



Shady Rill Picnic Area Floodplain Restoration Design

Middlesex, Vermont

Final Report
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Prepared for:
Winooski Natural Resources Conservation District
617 Comstock Rd # 1
Berlin, VT 05602

Prepared by:
Watershed Consulting Associates, LLC
208 Flynn Ave, Suite 2H
Burlington, VT 05401
P: 802.497.2367
info@watershedca.com



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I. Disclaimer

The intent of this report is to present the data collected, evaluations, analysis, designs, and cost estimates for the Shady Rill Picnic Area in Middlesex, VT under a contract between the Winooski Natural Resources Conservation District (WNRCD) and Watershed Consulting Associates, LLC (Watershed). Funding for the project was provided by a Vermont Department of Environmental Conservation Ecosystem Restoration Program grant. These practices do not represent a regulatory obligation of any type, nor is there any obligation for implementation.

The Winooski Natural Resources Conservation District (WNRCD) applied for and received a VT DEC Ecosystem Restoration Program grant to develop a restoration plan to address the issues on site. The design provides improved riparian buffer health, decreased compaction along the riverbank, designated access points to the river, and maintains the recreational benefits of the site. The following report details the design process and final recommended retrofit plan for the Shady Rill Picnic Area.

2 Existing Conditions

2.1 Site Assessment

The majority of the Shady Rill Picnic Area lies within the mapped river corridor and is within the Federal Emergency Management (FEMA) flood hazard area with a 1% annual chance of flooding (see Appendix A-1 for a map showing these boundaries). As such, the riparian area along this section of Martins Brook should be well vegetated with a robust riparian buffer. However, the site lacks an adequate buffer and is very compacted along the river's banks due to unrestricted access to the river's riparian zone and heavy use of the picnic areas along the river bank (Figure 2).



Figure 2. Unrestrained access to the river and well-used picnic sites along the stream bank have led to soil compaction.

Shady Rill Picnic Area is a popular recreational area and as such visitors to the park want access to Martins Brook. Currently, there are no designated access points to the river, so park visitors climb down the banks to the river along the length of the park. This has resulted in several areas where erosion is occurring because of this access or is worsened by the access (Figure 3).



Figure 3. The river is accessed along the length of the site, exacerbating erosion.

The road used to access the park from Shady Rill Road runs the length of the park and closely parallels Martins Brook. The road passes within the river corridor and would limit the extent of the proposed buffer restoration. This access drive is elevated above the surrounding ground surface, and acts as a barrier to floodplain access in high flows when the river is accessing its floodplain to the east of the access drive. Additionally, stormwater running off the road surface makes its way to the brook via overland flow, and this increased stormwater flow over the non-cohesive banks has increased bank erosion (Figure 4).



Figure 4. The access drive is elevated and preventing floodplain access to the west of the road.

A feature survey with limited topographic survey was completed for the site in two site visits. The first site survey was partially completed on February 27, 2018. At this time, snow and ice prevented completion of a full survey. The survey crew (Chase & Chase Surveyors) revisited the site on April 25, 2018, to collect the remaining site features. Existing LiDAR data (LiDAR-derived 1ft contours generated in 2014) was used in conjunction with surveyed elevation data to generate site-specific contours. An existing conditions plan was developed from this survey and can be found in Appendix A-2. During the site surveys, cross sections were collected at 6 locations along Martins Brook. These cross-section data can also be found in Appendix A-2 (page 2).

The previously completed Phase 2 Stream Geomorphic Assessment (2008; Appendix A-3) was reviewed to better understand the reach-specific geomorphic condition. A Phase 2 Stream Geomorphic Assessment was then completed for reach T1.01B, the reach that passes alongside the main picnic area, in July of 2018. This reach has been historically straightened and lacks habitat complexity. The reference stream type for this reach is riffle pool, but the reach has transitioned to a plane bed system. The 2018 Phase 2 assessment can be found in Appendix A-4.

Martins Brook, as it passes through the Shady Rill Picnic Area (reach T1.01B), has an approximate drainage area of 12.5 mi² (see Appendix A-5 for a map of the watershed). According to the Vermont Regional Hydraulic



Geometry Curves (2006)¹, this would equate to a bankfull depth of 2.04 ft and a bankfull width of 39.8 ft. However, as noted in the Phase 2 Rapid Geomorphic Assessment performed in July of 2018 as a part of this project (Appendix A-4) and the Phase 2 assessment completed in 2008 (Appendix A-3), reach T1.01B is not in dynamic equilibrium. The cross-sectional information from the 2018 assessment indicated a bankfull width of 59.1 ft and a mean depth of 2.7 ft while the 2008 assessment indicated a bankfull width of 60.87 ft and a bankfull mean depth of 2.2 ft. This indicates that the reach is both wider and deeper than expected given the drainage area of the site. This is likely influenced by the straightening of the reach, which has historically increased stream power, in addition to the site use at the Shady Rill Picnic Area.

