Native Vegetation Regulation 2005 Environmental Outcomes Assessment Methodology

Protecting and investing in healthy and productive landscapes for the people of New South Wales

Under clause 24 of the Native Vegetation Regulation 2005, I approve this document as the Environmental Outcomes Assessment Methodology.

Hon. Frank Sartor MP

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Contents

1 Introduction

In December 2003 the NSW Government undertook a major overhaul of natural resource management institutions in NSW by passing the *Natural Resources Commission Act 2003,* the *Catchment Management Authorities Act 2003* and the *Native Vegetation Act 2003*.

These new reforms were built on the Wentworth Group's report to Premier Carr in February 2003. Their report, titled "*A New Model for Landscape Conservation in New South Wales*" contained five interdependent recommendations:

1) strengthen and simplify native vegetation regulation ending the broadscale clearing of remnant vegetation and protected regrowth;
2) set environmental standards and clarify responsibilities for native vegetation management which will, over time, create healthy rivers and catchments;
3) use property management plans to provide investment security, management flexibility and financial support for farmers;
4) provide significant public funding to farmers to help meet new environmental standards and support on-ground conservation; and
5) strengthen institutions by obtaining scientific input into policy setting, improving information systems, and regionalising administration.

The Native Vegetation Reform Implementation Group was established to advise the Premier on how to implement the Wentworth Group's reforms. This group comprised senior representatives from farmer groups, environment groups, scientists and members of NSW public service agencies. The Native Vegetation Reform Implementation Group Report identified that:

> *"New South Wales needs a sound approach to the management of our native vegetation that:*
>
> - *is built on a shared commitment to develop the world's leading agricultural production systems that utilise maximum water efficiency and sustainable farming practices;*
> - *is capable of sustaining regional development with secure access to natural resources;*
> - *protects the environment by restoring and maintaining the quality of our water, soil and biodiversity; and*
> - *is based on mutual trust between farmers, environmentalists, governments, and the wider community."*

In December 2003 the *Natural Resources Commission Act 2003, Catchment Management Authorities Act 2003* and the *Native Vegetation Act 2003* were passed to deliver this framework.

The *Natural Resources Commission Act 2003* created the Natural Resources Commission. One of the primary functions of the Commission is to set State–wide standards and targets for natural resource management. The Commission is required to have regard to, among other things, the principles of ecologically sustainable development, the social and economic implications of its recommendations and advice, and regional variation in the environment.

The *Catchment Management Authorities Act 2003* creates Catchment Management Authorities. The Authorities have both an operational role and a planning role. Operationally the Catchment Management Authorities are responsible for approving property vegetation plans under the *Native Vegetation Act 2003* and delivering incentives to landholders from funding provided by Government. Catchment Management Authorities are also responsible for preparing catchment action plans. The catchment action plans are the link between the State-wide standards and targets and on ground actions at the regional level.

An objective of the *Native Vegetation Act 2003* is to end broadscale clearing except where the clearing will improve or maintain environmental outcomes. This Environmental Outcomes Assessment Methodology sets out the circumstances in which broadscale clearing is to be regarded as improving or maintaining environmental outcomes. It provides the scientific underpinning for, and the logic used in this assessment. It will continue to be refined as the science improves.

The Environmental Outcomes Assessment Methodology is applied using an objective, computer-based decision support software known as the Native Vegetation Assessment Tools (NVAT). This software weighs up the positive and negative benefits of different management actions helping assessment officers to make practical decisions based on the best scientific information available.

The Native Vegetation Assessment Tools will be used by Catchment Management Authorities to assist farmers prepare Property Vegetation Plans. Property Vegetation Plans will be the main vehicle for delivering on farm incentives and for securing and clarifying farmers' rights to manage native vegetation consistent with the *Native Vegetation Act 2003.*

Detailed explanations on the use of the software outlined in the methodology are provided in Operations Manuals.

The methodology and software has evolved as a result of extensive field trials, public submissions and review by panels of independent scientists, farming and environmental interests.

It will continue to be refined as scientific knowledge advances. All future improvements to the Native Vegetation Assessment Tools will require consideration by the Natural Resources Commission and approved by the Minister for Climate Change and the Environment (in relation to aspects of assessment concerned with salinity, soil, water quality, biodiversity and threatened species).

Notes in this document are explanatory notes and do not form part of the document for the purposes of the Native Vegetation Regulation 2005.

Note: For further information please see the following:

Wentworth Group of Concerned Scientists, 2003 *A New Model for Landscape Conservation in New South Wales.* NSW Government
http://www.wwf.org.au/News_and_information/Publications/PDF/Report/new_model_report_to_carr.pdf

Native Vegetation Reform Implementation Group, 2003 *Final Report.* Department of Infrastructure, Planning and Natural Resources
http://www.nativevegetation.nsw.gov.au/methodology/index.shtml

Department of Natural Resources (DNR), 2003 A New Approach to Natural Resource Management.
http://www.nativevegetation.nsw.gov.au/methodology/index.shtml

The Native Vegetation Assessment Tools (NVAT) were known in previous versions of this EOAM as the Property Vegetation Plan Developer (PVP Developer).

2 Assessment of broadscale clearing proposals

2.1 Overview

The *Native Vegetation Act 2003* states that broadscale clearing proposed in a development consent or a property vegetation plan may only be approved if the clearing will improve or maintain environmental outcomes. Sections 15 and 32 of the *Native Vegetation Act 2003* allows the Native Vegetation Regulation 2005 to make provision for or with respect to "the circumstances in which broadscale clearing is to be regarded as improving or maintaining environmental outcomes"

This document sets out the circumstances in which clearing and, where appropriate associated offsets, are to be regarded as improving or maintaining environmental outcomes.

This document is adopted into the Native Vegetation Regulation 2005 (as required by the *Native Vegetation Act 2003*) by clause 24 of the Native Vegetation Regulation 2005. The Environmental Outcomes Assessment Methodology can only be varied in accordance with the process set out in clause 25 of the Native Vegetation Regulation 2005. In particular, before any change takes effect, the Native Vegetation Regulation 2005 will need to be updated to refer to the amended version (clause 25(1)(g)) of the Environmental Outcomes Assessment Methodology.

The environmental outcomes of clearing are highly variable and depend on a range of issues such as the type of vegetation being cleared, how the clearing will be undertaken and the existing state of the landscape in the area where the clearing is proposed. This document and the data that underlies some of the requirements (see Chapter Section 2.4) reflect this complexity.

To facilitate timely assessment of clearing proposals in accordance with the Environmental Outcomes Assessment Methodology, the methodology has been programmed into a decision support tool called the Native Vegetation Assessment Tool (NVAT). This allows local environmental variables and details of the clearing and any offset proposals to be entered into the computer, with the results of ensuing computations being available to assist decision making by the appropriate authorities as to whether the proposed broadscale clearing is to be regarded as improving or maintaining environmental outcomes in accordance with this Environmental Outcomes Assessment Methodology. An officer delegated by the Minister must certify that the Native Vegetation Assessment Tool complies in all aspects with the Environmental Outcomes Assessment Methodology. Decisions made in accordance with the Native Vegetation Assessment Tool will be regarded as improving or maintaining environmental outcomes.

The Director General of the Department of Environment, Climate Change and Water (or delegate) will maintain version control of the Native Vegetation Assessment Tool in accordance with amendments to the Environmental Outcomes Assessment Methodology made under clause 25 of the Native Vegetation Regulation 2005. Version control is managed through the PVPs Agreements Data and Customer Service (PADACS) system that automatically maintains the version of the Native Vegetation Assessment Tool and its databases used for a Property Vegetation Plan. A PVP can not be generated without reference to the PVPs Agreements Data and Customer Service system.

Broadscale clearing must be assessed in accordance with Chapters 2 to 6. The overall impacts of proposed broadscale clearing are to be determined by separately assessing the impacts of the proposal on:

- water quality (Chapter 3);
- salinity (Chapter 4);
- biodiversity (Chapter 5); and

- land degradation (soil) (Chapter 6).

Where the broadscale clearing is of an invasive native scrub species listed in Table 7.1 the option is available to have the proposal assessed in accordance with Chapter 7 only.

Note: The PVPs Agreements Data and Customer Service (PADACS) system was known in previous versions of this EOAM as the Property Administration Management System (PAMS).

2.2 The improve or maintain test

Proposed broadscale clearing assessed under this test is to be regarded as improving or maintaining environmental outcomes if either:

1) **In relation to development applications**, the impacts of the proposed clearing will improve or maintain environmental outcomes for each *relevant environmental value* (that is, water quality, salinity, biodiversity and land degradation (soil)); or
2) **In relation to a draft Property Vegetation Plan (PVP)**, the impacts of the proposed clearing and the benefits from any offset whether the same property or elsewhere, will improve or maintain environmental outcomes for each relevant environmental value.

If a clearing proposal that involves clearing of native vegetation (other than invasive native scrub) the proposal must be assessed against each of the relevant environmental values (that is, water quality, salinity, biodiversity and soils). For each environmental value, the clearing (and, where relevant, any offsets) must improve or maintain environmental outcomes, according to this Environmental Outcomes Assessment Methodology.

If a clearing proposal is for the purpose of clearing of invasive native scrub (as defined by this Environmental Outcomes Assessment Methodology in Chapter 7), then that proposal is assessed **only under Chapter 7** to determine whether the proposed clearing will improve or maintain environmental outcomes. If the assessment under Chapter 7 indicates that the proposed clearing will improve or maintain environmental outcomes, then there is no need to assess the proposal under Chapter 3 (water quality), Chapter 4 (salinity), Chapter 5 (biodiversity) and Chapter 6 (soils).

For a clearing proposal that deals with the clearing of invasive native scrub, if the assessment under Chapter 7 indicates that the clearing will **not** improve or maintain environmental outcomes, then the clearing proposal must be assessed in the same way as a proposal that involves clearing native vegetation that is not invasive native scrub.

2.3 Offsets

Where management actions that have environmental benefits (referred to as offsets) are proposed in a Property Vegetation Plan, the benefits of the proposed action are to be determined by separately assessing the benefits of the offset in relation to each of the environmental values listed above.

In addition to any specific requirements for offsets set out in Chapter Sections 3 to 6, the benefits of a proposed offset may only be taken into account when assessing whether proposed clearing will improve or maintain environmental outcomes if the:

- benefits of the offset persist for at least the duration of the negative impact of the proposed clearing; and
- offset is additional to actions or works carried out using public funds or to fulfil regulatory obligations.

Offsets may only be proposed in a Property Vegetation Plan.

Note:

1. The principles for the use of offsets are:

A. the benefits of the offset persist for at least the duration of the negative impact of the proposed clearing (usually in perpetuity); and

B. the benefits from any offset whether the same property or elsewhere will improve or maintain environmental outcomes for each relevant environmental value; and

C. the offset vegetation for biodiversity is either of equal or greater regional conservation significance as the site proposed for clearing; and

D. management actions are likely to be deliverable and enforceable; and

E. permanent conservation measures are given greater value than other management actions; and

F. the benefits of the offset are assessed using the same methodologies used to assess the impacts of the proposed clearing; and

G. the offset is additional to actions or works carried out using public funds or to fulfil regulatory obligations; and

H. only benefits from the management action or permanent conservation action may comprise the offset.

2. Offsets (that are not related to how the proposed clearing is carried out) are not available as part of development applications as there is no way of ensuring that these actions are implemented by subsequent landholders.

3. When the Minister on the advice of the Natural Resources Commission, approves the appropriate method(s) within the Environmental Outcomes Assessment Methodology the net effect of impacts and benefits on water quality, land degradation (soil) and salinity will be assessed and the flow-on effects of the impacts and benefits between water quality, land degradation (soil) and salinity will be taken into account. Biodiversity outcomes will not be tradeable.

2.4 Data variation

2.4.1 Databases containing environmental information

Chapters 3, 4, 5, 6 and 7 specify the circumstances in which broadscale clearing is to be regarded as improving or maintaining environmental outcomes for water quality, salinity, biodiversity, soils and invasive native scrub respectively.

To apply these circumstances accurately and meaningfully to the enormous range of possible clearing and offset proposals in the diverse environments that exist throughout the State it is necessary to rely on detailed data about the state of the environment in NSW. The information is held in the following databases:

- threatened species profile database;
- vegetation benchmarks database;
- overcleared landscapes database;
- overcleared vegetation types database;
- coastal thinning genera database;
- major rivers database;
- important wetlands database;
- soil subregions database; and
- invasive native scrub species database.

These databases are available from the web site of the Department of Environment, Climate Change and Water.

2.4.2 Changing the databases

The databases are updated in response to increasing knowledge about the environment and changes in the environment itself. Prior to updating the databases the Director General of the Department responsible for that database must consult the Natural Resources Commission, the Catchment Management Authorities and any other public authorities, bodies or persons that are, in the opinion of the Director General, likely to be affected by the proposal.

