

# Guide to State Development Assessment Provisions

## State code 16: Native vegetation clearing (Material Change of Use or Reconfiguring a Lot – no clearing)

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# Part 1: About this guide

The State Development Assessment Provisions (SDAP) provide assessment benchmarks for development applications involving the State Assessment and Referral Agency (SARA).

This guide has been developed to help prospective applicants and the broader community understand how a development application involving native vegetation clearing should address the requirements of the SDAP: State code 16 (the code).

This guide is not a statutory document and is not intended to be exhaustive. It provides supplementary information only and is designed to be read in conjunction with the code.

The SDAP, including the code, is available online at [www.qld.gov.au](http://www.qld.gov.au)—search ‘the [State Development Assessment Provisions](#)’ and then select ‘State code 16’.



*It is recommended that you familiarise yourself with all local, state and federal laws that apply to developments involving vegetation clearing to ensure you are aware of any permits or approvals that are required under other legislation.*

*More complex development proposals may benefit from a free pre-lodgement service provided by SARA before lodging a development application. This will identify any potential issues or requirements for additional information.*



*For more detailed information about the role of SARA and seeking pre-lodgement advice, visit <https://planning.statedevelopment.qld.gov.au/planning-framework/state-assessment-and-referral-agency>*

## Vegetation management framework

The *Vegetation Management Act 1999* (VMA), in conjunction with other legislation such as the *Planning Act 2016* and the *Environmental Offsets Act 2014*, regulates the clearing of native vegetation in mapped regional ecosystems. A development approval is required for clearing native vegetation that is not Exempt Clearing Work, or clearing carried out under an Accepted Development Vegetation Clearing Code or Area Management Plan.

The contents of the code and this guide are consistent with, and are to be read and applied in accordance with, the purposes of the [VMA](#) and the [State Policy for Vegetation Management](#), Department of Natural Resources Mines and Energy, June 2019.



*For detailed information on the vegetation management framework, including Exempt Clearing Work and Accepted Development Vegetation Clearing Codes, visit [www.qld.gov.au](http://www.qld.gov.au) and search ‘vegetation management’. For further information on the vegetation management framework, phone **135 VEG (135 834)** or email [vegetation@resources.qld.gov.au](mailto:vegetation@resources.qld.gov.au).*

## Vegetation management mapping

The code is used to assess developments that involve clearing, or could result in future clearing, of native vegetation in regulated regional ecosystems or areas shown on the Regulated Vegetation Management Map and associated supporting maps current as at the time of lodging the development application<sup>1</sup>.

To assist in planning your development and preparing your development application, it is recommended that you obtain a Vegetation Management Report (also known as a “Property Report”<sup>2</sup>). To obtain a Property Report, use the online request form at [www.qld.gov.au](http://www.qld.gov.au) (search for ‘vegetation management maps’). Alternatively, the layers can be viewed in or downloaded from <https://qldglobe.information.qld.gov.au>

The Property Report provides a suite of maps relevant to assessments under the code, including:

- Regulated Vegetation Management Map
- Vegetation Management Supporting Map which includes:
  - Regional ecosystem mapping<sup>3</sup>
  - Essential Habitat Map<sup>4</sup>
  - Vegetation Management Wetlands Map
  - Vegetation Management Watercourse and Drainage Feature Map



*You will need a lot number and plan number to request a Property Report. These numbers can be obtained through QLD Globe by using the Parcel Label layer.*

The **Regulated Vegetation Management Map** show the different vegetation categories that are present on your land. This information will help you determine the type of approval you need for vegetation clearing. Therefore, it is useful to understand the types of vegetation in each category:

- Category A area—vegetation in an area that has been secured for a particular purpose or an area subject to particular requirements, for example, subject to a compliance notice, secured as an offset area or secured as a Declared Area (Voluntary)

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<sup>1</sup> Unless the *Planning Act 2016* provides otherwise.

<sup>2</sup> The Property Report may also include other related maps or information outside the vegetation management framework that may be of assistance e.g. protected plants flora survey trigger map under the *Nature Conservation Act 1992*. This information is supplementary information only and is not to be taken as advice on other laws that may apply to your proposed development. It is recommended that you familiarise yourself with all local, state and federal Acts and Regulations that apply to your proposed development.

<sup>3</sup> Referred to in the Queensland Spatial Catalogue and Queensland Globe as ‘Vegetation management regional ecosystem map’.

<sup>4</sup> Referred to in the Queensland Spatial Catalogue as ‘Vegetation management essential habitat map’.

- Category B area—remnant regional ecosystem
- Category C area—high-value regrowth vegetation
- Category R area—regrowth watercourse area
- Category X area—vegetation that is generally exempt from requirements under vegetation management framework dependent on the land tenure.

