Chainsaw Operation & Safety Guideline

For Bolton Conservation Land (Town of Bolton and Bolton Conservation Trust)

Approvals: **Bolton Conservation Agent _____ Date _____**

Director, Bolton Conservation Trust _____ Date _____

A. Introduction and disclaimer

This Guideline has been developed for the personnel of the Bolton Trails Committee who maintain the trails on lands throughout Bolton, Massachusetts. It is intended for those who use chainsaws while standing on the ground in the routine clearing of fallen or storm damaged trees that interfere with passage along the trails. It is not intended for any other purpose, e.g., the use of chainsaws for climbing or using some other method to reach areas of trees above safe and normal reach from the ground. Such activities are beyond the scope of the guideline and will only be performed by professionals engaged by the Bolton Conservation Commission or Bolton Conservation Trust. **Only individuals who have been trained and certified in accordance with this Guideline are permitted to use chainsaws on Town or Trust land. Requirements for certification are provided on Appendix 6.**

The use of chainsaws discussed in this Guideline can result in severe injury or death. The Guideline is to be used in conjunction with training, appropriate supervision and keen adherence to safety. Users of the Guideline should not attempt any activity described in the Guideline without first completing training and certification. The use of new techniques with which the user has not had prior experience should be practiced first under supervision and in a controlled environment before they are used in routine trail maintenance. In all cases the user of the Guideline should adhere strictly to the safety guidelines and equipment described in the Guideline and to be keenly aware of their own limitations in the use of a chainsaw. Although the Guideline has been developed with reference to a number of government and industry sources, the Bolton Trails Committee will not accept any liability expressed or implied for any injury or death from activities described in the Guideline.

Safety for Chainsaw Operators

Some eye-opening & sobering statistics (Reference 1-c):

- Chain can move at up to 68 mph which results in 600 sharp cutters passing any point in 1 second …..and you're holding it right in your hands. Nobody can move fast enough to get out of the way.
- 85% of injuries are caused by the moving chain. Of those, 74% are on the leg and hand areas.
- There are more than 100,000 chainsaw related injuries per year in the US. In 2007, 26,000 injuries were treated in emergency rooms (US Product Safety Council).
- The average number of stitches from a chainsaw accident is 110. There are no minor injuries!

Safety is the most important consideration in chainsaw operation. Period.

Never base the decision to use a chainsaw in a particular situation because you think *you might be able to do it*. Only proceed if you have been trained, can assure safety, and *you are sure you can do it.*

Many accidents occur because of complacency about safety, poor planning to address the situation at hand, and performing tasks which are either marginal or beyond the capability and competence of the operator or the operator's support team.

Carefully read the owner's manual for your saw and don't skip over the safety information which is generally in the first pages.

a. Before Starting a Chainsaw
- Check controls, chain tension, and all bolts and handles to ensure that they are functioning properly and that they are adjusted according to the manufacturer's instructions.
- Make sure that the chain is always sharp and the lubrication reservoir is full.
- Start the saw in a safe posture at least 10 feet from others outside of the work area.

b. Fueling a Chainsaw
- Use approved containers for transporting fuel to the saw.
- Never attempt to fuel a running or HOT saw.
- Use caution not to spill fuel or oil in conservation or parking areas.
- Have a spill kit available to contain and clean any spilled fuel or oil quickly.
- Ideally, enter the property with a saw already full and ready to run.
- Use only properly mixed fresh fuel and oil.

c. Operational Chainsaw Safety
- Make sure that a medical kit and cell phone are immediately available.
- Clear away dirt, debris, small tree limbs and rocks from the saw's chain path.
- Look for and avoid or remove fence wire, nails, spikes or other metal in the tree or nearby before cutting. Never attempt to cut through metal.
- Always hold the saw firmly with both hands with the right hand on the throttle and the fingers of the left hand wrapped around the handlebar with the thumb wrapped underneath.
- Do not operate a saw when fatigued. Be aware of your condition and take breaks as necessary.

- Shut off the saw (preferably) or engage its chain brake when carrying the saw on rough or uneven terrain.
- Keep your hands on the saw's handles, and maintain secure footing while operating the saw.
- Proper personal protective equipment must be worn when operating the saw, which includes hand, foot, leg, eye, face, hearing and head protection.
- Do not wear loose-fitting clothing.
- Be careful that the trunk or tree limbs will not bind against the saw.
- Watch for branches under tension, they may spring out when cut.
- Gasoline-powered chain saws must be equipped with a protective device that minimizes chain saw kickback. Be cautious of saw kick-back.
- To avoid kick-back, do not saw with the tip. If equipped, keep tip guard in place. Methods of avoiding kickback are provided in Appendix 3.
- Cutting with the bottom of the bar pulls the chain saw away from the sawyer. Cutting with the top of the bar pushes the saw back at the sawyer. Cutting with the bottom of the bar increases efficiency and decreases the sawyer's fatigue.

d. Team Work

- A team of at least two volunteers is required to conduct chainsaw work on conservation land. DO NOT do trail maintenance alone with a chainsaw! Make sure you have engaged another person to work with you to help with clearing and to be available if there is an accident, entanglement or emergency support is required. Both the chainsaw operator and the buddy should carry a cell phone to call "911" in the case of an emergency and contact numbers for others to bring additional equipment if required.
- One volunteer must be pre-approved as an operator, the other as a helper and lookout.
- While conducting clearing, keep at least 10 feet of space between the operator and others.
- Heavier wood sections should be cut into sizes manageable to move and stack.
- Leafy branches should be carried off trail and stacked to create habitat.
- Trunk sections and larger cut branches should be processed uniformly and stacked neatly off trail.
- All fall down debris should be removed from stonewalls, with cleared materials left on conservation land not on private land.
- When making a cut always have an escape route in mind. The planned route should be clear to move through and away quickly in the event the cut does not go as anticipated.
- Make sure everybody involved in the cut (even in the safety zone) is paying attention and has good communication in the event of the need to move or help quickly.
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B. Getting Ready to Go Out

One the most important elements of safe and effective use of a chainsaw in the woods clearly understanding the scope of the effort and planning to assure that all of the necessary equipment is assembled. Accidents have occurred and chainsaws left jammed in timber because of poor planning resulting in too few or the wrong tools brought to the site.

a. Basic operating equipment

i. The chainsaw – good working condition with a sharp, properly filed depth gauge and tensioned chain (more on sharpening and jointing in Appendix 5. A sharp chain with properly filed depth gauges is critical to safety. A poorly maintained chain will require much more force to cut and will invite accidents, not to mention frustration on the part of the operator. The cutters on the chain should have not been worn beyond the manufacturer's recommendations.

ii. Fuel and bar oil – Fill the saw with fuel mix and bar oil before going to the site. Carry fuel mix and oil in approved containers of the size that meet the needs of the type and duration of the chainsaw use. The most convenient containers are those that carry both fuel mix and bar oil in separate compartments. Avoid carrying a large container beyond the intended scope of the day's work, particularly if the walk to the site of the trail clearing is a significant distance from the vehicle accessible trailhead. A day's work will seldom require more than 3 tank refills. When the chainsaw runs out of fuel, make sure to fill both the fuel and the bar oil. Chainsaws are designed to run out of fuel before bar oil if both tanks were full initially. Running out of bar oil first can cause dangerous overheating and wear on the bar and chain.