Changes to the databases must be published on the internet.

2.4.3 Using more appropriate local data

Where an assessment of proposed broadscale clearing using the approved database(s) indicates that the proposal does not improve or maintain environmental outcomes, it may be possible to utilise more appropriate local data.

If an ***accredited expert*** certifies that data is available that more accurately reflects local environmental conditions (compared to the data in the approved databases) in relation to:

- vegetation benchmarks;
- overcleared landscapes;
- overcleared vegetation types;
- coastal thinning genera; and
- threatened species profile data, including (but not limited to) whether threatened animal species are likely to occur on the land in that vegetation type or key habitat feature in the subregion and the estimated percentage increase in population that can be expected in response to a proposed management action, as measured by either an increase in the number of individuals, or area of habitat component or key habitat feature;

the Catchment Management Authority Board or General Manager (exercising power delegated by the Minister) may authorise the replacement of the approved data with data that the accredited expert advises is more appropriate.

After the data is varied the proposal may be reassessed in accordance with clause 26(1)(a) of the Native Vegetation Regulation 2005.

In certifying that data is available that more accurately reflects local environmental conditions (compared to the data in the approved databases), the accredited expert must:

- Provide reasons for this opinion; and
- Comply with any assessment protocols approved by the Minister for Climate Change and the Environment (in relation to aspects of assessment concerned with salinity, soil, water quality, biodiversity and threatened species) and the Minister for Primary Industries (in relation to aspects of assessment concerned with fish and marine vegetation).

Accredited expert means a person accredited by the Minister for Climate Change and the Environment as an expert for the purposes of this Chapter Section, being accreditation on the basis of criteria approved by the Minister for Climate Change and the Environment (in relation to aspects of assessment concerned with salinity, soil, water quality, biodiversity and threatened species) and the Minister for Primary Industries (in relation to aspects of assessment concerned with fish and marine vegetation).

If broadscale clearing is approved after data has been varied in accordance with this Chapter Section the requirements of clause 29 of the Native Vegetation Regulation 2005 must be complied with.

3 Water Quality Assessment

3.1 Introduction

Riparian vegetation provides multiple benefits for water quality, land degradation (soil), salinity and terrestrial and aquatic biodiversity. Riparian (or riverside) vegetation therefore is used as a surrogate for water quality impacts, where the term "water quality" is used broadly to mean "river health". In addition to the sediment and nutrient aspects of water quality, this also encompasses aquatic habitat (for biodiversity protection) and geomorphologicall considerations.

"Riparian land is important because it is usually the most fertile and productive part of the landscape, in terms of both agriculture and natural ecosystems. It often has better quality soils than surrounding hill-slopes and, because of its lower position in the landscape, often retains moisture over a longer period" (Cotton Research and Development Corporation, 2003).

"Riparian land often supports a greater diversity of plants and animals than non-riparian land. This is a result of its wide range of habitats and food types, its closeness to water, its microclimate and its ability to provide refuge. Many native plants and animals are found only, or mainly, in riparian lands, and this makes these areas essential to many animals for all or part of their lifecycle" (Cotton Research and Development Corporation, 2003).

"Riparian land also provides a refuge for native plants and animals in times of drought and fire, as well as providing corridors for wildlife in highly-cleared landscapes" (Cotton Research and Development Corporation, 2003).

"Careful management of riparian land is vital for the conservation of Australia's unique biodiversity" (Cotton Research and Development Corporation, 2003).

3.2 The improve or maintain test for water quality

The water quality tool is to be used in the field during site visits. The user is to apply the tool if all or part of a stream or wetland area can be seen on the ground within the proposed Property Vegetation Plan area or within the following distances from the boundary of the Property Vegetation Plan area:

- coast and tablelands- 40 metres;
- western slopes and plains-100 metres; or
- estuarine areas-50 metres;

Otherwise there is no need to apply the tool and clearing is deemed to improve or maintain environmental outcomes *for water quality*.

3.2.1 Clearing that does not improve or maintain environmental outcomes for water quality

Subject to Chapter Section 3.2.3, below, the following clearing does not improve or maintain environmental outcomes *for water quality* and cannot be offset:

- clearing within 20 metres of, and within, a stream listed in Major Rivers Database (NSW Government, 1977);
- clearing within the riparian buffer distance around important wetlands or minor wetlands (as defined in Table 3.1).

Table 3.1 Definition of riparian buffer distances

Location	Size of stream/wetland			
	Minor watercourses, flood runners and effluents	**Minor creeks & lagoons**	**Minor rivers, minor wetlands & major creeks**	**Major rivers & important wetlands**
Coast & tablelands	10 m	20 m	30 m	40 m
Western slopes & plains	20 m	40 m	60 m	100 m
Estuarine areas	50 m from the astronomical high tide mark (where no obvious bank).			

3.2.2 Clearing that may improve or maintain environmental outcomes for water quality with appropriate offsets

Subject to Chapter Sections 3.2.1 and 3.2.3, it is deemed that clearing within the riparian buffer distance will not improve or maintain environmental outcomes for water quality without offsets. The offset:

- must provide commensurate vegetation cover (to minimise soil erosion and filter sediment); and
- must be within the riparian buffer distance that applies to the stream or wetland where the offset is to be located; the offset need not be on the same stream or lagoon as the clearing.

Offsets for water quality are calculated using the process described for biodiversity in Chapter 5. Proposed offsets may need to be assessed under Chapters 4 and 6 to determine whether the water quality offset has any negative impacts on salinity or land degradation.

3.2.3 Clearing that does improve or maintain environmental outcomes for water quality

The following clearing is deemed to improve or maintain environmental outcomes *for water quality*:

- clearing outside the riparian buffer distances for streams and wetlands; or
- clearing within the riparian buffer distances for streams and wetlands if it is for thinning of native vegetation to benchmark conditions for biodiversity (see Chapter Section 5.4).

3.3 Definitions

Stream means any river, creek, or natural watercourse, whether artificially modified or not, in which water flows, regardless of flow regime, in a defined flow path, bed or channel.

Effluent means an anabranch or distributary that is:

a) listed in the Major Rivers Database (see definition of Minor River); or
b) not listed in the Major Rivers Database but is shown on the topographic map in the Native Vegetation Assessment Tool.

Lagoon means a wetland that is visible on the ground but may or may not be marked on a 1:25,000 (or next best available scale) topographic map, is not listed in the Important Wetlands Database, is not a SEPP 14 Wetland and is not shown on the map of wetlands in the Native Vegetation Assessment Tool.

Major river means any part of a stream that is listed as a “major river” in the Major Rivers Database which is:

a) downstream of the most upstream tributary listed in the Major Rivers Database; or
b) downstream of another stream that is listed as a "major river" in the Major Rivers Database.

Minor river means any part of a stream that is:
a) listed as a tributary or effluent in the Major Rivers Database, and has one or more upstream tributaries that are 2nd order based on the topographic map in the Native Vegetation Assessment Tool; or
b) listed as a "major river" in the Major Rivers Database, and is:
   (i) above the highest tributary listed in the Major Rivers Database; and
   (ii) does not have another stream upstream of it that is listed as a "major river" in the Major Rivers Database; and
   (iii) has one or more upstream tributaries that are 2nd order based on the topographic map in the Native Vegetation Assessment Tool.

Major creek means any part of a stream that is:
a) Major creek has the same meaning as "Minor river" in the context of the Native Vegetation Assessment Tool.

Minor creek means any part of a stream that is:
a) not listed in the Major Rivers Database, is not an effluent or flood runner and the topographic map in the Native Vegetation Assessment Tool shows it has tributaries upstream of it; or
b) a listed tributary or effluent of a "major river" in the Major Rivers Database, and the stream section is above the highest 2nd order tributary marked on the topographic map in the Native Vegetation Assessment Tool; or
c) listed as a "major river" in the Major Rivers Database, and the stream section is above the highest 2nd order tributary marked on the topographic map in the Native Vegetation Assessment Tool.

Minor watercourse means any part of a stream:
a) that is not listed in the Major Rivers Database and the topographic map in the Native Vegetation Assessment Tool shows it has no tributaries upstream of it; and
b) for which there is a visible path where water flows intermittently, ephemerally or permanently, that may be vegetated and which may or may not have an eroded channel.

Important wetland means a wetland that is listed in the Important Wetlands Database or is a SEPP 14 wetland.

Minor wetland means a wetland that is shown on the map of wetlands in the Native Vegetation Assessment Tool but is not listed in the Important Wetlands Database and is not a SEPP 14 wetland.

Flood runner means a continuous channel across or down a floodplain that only carries flow during an overbank flood.

SEPP 14 wetland means a wetland that is shown on the map of SEPP 14 wetlands in the Native Vegetation Assessment Tool.

Visible channel means a visible path where water flows, regardless of flow regime, which shows some degree of incision or erosion.

Note:

1. The classification of major and minor rivers in the Major Rivers Database is based on the publication "*Restrictions on the removal of trees on NSW watercourses*" (NSW Government, 1977), stream ordering and visual inspection. All streams listed in the booklet, whether listed as "major rivers" or not, have been provided with the same protection zone (within 20 m of their banks) since 1964. Minor amendments have been made to the list in the booklet to make it suitable for current needs and the amended listing has been reorganised into one table for each Catchment Management Authority, and a separate table of "major rivers" (see in the Major Rivers Database). The amendments preserve the original protection afforded to listed streams.

2. The Commonwealth Department of Environment and Heritage has listed 'nationally important wetlands', a subset of which is a list of Nationally Important Wetlands in NSW. A list of these wetlands, *Nationally Important Wetlands in NSW*, is provided by Catchment Management Authority area in the Operations Manual (see the Important Wetlands Database).

3. SEPP 14 wetlands are shown on the map of SEPP 14 wetlands provided in the Native Vegetation Assessment Tool.

3.4 Using the modified Strahler Stream ordering system

Progressing upstream, rivers and creeks become progressively smaller and their default riparian buffer distance requirements reduce. For example, working upstream, the Murrumbidgee starts as a "major river" but it progressively dwindles to be a "minor river or major creek" and then to be a "minor creek" before it peters out altogether. Provision has also been made in the Major Rivers Database for streams, such as the Darling, that undergo name changes.

Where stream ordering is used in the above definitions, this is determined using the Strahler system, which starts with 1st order at the top of the stream network (based on a 1:25,000 or next best available scale topographic map). The modified Strahler system is illustrated in Figure 3.1.

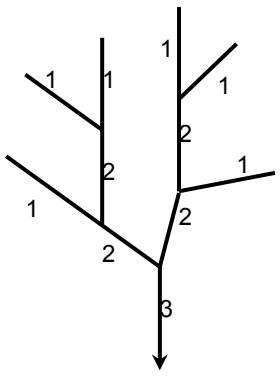

Figure 3.1 Modified Strahler stream ordering system

The stream ordering system is designed to produce results that are consistent between catchments, but also recognise legitimate regional differences. It is also designed to be simple enough to be useful to practitioners in the field, but at the same time reflect the differentiation in Table 3.1.

3.5 Measuring buffer distances

For streams, riparian buffer distances are measured on both sides of the stream from top of bank if this is defined, otherwise from the centre of the stream. Where a stream has more than one bank on either side, the bank closest to the main channel should be used, to protect vegetation on and within the stream banks.

For wetlands, riparian buffer distances are measured on all sides from the wetland limit. Where a wetland has more than one bank, the bank closest to the wetland area should be used.

Where a clearing or offset site is adjacent to a wetland, the distances for both streams and wetlands should be measured and the greater riparian buffer distance should be adopted.

