

## Felling

**F**xcept for firefighting and wilderness trail work, it is not common to fell trees with a crosscut saw. Much of my experience in felling with a crosscut saw was to obtain native building material for bridges, cribbing, puncheon, shake bolts, replacement logs for historical structures, or green logs for construction.



Felling is a dangerous operation. The USDA Forest Service requires that crosscut saw users working for or on behalf of the agency receive the required training and are certified to perform the specific crosscut saw work they plan to do. Simply reading this book is not enough.

## Safety Considerations

Safety considerations for felling apply whether you are using chain saws or crosscut saws. The forces acting on a tree are the same, whether hand or power tools are used. But different tools require different techniques. This guide discusses the correct procedures for felling with a crosscut saw.

Larger trees often require a two-person saw, so two fallers may be in the danger zone. There are some advantages to having two fallers. An additional set of eyes and ears will be alert to danger. Crosscut saw operations are relatively quiet, so a faller often can hear the stresses of wood as pressure is being released and the noises of branches breaking above the fallers.

The most important advantage of having a second faller is a change in mental and behavioral attitude evident in good teamwork. The saying, “Two heads are better than one,” applies here.

Each faller requires an escape route and an alternate route. The two fallers should not use the same escape route. If fallers need to rest during the cut, they should move to the safety zone. The rest should be as brief as possible. Sawing the back cut should progress deliberately and continuously until the tree begins to fall. Avoid rest breaks during back cutting. Additional safety considerations include:



For felling operations, if two sawyers are needed or if an observer/spotter is needed, justification for additional personnel, and the implementation process, shall be documented in the JHA.

- The loop- or pin-style handles on a two-person saw must detach quickly. Remove the handles to make sure they don't stick before performing felling cuts.
- Be sure all ax and saw handles are tight and in good repair.
- If metal wedges will be used, they should have all “mush-rooming” (deformed metal on the edges of the head) filed off to prevent the wedge from splitting when struck.
- When sizing up the tree, determine the side of the tree where the head faller will stand. This is usually the side that best enables the faller to remove the saw from the cut and place it on the ground just before the tree falls.
- If one handle of a two-person saw is hard to remove, that handle should be in the hands of the head faller who will not have to remove it.
- Wedges need to be driven into the woody part of the tree, not the bark. Remove bark as necessary with an ax before sawing.
- Shout a warning before starting the back cut and again before finishing it.
- If several trees are being felled on steep ground, work from the bottom of the slope toward the top to avoid working around trees that have been felled.
- No felling should be undertaken without all the required personal protective equipment, an ax, a set of wedges, and lubricant.



Snags and other hazard trees may be too dangerous to cut. Wedging snags produces vibrations that could dislodge material above the faller. Remember, a hazardous tree never needs to be cut. Explosives or other means can bring it down with less risk.

## Direction of Fall

In trail work, the purpose of felling is often to obtain construction material. You need to visualize the tree on the ground to make sure you can remove the logs you need for the project. Can a team of horses get to the site? Can the logs be winched out? Also, consider the visual effect of tree removal. Will the stump or slash be visible from the trail or structure? Is this acceptable?

Trees felled across the slope will be less likely to break, all other factors being equal. Trees felled downhill are in the air longer and pick up more speed. Uphill felling should be avoided, especially on steep slopes. The tree strikes the ground quickly, often bounces and kicks back over the stump. This is dangerous.

If a tree is not leaning more than 5 degrees from vertical and other factors are favorable (limb weight and distribution are even, winds are light, and so forth) a faller can generally drop the tree in any desired direction with proper placement of undercuts and wedges. Big trees with uneven limb distribution or noticeable lean can seldom be felled against the natural lean, even with wedges.