The bar oil must be environmentally acceptable, e.g., biodegradable, a requirement for both Bolton Town and Bolton Conservation Trust land. Since 100% of the bar oil used by a chain saw is actually thrown off the chain into the environment, it is critical that it be easily biodegradable. Many biodegradable bar and chain oils are available; check the internet and local hardware and equipment rental stores typically have them in stock. They are substantially more expensive than petroleum based oils, but are worth it. However, a reasonably good and less expensive substitute for commercial biodegradable bar oil is canola oil, available in local food markets. However, it is less viscous than commercial biodegradable bar oils and may leak more while the chainsaw is stored; place your chainsaw on several layers of newspaper.

iii. Chainsaw maintenance equipment – Combination tool (to remove/replace sparkplug and tension the chain), filing equipment (round file, filing guide, flat file and depth gauge…although the latter two aren't used each time the cutter links are filed), stump vise for filing in the field (more on sharpening and jointing gauges in Appendix 5).

b. Personal Protection Equipment (PPE)

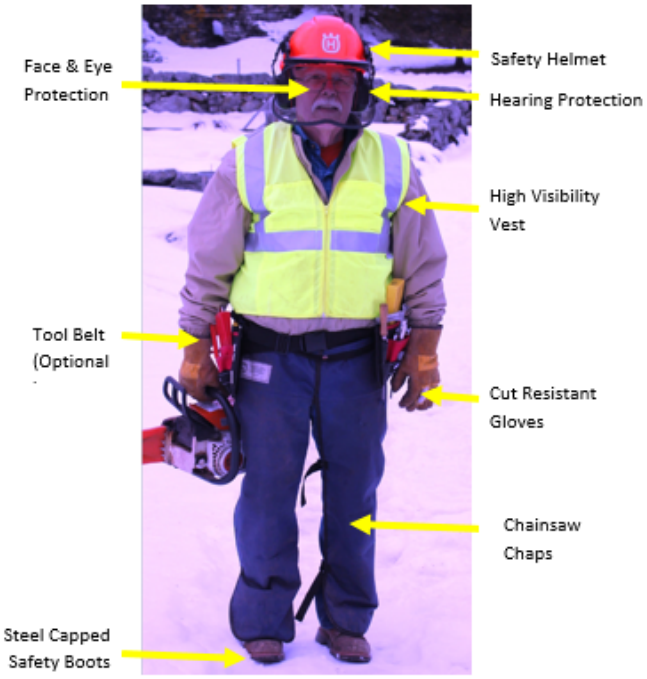
PPE is very important to safe and successful chain saw use. It doesn't make you invincible, but it certainly helps to reduce the probability and the consequences of unanticipated events. It may elicit gratuitous comment about being overly careful. Note the safety and injury statistics above. Safety conscious chainsaw operators live longer and happier lives than those who criticize them for their active attention to safety!

PPE for chainsaw work includes the following, all of which is mandatory for Trail Committee volunteers using chainsaws.

i. Helmet, preferably with integrated hearing and face protection. Note that helmets are intended to protect against falling objects. They do not protect against moving chains (which will cut through them very easily).

ii. Eye protection, particularly if the face protection is a mesh

iii. High visibility coat or vest so that all members of the trail maintenance party are easily seen to assure a safe distance from the cutting location



iv. Leg protection in the form of chainsaw chaps (Type A leg protection) worn over pants which protect the fronts of the user' legs. Chainsaw chaps are not designed to stop the chain from penetrating them; they are designed to have the chain cutters tear through the outer covering into the layers of ballistic fiber and jam the powerhead sprocket with the fiber. Once damaged, they should be replaced.

v. Foot protection - Sturdy non-slip boots with laces are best. Although not suggested in a number of manufacturers' manuals, they should have steel toes. In addition, a number of manufactures offer boots specifically designed per ASTM F1818-15 for chainsaw work (metal toes and other protection around the foot). Although the user's feet should be safely away from the plane of the chain, the movement of the timber being cut may suddenly bring the chain dangerously close to the user's feet. A chainsaw will cut through the soft toe of a normal work shoe almost instantaneously and there are no ballistic fibers to jam the sprocket. Better safe than sorry!

vi. Hand protection – Chain saw gloves or mittens which have ballistic fibers in the back to protect against contact with the chain if the hand slips off the front handle. These gloves are

somewhat insulated which provides some winter comfort and safety since cold hands don't provide the same control as warm ones. They are also designed so that the operator's thumb can be under the forward handle providing a more secure grasp. The gloves are also important protection when pulling the chain along the bar to file cutters and to pull the chain away from the bar to adjust for proper tension.

vii. A medical kit for first aid treatment *at the site of the work.*

c. The Buddy System – As indicated earlier DO NOT do trail maintenance alone with a chainsaw! Make sure you have engaged another person to work with you to help with clearing and to be available if there is an accident, entanglement or emergency support is required. Both the chainsaw operator and the buddy should carry cell phone to call "911" in the case of an emergency and other contact numbers to bring additional equipment if required.

d. Planning for the Activity

Carefully assess the objective for the day's work and what will be required to safely and effectively accomplish it. Planning includes a general understanding of the terrain and hazards that may be encountered during the activity, preferably as an outcome of a pre-visit to the site(s). The outcome of the assessment will define the tools and personnel required. It will also will define what is not needed, an important consideration if the walk to the site is long and/or difficult.

Planning for the activity also takes place at the site to assure that the activity can be safely accomplished with tools and personnel available. It is best developed through a job hazard analysis (JHA) which consists of identifying all of the hazards that could be encountered and the steps that need to be taken to mitigate or avoid them.

C. Tools to Improve Efficiency and Safety

In addition to the operating and safety equipment in Section C, some or all of the following items will make the operation safer and more efficient. Descriptions are provided in Appendix 4.

a. Medical kit - mandatory
b. Wedges (plastic)
c. Woods axe
d. Wire cutters
e. Chain sharpening equipment – See Appendix 5 for details on sharpening and tools.
f. Timber tongs
g. Timber lifting hook
h. Cant hook
i. 2-person log carrier
j. Rope and traction equipment
k. Something in which to comfortably carry equipment.

D. Chain Saw Tasks and Techniques

The purpose of the Trail Committee includes the maintenance of trails within the conservation land of the Town of Bolton. Consequently, the tasks and techniques provided in this guideline are limited to

those which are appropriate to clearing and maintenance of trails. It does not address the much broader topic of felling and bucking undamaged trees, a topic which can be explored in several of the references in Appendix 7.

1. **Limbing Techniques (removal of limbs)**

Limbing the bottom of small standing or storm damaged trees allows the sawyer to move in closer to the bole when felling the trees and will help the sawyer watch the tip of the bar to prevent kickbacks. When cutting a heavy limb, consider using a small cut opposite the final cut to prevent the material from slabbing or peeling off. However, the chain is more likely to be thrown when you are working with small material in a high density of limbs on standing trees, particularly pines. This is particularly true when the limbs are at or near chest height and the sawyer may be fatigued. Have others pull the cut limbs and stack them away from the cutting area. Trying to cut and move limbs alone while holding a running chain saw, even with chain brake engaged, is very risky.

