NSW GOVERNMENT | Environment, Climate Change & Water



Private Native Forestry Code of Practice Guideline No. 2

# Protocol for Re-evaluating Old-growth Forest on Private Property

## Introduction

This document sets out the agreed protocol for identifying and validating old-growth forest on private land. It describes ways in which:

- old-growth forests on private land are identified and mapped
- issues relating to clearing applications and private native forestry property vegetation plans (PNF PVPs) should be addressed in the assessment process
- various methodologies [including aerial photographic interpretation (API) pathways and coding methodologies] are used to identify old-growth forest under the *Native Vegetation Act 2003*.

In this protocol, summary text and tables on methodologies are included where appropriate. For full details of methodological descriptions, refer to the reports in the References and Further reading section.

The protocol is for use by Department of Environment, Climate Change and Water (DECCW) officers when:

- determining whether forest is old-growth
- validating old-growth forest for PNF PVPs
- prioritising old-growth forest for private land incentives.

Landholders will also find this protocol useful—especially the 'Identifying old-growth forest on private land' section, which contains information on delineating and checking the boundaries of old-growth forest on private land for the purposes of PNF.

The protocol uses as a basis the criteria and process that were used in the north-eastern and southern NSW projects undertaken as part of the comprehensive regional assessments (CRAs). Information in this protocol is drawn from previously published and unpublished reports and research papers undertaken as part of the upper and lower north-east CRAs (see NSW NPWS 1996, Clode and Burgman 1997, Resource and Conservation Division 1997, 1999).

## Old-growth forest definition

The Joint ANZECC–MCFFA (Australian and New Zealand Environment Conservation Council – Ministerial Council on Forestry, Fisheries and Aquaculture) National Forest Policy Statement Implementation Sub-committee (JANIS 1997) definition for old-growth forest was the same definition used for identifying old-growth forest in NSW in the CRA process. This was:

> Old-growth forest is ecologically mature forest where the effects of disturbance are now negligible.

In applying this interpretation to a forest ecosystem, the following principles apply:

- ecological maturity is defined by the characteristics of the older growth stages

- Where data are available on the structural, floristic, and functional qualities that characterise an ecologically mature forest ecosystem, these data should be used to assess the significance of disturbance.
- In most forests, a significant proportion of trees with age-related features and a species composition characteristic of the ecologically mature forest ecosystem will show negligible disturbance effects.

As part of the CRA process, aerial photographic interpretation was used to map the growth stages of most upper north-east, lower north-east and southern CRA areas on public and private land (see Figure 1).

