

LTS Trail Adopter's Handbook



Leominster Trail Stewards Adopt-A-Trail Program

Last Edited on: 3/1/2022

Adapted with permission from the
Appalachian Mountain Conservation

PREFACE

Welcome to the Leominster Trail Stewards' Adopt-A-Trail Program. Thank you for volunteering to maintain a section of our trail network! This Handbook is your training reference and guide to your role, responsibilities, and available resources.

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Introduction

The Leominster Trail Stewards formed in 2009 in response to the December 2008 ice storm that devastated our trails. Our immediate task was to clear the trails and make them safe for public use. That initial effort took us well into 2010, though we continue to find damage that occurred as a result of that storm in the woodlands adjacent to our trails.

The LTS is now recognized as the official trail maintenance group for the City's trail network and we organize and conduct several volunteer trail efforts each year with workers from groups as well as individuals. In cooperation with the Leominster Recreation Department and other conservation-minded groups, we lead hikes and other trail events in the Leominster.

The LTS is actively recruiting more volunteers to help maintain and repair the more than 35 miles of trails within our network.

LTS Trails Stewardship Program Mission Statement

The mission of the Leominster Trail Stewards is to improve and maintain the city's trails and to promote their appropriate use for the benefit and enjoyment of its residents and visitors.

The LTS Trails Stewardship Program is committed to the protection and care of the trails and pathways in our community while promoting and enhancing the experiences they provide. Through the high-quality work of dedicated volunteers, the trails program promotes stewardship, public service, and ethical recreation.

Please consider participating in the Adopt-A-Trail initiative outlined in the following pages.

LTS Roles & Contact Information

(Good thru 12/31/2022)

LEOMINSTER TRAIL STEWARDS' ROLES

CHAIRMAN: Neal Wynne
VICE CHAIRMAN: Open
TREASURER: Anne Seed
SECRETARY: Open
STEWARDSHIP COORDINATOR: Dick O'Brien
SOCIAL MEDIA COORDINATORS: Susie Herring/Jan McDaniel

STEERING COMMITTEE MEMBERS

Art O'Leary
Rich Powers
Susie & Roy Herring
Steven Snay

LEOMINSTER RECREATION DEPARTMENT

DIRECTOR: Judy Sumner

TRAIL STEWARDS' CONTACT INFO

Neal Wynne nwynne51@gmail.com
Dick O'Brien dobrien578@gmail.com
Judy Sumner
jsumner@leominster-ma.gov
Anne Seed anneseed8@gmail.com
Rich Powers..... rich@thepchelpdesk.com
Art O'Leary oleary5150@comcast.net
Susie & Roy Herring lindaherring@verizon.net
Jan McDaniel..... mcdanieljan@icloud.com
Deb Giovannucci.....
DebGio35@gmail.com

Trail maps are available on the Recreation Department's website:
<https://www.leominster-ma.gov/depts/programs/recreation/trails.asp>

LTS Adopt-A-Trail Program Overview

The Leominster Trail Stewards (LTS) and the Leominster Recreation Department cooperate to maintain more than 35 miles of trails within the City limits. The LTS' Adopt-A-Trail Program provides the opportunity for volunteers to perform basic maintenance on many of these trails. The LTS is beginning this program so that Adopters provide all the basic trail maintenance on our trail network so that our core group of trail stewards can address more difficult and demanding trail maintenance and repair tasks. There are no formal requirements for participating in the program other than a general familiarity with Leominster's trails and a willingness to take on responsibility for trail maintenance.

Basic skills training and signing the City's Waiver of Liability (more info below) are required for all new Adopters and will be provided by the LTS Board. Additionally, Adopters must re-certify every five years or be approved by a Section Leader.

Adopters' Responsibilities

Adopters have two responsibilities:

1. performing regular basic maintenance on a section of trail and reporting on that work, and
2. reporting current trail conditions or trail conflicts.

Consistent trail maintenance helps to preserve the surrounding environment by preventing erosion sedimentation and limiting other impacts on the surrounding environment by defining the trail while also creating a safe and enjoyable hiking experience for trail users.

The basic maintenance tasks of Adopters include clearing the trail corridor, cleaning drainage structures, maintaining the trail tread and maintaining assurance blazes on trailside trees. Most trail sections normally require 2 to 3 visits per year to accomplish these maintenance tasks. We recommend that Adopters spread these work trips out throughout the year. While basic maintenance can help to prevent severe trail damage, Adopter reports are also essential in helping to log more serious issues on the trail that will require the LTS Board's attention. Major construction projects are performed by or contracted out by the LTS Board and Leominster Parks and Recreation Department.

Each trail section chosen for the Adopt a Trail volunteers will have a Leominster Trail Steward assigned as a Section Leader for reporting major trail damage, vandalism or other issues not listed below.

Basic Maintenance Tasks of Adopters

In order of priority, the maintenance tasks of Adopters are:

- **Trail corridor clearing** – remove blowdowns, limbs, and encroaching brush annually to provide a clear trail corridor for unobstructed passage.
- **Drainage**– addressing water issues on the trail including cleaning waterbars and drainage ditches of dirt and debris each spring and fall.
- **Trail Assurance marking** – marking or re-marking trails with paint blazes.
- **Trail tread definition** – prevent the development of widened trails, braided tread and shortcutting of switchbacks by addressing the first two tasks.
- **Vandalism and littering** – addressing these when they occur on our trails and at our trailheads.

All work should be performed in a manner that protects the environment, natural resources, and the recreational experience of trail users.

Vegetation encroachment and debris, stormwater and snowmelt, and user impacts will be the main concerns you are working to address through your maintenance activities. Through observation and experience, you will learn a great deal about what works best on the section of trail you have adopted. First, try a conservative approach to things such as drainage cleaning, corridor clearing, or blocking bootleg trails. If you find on your next visit that something was not effective, you can take additional actions such as blazing, etc. If you need assistance or advice on your assigned trail, start

by contacting your Section Leader. The Section Leader is familiar with your trail and can walk the trail with you or alert you to specific problems.

After taking a trip out to work on the trail, Adopters must email a brief work report to the LTS Section Leader (even if no work was performed on that visit). A sample form is in the APPENDIX.

Trail Sections & Leaders

| Trail Sections | Section Leaders |
|-------------------------|---------------------|
| Monoosnoc Trail | Neal Wynne |
| Barrett Park Trails | Dick O’Brien |
| Prospect Park | Judy Sumner |
| Hill Street Park | Anne Seed |
| No-Town Reservoir | Art O’Leary |
| Johnny Appleseed Trails | Deb Giovannucci |
| | Suzie & Roy Herring |
| | Jan McDaniel |
| | Rich Powers |

Adopter Work Schedule

Adopters have a great deal of freedom and flexibility in how and when they maintain their trails. Adopters work on their own schedule and at their own pace during the spring, summer, and fall months (some trails are popular winter hikes, and Adopters have the option to perform corridor maintenance in the winter, as well). See **APPENDIX** for information on tools to use on the trails.

While every trail location is unique, here are some suggestions for the best tasks to perform at different times of year: (Please refer to the Glossary for explanation of terms)

March/May - An initial trip should be made in the spring before the heavy hiking season begins. Your focus should be on correcting immediate problems such as plugged drainage, overgrown sections and blowdowns that remain after the winter months. The best time to clean out drainage is in the spring and fall after leaf drop. It is helpful to keep drainage structures clear during summer rainstorms. It is also good to check for drainage problems when the water table is high and the soils are saturated. Checking drainage during, or immediately after, rainfall will help you learn which drainage features work and which ones do not (Please be sure to send work report to your Section Leader and Steward Coordinator – dobrien578@gmail.com by April 15th)

June/July - This is probably the best time to perform your annual trimming of branches. It is also a good time to check whether any of your blazes are blocked by branches and leaf cover.

