AHEAD OF THE STORM

Site: LaPlatte Headwaters Town Forest

Location: Gilman Road, Hinesburg, Vermont

Primary Problem

Gully erosion is occurring in several areas of the LaPlatte Headwaters Town Forest Area, specifically at the upstream end of two branches of a headwater tributary of the LaPlatte River. The gully erosion and headcutting are likely caused by increases in runoff from historic changes to landuse associated with farming and clearing the land between the 1800's and mid-1900's. This may have also been influenced by channel incision in the downstream LaPlatte River and subsequent tributary regeneration (incision of the tributary to match the new elevation of the receiving stream base elevation). Increased rainfall intensity and magnitude may also have led to the expansion of minor initial erosion to the larger erosion observed today. Many years ago car tires were thrown into the gully to stop the erosion. This project created a management plan for the gully erosion to improve water quality and flood resilience. (*See existing conditions site summary and plan.*)

The primary goals are to provide management options that would allow for improved water quality protection and flood resiliency by slowing runoff, reducing erosion, and enhancing vegetation. This project will improve water quality in the LaPlatte River watershed.

Management Recommendations and Stabilization Options

A management plan has been created to inform the Town Forest Committee. This plan includes an explanation of the processes occurring at the gully site that have led to the formation of the gullies. It also provides general recommendations that should be considered prior to any action in the LHTF and specific stabilization options for the gullies. A range of active stabilization options have been included that could be implemented over time, possibly in a phased approach, as funding or materials become available:

Seven Optimal Conservation Practices (OCPs) are recommended to mitigate stormwater runoff at the site.

1. Reroute trails if they are subject to erosion from the expanding gully.
2. Manage the site so that flow is not concentrated.
3. Apply proper optimal conservation practices during timber management.
4. Consider changing the LHTFMP High Priority Action to leave the tires in place and manage around them.
5. Place brush and logs in the upper gully to replicate the natural storage of sediment with wood.
6. Replicate the natural storage of sediment with wood in the gully.
7. Cover tires with soil and revegetate the gullies.

Site Constraints and Design Basis

The Town Forest is managed by a volunteer committee using the guidelines in the existing LaPlatte Headwaters Town Forest Management Plan. Current recommendations are consistent with the goals and restricted uses identified in that plan. A science-based approach was used to identify causes of gully erosion and possible management options to minimize future erosion and stabilize existing erosion. Multiple options for stabilization have been included for consideration to allow the Committee process options to weigh in the context of the overall forest plan. The natural approach recommended minimizes long-term maintenance procedures and costs.

Cost

Many of the management recommendations can be implemented for no cost as considerations prior to future action. Options have been provided for active stabilization of the gully, ranging from $0 using all volunteer labor to $40,000 for the most aggressive stabilization option.

AHEAD OF THE STORM

Existing Conditions Site Summary

Site: LaPlatte Headwaters Town Forest

Site Description

Gully erosion is occurring in several areas of the LaPlatte Headwaters Town Forest Area (Figure 1). The erosion was first discovered due to a conflict with one of the Hinesburg Area Recreation Trails (Bissonette Loop) that has since been relocated away from the head of the gully. This project will advise on management of the erosion to improve water quality and flood resiliency.

Drainage Patterns

The gully erosion is occurring at the upstream end of a headwater tributary of the LaPlatte River within the LaPlatte Headwaters Town Forest Area near the Hidden Meadow. At the upstream end of erosion on the main gully, erosion begins with a 1 foot deep and 1 foot wide channel. This area is well vegetated. Just downstream of where the gully begins the erosion is 5 feet deep and 10 feet wide, this quickly transitions to a gully almost 30 feet wide and over 10 feet tall. Approximately 800 tires have been thrown into the gully in an effort to stop the erosion. Approximately 400 feet down the main gully a side gully joins from the east. The side gully is up to 17 feet tall and 40 feet wide. Both gullies are actively eroding.

The drainage area at the start of erosion of the main gully is 5.8 acres and another 8.1 acres drains directly to the gully before a side gully enters carrying drainage from an additional 7.4 acres. The total drainage area at the junction of the side gully is 21.3 acres.

Downstream of the steep eroding section of gully, the valley walls were stable with approximately at 2H:1V slope with limited erosion at the toe. At this point a stream channel formed and water was present. Further downstream the valley opened up into a flat open wetland. Perennial vegetation covered the floodplain with small sediment deposition piles. The channel then became more defined and entered a forested area further downstream. The channel sinuosity increased and passed through a white cedar swamp. Then the channel passed through a 3-foot diameter driveway culvert at Brookside Lane. This culvert was in poor condition. The small size of the culvert likely would provide in-channel stormwater attenuation and allow sediment to settle out of slowed runoff. Downstream of Brookside Lane the channel is flows through a wetland meadow (Rosgen type E) and joins the LaPlatte River.