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4 Salinity Assessment

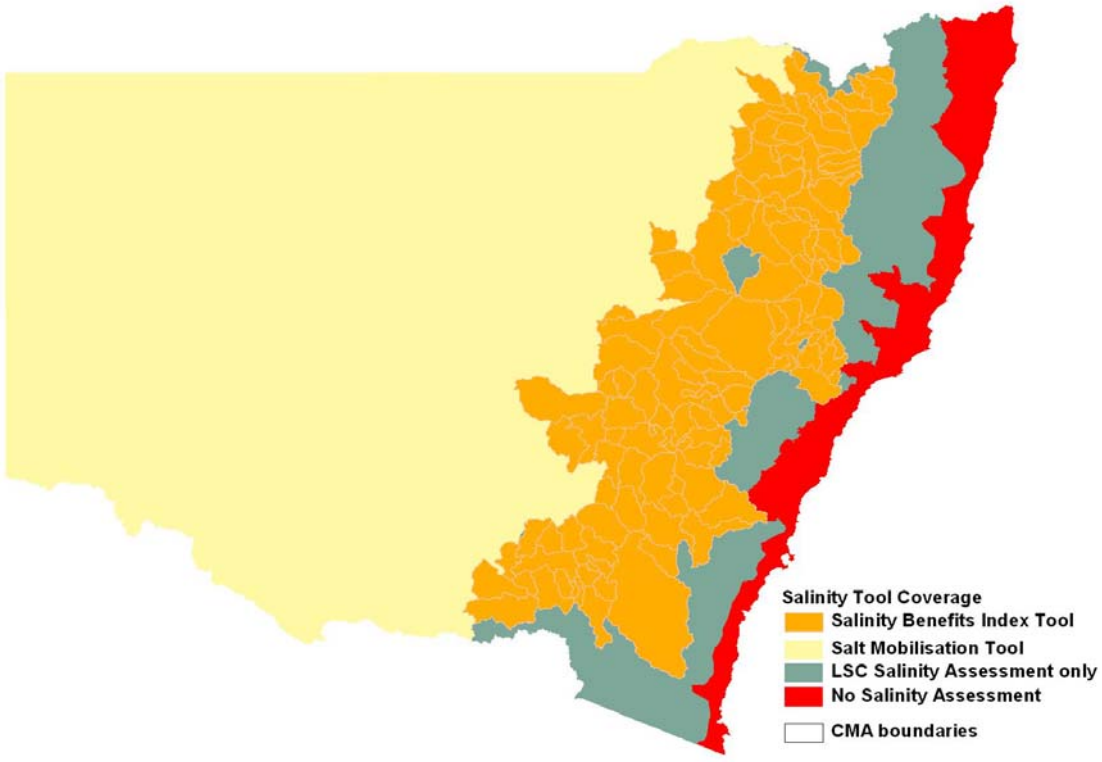
4.1 Introduction

This Environmental Outcomes Assessment Methodology defines the circumstances in which broadscale clearing is to be regarded as improving or maintaining environmental outcomes for salinity under the *Native Vegetation Act 2003* including for the purposes of agreeing to a Property Vegetation Plan.

The assessment of the impacts of clearing on salinity, and the calculation of offsets, varies with location in NSW of the proposal:

- in upland areas of the Murray-Darling Basin, most of the Hunter catchment and a few coastal catchments, where dryland salinity has been identified as a significant hazard, the procedure involves calculating a Salinity Benefits Index, which is a measure of the change in stream salinity from current levels arising from a change in land cover. Chapter Section 4.4 describes the procedure for applying the improve or maintain test to clearing proposals and evaluating offsets using the Salinity Benefits Index;
- in the western part of NSW, where the geomorphic province is best described as "plains" but can also include some upland areas, the hydrologic processes and connectivity of salt stores with the surface drainage network are not adequately represented by the Salinity Benefits Index modelling approach. Here, the assessment procedure involves calculating a Salt Mobilisation Index which is a measure of the change in salt mobilised following a change in land use or cover (Department Infrastructure Planning and Natural Resources, 2005). Chapter Section 4.5 outlines the procedure for applying the improve or maintain test to clearing proposals in these areas;
- on the coastal slopes and tablelands an assessment of salinity is undertaken using only the Land and Soil Capability Tool (LSC); and
- on the coastal plains, a salinity assessment is not required because the dryland salinity hazard is low except in the Hawkesbury-Nepean coastal plain.

Figure 4.1 Map showing where each salinity assessment procedure is used



4.2 Assessing salinity hazard

The Land and Soil Capability Tool provides a preliminary assessment of clearing and offset proposals to check whether they are likely to improve or maintain environmental outcomes for dryland salinity.

A salinity hazard assessment is undertaken for all Catchment Hazard Areas where the clearing of native vegetation is proposed, excluding most of the Coastal Plains Catchment Hazard Areas. The one Coastal Plains exception is the Hawkesbury-Nepean Coastal Plain, where a preliminary assessment of salinity hazard is required.

A salinity hazard assessment is not required where the proposal to clear native vegetation involves the removal of paddock trees, as defined for the ***BioMetric*** Tool.

The criteria used by the Land and Soil Capability Tool to assess salinity hazard depend on the Catchment Hazard Area in which the assessment is undertaken and include:

- evidence of salinity outbreaks in the Land and Soil Capability zone;
- evidence of salinity outbreaks down-slope from the Land and Soil Capability zone;
- whether the Land and Soil Capability zone is in a known high salt store area;
- permeability of the soil; and
- condition of existing native vegetation.

The criteria (and relationships between the criteria) used by the Land and Soil Capability Tool to determine the Land and Soil Capability Class are shown in Table 4.1 for all Slopes and Tablelands Catchment Hazard Areas and the Hawkesbury-Nepean Coastal Plain Catchment Hazard Area, and in Table 4.2 for the Inland Plains Catchment Hazard Area.

If a preliminary salinity hazard assessment by the Land and Soil Capability Tool results in Land and Soil Capability Class 3 to 6, in the case of a clearing proposal, or Land and Soil Capability Class 3 to 8 in the case of an offset proposal, then:

- where the Salinity Benefits Index Tool is available for the Catchment Hazard Area, this Tool must be run to determine the salinity offset requirement, if any; or
- where the Salinity Benefits Index Tool is not available for the Catchment Hazard Area, and the Salt Mobilisation Tool is available, then the Salt Mobilisation Tool must be run to determine the salinity offset requirements.

Table 4.1 Criteria for determining Land and Soil Capability Class for Salinity Hazard for all Slopes and Tablelands Catchment Hazard Areas and the Hawkesbury - Nepean Coastal Plains Catchment Hazard Area.

Evidence of salinity outbreaks in the Land and Soil Capability Zone	Evidence of salinity outbreaks downslope from the Land and Soil Capability Zone	Salt Store Class	Land and Soil Capability Class
No salt outbreaks	No salt outbreaks	Very Low	1
		Very Low to Low; Low	2
		Low to Moderate; Moderate Moderate to High	3-6
		High; High to Very High	7
		Very High	8
	Salt outbreaks observed but not extensive and no severe scalding	Very Low; Very Low to Low; Low; Low to Moderate; Moderate	3-6
		Moderate to High; High	7
		High to Very High; Very High	8
	Salt outbreaks extensive and severe scalding	Any	7-8
Salt outbreaks observed but not extensive and no severe scalding	No salt outbreaks	Very Low; Very Low to Low; Low; Low to Moderate; Moderate	3-6
		Moderate to High; High	7
		High to Very High; Very High	8
	Salt outbreaks observed but not extensive and no severe scalding	Very Low; Very Low to Low; Low; Low to Moderate	3-6
		Moderate; Moderate to High; High	7
		High to Very High; Very High	8
	Salt outbreaks extensive and severe scalding	Not Required	7-8
Salt outbreaks extensive and severe scalding	Not Required	Not Required	7-8

Table 4.2 Criteria for determining Land and Soil Capability Class for Salinity Hazard for the Inland Plains Catchment Hazard Area.

Evidence of salinity outbreaks in the Land and Soil Capability Zone	Salt Store Class	Soil Permeability Class [1]	Low Condition Vegetation [2]	Land and Soil Capability Class
No salt outbreaks	Very Low; Very Low to Low	Low	Yes	1
			No	1
		Moderate	Yes	1
			No	2
		High	Yes	2
			No	3
	Low; Low to Moderate	Low	Yes	1
			No	2
		Moderate	Yes	2
			No	3
		High	Yes	3
			No	4
	Moderate	Low	Yes	2
			No	3
		Moderate	Yes	3
			No	4
		High	Yes	4
			No	5
	Moderate to High; High	Low	Yes	3
			No	4
		Moderate	Yes	4
			No	5
		High	Yes	5
			No	6
	High to Very High; Very High	Low	Yes	4
			No	5
		Moderate	Yes	5
			No	6
		High	Yes	6
			No	7
Salt outbreaks and/or scalding	Very Low; Very Low to Low	Low	Yes	3
			No	3
		Moderate	Yes	3
			No	3
		High	Yes	3
			No	4
	Low; Low to Moderate	Low	Yes	3
			No	3
		Moderate	Yes	3
			No	4
		High	Yes	4
			No	4
	Moderate	Low	Yes	3
			No	4
		Moderate	Yes	4
			No	4
		High	Yes	4
			No	5
	Moderate to High; High	Low	Yes	4
			No	4
		Moderate	Yes	4
			No	5
		High	Yes	5
			No	6
	High to Very High; Very High	Low	Yes	4
			No	5
		Moderate	Yes	5
			No	6
		High	Yes	6
			No	7

[1] **Defined in Section 4.5.4**
[2] **Defined in Section 4.3.7**

4.3 Definitions

4.3.1 Streamflow

Streamflow is the total volume of water in a stream channel, for a specified time. It is measured at gauging stations and therefore is only known for discrete locations. In this model, streamflow (expressed in megalitres/year) is reported as an average annual value for the period 1975-2000.

Streamflow is separated into two flow components: quickflow and baseflow:

- Quickflow is the component of streamflow that is generated quickly during a rainfall event. It is sourced from surface runoff and lateral shallow subsurface runoff (i.e. pathways of water movement that are at or close to the ground surface). Quickflow is assumed to be a function of rainfall, soil, topography and land use.
- Baseflow is the component of streamflow that travels more slowly from the catchment to the stream and tends to sustain flow in a channel between rainfall events. It is sourced from rainfall that has infiltrated deep into the soil profile to recharge groundwater. This pathway of flow is typically slower than surface runoff pathways. Baseflow is assumed to be a function of rainfall, soil and land use.

4.3.2 Recharge

Recharge refers to the component of rainfall that infiltrates (percolates) down through the soil, beyond the root zone of the vegetation cover and into the groundwater aquifer. Rates of recharge tend to be slow. Where recharge water is discharged from a groundwater aquifer into a stream, it contributes to baseflow.

4.3.3 Surface Runoff

We use the term surface runoff to refer to the component of rainfall that flows at or relatively close to the ground surface and which, when it reaches a stream channel, contributes to the quickflow component of streamflow. It includes flow across the land surface and lateral shallow subsurface flow.

4.3.4 Salt Load

Salt load is the quantity of salt carried by a stream, over a specified time. It is a function of the salinity of streamflow and the volume of streamflow:

Salt Load (M) = Streamflow (V) * Salinity (M/V)

4.3.5 Stream Salinity

Stream salinity is the concentration of salt in a volume of water – in other words, the mass of salt per unit volume of water:

$$Salinity = \frac{Salt(M)}{Water(V)}$$

4.3.6 Local Reference Point

The local reference point is the nearest downstream gauging station from the list approved by the Minister. The list can be found in Tables 4.7 to 4.10 in Chapter Section 4.6.

4.3.7 Low Condition Vegetation

For the purposes of the salinity assessments:

- Native woody vegetation is in low condition if:
  - the over-storey percent foliage cover is less than 50% of the over storey percent foliage cover benchmark for that vegetation type; and
  - the percent ground cover tends(or is on average) less than 50%.
- Native grassland, shrubland, wetland or herb field is in low condition if:
  - the percent ground cover tends (or is on average) less than 50%.

Ground cover can comprise non-native species, including weeds, as the interest from a salinity perspective is in water use by the vegetation cover. This represents a slight variation on the definition of 'low condition' used in biodiversity assessments.

4.3.8 Paddock Trees

Paddock trees refer to "native vegetation with an over-storey projected foliage cover less than 25% of the lower benchmark for the vegetation community and where the ground layer is either exotic crop, ploughed fallow or almost exclusively perennial or annual exotic pasture (90% plus of the cover is exotic species)".

4.4 Using the Salinity Benefits Index Tool

At any given point along a stream network, stream salinity provides an integrated signature of the salinity processes operating in the area contributing to that point. The salinity benefits index value is used to determine whether the improve or maintain condition for a proposal to clear native vegetation is met and, if not met, the minimum level of offset (expressed in terms of the salinity benefits index) required to meet the improve or maintain test. The rationale for, and calculation of, the Salinity Benefits Index are described in Chapter Sections 4.4.4 and 4.4.5.

4.4.1 Clearing Areas

Clearing is deemed to improve or maintain instream salinity conditions if there is no increase in the long-term average stream salinity. The following general rules are used to interpret the Salinity Benefits Index (SBI) for clearing:

- If **SBI > 0**, then the proposal improves stream salinity outcomes and there is no requirement for salinity offsets;
- If **SBI = 0**, indicates that at the reference location there is no net change in average annual stream salinity, and there is no requirement for salinity offsets;
- If **SBI < 0**, then the proposal does not improve or maintain stream salinity outcomes. The proposal can only occur if actions are undertaken elsewhere on the property to offset the negative salinity impact.

4.4.2 Offset Areas

If offsets are required to mitigate against salinity impacts from a proposal to clear native vegetation, then the following rules are used to interpret the offset salinity benefits index relative to the clearing Salinity Benefits Index (SBI):

- If $\mathbf{SBI_{offset} \geq 0}$ and $\mathbf{SBI_{offset} \geq (SBI_{clearing}}$ ignoring its minus sign**)**, then the cumulative impact of the clearing and offset actions improve salinity outcomes;
- If $\mathbf{SBI_{offset} \geq 0}$ and $\mathbf{SBI_{offset} < (SBI_{clearing}}$ ignoring its minus sign**)**, then the proposed offset provides a partial offset to the clearing impact, but the net outcome is that stream salinity is not improved or maintained. Additional or alternative salinity offsets are required;

- If $\mathbf{SBI_{offset} < 0}$, then no salinity benefit is gained and the proposed offset does not improve or maintain stream salinity outcomes.