When limbing fallen trees, it is best to use the trunk of the tree as a "bench" on which to rest the power head of the chainsaw and stand on the opposite side of the trunk from the limbs being cut. As with any limbing operation, limbs should be removed and piled by others who remain away from the sawyer. If there is a need for the sawyer to move a limb, it should be done after the saw is on the ground, either off (preferably) or with the chain brake engaged.

2. Bucking Techniques

In most situations it is safest to buck logs from the uphill side unless the log may move uphill when it is bucked. This could occur because of the log's position, weight distribution, and pivot points. Always consider binds and pivot points. Learn to use the saw's bumper spikes (dogs) as a pivot point when you are felling or bucking. This technique will enhance your control of the saw and improve the saw's efficiency, while reducing fatigue. Begin bucking by cutting the offside first. This is the side the log might move to when it is cut, normally the downhill side. Cut straight down until you have space for a wedge.

Binds - Understanding directional pressure that may bind the saw is important for safe and efficient cutting. These binds determine bucking techniques and procedures. Look for landforms, stumps, blowdown, and other obstacles that prevent a log from lying flat, causing binds. When a bind occurs, different pressure areas result (below). The tension area is the portion of the log where the wood fibers are being stretched apart and the chainsaw's cut (kerf) opens as the cut is made. The compression area is where the wood fibers push together and the kerf closes as the cut is made. It is extremely important to determine what will happen to the log when it is cut. Inspect the log for all binds, pivot points, and natural skids. Various bucking techniques can be used to lower a suspended tree to the ground.

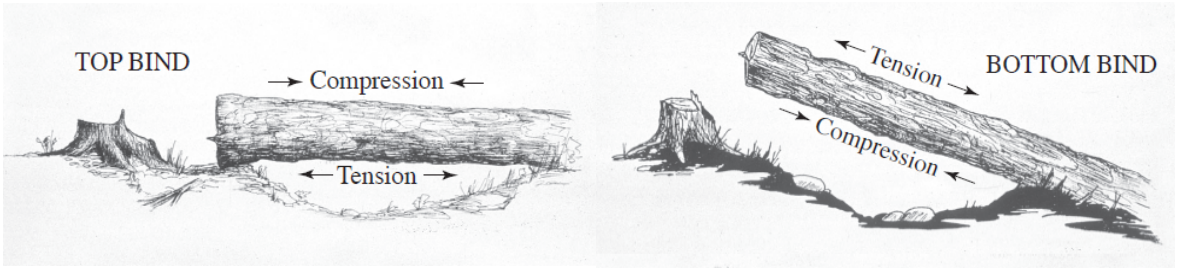
Determining Bind— Typically, logs have a combination of two or more of the four basic binds. It is the compression area that binds the saw.

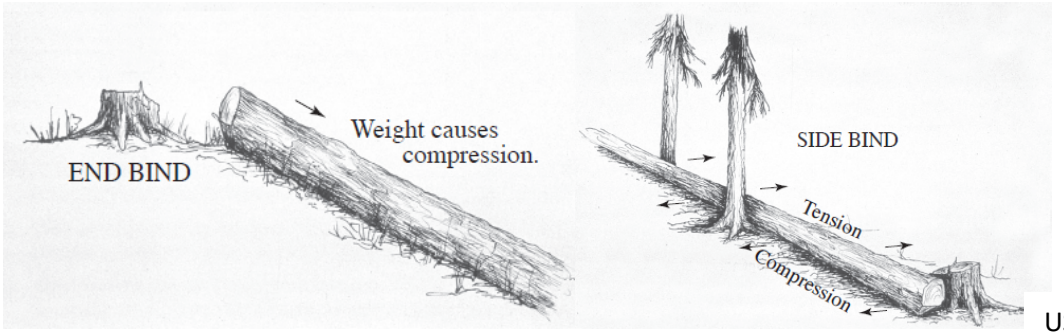
Top bind—The tension area is on the bottom of the log. The compression area is on the top and consequently a cut made from the top will eventually bind the saw.

Bottom bind—The tension area is on the top of the log. The compression area is on the bottom and consequently a cut made from the bottom will eventually bind the saw.

Side bind—Pressure is exerted sideways on the log as shown below. A cut in the compression side will eventually bind the saw. It is often seen in a situation called "interlacing" in which a trunk drops and is jammed between two or more nearby trees.

End bind—Weight compresses the log's entire cross section and will eventually bind a saw in a cut from any direction





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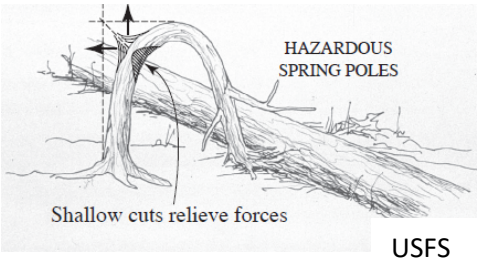
It is best to start bucking at the small end of the log and work toward the butt end, removing the binds in the smaller material first. Look for broken limbs and tops above the working area. Never stand under an overhead hazard while bucking.

Look for small trees and limbs (spring poles) bent under the log being bucked (as shown below). They may spring up as the log rolls away. If you can safely do so, cut these hazards before the log is bucked by first making small cuts in the compression area inside the bend of the spring pole to relieve pressure before making the cut to remove the spring pole.



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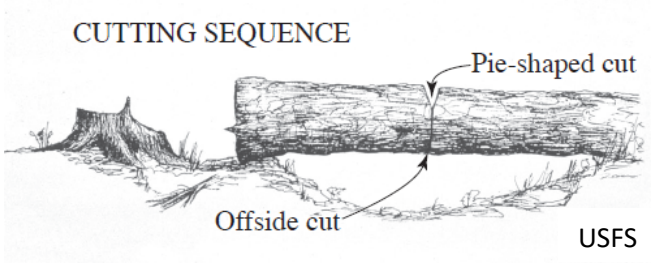
Determine the offside, i.e., the side the log might move to when it is cut. Clear the work area and escape paths. Allow more than 8 feet of room to escape when the final cut is made, establish solid footing and remove debris that may hinder your escape.

Determine the cutting sequence for the log before beginning to cut. First cut the top from the offside from a safe position, making a cut about one-third the diameter of the log. Position yourself to watch the kerf to detect log movement as indicated by a slight opening or closing of the kerf: there is no better indicator of how the log will react when the release cut is made. If the bind can't

be determined, proceed with caution. It may be necessary to move the saw back and forth slowly in the kerf about 3 seconds at a time to prevent it from getting bound as the kerf closes behind the guide bar. If the kerf starts to open, there is a bottom bind; if the kerf starts to close, there is a top bind.

Visually project the kerf's location to the bottom of the log. Reduce the amount of wood for the final cut by cutting a short distance into the log along this line and be prepared for kickback. The sequence of the remaining cuts depends on the type of bind. Generally the next cut will be a small (less than 1½ inches) pie-shaped cut removed from the compression area.



