

This Guide includes information on the potential hazards of timber harvesting operations and practical examples of ways you can control the risks associated with them. It is part of a series of forestry industry material and should be read and used together with the *General guide for managing risks in forestry operations* and specific guidance material for:

- [growing and managing forests](#)
- [cable logging](#)
- [coupe and harvesting site access and preparation](#)
- [log landings](#)
- [log extraction](#)
- [loading, transporting and unloading logs](#)
- [infield processing of forest products](#)
- [plant and equipment for forestry operations](#), and
- [general hazards in forestry operations](#).

These guides are available on the Safe Work Australia website.



Hazardous trees

Trees may be dangerous for a range of reasons, for example because of overhead hazards like hung-up trees or widow-makers as well as their characteristics and location. Dead or hazardous trees are unpredictable and extra care should be taken to identify hazards and put control measures in place to protect the feller. For example, these trees are more likely to fall unexpectedly or have branches break off.

An accredited feller should only fell a hazardous tree which is within their competency.

Damage to trees caused by fire, wind, snow or insects may mean all trees in an area are hazardous.

The risk from hazardous trees increases with high winds, periods of drought, recent isolation or dead limbs drying out. Features which identify trees as hazardous are in Table 1.

Table 1 Common hazards and risks associated with felling hazardous trees

High risk forestry activity	Felling hazardous trees
Hazards and risks	
<p>Trees are hazardous if they have any of the following features:</p> <ul style="list-style-type: none"> ■ widow makers i.e. branches hanging in the tree's crown ■ excessive rot content in the tree including dry sides, scars or hollows ■ burnt out tree butt ■ burnt out limb, which may fall ■ another tree lodged in the tree ■ vines connecting the tree being felled to other trees or the ground ■ tree trunk with substantial damage ■ defective tree located less than twice its length away from the tree to be felled ■ storm or snow damaged tree ■ tree's root system likely to uproot due to its location e.g. slope or wet area 	

Hazards and risks
<ul style="list-style-type: none"> ■ trees with exposed root systems ■ trees with excessive lean ■ trees larger than the capacity of the felling machine ■ thick undergrowth located at the tree base which cannot be cleared ■ interlocking limbs ■ location which restricts feller's safe movements e.g. rocks, steep banks, road fill ■ poor condition of wood fibre, making controlling the fall direction difficult ■ dead trees ■ trees with burnt out sections, and ■ burning trees.

Table 2 Control measures for felling hazardous trees

Felling hazardous trees
<p>1. Identify hazardous trees by referring to features in previous checklist</p>
<p>2. Prohibit work near the hazardous tree</p> <p>If the tree is assessed as being too high risk to fell then clearly identify the tree without placing yourself or others at risk. For example, mark the hazardous tree using log marking paint, tape the area of the coupe or harvesting site using highly visible log marking tape or record the location on the coupe or harvesting site plan.</p> <p>No work should be carried out in the hazardous zone until the tree is brought down. The 'hazardous zone' is:</p> <ul style="list-style-type: none"> ■ two tree lengths from the hazardous tree, or ■ two crown widths when broken limbs are hung up in trees.
<p>3. Select method to fell trees using hierarchy of controls - mechanical equipment</p> <p>If the hazardous tree is assessed as high risk, first consider using mechanical equipment to fell the tree.</p> <p>Use a harvester, dozer, excavator or skidder with a protective structure to remove the tree.</p>

Felling hazardous trees

4. Alternative methods to safely fell trees

Manual felling

Where the risk is assessed as manageable by manual felling techniques, the system of work should have the following minimum risk control measures in place:

- The felling should only be done by a feller assessed as competent against the relevant national unit of competency for the manual harvesting of trees and have current industry experience.
- Maintain the separation distance of two tree lengths from other workers.
- Use a recognised safe felling method e.g. see AS 2727-1997: *Chainsaws – Guide to safe working practices*. A hand feller may place preliminary cuts in the tree before using a machine to push the tree. When felling a widow maker or brittle top, the feller should work under a protective structure.
- Ensure the area around the base of the tree is scrubbed mechanically and escape routes are in place.
- Radio communication should be maintained between all operators.