To obtain consistent and meaningful results the Salinity Benefits Indices for the impacts of a clearing proposal and any proposed offsets must be evaluated at the same reference point.

Offsets must be located:
- on the 'same property' as that where the clearing is proposed, and
- in catchments of the same stream order (Strahler system) or lower, and
- in the same SBI catchment as that of the clearing proposal.

The 'same property' assumes a contiguous block of land, but this definition can be expanded at the discretion of the CMA to include a property that is fragmented, so long as the clearing and offset sites are within the same local catchment, groundwater flow system or salinity hazard area. In circumstances where group PVP proposals are considered, the 'same property' refers to all properties making up the group bid, but with offset areas still subject to the other constraints listed above.

4.4.3 Reference Location

Salinity Benefits Index values are evaluated at the Local Reference Point (see Tables 4.7 to 4.10 in Chapter Section 4.6). It is assumed that:
- where the Salinity Benefits Index is negative at the reference location, the offset will negate any adverse impact such that there is no change in average stream salinity anywhere along the stream length;
- where the local Salinity Benefits Index is positive at the reference location (hence not requiring a salinity offset), any negative impact that might occur downstream of this point will be negligible, reflecting the increasing attenuation of impacts with distance downstream of the area of change.

4.4.4 Conceptual Framework for the Salinity Benefits Index Tool

It is assumed that if:
- the quantities of water and salt flowing past a given point in a stream; and
- the physical characteristics, which influence catchment water and salt yields (e.g. rainfall, topography, soil properties, salt stores, land cover), of the area contributing to that point;
- are known, then the water and salt loads at the measurement point can be apportioned to different parts of the catchment based on hydrologic principles and salt storage patterns.

In other words, every part of a contributing catchment can be defined in terms of its contribution to catchment water yield and salt export.

The approach adopted assumes that:
- there are two salt stores within the system: a soil salt store and a groundwater salt store;
- the salt from the soil salt store is mobilised by surface runoff and contributes to the salt load in quickflow;
- the salt from the groundwater salt store is mobilised by recharge and contributes to the salt load in baseflow;
- changing land cover can affect quickflow and baseflow in different proportions; and
- that soil and groundwater salinities are unaffected by land cover change.

Therefore, to capture the different pathways for salt mobilisation and differences in the way that quickflow and baseflow are impacted by a land cover change, streamflow is separated into two flow components. Source area maps represent the spatial variability of each component. For example, the source area map for quickflow describes the relative significance of every part of a catchment in terms of its contribution to quickflow. These

source area maps are inputs to the Salinity Benefits Index Tool, which sits behind the Native Vegetation Assessment Tool software.

Because quickflow and baseflow are influenced by land cover, when a land cover change is made, the source area distributions also change. The differences between the current condition and new condition source area distributions are used to calculate new quickflow and baseflow volumes. The changes in quickflow and baseflow cause changes in their respective salt loads, and these new flows and salt loads are used to calculate a Salinity Benefits Index.

4.4.5 Calculating the Salinity Benefits Index

The Salinity Benefits Index is a measure of the relative change in stream salinity from current salinity levels at a specific location, caused by changes in land cover and/or management.

A Salinity Benefits Index value is calculated as follows:

$$SBI = \frac{\frac{Salt_{current}}{Water_{current}} - \frac{Salt_{new}}{Water_{new}}}{\frac{Salt_{current}}{Water_{current}}} = \frac{Salinity_{current} - Salinity_{new}}{Salinity_{current}} * 1000$$

Where the subscript *current* refers to the mean annual salt load, water and salinity under current land cover conditions and subscript *new* refers to these same terms under the proposed land cover changes (Herron *et al*., 2004). This equation says that the Salinity Benefits Index is the proportional change in stream salinity from current conditions caused by the land cover change.

The Salinity Benefits Index is evaluated at a reference point and applies to that reference point only. A reference point is a location downstream of the area of proposed clearing or other land use/management change at which measured streamflow and salinity data are available (i.e. a gauging station). The period 1975-2000 serves as the standard benchmark period for all catchment salinity assessments in the Murray-Darling Basin Salinity Management Strategy (MDBMC, 2003), and has therefore been used for deriving mean annual streamflow and salt load estimates for use in the Salinity Tool in the Native Vegetation Assessment Tool.

4.4.6 Defining Current Land Use Conditions

Streamflow

Streamflow is monitored in New South Wales' rivers by a network of gauging stations. A subset of these gauging stations is used to delineate the catchments used in the Salinity Benefits Index Tool for calculating the Salinity Benefits Index (see Tables 4.7 to 4.10 in Chapter Section 4.6). The selected gauging stations have good flow records and provide data, which is also used in NSW for surface water resources management planning.

The daily streamflow record for each gauging station is split into quickflow and baseflow components, using a digital filter approach. This is a standard hydrologic procedure for separating long term continuous records (Lyne & Hollick, 1979).

Salt Loads

Stream salinities are also measured at the gauging stations, although the record is generally shorter than for streamflow monitoring. Relationships between stream salinity and flow have been developed for each catchment based on the available data and these relationships are used to generate continuous time-series data of salinity, from which salt loads can be

calculated. Salt load is split into quickflow and baseflow salt loads using the approach in CATSALT v1.5 (Tuteja et al., 2003; Vaze et al., 2004).

Spatial Data

A catchment is represented as a grid composed of square pixels (or cells) with sides of 25 metres. To represent the spatial pattern of a particular catchment attribute, whether it is elevation, groundwater salinity, recharge or some other attribute, each pixel within a grid is assigned a numerical value representing the attribute value in that part of the catchment. Different catchment attributes, represented as individual grids, are combined to produce weighted surfaces, reflecting the contributions from each pixel to total quickflow, baseflow and associated salt loads.

The weighted surface is a source area map in which the magnitude of the value assigned to each pixel of a catchment reflects its contribution to the total. Table 4.3 lists the individual grid layers used to generate weighted surfaces for quickflow, baseflow, quickflow salt load and baseflow salt load.

The proportional contribution, P_i, that cell *i* makes to some catchment total (eg. baseflow) is a function of the value of that cell, w_i, in the weighted grid relative to the sum of all the cell values (Σ = sum of) within the weighted grid, Σw_i:

$$P_i = \frac{w_i}{\sum w_i}$$

When P_i is multiplied by, for example, the mean annual baseflow for the catchment, the result is the volume of water contributed by pixel *i* to the total at the catchment outlet.

Table 4.3 The catchment attributes combined to produce weighted surfaces for quickflow, baseflow, quickflow salt load and baseflow salt load.

Quickflow	Baseflow	Quickflow Salt Load	Baseflow Salt Load
Digital Elevation Model(DEM) →* Compound topographic index (CTI)	Climate → Recharge	Soil Salinity	Groundwater salinity
Climate → Runoff	Soils → Recharge	Salt Outbreaks	Baseflow
Soils → Runoff		DEM → Flowpath length	
Land Cover	Land Cover	DEM → slope	
		Quickflow	

* The → symbol indicates a processing step from the first attribute to a derived attribute.

Factors Influencing Quickflow and Baseflow

- *Rainfall* – influences the amount of water entering the system. Everything else being equal, a pixel with a high mean annual rainfall will be a more significant source of quickflow than one with low rainfall. Modelled rainfall grids (five kilometre grid resolution) are derived by interpolating between points where rainfall has been measured (Hutchinson, 1995);
- *Soils* – different soils have different physical properties, which influence how readily they store and transmit water. The best available mapped soils data are used to define the spatial pattern of soils across each catchment. Soil hydraulic properties are assigned to each of the different soil types, based on measured data and, where measured data is not available, standard modelling techniques for deriving soil hydraulic properties;
- *Runoff* – the soil hydraulic properties and rainfall data are in the generation of a state-wide runoff grid. Water balance modelling was undertaken for every unique combination of climate zone and soil type occurring in the state to calculate average annual runoff (in

mm). The spatial variability in runoff, as influenced by climate and soil type (i.e. no vegetation cover) is represented in the resultant runoff grid;

- *Recharge* – the soil hydraulic properties and rainfall data are in the generation of a state-wide recharge grid. Water balance modelling was undertaken for every unique combination of climate zone and soil type occurring in the state to calculate average annual recharge (in mm). The spatial variability in recharge, as influenced by climate and soil type (i.e. no vegetation cover) is represented in the resultant recharge grid;
- *Topographic position* – influences the re-distribution of catchment water between rainfall events. Locations with large contributing areas and low local gradients tend to accumulate catchment water. As a result they are more likely to generate quickflow (i.e. shed water quickly) when it rains because their relatively high moisture content prevents more rain from infiltrating. They also tend to be near the stream so delivery of runoff to the stream occurs quickly. Locations with low contributing areas and/or steep gradients tend to drain relatively quickly, which means that on average they tend to be relatively dry. When it rains, more rain can infiltrate. These areas tend to be distant from streams, and are less significant sources of quickflow. A modelled index, the compound topographic index (CTI of Beven and Kirkby (1979)) is used to reflect this characteristic;
- *Land cover* – influences the evapotranspiration term of the catchment water balance and the partitioning between overland flow and infiltrated runoff. Perennial vegetation types use more water through a year via evapotranspiration than annual vegetation types, which are active for only part of the year (Zhang *et al*., 2001). In general, trees use more water than perennial grass systems because they tend to have deeper root networks, and can access water stored deeper in the soil profile. Where there is no vegetation cover, the transfer of rainfall back to the atmosphere is by evaporation from the soil and this is restricted to a fairly shallow depth. These differences between vegetation types and cover influence the quantity of rainfall, which is available for quickflow and baseflow.

A water balance model is also used to calculate the weight assigned to each land cover class to reflect its influence on recharge and runoff. A bare soil condition is set as the reference condition and assigned a weighting of one (1). Since plant cover has the effect of reducing runoff and recharge, relative to bare soil, the land cover weightings are between zero (0) and one (1), where zero (0) is no runoff or recharge and one (1) is the same runoff or recharge as bare soil.

In the SBI Tool, the land cover/use layer maps to a look-up table which contains the land use weightings for runoff and recharge for every land cover/use type. These weightings vary from catchment to catchment.

Weighted Quickflow Surface

A weighted quickflow surface, QF_w, is generated by combining the runoff grid (based on soil-rainfall data) with the CTI surface and the weighted land use surface for quickflow (LU_{qf}):

$$QF_w = Runoff * CTI * LU_{qf}$$

Weighted Baseflow Surface

A weighted baseflow surface, BF_w, is generated by combining the recharge grid (based on soil-rainfall data) and the weighted land use surface for baseflow (LU_{bf}):

$$BF_w = Recharge * LU_{bf}$$

Factors Influencing Salt Load

- *Soil Salinity* – reflects the concentration of salt in the soil and available for mobilisation by quickflow. Everything else being equal, areas of high salinity are assumed to be more significant source areas of salt than areas of low salinity. Soil salinity spatial units are based on mapped soil type or geology, salt outbreak areas and landscape position.

Estimates of soil salinity for each spatial unit are based on measured data and generalisations from point data to the wider area. Soil salinity is adjusted by topographic factors to account for landscape connectivity. In other words, each pixel is weighted to reflect the concentration of salt that the quickflow generated on the pixel would acquire in its journey to the stream. If a pixel is close to the stream, its weighting will be less than a pixel that is far away from the stream network, everything else being equal. Furthermore, if quickflow from two pixels must travel the same distance to the stream, but the pathway for one pixel is through very saline cells, while the other pathway is through relatively non-saline cells, the pixel with the more saline pathway will have the higher weighting;

- *Groundwater salinity* – reflects the concentration of salt in groundwater and contributing to baseflow salt loads. Areas with high groundwater salinities are assumed to be more significant source areas of salt than areas of low groundwater salinity. Groundwater salinity spatial units are defined on the basis of groundwater flow systems mapping, and each unit is assigned a salinity value based on measured data and extrapolation from measured data to the wider area.

Weighted Quickflow Salt Load Surface

As quickflow salt load is a function of soil salinity and volume of quickflow, the weighted quickflow salt load grid, S_{QFw}, is generated by combining the weighted quickflow grid with the weighted soil salinity grid, $SoilEC_w$:

$$S_{QFw} = QF_w * SoilEC_w$$

Weighted Baseflow Salt Load Surface

As baseflow salt load is a function of groundwater salinity and volume of baseflow, the weighted baseflow salt load grid, S_{BFw}, is generated by combining the weighted baseflow grid with the groundwater salinity grid, $GWEC_w$:

$$S_{BFw} = BF_w * GWEC$$

4.4.7 Land Cover Change

Once the distribution of catchment exports is defined for current land use conditions, different land use changes can be modelled and the change in mean annual salt loads and streamflow estimated.