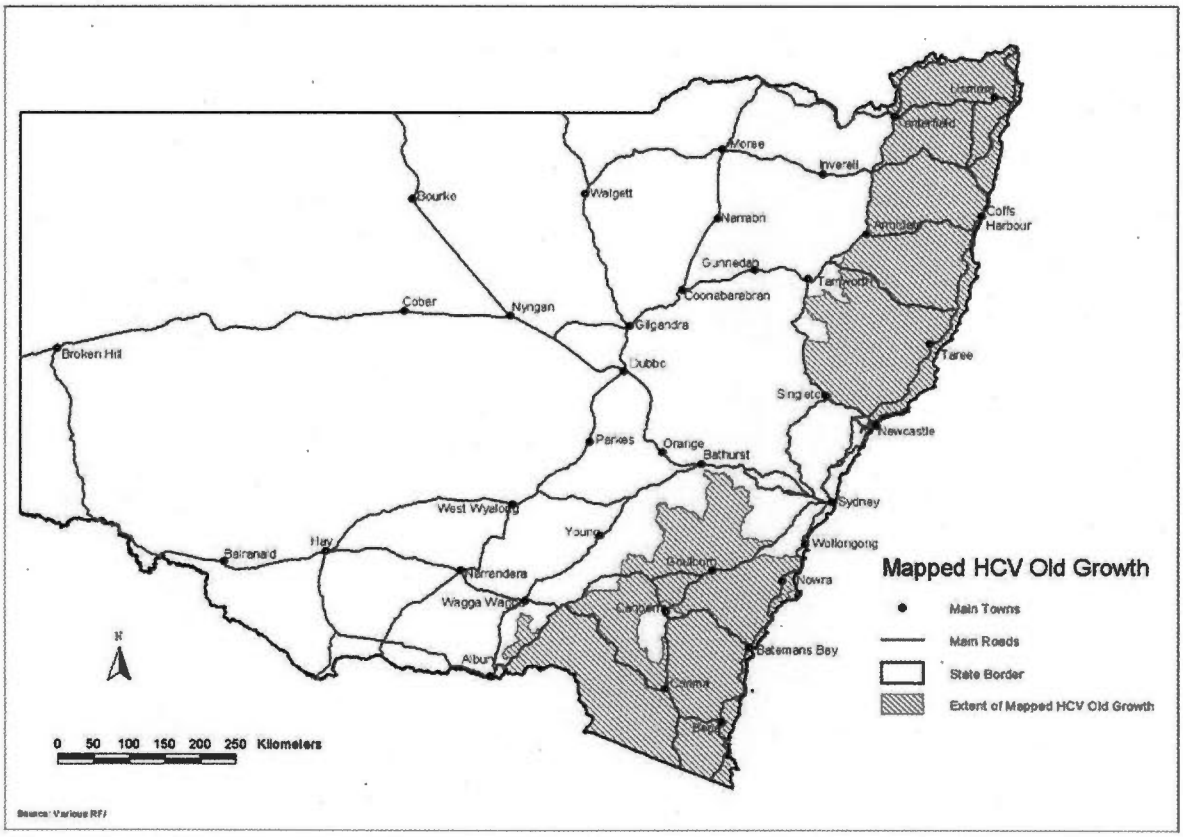


Figure 1: Area of mapping for forest growth stages

Disturbance history records were used on public lands to assess old-growth status. These data were not available for private lands. As a result of this lack of data and the age of the aerial photographs used for mapping (1992–1997), there may be some errors in the boundary of old-growth mapping on private land.

The mapped layer that defines old-growth forest on private land for matters relating to PNF PVPs and the Private Native Forestry Code of Practice (the Code) is a subset layer that uses only the growth stage codes tA (<10% regrowth and >30% senescence) and tB (<10% regrowth and 10%–30% senescence). This layer removes previously mapped areas that contained some regrowth and disturbance. Spatially, it represents about 55% of the extent of the CRA candidate old-growth map layer.

The old-growth forest definition in the Code is further refined as:

> Ecologically mature forest where the effects of disturbance are now negligible that have an area of forest greater than 5 hectares where:

- the overstorey is in a late to overmature growth stage, with the presence of relatively large old trees (many containing hollows and often with the presence of dieback or dead branches in the crown)
- the age (growth) structure of the stand, measured as relative crown cover, consists of less than 10% of regeneration and advance growth and more than 10% of late to overmature (senescent) growth
- the effects of unnatural disturbance are now negligible.

Old-growth woodlands west of the Great Dividing Range, whilst comprising a characteristic canopy of late to overmature trees (many with hollows), may comprise a woodland structure with less diverse or often shrubby understorey and a groundcover of grasses and herbs.

# Characteristics of old-growth forest

The above definition includes the concepts of 'ecological maturity' and 'negligible disturbance', which are central to the old-growth definition and are briefly discussed below:

## Ecological maturity

Ecological maturity can be assessed by examining forest communities, their component species or individuals, or their ecological processes, such as nutrient cycles and stream flows (McCarthy and Burgman 1995).

The development of ecological maturity of a forest can follow two sorts of models of change:

### Model 1: 'Climax community' model

This model assumes that forest development is essentially linear and progressive, where ecological maturity is defined by the 'climax community', meaning basically that variables such as mortality, recruitment and growth are within balance (McCarthy and Burgman 1995).