## Situational Awareness

Analyze the tree you plan to fell:

- Health of tree (live or dead)
- Footing
- Species
- Heavy snow loading
- Size and length
- Bark soundness
- Soundness or defects
- Direction of lean
- Twin tops
- Degree of lean (slight or great)
- Widow makers or hangups
- Type of lean (both the predominant, or head, and side lean)
- Heavy branches or uneven weight distribution
- Nesting or feeding holes
- Punky wood (swollen or sunken areas)

- Spike tops
- Knots
- Splits and frost cracks
- Rusty (discolored) knots
- Deformities, such as mistletoe damage
- Frozen wood
- Damage by lightning or fire

Analyze the base of the tree for:

- Thudding (hollow) sound when struck
- Insect activity
- Conks and mushrooms
- Feeding holes
- Rot and cankers
- Bark soundness
- Shelf or bracket fungi
- Resin flow
- Wounds or scars
- Unstable root system or root protrusions
- Split trunk

Examine surrounding terrain for:

- Steepness
- Stumps
- Depressions or humps in the ground
- Loose logs
- Debris that can fly back or kick up at the sawyers
- Rocks

Examine the immediate work area for:

- Snags
- People, roads, or vehicles
- Reserve (leave) trees that should not be damaged
- Powerlines
- Structures
- Widow makers
- Openings to fall trees
- Hangups
- Other trees that may be affected
- Fire-weakened trees
- Other trees that may have to be felled first
- Hazards such as trees, rocks, brush, or low-hanging limbs

## Felling Sizeup

Most accidents are caused by falling debris. When you approach the tree to be felled, observe the top. Check for all overhead hazards that may come down during felling. Throughout the cut, glance regularly at the saw, the kerf, and the top of the tree.

Look at the limbs. Are they heavy enough on one side to affect the desired felling direction? Do the limbs have heavy accumulations of ice and snow?

Are the limbs entangled with the limbs of other trees? If so, they can snap off or prevent the tree from falling after it has been cut.

Is the wind strong enough to affect the tree's fall? Wind speeds higher than 15 miles per hour may be strong enough to affect the tree's fall. If so, stop felling. Strong winds may blow over other trees and snags in the area. Erratic winds require special safety considerations.

Check all snags in the immediate area for soundness. A snag may fall at any time with a gust of wind, the vibration of a tree fall, or as the snag's roots succumb to rot. If it is safe to do so, fell any snag that is a hazard in the cutting area before cutting the tree you intend to fell.

Clear small trees, brush, and debris from the base of the tree. Remove all material that could cause you to trip or lose balance. Also remove material that will interfere with your use of the saw, wedges, and ax. Don't fatigue yourself with unnecessary swamping. Remove only as much material as needed to work safely around the base of the tree and to provide escape routes.

The importance of sound holding (hinge) wood cannot be overemphasized. Determine the condition of the holding wood by sounding it with an ax. Look up while doing so, in case debris is dislodged. Check for frost cracks or other weak areas in the holding wood. The desired felling direction can be adjusted to compensate for weak areas in the holding wood. The depth of the undercut also can be adjusted to best take advantage of sound wood that can serve as holding wood.

Most trees have two natural leans: the predominant head lean and the secondary side lean. The leaning weight of the tree will be a combination of these two leans. Both leans must be considered when determining the desired felling direction. The desired felling direction can usually be chosen within

45 degrees of the combined lean, provided there is enough sound holding wood to work with, especially in the corners of the undercut.

Use a plumb bob or ax to evaluate the tree's lean. Project a vertical line up from the center of the tree's butt and determine if the tree's top lies to the right or left of the projected line.

A pistol-grip tree (one with a trunk that may be nearly horizontal near the ground before turning straight up) may appear to be leaning in one direction while most of the weight is actually leaning in another direction.

Look at the treetop from at least two different spots at right angles to each other. Do so again later during the sizeup, taking every opportunity to determine the correct lean.

In summary, during felling sizeup:

- Check for snags.
- Observe the top.
- Assess the soundness of the holding wood.
- Swamp out the base.
- Assess the lean.