The land cover term is the only variable in the model. All of the other catchment characteristics are assumed to not change. When land cover is changed, the amount of rainfall that returns to the atmosphere changes, as do the amounts of rainfall that become runoff (quickflow) and recharge (baseflow).

If an area of annual crops is converted to woodland, runoff and recharge is reduced. In the model, the weightings for cropping, which might be around 0.7 or 0.8, are changed to the appropriate land cover weightings for woodland, which are more like 0.2 or 0.3. This causes the weighted quickflow and baseflow surfaces to change – in this instance the sum of the weighted grids for quickflow and baseflow under the proposed land use change are lower than under the current conditions. The sum of the weighted grid under the new condition is compared to that for the current condition. The ratio, which in this case will be less than 1, is multiplied by the mean annual quickflow (baseflow) to obtain a new mean annual quickflow (baseflow).

A change in quickflow and baseflow volumes influences the export of salt from the affected area and the weighted quickflow salt load and baseflow salt surfaces also change. Using the same approach, the new salt load for the land cover change is calculated.

The new exports are calculated as follows:

Quickflow

$$QF^{new} = \frac{\sum QF_w^{new}}{\sum QF_w} * QF_{ann}$$

Baseflow

$$BF^{new} = \frac{\sum BF_w^{new}}{\sum BF_w} * BF_{ann}$$

Quickflow Salt Load

$$S_{QF}^{new} = \frac{\sum S_{QFw}^{new}}{\sum S_{QFw}} * S_{QF}^{ann}$$

Baseflow Salt Load

$$S_{BF}^{new} = \frac{\sum S_{BFw}^{new}}{\sum S_{BFw}} * S_{BF}^{ann}$$

Where *QF* is quickflow, *BF* is baseflow, *S* is salt load and *new* denotes parameters for the new land use scenario. These equations compare the sum of all the cells in the weighted grid for the new land use scenario to that of the current land use for each flow and salt component and multiply the ratio by the current mean annual quickflow, QF_{ann}, baseflow, BF_{ann}, quickflow salt load, S_{QF}^{ann} and baseflow salt load, S_{BF}^{ann}, respectively. Thus, using information about current exports and the best available hydrologic and salt storage data, estimates of the impacts of land use changes on average annual streamflow and salt load are derived.

Finally, the salinity benefits index is calculated by:

- summing together quickflow and baseflow for current conditions and for the new conditions to produce total streamflows for current and new conditions;
- summing together the quickflow and baseflow salt loads for current conditions and the new conditions to produce current and new total salt loads;
- putting these values into the salinity benefits index equation; and
- rounding to the nearest whole (integer) number.

4.5 Using the Salt Mobilisation Tool

In the western parts of NSW, where landscapes tend to be flat and the connectivity between salt stores, hydrologic pathways and the stream network is not well understood, it is assumed that land cover changes which reduce average annual recharge benefit the environment through reducing the mobilisation of salt in the landscape.

The Salt Mobilisation Tool is used to calculate a Salt Mobilisation Index (SMI) for each site where clearing or offsets is proposed. The Salt Mobilisation Index is a measure of potential salt mobilisation as a function of recharge and salt store. The Salt Mobilisation Index is used to determine whether the improve or maintain condition for a proposal to clear native vegetation is met and, if not met, the minimum level of offset required to meet the improve or maintain test. The rationale for, and calculation of, the Salt Mobilisation Index are described in Chapter Sections 4.5.3 and 4.5.4.

4.5.1 Clearing Areas

Clearing is deemed to improve or maintain salinity outcomes if there is no increase in local recharge, hence salt mobilisation. The following general rules are used to interpret the Salt Mobilisation Index (SMI) for clearing:

- If **SMI ≥ 0**, then the proposal is deemed to improve or maintain salinity outcomes and there is no requirement for salinity offsets;
- If **SMI < 0**, then the proposal is deemed to not improve or maintain salinity outcomes. The proposal can only occur if actions are undertaken elsewhere on the property to offset the negative salinity impact.

The majority of proposals to clear native vegetation in western NSW are likely to cause an increase in local recharge, and will typically require offsets. The steps for calculating the salt mobilisation offset requirement are described in Chapter Sections 4.5.2 and 4.5.4.

4.5.2 Offset Areas

If offsets are required to produce a net no salt mobilisation outcome from a proposal to clear native vegetation, then the following rules are used to interpret the offset Salt Mobilisation Index relative to the clearing Salt Mobilisation Index (SMI):

- If $\mathbf{SMI_{offset} > 0}$ and $\mathbf{SMI_{offset} > (SMI_{clearing}}$ ignoring its minus sign**)**, then the cumulative impact of the clearing and offset actions is deemed to improve or maintain salinity outcomes;
- If $\mathbf{SMI_{offset} > 0}$ and $\mathbf{SMI_{offset} < (SMI_{clearing}}$ ignoring its minus sign**)**, then the proposed offset provides a partial offset to the clearing impact, but the net outcome is that some salt is mobilised and the improve or maintain test is not met. Additional or alternative salinity offsets are required;
- If $\mathbf{SMI_{offset} < 0}$, then the offset proposal is likely to increase salt mobilisation, hence provides no offset. The improve or maintain test is not met for salinity outcomes.

Offsets must be located:

- on the 'same property' as that where the clearing is proposed, and
- in catchments of the same stream order (Strahler system) or lower.

The 'same property' assumes a contiguous block of land, but this definition can be expanded at the discretion of the Catchment Management Authority to include a property that is fragmented, so long as the clearing and offset sites are within the same local catchment, groundwater flow system or salinity hazard area. In circumstances where group PVP proposals are considered, the 'same property' refers to all properties making up the group bid, but with offset areas still subject to the other constraints listed above.

4.5.3 Conceptual Framework for the Salt Mobilisation Tool

The approach adopted for assessing salinity impacts in relatively flat, floodplain environments is based on a very different assumption from the upland areas, where the assessment is based around the impacts on stream salinity. Here, the assumption is simply that reducing the mobilisation of salt stored in the ground is beneficial to the environment. Reducing salt mobilisation can be achieved through land cover changes that increase plant water uptake and, hence, reduce recharge. With respect to the clearing of native vegetation, unless the clearing involves the replacement of native grasses with some higher water use vegetation cover such as trees, the impacts will always be negative and require a salinity offset.

The Salt Mobilisation Tool uses current land cover, proposed land cover, salt store class, soil permeability class and the area of the clearing and offset sites to determine whether salinity outcomes are improved or maintained.

4.5.4 Calculating the Salt Mobilisation Offset requirement

The Salt Mobilisation Index is a function of the change in recharge caused by the proposed land cover change and the salt store weighting for the area. A limited set of recharge estimates has been defined to cover the range of land covers and soil types of the Inland Plains.

Each land cover available for selection in the tool has been classified into one of five classes according to its water use characteristics. In general, deep-rooted, perennial vegetation covers are on average higher water users than shallow-rooted or annual vegetation systems and the rating reflects this. Table 4.4 gives the water use efficiency rating that has been assigned to a range of different land cover options in western NSW.

For the native vegetation classes, it is assumed that water use will be less efficient where vegetation is in a "low condition" than where it is in a relatively undisturbed condition. Chapter Section 4.3.7 provides the definition of "low condition" for salinity purposes. Note that this definition differs somewhat from the biodiversity definition of low condition, since from a water use perspective a groundcover dominated by weeds can be as efficient as the natural groundcover. In other words, it is not the composition of the groundcover, so much as the extent of coverage, which is significant in terms of water use. In Table 4.4, each of the native vegetation classes has a water use efficiency classification reflecting the two conditions.

Paddock trees are assumed to be native vegetation remaining in areas of cropping or pasture (Chapter Section 4.3.8 for definition). The Salt Mobilisation Tool treats the clearing of paddock trees as having no impact on recharge, hence salt mobilisation. Thus clearing of paddock trees is deemed to maintain environmental outcomes.

Table 4.4 Vegetation covers classified into water use efficiency classes.

Vegetation Class	***Water Use Efficiency Class***	
	Not Low Condition	***Low Condition***
Arid and semi-arid shrublands[1]	*Very High*	*High*
Semi arid woodlands[1]	*Very High*	*High*
Sclerophyll grassy woodlands[1]	*Very High*	*High*
Dry sclerophyll shrub/grass forest[1]	*Very High*	*High*
Dry sclerophyll shrub forest[1]	*Very High*	*High*
Forested Wetlands[1]	*Very High*	*High*
Grasslands (native)[1]	*High*	*Moderate*
Horticulture (with DIMP[2])	*High*	*N/A*
High water use pasture (e.g. lucerne)	*High*	*N/A*
Response cropping	*High*	*N/A*
Pasture with paddock trees	*High*	*N/A*
No till cropping / Deep-rooted perennial pasture rotation	*High*	*N/A*
Continuous no till cropping	*High*	*N/A*
No till winter cropping	*Moderate*	*N/A*
Crops with paddock trees	*Moderate*	*N/A*
Summer-winter cropping	*Moderate*	*N/A*
Pasture (e.g. annual grasses/medic)	*Moderate*	*N/A*
Winter cropping (with conventional fallow)	*Low*	*N/A*
Annual pasture (e.g. oats)	*Low*	*N/A*
Horticulture (with no DIMP[2])	*Very Low*	*N/A*

[1] Based on Keith vegetation formations relevant to western NSW and non-native vegetation types relevant to western NSW.

[2] DIMP is drainage and irrigation management plan (DIMP).

Soil permeability classes are defined on the basis of their clay and sand content:

- low: light, medium and heavy clays;
- moderate: loams, clay loams;
- high: sandy loams, loamy sands, sands.

Sandy soils tend to have lower water holding capacities and higher conductivities than clay-rich soils, hence, everything else being equal, areas characterised by sandy soils have higher recharge rates.

The combined effects of soil permeability and water use efficiency on recharge are summarised in Table 4.5. Recharge estimates are based on values reported in the literature for areas with average annual rainfalls less than about 500 mm. It is the accuracy of the relative differences between classes, rather than that of the absolute values, which is significant for the calculations undertaken here.

Table 4.5 Estimates of average annual recharge (mm) in western NSW.

Soil Permeability Class	Vegetation Water Use Efficiency Class				
	Very Low	Low	Moderate	High	Very High
High	100	60	20	5	0.5
Moderate	60	30	10	3	0.1
Low	20	10	5	1	0.1

These values (in mm) are used to calculate the impact of changing land cover on recharge, *R*, on both the clearing and offset sites, as follows:

$$\Delta R_{clearing} = \left(R_{clearing}^{NV} - R_{clearing}^{proposed}\right) * A_{clearing}$$

$$\Delta R_{offset} = \left(R_{offset}^{current} - R_{offset}^{proposed}\right) * A_{offset}$$

where ΔR is the change in average annual recharge (mm) from changing land cover, multiplied by the area, *A*, of clearing. The subscripts and superscripts *offset*, *clearing*, *current*, *proposed* and *NV* refer to the offset site, clearing site, current vegetation cover, proposed vegetation cover and native vegetation, respectively. The formulation of the equation is such that a change to lower water use vegetation will result in a negative ΔR, whereas a change to higher water use vegetation will result in a positive ΔR.