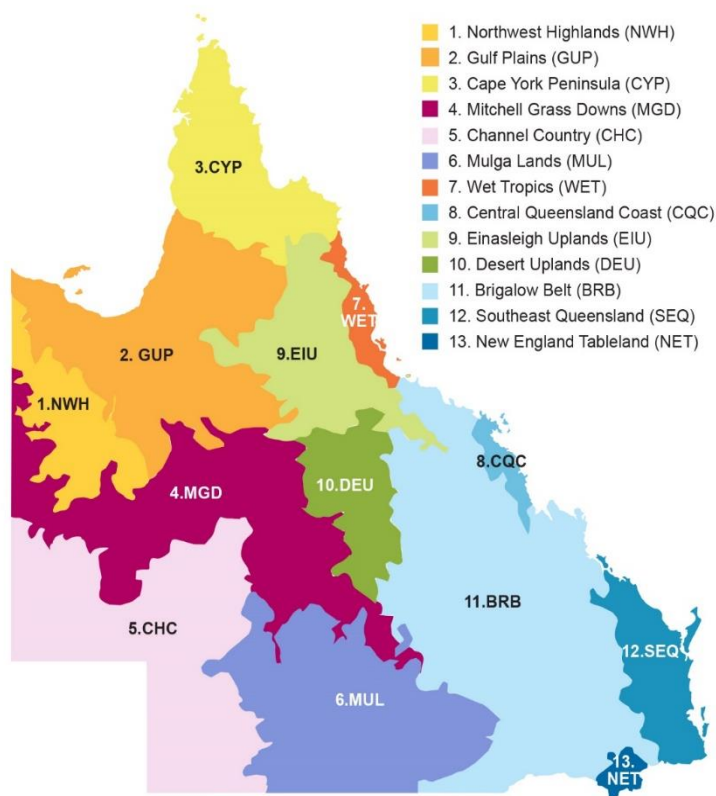
The **Vegetation Management Supporting Map** includes regional ecosystem mapping that is colour-coded in accordance with the class of regional ecosystems prescribed under the vegetation management framework:

- Pink—Endangered regional ecosystem
- Orange—Of Concern regional ecosystem
- Green—Least Concern regional ecosystem.

Regional ecosystems are further categorised into **regional ecosystem structure categories** to indicate the expected density or composition of vegetation in its natural state. The five groups of vegetation structure categories are:

- dense
- mid-dense
- sparse
- very sparse
- grassland.

Queensland has been divided into 13 bioregions, each of which represents a broad landscape pattern that is the result of the interplay between factors including geology, climate and biota. Within each bioregion, there are a number of regional ecosystems that make up the diversity of landscapes across the region. As each bioregion is different in nature, the vegetation management requirements under the framework differ.



**Figure 1: Queensland bioregions**

Each identified area on regional ecosystem mapping is called a polygon. Each polygon is labelled with a **regional ecosystem number** (a three-number code) identifying the regional ecosystem:

- The first number indicates the bioregion in which the regional ecosystem is situated.
- The second number refers to the land zone in which the ecosystem occurs.
- The third number refers to the specific ecosystem and denotes vegetation type.

**Example**


In the regional ecosystem code **6.3.21**:

- 6** is the code for the Mulga Lands bioregion
- 3** indicates alluvial systems such as creeks, rivers and floodplains
- 21** indicates low woodlands of mulga on low alluvial sand dunes.

Most regional ecosystem maps show polygons with more than one regional ecosystem number. The order in which the regional ecosystems are listed reflects the relative size and extent of these different regional ecosystems on the ground. If you have areas mapped as more than one regional ecosystem, you may need to determine precisely where on the ground each regional ecosystem is located.

### Example

A mixed polygon labelled **6.5.1/6.5.2, 70/30** contains approximately 70 per cent of regional ecosystem 6.5.1 and 30 per cent of regional ecosystem 6.5.2.

 *A full description of each regional ecosystem is available on the Regional Ecosystem Description Database (REDD). Access or download the database at [www.qld.gov.au](http://www.qld.gov.au) (search for 'regional ecosystem description database').*

The **Essential Habitat Map** under the vegetation management framework shows the habitat of Endangered, Vulnerable or Near-Threatened wildlife (protected wildlife) prescribed under the *Nature Conservation Act 1992*. The mapping relies on information sourced by a number of different government and non-government agencies and experts. Essential habitat is mapped over areas of vegetation that are likely to contain either:

- three or more essential habitat factors<sup>5</sup>  
or
- the relevant species at any stage of its life cycle.