Explosives

- Where a risk assessment has indicated other felling methods pose a higher risk, use a person with experience and the required licences and permits to use blasting explosives to remove the tree.

Note: Felling one tree into another tree to bring down that other tree should not be carried out unless:

- a risk assessment is carried out and documented by a competent person
- the risk assessment shows there is no other reasonably practicable method of felling the tree that is lower risk, and
- the person conducting the business or undertaking provides a documented work system which outlines the specific measures to be taken to control the risks identified in the risk assessment.

Table 3 Hazards, risks and control measures associated with fire damaged trees

High risk	Reduced risk solution	Preferred solution
<p>Manual felling of fire damaged trees with:</p> <ul style="list-style-type: none"> ■ limbs falling ■ burnt out butts, or ■ interlocked limbs. <p>Where brown leaves have fallen from limbs a different felling method should be considered.</p>	<ul style="list-style-type: none"> ■ Manual felling for hazardous trees, see item No. 4 in Table 2. ■ Daily harvesting contractor pre-start check to ensure no limbs are falling before manual harvesting starts. ■ Regular risk assessments carried out by principal contractor, harvesting contractor and manual feller to monitor controls and confirm the state of trees as the timber dries out during the harvesting operation. 	<ul style="list-style-type: none"> ■ Use mechanical harvesting for hazardous trees, see item No. 3 in Table 2.



Manual felling

Manual felling is carried out in an environment in which there are many common hazards.

To safely fell a tree manually, specific control measures are necessary and depend on the nature of the work area. Many of the hazards affecting hand fellers are also hazards for others working in the forest, particularly anyone working outside of a protective structure.

Table 4 Common hazards and risks associated with manual felling

High risk forestry activity	Manual felling
Common hazards and risks	
<ul style="list-style-type: none"> ■ unsuitable ground conditions and slope ■ falling objects e.g. limbs, dry stags, dead and brittle tops and widow makers ■ standing vegetation in the intended direction of fall ■ being struck by the butt of the tree ■ kickback or recoil from the chainsaw ■ hazardous trees ■ weather conditions including heat, wind, rain and cold ■ trips, and ■ fatigue 	

Table 5 Control measures for manual felling

Recommended process for manual felling
<p>1. Assess trees as safe to fall.</p> <ul style="list-style-type: none"> ■ Identify all hazardous trees (see section on Hazardous Trees). ■ Use mechanical help where possible for trees with excessive natural lean away from the intended direction of fall (see section on Machine-assisted manual tree felling). ■ Carry out ongoing checks for hazards, especially overhead hazards and changing conditions. ■ Stop operations in high winds.
<p>2. Maintain suitable separation distances from other people and work areas.</p> <ul style="list-style-type: none"> ■ Maintain a separation distance of two tree lengths. ■ On steep ground where there is a risk of felled trees sliding or rolling downhill, ensure no one is working below the tree feller. ■ Maintain radio communication with other forest workers. ■ Use signs and manage traffic where work area is close to roads. ■ Close roads if needed.

Recommended process for manual felling

3. Ensure escape routes.

- Where escape routes are impeded by undergrowth, remove material around the base of the tree using the blade of a dozer or skidder before felling.
- A 45 degree escape route should extend to an area at least 6 metres away from the stump (see Figure 3).

4. Minimise risks from elevated hazards.

- Fell trees into an open area where possible. Ensure falling trees do not strike brush or other standing vegetation as they fall.
- Avoid using wedges where there is a chance limbs may be dislodged.
- Where the tree is assessed as hazardous, apply the practices described in the section on Hazardous Trees.
- Consistently apply suitable felling methods—see AS 2727-1997: *Chainsaws - Guide to safe working practices*.