The change in recharge from the land cover change is multiplied by the salt store weighting, S_w, (Table 4.6) for the site to produce an index of salt mobilisation.

$$SMI = \Delta R * S_w$$

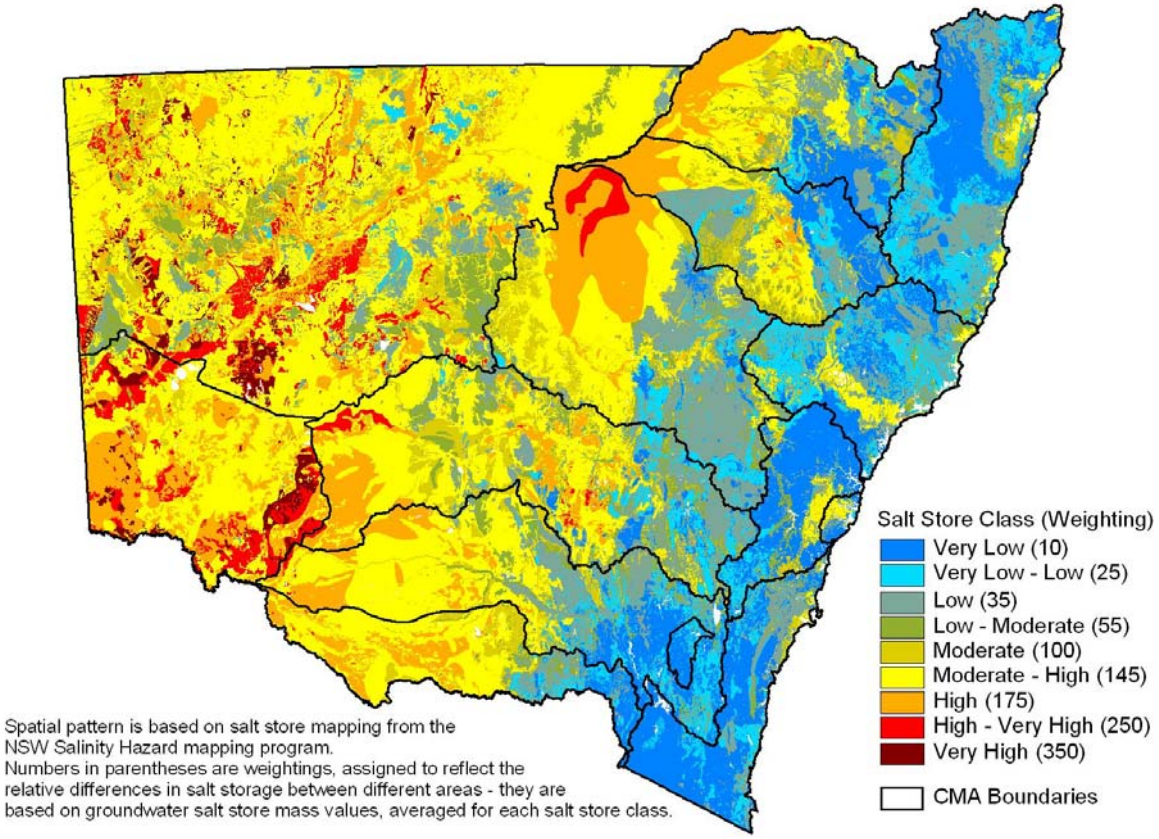
With respect to a proposal to clear native vegetation, a negative SMI value on the clearing site will indicate the need for a salt mobilisation offset and the magnitude of the SMI will indicate how large an offset is required.

Table 4.6 Salt store classes and their model weighting.

Salt Store Class	Weighting, S_w
Very High	350
High – Very High	250
High	175
Moderate - High	145
Moderate	100
Low – Moderate	55
Low	35
Very Low – Low	25
Very Low	10

Salt weightings have been assigned to a salt store map of New South Wales (Figure 4.2), which was produced as part of the Salinity Hazard Mapping project (Department of Natural Resources). The salt store map represents the spatial pattern of salt storage in the groundwater, regolith and soil, taken together. The PVP Mapper version has been classified into 9 classes (Table 4.6) and the weightings assigned to each class are based on the range of salinity values from groundwater data. Weightings have been used in preference to actual salinity values because of uncertainties in the soil, regolith and groundwater salt store data.

Figure 4.2 Map showing salt store class and weightings.



4.6 Catchments covered by the Salinity Benefits Index tool

Table 4.7 Border Rivers/Gwydir and Namoi

Stream Gauge Number	Description of Location	Stream Gauge Number	Description of Location
Border Rivers		**Namoi**	
416003	Tenterfield Creek	419001	Namoi River @ Gunnedah
416006	Severn River @ Ashford	419005	Namoi River @ North Cuerindi
416008	Beardy River @ Haystack No 4	419006	Peel River @ Carrol Gap
416010	Macintyre River @ Wallangra	419007	Namoi River @ Keepit Dam
416012	Macintyre River @ Holdfast	419012	Namoi River @ Boggabri
416020	Ottleys Creek @ Coolatai	419015	Peel River @ Piallamore
416021	Frazers Creek @ Ashford	419016	Cockburn River
416026	Reedy Creek	419020	Manilla River @ Briabri
416032	Mole River @ Donaldson	419022	Namoi River @ Manilla Railway Bridge
416039	Severn River @ Strathbogie	419024	Peel River @ Paradise Weir
Gwydir		419027	Mooki River
418001	Gwydir River @ Pallamallawa	419029	Halls Creek
418005	Copes Creek	419032	Coxs Creek
418012	Gwydir River @ Pinegrove	419035	Goonoo Goonoo Creek
418013	Gwydir River @ Gravesend Bridge	419036	Duncans Creek
418015	Horton River	419043	Manilla River @ Tarpoly Weir
418016	Warialda Creek	419045	Peel River @ Chaffey Dam
418017	Myall Creek	419051	Maules Creek
418018	Keera Creek		
418021	Laura Creek		
418022	Georges Creek		
418023	Moredun Creek		
418025	Halls Creek		
418026	Gwydir River @ Copeton Dam		
418029	Gwydir River @ Stonybatter		
418032	Tycannah Creek		
418033	Bakers Creek		

Table 4.8 Murrumbidgee and Murray

Stream Gauge Number	Description of Location	Stream Gauge Number	Description of Location
Murrumbidgee			
410001	Murrumbidgee River @ Wagga Wagga	410048	Kyeamba Creek
410004	Murrumbidgee River @ Gundagai	410057	Goobarragandra River
410025	Jugiong Creek	410059	Gilmore Creek
410026	Yass River	410061	Adelong Creek
410038	Adjungbilly Creek	410071	Brungle Creek
410039	Tumut River @ Brungle Bridge	410073	Tumut River @ Oddy's Bridge
410043	Hillas Creek	410087	Bullenbung Creek
410044	Muttama Creek	410103	Houlaghans Creek
410045	Billabung Creek		
410047	Tarcutta Creek	**Murray**	
		410091	Billabong Creek @ Walbundrie

Table 4.9 Castlereagh, Macquarie and Lachlan

Stream Gauge Number	Description of Location	Stream Gauge Number	Description of Location
Macquarie		**Castlereagh**	
421001	Macquarie River @ Dubbo	420004	Castlereagh River @ Mendooran
421007	Macquarie River @ Bathurst	420007	Castlereagh River @ Binnaway
421018	Bell River		
421019	Cudgegong River @ Yamble Bridge	**Lachlan**	
421025	Macquarie River @ Bruinbun	412002	Lachlan River @ Cowra
421026	Turon River	412004	Lachlan River @ Forbes
421035	Fish River	412009	Belubula River @ Canowindra
421040	Macquarie River d/s Burrendong Dam	412028	Abercrombie River
421041	Crudine Creek	412029	Boorowa River
421042	Talbragar River	412030	Mandagery Creek
421048	Little River	412043	Goobang Creek
421052	Lewis Creek	412050	Crookwell River
421053	Queen Charlottes Creek	412055	Belubula River @ Bangaroo Bridge
421058	Wyaldra Creek	412057	Lachlan River @ Nanami
421059	Buckinbah Creek	412065	Lachlan River @ Narrawa
421066	Pyramul Creek	412067	Lachlan River @ Wyangala Dam
421072	Winburndale Creek	412072	Back Creek
421073	Meroo Creek	412077	Belubula River @ Carcoar
421079	Cudgegong River @ Windamere Dam Site	412080	Flyers Creek
421101	Campbells River	412092	Coombing Creek

Table 4.10 Hunter and Hawkesbury (Capertee, Wollondilly and Wolgan)

Stream Gauge Number	Description of Location	Stream Gauge Number	Description of Location
Hunter		**Hunter**	
210055	Hunter River @ Denman	210002	Hunter River @ Muswellbrook Br
210044	Glennies Creek @ Middle Falbrook	210052	Pages River @ Gundy Recorder
210090	Martindale Creek near Martindale		
210089	Black Creek @ Rothbury	**Capertee**	
210088	Dart Brook @ Aberdeen No.2	212018	Capertee River @ Glen Davis
210087	Doyles Creek @ Doyles Creek	**Wolgan**	
210071	Glendon Brook @ Glendon Brook	212028	Wolgan River @ Newnes
210040	Wybong Creek @ Wybong	**Wollondilly**	
210031	Goulburn River @ Sandy Hollow	212270	Wollondilly River @ Jooriland
210014	Rouchel Brook @ Rouchel Brook (The Vale)	212271	Wollondilly River @ Golden Valley
210064	Hunter River (Singleton-Greta)		

Note: References

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5 Biodiversity Assessment

5.1 Introduction

This Environmental Outcomes Assessment Methodology defines the circumstances in which broad-scale clearing is to be regarded as improving or maintaining environmental outcomes for biodiversity under the *Native Vegetation Act 2003,* including for the purposes of agreeing to a Property Vegetation Plan.

BioMetric is the tool used to assess losses in biodiversity from proposed clearing and gains in biodiversity from proposed offsets. It is also used to assess thinning to benchmark stem densities. *BioMetric* incorporates data held by the NSW Department of Environment, Climate Change and Water in the following databases: vegetation benchmarks database, overcleared landscapes database, overcleared vegetation types database and coastal thinning genera database. *BioMetric* includes data on Mitchell Landscapes, vegetation formations, vegetation types and other associated data and formulae needed to assess the value of biodiversity in the context of national, regional, landscape and site scales according to the procedures included in this Environmental Outcomes Assessment Methodology.

Under Chapter Sections 5.2 – 5.3:

- Clearing of native vegetation does not improve or maintain environmental outcomes for biodiversity in vegetation types or landscapes that are overcleared unless the vegetation is in low condition;
- Native vegetation can only be cleared if losses from proposed clearing can be offset by commensurate long-term gains from revegetation or management of native vegetation. Offsets can only improve or maintain environmental outcomes if:
  1. i) offsets are in vegetation types of equal or greater Regional Value to the vegetation proposed for clearing or,
     ii) where the vegetation type proposed for clearing is less than or equal to 70% cleared in the Catchment Management Authority area, offsets may be in vegetation types with Regional Values up to 10% lower than the vegetation proposed for clearing; and
  2. improvement in Landscape Value from the offset is equal to or greater than the losses from proposed clearing; and
  3. improvement in Site Value from the offset is equal to or greater than losses from proposed clearing.

Prior to assessment of impact, the area to be cleared must be divided into zones comprising each vegetation type and relatively homogenous condition categories. Vegetation that is in low condition, and is greater than 0.25 hectares in area, must always form a separate zone from vegetation that is not in low condition. If the area to be cleared comprises more than one zone, separate assessments must be undertaken for each zone.

Thinning to benchmark stem densities is assessed under Chapter Section 5.4.

5.2 Overcleared vegetation and landscapes

This Chapter Section does not apply to clearing that is thinning to benchmark stem densities (Chapter Section 5.4).

5.2.1 The improve or maintain test

Clearing of overcleared vegetation does not improve or maintain environmental outcomes for biodiversity, unless the vegetation is in low condition.

Overcleared vegetation is native vegetation that:

1. occurs in a Mitchell Landscape that is more than 70% cleared; or
2. is a vegetation type that is more than 70% cleared; or
3. is an ecological community listed as 'critically endangered' or 'endangered' under the *Threatened Species Conservation Act 1995* (NSW) or listed as 'critically endangered', 'endangered' or 'vulnerable' under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).

Offsets cannot be used to balance the impacts of clearing overcleared vegetation that is not in low condition.

5.2.2 Determining whether the vegetation is in low condition

Vegetation in low condition is defined as follows:

- **Native woody vegetation**:
  1. with an over-storey percent foliage cover that is less than 25% of the lower value of the over-storey percent foliage cover benchmark for that vegetation type; and where
  2. a) less than 50% of the groundcover vegetation is indigenous species; or
     b) more than 90% of the area is ploughed; or
     c) more than 90% of the area is fallow; or
     d) 90% or more of the groundcover vegetation is regrowth but not protected regrowth.

- **Native grassland, wetland or herbfield vegetation** where:
  1. a) less than 50% of the groundcover vegetation is indigenous species; or
     b) more than 90% of the area is ploughed; or
     c) more than 90% of the area is fallow; or
     d) 90% or more of the groundcover vegetation is regrowth but not protected regrowth.

For the purposes of determining whether vegetation is in low condition, all vegetation types are assessed as **native woody vegetation** if the tallest structural layer is one metre or greater in height. In this case, the tallest structural layer is assessed as over-storey, and both over-storey and groundcover are assessed to determine whether the vegetation is in low condition.

Where all structural layers are less than one metre in height, the vegetation type is assessed as **native grassland, wetland or herbfield vegetation**. For vegetation types where the upper stratum is less than one metre in height, all strata are assessed as groundcover vegetation.

Only patches of vegetation greater than 0.25 ha are assessed separately (as distinct zones) from surrounding vegetation (e.g. a patch of vegetation with benchmark over-storey cover that is 0.25 ha or less is not assessed separately from surrounding vegetation with sparser over-storey cover).

The over-storey is assessed using one of the methods outlined in the *BioMetric* Operational Manual.

The groundcover is assessed using a method consistent with the *Native Vegetation Regulation 2005* and the *BioMetric* Operational Manual.