## Establishing Escape Routes

Look for a large, solid tree or rock for protection. The tree or rock must be at least 20 feet away from the stump and not directly behind it. Clear any debris that could trip you from the escape route. Practice your escape (figure 52).

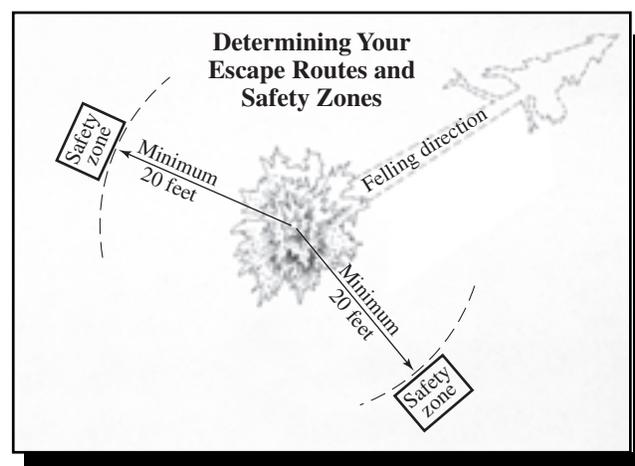


Figure 52—Keep the felling direction in mind when planning escape routes.

Walk out the intended lay of the tree. Look for any obstacles that could cause the tree to kick back over the stump or cause the butt to jump or pivot as the tree hits the ground. Look for any small trees or snags that could be thrown into your escape route. Ensure that the cutting area is clear of people.

Using the observations you made when walking out the intended lay of the tree, reexamine the escape route. Be sure that your chosen route (figure 53) will be the safest escape by walking out the entire length of the route—before you begin to cut.



Figure 53—Check the intended lay of the tree for unwanted obstacles.

## Placing the Undercut

We are going to discuss just the conventional undercut because of its broad application for all timber types and because it provides a solid foundation from which to learn additional cutting techniques.

Before beginning the undercut, prepare the tree for cutting (figure 54). Thick bark should be removed to:

- Prevent the bark from dulling the saw
- Prevent bark chunks from choking up the saw
- Make wedges more effective
- Better view the cuts to make sure they line up

I like removing the bark at the corners of the undercut because I can see the amount of holding wood that remains.



Figure 54—An ax can be used to remove bark from a log.

Trees that have burned or that have large plates of bark or stringy bark often collect blowing dirt and sand that could dull the saw. In addition, removing bark may allow the saw to start into the cut more easily.

Not all trees need to have the bark removed. If the tree is small or if it has smooth, clean bark, usually there is no need to remove the bark.

It takes three cuts to fell a tree. Two cuts form the undercut (or face cut) and the third forms the back cut. The correct relationship of these cuts results in safe and effective tree felling. Before discussing the felling procedure, we will analyze the mechanics of the felling cuts. The undercut and back cut form the hinge that controls the direction and fall of the tree.

The undercut serves three purposes.

- It allows the tree to fall in a given direction by removing the tree's support in the direction of the face.
- It enables control because the tree slips off, rather than jumps off, the stump.
- It prevents the log from kicking back as it begins to fall.

The undercut can be made by:

- Chopping out the entire undercut with an ax
- Making the undercut with a crosscut saw
- Making a horizontal cut with a crosscut saw and chopping the face out with an ax

### Chopping Out the Undercut with an Ax

Although this approach may appear to be the hardest, it has advantages in certain situations. If this method is used, the cut must be level so that the back cut, which is parallel to the undercut, also will be level.

