Tree Felling

Best practice guidelines for
Tree Felling

Vision, knowledge, performance

This Best Practice Guide is currently being rewritten.

A new version will be available by 2015.
He Mihi

*Nga pakiaka ki te Rawhiti.*  Roots to the East.

*Nga pakiaka ki te Raki.*  Roots to the North.

*Nga pakiaka ki te Uru.*  Roots to the West.

*Nga pakiaka ki te Tonga.*  Roots to the South.

*Nau mai, Haere mai*  We greet you and welcome you.

*ki te Wāōonui o Tane*  To the forest world of Tane.

*Whaia te huarahi,*  Pursue the path,

*o te Aka Matua,*  of the climbing vine,

*i runga, I te poutama*  on the stairway,

*o te mātauranga.*  of learning.

*Kia rongo ai koe*  So that you will feel,

*te mahana o te rangimārie.*  the inner warmth of peace.

*Ka kaha ai koe,*  Then you will be able,

*ki te tū whakaiti,*  to stand humbler,

*ki te tū whakahī.*  Yet stand proud.

*Kia Kaha, kia manawānui*  Be strong, be steadfast.

*Tenā koutou katoa.*
First edition July 2000
Revised edition January 2005
This Best Practice Guideline is to be used as a guide to certain felling procedures and techniques. It does not supersede legislation in any jurisdiction or the recommendations of equipment manufacturers.
FITEC believes that the information in the guideline is accurate and reliable; however, FITEC notes that conditions vary greatly from one geographical area to another; that a greater variety of equipment and techniques are currently in use; and other (or additional) measures may be appropriate in a given situation.

Other Best Practice Guidelines included in the series:

- Cable Logging
- Chainsaw Use
- Fire Fighting and Controlled Burnoffs
- Ground-based Logging
- Land Preparation
- Loading
- Maintenance Inspections of Yarder Towers
- Manual Log-making
- Mechanised Harvesting and Processing
- Mobile Plant
- Personal Protective Equipment
- Road and Landing Construction
- Silviculture
- Transport
- Tree Planting
- Working with Helicopters

© Copyright 2000, FITEC, New Zealand

ISBN 0-9582194-3-5
Best Practice Guidelines
for
Tree Felling
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1. Purpose of these guidelines</td>
<td>1</td>
</tr>
<tr>
<td>2. How to use these Guidelines</td>
<td>1</td>
</tr>
<tr>
<td>3. Acknowledgments</td>
<td>2</td>
</tr>
<tr>
<td>4. About best practice training material</td>
<td>2</td>
</tr>
<tr>
<td>Tree felling basics</td>
<td>3</td>
</tr>
<tr>
<td>5. Felling operation types</td>
<td>3</td>
</tr>
<tr>
<td>6. Felling objectives</td>
<td>3</td>
</tr>
<tr>
<td>Factors affecting tree felling</td>
<td>4</td>
</tr>
<tr>
<td>7. Boundaries</td>
<td>4</td>
</tr>
<tr>
<td>8. Operational planning</td>
<td>4</td>
</tr>
<tr>
<td>9. Terrain</td>
<td>4</td>
</tr>
<tr>
<td>10. Breakage</td>
<td>4</td>
</tr>
<tr>
<td>11. Felling and extraction direction</td>
<td>4</td>
</tr>
<tr>
<td>12. Piece size and stocking</td>
<td>5</td>
</tr>
<tr>
<td>13. Tree lean and form</td>
<td>5</td>
</tr>
<tr>
<td>14. Windthrow</td>
<td>5</td>
</tr>
<tr>
<td>15. Weather</td>
<td>5</td>
</tr>
<tr>
<td>16. Undergrowth</td>
<td>6</td>
</tr>
<tr>
<td>17. Extraction and processing method</td>
<td>6</td>
</tr>
<tr>
<td>18. Environmental constraints</td>
<td>6</td>
</tr>
<tr>
<td>19. Other workers and operations</td>
<td>6</td>
</tr>
<tr>
<td>Felling equipment and accessories</td>
<td>6</td>
</tr>
<tr>
<td>20. Motor-manual felling</td>
<td>6</td>
</tr>
<tr>
<td>21. Wedges</td>
<td>7</td>
</tr>
<tr>
<td>22. Felling levers</td>
<td>7</td>
</tr>
<tr>
<td>23. Hydraulic tree jacks</td>
<td>8</td>
</tr>
<tr>
<td>24. Mechanised felling</td>
<td>8</td>
</tr>
<tr>
<td>Motor-manual felling cuts</td>
<td>9</td>
</tr>
<tr>
<td>25. Scarf cut</td>
<td>9</td>
</tr>
<tr>
<td>26. Back cut</td>
<td>10</td>
</tr>
<tr>
<td>27. Alternative scarf cuts</td>
<td>10</td>
</tr>
<tr>
<td>28. Wing cut</td>
<td>10</td>
</tr>
<tr>
<td>29. Quarter cut back cut</td>
<td>11</td>
</tr>
<tr>
<td>30. Split-level back cut</td>
<td>12</td>
</tr>
<tr>
<td>31. Bore and release back cut</td>
<td>12</td>
</tr>
<tr>
<td>32. Bore cutting the scarf</td>
<td>12</td>
</tr>
<tr>
<td>Motor-manual trimming</td>
<td>13</td>
</tr>
<tr>
<td>Quality</td>
<td>14</td>
</tr>
<tr>
<td>Job prescriptions</td>
<td>14</td>
</tr>
<tr>
<td>Operational planning</td>
<td>15</td>
</tr>
<tr>
<td>33. Planning and stand assessment</td>
<td>15</td>
</tr>
<tr>
<td>34. Warning signs</td>
<td>15</td>
</tr>
<tr>
<td>35. Rules</td>
<td>15</td>
</tr>
<tr>
<td>36. Acceptable signs</td>
<td>15</td>
</tr>
<tr>
<td>37. Placement of signs</td>
<td>16</td>
</tr>
<tr>
<td>38. Work area safety</td>
<td>16</td>
</tr>
<tr>
<td>39. Entering tree felling areas</td>
<td>17</td>
</tr>
<tr>
<td>40. Opening a felling face</td>
<td>17</td>
</tr>
<tr>
<td>Training and supervision</td>
<td>17</td>
</tr>
</tbody>
</table>
Knowledge of hazards 18
Health hazards 18
Operational hazards 21
  Chainsaw hazards 22
  Tree and felling hazards 24
  Windthrow hazards 25
  Trimming hazards 26
  Machine hazards 27
Personal protective equipment requirements 28

Basic tree felling procedures 29
  Step 1 – Assess Stand Hazards 29
  Step 2 – Assess the Tree 29
  Step 3 – Clear around the tree and prepare an escape route 30
  Step 4 – Make the scarf cut 30
  Step 5 – Make the back cut 31
  Step 6 – Observe tree fall 31
  Step 7 – Move to next tree 31

Advanced tree felling procedures 32
  Felling small-diameter trees 32
    Silvicultural thinning 32
    Production thinnings 32
  Felling trees against their lean 32
    Large trees 32
    Medium-sized trees 33
    Small trees 33
  Felling trees with side lean 34
  Trees with heavy forward lean 34
  Felling multi-leader trees 35
  Felling dead or broken trees 36
  Felling hung-up trees 36
  Felling cut-up trees 37
  Tree driving 37
  Rules 37

Windthrow procedures 39
  Butting off an unstable root plate 40
  Butting off a stable root plate 40
  Felling broken trees 41
  Felling wrenched trees 41

Trimming procedures 42
  Lever limbing method 42
  Trimming large branches 43
  Cross-cutting stems in tension and compression 43
    Cross-cutting an overhung log 43
    Cross-cutting a suspended log 43

Assisted felling procedures 44
  Felling with hydraulic tree jacks 44
    Rules 44
    Using two jacks for large trees 44
    Using one jack for medium trees 46
    Using one jack for small trees 46
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skidder and tractor-assisted felling</td>
<td>46</td>
</tr>
<tr>
<td>Rules</td>
<td>46</td>
</tr>
<tr>
<td>General guidelines</td>
<td>46</td>
</tr>
<tr>
<td>Pushing trees over using the fairlead or arch</td>
<td>47</td>
</tr>
<tr>
<td>Back pulling trees</td>
<td>47</td>
</tr>
<tr>
<td>Equipment</td>
<td>47</td>
</tr>
<tr>
<td>Winching</td>
<td>47</td>
</tr>
<tr>
<td>Back pulling against the tree lean (no blocks)</td>
<td>48</td>
</tr>
<tr>
<td>Back pulling against the tree lean (using a block)</td>
<td>48</td>
</tr>
<tr>
<td>Back pulling a side leaning tree</td>
<td>49</td>
</tr>
<tr>
<td>Excavator-assisted felling</td>
<td>50</td>
</tr>
<tr>
<td>Hauler-assisted felling</td>
<td>50</td>
</tr>
<tr>
<td>Requirements for felling operation</td>
<td>50</td>
</tr>
<tr>
<td>Direct stropping</td>
<td>51</td>
</tr>
<tr>
<td>Mechanised tree felling procedures</td>
<td>52</td>
</tr>
<tr>
<td>Work area Safety</td>
<td>52</td>
</tr>
<tr>
<td>Planning and tree assessment</td>
<td>52</td>
</tr>
<tr>
<td>Work technique</td>
<td>52</td>
</tr>
<tr>
<td>General technique</td>
<td>52</td>
</tr>
<tr>
<td>Felling large and leaning trees</td>
<td>53</td>
</tr>
<tr>
<td>Glossary of terms</td>
<td>54</td>
</tr>
<tr>
<td>Index to unit standards</td>
<td>57</td>
</tr>
</tbody>
</table>
Introduction

Purpose of these guidelines
The Best Practice Guidelines for Tree Felling have been developed by FITEC to improve worker safety and performance. They combine industry training standards and best practice information to provide a valuable reference manual for people involved in tree felling.

These guidelines should be read in conjunction with the Approved Code of Practice for Safety and Health in Forest Operations. In particular, these guidelines provide direct support for Part 3 - Section 14 (Tree Felling) of the code.

They are a valuable reference document for the following Unit Standards registered on the NZQA framework.

Unit 1227 – Demonstrate Knowledge of Plantation Forest Harvesting
Unit 1230 – Trim and Prepare Felled Trees for Extraction
Unit 1247 – Thin Plantation Trees to Waste (Early Thinning)
Unit 1248 – Thin Plantation Trees to Waste in a Production Situation
Unit 1250 – Thin Plantation Trees for Extraction in a Production Situation
Unit 1255 – Fell Trees using Machine Assistance
Unit 1270 – Salvage Windthrown Trees
Unit 6945 – Fell Trees using a Mechanised Harvesting Machine
Unit 6950 – Demonstrate Knowledge of Thinning Plantation Trees
Unit 6953 – Fell Trees in a Commercial Forest Production Situation
Unit 6964 – Apply Environmental Management to Harvesting Trees
Unit 17756 – Assess and Deal with Individual Hazardous Trees
Unit 17763 – Demonstrate Knowledge of Tree Felling
Unit 17765 – Fell Trees in a Commercial Forest Harvesting Operation
Unit 17766 – Fell Trees Safely using a Chainsaw and Basic Techniques
Unit 17767 – Thin Plantation Trees to Waste (Late Thinning)
Unit 19765 – Assess and deal with individual windthrown trees in a forest plantation

How to use these guidelines
These guidelines have been arranged in the following main sections.

- **Tree Felling Basics** covers types of felling operations, machines and equipment, basic felling cuts, and hazards.
- **Basic Tree Felling Procedures** outlines basic procedures for a range of tree types and situations. It also covers training, procedures.
- **Advanced Tree Felling Procedures** covers particular tree types and techniques.
- **Windthrow Procedures** deals with trees affected by windthrow.
- **Trimming Procedures**.
- **Assisted Felling Procedures** and
- **Mechanical Felling Procedures** provide detail on planning considerations and operational procedures for these two types of felling operations.

The **Glossary of Terms** gives the meaning of terms used throughout these guidelines.

The **Index to Unit Standards** allows the reader to locate information related directly to the Unit Standards listed.
Acknowledgements
FITEC acknowledges the assistance of the Occupational Safety and Health Service, Liro Forestry Solutions, and numerous forest industry trainers, forestry contractors, and forest company staff in the development of these Best Practice Guidelines.

About best practice training material
FITEC has developed the material in this publication. It has been reviewed by representatives of the forest industry. At the time of publication, FITEC considers the practices and approaches in this publication to exceed accepted industry standards with regard to production and business management. In addition, the practices recommended in the publication exceed all the New Zealand regulatory standards, in particular those related to health and safety, environmental management, and human resources / employment.
This material is reviewed and reprinted regularly by FITEC.
Tree felling basics

Felling operation types
Felling of trees may be done for a variety of reasons. These include:
• Production forestry
• Land clearance
• Maintaining and removing shelter belts
• Urban forestry
• Silviculture (thinning to waste)
• Firewood harvesting
• Maintaining and removing trees near power lines
• Maintaining and removing trees for erosion control

Felling operations in forestry include:
• Silvicultural and production thinning
• Assisted felling using jacks, skidders, excavators and haulers
• Clearfelling

Felling operations may be:
Motor-manual – chainsaw
Machine-assisted – chainsaw with machine assistance with felling direction
Mechanised – completed by machine.

Felling objectives
The objectives of tree felling are to:
• Safely and effectively fell the tree
• Minimise damage to the tree and its surroundings.

The effectiveness of the felling in production situations can be measured by:
• The ease with which the stems can be extracted
• Its impact on value recovery.

The felling direction can affect extraction efficiency. If stems have to be turned during breakout or pulled head first (head pulled), the extraction speed will slow down.

Poor felling may also lead to felling damage. This may include breakage, slabbing of the butt, and drawwood. All have the potential to reduce the value of the tree. Other objectives of felling are related specifically to thinning operations.

Silvicultural thinning requires the removal of unwanted trees from the stand. This is done at an early age to improve the form, growth, and value of the crop trees.
Fallers should avoid damage to the remaining crop trees as this may reduce their value.
Trees are generally less than 15 m in height. No trimming is required but all trees must be completely severed from the stump. Felled trees must not be left hung up in crop trees.

Production thinning requires the removal of unwanted trees from the stand at mid-rotation. This will:
• Improve the growth and value of the crop trees
• Provide some income for the forest owner.