July/Aug - Brush and weeds grow rapidly in the summer so you should check for new brush that has grown into the trail. This is also a good time for touching up blazing because you are more likely to have dry days. August, which is warm and has less average rainfall, is a good time to do trail work.

Sept/Oct - Any of the basic maintenance tasks can be performed but this is a good time to look for any braided or bootleg trails that may have developed over the summer and to brush them in. It is also important to clean thoroughly all drainage after the leaves have dropped. This ensures good drainage in the late fall and early winter when the ground is frozen and seeps appear in many places, as well as in the late winter and early spring during snow melts and early rains.

Nov/Dec- It can be useful to travel your trail on skis or snowshoes in the winter and maintain the corridor. You will gain an entirely different perspective of your trail when there is snow on the ground and the tree branches are weighted down with snow. This is especially important for cross-country ski or snowshoe trails that must be brushed more extensively. (Please be sure to send your work report to your Section Leader and Steward Coordinator – obrien578@gmail.com and your Section Leader by Nov 15th)

Safety & Liability

All LTS Board members and trail Adopters must sign a Waiver of Liability in order to perform any trail maintenance work on City property. The City's waiver form is in the **Appendix**. It must be renewed every year. A copy of this is kept on file at the Recreation Department. *Basically, it states that you volunteer and work at your own risk on our trails and that you may be held liable for any damage or injury that may result to you, others or real property from your actions while you are performing your Adopter activities.* This is a standard policy for all trail volunteers with the City.

Since you are responsible for your own safety while working on trails, before venturing out, check the weather forecast, carry sufficient water, food, and first aid supplies, and wear appropriate clothing. Always let someone know your location and estimated time of return. It is also recommended that Adopters not work alone, especially when performing tasks such as blowdown removal or moving rocks. Make sure to properly carry your trail tools out to the work site. Adopters are welcome to involve families, friends, and other groups in trail work. **All volunteers are required to sign a Waiver of Liability before performing any work on the trails.** For safety's sake, productivity, and effectiveness of the leader, groups should be limited to the Adopter and no more than five additional persons. The Adopter is responsible for the work performed, providing instructions on tool use and safety, and confirming that the group has adequate preparation.

Leominster Trails Stewards follows COVID19 safety practices outlined by the City of Leominster, MA, and the US Centers for Disease Control. Below are webpages with more information:

https://www.leominster-ma.gov/about/covid_19.asp

<https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/visitors.html>

LTS safety practices include wearing face coverings, keeping "social distances" (at least six foot distances between people working on trails or hiking), frequent handwashing/hand sanitizing, frequent sanitizing of tools and solid workspaces, and coughing or sneezing into elbows, not hands or gloves.

Training

Experienced LTS Stewards will provide training in the best techniques and practices in maintaining trails to all Adopters at no cost. New Adopters are required to attend one of these training sessions before working on the trail, and current Adopters must retake the training every 5 years (or be recertified by their Section Leader). It is always helpful to share knowledge and experiences with other Adopters and learn from their experiences. The training sessions focus on basic trail maintenance techniques such as brushing out or brushing in a trail, blazing, cleaning and repairing drainage structures, and blowdown removal. Additional trainings are offered occasionally on topics such as trail hardening, log and rock steps, building trail bridges and boardwalks, backcountry first aid, chainsaw & axe use, doing trail assessments, and designing sustainable trails.

First Aid

At some point you may encounter ill or injured trail users or because of the nature of your trail work and use of trail tools, you may become injured. **We recommend Adopters have some knowledge of first aid and carry a first aid kit.** It would be advantageous for Adopters to be certified or knowledgeable in basic or wilderness first aid. LTS can provide you with a basic first aid kit or you may assemble your own kit by buying items individually at a pharmacy. It is important to know what is in your first aid kit and when and how to use the item. See the APPENDIX for a list of suggested first aid kit contents.

Communication

You will receive information from the LTS Stewardship Coordinator about training session, especial trails events, and more. In addition, your Section Leader will be in touch with you from time to time. The LTS Facebook page and direct email from the Stewardship Coordinator will periodically provide news and information.

Interacting with the Public

When you take on the role of Trail Adopter, you also take on the role as a trail ambassador for LTS. In these roles you will periodically have contact with other trail users. Take the time to chat with them, and always treat them with courtesy and respect; after all, you are a representative of the City and the LTS. Users will be curious about what you are doing, and you can give them a brief explanation of the trail maintenance you are performing and its value to the trail network and users like them. Many will thank you for your efforts. Some users are not aware that trail maintenance is performed by volunteers. Let them know about the Adopt-A-Trail program and how they can get involved!

It is important to maintain good relationships between the LTS and private landowners whose lands abut our trails. Adopters are expected to act in the spirit of partnership and as LTS ambassadors to the hiking public.

Feel free to call or email the LTS Stewardship Coordinator as he is always interested in conditions and events on our trails. Additionally, he is always glad to meet and talk with Adopters and may have some useful information about your trail or trails in general.

Reporting Trail Work

Complete a work report form and promptly send it to your section leader after every visit to your Section Leader and Steward Coordinator Dick O'Brien at dobrien578@gmail.com and "Trail Reports - Team LTS bb737ab6.thepchelpdesk.com@amer.teams.ms". It is important and useful for the LTS to keep track of the total number of hours volunteers contribute to the maintenance of our trails as this helps us when we seek grants, donations, and budgetary support for our trails. Work reports also help the LTS keep track of the status of trails. They alert us to problems where a trail crew should be deployed. Finally, these forms help us keep track of your volunteer hours so that we can recognize your efforts through LTS Trail Stewardship awards.

Work reports are to be submitted by email to your Section Leader as a Word or PDF attachment (work report can be found on the web or in the appendix here) making note of any problems such as serious erosion, damage to the trail, or missing signs or other issues.

Please note: Our trail network has a large backlog of serious problems to address with a limited volunteer staff, and a variety of factors are considered when prioritizing the trail crew's projects. Please do not be disappointed if your problem does not receive immediate attention.

Adopters are expected to send in a minimum of two reports a year: at least one by April 15 and the remainder by November 15. If no reports are received for a full year, and other arrangements have not been made with the Section Leader, the trail section will be made available for adoption by another Adopter.

GLOSSARY OF TERMS

Bench-cutting or Side-hilling: a sustainable-trails ‘best practice’ for creating desired cross-slope on a trail built on the side of a hill. The tread of the trail is dug out to create a trail that has <5% cross-slope for comfortable hiking and for providing a sustainable surface for the trail. The soil and stone removed from the trail is typically scattered downhill. Most trail builders and maintainers prefer a full bench cut as the full width of the tread is on firm native soil. Rogue Hoes, McLeods, pick mattocks and shovels are the typical tools used to perform bench-cutting. Rolling contour trail design typically requires bench cutting to create the desired trail.

Boardwalk: a more formal and larger trail structure than a bog bridge. The boardwalk enables users to cross over standing or moving waters, wet muddy areas, or ecologically sensitive areas on a trail without causing any negative impact to the resource. Usually they are a minimum of 3’ wide but can be up to 8’ wide and generally 2’ to 4’ or more above the ground. Boardwalks greater than 30” above the ground require railings for safety and code reasons. Typically constructed of wood but fiberglass, steel, and aluminum can also be used.