### Model 2:'Disturbance effects' model

This model assumes that disturbance results in a more complex cycle between growth stages in forest development where disturbance regimes impact on the normal mortality, recruitment and growth cycles and therefore states of ecological maturity.

Ecological maturity, rather than being simply measured by periods of time since prior disturbance, may be defined by structural attributes within the forest (Dyne 1992, Love et al. 1992, McCarthy and Burgman 1995, Clode and Burgman 1997).

Structural attributes refer to the physical characteristics of trees, or stands of trees, and how these are distributed throughout the forest. Structural attributes are the easiest aspects to measure in a forest. Examples of the structural attributes of old-growth forest include:

- many large, old trees, dead standing trees or stags (see 'Glossary')
- many fallen logs
- a deep, multi-layered canopy (Franklin et al. 1981, Scotts 1991, Milledge 1993).

As a result, forest growth is the main feature used to measure 'ecological maturity', as this can be mapped by using available aerial photography.

## The role of disturbance

The old-growth forest definition refers to 'negligible disturbance'. Some level of disturbance, however, is a feature of old-growth forests. The age of old-growth characteristics in a forest depends on a number of factors, such as the characteristics of past disturbances, the forest type and the site qualities. Disturbance regimes are intricately associated with vegetation growth and with the aging and growth stages of trees, stands of trees and the entire forest.

It is therefore important when assessing the impact of disturbance in an area of old-growth to consider:

- the type and frequency of disturbance
- the intensity or severity of disturbance
- the interval between disturbances
- the spatial extent of disturbances.

Types of disturbance relevant to the identification of old-growth forest include past logging, severe fire, and other activities such as mining. Moderate to intense disturbance regimes that affect forest maturity and alter the old-growth characteristics of structure, composition and function will remove the forest from the old-growth classification. See '4 Assess disturbance criteria' for more information on disturbance.

# Identifying old-growth forest on private land

## Landholder procedure

Under the Code, landholders must prepare PNF PVPs for areas of their properties where they wish to undertake PNF operations.

For properties in NSW shown in areas in Figure 1, DECCW will supply the landholder with the best available map indicating mapped old-growth forest (growth stages tA and tB) occurring on the property at the time of the CRA. The landowner should use this map to delineate and check the boundary of old-growth forest on their property, and then either:

- accept the growth stage map as being representative of the old-growth forest on their property and exclude the area from forest operations, or
- apply to DECCW for evaluation of the proposed PNF area for new growth-stage mapping and determination of old-growth forest. The landowner will need to identify the area in dispute and provide evidence to DECCW officers that the area is not old-growth forest. Evidence should include such things as photographic evidence of disturbance and logging records.

## DECCW procedure

If the landholder chooses the second option listed above, a DECCW API interpreter will assess the forest area using the latest available aerial photographs and the CRAFTI mapping disturbance indicators (for example, canopy gaps plus regrowth clusters, pioneer species, and clearings: refer to Table 1 for a full list of disturbance indicators and codes. For a full description of this process, refer to NSW NPWS 1996 and Resource and Conservation Division 1997).

If the area in dispute is less than 10% of the mapped area of old-growth forest, no field investigation is required and the determination will be done using the latest aerial photographs only.

Where field investigations are required, they will involve a cruise sampling technique based on the point-to-plant method (see 'Field validation techniques' below). Field investigations will confirm the growth stage of the area and its level of disturbance. During field investigations, all areas of potential old-growth forest will be assessed, whether previously mapped or not. Aerial photographic investigation (API) and field investigations will be undertaken by specialist DECCW officers.

## Methodology used for aerial photographic interpretation of old-growth forest

The process for API mapping and identification of old-growth forest involves three steps.