As with silvicultural thinning, damage to the remaining trees must be avoided.
The tree size can be large, with trees up to 25 m in height. Directional felling is critical to avoid damage and get the trees on to the ground. Trimming may be necessary, depending on the processing system.
Factors affecting tree felling

Boundaries
Felling boundaries may be indicated by:

- Painted trees
- Ridges
- Streams
- Roads.

Some boundaries have more sensitivity or risk, than others eg: fences dividing land ownership and powerlines. The boundaries of the block need to be checked during the planning phase. This will ensure that the different issues relating to the boundaries can be managed properly.

Operational planning
Thorough planning of the felling operation will ensure it is productive, safe, and profitable. If it is not adequately planned, problems may arise which are difficult to fix.

In many cases, roads and landings will already be formed. This will determine where the trees will be extracted to.

The contractor and the fallers will do much of this planning when they first walk the block. They will decide where to start felling and what hazards exist. It is important to document this information and ensure that everyone involved is clear about what is required.

Terrain
Knowing the lie of the land (topography) is critical for good felling. This will often dictate the extraction direction and, therefore, the felling direction.

Topography will have been one of the key factors in determining where roads and landings are located. During planning and felling consider the following:

- As trees tend to lean downhill, you must typically fell from the bottom of the hill to the top.
- Avoid felling across stumps, other trees, gullies, and ridges as this increases breakage.
- Be prepared to change your felling direction to suit subtle topography changes.

![Felling onto flat ground](image)

Avoid felling trees on stumps

Breakage
Breaking or shattering of trees during felling results in:

- Loss of value for the forest owner due to fewer logmaking choices and more short pieces left behind
- Loss of earnings for the contractor due to slower extraction.

The more pieces a tree breaks into, the more pieces must be extracted. It is better to extract a whole tree than a tree in two or three pieces.

The major causes of tree breakage are felling trees across one another or felling across stumps. Therefore, always try to directionally fell trees to minimise breakage and waste.

Felling and extraction direction
The most common extraction machines are rubber-tyred skidders, tractors, cable haulers, and swing yarders. Each has its own felling planning requirements.

All extraction methods work best if the felled stems can be extracted butt first (butt pull). The location of the landing will dictate felling direction. Butts should be pointing towards the landing as much as possible.
Piece size and stocking

The piece size can vary between and within stands. It is important to have equipment that is correctly sized for the task at hand. To safely fell larger trees, larger saws, longer cutter bars, and other equipment will be required.

The soil conditions, direction a slope is facing (aspect), silviculture and age will affect piece size.

At silvicultural thinning, tree volume may be 0.01 m³ to 0.2 m³ per tree.
At production thinning, it may be 0.2 m³ to 0.5 m³ per tree.
Clearfell trees may range from 0.7 m³ to 8 m³ per tree.
As piece size increases, so does tree height. This will affect the size of the safety zones, the amount of breakage, and possibly the amount of trimming needed.

Tree lean and form

Tree lean affects the direction a tree can be easily felled.

Predominant lean will be established by natural influences. These are:

- Topography
- Prevailing wind
-Aspect.

On flat land, trees will usually lean towards the north-east, or with the prevailing wind direction.

A further factor is the size and shape of the crown. Some trees may have more branches on one side. Typically, these are trees growing on the edge of a stand or in exposed positions. The weight of these branches can affect the direction the tree will naturally fall.

Windthrow

Windthrown trees pose extra difficulties for falling and extraction. Often trees are blown down (uprooted with the root plate still attached); blown over but still standing (wrenched); or the stems broken. Trees can be crossed over each other.

Windthrown trees can have extreme and complex tension and compression forces within them. This makes the job of identifying safe positions and cuts more difficult. As a result, only highly experienced fallers should work in windthrow.

Because of the potential hazards, safety becomes the number one aim. Production and felling quality will become less important, with logging crews often paid a daily rate instead of a volume rate. Machines for felling or assisted felling are used where possible.

Weather

Wind strength and direction, rain, and snow will affect tree felling.

Felling in strong winds is dangerous, especially if the wind direction is across or opposed to the felling direction.

Strong winds may cause loose material to fall, such as dead branches. The wind may also cause trees being felled to sit back on the back cut.

Very heavy rain and snow may also make felling dangerous, as visibility and footing are affected. Felling in thunderstorms is not safe, as there may be strong unpredictable wind gusts and lightning strikes.
Undergrowth
Heavy undergrowth is common in plantation forests. Undergrowth can hinder movement and reduce visibility. Clearing undergrowth may be necessary for:

- Tree access and work space
- Visibility of the tree crown and of obstructions in the landing zone
- A safe escape route from the felling zone.

Extraction and processing method

Skidders and tractors will typically work on flatter terrain and the falling may be only 1 day ahead of extraction.

Cable haulers and swing yarders, for safety reasons, will require a greater area of felling before they are set up than is needed for ground-based operations. Cable haulers or swing yarders also require fallers to leave high anchor stumps around the landing and on the back line.

Processing at landings may be either manual or mechanised. The volume of wood that can be processed varies substantially between methods and will affect the planning of the felling process.

The volume of timber felled at any one time will need to be matched with extraction and processing capabilities. Felling too few trees may result in a reduction in extraction productivity and profit for the contractor.

Environmental constraints

Felling of trees can damage native vegetation and leave tree tops in gullies and watercourses. Resource Consent requirements may limit certain felling and trimming activities within an area. Directional felling to avoid streams may be specified.

Other workers and operations

Tree felling should not take place within two tree lengths of other workers. However, it is important to be aware of other workers and machines working in the surrounding area, as they may be at risk from felling or machine operations.

Clearing undergrowth may be necessary for:

- Tree access and work space
- Visibility of the tree crown and of obstructions in the landing zone
- A safe escape route from the felling zone.

Felling equipment and accessories

Motor-manual felling

- Chainsaw of suitable size in good working order, sharp chain (refer to Best Practice Guidelines for Chainsaw Use).
- Wedges (3), driving tool
- First Aid kit
- Tool belt
- Adequate fuel and oil supply in appropriate containers
- Tool kit which may include:
  - bar wrench
  - file guide with depth gauge setter
  - tuning screwdriver
  - operator’s manual
  - feeler gauge
  - round file and flat file (including file handles)
  - sprocket and clutch grease gun
  - cleaning cloth
  - fire extinguisher
Suggested spares kit includes:
• Sharp chain
• Starter cord
• Starter spring
• Air and fuel filters
• Spark plug
• Chain breaking/joining tool and spare links
• Casing and cover screws
• Side cover nuts.

Wedges
Wedges are an integral part of a faller’s kit. They are used to:
• Stop the tree sitting back once the felling cuts have been completed
• Assist felling trees in a desired direction
• Alter the tree’s balance and weight distribution when felling trees against their natural lean
• Keep the saw cut open when crosscutting logs.

Typically, wedges are made of plastic, although there are aluminium and steel driving wedges in use. Wedges and driving tools range in size and capability. They should be selected according to tree size and expected lift requirements.

Small plastic wedges and a plastic hammer will usually be sufficient for smaller trees where you are not trying to force trees against their natural lean.

Long-tapered plastic, aluminium, or steel wedges are used for larger trees and when felling trees against their lean.

Note: Steel wedges may only be driven using wooden mauls or plastic hammers.

All tree fallers are required to have a set of at least three wedges and a driving hammer when felling trees greater than 20 cm in diameter. Wedges should be used where there is a risk of the tree sitting back.

Felling levers
When working in small trees, such as production thinnings, a felling lever with a cant hook can be useful for directional falling or downing hang-ups.

When felling, the tongue on the end of the bar can be set instead of a wedge and leverage applied by lifting the bar up.

If a small tree is hung up, the cant hook can be used to down the hang-up by rolling the stem away from the tree in which it is caught.
Hydraulic tree jacks

Hydraulic tree jacks are purpose-built for tree felling. They typically have a lifting capacity in excess of 15 tonnes. One jack may be suitable for most production situations. The second jack may be used routinely on large, heavy leaning trees.

The jack(s) are placed in cavities cut into the back side of the tree. The top and base plates of the jacks are designed to pivot during operation. The plates are also fitted with short studs or spikes. These two features ensure that the jacks do not pop out as the tree begins to lift.

Mechanised felling

A range of tracked or wheeled machines can perform mechanical harvesting. In New Zealand, excavators and purpose-built level swing machine bases are commonly used. These can be fitted with a range of different felling heads.

Mechanised felling operations are often limited by the slope of the ground, soil conditions, and tree size. The excavator-based machines are limited to easier terrain (maximum 22°). The level swing machine may be permitted to work on steeper slopes (up to 27°).

<table>
<thead>
<tr>
<th>Felling head type</th>
<th>Features</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feller director</td>
<td>Bar and chain</td>
<td>Clearfell:</td>
</tr>
<tr>
<td>(Feller-buncher)</td>
<td>Rotator mounted, scarf-cut-capable</td>
<td>• Hultdins F851 (CF)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Satco 630 (CF)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thinning:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hultdins F560 (TH)</td>
</tr>
<tr>
<td>Disk saw</td>
<td>Continuous rotation</td>
<td>Clearfell:</td>
</tr>
<tr>
<td>(Feller-buncher)</td>
<td>Accumulation of small trees</td>
<td>• Koehring 22&quot;</td>
</tr>
<tr>
<td>Harvester</td>
<td>Bar and chain</td>
<td>Clearfell:</td>
</tr>
<tr>
<td>(Harvester/Processor)</td>
<td>Delimb knives</td>
<td>• Waratah H24, H26</td>
</tr>
<tr>
<td></td>
<td>Rotator mounted</td>
<td>• AFM Lako 550Magnum</td>
</tr>
<tr>
<td></td>
<td>Scarf-cut-capable</td>
<td>• Satco 528</td>
</tr>
<tr>
<td></td>
<td>Bucking computer</td>
<td>Thinning:</td>
</tr>
<tr>
<td></td>
<td>Length/diameter measurement</td>
<td>• Waratah H20, H22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lako 60</td>
</tr>
</tbody>
</table>
Motor-manual felling cuts

The following section provides an overview of the chainsaw cuts used for felling. The specific procedures for felling in a range of situations are shown in later sections.

Felling of trees over 20 cm at stump height requires a **scarf**, **back cut**, and **hingewood**. The two basic cuts are the scarf cut and the back cut. Between these two cuts is the hingewood.

The hingewood acts the same way as the hinge on a door — guiding the tree to fall at right angles to the scarf line. The hingewood width should be no less than 1/10 of the tree's diameter.

If you cut through the holding wood on one side, then you lose control of the tree's fall.

You cannot compensate for a faulty scarf by making the hingewood thicker on one side. This will make it more difficult to fell the tree and will result in damage to the butt of the stem.

**Scarf cut**

The purpose of the scarf is to:

- Determine the direction in which the tree will fall
- Allow the tree to fall freely in the desired direction
- Minimise stem splitting, barber chairs, or slabbing.

The scarf is the first and most important cut made in felling a tree. It must be correct in every detail.

The consequences of an over cut scarf are:

- Loss of hingewood
- Loss of directional control
- The tree may break off the stump early in its fall and move back towards the faller.

The basic scarf cut is called the **conventional scarf**.

It is made up of two cuts; the top cut and the bottom cut.

1. The top cut is made first at an angle of 45°. This cut will be from 1/4 to 1/3 of the tree's diameter and will be facing the desired direction of fall. The cut will finish level and as near to the ground as is practicable.

2. The bottom cut is then made. It needs to be level and meet the two outside points of the angled top cut. When the cut section is removed, a clean opening will be left.

**HAZARD WARNING**

Some Dangerous Practices

Bottom cut of scarf has been made too deep, leaving no holding wood. Tree will fall without control and may "barber chair".

Cut has been allowed to carry on leaving no holding wood or hinge. Tree will fall without control.
Back cut
The purpose of the back cut is to allow the tree to fall forward. It is made after the scarf cut.

The back cut is made above the level of the bottom cut of the scarf — between 50 and 75 mm above is recommended. This creates a “step” that prevents the tree sliding back off the stump during its fall and allows the hinge to work effectively.

The conventional back cut is always horizontal.

The basic back cut starts at the back of the tree, directly behind the centre of the scarf. The cut is made forwards towards the scarf. One-tenth of the diameter of the tree is left uncut to act as the hingewood.

The hingewood should be parallel to the scarf and even across the diameter of the tree.

Alternative scarf cuts
There are three alternatives to the conventional scarf cut:

Vee scarf — where both top and bottom cuts are angled to reduce the amount of sloven when butting-off.

Swedfor scarf — where the top cut is much steeper. Should only be used on softwood, such as radiata pine, less than 40 cm in diameter. Because this scarf is more open, the tree can hit the ground without severing the hingewood. This can reduce the chances of the stem slipping downhill but the likelihood of butt damage will increase.

Humboldt scarf — where the top cut is flat and the bottom cut angled. Note the top cut is put in last so the wedge falls freely from the scarf. This helps reduce butt waste when felling on steep ground. It also reduces the potential for a drag becoming fouled on a stump in cable logging operations.

Wing cut
Wing cuts reduce the amount of felling damage to the valuable pruned butt log. They are short near-vertical cuts placed into the edge of the hingewood. They are put in after the scarf cut has been completed but before the back cut.

The following guidelines relate to wing cuts:
- Each cut needs to span the proposed hingewood width.
- Each cut should be not deeper than a guide bar width, usually 10 cm.
• Ensure the cut contacts solid wood beneath the bark below the bottom level of the scarf.

• Care must be taken when installing wing cuts to:
  ☐ cut only the outside of the hingewood, and
  ☐ be aware of the potential risk of kickback when using the tip of the guide bar.

If the tree being felled has heavy side lean, two wing cuts should not be used as they result in some 10% to 15% loss in hingewood strength. Only make a wing cut on the downhill side of the hingewood.

When in doubt about a tree’s side stability, do not wing cut the tension side.

**Quarter cut back cut**

Where the tree diameter is too large, or the cutter bar too small, to make the basic back cut a quarter cut may be used.

This involves making the back cut in two movements.

The first quarter cut is made from the back of the tree towards the hingewood (Step 1).

When the desired hingewood width is reached, the saw is bored in slightly to ensure an even hinge (Step 2).

The second quarter cut is completed from the other (safe) side of the tree. A single forward movement is completed until the desired width of hingewood is reached (Step 3). Make sure both cuts overlap.