### What if I think the vegetation on ground is different to the mapping?

If you think the Regulated Vegetation Management Map or regional ecosystem mapping for the development area is different from what is on ground, you may apply for a Property Map of Assessable Vegetation (PMAV). A PMAV is a property-scale map that shows the boundaries of vegetation categories on the property. An application for a PMAV must include sufficient information to demonstrate the proposed changes to the mapping should be made. Once the PMAV is made, it replaces the Regulated Vegetation Management Map for determining the location and extent of the areas of vegetation regulated under the vegetation management framework on your property.

If applicable, it is recommended that you apply for and receive the PMAV before lodging your development application.

PMAVs can be used to:

- confirm the vegetation category areas as currently mapped; or
- amend the mapping (e.g. to refine a regional ecosystem or regional ecosystem boundary).

 *For more detailed information about PMAVs and applying for a PMAV, visit [www.qld.gov.au](http://www.qld.gov.au) and search 'Property Map of Assessable Vegetation'*

## Glossary of terms and common abbreviations used in this document

Terms used in this guide have the same meaning as defined in the *Vegetation Management Act 1999* and the Glossary of Terms within the code.

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<sup>5</sup> Biological and non-biological requirements of a species that are necessary or desirable for the wildlife at any stage of its life cycle, including vegetation community, altitude, soils, position in landscape, or regional ecosystem.



Some common abbreviations used within the guide include the following:

AO = Acceptable outcome

Code = State Development Assessment Provisions, State code 16: Native Vegetation Clearing

MCU = Material Change of Use

PO = Performance outcome

PMAV = Property Map of Assessable Vegetation

RaL = Reconfiguring a Lot

REDD = Regional Ecosystem Description Database

SARA = State Assessment Referral Agency

SRI = Significant Residual Impact

SDAP = State Development Assessment Provisions

VMA = *Vegetation Management Act 1999*

## Key steps in the development assessment process

For an application proposing to undertake assessable development that requires assessment under the SDAP: State code 16, key steps in the process are as follows:

### 1. Determine location and extent of development footprint

It is important to ensure that you have determined all development and clearing areas to be assessed as part of the development application. This may include adding areas that could subsequently become Exempt Clearing Work as a result of the development approval—for example, adding areas to the development footprint for the firebreak exemption around infrastructure. See Appendix 1 'Avoid and Minimise' for further guidance on determining the development and clearing footprint including areas that will become exempt as a result of a MCU or RaL development application.

Details of the location and extent of the development and clearing footprint should be determined by providing:

- a. digital data in a format such as shapefile or .kml; or
- b. a map showing:
  - i. the boundary of the area on an image base; and
  - ii. 5 or more points visible in the image base that correspond to identifiable fixed features; and
  - iii. a description of the feature that each point represents; and
  - iv. the coordinates and zone references for each point, defined by reference to the geodetic reference framework prescribed for the [Survey and Mapping Infrastructure Act 2003, section 6\(4\)](#); or
- c. a description of the boundary of the area defined by reference to the geodetic reference framework prescribed for the [Survey and Mapping Infrastructure Act 2003, section 6\(4\)](#).

To facilitate prompt assessment, digital data is preferred.

## 2. Check mapping to determine the assessable clearing footprint for the application

Check the regulated maps and supporting maps to determine the assessable clearing areas for the development footprint. See guidance above 'Vegetation Management mapping'. This may include removing parts of the development footprint where the clearing is currently exempt under the VMA framework (e.g. clearing category X areas on freehold land) or accepted development (e.g. clearing under an Accepted Development Vegetation Clearing Code).

## 3. Seek pre-lodgement advice (optional)

You can arrange a pre-lodgement meeting with SARA before lodging the application. Understanding the precise location and extent of the development and clearing footprint to be assessed under a development application is vital to addressing the code. As such, it is recommended that you seek pre-lodgement advice from SARA if you have any uncertainty around the required development and clearing footprint to be assessed.



*A pre-lodgement meeting is strongly recommended to assist with understanding the requirements for technical assessment. For more details on seeking pre-lodgement advice, visit*

*<https://planning.statedevelopment.qld.gov.au/planning-framework/state-assessment-and-referral-agency>.*

## 4. Lodge Relevant Purpose determination application (if applicable)

When applying for a MCU and / or Operational Works development approval you must first obtain a Relevant Purpose determination from the Department of Resources before lodging a development application. This Relevant Purpose determination will confirm whether the proposal will result in the clearing of regulated vegetation and whether the clearing is for a relevant purpose permitted under section 22A of the VMA.

Clearing that is not for a relevant purpose is prohibited development under the *Planning Act 2016*, and a development application cannot be accepted to the extent it involves prohibited development.

For example, clearing in any category C areas or category R areas on the Regulated Vegetation Management Map is not a relevant purpose under the VMA. Accordingly, clearing of vegetation in these areas cannot be approved under a development approval, and is prohibited development under the *Planning Act 2016* unless the clearing can be undertaken as Exempt Clearing Work or in accordance with an Accepted Development Vegetation Clearing Code.