5.2.3 Determining whether the vegetation is in an overcleared landscape

An overcleared landscape is a Mitchell Landscape area in which more than 70% of native vegetation cover has been cleared. The Mitchell Landscape areas and whether they are overcleared are contained within the overcleared landscapes database.

The overcleared landscapes database is a database held by the NSW Department of Environment, Climate Change and Water and approved by the Director General, NSW Department of Environment, Climate Change and Water.

5.2.4 Determining whether the vegetation is an overcleared vegetation type

An overcleared vegetation type is a vegetation type of which more than 70% has been cleared within the relevant Catchment Management Authority area. The vegetation type and whether it is an overcleared vegetation type is identified from the list within the overcleared vegetation types database.

The overcleared vegetation types database is a database held by the NSW Department of Environment, Climate Change and Water and approved by the Director General, NSW Department of Environment, Climate Change and Water.

5.3 Assessing impacts of clearing generally

This Chapter Section does not apply to:

- clearing that is thinning to benchmark stem densities (under Chapter Section 5.4); or
- impacts of clearing on Threatened Species (under Chapter Sections 5.5-5.8).

5.3.1 The improve or maintain test

Clearing is to be regarded as improving or maintaining environmental outcomes for biodiversity if the losses in biodiversity from the proposed clearing can be offset by commensurate long-term gains in biodiversity from the proposed offsets. Offsets can only improve or maintain environmental outcomes for biodiversity if:

- either:
  1. where the vegetation type proposed for clearing is more than 70% cleared in the Catchment Management Authority area: offsets are in vegetation types of equal or greater Regional Value to the vegetation proposed for clearing; or
  2. where the vegetation type proposed for clearing is less than or equal to 70% cleared in the Catchment Management Authority area: offsets are in vegetation types of equal or greater Regional Value to the vegetation proposed for clearing, or are in vegetation types with Regional Values up to 10% lower than the vegetation proposed for clearing;

and

- improvement in Landscape Value from the offset is equal to or greater than losses from clearing; and
- improvement in Site Value from the offset is equal to or greater than losses from clearing.

Note: To illustrate condition 2 above, a vegetation type proposed to be cleared that is 60% cleared in the Catchment Management Authority area may be offset by a vegetation type that is no less than 50% cleared in the Catchment Management Authority area.

5.3.2 Assessing Regional Value

Regional Value is calculated from the relationship between the percentage(s) of the vegetation type(s) that is/are cleared relative to its/their pre-European (or pre-1750) extent(s)

within each Catchment Management Authority. The greater the percentage of the original extent of a vegetation type that has been cleared the higher is its Regional Value.

BioMetric calculates overall Regional Value for the vegetation type(s) using the equation set out below.

Regional Value of both proposed clearing site and proposed offset site is calculated using:

- The percent that each vegetation type has been cleared relative to predicted pre-European extent; and
- A generic species-area relationship; and
- The proportion of the site occupied by each vegetation type (zone).

$$\textit{Regional Value} = \sum_{i-1}^{n}\left(\left(1-\left(1-\left(\frac{\%cleared}{100}\right)\right)^{0.25}\right)\times\left(\frac{ZoneArea}{TotalArea}\right)\times 100\right)_i$$

Where:
i is the *n*th vegetation zone (of either the clearing or offset site);
%cleared is the percent of the vegetation type in the *i*th vegetation zone that is cleared;
ZoneArea is the area of the *i*th zone in hectares; and
TotalArea on the clearing site is the sum of the area of all zones in the proposal in hectares, where a site includes more than one zone.
TotalArea on the offset site is the sum of the area of all zones in the proposal in hectares.

5.3.3 Assessing Landscape Value

Landscape Value encompasses fragmentation, connectivity and adjacency of native vegetation around the clearing and offset sites as well as contributions from riparian areas and Site Value from offset sites. The assessor determines change in landscape value using the following variables:

- Percent cover of native vegetation in the landscape. This is current vegetation cover and future vegetation cover (with proposed clearing at the site and with proposed management actions at the offset site) within radii of 1.79 km (1000 ha) and 0.55 km (100 ha). Each circle is placed to encompass the maximum loss of native vegetation cover from clearing and the maximum gain in native vegetation cover from the management actions. The clearing and offset sites may be within different circles. Percent cover of native woody vegetation is assessed as a combination of extent and over-storey percent cover relative to benchmark cover for that vegetation type. Percent cover of native non-woody vegetation is assessed as a combination of extent and percent cover of native groundcover relative to benchmark cover for those vegetation types. The relevant scores are shown in Table 5.2;
- Connectivity. The loss in connectivity at a clearing site and gain in connectivity at an offset site are determined according to changes to linkage width classes and linkage condition classes and scored as shown in Table 5.3.3;
- Total adjacent remnant area. This is the total remnant area of which the clearing site is a part. It is recorded as extra large, very large, large, medium or small and scored as shown in Table 5.4;
- Percentage within riparian area (offset site(s) only). Additional points are awarded on the offset site if part or all of the site includes riparian area. Riparian area is defined in Chapter 3. The scores for percentage within riparian area are determined according to Table 5.5;
- Contribution of Site Value offsets to Landscape Value (offset site(s) only). Additional Site Value offsets may contribute to Landscape Value in Mitchell Landscapes and vegetation

types that are less than or equal to 30% cleared in the Catchment Management Authority. Where the Site Value score on the offset site is more than the Site Value offset requirements the additional Site Value score may contribute to offsets for Landscape Value, as defined in Table 5.6.

The relative weightings for these variables are provided in Table 5.1.

Change in Landscape Value with clearing
Change in Landscape Value with clearing is calculated as the difference between current Landscape Value and Landscape Value with clearing. Landscape Value at the clearing site encompasses fragmentation, connectivity and adjacency of native vegetation around the clearing site.

The change in Landscape Value at the clearing site(s) is determined using the following formula:

$$\textit{Landscape Value}_{\textit{Clearing site}} = \left(\sum_{v=a}^{d}(s_v w_v)\right)_{\text{Current}} - \left(\sum_{v=a}^{c}(s_v w_v)\right)_{\text{With proposed clearing}}$$

where:
s_v is the score for the vth variable (*a*-*d*) as defined below
w_v is the weighting for the vth variable (*a*-*d*) as defined below
a = percent cover of native vegetation within a 1.79 km radius of the site (1000 ha)
b = percent cover of native vegetation within a 0.55 km radius of the site (100 ha)
c = connectivity value
d = total adjacent remnant area

Change in Landscape Value with offset(s)
Change in Landscape Value with the offset(s) is calculated as the difference between the current Landscape Value and future Landscape Value at the offset site. Landscape Value at the offset site encompasses fragmentation, connectivity, adjacency of native vegetation cover with proposed management actions, percentage within riparian area and any contributions from additional Site Value.

The change in Landscape Value at the offset site(s) is determined using the following formula:

$$\textit{Landscape Value}_{\textit{Offset site}} = \left(\sum_{v=a}^{f}(s_v w_v)\right)_{\text{With proposed offsets}} - \left(\sum_{v=a}^{c}(s_v w_v)\right)_{\text{Current}}$$

where:
s_v is the score for the vth variable (*a*-*f*) as defined below
w_v is the weighting for the vth variable (*a*-*f*) as defined below
a = percent cover of native vegetation within a 1.79 km radius of the site (1000 ha)
b = percent cover of native vegetation within a 0.55 km radius of the site (100 ha)
c = connectivity value
d = total adjacent remnant area
e = percent within riparian area
f = contribution of additional Site Value offsets to Landscape Value

Details of Landscape Value variables

Table 5.1 Weightings of variables used to calculate Landscape Value.

Variable	Relative weighting
Percent cover of native vegetation within a 1.79 km radius of the site (1000 ha)	11
Percent cover of native vegetation within a 0.55 km radius of the site (100 ha)	9
Connectivity value	8
Total adjacent remnant area	6
Percent within riparian area	6
Contribution of additional Site Value offsets to Landscape Value	4

Percent cover of native vegetation is scored in 10% increments (deciles) within circles of 100 ha and 1000 ha as a combination of native vegetation extent and condition. Judgement is applied when scoring percent cover of native vegetation in the circles to determine vegetation condition from imagery. Judgement is used to score loss or gain in percent cover of native vegetation where the loss or gain in the percent cover moves up or down a decile and the overall loss or gain is less than 10%.

Note: to illustrate the above, 30 ha of native vegetation with a condition of 25% of the lower benchmark value in a 100 ha circle is scored as >0-10% cover.

Table 5.2 Details of scoring for percent cover of native vegetation within 1.79 km (1000 ha) and 0.55 km (100 ha) of site.

Radius of circle around site	Percent native vegetation cover within circle	Score
1.79 km (1000 ha)	0	0
	>0 - 10	1.8
	>10 - 20	3.6
	>20 - 30	5.4
	>30 - 40	6.6
	>40 - 50	7.8
	>50 - 60	9.0
	>60 - 70	10.2
	>70 - 80	10.8
	>80 - 90	11.4
	>90 - 100	12.0
0.55 km (100 ha)	0	0
	>0 - 10	1.8
	>10 - 20	3.6
	>20 - 30	5.4
	>30 - 40	6.6
	>40 - 50	7.8
	>50 - 60	9.0
	>60 - 70	10.2
	>70 - 80	10.8
	>80 - 90	11.4
	>90 - 100	12.0

Determining the connectivity value score

Connectivity value is determined according to the three step process set out below. The same process is used to determine the loss in connectivity at a clearing site and for the gain in connectivity at an offset site.

The site is linked to adjoining vegetation where the adjoining vegetation:

- is not in low condition; and
- has a patch size greater than 1 ha; and
- is 100 metres or closer for woody vegetation or 30 metres or closer for non-woody vegetation to the site; and
- is not separated from the site by a barrier such as a dual-lane or wider highway.

Step 1: Determining the number of linkage width class thresholds that are crossed – lost or gained.

The linkage width is the average width of the area of vegetation that links the clearing or offset site with the adjoining vegetation.

Table 5.3.1 Linkage width classes and thresholds.

Linkage widths (metres)				
0 – 5	>5 – 30	>30 – 100	>100 – 500	>500
Very Narrow	Narrow	Moderate	Wide	Very Wide

The number of linkage width class thresholds that are crossed by reducing or improving connectivity in the primary connecting linkage to the site with the adjoining vegetation are scored as 0, 1, 2, 3 or 4.

Step 2: Determining the number of linkage condition class thresholds that are crossed – lost or gained.

The condition of the vegetation that forms the connecting linkage, including vegetation on and off the clearing and offset sites, is assessed for its average condition class across the entire link. The linkage condition classes for woody vegetation are determined by assessing either i) over-storey cover and mid-storey cover or ii) over-storey cover and ground stratum cover according to Table 5.3.2a. The linkage condition classes for non-woody vegetation are determined according to Table 5.3.2b.

The number of linkage condition class thresholds that are crossed by reducing or improving connectivity in the primary connecting linkage to the site are scored as 0, 1, 2, 3, 4, 5 or 6. For non-woody vegetation, when a proposal takes the connectivity condition from one class to another, it is counted as crossing *two* thresholds.

Table 5.3.2a Linkage condition classes (woody vegetation)

Note: For the purposes of assessing connectivity, shrubland vegetation that is less than one metre in height without an over-storey (i.e. the over-storey benchmark is zero) is assessed as non-woody vegetation. Non-woody vegetation such as sedges, rushes or bulrushes that is one metre or greater in height is assessed as for woody vegetation, i.e. both the over-storey and the ground stratum cover are assessed.

		Over-storey condition			
		No native over-storey OR Exotic vegetation with similar structure to the proposal	% foliage cover <25% of lower benchmark OR Exotic vegetation with similar structure to the proposal	% foliage cover ≥25% of lower benchmark to lower benchmark	% foliage cover within benchmark
Mid-storey OR ground stratum condition	No mid-storey or ground stratum cover OR Exotic vegetation with similar structure to the proposal	Nil	Nil-Low	Low	Low-Mod
	% foliage cover of mid-storey or ground stratum cover <25% of lower benchmark OR Exotic vegetation with similar structure to the proposal	Nil-Low	Low	Low-Mod	Moderate
	% foliage cover of mid-storey or ground stratum cover ≥25% of lower benchmark to lower benchmark	Low	Low-Mod	Moderate	Mod-High
	% foliage cover of mid-storey or ground stratum cover within benchmark	Low-Mod	Moderate	Mod-High	High

Table 5.3.2b Linkage condition classes (non-woody vegetation).

Linkage condition class	Vegetation condition
Nil	Meets none of the definitions below
Low	**Percent foliage cover is less than 25% of lower benchmark in native grassland, wetland or herbfield** OR Exotic vegetation with similar structure to proposal
Moderate	Percent foliage cover is greater than or equal to 25% of lower benchmark and less than lower benchmark in native grassland, wetland or herbfield
High	Percent foliage cover is within benchmark in native grassland, wetland or herbfield

Step 3: Determining the connectivity value score

The final connectivity value score is calculated in Table 5.3.3 by considering both the number of linkage width class thresholds and the number of linkage condition class thresholds that are crossed.