Site Constraints

Soils in the gully were observed to be silty fine sand with clay. The soil downstream of the side gully is an extremely rocky loam classified as highly erodible. There is a change in soil type at the junction of the gullies and the upstream soils are a silt loam classified as potentially highly erodible. This same soil type extends up the extent of the gully and beyond along the flow path leading to the top of the gully. All soils in area have a Hydrologic Soil Group of D, meaning that soil has a limited infiltration opportunities.

An FEH zone, mapped river corridor, or mapped wetlands do not exist at this location. No utilities were observed.

Initial Recommendations

1. Determine the need to actively manage this area prior to making formal recommendations.
2. Manage the site so that flow is not concentrated.
3. Replicate the natural storage of sediment with wood in the gully.
4. Investigate the benefits of removing the tires, including possible water quality impacts.
5. Reroute trails if they are subject to erosion from the expanding gully.
6. Apply proper optimal conservation practices during timber management.

AHEAD OF THE STORM

Existing Conditions Photo Documentation Summary

Site: LaPlatte Headwaters Town Forest

Figure 1: The hidden meadow is well vegetated and partially drains to the main gully.

Figure 3: The upstream end of the gully has a headcut and changes elevation abruptly.

Figure 2: Upstream of the actively eroding gully top, a small channel is well vegetated and has a lot of roots.

Figure 4: Tires have been dumped into the main gully.