5. Use chainsaw safely.

- Follow safe work practices, for example as in AS 2727-1997: *Chainsaws - Guide to safe working practices*. Also see Figures 1 and 2.
- Ensure equipment is maintained including safety features of chainsaw e.g. hand guard and chain brake.
- Carry felling equipment including an axe, lifting and holding wedges suitable for the trees to be felled, a two-way communication device, wound dressings, chainsaw fuel and oil in an approved way.
- Use PPE suitable for the task being carried out, for example a hard hat with hearing protection, eye protection, high visibility clothing, safety footwear and leg protection. PPE should be reasonably comfortable for the wearer and should be well-maintained.



Accepted manual felling methods

Information on manual tree felling techniques is in the relevant chainsaw operators' manuals, AS 2727-1997: *Chainsaws - Guide to safe working practices* and the *Tree faller's manual*.

Except for trees with a clear lean in the intended felling direction, a holding wedge should be inserted into the back cut of each tree manually felled with a chainsaw.

If a tree sits back during felling the tree feller should follow a safe system of work in accordance with the procedures detailed in Appendix A.

FIGURE 1 Escape route and direction of felling

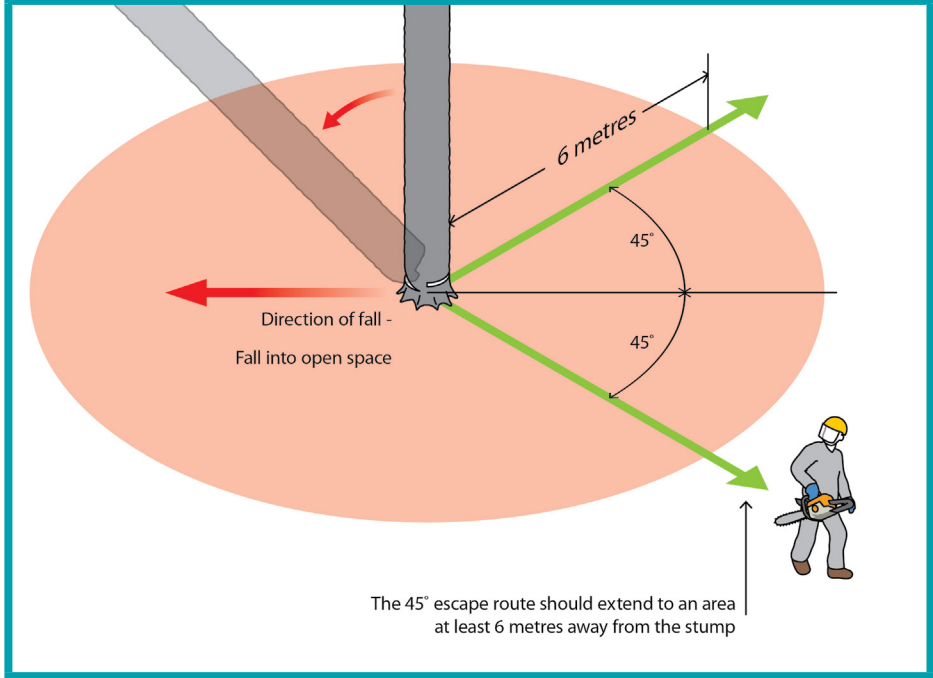
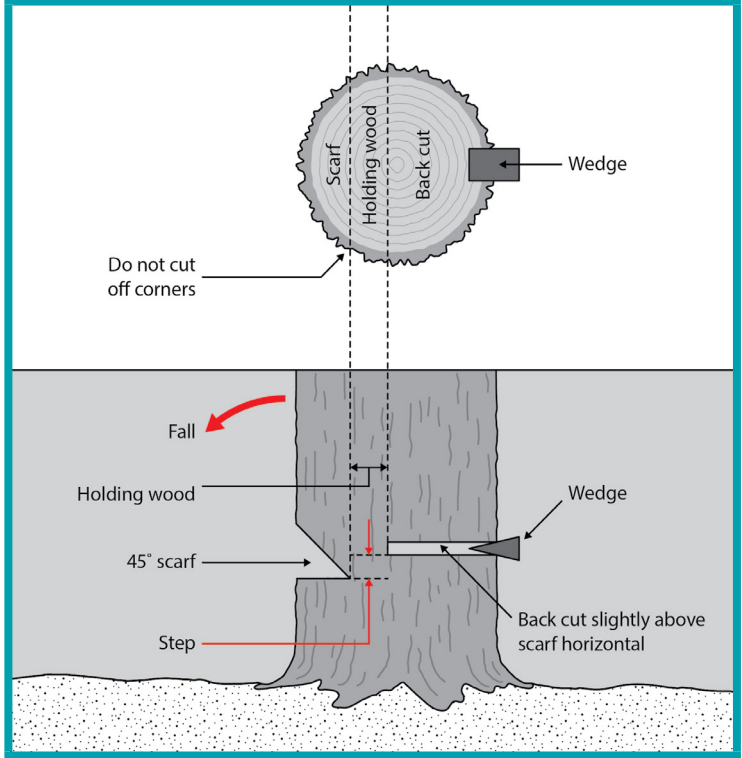