3 Site Restoration Alternatives

3.1 Identification of Initial Concepts

Three alternatives were evaluated as part of the design process. Two of the three alternatives were discarded for reasons described in brief below. Each restoration scenario consists of several individual activities, and many of these individual tasks are consistent between the three plans. For example, each of the plans note the need for designated access points for park visitors to the river. The preferred alternative was selected for 30% design following review and approval by the WNRCD and the Middlesex Conservation Commission on June 29, 2018.

3.1.1 Alternative 1:

This design includes riparian planting, hardened access points, and removing a sediment plug. This option would be the least costly but would also offer the least benefit. Although this proposed plan would improve site conditions, it would not allow for a full restoration of the riparian buffer. Leaving the access drive in this location would also not address the compaction due to vehicular traffic along the road. Additionally, park visitors have historically parked their vehicles to the east of the access drive, and this behavior would likely continue if the access drive were to remain in place. This would reduce the effectiveness of the riparian buffer restoration, and it would also not address the elevation of the access drive. The recommendations provided for Alternative 1 can be found in Appendix A-6. Due to the incomplete buffer restoration and high likelihood of vehicular and foot traffic trampling the plantings as well as a lack of improved floodplain access, this option is not recommended.

3.1.2 Alternative 2:

This design includes riparian planting, hardened access points, removing a sediment plug, road relocation, and lowering elevations and revegetating the existing road footprint. Watershed recommended pursuing Concept 2 for a full 30% design as this option has significant water quality and habitat benefits while maintaining the recreational appeal of the site. The recommendations provided for Alternative 2 can be found in Appendix A-7.

3.1.3 Alternative 3:

This design includes riparian planting, hardened access points, road relocation, lowering elevations where road is currently located, restricting motor vehicle access, allowing for floodplain access through existing berm, removing existing path, lowering elevation where path is located at lower end of park, and additional riparian buffer plantings. This plan has a significant benefit, but also incurs a high cost. While Concept 3 does allow for additional flood storage and further protection of the site from compaction due to vehicle access, it also restricts recreational benefits more than the other two concepts. The site is located above a large impoundment (Wrightsville Reservoir) that acts as a grade control. As such, the additional flood storage would

¹ http://dec.vermont.gov/sites/dec/files/wsm/rivers/docs/rv_vt_hydraulic_geometry_curves.pdf

not notably impact downstream flooding. There is also a single residence that may be impacted by these efforts. The recommendations provided for Alternative 3 can be found in Appendix A-8.

4 Selected Design

After reviewing initial recommendations, the project stakeholders decided that pursuing Alternative 2 would work best for the Shady Rill Picnic Area. This design balances the recreational site use with the improved habitat and riparian buffer area. The key points of this design are expounded upon below.

The 30% design plan can be found in Appendix A-9 – 30% Design.

4.1 Access Drive and Structure Relocation

Currently, the access drive to the picnic area runs closely alongside the stream and is raised above the surrounding ground surface. This raised drive infringes upon the stream's riparian buffer zone and prevents floodplain access at high flows due to its elevated position. Additionally, vehicles that access this site often park to the east of the access drive along the stream banks. It is recommended that the access drive be relocated along the western edge of the open field area. In addition to allowing better floodplain access and more complete restoration of the riparian buffer, it will also prevent additional compaction from vehicles driving along the road and parking along the stream bank.

A pavilion that provides shelter to park visitors and stores picnic tables in the off season is located within 30 ft of the stream bank (Figure 5). The stream buffer restoration area extends a minimum of 50 feet from the stream (except where the access drive prevents this at the park entrance), and the area where the pavilion is currently located is well within that riparian restoration area (see section 4.2 for details on the buffer restoration). It is recommended that this pavilion be relocated away from the stream. The recommended location for the pavilion, as shown on the 30% design plans (Appendix A-9), is located far enough away from the stream as to not infringe on the 50 ft buffer and is placed in a location that least impacts the field area for recreational use and where picnicking should be encouraged.



Figure 5. Pavilion that will be relocated and exposed soil that will be revegetated as a part of the project.