Table 1: API disturbance indicators (from Resource and Conservation Division 1997) that disqualify an ecologically mature forest from old-growth status. **Note:** the letters in the left-hand column refer to the CRAFTI API mapping disturbance code used to delineate observed disturbance at any site.

| | |
|---|---|
| **Public and private indicators** | |
| X | There is evidence of recent logging. This represents an obvious pattern on aerial photographs when regrowth after logging is not yet visible but the following features are visible: bare and disturbed ground, snig tracks, log dumps, canopy removal. |
| C | There is evidence of older logging in the form of snig tracks, and log dumps are still apparent on the aerial photographs, but regrowth of trees and understorey has obscured some or most of the logging evidence. |
| GZ | There are irregular clusters of crown gaps in the tallest canopy stratum, and regrowth is more or less present in the gaps at a lower height than the canopy. There may be a high proportion of uneven crown heights (two or more distinct strata with a significant height difference that is apparent from an aerial perspective). |
| GA | There are irregular clusters of crown gaps in the tallest canopy stratum, with thick regeneration of pioneers, such as acacias, callicoma and tobacco bush, apparent. |
| GW | There are irregular clusters of crown gaps in the tallest canopy stratum, with thick regeneration of exotic pioneers, such as lantana, privet and camphor laurel, apparent. |
| W | There are high proportions of other exotic weeds, such as privet. |
| L | Lantana is visible in patches on the photography; it may be viewed as a point source or in the understorey over at least 50% of the canopy. |
| S | There is a high proportion (>5 per hectare) of dead standing trees or stags in the canopy. Their presence may be due to ringbarking, fire, prolonged drought or other environmental stresses. |
| D | Dieback is visible, being manifest by sparse foliage on otherwise dense stands, dead branches and dead trees. |
| P | There is evidence of grazing, such as reduction of crown cover/partial clearing, pasture improvement, and infrastructure construction such as dams, tracks and yards. More than one such feature must be present. |
| **Additional private rules indicators (because of the lack of private land logging history, these additional disturbance indicators are also included)** | |
| B | Landslips |
| O | Evidence of past clearing, now regenerated, such as windrows, tracks and shaped vegetation patterns. |
| J | Constructed tracks and transmission lines |
| **Other disturbance indicators** | |
| e | Erosion |
| b | Landslips |
| m | Mining, including mine sites, tailing dumps, top soil removal |
| R | Rural residential subdivisions |
| J | Other. Particularly used for tracks and evidence of disturbance in non-forest areas, but also for other forms of disturbance not listed. |

## Step 1. Determining ecological maturity

Step 1 involves assigning a measure or surrogate measure of ecological maturity (called structural maturity) to forest stands, based on API of crown forms. The three forms used to define forest growth stage in this methodology are: regrowth, mature and senescing (Woodgate et al. 1994).

Latest available colour 1:25 000 scale aerial photographs will be used to interpret the growth stage of disputed forest stands by assessing crown form characteristics of individual trees, groups of trees and the forest stand. Field site assessment may be needed to verify mapped interpretations with actual ground features when it is difficult to discriminate between senescing and mature growth stages of tree crowns.

### Step 2. Assigning a disturbance level

Step 2 involves assigning a disturbance significance level to forest stands by using qualitative API assessment. As mapped logging history records are not available on private property, levels of disturbance (negligible or significant) will be assessed by using the CRAFTI API mapping disturbance indicators such as canopy gaps plus regrowth clusters, pioneer species, and clearings (refer to Table 1 for a full list of disturbance indicators and codes).

### Step 3. Assessing old-growth status

Step 3 assigns old-growth status to forest stands on the basis of their structural maturity and assessed disturbance level. When information on the spatial extent of any rainforest present or additional post-aerial photo site disturbance is taken into account, the resultant layer defines the extent of old-growth forest on the site.

## Field validation techniques

Field assessment will follow a sampling technique based on a hierarchical system of assessing and confirming the proportions of each growth stage in any forest stand as well as assessing the presence or absence of any site disturbance.

This method requires measurements of growth stage and canopy at a set number of points along a transect within the area identified by API as old-growth forest. It can also be used for confirmation of growth stage proportions in forest stands when other methods are inconclusive, or for calibration of other methods when different types of forest are encountered.