*Contact the Department of Resources, Veg Hub on 135 VEG (135 834) to discuss the purpose of your clearing and whether a Relevant Purpose determination is required.*



*For further information and to apply for a Relevant Purpose determination visit [www.qld.gov.au](http://www.qld.gov.au) and search 'Relevant Purpose determination'.*

## 5. Lodge Development Approval application

Once the Relevant Purpose determination is approved, the development application can then be completed addressing all relevant assessment benchmarks under the *Planning Act 2016* framework. For vegetation management, this means assessing the proposed development against SDAP: State code 16 (the code). A response template for the assessment benchmarks for the code is available online at [www.qld.gov.au](http://www.qld.gov.au) (search '[State Development Assessment Provisions](#)' and then select 'State code 16 response template').

A Development Approval application can be lodged with the relevant assessment manager. The relevant assessment manager is either local government or SARA.

If the assessment manager is SARA, you can apply online via [MyDAS2](#) available at [www.qld.gov.au](http://www.qld.gov.au) (search 'Online planning services' and then select 'MyDAS2').

If the assessment manager is local government, local government will confirm whether the application will need to be referred to SARA (for one or more state interests).

## 6. Technical advice provided

Once a development application is lodged and accepted by the Assessment Manager or Referral Agency, the Department of Resources provides technical agency advice for proposals involving the clearing of native vegetation, and works closely with the Assessment Manager / Referral Agency on whether an application complies with the code, including any potential offset requirements under the Queensland environmental offsets framework<sup>6</sup>.

## 7. Decision Notice issued

If the proposal adequately addresses all relevant state codes, SARA either: issues a Decision Notice (with or without conditions) as Assessment Manager; or provides local government as the Assessment Manager, with a Referral Agency Response (recommending conditions be imposed where required to meet the assessment benchmarks under the relevant SDAP state codes).

**Note:** FastTrack5 referral and assessment process is also available for Operational Work development applications for Managing Thickened Vegetation. The FastTrack5 process allows for a reduced application fee, reduced assessment and decision-making time frames by SARA, and will not be subject to an information request. Standard conditions will generally be applied.



*For further information on the FastTrack5 assessment process, visit [www.qld.gov.au](http://www.qld.gov.au) and search 'FastTrack5'.*

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<sup>6</sup> If there is insufficient information to assess the application, you may be requested to provide further information.

# Part 2: Assessment against the Performance Outcomes of the code

## Application of code

The complete version of SDAP (sections 1 to 4) provides guidance on the application and interpretation of the state codes, how they are used in assessment and how multiple state codes or matters of state interest are managed etc.

The Purpose Statement of the code provides the overall intent of the code, for example, environmental values / outcomes the code seeks to manage and / or protect. Development will comply with the code if it can be shown to meet the code's Purpose Statement.

Performance outcomes (POs) set the benchmarks for achieving the Purpose Statement of the code. Generally, your application must meet all of the POs relevant for your application. If the application does not meet one or more of these POs, those aspects of the application will then be assessed against the Purpose Statement of the code<sup>7</sup>.

Some POs may provide for an Acceptable Outcome (AO). AOs identify one way a PO can be met. An application that complies with all applicable AOs for a corresponding PO is considered to satisfy that PO.

In some cases there will be two corresponding POs for a particular environmental value / outcome whereby the first PO will provide for the assessment benchmark and the corresponding second PO will provide for rehabilitation and / or provision of an environmental offset. For example, PO5 and PO6 for wetlands. These corresponding POs are to be assessed in conjunction with each other. The assessment must address the first PO (eg PO5). If the proposal meets the first PO (eg PO5), then the second PO (eg PO6) is automatically met. If you have adequately demonstrated that the proposal cannot meet the first PO (eg PO5), only then can you address the second PO (eg PO6) and propose rehabilitation and / or an environmental offset (where relevant).

Where a development involves multiple development applications, thresholds considered under the code may be assessed having regard to **cumulative impacts** for any development approval applying to the premises<sup>8</sup>.

## Table 16.1: Performance Outcomes relevant for each development type and clearing purpose

The code groups together all the POs for each application type and clearing purpose into numbered tables. This guide likewise follows the same order as the code, providing guidance per table (i.e. per clearing purpose). Additional guidance for some aspects may be provided within an appendix<sup>9</sup>.

It is only necessary to provide a response to the POs relevant for the application type and clearing purpose/s. Table 16.1 of the code specifies which tables of POs are relevant for each application type

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<sup>7</sup> Refer to the complete version of SDAP (sections 1 to 4) for further information on assessments against the purpose statement.

<sup>8</sup> See section 22(3)(d) of the Planning Regulation 2017.