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The log can settle slowly into this space, preventing dangerous slabbing and splintering. This practice is extremely important when cutting large logs. The final cut, or release cut, will be made through the tension area. Because the offside has been cut, you only have to use enough bar to finish cutting the remaining wood. This allows the sawyer to stand back, away from the danger.

The location of the pie-shaped section and the release cut vary depending on the type of bind.

Top Bind: Remove a pie-shaped section from the top and make the release cut from the bottom.

Bottom Bind: Remove a pie-shaped section from the bottom and make the release cut from the top.

Side Bind: If you are not certain the job is safe, do not make the cut. Normally, the offside is the side with tension; the tension side is usually bowed out (convex). Look for solid trees with no overhead hazards or other objects that you can stand behind for protection while cutting. Remove a pie-shaped section from the compression area, and then make the release cut in the tension area.

End Bind: Cut from the top down, inserting a wedge as soon as possible since the entire log is under compression. Finish by cutting down from the top. If possible, scrape out the dirt immediately underneath the cut before starting to make sure that the chain does not cut into the dirt. Cutters are blunted extremely quickly in dirt; this precaution may save a great deal of sharpening or potentially requiring a new chain.

Buck small sections that will be easy to control when they begin moving. Removing a single section of log may require that other binds be eliminated first. Angled bucking cuts, wide on top and made on the offside, allow a single section of log to be rolled away from the remaining log. All logs must be completely severed when bucked.

3. Bucking and Felling Storm Damaged Trees

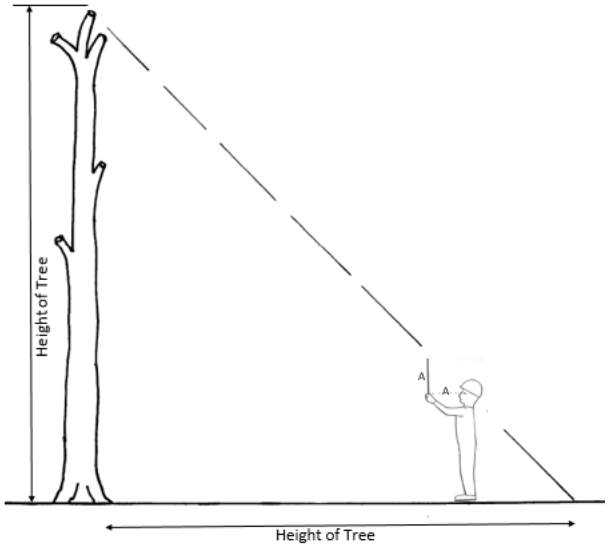
a. Felling Standing Trunks

These are trees that have had their entire tops removed by a storm. They are felled using standard felling techniques and precautions

Direction of fall - The lean and anticipated behavior of the tree when felled without external guidance (pull ropes or guide ropes) can be determined by lining the tree up with the vertical line of a plum bob or similar weight on a string. In a pinch, an axe can be used as long as you look at the tree in the direction of the plane of the blade so that the handle is actually vertical as you view it. Look at the tree from several of directions until you find the location from which you see the greatest lean. A direction perpendicular to the line from you to the tree will predict the probable direction of fall. Of course this assumes that there aren't mitigating snags or hang-ups such as other trees or vines.

If the trunk must fall in a direction other than that predicted by its lean, it can be pulled with a come along, block and tackle or winch attached relatively high on the trunk. It may also be stayed by ropes anchored perpendicular to the required direction of fall. However, it is critical that the area through which the ropes will pass during the fall must be clear of any entanglement. (*We may add additional information on use of pull and guide ropes later.*)

The distance the top may fall from the base – This can be estimated by using the "stick trick" method. Walk back from the tree while holding a vertical stick (axe handles have also been used) in your outstretched fist at the level of your eye. The stick should be as long above your hand as the distance from your eye to your hand. Look up at the top of the trunk until it lines up with the top of stick. Step back from the tree at least your own height. That is the probable location of the fall. However, a safe distance is typically 50% further away from the stump since upper pieces may break off on impact and go further from the stump.

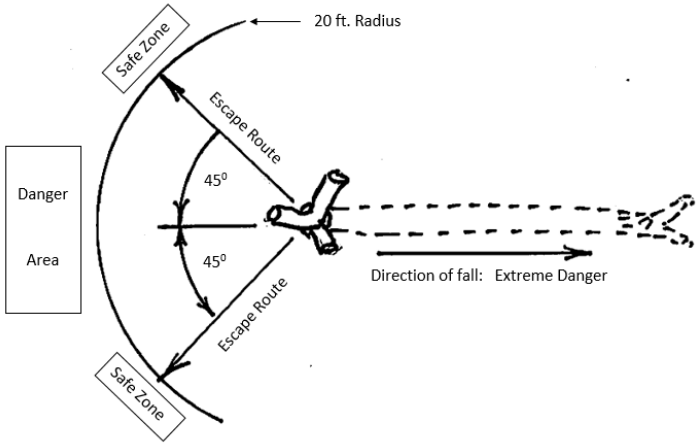


The "Stick Trick" - Determining where the top of the tree will hit when it is felled. The length of the stick is the same as the distance from the eye to the bottom of the stick.

- Escape routes and safety zones

A safety zone and escape routes should be established before starting to cut. Since most injuries occur within 15 ft. of the base of the tree, the safety zone should be at a perimeter of at least a 20 ft. radius beyond the base of the tree. It should extend $\pm$ 45^0 from a line opposite the direction of expect fall of the trunk.

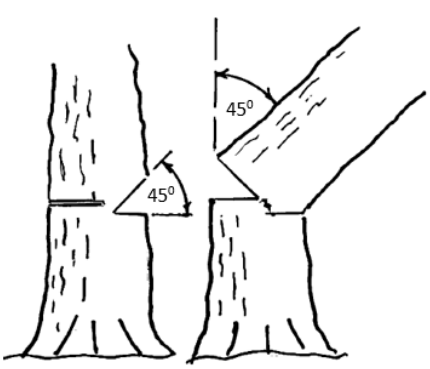
The escape route should be away from the base of the tree within the angle of the safe zone. It is very important that the escape route be cleared of debris and trip hazards.



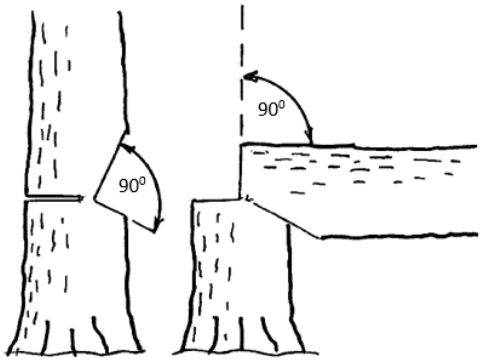
- Making the cuts

The "common notch" (shown below) - has been used to fell trees for many years. It consists of an initial notch in the trunk on the side of the tree in which it is expected or desired to fall. The notch is made from an initial flat bottomed cut about 1/3 of the way into the trunk. A second cut is made above the first cut at about 45^0 down toward the bottom of the bottom of the first cut, intersecting at the back of the first cut. The final horizontal cut is made on the back side of the trunk about an inch above the vertex of the face cuts and stopping at about 10% of the trunk's diameter away from the vertex, leaving an area of the trunk to act as a hinge when the tree falls, helping greatly to assure that then tree falls where intended. One significant drawback of the standard notch is that as it closes the notch after falling through 45^0, the tree breaks the hinge which no longer provides the intended function of directing the fall. For the same reason, be very careful about making and leaving the horizontal face cut go beyond the vertex of the notch. The kerf of the overcut will close very early in the fall and prematurely break the hinge, well before the trunk falls through 45^0.