The difficulty with any field assessment is the efficacy of the sampling design in accounting for heterogeneous forests or API polygons—that is, the resources and survey effort and time required to sample all forest variations across the sampling area. Sampled areas can vary according to site conditions, stand condition, patch size and available resources.

### 1 Reassess forest structure and disturbance

The API assessing officer will review the latest aerial photographs to reassess the forest structure characteristics and disturbance levels by using the CRAFTI API mapping disturbance indicators (see Table 1). Reassessment will not occur on non-loggable areas (for example, slopes greater than 30° and non-commercial areas).

The new mapped polygon boundaries will delineate the area of old-growth forest at the site, subject to the field validation set out in Figure 2.

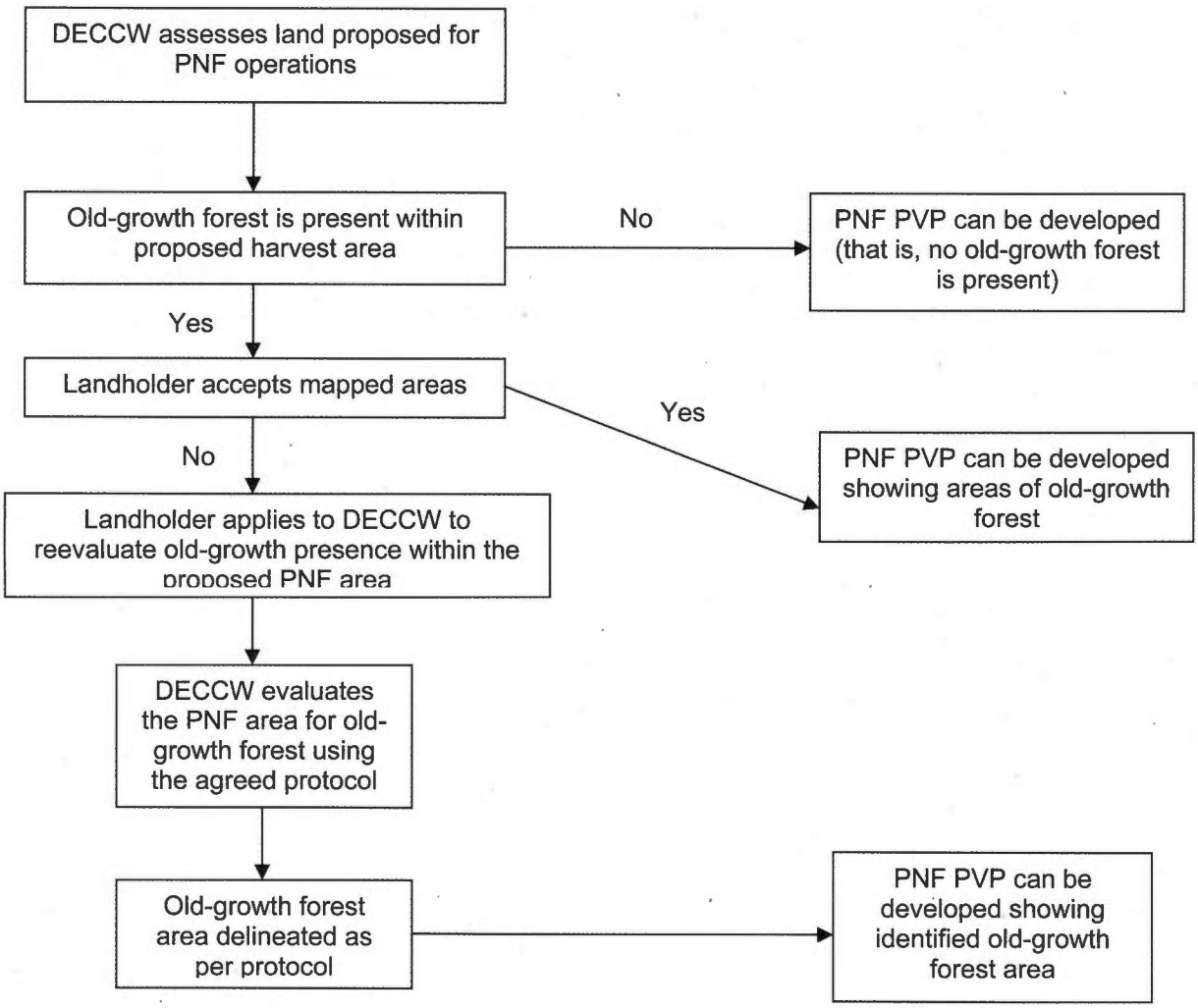


Figure 2: Summary of the process for determining old-growth forest

## 2 Sample new polygons

A transect will be designed to sample the new polygons identified as being old-growth forest. The site inspector will select a location for the transect (including the compass bearing) within the polygon by using API of the latest aerial photos. The transect will be designed to provide an unbiased sample of forest stand variation within the polygon.

The transect starting point in the field will be located from API and a GPS reading will be taken at the transect starting point. The site inspector will use a compass to derive the predetermined transect direction.

The minimum transect length is 10 points at a 50-metre spacing along a straight line, sampling a 30-metre radius area at each point or an area of approximately 2.8 hectares.

## 3 Validate growth stage

The site inspection will aim to validate the previously assessed API growth stage ratios of regrowth and mature and senescent trees for the forest stand in dispute. The stand will be downgraded to 'degraded old-growth forest' only if the new calculated growth stage code is not tA or tB.

At each 50-metre interval along the transect (including the starting point), the site inspector will estimate the distance in metres from the point to the centre of the nearest regrowth or mature or senescent trees that would be visible if viewed by API from above—that is, where more than 50% of the crown is not obscured from above. It is essential to choose the closest suitable tree from the measuring point.