FIGURE 2 Tree felling





Tree jacking

Tree jacking is the process of felling a tree by inserting a purpose-built jack into a hole cut into the tree to bring down the tree in a particular direction.

The worker carrying out the jacking operation should be trained and assessed as competent to carry out the procedure.

Before using a jack to fell a tree a thorough assessment should be made of the surrounding area for visible hazards and the quality of the wood in the tree to be felled. Tree jacks should only be inserted into holes cut into solid wood. Workers not involved in the tree jacking operation should move to a safe place at least two tree lengths away from the tree until the tree has been safely brought down.

A suitable jack, for example a hydraulic jack should be used to bring the tree down. Bottle jacks should not be used.



Thinning

Thinning is a selective felling operation which may include one or more of the following:

- thinning to waste—normally work carried out in young crops to improve the quality of the stand
- thinning to extract small piece size material for posts or pulp
- thinning for saw log and small produce, and
- thinning for stand improvement.

The safety procedures for thinning operations are similar to those for felling other trees. However, the controls outlined in Table 6 should also be used by everyone involved in thinning operations.

Table 6 Control measures for thinning operations

Recommended safety procedures for thinning operations
1. Identify hazardous trees by referring to features in Table 1.
2. Fellers should keep watch on the falling tree and lookout for limbs and branches which may be thrown back.
3. Fellers should be aware of dead or defective trees.
4. Fell or remove dead or defective trees which are in the intended fall direction before starting thinning operations.
5. Bring hung up trees to the ground.
<ul style="list-style-type: none"> ■ Where a tree is hung up it should be brought to the ground as soon as possible. ■ The feller should not leave the area until the tree is grounded, except to seek assistance. Before leaving to seek assistance, the feller should make other people in the immediate area aware of the danger and should mark the hung up tree and the area surrounding the tree at two times the height of the tree with hazard tape. ■ Tell the person in charge of the thinning operation whenever a tree cannot be completely felled so a different way of bringing it to the ground safely can be used.



Machine-assisted manual tree felling

Machine-assisted manual tree felling should only be carried out by an operator with training and experience relevant to the task.

Before starting a machine-assisted manual tree felling operation workers should be consulted and told about the operation to be carried out. The control measures and sequence of events should be agreed and understood.

Consultation should include assessing the tree to be felled and the surrounding trees for visible hazards that may present an unacceptable risk. In machine-assisted manual tree felling the feller should always have control of the felling operation and be in radio contact with the machine operator.