A wedge may be used to keep the first quarter cut open while cutting the second.

Note: The final back cut must always be made from the safe side of the tree, away from any side lean.
**Split-level back cut**

The split-level back cut is useful when felling smaller trees that are leaning back. It is similar to the quarter cut except the final cut angles below and slightly overlaps the first.

A wedge is set in the first cut opposite the direction of fall. The sloping second cut reduces the chance of hitting the wedge with the saw and maintains an even back cut step on both sides of the tree.

**Bore and release back cut**

(1) First a bore cut is made from behind the hingewood toward the back of the tree. The backward progress of the bore cut is stopped when there is sufficient wood to hold the tree (holding strap).

On large-diameter trees, the bore cut may be made from both sides of the tree. Both bore cuts should be parallel, and the hingewood width uniform.

(2) Make the final back cut from the back of the tree, through the holding strap.

**Bore cutting the scarf**

Where the tree diameter is greater than twice the length of the cutter bar a bore cut may be made from the scarf side of the tree.

Make the scarf cut on such trees wider than normal to allow you to get the saw into the front of the scarf and bore it out.

Bore through the centre of the scarf face at the proposed back cut height. Fan the cut to minimise the reduction in hingewood.
**Motor-manual trimming**

Trimming involves cutting off the sloven and all accessible branches, and cutting off the head of the tree (heading off) if it is still attached. If the tree is multi-leadered, then one or more of the leaders may be cut off. Motor-manual trimming prior to extraction is common in ground-based operations. In this situation, about two-thirds of the faller’s time is spent trimming. Trimming is dangerous on steep slopes because of the risk of stem movement.

Chainsaw trimming is very strenuous. A high percentage of injuries occur during trimming. It is also linked with many back injuries and chronic back pain.

The key to safe (and less energy-sapping) trimming is to use a smooth flowing motion with the saw. There are five basic rules for work technique in chainsaw trimming. Where practicable, work with the stem on your right, and work from the butt to the head.

1. **Work at the correct height**
   - The best working height is above your knees and below your hips.
   - Support the chainsaw on the trunk of the stem being trimmed or on your thigh.

2. **Maintain a good firm stance**
   - If you stand with your feet apart you will be in the best position to control the chainsaw in the event of a kickback.

3. **Work with the chainsaw close to your body**
   - Having the saw close to your body puts less strain on your back.
   - Also, the sawdust will pass to one side instead of being directed at you.

4. **Change your grip on the handles**
   - Let the rear handle roll freely in your right hand.
   - Use your right thumb on the throttle as required.
   - Always keep your thumb around the front handle.
   - Rotate the holding position on the front handle to suit the position of the saw.
   - Always have the saw running at full throttle when the chain engages a branch.

5. **Let the saw function as a lever**
   - Alternate between the forward and backward running part of the chain.
   - Use the bar nuts as the lever centre point.
   - The saw should operate like a pendulum with one side of the guide bar always against the trunk.

Ideally, trimming should be carried out while walking alongside the tree, provided the tree is stable and debris or scrub is not a hindrance. This technique is called the Swedfor.

If trimming is done standing on the stem, the distance to the ground should be no greater than 1.5 m. This method of trimming can cause back strain and result in falls, trips, and injury.

Trees that are actually on the ground can be trimmed with relative safety.
Beware of a tree suspended by its branches, as one large branch may hold the tree up. Cutting this branch can result in the tree dropping suddenly and rolling on top of you.

When a tree is held up off the ground, trim the large branches from the outside in by making cuts to test its stability.

Always work on the uphill side of a stem on a slope.

Use the straight sections of the bar when trimming, not the tip or nose, to lessen the chance of kickback resulting.

Watch for limbs that are under tension, which can spring back and inflict severe injury. Stand on the side away from the tension and release the tension with two cuts (first on your side and then on the other side).

Make successive cuts to lower the stem to the ground

Quality

Tree felling is an important phase in the logging process. Good felling and trimming techniques will maximise volume recovery and the value of the stand by:

• Keeping stumps low
• Reducing breakage
• Reducing stem damage (such as slabbing and draw wood)
• Presenting the stem for efficient extraction
• Reducing the chance of a drag fouling in a cable logging operation
• Reducing the need for re-trimming.

Job prescriptions

The job prescription is a written instruction from the forest owner to the harvesting contractor. It details the requirements for the felling operation as determined during the harvest planning process.

The job prescription may contain the following information:

• Compartment and setting locations
• A map showing road and landing locations
• Crop characteristics, including:
  - species
  - average piece size, height, and diameter
  - stocking
  - predicted breakage and pulp
• Environmentally sensitive areas including:
  - streams
  - boundaries
  - historic or cultural sites
• Other felling hazards including:
  - cliffs
  - tomos
  - powerlines
  - fences
• Resource Consent
• Terrain and soil classification.

It is important that all members of the crew are briefed on the prescription, especially parts applying to felling and extraction.

The job prescription provides the framework for the contractor’s operational planning.
Operational planning

Planning and stand assessment

All felling operations shall be under the control of a competent person fully experienced in the kind of work to be undertaken.

The person in charge of felling operations shall exercise control and supervision of the work to ensure that safety precautions are being observed.

The fallers and the person in charge of the operation shall identify hazards specific to the site.

All dead or defective trees that could cause danger to persons using roads, skids, or tracks shall be felled before extraction operations begin. This includes trees that have been disturbed by road or skid construction.

Forest managers should be informed when and where a new operation or stand harvest is commencing.

Notify neighbouring landowners when felling trees near boundaries.

Warning signs

Rules

- Signs warning of work in progress shall be displayed when work is on or near public or private roads or adjacent to boundaries.
- Planning of appropriate warning methods shall be prepared as part of hazard management.
- Permanent signs shall comply with the Manual of Traffic Signs and Marking, published by Transit New Zealand/LTSA.
- Temporary traffic control signs shall comply with the Code of Practice for Temporary Traffic Management, Transit, September 1st 2000.

Temporary signs shall be removed or covered when no longer valid or when work has ceased.

Where there is a road control authority, formal authorisation shall be obtained and compliance made with any conditions set by the authority before any signs warning of operations are placed and work commences.

Note that Transit jurisdiction covers all private forest roads that can be accessed by the public. If a road cannot be accessed by the public, the forest owners are considered the road control authority, and their policies apply.

Acceptable Signs

According to the Transit code, the following signs may be used.

- Advance warning signs

- Direction and protection signs
Placement of signs

Tree felling operations within two tree lengths of a road must have warning signs.

Transit requirements for sign placement relate to average annual vehicle usage. The following guidelines relate to traffic control on Level 1 roads — these are roads that carry less than 10 000 vehicles per day.

• The distances between the advance warning sign and the edge of the operational area vary with traffic speed.

• The diagram that follows gives an example of the required signs and placement. Road closure is less than 5 minutes at any one time. For full details refer to the Transit Code.

Work area safety

It is important to check the work area for hazards before you start felling or cutting. Under the Health and Safety in Employment Act 1992, you are required to avoid any activity that will harm yourself or another person in any place that you work.

Before any tree felling can commence:

• Inform all staff in the immediate area.

• Check on the distances to nearest workers to ensure an adequate safe working distance (two tree lengths minimum).

• Check that there are no other persons, children, or animals in the work area.

• Do not work in adverse weather conditions such as high winds, heavy rain, or snow.

• Always ensure you have a clear work area where you have stable footing and do not have to reach or work off balance.
When felling trees:
- Ensure other people are at least two tree lengths away unless they are part of the felling operation, assisting, supervising, or involved in training.
- Ensure that other operations, machines, and operating ropes are two tree lengths away.
- Fallers and observers shall ensure the safety area is maintained.
- Always have an escape route planned and cleared, at 45° to the side and rear of the direction of fall.
- Trees shall be felled into an open area unless there is no alternative.
- No tree shall be felled within two tree lengths of any road, railway or public access unless adequate provisions have been made to control traffic (signs, barriers, personnel).

If it is necessary for there to be more than one person at the tree with the faller:
- Only one person shall be making felling cuts at one time.
- Only one chainsaw shall be working while the felling cuts are being made.
- The person not making the felling cuts must be behind the tree being felled, positioned up the escape route in full view of the faller and able to see the top of the tree.

**Entering tree felling areas**
Every person entering an operational area shall:
- Notify the supervisor or foreman before entering the felling area.
- Exercise care when approaching workers engaged in any felling operation.
- Attract the attention of the faller before going within two tree lengths of the faller.
- Not enter the area until acknowledged or signalled to do so.

**Opening a felling face**
Before commencing felling you should have a sound knowledge of the stand and the procedures to be used in your logging operation. You should know your position in relation to landings, roads, other workers, and any hazards.

Before starting your saw, you need to determine the best position to start felling. Generally, the best position to begin will be in an area that allows you to fell trees into a clear area, with the prevailing lean. Once you have a face opened you have more clear area to work in which allows for more options to be available when problem trees occur.

If the terrain is difficult fell into gullies first. Felling with the contour rather than across narrow gullies is preferable because it reduces breakage.

**Training and supervision**
Accidents can result in lost time, disability, or death. This will increase costs for the employer through increased accident insurance levies, and potential loss of jobs and contracts.

The Approved Code of Practice for Safety and Health in Forest Operations requires that employees be supervised by a competent person until they are sure the employee can work safely and is not likely to harm themselves or anyone else.

Extra attention must be given to the training and supervision of new or inexperienced operators as most serious injuries occur to operators with less than 6 months’ experience.

All operators must be under a documented training programme and should be aiming to pass the relevant NZQA Units that apply to tree felling.

Workers involved in tree felling need to be fit, active, alert, properly trained or supervised, and appropriately equipped.
Knowledge of hazards

As part of the supervision and training programme, operators need to be shown the hazards they will face on the job and the controls to avoid being harmed by those hazards.

Before starting any new block, all operators must be involved in identifying any significant hazards on the site and the way those hazards will be controlled. There must be documented evidence on site listing the hazards and controls, and showing that all have been explained to all operators.

The two main hazard categories are health hazards and operational hazards. All operators should be familiar with both categories of hazards.

Health hazards

Tree felling is a very physically demanding job. To maintain peak performance and prevent accidents through fatigue, operators must take special care of their bodies. This includes their physical fitness, diet, water intake, personal hygiene, and sleep. How you treat your body away from work affects your performance at work.
# Health hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of rest/sleep</td>
<td>• Build short frequent rest breaks into your work routine.</td>
</tr>
<tr>
<td></td>
<td>• Take at least two evenly spaced 30-minute rest breaks during the working day.</td>
</tr>
<tr>
<td>Early starts</td>
<td>• Ensure each night you replace the sleep you lose in the morning.</td>
</tr>
<tr>
<td></td>
<td>• If you get up earlier go to bed earlier.</td>
</tr>
<tr>
<td></td>
<td>• Once early starts have finished, allow time for your body to recover.</td>
</tr>
<tr>
<td>Alcohol abuse</td>
<td>• Avoid drinking alcohol at least 24 hours before carrying out any hard physical work.</td>
</tr>
<tr>
<td>Lack of nutrition</td>
<td>• Start each day with a high carbohydrate breakfast like porridge, cereal, toast, bananas, pasta, or potatoes.</td>
</tr>
<tr>
<td>(most accidents occur between 9 and 11 a.m. when you are tired and running low on energy, so stop and have a smoko break)</td>
<td>• Eat high protein foods like lean meat, chicken, eggs, milk, and cheese at night.</td>
</tr>
<tr>
<td></td>
<td>• Eat at the start of a break, and rest to allow digestion.</td>
</tr>
<tr>
<td></td>
<td>• Always eat a high-carbohydrate snack straight after work.</td>
</tr>
<tr>
<td>Exposure to sun</td>
<td>• Wear sun block.</td>
</tr>
<tr>
<td></td>
<td>• Wear light shirts on hot days.</td>
</tr>
<tr>
<td></td>
<td>• Wear a hat.</td>
</tr>
<tr>
<td></td>
<td>• Carry out regular health checks.</td>
</tr>
<tr>
<td>Drugs</td>
<td>• Avoid all non-prescription drugs as they seriously affect both your mental and physical ability to work.</td>
</tr>
<tr>
<td></td>
<td>• Inform the boss if you are on any medication that may affect your work. Stay home if necessary.</td>
</tr>
<tr>
<td></td>
<td>• Before receiving any medication, tell your doctor what you do for a living.</td>
</tr>
<tr>
<td></td>
<td>• If you are on long-term medication for a serious health complaint, inform the boss or crew of your condition in case you are involved in an emergency at work.</td>
</tr>
</tbody>
</table>
# Health hazards (cont. . .)

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early over-exertion/sprains and strains</td>
<td>• Start each day with a 10–15 minute warm-up and then a few stretches.</td>
</tr>
<tr>
<td></td>
<td>• Start the day slowly until muscles are warmed up properly.</td>
</tr>
<tr>
<td></td>
<td>• If starting a new job, allow time for the body to get used to it before working flat out.</td>
</tr>
<tr>
<td></td>
<td>• Do some stretches at the end of the day.</td>
</tr>
<tr>
<td></td>
<td>• Take particular care when starting back at work after the holidays.</td>
</tr>
<tr>
<td>Hypothermia/chills</td>
<td>• Polypropylene clothing (thermal underwear) is excellent for cold, wet weather.</td>
</tr>
<tr>
<td></td>
<td>• If necessary also wear hi-viz rainwear.</td>
</tr>
<tr>
<td></td>
<td>• Put a hat and warm clothes on when you stop for a break.</td>
</tr>
<tr>
<td></td>
<td>• Bring spare dry clothing even on fine days. The weather can turn bad very quickly.</td>
</tr>
<tr>
<td>Lack of hygiene/infection</td>
<td>• Clean and dress any cuts or scratches received on the job as soon as possible and keep them covered.</td>
</tr>
<tr>
<td></td>
<td>• Make sure the first aid kit is kept fully stocked.</td>
</tr>
<tr>
<td></td>
<td>• Carry water and soap on the job to wash hands before smokos.</td>
</tr>
<tr>
<td></td>
<td>• Bath or shower every night.</td>
</tr>
<tr>
<td></td>
<td>• Eat a balanced diet to keep your body healthy.</td>
</tr>
<tr>
<td></td>
<td>• Wear clean clothes against the skin every day.</td>
</tr>
<tr>
<td>Occupational Overuse Syndrome (OOS)</td>
<td>• Use correct techniques.</td>
</tr>
<tr>
<td></td>
<td>• Ensure chainsaw and tools are well maintained.</td>
</tr>
<tr>
<td></td>
<td>• Have regular medical examinations.</td>
</tr>
<tr>
<td></td>
<td>• Use pre-work warm up and stretching techniques throughout the day.</td>
</tr>
<tr>
<td></td>
<td>• Incorporate rest breaks into your day.</td>
</tr>
</tbody>
</table>
Health hazards (cont . . .)