Bog Bridge: a low-to-the-ground, man-made structure usually built where a trail crosses a wet or muddy area to lessen the impact of users traveling through the area and to provide more enjoyable travel through the area. Usually consisting of sleepers resting on the ground supporting one or more planks set on top of the sleepers to keep the user out of the mud or water through which the bog bridge passes. Also referred to as “puncheons.”

Braided Trail: a section of trail consisting of several short alternative trails created to get around a trail obstacle like a fallen tree or mudhole. Remove or fix the obstacle and then brush in the alternative trails to re-establish the original trail route.

Brushing In or Out: “brushing in” a trail refers to closing an unwanted or rogue trail by piling downed trees and brush in the trail corridor to make it appear as though there is no trail there. “Brushing out” a trail is clearing the trail of unwanted vegetation or forest debris to clear the trail corridor for ease of use.

Control Points: these are the features that a trail wants to travel by because they are of interest to users, Alternatively, they are the features that designers want the trail to avoid because of sensitivity or other concerns.

Cribbing: a best practice when building up the downhill side of a trail. It involves embedding large stone or logs into the hillside to hold back or retain soil/gravel that makes up the tread on a trail. The steeper the hillside, the taller the cribbing must be to produce a trail with acceptable cross slope. Typically done when shoring up a ½ bench cut on a sidehill trail. If it will take too much cribbing to build the trail tread up to the desired height, then a retaining wall will be installed to hold the soil/gravel needed to establish the trail tread.

Cross Slope: the angle of the tread going across the trail or perpendicular to the running grade; typically, 0% on level ground and <5% on hillsides. Trails have <5% cross slope on hillsides to shed water and avoid erosion. Cross slope greater than 5% creates an uncomfortable surface on which to hike.

Flush-cutting: the practice of cutting larger tree stumps very low to the ground to minimize tripping hazards along the trail. Usually done when the stump is too large to easily dig out of the trail treadway. Trail builders try to minimize the number of times large trees have to be removed for creation of a trail. The alternative of going around the tree is preferred!

Natural Surface Trail: a trail whose tread consists of native soil, stone or stone aggregate or wood chips.

Pedestrian Trails: trails deliberately designed for hikers, walkers, trail runners, snow-shoers, and x-country skiers.

Rolling Contour Trail: a trail whose route generally follows the contours of a hill while dipping up or down to shed water off the trail.

Running Slope: the steepness (up or down) of a trail usually expressed as a percent grade. Most User Accessible (UA) trails are less than 5% running slope, while non-UA trails are designed to be 10% or less in running slope. Trails over 10% usually need to be “hardened” to be sustainable.

Sawyer: a person who is trained and certified to use a chainsaw for dropping and removing trees from the trail corridor.

Shared Use Path: a path designed and built for several different user groups (e.g. hikers, walkers, in-line skaters, bicyclists, strollers, runners, etc.).

Single Track Trail: a trail designed to accommodate users walking in single file.

Sustainable Trail: a trail that requires a minimum amount of resources to build and maintain and that causes a minimum amount of disturbance to the environment.

Switchback: a sustainable-trails “best practice” used when a trail ascends/descends a steep hill or mountain. The switchback keeps the running slope from exceeding 10% or ½ the slope of the hill which reduces erosion on the trail and creates a more enjoyable hiking experience for users because the grade is more reasonable.

Trail Assessments: detailed reports on the existing conditions of a trail or trail network.

Trail Blazing: a mark typically painted on a trailside tree indicating the presence of a particular trail. Also called “assurance blazing”, these marks can be circles, squares, rectangles, triangles, or diamond shaped. Good colors for assurance blazing are bright red, orange, yellow and blue. This is a relatively cheap method of providing way-finding direction on a trail or trail system.

Trail Corridor: the space through which users travel on trails. A typical trail corridor for a single-track trail is 6’ wide and 8’ -10’ high and clear of any impediments.

Trailhead: usually where a trail begins; trail maps and Rules & Regs signs are typically posted on a kiosk at the trailhead.

Trail Signage: typically trails have one of 3 types of trail signage; either interpretive, directional, or regulatory. Interpretive signage provides information about the natural or cultural history of a property. Directional signage points the way and gives the distance to a feature or the next trail intersection, regulatory tells the user what they can and cannot do on the property.

Trail Tread: the actual surface on which the user travels, e.g. dirt, grass, pavement, stone, woodchips, wood, fiberglass, etc.

UA Trail: a trail intentionally designed for those with physical impairments. UA guidelines dictate a firm and stable surface, a minimum of 3’ wide, a running grade of 5% or less and other requirements for those with mobility issues.

Viewshed: the area seen from a scenic vista created on a trail.

Waterbar: a drainage structure built in the tread of a trail to remove water from the trail.

APPENDIX

Basic Trail Maintenance

Basic trail maintenance is fundamental to the sustainability and enjoyment of our trail system. The work that you perform as an Adopter helps to define the trail, limit user impacts to the surrounding environment, prevent erosion, and improve the user experience. Without your work, trails would likely become overgrown or blocked by blowdowns. Drainage structures would fill with leaves and sediment, sending water onto, rather than away from, the trail. Trail users may become disoriented without wayfinding assistance from blazes, and wayfinding signposts. Poorly defined trails tend to become braided or widened, which amplifies the impact of users on the surrounding landscape and can increase erosion. Limiting user impacts is particularly important in sensitive environments, like wetlands, watershed lands, or priority habitats. While the scope of your basic maintenance work may not address all issues you encounter on the trail (sometimes you'll find a blowdown too large or an eroded trail segment that requires major trail reconstruction, or bog bridges that need replacement), your work does help to prevent small issues from becoming major problems. Additionally, your work reports help to inform the work of the LTS Board.

Prior to the gating of many of our trail entrances on the west side of the city and prior to a more regulated approach to motorized vehicle use on public recreational lands, the trail network in the Monoosnoc Hills area was severely impacted and abused by careless users. While much of that activity stopped some 20 years ago, we are and will continue to be affected by this impact for decades to come. In order to make our trail network much more sustainable and enjoyable to hike, it will take many years and many dollars. LTS and the City have begun a trail master plan to envision how we might fix the problems and produce a first-class trail network for all to enjoy. Providing for the basic trail maintenance is the first step in addressing the issues affecting our trail system. Your maintenance work will help the trail endure, allow it to be enjoyed by countless visitors, and free up manpower to slowly address some of the historical abuses done to our trails.

In order of priority, here are the tasks Adopters perform each year. It is recommended that Adopters take time to simply visit the trail, assess conditions, and take a personal inventory of structures and their condition as a baseline for monitoring any changes in the trail condition.

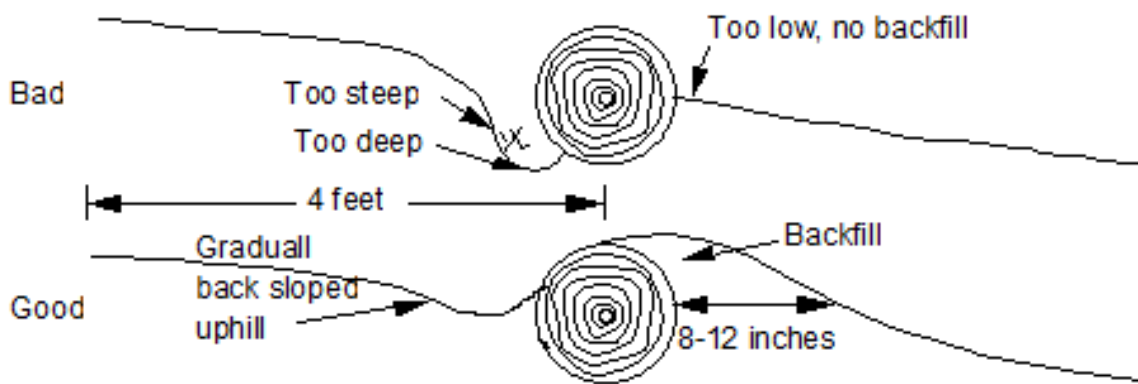
Drainage

You will encounter structures that are meant to move water across and off the trail, such as drainage dips and waterbars, as well as structures meant to carry water along the trail (side ditches). All are prone to filling with leaves, branches, and sediment, which in turn causes water to flow onto the trail and lead to soggy tread conditions or erosion. Clearing this debris and keeping these drainage structures open is one of the most important things Trail Adopters can do each year.