Machinery

Machinery used in felling operations must have an operator protective structure and FOPS suitable for forestry operations—see section 2 of the *Guide to managing risks of plant and equipment for forestry operations*, and have sufficient height reach and be able to safely control the felling direction of the tree.

The machine operator should:

- ensure the machine has the capacity to push the tree safely, and
- clear the under-storey around the tree and create a safe footing for the manual feller to work on. Hazardous trees should be cleared from within two tree lengths of the tree to be felled.



The felling operation

Where an excavator or other mobile plant is to be used to push the tree in a direction other than its natural lean the machine should be placed in position before the tree feller approaches the tree.

The log grab fitted to the dipper arm or the tree pushing attachment should be:

- in contact with the trunk of the tree with only enough push force applied to prevent the tree sitting back during the felling operation, and
- high enough above the ground so the excavator can provide enough force to push the tree after the felling cuts are made.

When the machine is in position:

- the controls should be isolated to stop the machine or attachments from moving unexpectedly, and
- once the controls have been isolated the tree feller may approach the tree and place the scarf cuts. The depth of the scarf should be approximately one third of the tree's diameter and not exceed one half of the diameter of the tree.

After the scarf is removed the feller should place a back cut in the tree but leave sufficient even holding wood to stop the tree moving backwards.

At no time while the back cut is being made should the machine operator apply extra force to the trunk of the tree, unless told to by the feller, as the tree may split or cap up.

Once the scarf cuts and the back cut are done the tree feller should leave the area by the safest route to a safe zone. This zone should be agreed between the feller and the machine operator before starting work.

The machine operator may then push the tree steadily and in a controlled way until it is committed to fall. If the tree will not fall the machine operator should isolate the controls with the attachment still in contact with the tree trunk and ask the feller by radio to return to the tree and remove more hinge wood.

Once the tree feller removes more hinge wood the tree feller should go back to the safe zone before the machine operator starts to push the tree again.

The feller should ensure the width of the hinge wood is not reduced below five percent of the diameter of the tree.

If the hinge wood has been progressively reduced to five percent and the tree will still not fall the feller should stop the operation and ask the person in charge to assess the risk of continuing.



Back pulling

Back pulling is a mechanically-assisted method of felling a tree against its natural lean. A line is attached to the tree being felled and cuts are placed in the tree by a feller. The line is tensioned using mobile plant to bring the tree down. This technique is useful where the natural fall direction of the tree would bring it into contact with electric lines or other structures or would otherwise create an unsafe situation. The operation should always be under the direction of a competent person.

The feller and the machine operator should be able to communicate clearly with each other and, where possible, be able to see each other at all times. Systems like two-way radios, mobile telephones and agreed hand signals or whistles can be used to communicate.

The machine used for back pulling should be capable of pulling the tree and be able to operate safely on the terrain where the tree is being felled.

- The line attached to the tree should be firmly fixed as high as possible and tension applied and maintained on the line before felling starts. Where possible the machine used for pulling the tree should be operated at least two times the length of the tree being pulled away from this tree. If this is not possible an assessment should be carried out by a competent person to identify an alternate safe method to bring the tree down, for example using a tree feller positioned in an elevated work platform to cut the tree into sections and a crane to lower each section as it is cut off.



Tree climbing for back pulling operations

Tree climbing is required when setting up a tree for back-pulling operations.

Where there is a risk of a person falling the person conducting the business or undertaking must implement control measures to minimise this risk, so far as is reasonably practicable. Safety belts or harnesses should be worn when working above 2 metres in height. Climbing equipment should be suitable for its intended use and used, maintained, inspected, tested and stored according to the manufacturer's recommendations.

The climber should use a climbing assembly with a breaking strength not less than 2500 kg. Climbing equipment should also include:

- a safety belt with double D rings
- steel spurs which are long and sharp enough to hold in the tree being climbed
- a climbing rope which should
 - be laced to the climbing belt and pass through at least three D rings secured to the safety belt, and
 - have an eye splice at one end of the rope.