<sup>9</sup> A reference to an appendix is a reference to an appendix in this guide.

and clearing purpose. Tables that are not relevant to your application type and clearing purpose can be left blank or deleted. For example, a development application for operational works that involves managing thickened vegetation, only Table 16.2 and Table 16.15 are relevant and therefore the remaining tables can be left blank or deleted.

## **Table 16.9: Material change of use and / or reconfiguring a lot for which there will be no clearing as a result of the material change of use or reconfiguring a lot**

This table can only be used to address the code in circumstances where the development involves a MCU or RaL, and:

- no clearing is required for the development; and
- no additional Exempt Clearing Work under Schedule 21 of the Planning Regulation 2017 will become available as a result of the MCU and / or RaL being approved.

As there are no prescribed AOs, the application will need to address the PO directly.

### **Performance outcome 93**

To meet this PO the application will need to satisfy all of the following:

1. Identify the location and extent of the development footprint to be assessed under the development application. See guidance in Part 1 of this guide 'Key steps in Development Assessment process: Step 1- Determine location and extent of development footprint'.
2. Demonstrate that no clearing as a result of the MCU and / or RaL will occur. Accordingly, demonstrate that no clearing is proposed, and that the location of the proposed development infrastructure / boundaries etc. in existing cleared areas is sufficiently buffered from regulated vegetation to ensure no potential future clearing will become available (i.e. Exempt Clearing Work) as a result of the development being approved.

For MCU applications, this includes demonstrating that there will be no additional Exempt Clearing Work under Schedule 21 of the Planning Regulation 2017 that will become available if the MCU is approved. See Appendix 1 'Avoid and Minimise' for guidance on identifying "clearing as a result of a material change of use".

For RaL applications, this includes demonstrating that there will be no additional Exempt Clearing Work under Schedule 21 of the Planning Regulation 2017 that will become available if the RaL is approved. See Appendix 1 'Avoid and Minimise' for guidance on identifying "clearing as a result of reconfiguring a lot".

# Appendix 15: Measuring tree height and measuring slope

## Measuring tree height

There are several methods you can use to measure the height of trees.

### Using specialist tools

The clinometer is a tool commonly used by foresters to measure tree heights and slope angles. If you have a clinometer, please follow the manufacturer's instructions for use.

There are also many videos online that show how to make and use a simple clinometer, using a protractor, some string and a small weight.

The heights of the crown can also be measured using a laser instrument called a hypsometer. If the top of the tree is not directly above the base of the trunk, it is important to also measure the point directly below the highest point of the tree canopy to get an accurate crown height.

### Pencil (or stick) method

This is a very simple method requiring only a pencil (or small straight stick) and a tape measure. Take a pencil (or small stick) and move several metres or more away from the tree (refer to Figure 6).

Outstretch your arm and hold the pencil so that you can measure the height of the tree on the pencil (e.g. line up the top of the pencil with the top of the tree and slide your thumb along the stick to correspond with the base of the tree). You may also need to move closer or further away from the tree to allow a length of the pencil to align with the height of the tree.

Keeping your thumb in the same position and lined up with the base of the tree (and your arm still outstretched), turn the pencil at the base of the tree by 90°. Note the location on the ground that lines up with the top of the pencil. Mark or note this point on the ground and then measure the distance from this point to the base of the tree. This is the height of the tree.