AHEAD OF THE STORM

Existing Conditions Photo Documentation Summary

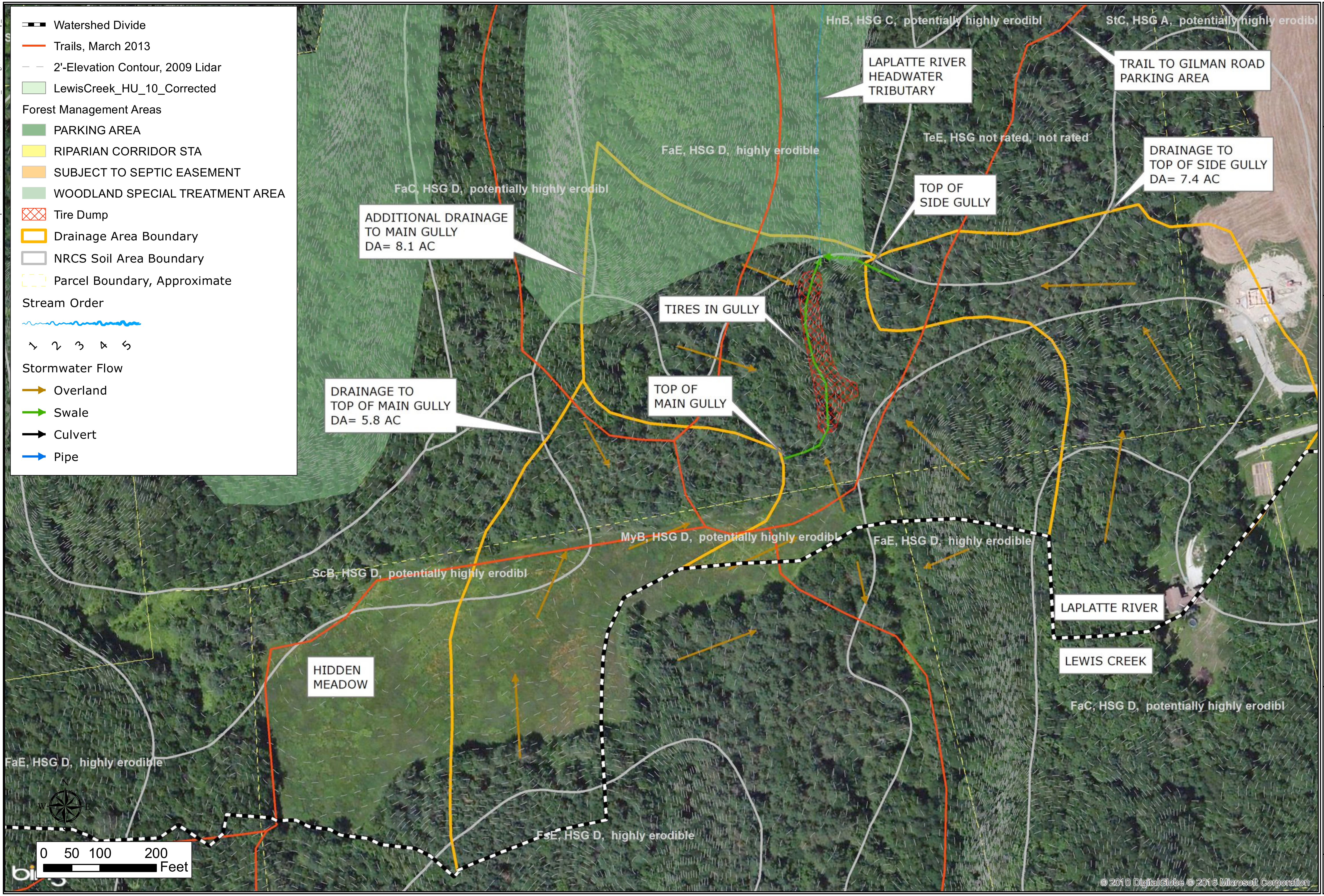
Site: LaPlatte Headwaters Town Forest

Figure 5: The tires are accumulating some sediment and debris in the gully.

Figure 7: The side gully is not very long, but has steep, tall side slopes.

Figure 6: A side gully enters the main gully.

Figure 8: The channel downstream of the gully has little erosion on the banks.



Map By: JCL
MMI#: 3452-22
MXD:
1st Version: 12/23/2015
Revision: 10/3/2016
Scale: 1"=150'

01

EXISTING CONDITIONS

AHEAD OF THE STORM
LAPLATTE HEADWATERS TOWN FOREST

GILMAN ROAD
HINESBURG, VERMONT

CONCEPT DESIGN

SOURCE(S):
2009 LIDAR 2 FT CONTOURS, VCGI
BING AERIAL
NRCS SOIL MAPPING
MMI FIELD DATA
HINESBURG- TRAILS, FOREST AREAS

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AHEAD OF THE STORM

Site: LaPlatte Headwaters Town Forest

Location: Gilman Road, Hinesburg, Vermont

MANAGEMENT PLAN AT GULLY EROSION ON HEADWATER TRIBUTARY

Primary Problem

Gully erosion is occurring in several areas of the LaPlatte Headwaters Town Forest Area, specifically at the upstream end of two branches of a headwater tributary of the LaPlatte River. Many years ago car tires were thrown into the gully to stop the erosion. *(See Existing Conditions Site Summary).* This plan advises on the management of the erosion to improve water quality and flood resilience.

LaPlatte Headwaters Town Forest Area Background

The LaPlatte Headwaters Town Forest Area (LHTF) is owned by the Town of Hinesburg and has a conservation agreement with the Vermont Land Trust, the Vermont Housing and Conservation Board, Trust for Public Land, the Vermont Fish and Wildlife Department, the Vermont Department of Environmental Conservation, and the Vermont Department of Forest, Parks, and Recreation. The Hinesburg Select Board has put in place a Town Forest Committee that provides stewardship of the LHTF using the *LaPlatte Headwaters Town Forest Management Plan* as a guiding document (LHTFMPC, 2009). The recommendations in this document to stabilize the gully erosion consider the LHTFMP guidance. The Forest Vision Statement is:

> *"The LHTF is a special place where we come to enjoy, learn from, and care for the land, its forests, streams, wetlands, and inhabitants. We will observe natural processes at work and model management activities to reflect these processes. We will monitor changes and adapt our future management in response to what we learn. All of us will have opportunities to explore the LHTF's unique and diverse natural systems and our place within them."*

LHTFMP Goals that Apply:

Allow natural processes to govern the LHRF's ecosystems and model any active management on these processes to the extent possible.

Protect the water quality of the LaPlatte River and its tributaries.

Monitor and respond to ecological changes.

Summary of LHTFMP Restricted Uses

Trash – No storage of unsightly materials are allowed in the LHTF. – Note that the tires were placed prior to creation of the LHTFMP.

Excavation – no filling or excavation unless necessary to carry out permitting uses such as wetland restoration

Woodland Special Treatment Area (WSTA) – Additional restrictions apply to areas within this zone. The junction of the two gullies is just upstream of this area and the lower approximately 50 feet of the east gully is located within the southeastern tip of the WSTA. No machinery is allowed to be operated within this area. All activities will focus on conserving and improving habitat for the Indiana Bat and natural communities.

The gully area is not in the Riparian Corridor Special Area and therefore the restrictions in that area to do not apply.

Indiana Bat habitat is located on the LHTF land and any active management would need to ensure that bat roost trees would not be damaged or taken down.

<u>LHTFMP High Priority Action Identified for the Gully Site:</u>

"Remove tires from the gully where it is eroding the main access trail at the intersection of the trail loop at Owl's Knoll. These were placed in the gully under old government recommendations for erosion control. Removal will likely result in increased erosion, but the tires are ineffective and leach pollutants into the stream." Taken from Page 74. The walking trail referenced has been rerouted since this was written.