After passing around the climber and the tree, have the standing end passed through the eye and secured with a catspaw knot—also known as a sheep bend—or a mechanical rope-adjusting device.

Lineman hooks should not be used as climbing spurs. Tools carried and used by the climber should be safely secured when not being used to prevent workers below being hit by falling objects. If the climber is using a chainsaw it should be secured to the tree using a steel chain, a steel-core wire rope or other suitable means.



Mechanical felling

Many hazards identified for manual felling also apply to mechanical felling. However, risks to the machine operator are minimised by the protection provided by the machine. Machinery used for mechanical felling includes custom-built feller-benchers, single grip harvesters and processors and excavator-type machinery with after-market felling heads.

Table 7 Common hazards and risks associated with mechanical felling

Mechanical felling
<ul style="list-style-type: none"> ■ limbs hanging in retained trees ■ vines connecting other trees to the tree being felled or to the ground ■ high winds affecting the fall direction ■ dead or partially dead trees ■ tree felled into other work areas ■ machine not suitable for slope or terrain increasing the risk of the machine rolling over ■ ground workers being crushed or struck by mobile plant ■ slips, strains and falls getting into and out of the machine ■ mechanical harvester selected is not suitable to harvest the tree size in the coupe or harvesting site ■ poor visibility making it difficult to see overhead hazards ■ loose objects in the cabin of the mechanical feller ■ poor communication e.g. interrupted signals ■ mechanical failure, and ■ falling objects which can penetrate or crush the cabin space.

Table 8 Control measures for mechanical felling

Mechanical felling
<ul style="list-style-type: none"> ■ weight and power of mechanical harvester is suitable for the site conditions and tree size ■ operator is trained in working limits of machine and techniques for different trees and ground conditions ■ machine is operated in accordance with manufacturer’s specifications ■ cabin visibility allows the operator to see and check for hazards, especially overhead, and changing conditions ■ operator carries out a risk assessment of the felling area to decide if the risks are manageable e.g. how rocks, slopes or hollows could affect the operation ■ ensure oral, visual or radio communications with other forest workers ■ operation is within an agreed safe work area—usually at least two tree lengths separation ■ operator protective structure is suitable given the size of the trees being felled ■ handrails and steps

Mechanical felling
<ul style="list-style-type: none"> ■ operator seat and seatbelt used and maintained, and ■ PPE is suitable for use and correctly maintained e.g. high visibility clothing, safety footwear, hearing protection, safety helmet when outside the cabin and protective gloves when handling fuels or sharpening chains.

Table 9 Specific hazards, risks and control measures for mechanical felling

High risk activity or hazard	Reduced risk solution	Preferred solution
Chain breaks—possible exposure to chain shot.	No interim solutions.	<ul style="list-style-type: none"> ■ Install chain shot guard. ■ Reinforced windscreen preferably of polycarbonate construction as laminated glass will permit penetration and is therefore not suitable. ■ Never use a saw so the saw bar is directly in line with the cab or other people—preferably direct it at unoccupied section of plant. ■ Inspect cutting equipment daily. ■ Replace chain when required and per manufacturers' specification or more frequently. ■ Keep ground workers at least 70 metres away from a working harvester/processor or to manufacturer's specified safe working distance, whichever is greater.
Maintenance e.g. greasing a harvester head while the engine is running.	No interim solutions.	Complete shutdown and isolate the machinery while doing maintenance e.g. greasing and changing chainsaw bars and chains.
Felling trees beyond the machine's capability as specified by the manufacturer.	No interim solutions.	Should not be carried out.