4.2 Riparian Buffer Restoration and Sediment Plug Removal

Riparian buffer plantings are recommended for the area along Martins Brook (Figure 6). The access drive will be relocated to allow for a minimum 50-foot buffer from the stream except at the entryway to the picnic area. The entrance will remain in the same location due to the high cost and topographic challenges of relocating the entryway. A mix of native trees, shrubs, and wildflower and low-mow grass mix are recommended for the site (see Table 1 for a list of species). A full list of the recommended species, photos of the plants, a description of their benefits, planting information, and a rendering of what the site would look like after the restoration is complete can be found in Appendix A-10. The design calls for larger sized stock as past experience has shown that there is often long-term cost savings when more mature plants are used due to the high die-off of smaller plants and the need for replanting to maintain adequate vegetated cover.



Figure 6. A section of the area abutting Martins Brook where the buffer restoration plantings will be implemented.

A sediment plug has developed in the lower end of the park site. It is recommended that this plug be excavated in order to allow better floodplain access in this area. This lower area floods primarily when there are backwater conditions at the Wrightsville Reservoir.

Both of these recommendations can be viewed on the 30% plans found in Appendix A-9.



Table 1. Preferred plant species and quantities for recommended plantings.

Common Name	Latin Name	Quantity	Size	Planting Notes
Balsam Fir	<i>Abies balsamea</i>	10	1-2" Caliper	Min. 15-20' apart from other large trees
Red Oak	<i>Quercus rubra</i>	3	1-2" Caliper	Min. 15-20' apart from other large trees
Paper Birch	<i>Betula papyrifera</i>	2	1-2" Caliper	Min. 15-20' apart from other large trees
Serviceberries	<i>Amelanchier arborea</i>	2	Min. 36" Tall	Plant ~4' on-center
Lilac	<i>Syringa vulgaris</i>	2	Min. 36" Tall	Plant ~4' on-center
Red Osier Dogwood	<i>Cornus stolonifera</i>	35-40	Min. 36" Tall	Plant ~4' on-center
Silky Dogwood	<i>Cornus amomum</i>	35-40	Min. 36" Tall	Plant ~4' on-center
Black Chokeberry	<i>Aronia melanocarpa</i>	8-10	Min. 36" Tall	Plant ~4' on-center
Lady Fern	<i>Athyria felix-femina angustum</i>	30-35		Plant 12-18" on-center. Plant in partly shaded areas (under larger trees). Add humus to area surrounding roots. Embed such that root crown is 0.5" below soil. Water frequently.
Sweet Fern	<i>Comptonia peregrina</i>	30-35		Plant 2-3' on-center. Dig hole 3" deeper and twice as wide as root ball. Spread roots gently when planting. Avoid covering crown of root ball (where branches emerge from ball). Water after planting. Water only during extended dry spells thereafter.
Low-mow Grass Seed Mix	<i>Festuca rubra</i> , <i>Festuca brevipila</i> 'Charlot', <i>Festuca ovina</i> var. <i>duriuscula</i> 'Heron', <i>Lolium multiflorum</i>	25 lbs. (mixed with wildflower mix)		See Detailed Planting Notes
Riparian Buffer Wildflower Seed Mix	<i>Various - see full planting plan</i>	25 lbs. (either alone or with grass seed)		See Detailed Planting Notes

4.3 Hardened Access Points and Designated Parking

Currently, Martins Brook can be accessed along the length of the Shady Rill Picnic Area. The banks are susceptible to erosion, and the foot traffic from park visitors climbing down the stream banks along the length of the site increases the bank erosion. During site visits it was observed that the stream banks consist of primarily non-cohesive boulder and cobble materials (Figure 7). Additionally, the use of the site above the streambanks has resulted in significant compaction and areas with bare soils. The sources of the compaction are foot traffic as well as vehicular traffic. In addition to driving into the site along the access drive that closely parallels the stream, visitors to the area regularly park vehicles to the east of the access drive within a few feet of the stream banks. This compaction and lack of adequate vegetation allows for little to no natural infiltration along the length of the site to the east of the access drive. As such, stormwater inputs to the stream via overland flow can further undermine bank stability. Erosion was noted along more than 100 feet of the banks on this side of the stream. Erosion was limited to that stretch primarily because much of the remainder of the banks along this side are armored with riprap.



Figure 7. The non-cohesive stream banks are highly susceptible to erosion.