Gully Erosion Site Background

The gully erosion and headcutting are likely caused by increases in runoff from historic changes to landuse associated with farming and clearing the land between the 1800's and mid-1900's. This is a young forest, still recovering from the deforestation and the associated altered hydrology that likely concentrated stormwater flows and began the gully erosion. This may have also been influenced by channel incision in the downstream LaPlatte River and subsequent tributary regeneration (incision of the tributary to match the new elevation of the receiving stream base elevation). Increased rainfall intensity and magnitude may also have led to the expansion of minor initial erosion to the larger erosion observed today.

The soils are Munson series silt loam that is classified as 'potentially highly erodible' (USDA NRCS). The east side gully may reach another soil type Farmington series stony loam classified as highly erodible as it continues to erode uphill. It is expected that erosion will continue to move upstream into the forest as it will not reach a soil that resists erosion.

An estimated 800 tires were placed in the gullies to slow the flow of water and reduce the rate of erosion. It is believed that the tires were installed by a previous landowners in the 1970's and 1980's. The streambed has continued to erode since the tires were installed (LHTFMP, 2009). Headcutting upstream of the tires and erosion underneath the tires were observed in 2015. Observations by park uses indicate that the headcutting upstream of the tires has progressed upgradient 3-4 feet every year since 2005.

Local wood, roots, and tires resist some erosion at the gully site. In some locations the tires are capturing sediment and debris. Material that is eroded may be permanently or temporarily captured in the downstream wetlands, connected forested floodplains, and in the slow water area created by the small culvert at Brookside Road. A portion of the sediment is likely transported to the LaPlatte River during floods.

Channel Morphology

A Phase 2 Stream Geomorphic Assessment and Corridor Plan were completed for the LaPlatte River reach M17 (LWP, 2006; LWP, 2007). The assessment reported that there was major widening, planform change, and channel down-cutting. The channel is in stage III of the F channel evolution model meaning the channel is cutting down and widening. The stream reach has departed from its reference condition (C-type channel to a B-type channel) and is considered to be in poor geomorphic condition with high sensitivity to change when disturbed by flood or large sediment input event. The departure has been caused by historic straightening, dredging, and berms. The planform adjustments are producing sediment.

The corridor plan describes M17 as being incised with little hydrologic connection to the adjacent floodplains. Due to high sediment supply, in part from the LHTF and other headwater areas, the plan suggests that deposition of sediment could allow for floodplain and meander redevelopment by passive restoration. Aggradation to reverse historic incision in the downstream river reach is a positive benefit of sediment supply in the upstream reaches.

Water Quality

Water quality has been sampled in the LaPlatte River downstream of Hinesburg Village (SCRW, 2016). Results show that water quality is poor due to high levels of Phosphorus and *E. Coli* bacteria. The data are too limited to confirm that the gullies in the LHTF are the main cause of this downstream water quality issue, but the findings do indicate that any sediment containing Phosphorus would be contributing to a larger problem.

Discarded tires are not considered hazardous waste, but there are some impacts to water quality from compounds they release (Liu, et. al., 1998). Research has shown that concentrations of metals and organics were below the toxicity levels that are used to determine if there is a significant hazard to human health, although low levels of barium, cadmium, chromium, lead, and some volatile organic compounds were detected in leachate around tires buried below groundwater level (Downs et.al., 1996). Other studies have shown that tires above the water table do not elevate any of the substances with a primary drinking water standard or any tested organic compounds, but do show increases of chromium, zinc, iron and manganese in the leachate (Liu, et. al., 1998; Humphrey and Katz, 2001). Increased trace metals in downstream surface waters and groundwater is a common finding where tires (whole or crumb) are in place for a long time. Research concluded that water quality impacts are minor and that the primary environmental impact of discarded tires is the potential for fire and the toxic air pollutants that are created when tires are burned.

Risk

Infrastructure does not exist upstream of the gully erosion. Trails in the park near the erosion can be moved to avoid ongoing erosion. The gully erosion is thus a water quality and Town Forest management issue more than an immediate risk to property or infrastructure.

Management Recommendations and Stabilization Options

The following list of recommendations incorporates the findings of the site assessment and application of watershed science to implement optimal conservation practices (OCPs) that can be adopted by the Town Forest Committee for future management at the LHTF gully sites. A range of active stabilization options have been included that could be implemented over time, possibly in a phased approach, as funding or materials becomes available. Where applicable, examples of design details and cost estimates have been included for each recommendation.

1. Reroute trails if they are subject to erosion from the expanding gully.

    Description: The Town Forest Committee has already used this approach to management at the site. A trail was previously located where one of the gullies has now extended upgradient. That trail was rerouted away from the erosion path instead of employing hard armoring. This approach to avoiding conflicts where possible is recommended if additional conflicts arise in the future.

    Cost: This recommendation can be implemented at no cost as a consideration in future management activities.