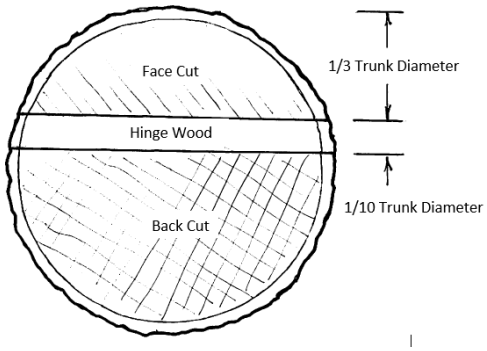
The "open face notch" (shown below) – is a better and safer method and has been generally adopted in recent years having been introduced to the US by a Swedish logging instructor Soren Eriksson in the 1980s (Ref. 1 a). The open face notch is bounded by a lower face cut also at 45^0 upward so that the included angle is 90^0. The back cut also leaves 10% of the diameter for a hinge but is at the same level as the vertex of the face cut. This assures that the hinge remains intact throughout the tree's fall, better guiding it to its intended direction. The open face notch also minimizes kick back of the base of the trunk since the hinge doesn't fail until almost the end of the fall.



Common Notch – Face cut closes when trunk has dropped 45⁰ and breaks hinge eliminating directional control for the remainder of the fall.



Open-Face Notch – Face cut closes when trunk has dropped 90⁰ and maintains directional control until throughout the entire fall.

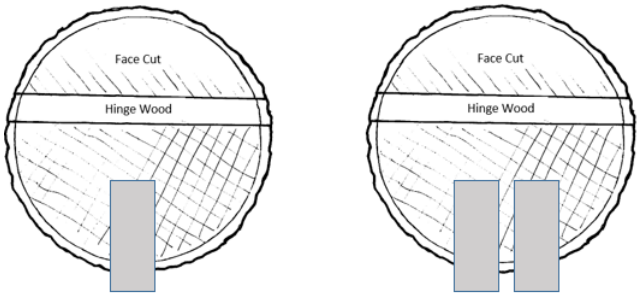


Approximate Dimensions – Face Cut and Hinge Wood
(Back cuts establishes the dimension of the hinge wood.)

- Wedges and Pull Ropes

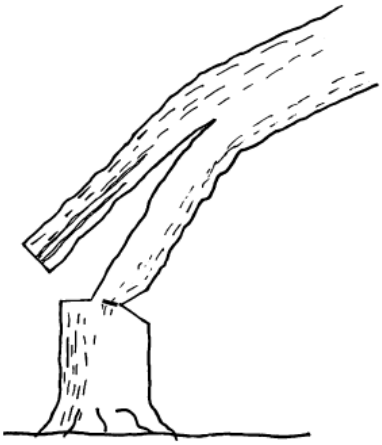
Wedges and/or pull ropes can be used to assure that the tree falls in the direction intended and doesn't lean backward as the final cut is made.

Wedges should be inserted in the kerf of the final (back) cut, preferably behind the bar as the last portion of the cut is made on a larger tree. The saw is then removed and the wedge(s) is pounded in. The enormous mechanical advantage of a wedge will often not only restrain the tree from falling back, but assist in it falling forward. Make sure the bar is removed before pounding in a wedge and also assure that the escape route is entirely clear (including the saw which is sometimes put down directly in the previous escape path before the wedge is pounded in). The wedges should be put in parallel to the direction of fall.



Wedge Position – Wedges should always be balanced and be parallel with the direction of intended fall.

Pull ropes are also useful to down the trunk and assure is doesn't fall over backward or pinch the saw in the back cut. The rope should be attached to the trunk as high as possible *prior to making any cut.* It should then be anchored 50% beyond the anticipated contact of the top of the trunk with the ground and be attached to a pulley, block and tackle, or come-along. Tighten it snugly to take out slack during the cutting. Do not develop any tension until the back cut is completed in order to avoid premature movement while the saw is still in the back cut. When a tree is pulled over prematurely due to extreme lean or tensioned pull rope, it may "barber chair" a condition during which the lateral load on the trunk prematurely splits the wood up from the back cut and dramatically sends the back lower portion of the trunk backward which can eject the saw and/or seriously injure the sawyer. Barber chairing is often caused by overcutting the lower cut of a common notch which locks the hinge very early as the tree falls even if there is no pull rope involved. For that reason any overcut of the lower cut of a common notch must be corrected with an adjusted upper face cut so that both cuts meet at the same place.



Barber Chairing – The trunk splits up from a point in the back cut rather than bending the hinge. It is often due to overcutting the lower face cut which locks the hinge prematurely. It is extremely dangerous and can eject a running chainsaw or seriously injure the operator

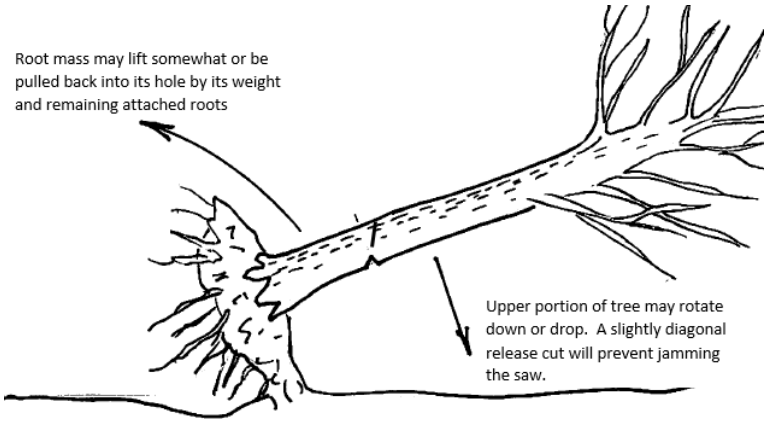
b. Uprooted Trees

Uprooted trees are very unpredictable during final felling or bucking. The strategy must be thought through very carefully before proceeding. Depending on their support, they can behave very differently from what may be expected.

- Partially Uprooted Trees

These are trees that have been uprooted, are steeply tipped, but not on the ground. As seen in the diagram below their tension and compression area are highly depended on their position and the influence of the mass of the tree vs the root mass. The root mass may not only be affected by gravity but by the effect of the remaining roots which can either provide a right load or provide support to the remaining root mass. If the root mass is large, it can generate tension on the top of the trunk. If the tree is hung up the tension area may be on the bottom. If the first case (not hung up) is apparent, the first cut should be in the assumed compression area under the trunk with a pie-shaped section taken out as described above. Cut at a point where the top cut will not be too high to be comfortable and safe. Cut slowly watch the kerf very carefully to detect its motion. If it starts to pinch your assumption is correct, remove the saw and very carefully and slowly start to

cut in the upper tension area. Keep in mind that the remaining trunk attached to the roots will quickly move up as the root mass settles back into its hole in the ground.