High risk activity or hazard	Reduced risk solution	Preferred solution
Machine instability during felling.	<ul style="list-style-type: none"> ■ Ensure harvesting attachment is properly clamped to tree. ■ Do not overreach with boom. ■ Place machine straight up and down slope. 	<ul style="list-style-type: none"> ■ If lean of tree and slope is beyond the specified machine capability, leave for hand felling. ■ Do not fall if wind conditions make fall direction unpredictable.
Felling near overhead power lines.	<ul style="list-style-type: none"> ■ Work at least two tree lengths away from power lines. ■ Only fell trees parallel with or away from power lines. 	<ul style="list-style-type: none"> ■ Liaise with power companies to switch power off as necessary.
Patches of rock, vines, dead trees and tunnel erosion within steep or dense areas.	<ul style="list-style-type: none"> ■ High risk areas marked on harvest planning map based on aerial photographs and historical records. 	<ul style="list-style-type: none"> ■ Forest owner and operator should walk area before starting work to identify high risk areas and adjust or select harvesting techniques to suit. ■ High risk areas should be recorded on the planning map for the benefit of the next rotation.



Further information

Codes of practice, guidance material and other resources are available on the [Safe Work Australia](http://www.swa.gov.au) website (www.swa.gov.au).

APPENDIX A – PROCEDURES FOR BRINGING DOWN TREES THAT SIT BACK DURING FELLING

Procedure 1

Can you wedge the tree?

- Take the following factors into account in assessing the tree to determine if it can be wedged and felled in the original desired direction:
 - tree should be less than 100 cm in diameter
 - tree should not have excessive weight of foliage or branches on the back side
 - tree should be solid
 - wind strength and direction should allow the tree to move forward in the desired direction, and
 - retain 10% of the diameter of the tree as hinge wood to allow for safe wedging.

Further information is in the *Tree faller's manual – Techniques for standards and complex tree-felling*

If you answered NO to any of the above, go to procedure number two.

If you answered YES follow the procedure below.

- Insert lifting wedge(s) in the back cut—aluminium is recommended. If this is not possible bore a hole wide enough for the wedge(s) in or just below the compressed back cut. On small trees this bore cut may extend through the hinge wood in the centre of the tree, but do not cut the hinge wood on the corners. This should be done:
 - as near as possible to the back of the tree
 - in a position where the wood is solid
 - not in a pronounced spur which may split, and
 - in a position which maximises the distance between the wedge and the hinge wood.

Note: Where two wedges are used they should be spread at 45 degrees either side of the centre of the back cut.

- Drive wedges until the tree leans forward and falls. If the tree leans forward but will not fall, the width of the hinge wood may be reduced to five percent of the diameter of the tree.

Procedure 2

Can the tree be felled backwards from the original intended fall direction? The following is an example of how this may be done.

- Assess the tree to see if it is safe to fell the tree backwards. Do not go out in front of the tree to prepare the escape routes.
- A clear area is already available.

If you answered NO go to procedure number three.

- Tree should be less than 100 cm in diameter.
- There is room to fell the tree without hitting standing timber.

Note: There should be a clear area equal to the height of the tree in the intended fall line and in an area of 45 degrees either side of the intended fall line.

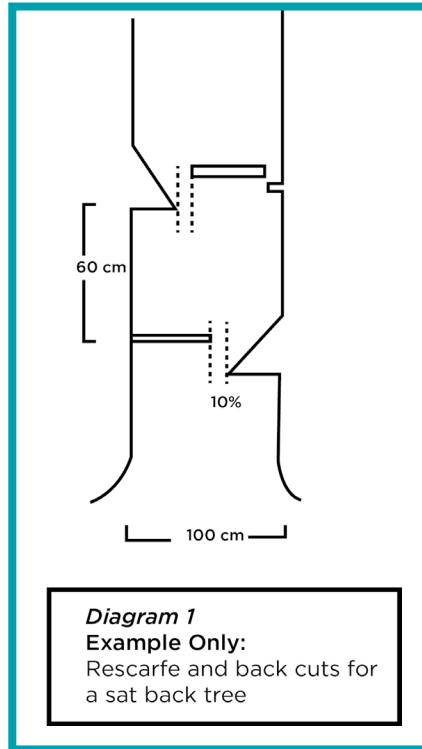
- The tree can be re-scarfed a minimum of 60 cm above the original back cut and then back cut without having to use the chainsaw above chest height.
- Retain 10 percent of the diameter of the tree as hinge wood.
- There is a clear area for new escape routes on the other side of the tree.