2. Manage the site so that flow is not concentrated.

    Description: As management activities are undertaken at the site, ensure that changes to the landscape are not concentrating the flow of water. Historic channelization and concentrated flow may have contributed to directing water to the current gully locations. The soils at the site have proven to be highly erodible at the site of the current gullies and it is expected that any additional concentrated flow points in steep locations would cause similar gullies to form. Any future projects should be designed to ensure that water is still able to spread out and sheet flow across the forest floor.

    Cost: This recommendation can be implemented at no cost as a consideration in future management activities.

3. Apply proper optimal conservation practices during timber management.

   Description: Timber harvest and management can cause significant changes in the landscape, often channelizing runoff and increasing chances of erosion. Optimal Conservation Practices for silviculture in forested headwaters have been contemplated as part of a study looking at ways to increase flood resiliency on state lands and compiled into guidance, "Optimal Conservation Practices (OCPs) for Attenuating Flood Damage & Enhancing Water Quality in the Forested Headwaters of Vermont" (Brynn & Underwood, 2015). Although not all OCPs may be applicable for every site, the report was based on similar steep headwater areas, so many of the practices are appropriate for the LHTF site. It is recommended that as forest management, timber harvest activities, or changes in access are undertaken at the site, they follow the guidelines for optimal conservation practices as outlined in this report.

   Cost: This recommendation can be implemented at no cost as a consideration in future management activities.

4. Consider changing the LHTFMP High Priority Action to leave the tires in place and manage around them.

   Description: The LHTFMP lists removal of the tires from the gullies as a High Priority Action. It is recommended that the committee consider the pros and cons of this action using information summarized in the above sections, based on the LHTF management goals. If the original basis of this Action was to improve water quality in the downstream receiving water, then the Committee should consider leaving the tires in place instead of disturbing the area and transporting the tires and their water quality impacts to another location. If the Action was to improve aesthetics, then the Committee should consider implementing one of the following restoration recommendations. If the Action was to remove non-natural materials from the LHTF, then the Committee should weight this against the impact of removal. If the ultimate decision is to remove the tires, then a safe disposal site would need to be located, a contractor would likely need to be hired to remove the tires, and significant stabilization would be required. Stabilization should be in the form of revegetation and natural log and brush structures, similar to recommendations in the following restoration recommendations.

   Cost: This recommendation can be implemented at no cost if the decision by the Town Forest Committee is ultimately to leave the tires in place.

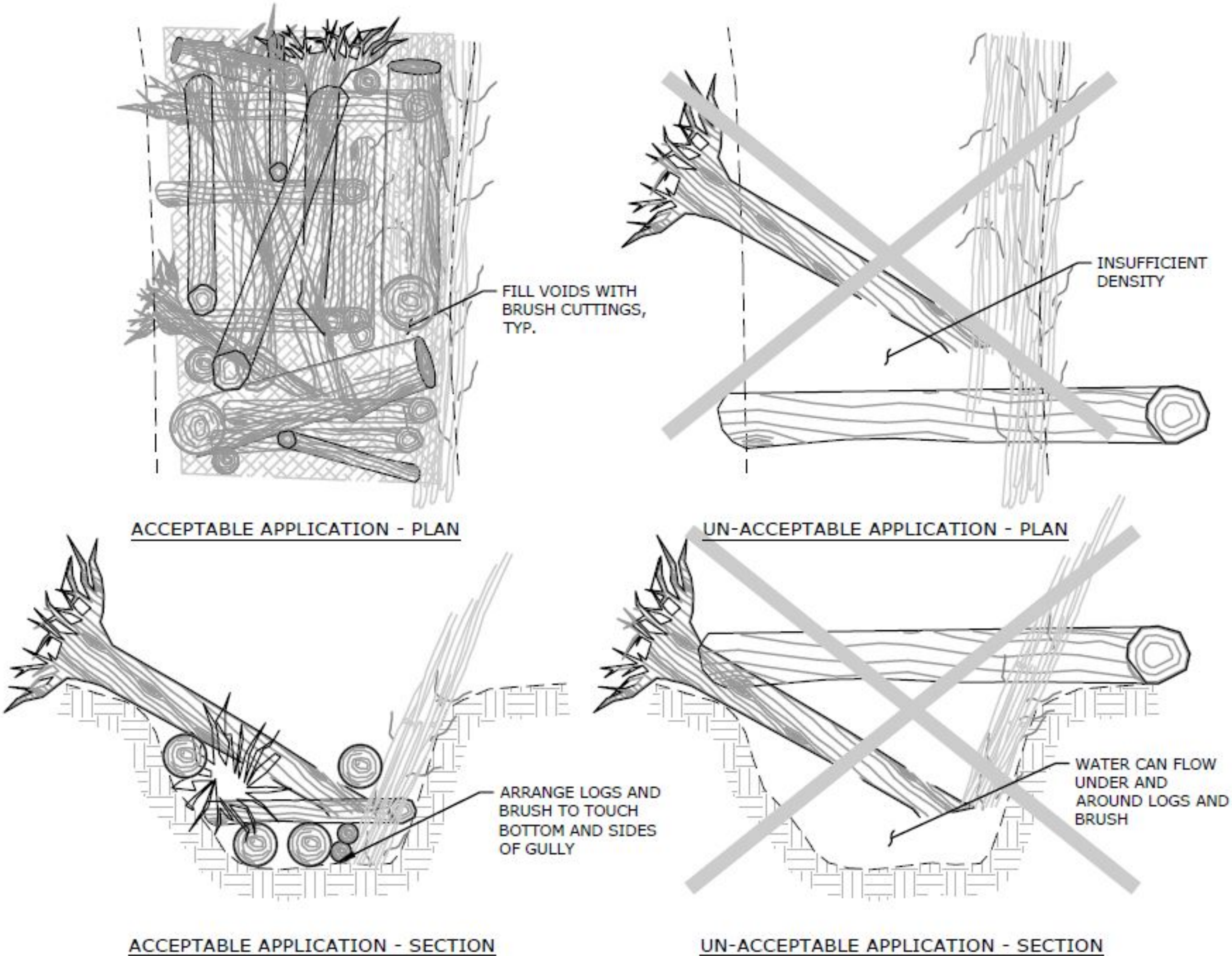
5. Place brush and logs in the upper gully to replicate the natural storage of sediment with wood.