If the tree is hung up, the tension area may be on the bottom in which case the cutting sequence should be reversed. Regardless of the assumption, the kerfs should be watched very carefully to confirm it or change strategy.

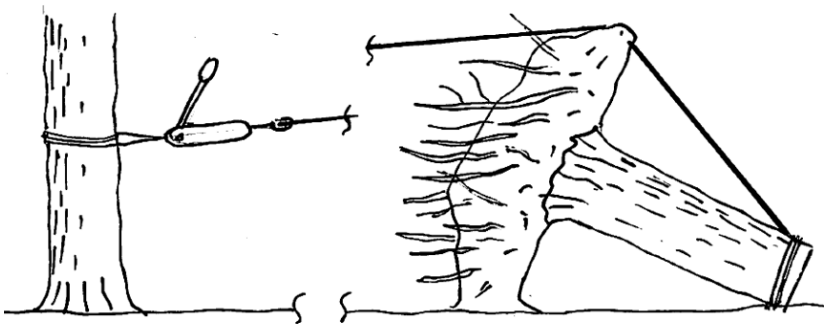
If the tree is clearly hung up and the initial bucking cut has been made, don't be tempted to buck subsequent pieces off to work up the trunk until the remainder of the hung-up tree hangs at a lower angle approaching vertical and the tree falls backward away from the hang up. This can be extremely dangerous as the remainder of the tree becomes very unstable as it approaches a vertical condition and can fall precipitously in an unanticipated direction. The best way to handle the remaining hung-up portion of the tree is to secure it at the butt and pull it along the ground away from the hang-up. When doing this make very sure that everyone involved is a safe distance from the operation as separating a hang up in this way will inevitably cause branches to break and drop or have the hung up tree drop unexpectedly.

If the root mass does not drop into its original hole and there is a good reason to have it do so, a rope can be attached to the stump, routed over the root mass and pulled with a block and tackle from an anchor a safe distance safe away on the opposite side of the hole. All personnel involved in the effort should stand a safe distance away from the operation as the root mass may drop very suddenly.

Completely Uprooted Trees

These trees have fallen over completely and are lying on the ground, only supported by their branches. It's best to start by limbing the tree and then start bucking from the small (top) end of the tree using the procedures described above. As you buck toward the base of the tree be very careful to watch the kerf. As sections are bucked off, the end of the remaining trunk attached to the root mass may either drop down or move up as the root mass settles into its hole. Watch the kerf carefully at each cut; its behavior will help to predict the behavior of the trunk. *Do not cut in the immediate vicinity of the root ball as it may actually fall towards the trunk, jam the saw and/or injure the sawyer.* As the remainder of the tree attached to the root mass starts to lift slightly, it is probably prudent to attach a rope to the top of the stump and pull it upright with a block and tackle from an anchor a safe distance safe away on the opposite side of the hole. All personnel

involved in the effort should stand a safe distance away from the operation as the root mass may drop very suddenly.



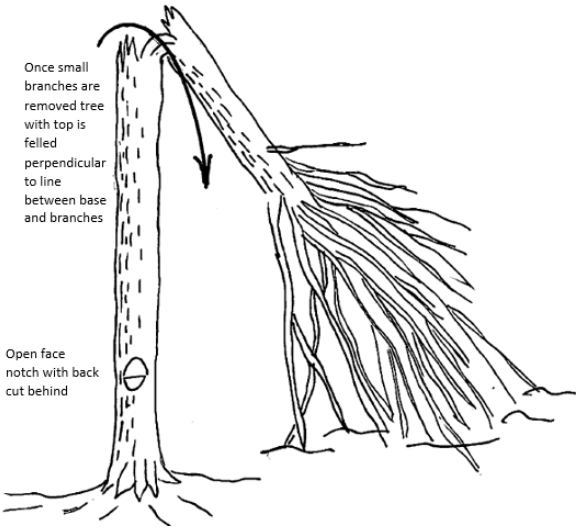
Pulling over an uprooted root mass and extended stump to stabilize them in preparation for final bucking.

c. Broken Trees

- Broken Tree with Top on the Ground

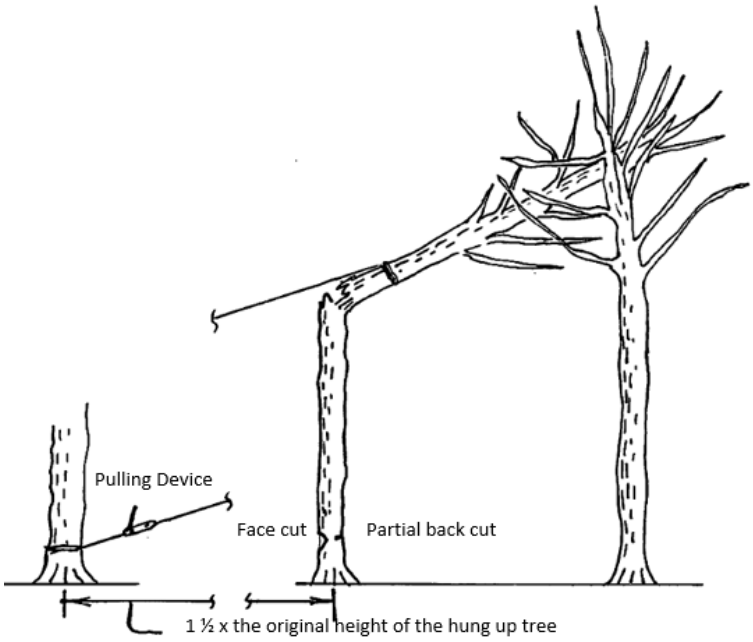
This is not an unusual windstorm-related event in Bolton. If the tree is well off the trail and poses no threat to the trail, leave it as it is found. If it is obstructing the trail in a manner in which it is not practical to reroute the trail, it should be felled. If the tree is broken but the hinge in the broken area appears solid, clean up the upper branches touch the ground but don't remove all of the support of the broken section from the ground. Removing the support could allow the hinge to further close and peal back the remaining wood and bark at the hinge, possibly dropping the broken part of the trunk onto people in the vicinity.

The main trunk with the remaining broken section is felled as described above in a direction perpendicular to the line between the base of the tree and the remaining broken section where it touches the ground,



- Broken Tree with Top Hung Up on Other Trees

This situation is also not uncommon in Bolton. In this case a pull rope with a come along, winch or block and tackle are attached to the broken section just above the break with a timber hitch to avoid rolling down the trunk. The pull rope is anchored directly away from the direction of the hung-up broken end. It should be anchored a distance of 1 1/2 times the height of the unbroken tree as the broken top my actually flip forward during the pull-down and extend the full height of the original tree as it hits the ground. An open face notch should be made in the side away from the hang-up and a partial back be made so that the sawyer is well out of the danger area when the tree comes down. The only safe areas in an operation of this type are outside the entire drop zone of 1 tree-height radius as the top of the tree could drop behind the felling direction or on rare occasions go in the direction of the tree. When the sawyer is well out of the danger zone, the pull rope is used to break the tree at the hinge and fell it.