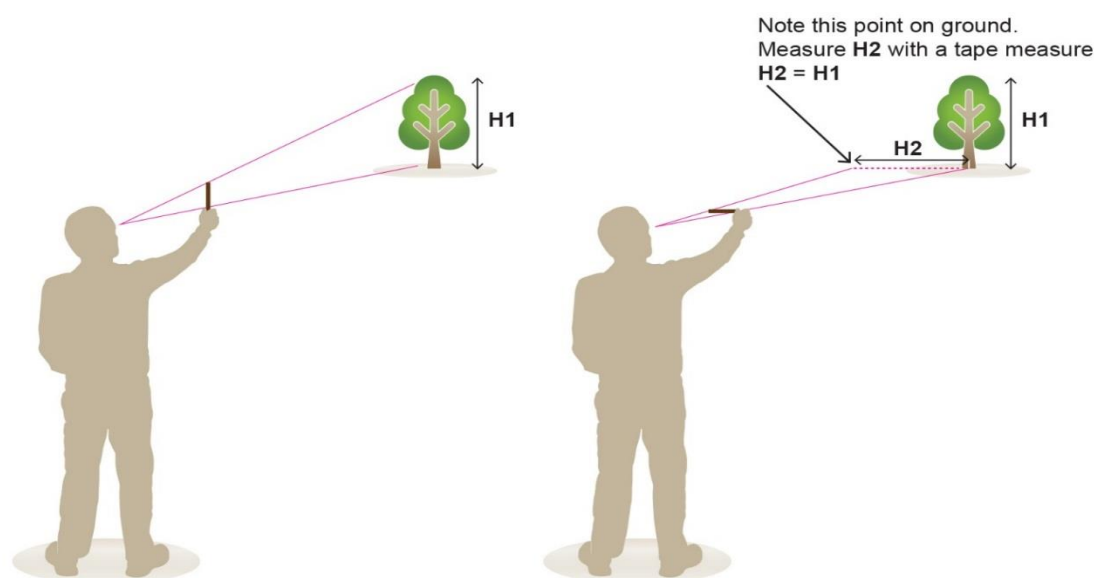
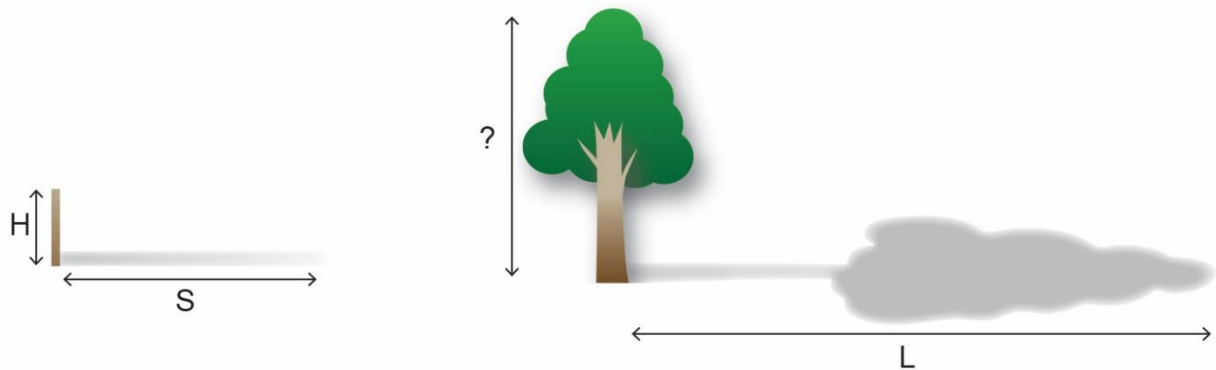


Figure 6: The pencil method

### Stick and shadow method

For this method you will need to see the tree's shadow on the ground. You will also need a tape measure, a calculator and a stake of any height to hammer into the ground. Refer to Figure 7.



**Figure 7: Stick and shadow method**

1. Hammer a stake vertically into the ground so you can see its shadow. Record the height of the stake above ground ( $H$ ) and the length of the stake's shadow ( $S$ ) from the base of the stake.
2. Measure the length of the tree's shadow from the centre of the base of the tree ( $L$ ).
3. Ensure that both shadow measurements are taken within a few minutes of each other, using the same units (e.g. metres).
4. The tree's height may be estimated using simple proportions:

$$\text{Height of tree} = \frac{\text{Height of stake above ground (H)}}{\text{Length of stake's shadow (S)}} \times \text{Length of tree shadow (L)}$$



## Stick method 2

You can measure the height of trees by projecting a right-angled triangle (one that includes a  $90^\circ$  angle) using your arm, a stick and your line of sight (refer to Figure 8).

1. Find a straight stick or length of dowel about 750 mm long. Holding the stick upright in your outstretched hand and in front and level with your eye, measure the horizontal distance from your eye to the stick. Mark the same distance on the stick.
2. Grasp the stick at the mark and hold it out in front of you with your arm fully extended and at eye level. The stick must be held vertically pointing upwards. (The distance from your eye to the base of the stick should equal the length of the stick above your hand.)