Two strategies are recommended in the proposed site restoration plan to address these issues. The first is to install four hardened access points along the length of the site. These access points will restrict foot traffic to these locations and will limit additional stream bank erosion associated with foot traffic. The access point closest to the entrance to the park will be handicap accessible while the remaining three access points will consist of a path with hardened stairs leading down to the stream bed (Figure 8). It is recommended that a sign be installed at each of these access points to inform visitors of the need to remain on the paths. An example of a possible sign design can be found in Figure 9.

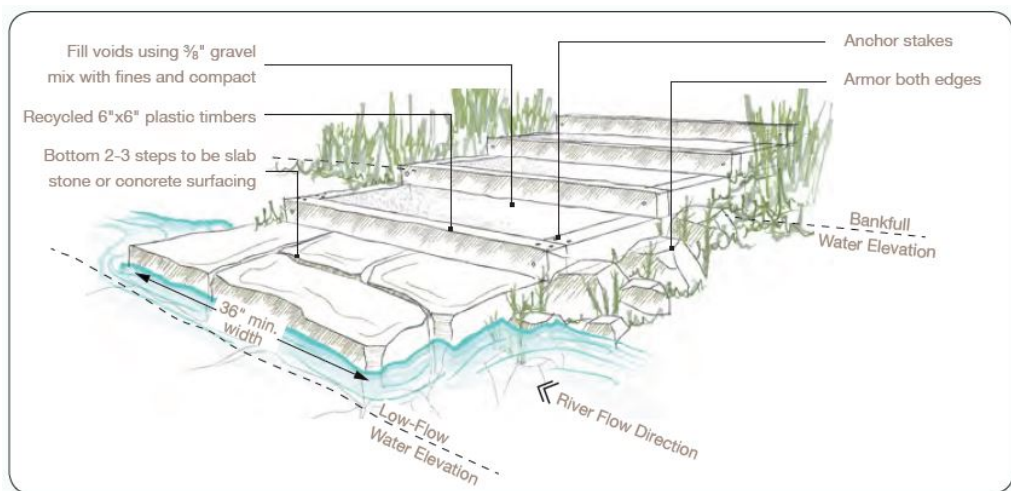


Figure 8. An example of a hardened access point to be installed along the picnic area to access the stream. Obtained from:

<http://www.iowadnr.gov/Things-to-Do/Canoeing-Kayaking/Water-Trail-Development>.



Figure 9. An example design for a sign that could be installed at each hardened access point.

5 Cost Estimates

Cost estimates have been calculated for construction and materials (see Table 2) including an itemized plant cost (Table 3).

Table 2. Probable construction costs.

Description of Item	VTrans Item Description	Estimated Quantity	Unit	Unit Price	Cost
Hardened Access Paths		3	#	\$3,000	\$9,000
Handicap Accessible Access Path		1	#	\$4,500	\$4,500
Excavate Existing Gravel Drive	Excavation of surfaces and pavements	500	CY	\$21.94	\$10,970
New Gravel Drive	Subbase of Gravel	250	CY	\$25.11	\$6,278
Excavate Sediment Plug	Common Excavation	200	CY	\$9.86	\$1,972
Planting Materials		See Planting Details		\$14,893	\$14,893
Signage		4	#	\$300	\$1,200
Prep/Restoration of Site and Misc. Work (15% of total)					\$7,322
Contingency (20% of total)					\$11,227
Total Estimate:					\$67,361



Table 3. Probable plant costs.

Common Name	Latin Name	Quantity	Size	Planting Notes	Probable Cost	
Balsam Fir	<i>Abies balsamea</i>	10	1-2" Caliper	Min. 15-20' apart from other large trees	\$595/tree	\$5,950
Red Oak	<i>Quercus rubra</i>	3	1-2" Caliper	Min. 15-20' apart from other large trees	\$425/tree	\$1,275
Paper Birch	<i>Betula papyrifera</i>	2	1-2" Caliper	Min. 15-20' apart from other large trees	\$489/tree	\$978
Serviceberries	<i>Amelanchier arborea</i>	2	Min. 36" Tall	Plant ~4' on-center	\$249/tree	\$498
Lilac	<i>Syringa vulgaris</i>	2	Min. 36" Tall	Plant ~4' on-center	\$40/shrub	\$80
Red Osier Dogwood	<i>Cornus stolonifera</i>	35-40	Min. 36" Tall	Plant ~4' on-center	\$42.95/shrub	\$1,718
Silky Dogwood	<i>Cornus amomum</i>	35-40	Min. 36" Tall	Plant ~4' on-center	\$42.95/shrub	\$1,718
Black Chokeberry	<i>Aronia melanocarpa</i>	8-10	Min. 36" Tall	Plant ~4' on-center	\$36.95/shrub	\$370
Lady Fern	<i>Athyria felix-femina angustum</i>	30-35		Plant 12-18" on-center. Plant in partly shaded areas (under larger trees). Add humus to area surrounding roots. Embed such that root crown is 0.5" below soil. Water frequently.	\$12.95/gallon pot	\$453
Sweet Fern	<i>Comptonia peregrina</i>	30-35		Plant 2-3' on-center. Dig hole 3" deeper and twice as wide as root ball. Spread roots gently when planting. Avoid covering crown of root ball (where branches emerge from ball). Water after planting. Water only during extended dry spells thereafter.	\$12.95/gallon pot	\$453