Some advantages of chopping out the undercut include:

- Chopping out the undercut is about as fast as sawing, at least on smaller trees.
- Chopping out the undercut may be best in restricted areas where one side of the tree does not offer standing room for the second sawyer or does not have adequate clearance for the end of the saw.
- Chopping out the undercut will allow the sawyer to limit the number of cuts. It is hard to apply lubricant to the bottom edge of a saw in the horizontal felling position. Chopping is especially useful if the tree is extremely pitchy.
- Chopping out the undercut is a good alternative when the saw handles cannot be vertical, when a stiff bucking saw is used, or when any combination of factors leads to an uncomfortable sawing position.
- The lower side of the tree has compression wood, which is hard on the saw set and makes work tiresome and slower.

Someone inexperienced at chopping may have trouble getting the chips to fall out properly. The best way to effectively remove the chips is to plant part, but not all, of the edge of the ax. Chop the near side of the tree, leaving the inside corner of the ax outside the tree. On the next stroke, chop the far side of the tree, leaving the outside edge of the ax outside the tree. Finish off with a keenly placed cut in the middle between the first and second cuts. A large chip will be removed (figure 55).

### Using a Crosscut Saw and an Ax

Making the horizontal cut with a saw and chopping out the undercut with an ax uses both tools to their best advantage.

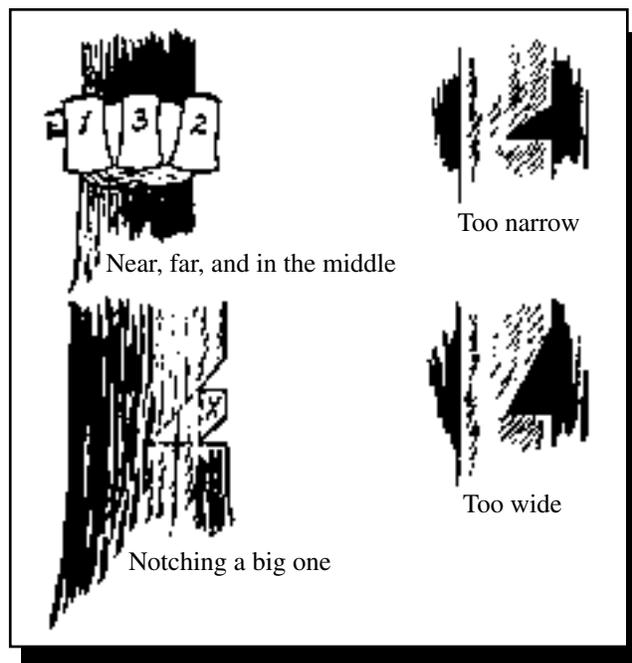


Figure 55—Notching a tree to determine the direction of fall.—Bernard Mason's *Woodsmanship* with drawings by Frederic H. Kock

It is often the preferred method. The horizontal saw cut is put in first, allowing the sawyer to place a level cut. The ax is often the best tool for the sloping cut, ensuring that it matches up with the horizontal cut and does not extend past the horizontal cut, forming a dutchman.

### Making the Undercut With a Saw

This method reduces the vibration delivered to a tree, but is generally not recommended because:

- A high degree of skill is required to have both cuts meet exactly. When the cuts don't meet exactly, they create a dutchman. Careful ax work *MUST* be used to clean out the dutchman.
- Saws do not function well when they are used to cut diagonally. The body position of the faller's arms and the handle placement make for cumbersome sawing because the saw blade and handles are on a 45-degree angle. Awkward positioning also can be a safety concern.

Observe overhead hazards and look up frequently during the undercut (figure 56).

The face of the undercut should be in the general direction of the tree's lean. Depending on structures, roads, other



Figure 56—Hazard trees need to be removed to prevent anyone from working under them.

trees, trails, and plans for removing the log, the desired felling direction may be to one side or the other of the lean. Normally, the desired direction is less than 45 degrees from the lean.

I recommend that inexperienced fallers make the sloping face cut first. Remember that the saw must still be level, even though it's tilted at a 45 degree angle. It is easier to line the horizontal second cut up with the ends of the sloping cut than it would be to line a sloping cut up with the ends of the horizontal cut.