The flow of water may cause a waterbar to become undercut or incised. Taking the time to not only clean, but re-shape, a drainage dip will go a long way towards preserving the usefulness of the structure and the condition of the trail. You may find waterbars that were built with rock, a log, or simply an earthen berm. The same cleaning and reshaping principles apply to all. To establish a good shape for the drainage dip, try to blend the uphill edge of the dip into the tread 4 feet from the bar, and gradually form a broad dip on the uphill side of the log, rock, or berm, using extra soil to bury or partially bury the rocks or log on the downhill side. If the uphill side is too steep, traffic and water will collapse it and the soil will clog the waterbar or dip. Water should move off the trail via the dip in a sheet, rather than a deep channel.

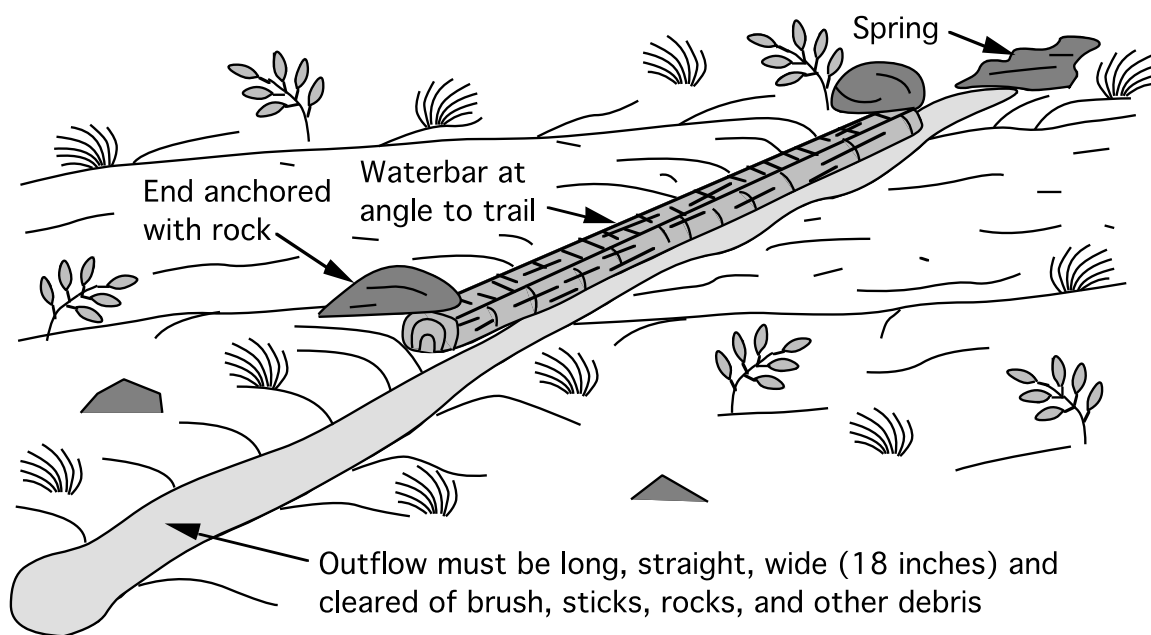
When clearing drainage dips, pull all mineral soil and rock that has been deposited in the dip up and over the structure and use it to build up the downhill side of the structure. The mound of dirt backfills the waterbar and rebuilds the dip.

Leaves, roots, and organic debris should be discarded. Do not cast useful soil off the trail. Waterbars that do not have sufficient backfill on the downhill side are likely to become undermined, and dips that have worn down too much may allow water to flow over them down the trail. Cut out loose roots and remove rocks as these will collect debris.



Waterbar Cross Section

Some of the most effective tools for cleaning drainage are the hazel hoe, adze hoe, Rogue hoe, or McLeod. A shovel is helpful when large amounts of dirt must be moved. A pick mattock or a cutter mattock is often used for clearing dirt, cutting roots, and prying rocks. The pick mattock is heavy, and the blade is narrow, but it is a widely used tool for clearing drainage due to its versatility. Some Adopters have found that ordinary garden hoes, which are easy to obtain and light in weight, are satisfactory for cleaning drainage. The handles can be cut off at about four feet, making them easier to carry and use.

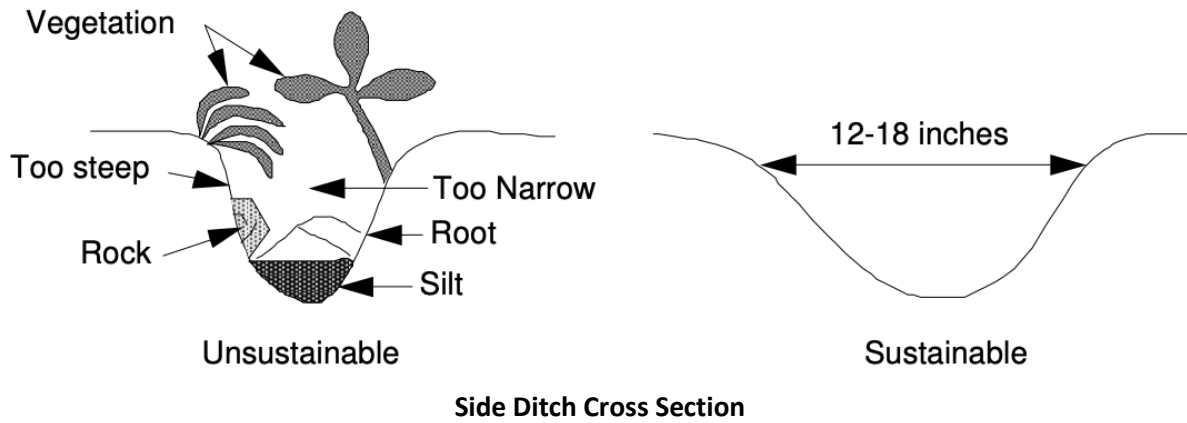


Waterbar Outflow

The outflow at the end of the waterbar or dip should be straight, wide (at least 18 inches), deep, and root-free with side slopes graded. If the outflow is not adequate, it will clog and cause the waterbar to fill up with dirt and debris. It should drop off sufficiently so that water is carried off the trail and does not back up or re-enter the trail further down, but the outflow should not drop precipitously off the downhill side of the trail or channel the water. If it does, the outflow will erode back up toward the trail and eventually into it. Brush out the area along and at the end of the ditch to facilitate cleaning. Outflows often require considerable digging and removal of roots, vegetation, and rock. Curved ditches slow the water down and allow silt to deposit. If the outflow is too shallow, water may overflow onto the trail, but steep sides may collapse and clog the ditch. **A good, wide ditch will require less maintenance over time and ensure adequate drainage!**

Streams with shallow channels crossing the trail or near the trail should also be checked and cleared of debris. Logs, brush, rocks, and leaves may clog the channel and divert the water so that it runs down the trail.