At each point, these measurements will be recorded on the field proforma sheet. Table 2 is an example of a proforma sheet.

Table 2: Old-growth private property site inspection proforma

Date: ...../...../..... Recorders: .....

Landholder.....

API code:.....

Photography/year.....

1:25 000 map sheet:.....

Location .....

Transect no:.....

Starting point: Easting ..... Northing .....

Finishing point: Easting ..... Northing .....

| Point | Regrowth | | Mature | | Senescent | | Disturbance indicators | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | r | D | r | D | r | Recent logging | Older logging | Exotics | Stags or dieback | Grazing infrastructure | Constructed tracks |
| 1 | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| Total | | | | | | | | | | | | |

**Notes:**

r = the average of the longest and shortest crown radii
D = distance to nearest tree in that growth stage visible by API

If regrowth or a mature or senescent tree is not present within the 30-metre radius of the point, a null score will be recorded. Measurement should be recorded as the horizontal distance, as a slope will affect the distance measured from a transect point to sampled trees.

As the distance to each tree is measured, the site inspector will also measure and record the diameter of the crown as it extends along the same axis from the central measuring point. Note that an alternative method of taking two cross-sectional crown measurements along the maximum and minimum diameter of the tree crown can be employed when the first method does not give an accurate representation of the crown dimensions (for example, when there are leaning trees with contracting crowns).

Whatever method is employed, it is important to accurately measure the crown width. The use of a clinometer to ensure that the inspector is standing vertically under the canopy edge may help achieve a consistent measurement of this variable.

At each point, the presence of disturbance indicators will be recorded if any are visible within the 30 metres (see '4 Assess disturbance criteria' below).

The site inspector will conduct measurements of at least 10 points along any transect (which may need to change direction to follow the most homogenous or representative area). The length of each transect should be the same, even if the transect changes direction. It is most important to collect data for at least 10 points along each transect.

Recommended sampling requirements for any site are shown in Table 3.