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dehydration/heat exhaustion</td>
<td>• Regularly drink fluids at a rate of 0.5 litres per hour and up to 1 litre per hour in hot conditions.</td>
</tr>
<tr>
<td></td>
<td>• Drink before you feel thirsty.</td>
</tr>
<tr>
<td></td>
<td>• Do not drink fluids, like soft drinks and cordials, that have more than 8% carbohydrate content.</td>
</tr>
<tr>
<td></td>
<td>• Drink high carbohydrate drinks after work to replace energy levels.</td>
</tr>
<tr>
<td></td>
<td>• Drink plenty of water at night to recharge the body.</td>
</tr>
<tr>
<td></td>
<td>• Drink a couple of glasses of water before leaving for work.</td>
</tr>
<tr>
<td>Ineffective personal protective equipment (PPE)</td>
<td>• Do not perform felling tasks if protective equipment is ineffective.</td>
</tr>
<tr>
<td></td>
<td>• Clean dirty hi-vis garments and oil-soaked protective legwear.</td>
</tr>
<tr>
<td></td>
<td>• Replace any soiled or worn, damaged, or expired protective equipment.</td>
</tr>
<tr>
<td></td>
<td>• Routinely check the condition of your protective equipment.</td>
</tr>
</tbody>
</table>

Operational hazards

Operational hazards will be specific to the type of felling operation being undertaken. The following are operational hazards relating to:

• Chainsaws
• Trees and felling
• Windthrow
• Thinning
• Machines
**Operational hazards**

<table>
<thead>
<tr>
<th>Chainsaw hazards</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cuts when sharpening chain</strong></td>
<td>• Work on a firm base.</td>
</tr>
<tr>
<td></td>
<td>• Use file handles and file guides.</td>
</tr>
<tr>
<td></td>
<td>• Always rotate the chain in the direction it travels when sharpening</td>
</tr>
<tr>
<td></td>
<td>or tensioning.</td>
</tr>
<tr>
<td><strong>Moving chainsaw chain</strong></td>
<td>• Wear all required protective equipment, and ensure it is in good</td>
</tr>
<tr>
<td></td>
<td>condition.</td>
</tr>
<tr>
<td></td>
<td>• Use correct stance and work techniques.</td>
</tr>
<tr>
<td></td>
<td>• Take appropriate action if low in energy, dehydrated, or fatigued.</td>
</tr>
<tr>
<td><strong>Kickback</strong></td>
<td>• Do not use upper tip of cutter bar.</td>
</tr>
<tr>
<td></td>
<td>• Avoid accidental contact between upper tip of cutter bar and branches</td>
</tr>
<tr>
<td></td>
<td>and logs other than the one being cut.</td>
</tr>
<tr>
<td></td>
<td>• Always maintain a firm 2 handed grip and good stance while cutting.</td>
</tr>
<tr>
<td></td>
<td>• Always use the mitt.</td>
</tr>
<tr>
<td></td>
<td>• Ensure that the chain brake is working.</td>
</tr>
<tr>
<td><strong>Burns from exhaust/muffler</strong></td>
<td>• Keep bare skin away from exhaust and muffler.</td>
</tr>
<tr>
<td><strong>Chainsaw exhaust fumes</strong></td>
<td>• Do not operate saw in poorly ventilated or confined areas for</td>
</tr>
<tr>
<td></td>
<td>prolonged periods.</td>
</tr>
<tr>
<td><strong>Fires</strong></td>
<td>• Do not smoke when refuelling.</td>
</tr>
<tr>
<td></td>
<td>• Move away from refuelling area before starting saw.</td>
</tr>
<tr>
<td></td>
<td>• Do not disconnect HT lead.</td>
</tr>
<tr>
<td></td>
<td>• Wipe up fuel spills.</td>
</tr>
<tr>
<td><strong>Vibration injuries</strong></td>
<td>• Ensure the vibration damping mounts on the saw are in good condition.</td>
</tr>
<tr>
<td><strong>A poorly maintained saw</strong></td>
<td>• If any part of a saw is not working correctly due to damage or wear,</td>
</tr>
<tr>
<td></td>
<td>it should be repaired, replaced or sharpened.</td>
</tr>
</tbody>
</table>
### Operational hazards (cont. . .)

<table>
<thead>
<tr>
<th>Chainsaw hazards</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Other workers</strong></td>
<td>• Apply the two tree length rule.</td>
</tr>
<tr>
<td></td>
<td>• If being supervised or trained, ensure the other worker is aware of your proposed actions, escape route, and safe position.</td>
</tr>
<tr>
<td></td>
<td>• If working together, only one person cutting at a time.</td>
</tr>
<tr>
<td></td>
<td>• Only one chainsaw can operate while felling cuts are made.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tree and felling hazards</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wedges</strong></td>
<td>• Hit the wedge squarely.</td>
</tr>
<tr>
<td></td>
<td>• Do not use damaged wedges.</td>
</tr>
<tr>
<td></td>
<td>• Wear eye protection when inserting wedges.</td>
</tr>
</tbody>
</table>

| **Hung-up trees**                 | • Never work under a hang-up.                                           |
|                                   | • Do not leave hung-up trees unattended.                                |
|                                   | • Hung-up trees must be brought down immediately or the area isolated from other activities and workers. |
|                                   | • Use a machine to pull down hang-up if necessary.                      |
|                                   | • Drive down if appropriate.                                            |
|                                   | • Use a felling assistant/observer.                                     |
|                                   | • No unprotected people within two tree lengths of likely direction of fall. |

| **Loose debris in crown, dead top, tangled crowns, vines and rot** | • Check tree’s crown before felling.                                   |
|                                                                 | • Use a felling assistant/observer.                                    |
|                                                                 | • Drive down if appropriate.                                          |
|                                                                 | • Use a machine to pull down hang-up if necessary.                    |

| **Tree falling in wrong direction** | • Use correct techniques.                                               |
|                                     | • Have escape route prepared.                                           |
|                                     | • Keep your eyes on the tree as it falls.                               |
### Operational hazards (cont. . .)

<table>
<thead>
<tr>
<th>Tree and felling hazards</th>
<th>Control</th>
</tr>
</thead>
</table>
| Tree jumps or slides when it hits ground | • Have escape route.  
 • Always keep eyes on tree as it falls.  
 • Move away from the stump as the tree falls. |

#### Felling operations

<table>
<thead>
<tr>
<th>Action</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>You must not be within two tree lengths of other felling operations unless you are:</td>
<td>• Use clear, prearranged procedures, techniques, and signals.</td>
</tr>
<tr>
<td>□ assisting or supervising the faller</td>
<td></td>
</tr>
<tr>
<td>□ training or being trained</td>
<td></td>
</tr>
<tr>
<td>□ positioned up the escape route in full view of the faller</td>
<td></td>
</tr>
<tr>
<td>□ able to see the top of the tree being felled from a safe position.</td>
<td></td>
</tr>
<tr>
<td>□ behind the tree being felled</td>
<td></td>
</tr>
</tbody>
</table>

#### Overcut hingewood

<table>
<thead>
<tr>
<th>Action</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid or correct overcuts in the scarf before starting the back cut.</td>
<td></td>
</tr>
<tr>
<td>If back cut is overcut, tree will not fall where intended — retreat up the escape route and watch the tree fall.</td>
<td></td>
</tr>
<tr>
<td>Ensure backcut progress is parallel to the scarf.</td>
<td></td>
</tr>
</tbody>
</table>

#### Slope and/or ground conditions

<table>
<thead>
<tr>
<th>Action</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear any obstacles from around the tree before making any cuts.</td>
<td></td>
</tr>
<tr>
<td>Ensure you have a firm footing before making any chainsaw cuts.</td>
<td></td>
</tr>
</tbody>
</table>

#### Weather conditions

<table>
<thead>
<tr>
<th>Action</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop felling in heavy wind, rain, and thunderstorms.</td>
<td></td>
</tr>
<tr>
<td>Assess how the wind will affect felling. If possible, adjust felling direction or move to a more favourable site.</td>
<td></td>
</tr>
</tbody>
</table>

#### Attaching strops during machine-assisted felling

<table>
<thead>
<tr>
<th>Action</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use a ladder or other stable platform for attaching the strop as high as possible up the tree.</td>
<td></td>
</tr>
<tr>
<td>Do not climb the ladder or machinery wearing spiked boots — there is an increased risk of falling.</td>
<td></td>
</tr>
</tbody>
</table>
Operational hazards (cont. . .)

<table>
<thead>
<tr>
<th>Windthrow hazards</th>
<th>Control</th>
</tr>
</thead>
</table>
| **Windthrown trees (blown over or broken)** | • Use experienced and trained fallers only — windthrow felling is more hazardous than normal felling operations.  
• Always endeavour to work from the outer edge and progress in the same direction as the wind throw.  
• Approach all trees with caution.  
• Assess tree stress carefully and use the approved and appropriate technique.  
• If in doubt, have the tree moved to a safe position by machine.  
• Do not work close to or forward of wrenched trees.  
• Use a bar length which allows all cuts to be made from one side of the tree.  
• Have felling aids either on hand or available on site.  
• Do not work too far in advance of the extraction machine.  
• Work in close cooperation with the extraction machine operator. |
| **Wrenched trees (still standing)** | • Always endeavour to work from the outer edge, and progress in the direction of the windthrow.  
• Assess forces in the tree before making any cuts.  
• Assess the stability of the rootplate - it may move when the cuts are made, making footing unstable.  
• Consider the likely reaction before making any cuts.  
• Minimise scarf depth and be alert to saw jambing.  
• Use bore and release cutting techniques.  
• Watch for changes in the tree lean during and after cutting.  
• If in doubt about your safety, seek assistance from a more experienced faller or machine operator.  
• Use machine assistance to eliminate or minimise risk. |
**Tree felling basics**

### Operational hazards (cont . . .)

<table>
<thead>
<tr>
<th>Trimming hazards</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tree movement</strong></td>
<td>• Assess forces in the stem and branches before trimming.</td>
</tr>
<tr>
<td></td>
<td>• Trim only on the safe side of the stem or branch.</td>
</tr>
<tr>
<td></td>
<td>• Do not trim on slopes where the stem may move downhill when cut.</td>
</tr>
<tr>
<td></td>
<td>• If deemed unstable, trim only on the uphill side of the stem.</td>
</tr>
<tr>
<td></td>
<td>• If in doubt, do not attempt to trim the tree.</td>
</tr>
<tr>
<td><strong>Ground hindrance (ground vegetation, slash)</strong></td>
<td>• Clear around where you plan to cut to provide an escape path and secure footing, and reduce the risk of kickback.</td>
</tr>
<tr>
<td></td>
<td>• Trim while standing on the top of the stem only where necessary.</td>
</tr>
<tr>
<td></td>
<td>• Do not work from the top of a stem over 1.5 m off the ground.</td>
</tr>
<tr>
<td><strong>Stem or branches under tension</strong></td>
<td>• Assess the degree of tension before making relieving cuts.</td>
</tr>
<tr>
<td></td>
<td>• Cut the compression side first — assess the degree of tension from the tendency to bind.</td>
</tr>
<tr>
<td></td>
<td>• Always cut from the safe side of the stem or branch.</td>
</tr>
<tr>
<td><strong>Elevated stems</strong></td>
<td>• Do not work from the top of a stem over 1.5 m off the ground.</td>
</tr>
<tr>
<td></td>
<td>• Wear spiked boots.</td>
</tr>
<tr>
<td></td>
<td>• Cut supporting branches progressively to lower the stem to the ground.</td>
</tr>
<tr>
<td><strong>Overhead hazards</strong></td>
<td>• Look into surrounding standing trees for overhead hazards before moving forward to trim the felled tree.</td>
</tr>
<tr>
<td></td>
<td>• If necessary, fell the hazardous tree (using the appropriate techniques) before proceeding with trimming.</td>
</tr>
</tbody>
</table>
### Operational hazards (cont. . .)

<table>
<thead>
<tr>
<th>Machine hazards</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fallers working with machines</strong></td>
<td>• Use clear, prearranged procedures and signals.</td>
</tr>
<tr>
<td></td>
<td>• Faller is in control.</td>
</tr>
<tr>
<td></td>
<td>• Identify and keep to safe positions.</td>
</tr>
<tr>
<td><strong>Poor visibility for machine operator</strong></td>
<td>• Machine operator must be aware of your presence before you go inside the machine’s hazard zone.</td>
</tr>
<tr>
<td></td>
<td>• Ensure windows are clean and free of unnecessary glare.</td>
</tr>
<tr>
<td><strong>Machine movement</strong></td>
<td>• Unprotected workers must stay clear until the machine has stopped moving and operator indicates it is safe to approach.</td>
</tr>
<tr>
<td></td>
<td>• Do not get between the felling head and the ground.</td>
</tr>
<tr>
<td><strong>Machine instability</strong></td>
<td>• Stay clear of machines when they are working.</td>
</tr>
<tr>
<td></td>
<td>• Do not operate machines beyond their slope capabilities, taking into account machine and terrain.</td>
</tr>
<tr>
<td></td>
<td>• Wear the seat belt.</td>
</tr>
<tr>
<td><strong>Tree movement</strong></td>
<td>• Unprotected workers must not be within two tree lengths of a falling tree. Because many harvesting machines slew after felling it is not safe to be behind the machine.</td>
</tr>
<tr>
<td></td>
<td>• Use a machine of appropriate size and capability for the job.</td>
</tr>
<tr>
<td><strong>Ineffective protective structures</strong></td>
<td>• Protective structures must be built to specific standards and be maintained in good condition. Refer to Section 4 of the Approved Code of Practice for Safety and Health in Forest Operations</td>
</tr>
<tr>
<td></td>
<td>• Damaged structures must be assessed by the original designer or other suitably qualified registered mechanic or structural engineer.</td>
</tr>
<tr>
<td><strong>Hydraulic equipment</strong></td>
<td>• Never work under raised hydraulic equipment</td>
</tr>
<tr>
<td></td>
<td>• Do not work on live or pressurised hydraulic systems without full protective equipment.</td>
</tr>
<tr>
<td></td>
<td>• Ensure equipment is lowered or chocked and stable before entering danger zones.</td>
</tr>
</tbody>
</table>
Operational hazards (cont . . .)