Appendix 1 – Glossary of Terms

Bucking: Cutting trunks or large branches on or near the ground into manageable sections for removal.

Widow Maker: A tenuously supported broken branch that has the potential to drop to the ground when the associated or nearby trees are disturbed during cutting. They pose a serious threat to a chainsaw operator (particularly) or others in the vicinity.

Limbing: Removing the limbs from a tree trunk.

Kerf: The channel that a chainsaw (or any other saw) makes in cutting.

Bind: The closure of a kerf during cutting through the compression side of timber that has the potential to jam the bar and chain.

Appendix 2 - Situational Awareness

Felling or clearing storm damaged trees:

Check the trunk for:

- Soundness or defects (see base below)
- Twin tops
- Widow makers and hang-ups
- Vines (very important and an increasingly common condition in Bolton)
- Footing
- Direction of lean
- Degree of lean (slight or great)
- Nesting or feeding holes
- Heavy branches or uneven weight distribution

Check the base of the tree (if the trunk is still attached) for:

- Thud (hollow) sound when struck
- Signs of decay and weakness including, conks and mushrooms, shelf or bracket fungi, wounds or scars, insect activity, unsound bark
- Unstable root system or root protrusions

Check the surrounding terrain for:

- Steepness
- Irregularities in the ground
- Draws and ridges
- Rocks
- Vines (very important and an increasingly common condition in Bolton)
- Stumps
- Loose logs
- Ground debris that can fly or kick up at the sawyer or others on the crew

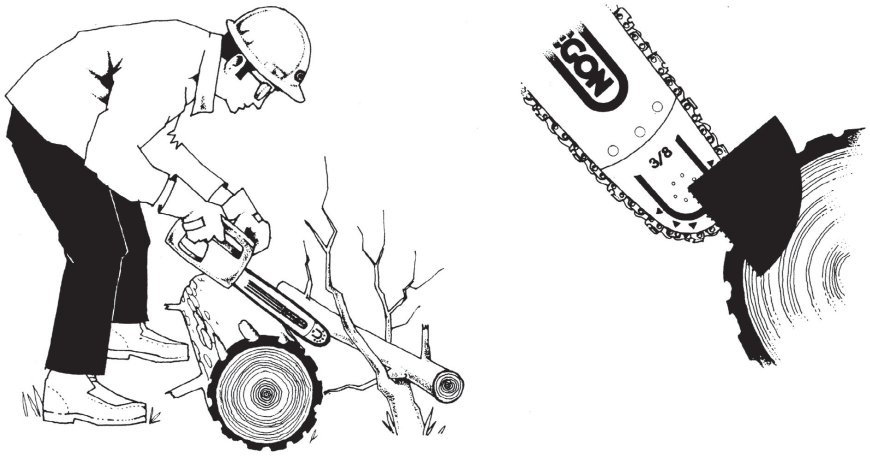
Check the immediate work area for:

- People
- Powerlines
- Hang-ups and widow makers
- Vines or snags
- Openings to fall trees into
- Other trees that may be affected

- Hazards such as trees, rocks, brush, or low-hanging limbs
- Other trees that may have to be felled or cleared first

Appendix 3 - Avoiding kickback

Kickback is the most powerful reactive force you will encounter while operating a chain saw. Kickback can occur while felling, removing limbs, bucking, or cutting brush when the upper quadrant of the bar nose contacts a solid object or is pinched (figure below).



During kickback, the bar is forced up and back in an uncontrolled arc toward the sawyer. Many factors determine the severity of the kickback and the arc, including: chain speed, angle of contact, condition of the chain, and the speed at which the bar contacts the object.

Ways to avoid kickback:

- Hold the saw with both hands, securely gripping the handle and the handlebar between your thumb and forefinger.
- Be aware of the location of the bar's nose at all times.
- Never let the bar's nose contact another object.
- Never cut with the power head higher than your shoulder.
- Never overreach.
- Pull the saw smoothly and straight out of the cuts. This technique will help to reduce kickbacks and fatigue.
- Cut one log at a time.
- Stand to the side of the kickback arc.
- Use caution when entering a partially completed cut.
- Use a properly sharpened and tensioned chain at all times.
- Watch the cut and the log for any movement that may pinch the chain.
- Use a low kickback chain.

Appendix 4 - Additional Equipment to Improve Efficiency and Safety

a. Medical kit (required!) - Should be a relatively small, robust and waterproof Class IV kit
b. Wedges – They are used for a number of functions, most notably driving in the back fut of a trunk to be felled and maintaining the kerf in any operation to keep the chainsaw bar from jamming in the compression side of fallen timbers when bucking. They should always be plastic to avoid damage to the chain, kickback, and ejection of pieces of metal. In addition, a plastic wedge will not harm the eye or poll of an axe or hatchet when driving a plastic wedge.

c. Woods axe – The axe is typically used for driving plastic wedges, in addition to being used for a number of operations with its sharp edge (trimming branches from a trunk, enlarging a kerf to insert a wedge, removing dirty bark prior to making a cut with a chainsaw.) The axe should be relatively small (2 1/2 – 3 lbs.) and have a reasonably large poll (the opposite side to the edge). Typical lengths are 24 inches long. The axe should have a sturdy leather cover. Preferably with a very solid belt loop. The axe should never be used to drive a steel wedge (there shouldn't be one in a trail maintenance kit anyway!). Hitting a steel wedge will widen the ("eye") in the axe head and make the handle dangerously loose.

d. Wire cutters – There is a large amount of old fencing in Bolton that was often fastened to trees. Look for it carefully as it's rusty and camouflaged. Never let a chain touch metal, particularly fence wire. Identify any fence wire as part of the site JHA and remove it before using a chainsaw anywhere near it.
e. Chain sharpening equipment – See Appendix 4 for details on sharpening and tools.

f. Timber tongs – One-hand timber tongs are very useful to lift and pull smaller logs (6-12 in. diameter), particularly if they are dirty

g. Timber lifting hook – It's used with one hand to pull and roll smaller logs (6-12 in. diameter). This makes It is also very useful to steady and distribute the weight of a small log which is being carried with timber tongs

h. Cant hook - A cant hook is typically used to roll larger logs and rolling trees to dislodge them from a hang-up on other trees. Several versions have a detachable log stand which is particularly useful to lift a log and cross cut it while it is securely held on the stand. Be fairly sure that you're in a situation in which you'll use it. They're heavy and the log stand has limited use in the woods unless you're building a bridge from heavy timber.

i. 2-person log carrier - Very useful for dragging large logs with 2 people. Those with a swivel (below) make dragging or lifting large logs more manageable.