Common Name	Latin Name	Quantity	Size	Planting Notes	Probable Cost	Common Name
Low-mow Grass Seed Mix	<i>Festuca rubra</i> , <i>Festuca brevipila</i> 'Charlot', <i>Festuca ovina</i> var. <i>duriuscula</i> 'Heron', <i>Lolium multiflorum</i>	25 lbs. (mixed with wildflower mix)		See Detailed Planting Notes	\$300/50 lbs.	\$150
Riparian Buffer Wildflower Seed Mix	<i>Various - see footnote</i>	25 lbs. (either alone or with grass seed)		See Detailed Planting Notes	\$1,250/25 lbs.	\$1,250
					TOTAL	\$14,893
Riparian Buffer Wildflower Seed Mix Contains: <i>Panicum clandestinum</i> , <i>Carex vulpinoidea</i> , <i>Elymus virginicus</i> , <i>Elymus riparius</i> , <i>Schizachyrium scoparium</i> , <i>Sorghastrum nutans</i> , <i>Andropogon gerardii</i> , <i>Panicum virgatum</i> , <i>Juncus effuses</i> , <i>Chamaecrista fasciculata</i> , <i>Cornus amomum</i> , <i>Baptisia australis</i> , <i>Verbena hastata</i> , <i>Eupatorium perfoliatum</i> , <i>Heliopsis helianthoides</i> , <i>Monarda punctata</i> , <i>Rudbeckia hirta</i> , <i>Veronica gigantea</i> , <i>Viburnum dentatum</i> , <i>Euthamia graminifolia</i> , <i>Helenium autumnale</i> , <i>Lobelia siphilitica</i> , <i>Parthenium integrifolium</i>						

Based on the costs as outlined for excavation, materials, and planting, the total project cost is estimated to be approximately **\$67,000**. This cost is an estimate only and is subject to change based on local conditions including material costs, trucking, equipment, and personnel. If the road materials are able to be reused for construction of the new access drive, the costs may decrease.

6 Restoration Design Visualization

A colorized site rendering was developed to better illustrate the vision for the site once the recommended plan is implemented at the site. These visualizations can help to convey the design in a way that black and white engineering plans cannot, particularly to non-technical stakeholders. The visualization of the proposed site condition is shown with and without park visitors (Figure 10; also provided in high resolution format as Appendix A-11).



Figure 10. Existing site conditions (upper) are shown compared to colorized visualizations of the proposed site conditions without park visitors (middle) with park visitors (lower).



7 Permitting Information

Several potential permits and regulations were investigated to ensure that the recommended retrofits for the site are feasible. A construction general permit was deemed not required as less than 1 acre of land will be disturbed during project construction. An operational stormwater permit is not required as only minimal new impervious is being created as a part of this project. Although the site is situated within the river corridor, the proposed stormwater retrofits will not result in any net fill within the corridor.

7.1 Stormwater Permitting

The project will not create significant new impervious surfaces, and therefore no operational stormwater permit is required.

7.2 Stream Alteration Permitting

As the project will not affect more than 10 cubic yards of material below the stream's top of bank elevation, a stream alteration permit is not necessary.

7.3 River Corridor

This project should not pose an issue with respect to the river corridor regulations. The proposed design is fairly minor earth disturbance and not structural in nature, so it would not constitute a new encroachment in the river corridor.

8 Final Recommendations:

It is the recommendation of this report that funding be sought for the 100% design and implementation through VT DEC's Clean Water Fund. The proposed restoration plan will not significantly impact recreational use of the Shady Rill Picnic Area while improving the riparian buffer and stream habitat and filtering stormwater runoff from the access drive and mowed field. The Shady Rill Picnic Area is a valuable asset to the area, and this proposed plan will help to improve the health of the natural resources at this location and along Martins Brook and receiving waters. Educational signs on site would help visitors to understand the importance of preserving the stream buffer and the steps being taken to protect surface waters for the future.