If you answered NO to any of the above, go to procedure number three.

If you answered YES follow the procedure below (see diagram 1).

- Cut a new scarf at least 60 cm above the original back cut. The higher it can be cut the better. However, this should not be above chest height.

- Back-cut the tree using the heavy leaning tree method i.e. bore in behind the hinge wood and cut back leaving a small strap of wood at the back of the tree. Cut this strap last at 50 mm below the bore cut(s).
- Proceed along escape routes paying extra attention to the felling tree to ensure the block of wood between the two cuts does not pivot backwards and allow the tree to slide back over the stump.

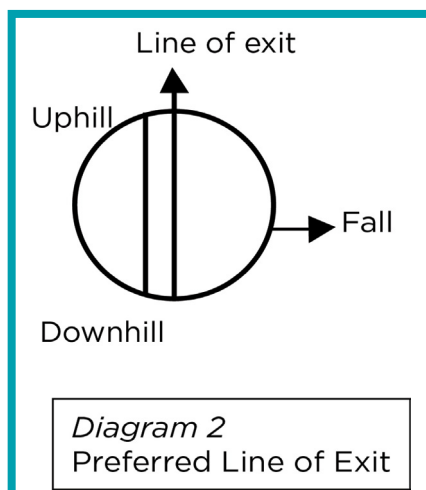


Procedure 3

Where the tree cannot be felled using either Procedure One or Two.

Where a feller has determined it is not possible to safely fell the tree using standard tree felling procedures one of the following procedures are to be used:

- Leave the stump of the tree by the safest exit route e.g. as near as possible to 90 degrees from the intended fall line and on the uphill side, where possible (see diagram 2).
- Mark the exit point so re-entry can be by the same route.
- Report to the person in charge—the Bush Boss.



- Re-assess the tree to determine which is the best and safest way to bring it down and then choose from one of the following techniques:

(i) The feller should:

- tape off the area at two times the height of the tree
- tape the sat back tree
- tape off entry roads and tracks
- vacate the area and wait for the wind to bring the tree down, or fell it with explosives
- tell everyone present on the operation:
 - that a tree has been left standing
 - the specific tree location
 - the direction the tree should fall, and
 - stop work around the danger area.

Contractors should ensure there is an adequate supply of approved marking tape on their logging operations.

(ii) Use an excavator to push the tree in the intended direction.

If this method is selected a risk assessment should be carried out before work starts and the following criteria adhered to:

- the tree has a diameter less than 100 cm diameter at breast height
- the excavator operator is given the right not to do the work
- the excavator is big enough to bring the tree down
- the excavator is fully guarded for bush operation
- the excavator is fitted with a log grab, fixed head, heel boom or felling head capable of controlling the tree.

Note: A rotating grab should not be used as the operator will not be able to control the fall direction as the grab may rotate and allow the tree to fall back towards the machine.

- the person in charge—the Bush Boss decides to use an excavator
- the feller ensures the tree has sufficient holding wood—10% of the diameter of the tree, to sustain a controlled push
- the excavator operator has walked through and inspected the site and job before taking the excavator in
- the excavator operator gets to the tree without having to scrub to remove ground foliage or remove debris
- the excavator can be placed immediately behind the tree
- the attachment is as high as possible on the tree but just below full reach so the operator can lift and push at the same time
- push with a smooth constant action and do not rock the tree
- be aware of dry heads and limbs, and
- ensure all other people stay at least two tree lengths away until the tree is brought down.