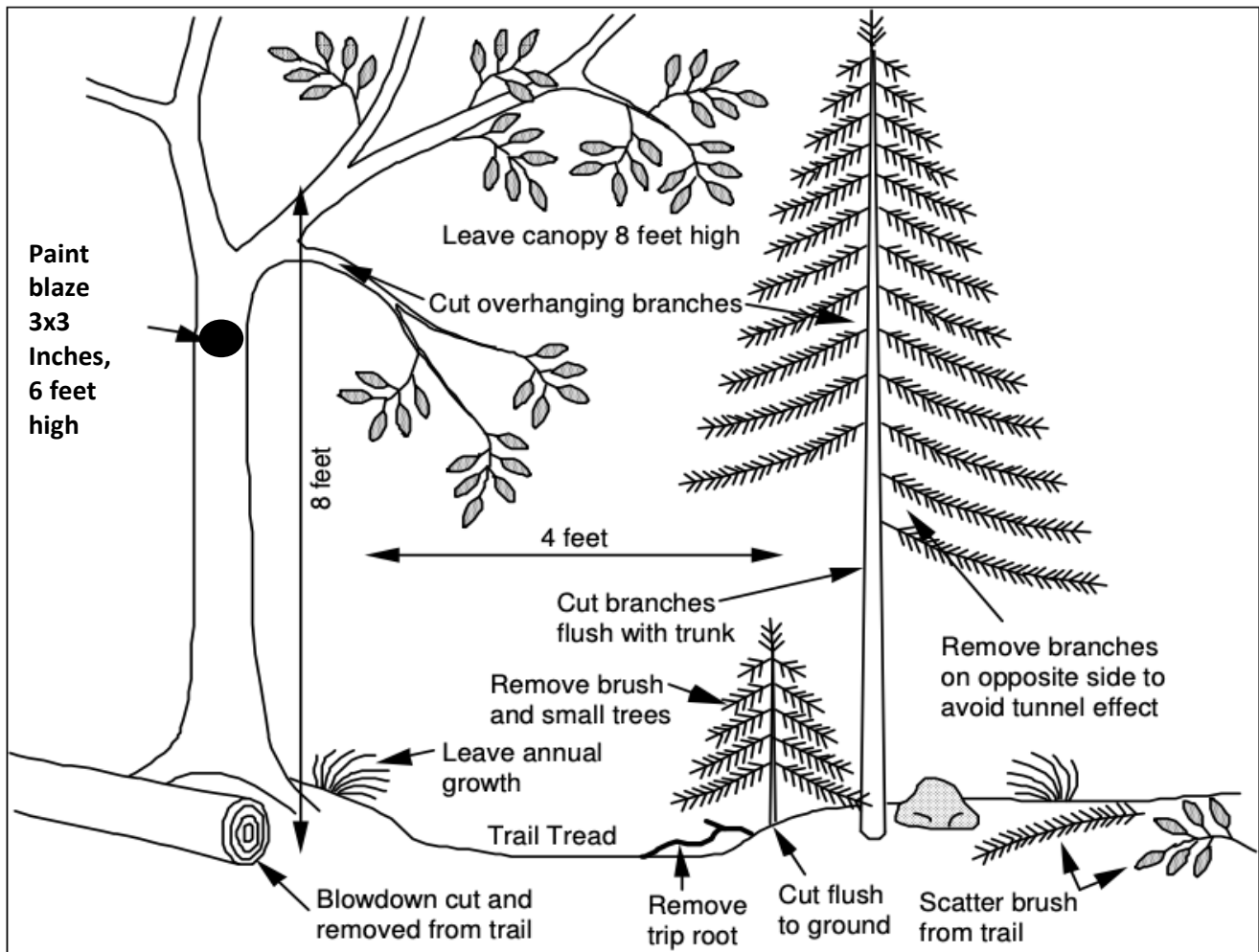
Side ditches are useful in areas of wet, saturated soils. They are particularly helpful in directing water alongside a trail in places where a waterbar cannot be placed across the trail. Ditches can be dug along one or both sides of the trail to provide drainage for ground seepage and to create a high, dry trail tread. Drainage ditches should be carried down the trail to the next waterbar, which will direct the water away from the trail. Ditches silt in and become vegetated and, like waterbars, need to be checked each year. The same principles apply to ditches as to waterbars and water dips. Avoid leaving large, unsightly mounds of dredge mud and debris along the side of the ditch. Organic mud and leaves should be discarded as they hold water and make the trail muddier.



Trail Corridor Clearing

Clearing the encroaching vegetation from the trail corridor helps to keep users on the trail and minimize impact to the natural environment. A properly cleared trail is one upon which an adult hiker with a full pack can walk erect without touching trees, limbs, or brush. The line of sight and the footing are clear. The chart below gives the correct corridor height and tread width for Leominster’s trails. A 4’ wide x 8’ high trail corridor is sufficient for most wooded trails. Trails used as cross-country ski trails should be brushed wider and taller. A narrower width is preferable for our “wilder” trails; generally, 18” to 24”. Most of our Fire Roads are 8’ – 12’ wide and over 12’ tall.

| <u>Trails:</u> | <u>Basic</u> | <u>“Wilderness”</u> | <u>X-Country Ski</u> | <u>Fire Road</u> |
|-----------------------|-------------------|---------------------|----------------------|---------------------------|
| Brushing Width | 4’ wide x 8’ tall | 3’ wide x 6’ tall | 8’ wide x 12’ tall | 8’ – 12’ wide x 12’ tall’ |
| Tread Width | 24” wide | 18” wide | NA | 8’ |



Lateral branches extending into the trail become heavy when wet or laden with snow. Users brushing against these branches quickly become wet. Adopters, if possible, should walk their trails in rain or just after a rainstorm, or during the winter with snowpack on the trail, to gain a good appreciation of how much brushing is needed.

Limbs on trees should be cut flush with the outside edge of the branch collar. Branch stubs are unsightly, hazardous, and take longer for the tree to heal. Branches growing toward the trail should be cut back to a limb growing away from the trail. Some branches on the opposite side of the tree should be removed to avoid creating a tunnel-like appearance of the trail. A canopy left over the trail at a height of eight feet or more will suppress underlying growth.

Low shrubs and young trees that tend to encroach upon the sides of the trail should be cut flush with the ground for aesthetic and safety reasons. Avoid leaving pointed stumps, which are potentially dangerous if stepped on or fallen upon. Annual growth, such as ferns and grass, can be left unless it is particularly thick and aggravating. Avoid clearing branches if doing so exposes fragile plants and mosses to trampling. Remove all dead trip roots from the trail. Do not cut live roots in the ground or brush on the downhill side of a side-hill trail because they help hold the soil. Do not cut trees and undergrowth heavily on the inside of a corner where users may shortcut the turn.

After trimming, it is very important to remove all branches and debris off the trail. Pick up all branches, trees, and debris and scatter them well off the trail with the cut end facing away from the trail. Piles should be avoided because they are unsightly and can create a fire hazard. Downed trees should be dragged butt first until the top is completely off the trail. This helps conceal the tree. Large limbs and small trees can be thrown clear of the trail, provided they do not hang in the branches of shrubs and trees next to the trail or stick up butt first. Be sure not to throw brush into drainage ditches or their outflows.

The LTS Stewardship team will patrol the trail network in the spring with the intent of removing all large blowdowns before June 15.

Larger trees requiring the use of a chainsaw to cut them up can only be cut up by LTS trail stewards who are approved to use a chainsaw on City property. If you have a tree that is too large for you to handle, include a note in your work report and inform your Section Leader so that arrangements can be made for a crew to remove it.