<table>
<thead>
<tr>
<th>Machine hazards</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broken saw chain</td>
<td>• The chain may break or fly off the bar; stay clear at least 70 m when machine is operating.</td>
</tr>
<tr>
<td>Overhead hazards (power lines, trees, sailors, broken heads)</td>
<td>• Check logging plan for hazards.</td>
</tr>
<tr>
<td></td>
<td>• Operations around powerlines must comply with OSH Approved Code of Practice for Safety and Health in (Part 2) Maintenance of Trees Around Powerlines.</td>
</tr>
<tr>
<td></td>
<td>• Check for overhead hazards before getting out of a protected cab</td>
</tr>
<tr>
<td>Proximity to other workers or machines</td>
<td>• Do not fell trees within two tree lengths of workers or other machines</td>
</tr>
<tr>
<td></td>
<td>• Make sure it is safe before felling any trees.</td>
</tr>
</tbody>
</table>

Personal protective equipment requirements

The approved Code of Practice for Safety and Health in Forest Operations requires manual tree fallers to have and use the following protective equipment:

- Hi-vis helmet fitted with Grade 4 earmuffs
- Hi-vis shirt, vest, or coat
- Approved protective legwear, chainsaw chaps, or trousers
- Protective eyewear, unless it creates a greater hazard
- Safety footwear providing ankle support
- First Aid Kit with at least two large sterile wound dressings

In addition, each faller should:

- Carry a fire extinguisher.
- Carry a means of communication (such as radio, pager, or whistle) and/or have arranged for regular communication with other workers on site. Note that no person shall be allowed to work alone unless all practicable steps have been taken to ensure they have a means of getting help in an emergency.

Many forest owners will specify protective equipment requirements other than those required by the Code.
Basic tree felling procedures

Step 1 – Assess stand hazards

• Assess the stand for hazards relating to the trees, terrain, other operations, and so on
• Determine the steps required to eliminate, isolate, or minimise any hazards identified
• Ensure the hazards and control measures are communicated to appropriate crew members.

Step 2 – Assess the tree

You must assess each tree to be felled to:

• Identify hazards.
• Determine if you are capable of felling it safely.
• Plan the felling cuts, and plan your own movements.

*It is a very important step as a hazard missed may cause harm to the faller. If you do not think you can fell the tree safely, get assistance.*

• Assess the tree diameter — is it over 20 cm? (All trees over 20cm at stump height require a scarf/backcut/hinge wood)
• Look for dead or broken branches or debris that may be dislodged during felling.
• Look for branches interlocking with branches of other trees.
• Look for any vines that may affect the direction of fall.
• Look for malform.
• Assess the tree for predominant and side lean.
• Identify the location of the heaviest branches and the general crown weight so you can select the direction of fall.
• View the tree from different angles so you don’t miss anything.
• Look for any rot around the base of the tree where the felling cuts are to be made. This may affect the direction of fall.
• Assess the ground conditions around the base of the tree.
• Determine the wind direction and strength relative to the proposed felling direction. Don’t fell trees in high winds.
• Determine if wedges or other felling aids may be required.

Having assessed the tree, you will have decided:

• If you are capable of felling the tree
• The desired felling direction
• Whether felling cuts are required
• The felling cuts to be used
• The safest position to complete the felling cuts from.
Basic tree felling procedures

Step 3 – Clear around the tree and prepare an escape route

You must clear vegetation or obstacles from around the base of the tree. This will allow you to access the tree and gain a sure footing.

Having decided on a felling direction, you will need to identify an escape route. This will be to the side and behind the tree.

1. Ensure you are wearing earmuffs and protective visor or glasses.
2. Start your saw using either the cold or warm start technique.
3. Using the bottom of the bar, clear any vegetation and low branches. Throw cut material to the side. Be aware of the kickback zone of your bar.
4. Clear an escape route on the side of the tree where the final back cut is made.
5. Lay out felling aids if required.

Step 4 – Make the scarf cut

The scarf cut is a two-step process – the top cut then the bottom cut. Where practical make the scarf cut while standing on the right hand side of the tree in relation to the proposed direction of fall.

1. Line the saw up with the proposed felling direction. All professional chainsaws have sights on them.
2. Position your body correctly before starting the first cut. Rest your left shoulder against the tree to relieve the potential strain on your back. You can also rest your right elbow on your right knee.
3. Grip the front handle in the middle of the bend (position 2 of the 3-position grip). This means that the chainsaw’s guide bar will naturally be hanging at the 45° angle.
4. Start the top cut, keep the saw level, and continue until the cut is \(\frac{1}{4}\) to \(\frac{1}{3}\) the diameter of the tree.
5. Ensure the top cut finishes level and that it is at the same height on both sides of the tree.
6. Grip the front handle on the side of the saw (position 3 of the 3-position grip). Activate the throttle with your thumb.
7. Commence the horizontal bottom cut at the right height to meet the top cut. Ensure you do not cut into the hingewood.
8. When making the bottom cut, look down the kerf made by the top cut to check that you do not cut past the top cut line. Keep the scarf line horizontal.
Basic tree felling procedures

(9) Stop cutting when the bottom and top cuts meet.
(10) Remove the section of cut scarf and check that the opening is clean, with no overcuts.

Step 5 – Make the back cut
Having completed the scarf cut, the faller moves to the back of the tree to complete the back cut.

1. Where practical, make the back cut using a pulling chain (the bottom of the bar).
2. Start the back cut directly behind the centre of the scarf. The back cut must be at least \( \frac{1}{10} \) the tree diameter (but never less than 5 cm) above the bottom cut.
3. Continue the back cut ensuring that the saw is kept horizontal. By keeping the front handle pointed in the direction of fall, the back cut can be kept parallel to the scarf.
4. When the bar is far enough into the tree, throttle off. Insert a wedge into the centre of the back cut and hammer it in firmly. This reduces the chance of the tree sitting back.
5. When you are close to the hingewood, slow the back cut. Watch for tree top movement.
6. If it is necessary to wedge the tree over, switch the saw off while wedging.

Step 6 – Observe tree fall
Once the back cut is completed, and the tree is beginning to fall:

1. Remove saw from the cut and apply the chain brake
2. Move into the planned escape route
3. Watch for falling material
4. Watch for the tree kicking back or bouncing once it hits the ground.

**DO NOT TURN YOUR BACK ON THE TREE**

Step 7 – move to next tree
When assessing the next tree:

- Shut the saw off before carrying it
- Never carry it by the front handle with the bar to the rear (if you slip you can cut the back of your leg(s))
- Never carry the saw on your shoulder (if you slip you can cut your neck)
- Carry the saw so it can be thrown aside if you fall
- Make your way carefully on uneven or unstable ground.

Basic tree felling procedures
Advanced tree felling procedures

Felling small-diameter trees

Silvicultural thinning
• If the trees are very small (less than 15 cm diameter), simply cut through the stem in one pass from the back of the tree, towards the front.
• Keep the cutter bar aligned perpendicular to the desired direction of fall.
• On slightly larger trees, up to 20 cm diameter, it is preferable to make a front cut or small scarf aligned in the direction of fall.
• All trees must be severed from the stump.

Production thinnings
• All trees should be scarfed and back cut.
• Some small-diameter trees require wedging. If the tree diameter is small, you may not be able get the wedge into the back cut without hitting the chain. In this case a split level back cut is desirable.
  • The back cut is made in two halves, with a wedge being set firmly in the half which is cut first.
  • The second half of the back cut then releases the tree to fall forward.
  • If it does not fall, an additional wedge may be set in the second half of the back cut after the chainsaw has been removed.

Felling trees against their lean
The method used will depend on the degree of tree lean. For heavily back leaning trees, machine-assisted methods are more appropriate (see Assisted Felling Procedures, page 44).

Wedges can be used for slightly back-leaning trees.

Large trees (where the bar does not go right through the tree)
(1) Cut a conventional scarf according to where you want the tree to fall.
(2) Make the first cut of a quarter-cut back cut.
(3) Insert a wedge into the first quarter-cut and set firmly.
(4) Ensure you do not over-cut the hingewood.
(5) Start the second quarter-cut and ensure both cuts overlap.
(6) When far enough forward, insert a wedge into the second quarter-cut.
(7) As you progress with the second quarter-cut, stop to drive the wedges.
(8) Complete the second quarter-cut. Stop your saw, and drive the wedges alternately until the tree begins to fall.

Medium-sized trees (where the bar does go right through the tree)

(1) Cut a conventional scarf according to where you want the tree to fall.
(2) Start a conventional back cut, cutting from the back of the tree towards the hinge wood. When the bar is far enough into the cut, insert one or two wedges into the back cut.
(3) Continue the back cut, stopping a couple of times to drive the wedge(s) in more.
(4) Stop your saw when the hingewood is reached and drive the wedge(s) until the tree begins to fall.

Small trees (where there is a risk of hitting the first wedge with the chain)

(1) Cut a conventional scarf according to where you want the tree to fall.
(2) Start the first cut of a split-level back cut.
(3) When the first cut is completed, insert a wedge in the back of the tree. Ensure you do not over-cut the hingewood.
(4) Start the final back cut at the same level but angled below, and overlapping, the first
(5) Complete the final back cut. Stop your saw, insert another wedge in the final cut (if necessary) and drive the wedge(s) home until the tree begins to fall.
Felling trees with side lean

The method used will depend on the degree of side lean. For heavily side-leaning trees, machine-assisted methods are more appropriate (see Assisted Felling Procedures page 44).

Assess predominant and side lean to identify the safe side of the tree. Where the side lean is slight, wedges and a variation in hinge width can be used.

1. Make the scarf facing the intended direction of fall.
2. Make a wing cut on the downhill side of the hingewood only.
3. The back cut is made as a quarter cut. The hingewood width on the lean side of the tree is slightly less than normal. Start the first quarter cut on the leaning side of the tree.
4. Insert a wedge in the first quarter cut when it is completed.
5. Start cutting the final quarter cut. Tap the wedge in further as the cut is made. Stop the cut when you reach the hingewood. Remember to leave a wider hinge on this side of the tree.
6. Drive the wedge home, and the tree should fall in the right direction.

Trees with heavy forward lean

The following trees are difficult to fell safely using conventional methods:
- Trees that have very heavy forward lean.
- Trees with more head weight in the felling direction.
- Species prone to slabbing (e.g., tawa and willow).

Using a conventional scarf and back cut on heavy front-weighted trees is dangerous. As a conventional back cut is made, high tension forces in the uncut wood creates a split or “Barber Chair”. If this happens you may lose control of the tree, and it may slide backwards off the stump.

Use the following bore and release method to reduce the chance of a heavy-leaning tree splitting:

1. Cut a conventional scarf slightly higher than you normally would. Make the scarf shallower than normal if you think the bar will jam.
2. Remove the bark from the back of the tree so that the solid anchor wood can be gauged. With very heavy forward-leaners, do this carefully!
3. Start the bore cut well behind the scarf.
4. Cut forwards towards the scarf to establish the hinge. The boring cut must be made from both sides of the tree if the bar is not long enough. Don’t go too far forward or you will risk getting your saw jammed!
5. When you have cut to the hingewood, cut towards the back of the tree leaving sufficient wood uncut to act as an anchor (holding strap).
(6) Do not go in front of or behind the tree once the bore cut has been made!

(7) Start the final back cut to release the anchor wood, cutting from the back of the tree. Make this cut below the level of the bore cut. The lower the final release cut, the slower the tree will fall.

(8) As the anchor wood is cut, watch for signs that the tree is falling. **Be aware that the tree will fall very quickly.**

If the tree diameter is small, the bore cut may cut the holding strap at the back of the tree. In this case, angle the bore cut to reduce its effective width.

**Felling multi-leader trees**

Whenever possible, each leader on a multi-leader tree should be felled separately in the direction of its lean.

When the dividing point of the leaders is close enough to the ground to be reached safely do the following:

1. Put a normal scarf in the first leader, facing the direction of lean.
2. Bore in behind the scarf at the correct height, leaving the required amount of hingewood.
3. Cut back towards the dividing point of the leaders. Slow the back cut near completion, as the leader will fall very quickly.
4. When the first leader is safely felled, the remaining one can be felled normally.
5. Cut the stump off at ground level.

Each leader needs to be considered as a tree and felled accordingly.

Note that it may be unsafe to trim the first leader until the second is felled. This will depend on the lean and condition of the standing leader.

If the dividing point is above shoulder height, then fell the two leaders as one tree.

1. Scarf the tree deep and wide enough to cover both leaders. It must be made in solid wood without a join or fault line running through it.
2. From the safest position, make the back cut evenly towards the holding wood.
3. Use wedges to ensure that both leaders start falling together.
Felling dead or broken trees

Each dead or broken tree will pose different problems, and should be assessed carefully. There is a risk that these trees have rotten and/or loose material in the top that may fall as soon as the tree is jarred or vibrated. If in doubt about your safety, arrange for assistance. This may be a skidder or excavator, or a more experienced faller.

All cuts need to be made from the safe side of the tree (away from any lean and not below any overhead material). If it is likely that the tree is rotten, it should be felled before the trees around are felled.

**Do not leave it standing as you work around it — it may fall at any time.**

Dead trees or trees with no top have less crown weight than healthy trees, and require slightly different felling techniques. Without the sail effect of branches the tree will fall very quickly, and without the cushioning effect of the branches may bounce or slide after hitting the ground.

Check thoroughly to ensure if wedging can be safely undertaken.

Driving dead trees can also pose dangers as the dead tree may break, with the upper stem falling backwards towards the faller.

Fell directly to the lean. You may need to use a plumb to assess lean.

Follow the steps below when felling these trees:

1. Standing on the safe side of the tree, insert a scarf cut. Make the scarf cut slightly deeper than normal.
2. Watch the top of the tree when putting in the scarf. The scarf may be higher than normal to make this easier. The tree may fall at anytime.
3. Check the condition of the sawdust — is there sign of rot?
4. Once the scarf has been cut, remove the scarf wedge and check it for rot.
5. Start the back cut.
6. Place a wedge in the back cut as soon as practicable to ensure the correct direction of fall. **Do not drive the wedge hard.**
7. Complete the back cut. Retreat up your escape route and watch the tree as it falls.