   Description: The upstream extent of the gully erosion has continued to move upgradient. It is recommended that brush and logs are placed in the upper gully to slow water and catch sediment. This will slow the rate of erosion. This technique replicates the natural storage of sediment. In the narrow upper section of the gullies volunteers can likely perform the labor by hand. Logs and brush could be accumulated from the forest during routine management. Examples of natural wood applications are included below that apply to this and the following recommendation. Wood was observed holding back sediment in the channel downstream of the gullies and can be used as an example (Photo 1). A nearby recent gully erosion repair project was completed using natural wood techniques that could be applied here (Photo 2). Typical engineering details of this type of natural wood application are found below including "Brush and Small Log Application", "Log Stack Application", and "Log Check Dam" (Figures 1, 2, and 3).

   Cost: This recommendation can be implemented at little to no cost with volunteer labor and could cost in the range of $0 to $4,000.

Photo 1. Logs across the downstream channel are stabilizing the channel bed and catching sediment and debris.

Photo 2. Example of log check dam and brush and small log application at gully erosion site adjacent to Pond Brook in Monkton, Vermont. This photo was taken at time of installation, prior to accumulation of sediment between the logs and brush.

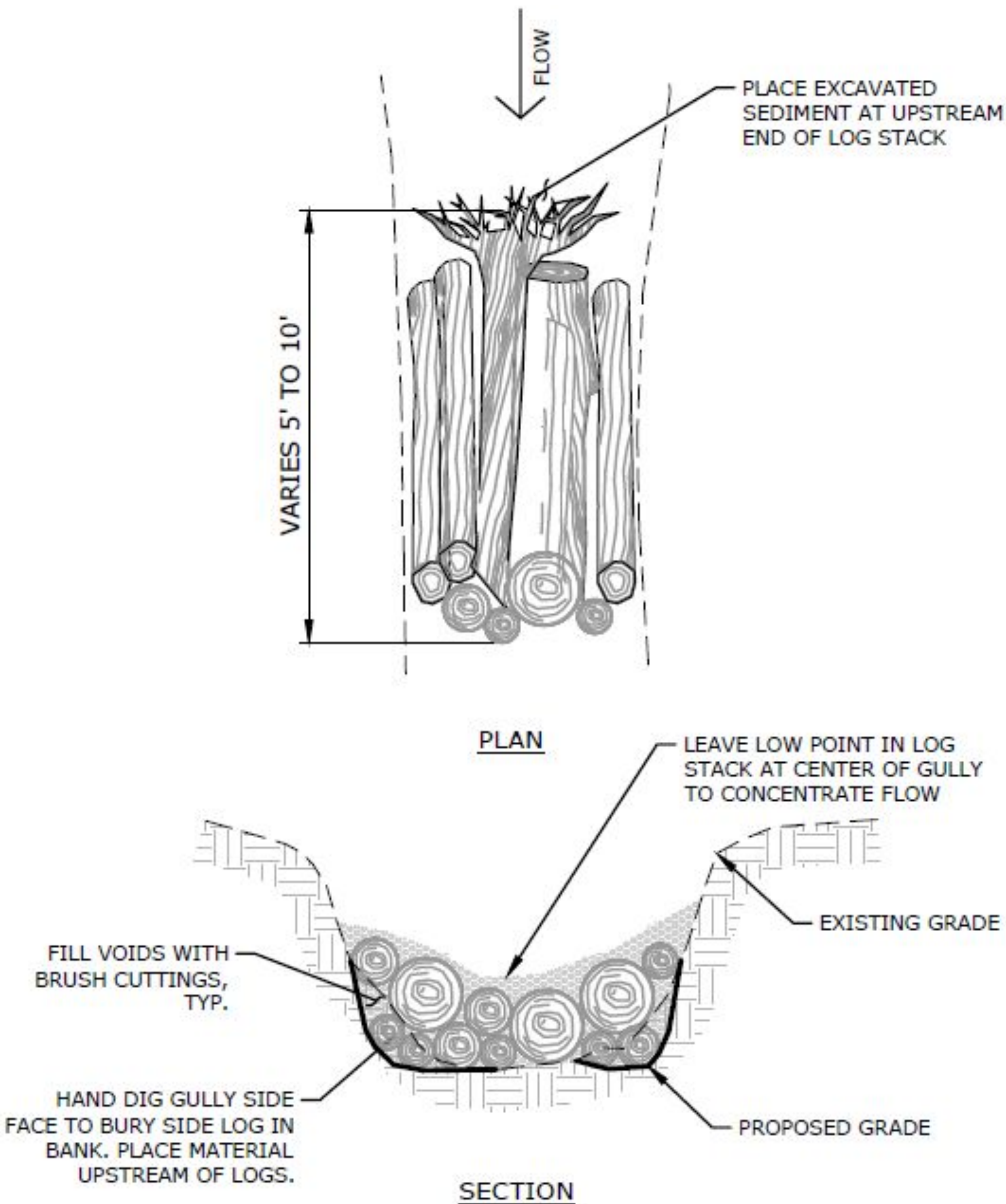


BRUSH AND SMALL LOG APPLICATION

NOT TO SCALE

1. INSTALL SMALL LOGS AND BRUSH IN CHANNEL TO STOP EROSION, SLOW FLOW, AND CATCH SEDIMENT.
2. CUT LOGS TO FIT AND FILL THE CHANNEL, EXPECTED LENGTH IS 4' TO 6' LONG. THIS WILL REQUIRE TURNING PIECES AND STACKING SO THAT INDIVIDUAL PIECES FIT DOWN INTO CHANNEL AND TOUCH THE BOTTOM.
3. FILL VOIDS WITH BRUSH CUTTINGS.
4. INSTALLATION IS EXPECTED WITH CHAINSAW AND HANDWORK.
5. USE EXISTING DOWNED WOOD WHERE POSSIBLE.
4. WHERE NEW CUT WOOD IS REQUIRED CONSULT WITH LANDOWNER AND FOREST MANAGEMENT PLAN.

Figure 1: Typical detail of natural gully stabilization technique, Brush and Small Log Application.