Some trees will fall during the course of the season and can be removed by Adopters if it is safe to do so. Blowdowns across the trail and trees leaning over the trail ("leaners") should be removed. A large blowdown lying across the trail should be cut on each side of the trail and the center section removed. Smaller blowdowns can be cut in pieces and dragged away from the trail. Leaners have to be cut down and dropped into the trail before cutting up for removal. Sometimes a large tree falls parallel to the trail with branches projecting into the trail. If the tree is not in the trail, the projecting side branches can be cut off. Be sure to cut the side branches flush with the trunk. Most blowdowns, including relatively large ones, can be cut with a bowsaw or a folding saw.

Trail Definition

One of the goals of our trail maintenance program is to minimize the impact to our natural areas and watershed lands. Your efforts to provide good trail definition and maintain dry trail treads plays a major role in achieving this goal. Poorly blazed trails, unclear trail corridors and wet, muddy trail tread lead to braided trails and overly wide trails that create more impact on the environment than is needed. Bootleg trails often develop when users cut switchbacks, so as Adopters, you need to ensure that users stay on the trails. In wet areas or when blowdowns are not removed, users utilize to the side of a muddy or blocked trail, widening it. Adopters need to address these situations and resolve them. When the trail is poorly brushed out or not blazed, users are unsure of the direction and so they may take multiple routes. This also causes more adverse impact to the environment and needs to be eliminated.

In dealing with these problems, first try to determine why they are happening. Blazes may be faint or misplaced. A blowdown or brush projecting into the trail can force people to take a different direction. After correcting these problems, block off the bootleg trail with brush. Large gnarled logs and dead softwoods are particularly effective, as users will usually take the path of least resistance. Allow new growth in the trail you have blocked off and minimize trimming so that the entrance is less visible. Where a trail diverges in two, for example around a tree in the trail, brush in the less usable of the two routes.

Users will sometimes avoid using rock or log steps, no matter how clear and well placed they are leading to the death of vegetation along the steps and the erosion of soil helping to retain the steps. This will lead to the failure of the steps. In these cases, "gargoyles" consisting of large rocks should be placed alongside the steps to focus traffic onto the steps. Make sure that the gargoyles are large enough and secure enough not to be knocked loose if kicked or stepped on.

Trails in Wet Areas

Almost all low sections of trails will pass through wet areas. Higher up, many trails pass through mountain bogs. These areas are often muddy, slippery, or have puddles of water on the tread. Users who want to avoid getting their footwear muddy may walk to the side of the trail tread. This results in destruction of vegetation along the treadway and progressive widening of the trail. Basic training does not cover techniques used to elevate tread out of boggy areas, but you may be able to help by investigating the drainage of the area. In many cases, maintaining proper drainage uphill is a solution. Or you may find a low area which can be opened up, so the water flows off the trail. Another option is to dig drainage ditches along both sides of the tread, throwing any soil onto the tread (even if it is wet and muddy) to build up the tread.

Trail Marking (Blazing)

A properly blazed trail is important in providing assurance to users that they are on the trail and it reduces impact on the environment. Blazing is the final task for the Trail Adopters, after corridor clearing and tread work. Blazing is intended to reassure users that they are on a trail, it is not intended to “hold their hand” while in the woods. Users will benefit more from a properly maintained trail corridor than an overly blazed trail.

Standards & Practices of Blazing

- **Only use blue, yellow, orange or red paints provided by the LTS**
- Paint a 3” diameter circle with crisp lines

Tips for tree blazes:

- Lightly scrape a spot for the blaze mark or arrow; do not scrape through the bark but just enough to provide a smooth surface
- After painting blaze, use the scraper to improve the line or shape of the blaze so that a “perfect” dot remains
- Live trees are always preferred to dead trees, larger trees are preferred over smaller trees
- Avoid trees with shedding bark like birches, use trees with contrasting colored bark so paint is visible

General Standards:

- Paint blazes approximately 6’ off the ground on trees on the RIGHT side of the trail!
- At turns in a trail, LTS uses directional arrows below the “dot” to indicate the turn
- Ideally, there should be no more than one blaze within sight at a time (usually 100’ to 200’)
- 2-person teams work best: one to paint and one to scrape

Tips for Success:

- Blaze entirely in one direction, then turn back and blaze in opposite direction
- Do *not* automatically repaint old blazes—the old blazes could be:
 - wrong color, shape, or size
 - too many in number and some old ones should be lightly scraped off or left to fade away
 - poorly located on the trail, or not on a live tree
- Only blaze after brushing the corridor so you can easily see where exactly a blaze is or is not needed and which tree to put it on
- It is best to blaze when it is warm and dry; do not blaze during or immediately after a rain event, or if rain is predicted within 24 hours as paint may not properly set when wet
- Paint blazes on rocks or boulders only as a last resort.

LTS-Provided Paint Kits

- **Please, only use paint provided by the LTS**
- Paint kits for blazing are available in the warm months from the LTS tool trailer
- Contents: 1 of each - 1-1/2” sash paint brush, 1-1/2” paint scraper, 10” bastard file, a paint holder, latex paint of the approved color, rags for cleanup of spills
- Optional (not supplied by LTS): tool belt to hold file and scraper.

Correct Use of Colors

- blue paint for the Monoosnoc Ridge Trail from the West Street trailhead down to the Sholan Farms trailhead
- yellow on all other trails in the watershed lands on the West side of the City
- yellow and orange on trails at Prospect Park
- yellow, orange, red, black and blue on the trails at Barrett Park

Trail Tools

Adopters are allowed to use their own tools while performing their trail maintenance work. *Forestry Suppliers I, A. M. Leonard's, and Trail Services Inc* are 3 suppliers of good quality trail tools. Local hardware and garden shops also carry tools that can be used for trail maintenance. By owning your own tools, you will appreciate their comfort, condition, and availability. Experience has shown that when buying tools, it pays to purchase high quality tools that will do the job and last, even if they are more expensive. Consider putting a bright color on a portion of your tool to make it easier to find on the trail or in the brush if you misplace it. Initial or label your tools so you can easily identify them, so they do not get mixed up with other tools.

If you are working alone, it will be difficult to carry enough tools to do everything on one work trip. Thus, on each work trip, plan to do a specific task. When blazing, take only the paint kit and perhaps clippers. When brushing, take clippers and a bow saw. For drainage work, the hazel hoe will handle most chores. If you have people to help you, it is possible to bring a greater variety of tools. If your trail is some distance from the road, consider the weight of the tools you will need for the task.

The essential tools for basic maintenance are a pair of clippers, a bow saw, a tool for cleaning drainage (hazel hoes are ideal), and a blazing kit. A brief description of the commonly used tools and their uses is provided below. Keep in mind that improper use of a tool can result in serious injury. The skills sessions provide instruction on the safe and proper use of tools.

Clippers, pruning shears, or lopping shears

These are one of the primary tools of Adopters. They come in a variety of types and the ones used depend on the work to be done and the preferences of the Adopter. The handles may be made of wood, steel, or aluminum. The cutting heads are either the sliding blade-and-hook type or the anvil type. Some have simple pivot actions while others have compound or gear-driven actions that provide increased cutting power. Most clippers provide a one to two-inch diameter cut. Pole clippers have a six to eight-foot handle. These are useful for cutting high limbs along ski touring trails. Small hand clippers or pruners are useful for light pruning and can be carried in a pocket. They are especially useful for pruning krummholz above timberline.