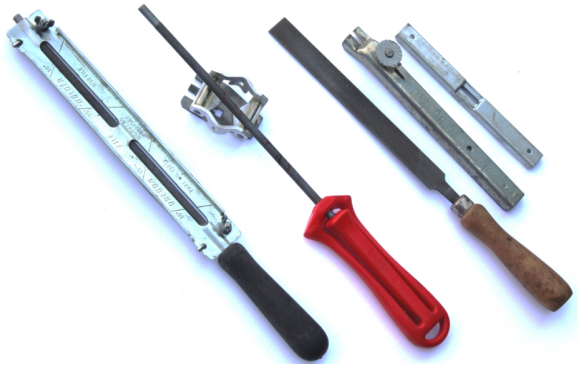
j. Rope and traction equipment – Strong rope (1/2 in. is preferable) and a block and tackle, cable "come along", or continuous rope "come along" to clear an entanglement. Also include rope to tie the pulling device to the tree and anchor.

k. Something in which to comfortably carry equipment. This can include a backpack with corrugated or some other intermediary between the equipment and the user's back. Many people prefer to carry tools they use continually in a tool belt or pouch which they purchase or make for their specific use. Commercially available tool belts are often very expensive ($150+), hence the homemade or carpenters' variety prevail (below)

Appendix 5 - Staying sharp – a key component of safety and efficiency

As mentioned above, a well maintained and sharp chainsaw is an integral component of safe use. A dull or poorly tensioned chain will not cut straight and will cut very slowly, requiring a dangerous amount of force with a corresponding amount of fatigue, frustration and potential for accidents. Sharpening of the chain's cutters and filing the gauges are relatively straight-forward and, in most cases, don't require a trip to a commercial sharpener….or the purchase of a new chain. Although there are a myriad of power devices to sharpen chain cutters on or off the bar, the simplest and a highly effective method is with a round chain file and guide to assure that the file is held at the correct angle and depth of the cutting face of the cutter. In most cases the sharpening can take place in the woods with the use of a stump vise which is tapped into the top of a stump or side of a large log as illustrated below. The vise holds the saw by the bar, permitting the chain to be moved with a gloved hand to move each cutter to a filing location. The same approach is used with a bench vise, making sure that the jaws are only in contact with the bar.

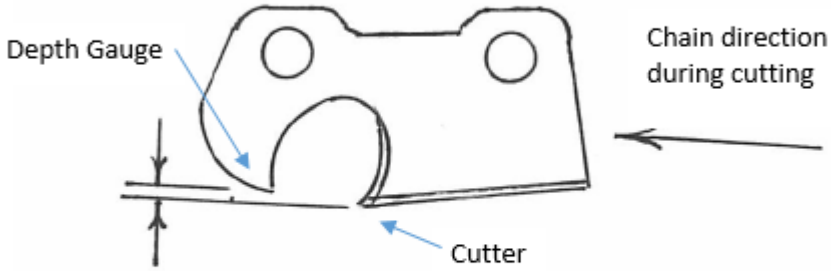
The cutters are filed with a chain saw round fie of the correct diameter for the chain. The angle with the bar and the depth to the cutter face are controlled by the file guide. 30^0 is fairly standard, although 35^0 will cut faster on soft wood and 25^0 is better on hard wood and frozen wood (and the cutters stay sharp longer).



Make sure that the left and right cutters are sharpened to the same length. Often the right cutters (facing down the bar from the power head) are dulled more quickly and severely since they are closer to the ground when making low cuts on stumps. Consequently they require more filing to re-sharpen. It's important to file the left side (whether it needs it or not) to have both sets of cutters the same length. It's also useful to mark the first cutter you sharpen with chalk to keep track of when you've completes sharpening one side of the chain.

To cut effectively, the cutter's depth gauge must be filed with a flat file and a depth gauge tool to assure that the cutter cuts to the proper depth in the wood. This aspect of chain maintenance is often overlooked, but is critical to efficient cutting. It's very similar to setting the blade on a woodworking plane. In most cases the depth gauge tool is designed to file the depth gauge to 0.026 in. below the top of the cutter.

Relationship of Depth Gauge and Cutter



Depth gauge gap (generally 0.026 in.) Note that as the cutter is sharpened the cutting edge moves the right and the gauge gap is reduced causing the cutter to cut a thinner slice of wood. The gauge then needs to be filed down to maintain the gap.

Appendix 6 - Bolton Trail Committee Chainsaw Certification

Bolton Trails Committee volunteers who plan to work on trails with a chain saw must:

1. Attend a classroom session to cover the contents of this Guideline including an extensive question and answer session (by both instructors and volunteers).
2. Attend a field practical exercise which will cover
   - operational safety,
   - PPE,
   - demonstration of the use of additional equipment, and
   - demonstration and an exercise in the proper felling and bucking techniques in a variety of circumstances.

The Trail Committee members who are certified will be issued with a folded wallet-sized personal certification card which they must carry with them when using a chainsaw on Town of Bolton or Bolton Conservation Land trails. The card will be signed and dated by Bolton's Conservation Agent and a director of the Bolton Conservation Trust. It will also include a summary of basic chainsaw safety rules.

Appendix 7 - References

1. The following may be purchased on-line at a relatively reasonable cost, i.e., under $25

    a. Jepson, Jeff (2009) *To Fell a Tree,* Longville, MN, Beaver Tree Publishing

    This book clearly provides the best consolidated reference to everything that a Trails Committee volunteer will need to safely and efficiently operate a chainsaw for trial maintenance. It provides very good descriptions of felling storm damaged trees and dislodging hung up trees. However, as indicated in the introduction to this Guideline, none of the more sophisticated techniques should be performed without direct supervision by a person who has extensive experience in the activity.

    b. ForestWorks (2009) *Chainsaw Operator's Manual,* (2011) *Tree Feller's Manual,* Clayton South, VIC, Australia

    Provide very well-illustrated and comprehensive descriptions of the components of the chainsaw, how they work and how they should be maintained including a very detailed description of the cutting action of the cutters on the chain and how/why they should be maintained. Also excellent description of how and why to crosscut trees in various support conditions and standard felling techniques including detailed descriptions of hinges and there use in standard controlled felling of trees as well as felling of wind damaged trees.

    c. Ruth, Brian & Jen (2009) *Homeowners Complete Guide to the Chainsaw*, East Petersburg, PA, Fox Chapel

    This book provides a very detailed and excellently illustrated step-by-step description of the use and maintenance of a chainsaw including felling, limbing and bucking. Although clearly addressing homeowners who intend to use it around their homes for yard maintenance, cutting firewood and milling timber, it provides very useful information for trail maintenance including chainsaw add-ons to improve safety and efficiency.

    d. Philbrick, Frank & Stephen (2006) *The Backyard Lumberjack,* North Adams, MA, Storey Publishing
    Well illustrated summary focused on felling, bucking, splitting and storing firewood.

2. The following are US Government publications and can be downloaded from various websites

    a. US Forest Service (2006) *Chain Saw and Crosscut Saw Training Course - Student's Guidebook*, Missoula Technology and Development Center - 0667-2805MTDC

    https://www.fs.fed.us/t-d/pubs/pdfpubs/pdf06672805/pdf06672805dpi300.pdf

    This is a very comprehensive treatment of both chainsaw and crosscut saw use. It covers an enormous amount of information on operation and maintenance of the saw, safety, timber behavior during chainsaw work and job hazard analysis (JHA), a critical component of safe use of saws, particularly chainsaws….and it's FREE!

    b. BCHW/USFS Chain Saw and Crosscut Saw Certification Program

    http://www.bchw.org/Tech%20tips/SawCertification/BCHW%20Saw%20Cert.htm

    A complete list and links to all documents and videos associated with the use of chainsaws …. and crosscut saws. A superb resource list!