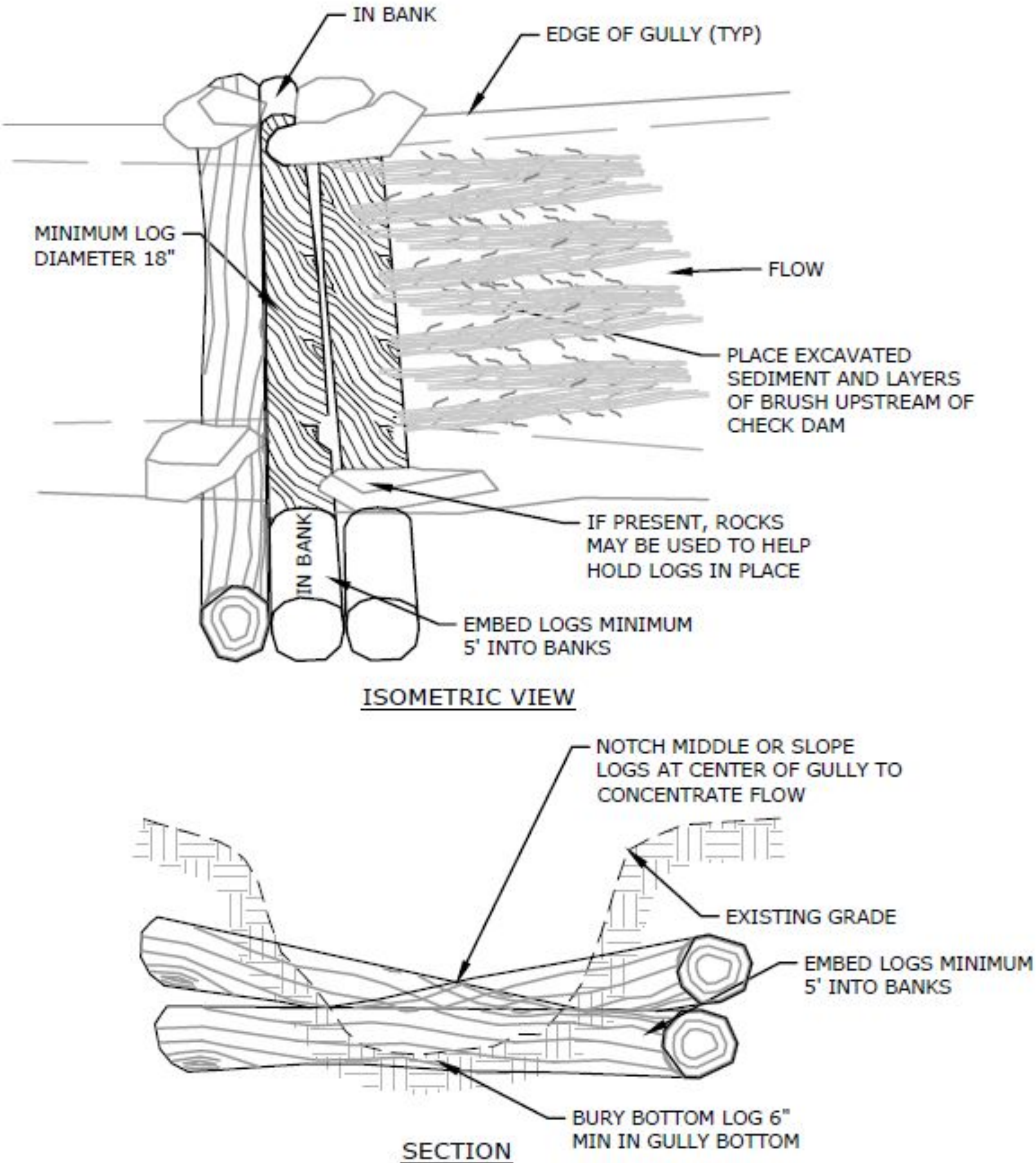


LOG STACK APPLICATION

NOT TO SCALE

1. INSTALL SMALL LOGS AND BRUSH IN CHANNEL TO STOP EROSION, SLOW FLOW, AND CATCH SEDIMENT.
2. STACK LOGS AND FILL VOIDS WITH BRUSH SO THAT INDIVIDUAL PIECES FIT DOWN INTO CHANNEL AND TOUCH THE BOTTOM AND VOIDS ARE FILLED.
3. INSTALLATION IS EXPECTED WITH CHAINSAW AND HANDWORK.
4. USE EXISTING DOWNED WOOD WHERE POSSIBLE.
4. WHERE NEW CUT WOOD IS REQUIRED CONSULT WITH LANDOWNER AND FOREST MANAGEMENT PLAN.

Figure 2: Typical detail of natural gully stabilization technique, Log Stack Application.



LOG CHECK DAM

NOT TO SCALE

1. INSTALL SMALL LOGS AND BRUSH IN CHANNEL TO STOP EROSION, SLOW FLOW, AND CATCH SEDIMENT.
2. INSTALLATION IS EXPECTED WITH CHAINSAW AND SMALL EXCAVATOR.
3. USE EXISTING DOWNED WOOD WHERE POSSIBLE.
4. WHERE NEW CUT WOOD IS REQUIRED CONSULT WITH LANDOWNER AND FOREST MANAGEMENT PLAN.

Figure 3: Typical detail of natural gully stabilization technique, Log Check Dam.

6. Replicate the natural storage of sediment with wood in the gully.

   Description: Similar to the previous recommendation, it is recommended that logs and brush be placed along the entire length of the gullies. The gullies are very large and may require a small machine to help move the logs into place in the gullies. Logs and brush could be accumulated from the forest during routine management. Examples of engineering details of this type of natural wood application include "Brush and Small Log Application", "Log Stack Application", and "Log Check Dam" (Figures 1, 2, and 3).

   Cost: This recommendation could cost in the range of $5,000 to $25,000. The range of costs depends highly on availability of volunteer labor and availability of wood from ongoing timber management.

7. Cover tires with soil and revegetate the gullies.

   Description: This recommendation would include hauling topsoil or other fill suitable for growing vegetation to the gully locations and spreading over the tires. This would require access for trucks and an excavator to place the soil. This would smooth the slope between the downstream channel and gully erosion occurring upstream. This area would remain steep, so some grade control such as the "Log Check Dam" is also recommended to reduce erosion potential on the newly graded slopes (Figure 3). Vegetation is recommended that is compatible with the surrounding forest and will help resist erosion.

   Cost: This recommendation could cost in the range of $20,000 to $40,000.

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