A general rule for the sloping cut is to make a 45-degree angle cut to a depth of at least one-third the diameter of the tree. The face of the cut must not close until the tree is fully committed to your planned direction of fall (figure 57). As the face closes, the holding wood breaks. If the holding wood breaks and the tree is still standing upright, the tree could fall away from the desired direction.

The horizontal cut is a level cut. If the proper relationship of the three cuts is maintained, the horizontal cut dictates the direction of fall. When there is any danger from above, the cutting should be done while the sawyer is standing,

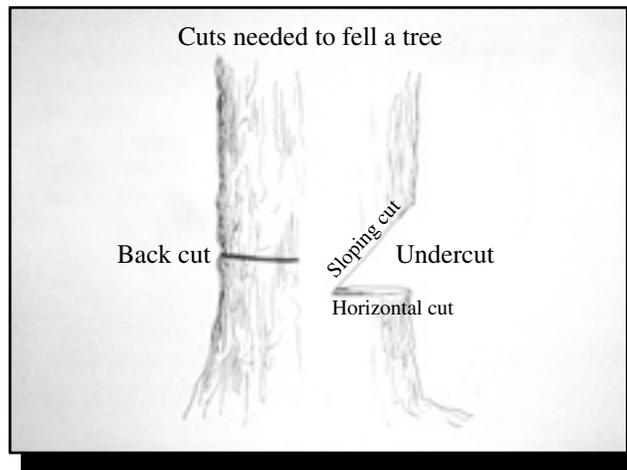


Figure 57—An undercut and a back cut are required to fell a tree. A horizontal cut and a sloping cut make up the undercut. The sloping cut is often made with an ax instead of a crosscut saw. The back cut is the third cut needed to fell a tree.

allowing the sawyer to watch the top and escape more quickly. After selecting the desired felling direction, estimate one-third the tree's diameter and begin the horizontal cut. On larger trees you may need to place a wedge in the horizontal cut to prevent the saw from binding.

Short snags sometimes require an undercut deeper than one-third the tree's diameter to offset the tree's balance. Trees with heavy leans may not allow you to insert the horizontal cut as deep as one-third of the tree's diameter without pinching the saw.

When the horizontal cut is complete, remove the bark from an area on both sides of the kerf. The bark can be removed with an ax.

Lining up the horizontal cut with the sloping cut so that they meet, but do not cross, is one of the most difficult tasks in felling. When the cuts cross, a dutchman is formed (figure 58). If a tree with a dutchman was felled, first the dutchman would close, then the tree could split vertically (barber chair), or the holding wood could break off. Felling control would be lost. A weak tree might snap off somewhere along the bole or at the top.

It is difficult for one sawyer to make the sloping cut and the horizontal cut meet correctly on the opposite side of a large tree. This is because the sawyer cannot look behind the tree while sawing. Practicing on high stumps will help you become skilled at lining up these cuts.



Figure 58—When the sloping cut and the horizontal cut do not meet exactly, a dutchman is formed. This kerf-wide cut makes the direction of the tree's fall harder to predict. It can also cause the tree to barber chair, lifting the log off the stump and placing the sawyers at great risk.

The holding wood is the wood immediately behind the undercut. The most important portion of the holding wood is in the very corners of the cut (the first 4 to 8 inches inside the bark).

If the horizontal cut is so low that cleaning it up will create too deep of an undercut, stop the horizontal cut directly above the end of the sloping cut. This will leave a step face in the undercut, but that is better than creating a dutchman or having too deep of an undercut.

The undercut needs to be cleaned out to a V-shape. Any remaining wood will cause the face to close prematurely. This causes the holding wood to break behind the closure, which can alter the direction of the fall or cause a barber chair.

The sloping face cut must be large enough to keep the tree under control until it is close to the ground. If the "mouth" is too small, the face cut will close quickly and all control of the tree will be lost. In most cases, the size of the face cut is adjusted for the lean of the tree. Never leave a dutchman in any undercut.