If a split-level back cut is made, a wedge can be inserted into each cut.

If the tree does not fall with one or two wedges (split-level), a third wedge can be inserted in a horizontal bore cut made below one of the wedges. This doubles the amount of lift that can be obtained.

Felling hung-up trees

A hung-up tree is a cut, windthrown, or pushed tree that is caught up or lodged against another tree, which prevents it from falling.

A hung-up tree must not be left unattended. It must be brought down as soon as possible, or isolated from the operation.

**Under no circumstances should the tree in which the hang-up is lodged be felled manually.**

No person outside a protected machine cab should be within two tree lengths of the intended or likely direction of fall of a hang-up.

In thinning operations, a cant-hook, a levering device, or posting can be used to dislodge the tree.

In clearfell, two options for bringing down a hung-up tree are tree driving or use of machine-assisted felling (skidder, tractor, or excavator).
Felling cut-up trees

A cut-up tree is one that has been scarfed and back cut, but which has not fallen. It may have wedges in the back cut.

It must be treated with caution as a change in wind direction or strength may be sufficient to push it over.

Cut-up trees must not be left unattended. They must be brought down as soon as possible or isolated from the operation.

No person outside a protected machine cab should be within two tree lengths of the intended or likely direction of fall of a cut-up tree.

The following options should be used to fell cut-up trees:

• If a machine is present, use it to assist the fall of the cut-up tree.

• If a machine is not present:
  1. If practical, bore a single bar width into the centre of the back cut. Insert a wedge into the bore cut and drive it home until the tree falls.
  2. Alternatively, make a second series of cuts the diameter of the tree above the original cuts, and fell directly to the new lean.

Tree driving

The term "driving" means pushing a tree over by felling another tree into it. Tree driving may be used to fell the following trees:

• Hung-up trees
• Broken trees
• Cut-up trees
• Slightly back-leaning trees.

Driving is most often used to bring down any of the above trees where more conventional methods (described earlier) have failed.

If you decide that a tree will be driven over before you make any cut to it, you must first prepare the work areas and escape routes around both trees before making any cuts.

Rules

• Tree driving is not acceptable as a normal felling practice. In the interests of safety it may be used to help fell difficult or dangerous trees.
• The tree to be driven shall have a holding wedge inserted in the back cut at the earliest opportunity and prior to any cut on the driving tree.
• The maximum number of trees in a drive without an observer is two (i.e., one on to one).
• A competent person shall act as observer to warn on the movement of trees whenever an initial one-on-one drive is unsuccessful and a further driving tree is necessary.
Follow the steps below when tree driving:

1. Tree driving must be pre-planned.
2. Ensure people are well clear of the area. Remember the two-tree length rule applies to the driving tree and the tree to be driven.
3. Choose a driving tree. It must be:
   - of sufficient size and weight to make the drive successful
   - no more than 20° off the proposed direction of fall of the tree being driven
   - in sound condition (don’t use a dead tree as a drive)
4. Prepare the area around both trees, and clear an escape route away from the driving tree.
5. Scarf, back cut, and firmly wedge the tree to be driven.
6. When scarfing the driving tree carefully align the direction on the tree to be driven. Keep watch on both trees.
7. Make the appropriate back cut to ensure felling direction is maintained.
8. Remove and shut off the saw as the driving tree starts to fall. Move up the escape route and watch for any dislodged or flying material.
9. Watch that the front tree (the driven tree) does not sway forward then backward, and break off into the felling zone.
10. If the drive is unsuccessful and trees are hung-up, either:
   - call for an observer to assist, or
   - isolate the area and get a machine to finish the work
Windthrow procedures

Wind-affected trees may be either uprooted, wrenched, or broken. These trees can constitute a major problem for both cutting and extraction. When the stem is disturbed or cut the tension may be released. The stem, or parts of it, may break or move suddenly with considerable force. This is made worse because tension in the stem may be in multiple directions.

Manual felling of windthrown trees is very hazardous and should not be done by inexperienced fallers. Where possible, a machine should be used to complete or assist the felling operation.

Extreme care is needed when cutting or breaking out windthrown stems. The safety of workers in windthrow operations is paramount, with production rate and cost secondary.

Windthrown trees that have the root plate or rootwad still attached can be dangerous. When crosscut, the root plate may spring back to its original position and the stem may move sideways or upwards towards the faller. This is a major hazard for the person cutting the stem.

The following are general guidelines for felling windthrown trees.

- Work from the outside of the stand in the direction of the windthrow.
- Approach each tree with caution.
- Identify the tension and compression zones and side bind in the stem. These are not always obvious until you begin cutting.
- Assess how the stem is going to move when tension is released — upwards and/or sideways.
- Assess the direction and how far the root plate is going to move when released.
- When deciding on the cutting sequence, always make a relief cut into the compression wood first. The depth this cut can be made before the bar begins to pinch indicates the amount of tension to be released.
- When making the relief cut, stand on the safe side of the tree. All cuts must be made from the safest position.
- Do not stand where there is danger of a root plate or stem springing back, or any branches or slash moving towards you.
- If the compression is severe, make the relief cut a vee cut.
- If tension is severe or dangerous to release by hand, use a machine to pull the tree to a better position before cutting off the root plate.
- Generally, machines and fallers should work close together, having the machine handy to assist if necessary.
- Never stand on trees when they are being cut.
- Use a machine to bring down standing but bent, leaning, or partially uprooted trees.
- Avoid head pulling as it requires trimming or butting to be carried near or under other wind throws.
- Have a cutter bar that is long enough to complete any cuts from the safe side of the tree.
- Stand sufficiently clear and have an escape route planned when trees or stems are first broken out.
- When working on steep slopes, or where cuts can not be safely completed, leave some holding wood between the stem and root plate. This will be broken off during the extraction phase. However, this may increase the risk of rolling root plates during breakout.
- The safest option is usually to extract the tree and root plate to a position where butting off can take place with minimal risk.
Butting off an unstable root plate

Follow the steps below when upward or side movement in the stem is anticipated and root plate movement is minimal.

1. Stand on the safe side of the tree. All cuts will be made from this side (Position A).

If it is safe to make the cuts from the right-hand side of the tree (looking up the stem), you will have greater reach when making the final angled cut.

2. Make the first cut on the compression side (bottom) of the stem. Stop the cut when the kerf begins to close on the bar. The depth of this cut will indicate the amount of tension in the tree.

3. Move slightly closer to the root plate (Position B) to make the final cut.

4. Start the final angled cut across the upper side of the stem. Step this final cut down from the first. The greater the distance between the two cuts, the slower the reaction will be. Angle the final cut at about 35° away from the root plate.

5. As you near the end of the cut, watch for movement of the stem and root plate.

Butting off a stable root plate

Where there is only slight to moderate tension in the tree, the faller can complete the cuts standing square-on to the cut zone.

Follow the steps below to cut a root plate off a stem where the tension is slight to moderate:

1. Stand on the safe side of the tree. All cuts will be made from this side.

2. Reach over the stem and make the first cut (Cut 1) on the tension side (far side). Be careful not to cut the top of the stem — this may lead to the stem splitting unexpectedly. Stop when you reach 1/3 the stem diameter.

3. Make a bore cut near the bottom of the stem (compression side) and cut down (Cut 2). Move the saw back and forth to widen the cut and reduce the chance of the bar pinching. If the bore cut is made too high the compression will be severe, pinching the cutter bar.

4. The third cut (Cut 3) is either made as a bore cut from near the top of the stem, or as an up cut from Cut 2. Leave a triangle of holding wood on the top of the stem.

5. As you near the end of the cut, watch for movement of the stem and root plate.

An alternative to Cut 4, is to make an up cut through the holding wood, leaving 3–4 cm on top. This can then be cut from above as a final cut. Although this reduces draw wood, the release of tension will be very rapid.

If the root plate moves forward (pinching the final cut), a second final cut can be bored below where the first attempt ended.

Windthrow procedures
Felling broken trees

Broken trees are a common result of windthrow. The procedures for broken trees have been described previously (page 36).

Felling wrenched trees

Wrenched trees are standing trees which are bent over and/or weakened around the root plate.

The felling techniques required are similar to those for trees with heavy forward lean (page 34). However, there are added hazards because of the potentially unstable root plate.

Extreme care should be exercised when felling wrenched trees because of possible movement of the root plate (upon which you are standing).

If there is doubt about the root plate stability, the tree should be completely uprooted before being butted off.
Trimming procedures

Lever limbing method

The saw is levered around the point where the bar enters the side cover.

The idea behind the lever method is to move the saw the shortest distance between limbs, using a zigzag pattern. The weight of the saw can be supported some of the time by the tree stem, otherwise use your thigh.

When using the backward-running chain (bottom of the cutter bar), lift the rear handle and press down on the front handle. When cutting with the forward-running part of the chain (top of the cutter bar), apply pressure to the rear handle so that the chain will cut up through the limb. Use the area of the cutter bar close to the saw to get maximum leverage.

The procedure for Lever Limbing is as follows (see diagram below):

1. Start with the saw on the right hand side of the stem (working towards the top). Support the weight of the saw on the stem and use the forward-running chain.
2. Tilt the saw on to its left side. Rest the cutter bar against the stem and use the forward-running chain.
3. Support the saw between your thigh and the stem. Use the backward-running chain.
4. Move the saw forwards towards the next branch, supporting it against your thigh. Use the forward-running chain.
5. Tilt the saw on to its right side and rest the cutter bar or saw body on the stem. Use the forward-running chain with your thumb operating the throttle.
6. Support the saw on the stem and use the backward-running chain. Move forward and start again at step one.
Trimming large branches

It may be difficult to use normal limbing methods on large or loaded (under tension) branches.

To avoid pinching the bar it may be necessary to cut the branch in stages or sections, working in towards the stem from the outer and thinner parts of the branch.

With very large branches it may be necessary to make two cuts, the first being similar to a scarf in tree felling.

Assess large branches carefully before you cut:

- Cut off any light branches or scrub that are in your way
- Cut off outer sections of a large limb to reduce weight or tension
- Remove the main section of the branch.

Be aware that branches can be under tension. They may move with considerable force when this is released.

Cross-cutting stems in tension and compression

In preparation for extraction, a stem may need to be cross cut. The sequence of cuts made will depend on the forces in the stem.

You should assess the forces in the stem before making any cuts. Assess the stem from a safe position.

Also, assess the possible movement of the log and stem when the cut is completed. If you think you cannot make the cuts safely, don’t make them. Ask for assistance from the extraction machine operator or a more experienced faller.

Cross-cutting an overhung log

Use the sequence of cuts shown at left for cross-cutting a log that is overhung.

Note that the top of the stem is under tension; the bottom is under compression.

Cross-cutting a suspended log

Use the sequence of cuts shown at left for cross-cutting a log which is suspended.

Note that the top of the stem is under compression; the bottom under tension (the opposite of above)
Assisted felling procedures

Situations may arise where some trees cannot be safely felled by a chainsaw alone.

These trees may include:

- Very large trees
- Trees adjacent to environmentally sensitive areas
- Heavily leaning or very malformed trees

In many cases, these trees need to be felled in the opposite direction to the natural lean or crown weight of the tree.

In these circumstances there are several techniques that can be used. These include the use of the following machines to assist in felling:

- Hydraulic tree jacks
- Tractor
- Cable hauler (or swing yarder)
- Skidder
- Excavator

Felling with hydraulic tree jacks

Rules

- There shall be two competent persons engaged on operations where tree jacks are used to fell trees against their lean.
- Trees shall be felled directly against their lean.
- Only jacks designed for tree felling can be used for this purpose.

Using two jacks for large trees

Follow the steps below when using two jacks:

1. Make the scarf cut (Cut 1). It should be no more than 1/4 of the tree diameter.

2. Measure and mark where the blocks are to be removed from the back of the tree. The bottom horizontal cut is part of the back cut. It should be stepped up from the scarf an extra 50 mm on what you would normally do.

3. Cut out the blocks taking care not to cut more of the holding wood than is necessary (Cuts 2 and 3). You need a good amount of holding wood to prevent the tree sitting back before the jacks are seated and the tension taken up.

4. Insert the jacks, making sure that the top and bottom jack plates are sitting on wood and not overlapping on to bark.

5. Pump the cylinders up to approximately one-third of the maximum pressure.

6. Bore cut the holding wood at the back of the tree (Cut 4). Make the cut slightly lower than the jack base plates.
(7) Bore cut the holding wood from one side of the tree between a jack and the hingewood (Cut 5). **Do not cut under the jack cylinders.**

(8) Make the final bore cut from the opposite side of the tree (Cut 6). The cutting up procedure is now complete.

(9) The chainsaw operator should now stand clear watching the top of the tree for movement while the jack operator pumps up the pressure.

(10) The jack operator should be watching the pressure gauge.

(11) Both operators should work in unison while the tree is felled.
Using one jack for medium trees
Where tree size and lean dictate only one jack needs to be used, the steps above can be modified. The jack can be located at the back of the tree opposite the direction of fall.

The back cut can be made as two quarter cuts inserted below the level of the jack base.

Using one jack for small trees
For smaller trees where there is insufficient room to have even one jack inserted before the tree sits back, a modification of the split-level back cut is used. The technique is:

1. Make the scarf cuts as normal for jacking (approximately 1⁄8 of the tree diameter).
2. Make the first split-level back cut at least 75 mm above the bottom cut of the scarf.
3. Take it forward to establish the required amount of hingewood. This cut will serve as the jack’s seat, so it is critical that it is level and made at the correct height.
4. Mark out the height and width required for the jack block. Again, make sure that the block removed is the absolute minimum.
5. Insert the jack and take it up to one-third of the maximum pressure on the gauge.
6. Make the second split-level back cut, ensuring that the tip of the bar just overlaps the first cut.
7. Cut forward to establish the required hingewood and remove the chainsaw.
8. The jack operator can now jack the tree over.

Skidder and tractor-assisted felling
Skidders or tractors used for extraction are often available to assist the felling of difficult trees.

Rules

- Where machine-assisted felling is required, the machine may work within one tree length of the tree being felled provided that:
  - The machine shall be of sufficient size to handle all aspects of the operation
  - The faller and the machine operator must have an effective means of communication
- When using rope pulling, the rope shall be secured as high up the tree as practicable
- The machine shall not be in direct line with the intended direction of fall.