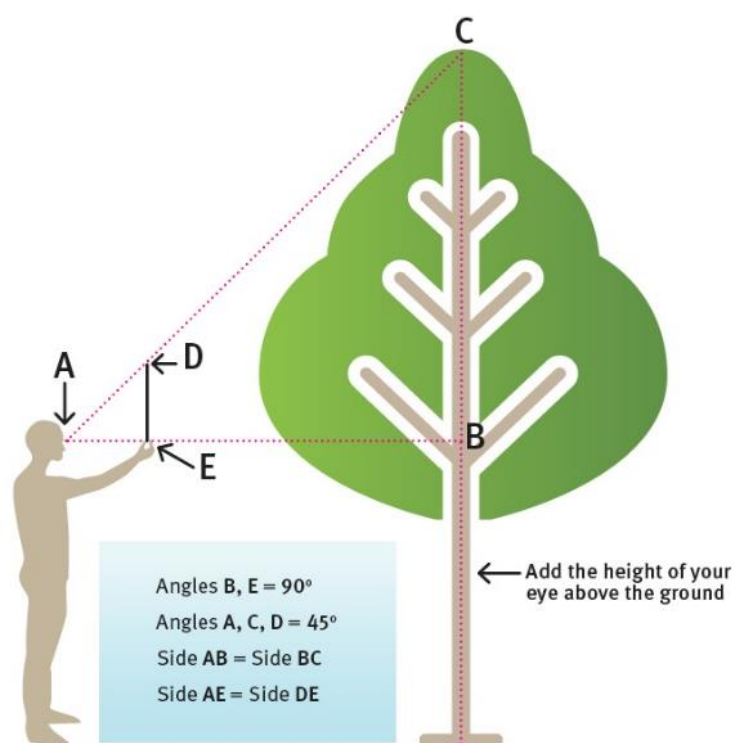


Figure 8: Diagrammatic representation of stick method 2

3. Walk toward or away from the tree until the tip of the stick is visually lined up with the top of the tree. It's often easiest to walk along the contour so the mark on the stick remains lined up with a point on the tree the same height as your eye. When sighting the top and bottom of the stick, move your eyes rather than your head.
4. The height of the tree will be the distance from your eye to the tree trunk (measure this distance with a measuring tape) plus the height of your eye above the ground.

$$\text{Height of tree} = \text{distance A to B} - \text{eye height}$$

5. If no long-distance measuring device is available, calibrate your step (the walking distance between your two feet) or pace (walking distance for two steps) over a known distance (e.g. 20 metres). Then measure the distance from A to B in paces or steps and convert to metres.

## Smartphone apps

Various smartphone apps are available that claim to help measure tree height. Care should be taken if using these because:

- the accuracy may depend on the quality of your phone (and may require some manual calibration)
- some apps still require subsequent trigonometric calculations
- the reliability and accuracy of the app may not be proven.

If such apps are used, it is recommended to first verify the results with other methods before using the apps operationally.

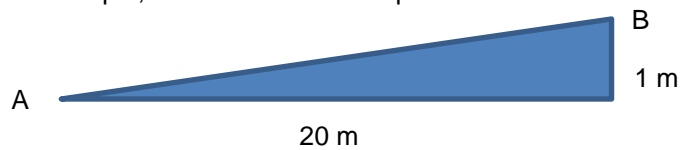
## Measuring slope

### Definition

For the purposes of the code, slope is measured in percentages, and is defined as the change in vertical height relative to the change in horizontal distance multiplied by 100.

$$\text{Slope (\%)} = \frac{\text{Vertical distance}}{\text{Horizontal distance}} \times 100$$

For example, for this illustrated slope from A to B:



$$\text{Slope (\%)} = \frac{1}{20} \times 100 = 5\%$$

The location of points A and B should be selected so the line between them is representative of the slope in question. For example, don't choose high or low spots in the landscape for these points.

### Using a clinometer

The Suunto clinometer (clino) is a tool commonly used by foresters to measure tree heights and slope angles. There are many types of clinometers that are relatively inexpensive. If you can have access to one, ensure it has a scale to measure percentage slope.

Using a clinometer is one of the most accurate methods of measuring slope—differences in vertical height and horizontal distances may be measured accurately in order to calculate the slope. The exact measuring method will depend on the equipment used; please follow the manufacturer's instructions.



Figure 9: Surveyor's level

### Homemade clinometer

You can also make your own clinometer using a large protractor with a hole drilled (as shown in Figure 10), string and a small weight.

Attach the string through the drilled hole and tie the small weight to the other end of the string. When the flat edge of the protractor is held horizontally, the string should hang down vertically and indicate 90° on the protractor.

To measure a slope, look along the flat edge of the protractor and line it up with a point in the distance (up or down slope) that is the same height above the ground as your eye. The aim is for the flat edge of the protractor to be parallel to the slope you are measuring.

Using the location of the string against the protractor's scale, read off the angle observed—that is, the angle between the 90° line on the protractor and the location of the string.

This angle is in degrees and needs to be converted to a percentage. To do this, use a scientific calculator to find the 'tan' of this number and then multiply by 100. For example, if you measured 3°, then:

$$\tan (3^{\circ}) \times 100 = 5.2\% \text{ slope}$$

### Using a line level

You will need string, two stakes, a line level and a measuring tape.

Hammer one stake into the ground on the upper side of the slope. Tie a long piece of string (e.g. 10 metres) to the base of the stake and lay the string out directly down the slope.

Walk down to near the end of the string. Hammer the second stake vertically into the ground and pull the string tight to the base of the second stake. Ensure both stakes are in locations that are representative of the overall slope. Raise the string up the second stake until it is perfectly horizontal, as indicated by using the line level along the top of the string.

