweet singletrack*. Boulder, CO: IMBA, 2004.

Missoula Technology and Development Center. *Geosynthetics for Trails in Wet Areas.* 2008 Edition. Missoula, MT: U.S. Department of Agriculture Forest Service, 2008.

Missoula Technology and Development Center. *Trail Fundamentals and Trail Management Objectives: Training Reference Package*. Missoula, MT: U.S. Department of Agriculture Forest Service, 2011.

Missoula Technology and Development Center. *The Standard Trail Plans and Specifications: Trail Bridge Plans.* Missoula, MT: U.S. Department of Agriculture Forest Service, 2008.

Missoula Technology and Development Center. *The Standard Trail Plans and Specifications: Trail Plans.* Missoula, MT: U.S. Department of Agriculture Forest Service, 2014.

Missoula Technology and Development Center. *Trail Construction and Maintenance Notebook.* 2007 Edition. Missoula, MT: U.S. Department of Agriculture Forest Service, 2014.

Outdoor Stewardship Institute. *OSI Trail Skill Series.* Denver, CO: Outdoor Stewardship Institute, a program of Volunteers for Outdoor Colorado, 2009.

Parker, Troy Scott. *Natural Surface Trails by Design: Physical and Human Design Essentials of Sustainable, Enjoyable Trails.* Boulder, CO: Natureshape LLC, 2004.

Schubert, John. *PCTA Trail Skills College Field Reference Course 207. Trail Decommissioning & Wildland Restoration.* Sacramento, CA: Pacific Crest Trail Association, 2019.

Schubert, John. *PCTA Trail Skills College Field Reference Course 300. Rock Retaining Walls.* Sacramento, CA: Pacific Crest Trail Association, 2019.

Staff of AMC's Trails Department. *AMC's Complete Guide to Trail Building & Maintenance: Proven Techniques, Safety Guidelines, Equipment Tips.* Fourth Edition. Boston, MA: Appalachian Mountain Club Books, 2008.

Zeller, Janet & Ruth Doyle, Kathleen Snodgrass, USDA Forest Service. *Accessibility Guidebook for Outdoor Recreation and Trails.* Missoula, MT: U.S. Department of Agriculture Forest Service, 2012.