General guidelines

- The faller controls the operation.
- Communication signals between the faller and the machine operator must be clarified before starting the operation. It is advisable to use helmets equipped with two-way radio communication so both operators can readily talk to each other.
- Persons other than those directly involved in the operation must be kept at least two tree lengths away.
- Machines must be suitably equipped for the operation. The selection of machinery and method will be determined by terrain, accessibility, machine availability, and the size, weight distribution, and amount of lean of trees to be felled.
- Machines must be of sufficient size, and equipped with a ROPS and FOPS canopy.
- Cable tractors and arch, or cable skidders, can be used to winch trees over. They should be sited in a safe position forward or to one side of the intended felling direction. They can also be used to apply leverage behind the tree using the top of the arch or fairlead frame to gain extra elevation. Using the blade to push a tree over is not considered best practice.
**Pushing trees over using the fairlead or arch**

Trees with moderate tree lean and uneven crown weight may be pushed over using the fairlead. This requires enough space behind the tree for the machine to position itself.

This method should not be used with machines that have exposed fairlead rollers unless an additional pushing plate or spike is fitted to the fairlead housing or arch.

Use the following steps when pushing a tree using the fairlead or arch:

1. Align the machine directly behind the tree, opposite the intended direction of fall.
2. Position the machine so the arch or fairlead housing is lodged firmly against the tree.
3. To ensure the correct position is maintained when leverage is applied, run the winch rope through the fairlead and attach a strop just above where the felling cuts will be placed. Tension the rope to hold the machine in line and stop the fairlead from riding up the tree.
4. Apply only sufficient pressure to hold the tree in place while the felling cuts are completed.
5. Once the cuts are made, the faller should retreat to a safe position before signalling for pressure to be applied.
6. Move clear along the escape route watching the tree at all times.
7. The machine operator should then apply pressure on the tree slowly to allow the head weight to move forward without placing too much strain on the hingewood.
8. Release the winch rope and move the machine forward when gravity and the felling cuts control the felling direction.

**Back pulling trees**

**Equipment**

- The winch rope and strop must be of sufficient length and breaking strength to ensure safe positioning and purchase to pull the tree in the desired direction when the felling cuts are completed.
- The pulling strop when positioned on the tree should be of sufficient length to hang within reach from the ground for connecting the winch rope.
- Eye-to-eye splices should not be used in any pulling rope. Joining with splices considerably reduces the rope’s safe working load.
- Do not use knots in any wire rope.
- Ropes, blocks, and shackles must be of sufficient safe working load (SWL) and condition to handle the job in hand.
- Never allow people to work or stand “in the bight” of an operating rope.

**Winching**

- Work out your visual and vocal communication before you start the work.
- Use sound stumps of sufficient size for the job in hand.
- Strops used on stumps should be at least 1.5 times the safe working load (SWL) of the pulling rope and should be notched so they do not slip off.
- Machines used must have sufficient weight and winching power to control the tree to be felled. They should be equipped with ROPS and FOPS to protect the operator from roll over or falling objects.
- Make sure all the equipment you need is on site.

---

**Assisted felling procedures**
Assisted felling procedures

Secure the rope as high as practicable on the tree. This may require a ladder.

Position the pulling machine in the intended direction of fall. It must be at least two tree lengths from the tree. Engage the park brake and place the blade down.

Tension the rope to hold the tree in position.

Scarf the tree in the normal manner.

Back cut the tree in the normal manner, ensuring adequate hingewood is retained. Use wedges to hold the back cut open if necessary.

Retire to a safe position and signal the pull to commence.

Pull slowly with the winch at first, and then increase speed until the felling cuts take control.

Back pulling against the tree lean (no blocks)

The winch rope may be used directly off the pulling machine only if the machine can be positioned at least two tree lengths from the tree to be pulled or positioned where there is no risk of being struck by the falling tree.

Follow the steps below when back pulling directly off the winch:

(1) Before any work begins, discuss fully with your co-workers what you intend to do. Winch and machinery operators must know what is required in relation to line tension and pulling speeds.

(2) Secure the rope as high as practicable on the tree. This may require a ladder.

(3) Position the pulling machine in the intended direction of fall. It must be at least two tree lengths from the tree. Engage the park brake and place the blade down.

(4) Tension the rope to hold the tree in position.

(5) Scarf the tree in the normal manner.

(6) Back cut the tree in the normal manner, ensuring adequate hingewood is retained. Use wedges to hold the back cut open if necessary.

(7) Retire to a safe position and signal the pull to commence.

(8) Pull slowly with the winch at first, and then increase speed until the felling cuts take control.

Back pulling against the tree lean using a block

If you cannot get two tree lengths from the tree (in the direction of fall), a block can be rigged to alter the pulling direction. This method positions the winch and operator in a safe position. It also allows good vocal and visual contact.

The method requires a suitable stump in the intended direction of fall. A large block is anchored to the stump and the winch rope is run off the drum, through the block, and connected to the tree.

Follow the steps below when back pulling using a block:

(1) Before any work begins, discuss fully with your co-workers what you intend to do. Winch and machinery operators must know what is required in relation to line tension and pulling speeds.

(2) Locate an adequate stump in the intended direction of fall. Ideally, the stump should be more than one tree length away to make de-rigging the block easier.

(3) Notch the stump, and fit a block strap. Connect the block to the strap using a shackle.
(1) Before any work begins, discuss fully with your co-workers what you intend to do. Winch and machinery operators must know what is required in relation to line tension and pulling speeds.

(2) Secure the rope as high as practicable on the tree. This may require a ladder.

(3) Identify the direction of lean, and the intended direction of fall.

(4) Position the winch 80° the other side of the fall direction. Engage the park brake and place the blade down.

(5) Tension the rope to hold the tree in position.

(6) Scarf the tree in the normal manner but opposite the lean.

(7) Back cut the tree in the normal manner, ensuring adequate hinge-wood is retained. Use wedges to hold the back cut open if necessary.

(8) Retire to a safe position and signal the pull to commence.

(9) Pull slowly with the winch at first, and then increase speed until the felling cuts take control.

**Back pulling a side leaning tree**

Modifying the hingewood width can allow the controlled felling of a side leaning tree. The hingewood should be narrow in the direction of lean. The felling steps for side leaning trees are shown on page 50.

The two back pulling methods shown above can be used to back pull side leaning trees.

A third method allows you to back pull the tree in the confined space without stumps being present. In this method the winch is positioned 80° beyond the intended direction of fall.

Follow the steps below when back pulling a side leaning tree in a confined space:

(1) Before any work begins, discuss fully with your co-workers what you intend to do. Winch and machinery operators must know what is required in relation to line tension and pulling speeds.

(2) Secure the rope as high as practicable on the tree. This may require a ladder.

(3) Identify the direction of lean, and the intended direction of fall.

(4) Position the winch 80° the other side of the fall direction. Engage the park brake and place the blade down.

(5) Tension the rope to hold the tree in position.

(6) Scarf the tree in the normal manner in the intended direction of fall.

(7) Make the back cut, keeping more hingewood opposite the lean.

(8) Complete the back cut. Stop your saw and move to a safe position.

(9) Signal the winch operator to slowly pull the tree over.

(10) Stop winching when the felling cuts take control of the tree fall. The tree will free fall, swinging on the rope with no danger to the operator or equipment.
Excavator-assisted felling

Excavators are being used increasingly in logging operations. This makes them available to assist with the felling of difficult and dangerous trees.

Large excavators (20 tonnes plus) should be used. They will be fitted with COP Grade 3 with side intrusion. The chainsaw operator must not be directly under the boom.

The excavator should have a lock-out mechanism fitted to the hydraulics so that the boom does not drop if a hose bursts.

The excavator should be directly behind the tree. This is the position from which it can apply the most leverage.

The excavator should contact the tree with either the bucket or live heel. Holding the tree with the grapple is not considered best practice. The grapple can knock bark down on to the faller and even the smallest boom movement will alter the forces on the tree.

The procedure for felling is as follows:

(1) Establish clear signals with machine operator as the faller controls the operation and must be able to tell the operator when to push or stop.

(2) Check the line of sight between faller and machine operator.

(3) Clear the work area and escape route.

(4) Cut the scarf. This may be slightly shallower than normal (1/4 of the tree diameter)

(5) Position the bucket of heel against the tree and increase pressure slightly.

(6) Commence back cut. The faller must be beside the tree and beside where the boom/bucket would fall in case of a mechanical failure. Never underneath it.

(7) When the back cut is completed, stop the saw and move to the escape route.

(8) Signal machine operator to apply pressure as required.

Hauler-assisted felling

On very steep terrain, the hauler may be the only machine with enough power to assist with felling. The most common method of pulling over trees with a hauler is by direct stropping.

Requirements for felling operation

- Using a hauler to back pull trees is an operation that should only be conducted by experienced fallers and operators.

- The faller may require an assistant to help with rigging.

- The faller should have direct communication with the hauler driver.

- Clear and precise communication between all those involved in machine-assisted felling is vital to its safety.

- The faller is in control.

- Communication can be by:
  - voice radio
  - tooters.

- Whichever system is used, a clear set of pre-arranged signals and commands is necessary so that the machine operators know when to apply power and when to stop.
Direct stropping

Typically the tree to be felled will be leaning over a sensitive area, such as a stream. The cutting procedure will most likely be that used for side leaning trees (page 50). Felling directly back against the lean may result in the tree hitting the mainrope or skyline during its fall. This will cause a shock loading of the ropes.

The work method for the direct stropping method is as follows:

1. Take carriage/butt rigging back close to the tree.
2. Use a long strop to reach to the tree.
3. The strop is hitched around the tree as high above the ground as possible (use a ladder).
4. Main rope is lightly tensioned.
5. Make the scarf cut. The intended direction of fall is angled away from the skyline.
6. Tension the mainrope to hold the tree weight. Do not over-tension.
7. Make the back cut(s).
8. When the cut is completed, stop your saw and move to a safe position.
9. Signal the hauler driver to slowly apply tension to the mainrope. Mainrope is pulled in to pull the tree over towards the hauler and away from the stream or other sensitive area.
Mechanised tree felling procedures

Work area safety
It is important to check the work area for hazards before you start felling or cutting. Under the Health and Safety in Employment Act 1992, you are required not to do anything that will harm another person in any place that you work (this includes harm to yourself).

- Work area safety requirements are much the same as for previously discussed types of felling operations:
  - Determine the machine’s work zone (70 m to 100 m)
  - Check that there are no other persons, children, or animals in the work area
  - Set agreed working procedure with other members of the crew. Do not change these without telling others
  - Before each period of operation check the correct functioning of controls, instruments, and safety equipment
  - Stop the machine immediately someone enters the safety zone
  - The safety zone for felling is two tree lengths (approximately 70 m).
- Do not work in adverse weather conditions such as high winds, heavy rain, or snow.
- Always ensure you have a clear work area where the machine is on stable ground.
- Make your way carefully on uneven, sloping, or unstable ground.
- Check for hazards in the area — such as electricity or telecommunication cables. If in doubt, seek advice from the controlling authority. The machine should stay at least 5 m away from power lines.
- Always check for any material such as branches or tops which may dislodge and fall on to the machine as the tree fails.
- The operator should be in radio contact with other parts of the operation (extraction and landing).
- Never leave the boom or felling head suspended.
- Never pass the head or boom over another machine or person.

Planning and tree assessment
Many of the same rules as mentioned previously for manual felling apply to mechanised felling.
Walking the block to identify hazards is essential.
Opening felling faces so as to assist extraction is important to the whole operation.
Each tree should be regarded as unique and felled accordingly. Very large or malformed trees should be approached with caution or left for manual felling.

Work technique
The work technique will vary with the type of machine being used, depending on whether it is a disc or bar saw and whether the head is fixed to the boom or has a rotator.

General technique
(1) Clear scrub away from around tree for better vision and to avoid machine damage.
(2) Remove lower branches on stem if necessary.
(3) Assess tree lean and crown weight.

(4) Decide where tree will be felled.

(5) Approach tree from the side away from the lean.

(6) Determine distance from the machine to the tree being felled. Overreaching reduces the machine’s power in the boom and arm, and reduces stability. Being too close can mean that the boom is at full lift when the dipper arm is brought in close, reducing the ability to control the tree after it is severed.

(7) Grasp the stem in the felling head.

(8) Fine tune the positioning; place the head as low on the tree as possible to ensure a low stump.

(9) Check the head is in the correct position for the desired felling direction.

(10) Tighten grasp on tree.

(11) Place some push tension in the stem.

(12) Make the felling cut in a single smooth cut.

(13) Whilst cutting push the tree in the direction of required fall, avoiding upward pressure.

(14) Once the cut is complete allow the saw to retract.

(15) Check that the saw has returned before moving the tree.

(16) A small amount of upward lift may be required as the chainsaw completes the cut. This will keep the cut open and avoid jamming.

(17) Lift the stem away from the stump when the cut is complete and the saw is retracted.

(18) Swing the tree to the bunch position when the fall is complete.