Table 3: Sampling requirements for assessing old-growth forest

| Area | Sampling requirement |
|---|---|
| Up to 25 hectares | 1 transect at a minimum of 10 points |
| 25–50 hectares | 2 transects at a minimum of 10 points each |
| 50–100 hectares | 3 transects at a minimum of 10 points each |
| >100 hectares | An extra 3 transects per 100 hectares is recommended |

## 4 Assess disturbance criteria

The site inspector assesses the disturbance criteria and their extent throughout the polygon by measuring the extent of disturbance indicators (see below) at each of the 10 transect points.

If any disturbance indicators are recorded in 6 out of 10 or 8 out of 15 sampling points, the surveyed forest area/mapped polygon will be downgraded to 'degraded old-growth forest'.

The above site assessment considers the type and extent of disturbance as well as the intensity and duration of the impact and whether the forest is likely to recover, on the basis of the level and extent of old-growth characteristics disturbed or removed. Where sufficient evidence is documented that the mapped polygon is significantly disturbed, the forest will be downgraded.

Non-pervasive evidence of disturbance (for example, a track or number of older stumps that indicate some tree removal in the past, or the restricted presence of weeds) would not be sufficient for a forest stand to be removed from consideration as old-growth forest. It must be demonstrated that at least 50% of the overall stand has been affected by the localised disturbances, and that both old-growth structure and function have been compromised.

The site inspector will assess the site by using the following disturbance indicators:

### Site disturbance indicators

1. **Recent logging.** Evidence of recent logging activity within the last 10 years is denoted by the presence of bare earth, snig tracks, log dumps, logging debris, little or no regrowth, large open areas and associated canopy gaps.
2. **Older logging.** There is visible evidence of older logging activity such as stumps, log dumps and constructed snig tracks. Older logging could be evident in the form of very lightly logged forest, or stands logged more heavily and often. Evidence of historic logging per se does not necessarily mean there is a significant impact on the structure and floristics of the forest stand. Quantitative assessment classifies stumps over 40 centimetres in diameter as 'older logging' only if there is visible disturbance to the canopy in the form of canopy gaps **plus** regrowth clusters or native pioneers or woody weeds. This indicator therefore must be a combination of the presence of stumps over 40 centimetres in diameter **and** gaps **and** clusters **or** regrowth **or** thick regeneration of native pioneers or weeds.
3. **Exotic woody weeds.** Within a 30-metre radius there is more than 30% spatial cover of exotic woody weeds such as blackberry, privet and camphor laurel.

4. **Ringbarked or dead standing trees.** This includes ringbarked trees and trees affected by dieback or bell bird activity. Generally, these dead trees will be over 40 centimetres in diameter and not have died from natural causes.
5. **Grazing infrastructure.** This includes the presence of fence lines, yards, dams or other watering points and does not include only the presence of cattle, their tracks or camps. There must be a noticeable and significant impact on the structure (presence of gaps and regrowth) and floristics of the forest stand in question.
6. **Constructed tracks.** This includes constructed tracks that have required the removal of canopy trees, resulting in linear strips of regrowth of native pioneers or woody weeds. It does not include temporary farm or bush tracks.

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## Glossary of terms and acronyms