Bow saws and pruning saws

These are also among the most frequently used tools and again come in a variety of shapes and sizes. Most have chrome-plated steel or aluminum frames and blades ranging from 21 to 36 inches. Some are collapsible or folding and can easily be carried in a pack. The smaller saws are useful for cutting saplings and limbs that are too large for the clippers. The larger saws are used for cutting blowdowns. By making an undercut in addition to the top cut, a sharp bow saw can quickly cut leaners 12 inches in diameter. Pole saws are available for cutting high limbs. Non-folding saws can be lashed to the back of a pack. Adopters use different types of sheaths, such as a segment of garden hose, cardboard, cloth, or aluminum, to cover the blade.

Pick mattock



The pick mattock is one of the most important tools used for basic maintenance when a large number of rocks are encountered. It is a heavy, sturdy tool that can be used to dig through rocky soil and roots. A pick mattock, which has a head with an adze, is favored by most maintainers because it can be used for cleaning waterbars and drainage and for prying out rocks when they are encountered.

Hazel hoes and grub hoes



These tools are used for cleaning waterbars, cleaning drainage ditches, and side hill grubbing. A hazel hoe has a six to eight-inch-wide adze blade and a curved handle. Grub hoes have a narrower blade and are essentially mattocks without a pick or cutter blade. Garden hoes with the handle shortened represent a lightweight alternative.

McLeod and Rogue Hoe



These tools combine a rake on one side, and a hoe on the other, and can also be used to tamp. They offer the advantage of longer handles and multi-functionality when cleaning drainages, shaping dips, or working on tread.

Shovels

Shovels, which come in different forms, are useful for removing loose soil from drainage and installing new drainage dips and side ditches. Shovels should not be used for prying out rocks as they may break. A pick mattock or crowbar should be used to remove the rock. Some maintainers slightly sharpen the shovel blade to facilitate cutting through small roots. Small folding shovels or foxhole shovels are light and can be carried in a pack.

Axe

The axe is used in trail work for cutting logs for trail reconstruction. It is also used for removing blowdowns. A three and a half pound, single bit axe head is most commonly used in trail work. Old or nicked axes, referred to as root axes, are used for cutting out roots. Axes are safer and more efficient when kept sharp. Axes should always be sheathed when not in use.

Please inquire about special training requirements before using an axe on your adopted trail.

Swizzle stick



The swizzle stick or weeder consists of a straight or serrated blade attached by one or both ends to a long handle. This tool is used for clearing brush and low growth along trails. Because swizzles are swung like a golf club, it is important that the user maintain a safe distance from other people. It is recommended that the nuts that are supplied with the swizzle be replaced with aircraft style nylon insert lock nuts before going out into the field. You should also carry replacement nuts and bolts and the tools needed to install them. Never lay an uncovered swizzle on the ground; lean it against a tree.

A variety of other tools are used for specialized purposes in trail work. These include bark spud or peeler, chainsaw, crosscut saw, digging bar, fire rake, pick, and Pulaski (which has a single bit axe blade and a grub hoe blade). Other tools used in trail clearing are the safety or brush axe, brush hook, machete, and hatchet. These are used in cutting brush, saplings, and limbs but have the disadvantage that it is difficult to cut flush with the ground or tree. These are probably best used when clearing heavily overgrown areas or putting in a new trail but are discouraged for routine maintenance.

Tool Safety

The use of tools in trail maintenance carries some risks and hazards. Listed below are some of the risks and recommended safety gear that Adopters should consider carrying. Much of the needed Safety equipment is available from the City tool trailer. Adopters should provide their own basic safety equipment which includes sturdy boots, work gloves, and appropriate dress for the weather. Adopters are responsible for returning all the borrowed tools in good shape! Know your abilities and limits; take the time to maintain tools in good working condition; and take breaks before you are too tired. Besides protecting yourself, it is important to be aware of anyone near you when you are using tools. Generally, leave 10' between you and the next closest worker. It is also recommended to carry a first aid kit with the group when working and to complete wilderness first aid training every two years.

Risks associated with trail maintenance and recommended safety equipment

| Task | Risks | Safety Equipment |
|----------------|---|--|
| Brushing | Bees, eye pokes, rotten trees, loose footing, blisters, sharp branches, sharp tools | Eye protection, gloves |
| Axe use | Sharp tools, dull tools, loose footing, blisters, tree cutting risks* | Gloves, hardhat, shin guards, boots |
| Chainsaw use** | Kickback, severe ragged cuts, tree-cutting risks, deafness*** | Kevlar chaps, eye and hearing protection, boots, gloves |
| Log work**** | Sharp tools, slippery logs, rolling logs, back strain, loose footing | Gloves, shin guards |
| Rock work | Crushed fingers and toes, back strain, loose footing, striking head with pry bar, abrasions, rocks rolling downhill | Gloves, shin guards, hardhat |
| Tree cutting | Falling branches and timber ("widow makers"), spring poles, bees, chainsaw or axe use risks | Gloves, boots, hardhat, ropes or winches, wedges, axe or chainsaw gear |

* Dull axes may glance off your target and inflict serious cuts.

** All Chainsaw users must be properly trained and take a chainsaw safety certification course and be approved by the Stewardship Coordinator in order to cut on City land. Courses are periodically held in the area and often in conjunction with the Mass. Trails Conference. Chainsaw users cannot cut alone.

*** Sustained use of chainsaws without hearing protection causes deafness.

**** Logs are surprisingly heavy and working with them can be as risky as working with rocks.

Tool Cache Information

The LTS has access to a large quantity of trail tools available from the City for use on our trail network. These are located in the tool trailer garaged at Barrett Park, Leominster and may be borrowed by Adopters. Tools should be signed out and returned promptly after each trip because they are used by other Adopters and trail crews. When tools are not returned, another Adopter is denied the opportunity to use them and the LTS must expend scarce funds to replace them. You do not have to make reservations for tools, but it is best to call ahead to ensure that someone is available to unlock the trailer so you can obtain the tools you will need for your trail work project.

First Aid Kit Contents

The following items are recommended in a standard first aid kit for trail crews. Kits should be with the Adopter at all times or with the tool cache area on the worksite. All volunteers must be made aware of where the first aid kit is at all times.

| | |
|--|---|
| ABSORBING <ul style="list-style-type: none"> <input type="checkbox"/> 4 triangular bandages <input type="checkbox"/> 3 rolls 2x4.5 yd. cling gauze <input type="checkbox"/> 6 4x4 gauze pads <input type="checkbox"/> 6 2x2 gauze pads <input type="checkbox"/> 2 ace bandages <input type="checkbox"/> 2 maxi pads <input type="checkbox"/> 2 combine gauze <input type="checkbox"/> 6 safety pins <input type="checkbox"/> 8 tampons | STICKY <ul style="list-style-type: none"> <input type="checkbox"/> 1 roll ½-inch tape and DUCT Tape <input type="checkbox"/> 1 roll 1-inch tape <input type="checkbox"/> 1 roll 2-inch tape <input type="checkbox"/> 1 tube Neosporin <input type="checkbox"/> 20 Band-Aids <input type="checkbox"/> 5 large Band-Aids <input type="checkbox"/> 8 butterfly bandages <input type="checkbox"/> 2 pkg moleskin <input type="checkbox"/> 1 pkg second skin |
| CLEANSING <ul style="list-style-type: none"> <input type="checkbox"/> 6 alcohol pads <input type="checkbox"/> 6 iodine pads <input type="checkbox"/> 1 baby toothbrush or iodine scrubby | DRINKING <ul style="list-style-type: none"> <input type="checkbox"/> 1 bottle Potable Aqua <input type="checkbox"/> 1 pack Aqua Mira |
| RELIEF <ul style="list-style-type: none"> <input type="checkbox"/> 6 Pepto-Bismol tabs <input type="checkbox"/> 8 Benadryl caps <input type="checkbox"/> 10 Ibuprofen (Advil) <input type="checkbox"/> 10 Acetaminophen (Tylenol) <input type="checkbox"/> 1 insta-glucose (or Cake Frosting) | WASTE <ul style="list-style-type: none"> <input type="checkbox"/> 2 gallon Ziplocs <input type="checkbox"/> 4 quart Ziplocs <input type="checkbox"/> blue bags |
| MISC. <ul style="list-style-type: none"> <input type="checkbox"/> 8 pairs of gloves <input type="checkbox"/> 1 Sam Splint <input type="checkbox"/> Tweezers <input type="checkbox"/> Trauma Shears <input type="checkbox"/> 1 Pocket Mask <input type="checkbox"/> Lighter <input type="checkbox"/> First Aid Handbook <input type="checkbox"/> Notepad <input type="checkbox"/> Pen, Pencil, Marker | OPTIONAL ITEMS <ul style="list-style-type: none"> <input type="checkbox"/> Hydrocortisone <input type="checkbox"/> Bulb syringe <input type="checkbox"/> Hand sanitizer <input type="checkbox"/> Liquid soap <input type="checkbox"/> Lip cream and sunscreen |