**Felling large and leaning trees**

- Larger trees should be released once the tree is falling; this will avoid machine damage.
- Larger trees may need to be double-cut to avoid butt damage and barber chairing.
- The use of double-cuts allows the tree to fall freely, minimises butt damage, and avoids bar damage. A double cut consists of a front or compression cut and the back or release cut.
- The front cut should be 90° to the desired direction of fall.
- The back cut should be higher than the front cut.
- Slight forward and upward pressure should be applied to the tree as it is cut.
- Aligning of the two cuts is important as there may be holding wood left on either side of the cut which may cause damage to the cutting unit if the cuts are not parallel.
- Avoid over-cutting the release cut with the front cut, as this can stop the cutting unit from returning as the tree begins to fall.
- Trees with a heavy lean forward can be felled by either uprooting or placing multiple front cuts to create a larger area to absorb compression while making the back cut.
## Glossary of terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arch</strong></td>
<td>Structure on rear of skidder or tractor with a fairlead at its apex, for lifting log ends off the ground. Can be used as a pushing point in machine-assisted felling</td>
</tr>
<tr>
<td><strong>Back cut</strong></td>
<td>Final felling cut, the back cut will progress until the tree starts to fall in its intended direction or the hingewood is reached</td>
</tr>
<tr>
<td><strong>Barber chair</strong></td>
<td>Vertical split in stem as a result of poor felling technique</td>
</tr>
<tr>
<td><strong>Bight</strong></td>
<td>The area or angle between two parts of a rope running through a block or obstruction. Standing in a bight is dangerous</td>
</tr>
<tr>
<td><strong>Bind</strong></td>
<td>Term used to describe obstructions:</td>
</tr>
<tr>
<td></td>
<td>(a) pressure which traps a cutter bar in a cut, whether it is a felling, bucking, or trimming cut</td>
</tr>
<tr>
<td></td>
<td>(b) ropes or trees being hindered from moving by some obstruction</td>
</tr>
<tr>
<td><strong>Block</strong></td>
<td>Metal casing and sheave for changing direction and holding position of moving ropes</td>
</tr>
<tr>
<td><strong>Boring</strong></td>
<td>Using the tip of the cutter bar to cut into a log or tree</td>
</tr>
<tr>
<td><strong>Bottom cut</strong></td>
<td>The lower cut in a scarf</td>
</tr>
<tr>
<td><strong>Breakage</strong></td>
<td>Loss of stem volume caused by trees breaking during felling and extraction</td>
</tr>
<tr>
<td><strong>Bucking</strong></td>
<td>Cutting across the grain of the stem, cutting stems into logs</td>
</tr>
<tr>
<td><strong>Butt</strong></td>
<td>Base of standing tree, large end of a felled tree, large end of a log</td>
</tr>
<tr>
<td><strong>Butt rigging</strong></td>
<td>Section of rigging between the main rope and tail rope in a hauler operation where strops and carriages are attached</td>
</tr>
<tr>
<td><strong>Cable logging</strong></td>
<td>Any logging system which uses a stationary winch to drag stems to a central point</td>
</tr>
<tr>
<td><strong>Cable hauler</strong></td>
<td>Principal machine in a cable logging operation, consisting of winches and spar</td>
</tr>
<tr>
<td><strong>Cant hook</strong></td>
<td>A hand tool consisting of a lever or bar with a hinged steel hook used for rolling stems or logs</td>
</tr>
<tr>
<td><strong>Carriage</strong></td>
<td>A load-carrying device, with sheaves, which travels along a wire rope for hauling logs</td>
</tr>
<tr>
<td><strong>Chain brake</strong></td>
<td>Safety device on a chainsaw designed to stop the chain in the event of a kickback</td>
</tr>
<tr>
<td><strong>Clearfell</strong></td>
<td>To fell all trees in an area, as opposed to thinning which removes selected stems from the stand</td>
</tr>
<tr>
<td><strong>Compression wood</strong></td>
<td>Where a tree or log bends inwards. Can result in jamming of the chainsaw in the closing cut</td>
</tr>
<tr>
<td><strong>Cross cut</strong></td>
<td>Cutting across the grain of the stem, cutting stems into logs</td>
</tr>
<tr>
<td><strong>Cutover</strong></td>
<td>Clearfelled area of forest</td>
</tr>
<tr>
<td><strong>Cutter bar (guide bar)</strong></td>
<td>Bar which supports chain on chainsaw</td>
</tr>
<tr>
<td><strong>Cutting plan</strong></td>
<td>Operating plan for felling trees in a given area</td>
</tr>
<tr>
<td><strong>Delimb</strong></td>
<td>To remove branches (limbs) from the stem after felling</td>
</tr>
<tr>
<td><strong>Directional felling</strong></td>
<td>Felling trees according to a predetermined pattern to reduce breakage, facilitate extraction, or avoid sensitive areas</td>
</tr>
<tr>
<td><strong>Drive or driving</strong></td>
<td>Felling a tree so that it deliberately falls against another tree which has been scarfed and back cut to push it in the desired direction</td>
</tr>
<tr>
<td><strong>Escape route</strong></td>
<td>A predetermined and prepared track that the faller uses to move away from the butt of the tree during felling, to avoid danger</td>
</tr>
<tr>
<td><strong>Felling face</strong></td>
<td>The edge of the stand of trees where felling is taking place</td>
</tr>
<tr>
<td><strong>Felling jack (tree jack)</strong></td>
<td>A hydraulic jack which can be inserted in the back cut of a tree to assist in felling it in the desired direction</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Felling lever</td>
<td>Steel lever inserted into a backcut to provide lifting force as an aid to felling small trees</td>
</tr>
<tr>
<td>Felling wedge</td>
<td>See wedge</td>
</tr>
<tr>
<td>FOPS</td>
<td>Falling Object Protective Structure</td>
</tr>
<tr>
<td>Hang up</td>
<td>A tree caught in or against another, preventing it from falling to the ground. Generally refers to trees hung up during felling but can refer to partially windthrown trees as well</td>
</tr>
<tr>
<td>Haul</td>
<td>To pull trees from stump to landing</td>
</tr>
<tr>
<td>Hauler (cable hauler)</td>
<td>Principal machine in a cable-logging operation, consisting of winches and spar</td>
</tr>
<tr>
<td>Head</td>
<td>Top of tree</td>
</tr>
<tr>
<td>Hingewood</td>
<td>Wood left uncut between scarf and back cut to control the tree during its fall</td>
</tr>
<tr>
<td>Hi-viz</td>
<td>High visibility clothing/helmets, usually a bright fluorescent colour</td>
</tr>
<tr>
<td>Humboldt scarf</td>
<td>Scarf where the bottom cut is angled and the top cut is horizontal</td>
</tr>
<tr>
<td>Kerf</td>
<td>Width of the saw cut</td>
</tr>
<tr>
<td>Kickback</td>
<td>Sudden force that throws the saw back towards the operator. Generated by the moving chain striking an object when passing around the tip of the cutter bar</td>
</tr>
<tr>
<td>Landing (skid, dump)</td>
<td>Prepared area to which stems are extracted</td>
</tr>
<tr>
<td>Lean</td>
<td>How much the tree is away from vertical</td>
</tr>
<tr>
<td>Main rope</td>
<td>Primary hauling rope used to drag trees in to the winch</td>
</tr>
<tr>
<td>Mechanised</td>
<td>Mechanised logging systems rely on machines to do the bulk of the physical work, with people working as operators</td>
</tr>
<tr>
<td>Mobile tailhold</td>
<td>A self-propelled unit (bulldozer or excavator) which is attached to ropes and blocks used in hauler operations</td>
</tr>
<tr>
<td>Motor manual</td>
<td>Refers to work carried out by people using hand-held power tools (e.g., chainsaw)</td>
</tr>
<tr>
<td>Multi-leader</td>
<td>Tree that has more than one main stem, may be from ground level or occur up the stem</td>
</tr>
<tr>
<td>Over cut</td>
<td>Where one cut of the scarf is extended beyond the other, e.g., the back cut extends into the hingewood. Potentially dangerous</td>
</tr>
<tr>
<td>Piece size</td>
<td>Average size of stems in a setting</td>
</tr>
<tr>
<td>Pinching</td>
<td>When a cut being made closes on the cutter bar trapping the saw</td>
</tr>
<tr>
<td>Pre-fell</td>
<td>Area felled ahead of the extraction phase of the logging operation, usually associated with hauler logging or when shifting to a new stand</td>
</tr>
<tr>
<td>Production thinning</td>
<td>Cutting selected stems from a stand for extraction and sale</td>
</tr>
<tr>
<td>Recoverable volume</td>
<td>Amount of merchantable wood that should be extracted</td>
</tr>
<tr>
<td>Root plate (root wad, root ball)</td>
<td>Mass of roots and dirt which is tipped up and exposed when a tree is windblown or pushed over without being severed or broken off from the stump</td>
</tr>
<tr>
<td>Rope</td>
<td>In logging usually wire rope used on winches</td>
</tr>
<tr>
<td>ROPS</td>
<td>Roll Over Protective Structure</td>
</tr>
<tr>
<td>Safety boots</td>
<td>Work boots fitted with steel toecaps</td>
</tr>
<tr>
<td>Safety helmet</td>
<td>Hard hat designed to protect against falling objects</td>
</tr>
<tr>
<td>Safety mitt</td>
<td>Glove attached to forward handle of chainsaw, to prevent hand slipping off handle if saw kicks back</td>
</tr>
<tr>
<td>Safe working load</td>
<td>The maximum permissible load that can be applied to a wire rope (1/3 of breaking strain)</td>
</tr>
<tr>
<td>Sailer</td>
<td>Broken limb or tree crown which falls from upper part of tree when disturbed by wind or tree felling</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Scarf</td>
<td>Notch cut in tree to establish its direction of fall</td>
</tr>
<tr>
<td>Setting</td>
<td>Proportion of a compartment or stand logged to one landing</td>
</tr>
<tr>
<td>Sit back</td>
<td>Tree which settles back over the back cut</td>
</tr>
<tr>
<td>Skidder</td>
<td>Rubber-tyred or sometimes tracked machine for ground hauling stems and logs</td>
</tr>
<tr>
<td>Skyline</td>
<td>In cable logging, the rope between the spar and the tailhold along which the carriage travels; it provides lift from the ground for the stems being extracted</td>
</tr>
<tr>
<td>Slab (slabbing)</td>
<td>Splitting of wood in the butt log during felling or bucking which damages the log and reduces value</td>
</tr>
<tr>
<td>Slash</td>
<td>Branches, bark, tops, heads, broken logs, and dead wood left on the ground after logging</td>
</tr>
<tr>
<td>Snag</td>
<td>Dead or dying trees which are still standing</td>
</tr>
<tr>
<td>Spar</td>
<td>Pole supported by guylines which supports the lines of a cable system</td>
</tr>
<tr>
<td>Stand</td>
<td>Term for a designated area of forest with specific characteristics (usually by age)</td>
</tr>
<tr>
<td>Stem</td>
<td>Trunk of a tree from stump to tip</td>
</tr>
<tr>
<td>Stocking</td>
<td>Number of stems per hectare</td>
</tr>
<tr>
<td>Strop</td>
<td>Short length of wire rope or chain with connecting device or hook which forms a noose around the stem. The strop is connected to the main inhaul rope of the extraction machine</td>
</tr>
<tr>
<td>Stump</td>
<td>The base of a tree and its roots, left in the ground after felling</td>
</tr>
<tr>
<td>Stump height</td>
<td>The distance from the ground on the uphill side of the stump to the top of the stump</td>
</tr>
<tr>
<td>Swing yarder</td>
<td>Cable logging machine that can swing the boom around from side to side whilst operating the haul ropes</td>
</tr>
<tr>
<td>Tailhold</td>
<td>The object to which a tail rope block or skyline is attached can be a stump or a heavy machine (bulldozer or excavator)</td>
</tr>
<tr>
<td>Tail rope</td>
<td>A rope on a hauler used to pull the main rope, butt rigging, and/or carriage out to stems to be extracted</td>
</tr>
<tr>
<td>Tension</td>
<td>A pulling force</td>
</tr>
<tr>
<td>Tension wood</td>
<td>Where a tree or log bends outwards. Can result in splitting or sudden movement of the tree or log if not cut correctly</td>
</tr>
<tr>
<td>Thinning</td>
<td>Felling selected trees in a stand to a prescribed pattern and stocking, to waste or for extraction</td>
</tr>
<tr>
<td>Tie back</td>
<td>Rope used to attach machine to an anchor point, usually a stump</td>
</tr>
<tr>
<td>Top cut</td>
<td>The upper cut, usually angled, of a scarf</td>
</tr>
<tr>
<td>Undergrowth</td>
<td>Layer of vegetation growing under the canopy of crop trees</td>
</tr>
<tr>
<td>Uproot</td>
<td>Tree blown or pushed over with the stump and roots still attached</td>
</tr>
<tr>
<td>Wedge</td>
<td>Tapered plastic, steel, or aluminium alloy tool which is driven into a back cut by a hammer to prevent the tree from sitting back on the back cut, or to force it towards the desired direction of fall</td>
</tr>
<tr>
<td>Winch</td>
<td>A powered drum used to wind rope in or out</td>
</tr>
<tr>
<td>Windthrow</td>
<td>Trees blown down by the wind. Stems have been snapped or the rootplate has rotated out of the ground.</td>
</tr>
<tr>
<td>Wind wrenched</td>
<td>Trees blown over by the wind, but still standing. Stems may be severely bent</td>
</tr>
<tr>
<td>Wing cuts</td>
<td>Small cuts made beside the scarf to reduce the amount of slabbing (butt damage) when trees are felled</td>
</tr>
<tr>
<td>Yarder</td>
<td>see swing yarder</td>
</tr>
<tr>
<td>Unit</td>
<td>Page Numbers</td>
</tr>
<tr>
<td>------</td>
<td>--------------</td>
</tr>
<tr>
<td>1230</td>
<td>Trim and prepare felled trees for extraction</td>
</tr>
<tr>
<td>1247</td>
<td>Thin plantation trees to waste (early thinning)</td>
</tr>
<tr>
<td>1250</td>
<td>Thin plantation trees for extraction in a production situation</td>
</tr>
<tr>
<td>1255</td>
<td>Fell trees using machine assistance</td>
</tr>
<tr>
<td>1270</td>
<td>Salvage windthrown trees</td>
</tr>
<tr>
<td>6945</td>
<td>Fell trees using a mechanised harvesting machine</td>
</tr>
<tr>
<td>6953</td>
<td>Fell trees in a commercial forest production situation</td>
</tr>
<tr>
<td>17756</td>
<td>Assess and deal with individual hazardous trees</td>
</tr>
<tr>
<td>17763</td>
<td>Demonstrate knowledge of tree felling</td>
</tr>
<tr>
<td>17765</td>
<td>Fell trees in a commercial forest harvesting operation</td>
</tr>
<tr>
<td>17766</td>
<td>Fell trees safely using a chainsaw and basic techniques</td>
</tr>
<tr>
<td>17767</td>
<td>Thin plantation trees to waste (late thinning)</td>
</tr>
<tr>
<td>19765</td>
<td>Assess and deal with individual windthrown trees in a forest plantation</td>
</tr>
</tbody>
</table>
Poroporoaki

Whaia te huarahi o te mātauranga
Pursue the path of learning.

Ka piki ake koe, ka whānui atu nga pae.
The higher you climb, the wider the horizons.

Rapuhia nga pae i roto, I tōu nei ngakau.
Seek also the horizons within your self.

E tipu, e awhi, e tū.
Grow, embrace, stand tall.
Vision, knowledge, performance