| | |
|---|---|
| API | Aerial photographic interpretation. |
| API pathway | Sequence of decisions and coding relating to API growth staging. |
| Atypical crown form | Tree species displaying non-Jacobsian developmental characteristics . |
| Bole | The main stem of a tree. |
| BOGMP | Broad Old-Growth Mapping Project. |
| Compositional attributes | Living or secondary attributes of old-growth forest including the presence of certain indicator species or life forms such as epiphytes as well as a high diversity of fauna and flora species. |
| Crown | The leaf-bearing branches of a tree. |
| Crown break | A gap in the canopy cover of the overstorey as viewed vertically from above or below. |
| Crown form | The shape or outline of a crown as detected from API. Generally described as being apical (pointed), regular (round) or irregular. |
| Crown cover | The vertical projection of the periphery of tree crowns (crowns assumed to be opaque) within a designated area. Crown cover is estimated in terms of percentage classes of apical, regular or irregular crowns as a proportion of total crown cover. |
| CRA process | Comprehensive Regional Assessment Process. |
| CRAFTI | Comprehensive Regional Assessment Aerial Photographic Interpretation Project undertaken for the Upper North East/Lower North East and southern CRAs. |
| Dbh/dbhob | Diameter at breast height/diameter at breast height over bark. |
| Extending crown | Crown containing healthy leaf bundles at the end of branches and where expansion of the crown is still occurring. |
| Floristic | The plant species composition of an area. |
| Forest type | The unit of forest classification based on overstorey species and structure developed by State Forests of NSW for the forests of NSW. Also known as 'Baur' (see *Research note 17: Forest Types in New South Wales*). |
| Forest ecosystem | The unit of forest classification used for the CRA process and based on an analysis of all floristics, not just canopy species. |
| Functional attributes | Attributes of old-growth forest such as reproduction, nutrient cycling, and regulation of water flow and energy flow. |
| GIS | Geographic Information System. Computer software allowing the storage, retrieval and analysis of mapped and point locality information. |
| Growth stage | An estimate of the maturity of a tree based on assessments of indicators of relative age such as tree height, crown form, crown shape and vigour, and presence of dead branches. Growth stages are classified under three groups; regrowth, mature and senescent. |
| Interpretability | Classification of floristic types based on whether mature and senescing crown forms can be readily discriminated using 1:25 000 scale colour aerial photographs. 'Easy' denotes they can be. 'Difficult' denotes they cannot be. |
| Jacobsian | Tree species or forest types for which the classic signs of development and senescence of the crown are detectable from API (Jacobs 1955). |
| JANIS criteria | *Nationally agreed criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia* (JANIS 1997) |
| Non-Jacobsian | Tree species or forest types for which the classic signs of development and senescence of the crown are **not** detectable from API (Jacobs 1955). |
| Linework | Mapped attributes and polygons generated by API. |
| Overstorey | The layer of vegetation that comprises the tallest or topmost stratum or canopy. |
| Pyrophytic | Vegetation adapted to fire, including eucalypts, brush box and turpentine. |
| Polygon | Area delineated by interpreters on photo overlays and consisting of a homogenous crown appearance interpreted from 1:25 000 aerial photographs within which the growth stage was estimated. |
| Post-photo disturbance | Disturbance that has occurred after photographs have been shot and that therefore will not be represented on the photographs. Such disturbance could be, for example, logging, clearing, fire, windthrow from severe storms, and localised defoliation by insects. |

## Glossary of terms and acronyms *continued*

| | |
|---|---|
| Primary branches | The main or forming branches of the crown that branch from the main stem of the tree, above the height of the crown break. Also known as 'first order branches'. |
| NFPS | The National Forest Policy Statement (Commonwealth of Australia 1992). It is an agreement by the Commonwealth, State and Territory Governments on broad goals for the management of Australia's forests. |
| Relative stand density | The crown cover within each mapped polygon, expressed as a percentage of the crown cover of a fully stocked stand for the particular forest type. |
| Secondary branches | Branches arising from primary branches, whether by normal division into two branches, or by resprouting from a primary branch. |
| Senescent | The growth stage of forests in the late mature to over mature age class. |
| Stable crown | Crowns having a stable width and height. |
| Stag | A standing dead and dry tree greater than 30 centimetres diameter at breast height, and greater than 3 metres in height. |
| Structural attributes | Characteristics of old-growth forest such as large, live old trees, large standing dead trees, large fallen logs on the forest floor, deep litter layers, multiple strata and a complex understorey. |
| Succession | The change in the composition and structure of an ecosystem as competing organisms respond to and modify the environment. |
| Typical crownform | Refers to those species displaying Jacobsian developmental characteristics. |
| Retracting crown | Crown extent is contracting owing to an increase in branch death and declining leaf area. |
| Vegetation type | Refers to a classification of plant communities based on structural and floristic characteristics other than Research note 17 types (see definition of 'Forest type'). |



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