Once the face has been cleaned, recheck the felling direction. Place the saw back in the face and check by gunning, visualizing an imaginary line perpendicular to the saw that indicates the expected direction of fall. Alternatively, place an ax head in the face and look down the handle (figure 59). The back of the undercut should be perpendicular to the desired felling direction.



Figure 59—A double-bit ax is being used as a T-square to indicate the direction of fall in this 1939 photo from West Virginia. Today, hardhats and eye protection would be required dress.

If the tree is not aimed in the direction that you want it to fall, extend the horizontal and sloping cuts as needed, keeping each cut in its original plane.

Each sawyer pulls alternately. The sawyers should be facing the direction the tree will fall. The saw is pulled back and forth with a slight upward arc at the end of the stroke.

## Making the Back Cut

With a well placed undercut established, half the job is done. To successfully position the tree's direction of fall, the back cut needs to be sawn.

The relationship of this cut to the face cut is important for positioning the tree's direction of fall and the sawyer's safety. The back cut can be made from either side of the tree. Choose the safest side of the tree to cut from, (not under any lean, with a good escape route, and so forth).

The two most important elements of this cut are the holding wood and stump shot. The best way to envision these cuts is by the use of a rectangle. The bottom corner is the back of the horizontal cut. The opposite upper corner will be the back of the back cut (figure 60).

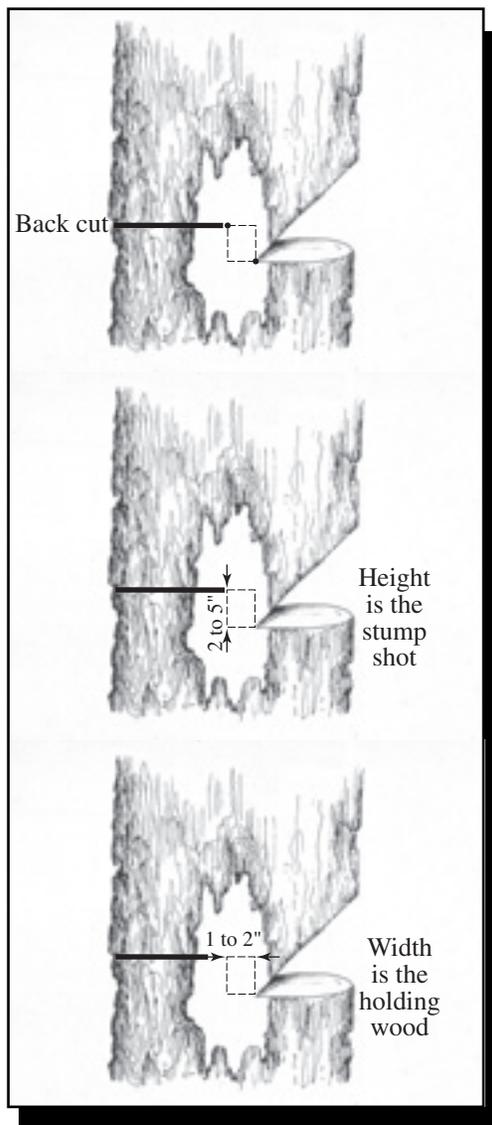


Figure 60—An imaginary rectangle can help the sawyer understand the importance of the back cut. The dimensions of this rectangle are based on a 24-inch diameter tree.

The height of the rectangle is referred to as the stump shot. It is an antikickback device to prevent the tree from kicking back over the stump if it hits another tree on its fall. This is especially important to sawyers who are felling trees through standing timber.

The width of the rectangle is the holding wood. As the back cut is made, the sawyer must be sure not to cut this wood. Maintaining the holding wood is the key to safe and effective felling.

Hold the saw level so that the back cut will be level when the cut is complete. Make sure that when the back cut is finished, it will line up with the top corner of the opposite rectangle. If the cut is angled, wedging power and the height of the stump shot could be altered.