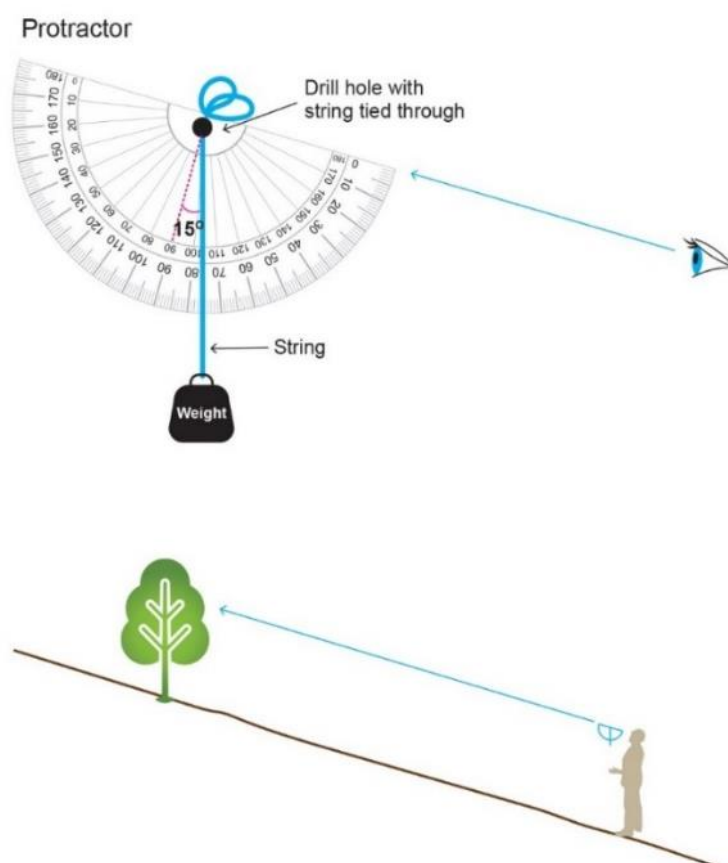
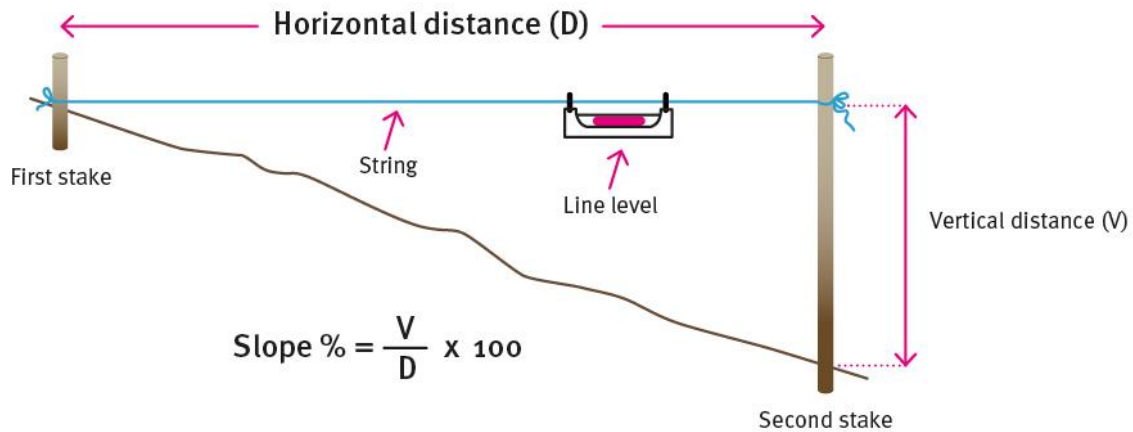


Figure 10: Home-made clinometer and its use in the field



**Figure 11: Using a line level to measure slope**

Measure the second stake between the string and the ground. This is the vertical distance for the slope calculation. Keep the string tight and measure the length of string between each stake. This is the horizontal distance for the slope calculation.

Use these two distances to calculate slope as shown in Figure 11.

### Topographic map

Topographic maps show contour lines that join points of equal elevation. Contour lines that are spaced evenly apart indicate a fairly uniform slope. If ground observations confirm a uniform slope, you can calculate the slope by determining vertical height from adjacent contour lines and the horizontal distance from the scale bar of the map.

For example, if the contour interval is 10 metres, this is the vertical height for the slope calculation. If the horizontal distance between the contour lines is 400 metres (using the scale bar on the map), the slope will be  $(10 \div 400) \times 100 = 2.5\%$ .

Care should be taken to ensure you locate yourself accurately on the map and that the land between the contour lines is of uniform slope. If not, other more reliable methods should be used.

### Smartphone apps

Various smartphone apps are available that claim to measure slope. Care should be taken if using these because the:

- accuracy may depend on the quality of your phone's components
- reliability and accuracy of the app may not be proven.

If such apps are used, it is recommended to first verify their results with other methods before using the apps operationally.