Adopter Work Report Form

LTS VOLUNTEER TRAILS PROGRAM

Work Date: _____
One report per section of trail

| | |
|-------------|--|
| Adopter: | |
| Section: | |
| Trail Name: | |

| Work Party Information (Add additional work party members to notes) | Work Hours |
|--|------------|
| Adopter | |
| | |
| | |
| | |
| | |
| Total Hours | |

| Total Length of Trail Maintained on this Trip: | | Miles |
|---|-----|---------------------------------------|
| Drainage Maintenance | | Trail Definition |
| Drainage Structures Cleaned | # | Brushing (Corridor Standardizing) ft. |
| Side Ditch Cleaned | ft. | Blowdowns Removed # |
| | | Closed Non-Designated Trails ft. |
| No basic maintenance work performed on this visit | | Blazes Painted # |
| | | Gargoyles Installed ft. |
| | | |
| | | |

Other Notes: Please list any suggestions, questions, assistance requests, and any new issues or challenging trail problems like damaged trails signs and large blowdowns.

Vandalism and/or litter addressed:

Please send completed work reports to _____ and your Section Leader

**CITY OF LEOMINSTER
VOLUNTEERS' 2021 LIABILITY WAIVER FORM**

RISK AND WAIVER: I (for myself as a participant/volunteer, or as parent or guardian of a participating minor), _____, (hereinafter the Volunteer), understand the work that I have volunteered to do and I hereby state that I am qualified and physically capable of performing the work and accomplishing the activities for which I have volunteered, and that I will do them as directed by a properly authorized supervisor. I certify that I am in good mental and physical condition for what is potentially a very strenuous activity. I understand the inherent risks associated with acting as a volunteer including the risk of physical injury or death due to the use of various types of equipment, lifting of heavy objects and outdoor elements and the risk of aggravating any preexisting physical condition I may have in the performance of these services. **Further, I understand that I risk exposure to the Coronavirus and agree to follow all City and State Covid-19 guidelines and protocols in performance of my volunteer trail maintenance activities.**

I hereby assume all risks and dangers and all responsibility for any direct or indirect losses and/or damages, whether caused in whole or in part by my actions or inaction while participating in volunteer trail activities on this property or City of Leominster property with the members of LEOMINSTER TRAIL STEWARDS: (hereinafter LTS). I, on behalf of myself or on behalf of the participating minor, my personal representatives, dependents and heirs hereby voluntarily agree to release, waive, discharge, hold harmless, defend and indemnify LTS, the City of Leominster and their owners, agents, officers and employees from any and all claims, actions or losses for bodily injury, property damage, wrongful death, loss of services or otherwise which may arise out of my use of LTS or City of Leominster equipment or my participation in LTS trail training workshops.

MEDICAL TREATMENT: I hereby release and forever discharge LTS and the City of Leominster from any claim whatsoever which arises or may hereafter arise due to any first aid, treatment, or service attempted or rendered in connection with the volunteer activities of LTS.

INSURANCE: I understand that neither LTS nor the City of Leominster does not carry or maintain health, medical, or disability insurance coverage for any Volunteer. ~~In order to~~ be compensated for costs due to an injury, each Volunteer is encouraged and expected to obtain their personal medical or health insurance coverage.

WAIVER PROVISION SEVERABILITY: I expressly agree that this Waiver & Release is intended to be as broad and inclusive as permitted by the laws of the State of Massachusetts, and that this Waiver & Release shall be governed by and interpreted in accordance with the laws of the State of Massachusetts. I agree that ~~in the event that~~ any clause or provision of this Waiver & Release shall be held to be invalid by any court of competent jurisdiction, the invalidity of such clause or provision shall not otherwise affect the remaining provisions of this Waiver & Release, which shall continue to be enforceable.

WORKERS COMPENSATION: I understand that I am not entitled to Workers Compensation for any injury suffered while involved in volunteer work or projects for LTS or the City of Leominster. Further, I will provide my own health insurance.

LEGAL FEES: I further agree to hold harmless and indemnify LTS and the City of Leominster and their respective agents or representatives, for all defense costs, including attorney's fees, and any other costs associated with my participation as a volunteer. This clause applies to claims made by me or by any third party for incurred or perceived damages, injunctive relief, or penalties.

| | |
|------------------------|---------------------------|
| Emergency contact name | Phone Number |
| Volunteer Name – Print | Parent/Guardian Name |
| Volunteer Signature | Parent/Guardian Signature |
| Address | Parent/Guardian Address |
| Telephone | Date |
| E-Mail: | |

FURTHER READING

The books and manuals listed below provide further information on topics related to the maintenance of hiking trails as well as other interesting information about recreational trails. The websites for both American Trails (www.americantrails.org) and the American Hiking Society (www.americanhiking.org) also provide useful facts and information about trail design, trail construction, trail maintenance, and more. Finally, the U.S. Forest Service and the National Park Service are useful resources relative to many aspects about recreational trails.

Massachusetts Trail Guidelines and Best Practices Manual, Dept. of Conservation and Recreation, 101 pp., 2014

AMC White Mountain Guide, 30th ed., Appalachian Mountain Club, Boston, MA, 2017.

Birchard Jr., William and Proudman, Robert D. **Appalachian Trail Fieldbook. A Self-Help Guide for Trail Maintainers**. The Appalachian Trail Conference, 2nd ed., Harpers Ferry, WV, 48 pp., 2003.

Birkby, Robert C. **Lightly on the land: The SCA Manual of Backcountry Work Skills**, Student Conservation Association, 2nd ed., The Mountaineers, Seattle, WA, 341 pp., 2nd ed.

Parker, Troy Scott. **Natural Surface Trails by Design: The Physical and Human Essentials of Sustainable, Enjoyable Trails**. 80 pp., 2004. *Contains excellent diagrams and photos, along with concise language.*

Waterman, Laura and Waterman, Guy. **Backwoods Ethics. Environmental Issues for Hikers and Campers**. 2nd ed., The Countryman Press, Woodstock, VT, 280pp., 1993.

Wilkerson, James A. (ed.) **Medicine for Mountaineering & Other Wilderness Activities**. 6th ed., The Mountaineers, Seattle, WA, 397 pp., 2010. *Other first aid manuals are available.*