Keep at least three wedges and an ax or single jack hammer readily accessible. The ax should be within arm's reach. The size of wedges you will need depend on the tree's diameter.

If there is any wind, two wedges are recommended. The second wedge adds stability. With just one wedge in place, the tree can set up a rocking action between the holding wood and the lone wedge. A strong wind could tear out the holding wood.

Remove thick bark immediately above and below the back cut, where the wedges will be placed. The bark could compress, reducing the wedge's lifting power. Before starting the back cut, lubricate both sides of the crosscut saw. A saw in the horizontal position in the back cut is more prone to accumulate pitch than a saw used vertically for bucking. If the tree is very pitchy, the saw may need to be removed from the cut when you apply solvent. Sometimes solvent can be splashed or sprayed from the underside of the saw.

Sound a warning before the back cut is started, just in case someone has wandered into the cutting area. The sawyers position themselves with their backs toward the center of the tree. This position is natural, and also allows the sawyers to face their escape routes. The back cut should be sawn parallel to the face cut, keeping the holding wood equal from corner to corner. The sawyers need to keep an eye on the top of the tree as the back cut progresses. If the tree is a heavy leaner, each of the corners can be cut out first, finishing the cut by sawing parallel to the face cut. This technique reduces the chance that a tree might barber chair.

Once the cut provides enough clearance from the back of the saw, a wedge or wedges can be driven into place. On smaller trees, a single wedge can be used, but usually two or more wedges are needed. After every couple of inches of sawing, stop and drive the wedges in a little. Wedging redistributes the center of gravity of the standing tree by hinging the tree on the holding wood. It also prevents the tree from sitting back and binding the saw.

Observe the top of the tree to coordinate the strike of each blow against the wedge with the forward sway of the tree. The wedges are easier to drive when you do so. Striking the wedge when the tree's pressure is on the wedge not only damages it, but also causes excessive vibration and could dislodge an overhead hazard.

The sawyers need to communicate so each of them knows about how many inches of holding wood remain so they can adjust their cutting to ensure that the back cut remains parallel to the face cut. A sawyer working alone needs to look around the tree periodically to accomplish this. Progressing too far and cutting the holding wood from one corner could mean the loss of felling control.

The back cut must not proceed so far toward the undercut that it removes the holding wood. This narrow strip of holding wood must be left completely across the stump. The holding wood controls the tree's fall and prevents it from slipping off the stump prematurely.

Sound another warning when the back cut is completed and the tree is ready to fall. If the tree has not committed to fall and the holding wood is narrowing, the tree is sitting back on the wedges. Stop sawing and leave the holding wood intact. The second faller removes the saw handle and proceeds along the escape route to the safety zone. At the same time, the head faller removes the saw and places it behind the tree in a predetermined location away from the escape route. Never take the saw with you along the escape route—it could impede your progress.

With the second faller watching, the head faller drives the wedges, causing the tree to lift and commit to fall. You can see the top of the tree begin to move before you can see the saw kerf widen. The head faller proceeds along the escape route to safety before the tree actually falls.

If for any reason the sawyers feel unsafe or unsure, they should proceed immediately along the escape route. **Leave the saw wherever it lies.**



Fell no tree if you are uncomfortable with the task. If you have started to fell a tree but are having second thoughts, do not feel that you are committed to finishing the job in an unsafe manner. If a cut has been started but is terminated before the tree is on the ground, you **MUST** flag the area around the tree, declaring it a danger zone. Warn people to remain clear of the area until someone else can take the tree down.

Once you've reached a safe location, both sawyers need to continue looking up for overhead hazards. There is a tendency to look at the tree as it hits the ground, leaving the sawyers unaware of limbs that may be thrown back from other trees near the stump. **LOOK UP!** If rocks or other material are dislodged when the tree hits the ground, yell a warning!