Where there is more than one linkage from the adjoining vegetation to the clearing or offset site, the linkage with the highest combination of current linkage width class and condition classes is used to determine the connectivity value score.

Table 5.3.3 Scores for loss/gain of connectivity value based on number of thresholds crossed.

		Number of linkage width thresholds crossed			
		0	1	2	3 or 4
Number of linkage condition thresholds crossed	0	0	2	4	6
	1	1	3	5	7
	2	2	4	6	8
	3	3	5	7	9
	4	4	6	8	10
	5	5	7	9	11
	6	6	8	10	12

Table 5.4 Criteria for assessing total adjacent remnant area. Adjacent remnant area is the area (ha) of native vegetation that is not in low condition and is linked (≤100 m for woody vegetation and ≤30 m for non-woody vegetation) to the clearing or offset site.

Total adjacent remnant area (ha)	Score	Percent native vegetation cleared in the Mitchell landscape			
		<30%	30-70%	>70-90%	>90%
Extra large	12 points	>1000 ha	>200 ha	>100 ha	>50 ha
Very large	9 points	>500 – 1000 ha	>100 – 200 ha	>50 – 100 ha	>20 – 50 ha
Large	6 points	>200 – 500 ha	>50 – 100 ha	>20 – 50 ha	>10 – 20 ha
Medium	3 points	>100 – 200 ha	>20 – 50 ha	>10 – 20 ha	>1 – 10 ha
Small	0 points	≤100 ha	≤20 ha	≤10 ha	≤1 ha

Table 5.5 Scoring percentage of offset site in riparian area (riparian buffer distances as defined in Table 3.1 of Chapter 3).

Score	0 points	4 points	8 points	12 points
Percent within riparian area	<1%	1 - 10%	>10 - 25%	>25%

Additional improvement in Site Value at offset sites may contribute to Landscape Value in Mitchell Landscapes and vegetation types that are less than or equal to 30% cleared in the Catchment Management Authority. Where the change in Site Value score at the offset site is more than the Site Value offset requirements, the additional Site Value score as a proportion of the required Site Value score may contribute to offsets for Landscape Value (up to a maximum of 12 points contribution to Landscape Value).

Note: for example, if a proposal required a Site Value of 500 and the proposed offset scored 800 then the extra 300 would contribute 6 points (60% of the required Site Value) towards Landscape Value provided that the Mitchell Landscape and the vegetation type on the clearing site are both less than or equal to 30% cleared in the Catchment Management Authority area..

Table 5.6 Criteria for scoring contribution of additional Site Value offsets to Landscape Value. Additional Site Value score can only contribute to Landscape Value where Mitchell Landscapes and vegetation types are both less than or equal to 30% cleared in the CMA area.

Contribution of additional Site Value score	Points that contribute to Landscape Value score
Mitchell Landscape and/or vegetation type on the clearing site are more than 30% cleared in the CMA area, or there is no additional Site Value score.	0
Mitchell Landscape and vegetation type are both 30% or less cleared in the CMA area and the additional Site Value score as a proportion of the required Site Value score is as shown below	
>0 - 10%	1
>10 - 20%	2
>20 - 30%	3
>30 – 40%	4
>40 – 50%	5
>50 – 60%	6
>60 – 70%	7
>70 – 80%	8
>80 – 90%	9
>90 – 100%	10
>100%	12

5.3.4 Assessing Site Value

Site Value is the quantitative measure of structural and floristic condition of native vegetation assessed for each zone. Ten condition measures in Site Value are assessed against benchmark values as detailed in Table 5.7. For both proposed clearing and proposed offset sites Site Value is calculated as:

$$\textit{Site Value} = \sum_{z=1}^{n} \left(\left(\frac{\left(\sum_{v=a}^{j} (s_v w_v) + 5\left((s_a s_g) + (s_b s_i) + (s_h s_j) + (s_c s_k) \right) \right) \times 100}{c} \right) \times (ZoneArea) \right)_z$$

where:
z is the *n*th vegetation zone
s_v is the score for the *v*th variable (*a-j*) as defined in Table 5.7
w_v is the weighting for the *v*th variable (*a-j*) as defined in Table 5.7
$k = (s_d + s_e + s_f)/3$
c is the maximum score that can be obtained given the variables *a-j* that have a benchmark greater than zero for the vegetation type (i.e. this varies depending on which variables are in the vegetation type)
ZoneArea is the total area of the *n*th vegetation zone in hectares

The multipliers for *native over-storey cover x proportion of over-storey species occurring as regeneration* ($s_b s_i$) and *number of trees with hollows x total length of fallen logs* ($s_h s_j$) may be omitted from the above Site Value equation (and *c* recalculated accordingly) for determining Site Value in clearing or offset zones that comprise vegetation types from the following vegetation formations: Grasslands, Heathlands, Alpine Complex, Freshwater Wetlands, Saline Wetlands and Arid Shrublands.

Table 5.7 Explanation of the way each variable in Site Value is calculated

Variable		Score in *BioMetric*				Percent weighting
		0	1	2	3	
a	Native plant species richness	0	>0-<50% of benchmark	50-<100% of benchmark	≥benchmark	25
b	Native over-storey cover	0-10% or >200% of benchmark	>10-<50% or >150-200% of benchmark	50-<100% or >100-150% of benchmark	within benchmark	10
c	Native mid-storey cover	0-10% or >200% of benchmark	>10-<50% or >150-200% of benchmark	50-<100% or >100-150% of benchmark	within benchmark	10
d	Native ground stratum cover (grasses)	0-10% or >200% of benchmark	>10-<50% or >150-200% of benchmark	50-<100% or >100-150% of benchmark	within benchmark	2.5
e	Native ground stratum cover (shrubs)	0-10% or >200% of benchmark	>10-<50% or >150-200% of benchmark	50-<100% or >100-150% of benchmark	within benchmark	2.5
f	Native ground stratum cover (other)	0-10% or >200% of benchmark	>10-<50% or >150-200% of benchmark	50-<100% or >100-150% of benchmark	within benchmark	2.5
g	Exotic plant cover (calculated in *BioMetric* as percent of total native ground stratum and mid-storey cover)	>66%	>33-66%	>5-33%	0-5%	5
h	Number of trees with hollows	0 (unless benchmark includes 0)	>0-<50% of benchmark	50-<100% of benchmark	≥benchmark	20
i	Proportion of over-storey species occurring as regeneration	0%	>0-<50%	50-<100%	100%	12.5
j	Total length of fallen logs	0-10% of benchmark	>10-50% of benchmark	>50-<100% of benchmark	≥benchmark	10

Site Value is calculated from site condition in the zone(s) and area(s) of the zone(s), using the above equation.

Current Site Value is determined as follows:

- establish plots or transects in the vegetation zone(s) in the clearing and offset sites in accordance with the *BioMetric* Operational Manual (regeneration is measured across the whole zone);
- measure data for the condition variables – native plant species richness, native over-storey cover, native mid-storey cover, native ground stratum cover (grasses), native ground stratum cover (shrubs), native ground stratum cover (other), exotic plant cover, number of trees with hollows, over-storey regeneration, and length of fallen logs;
- enter the measured condition data into *BioMetric*;
- enter benchmark data for the vegetation type (which may be benchmark data for the vegetation class) directly into *BioMetric* from the vegetation benchmarks database, data obtained from reference sites or from scientific literature;
- the measured data and the benchmark data for condition variables generate a score in *BioMetric* for the current site condition of the native vegetation in the zone. A score between zero and three in relation to the benchmark (0=low, 1=moderate, 2=high, 3=very high) is allocated to each condition variable showing the relationship between its measured value and its benchmark value.

The condition scores for current Site Value are multiplied in *BioMetric* by the area of the zone(s) to provide the measure of current Site Value, using the above equation.

Change in Site Value with clearing

Change in Site Value with clearing is determined from the difference between the current Site Value and the predicted Site Value following clearing in the zone(s) on the clearing site.

Site Value following clearing is determined by predicting the impact of clearing on each condition variable according to the loss in the condition variable.

The condition scores for Site Value with clearing are multiplied in *BioMetric* by the area of the zone(s) to provide the measure of Site Value following clearing, using the above equation for calculating Site Value.

Change in Site Value with offset(s)

Change in Site Value with the offset is determined from the difference between the current Site Value and predicted Site Value with the management actions in the zone(s) on the offset site.

Site Value with offsets is determined by:

- predicting the future score for each condition variable for the vegetation zone(s) in the offset site with the proposed management actions in the vegetation zone(s), based on the predicted increase in the condition variable with management actions. Ten management actions can be undertaken by the landholder, in any combination, to improve condition variables in the offset site; and
- multiplying the predicted improvement in condition in the vegetation zone(s) with the management actions in the vegetation zone(s) by the area of the zone(s).

The condition scores for the site condition with the management actions on the offset site are multiplied in *BioMetric* by the area of the zone(s) to provide the measure of Site Value with the management actions on the offset site, using the above equation for calculating Site Value.

The ten management actions are stock grazing exclusion, strategic stock grazing, planting or direct seeding of native vegetation, weed control, erosion control, feral and/or over-abundant native herbivore control, provision of artificial hollows, exclusion of fertilisers, retention of all dead timber, retention of all regrowth (as defined in the *Native Vegetation Act 2003).* Future scores for the condition variables are increased with management actions. When scoring a predicted increase in value of a variable with management, the assessment officer must assess which management action(s) need to be undertaken to achieve the increase in value of one or more variables and how much increase in the variable(s) is achieved from undertaking the management action(s), based on guidelines within the *BioMetric* Operational Manual, including:

- planting or direct seeding will increase cover values of relevant condition variables, but will only increase species richness if the species are indigenous to the areas and the seed is sourced locally;
- where a condition variable is currently absent from the proposal site and adjacent areas then an increase cannot generally be scored unless it is specifically introduced;
- where an increase is not feasible because of other pressures associated with the proposal (e.g. heavy grazing or very high exotic cover) then an increase should not be scored;
- management actions other than the ten actions listed above may be required in combination with one or more of the ten management actions to improve the condition variables. These could include controlling human disturbance, ecological burning, ecological thinning, and reducing water extraction from wetlands.

Note: where over-abundant native herbivore control is used as a management action, it is the responsibility of the landholder to obtain any other necessary approvals required under other legislation.

The score for improvement in Site Value for each zone in the offset site is not simply the difference between the current score and the score with management actions. This is because the extent to which the zone could be degraded over time, as allowed under the provisions of the *Native Vegetation Act 2003* is taken into account. Thus the score for improvement in Site Value in the offset zone(s) with management actions includes factors that recognise past good management above that required by the *Native Vegetation Act 2003,* and past good management that has resulted in a score of 3 for one or more condition variable, where the landholder agrees to continue such management as part of the Property Vegetation Plan.

5.4 Assessing thinning to benchmark stem densities

Note: Thinning under Section 5.4 may not be suitable for assessing thinning of invasive native scrub (see Chapter 7.0 for further details).

Thinning means ecological thinning, where:

- Individual trees or shrubs are removed to benchmark stem densities or greater, with no disturbance to native groundcover, soil and non-target plants (for example, chemical treatment of individual plants, ringbarking) or minimal disturbance to native groundcover, soil and non-target plants (for example, grubbing), and
- No more than 80% of the area of each vegetation zone is thinned, and
- Stems greater than 30cm diameter at breast height over bark (dbhob) are not removed.

Ecological thinning is the removal of individual trees or shrubs that are above benchmark stem densities. The purpose of ecological thinning is to reduce competition between the trees or shrubs to allow growth and maturation of the remaining trees and shrubs, and

growth of groundcover. Ecological thinning allows natural regeneration and subsequent growth of native trees, shrubs and groundcover, thus improving or maintaining vegetation composition and structure.

For the purpose of this methodology:

- thinning means ecological thinning to improve or maintain environmental outcomes, and
- stem diameter classes are determined by measuring the dbhob of the stems of the trees and/or shrubs. The stem diameter class of multi-stemmed trees or shrubs is the stem of the tree or shrub with the largest dbhob.

In coastal Catchment Management Authorities, this Chapter Section only applies to species of the genera listed in the coastal thinning genera database (Table 5.8) in vegetation types in the overcleared vegetation types database (section 2.4.1) in the following vegetation formations (Keith 2004):

- Wet Sclerophyll Forests (grassy subformation); and
- Wet Sclerophyll Forests (shrubby subformation); and
- Grassy Woodlands; and
- Dry Sclerophyll Forests (shrub/grass subformation); and
- Dry Sclerophyll Forests (shrubby subformation).

The coastal thinning genera database is a database held by the NSW Department of Environment, Climate Change, and Water and approved by the Director General, NSW Department of Environment, Climate Change and Water, which includes:

- A list of genera which may be thinned in coastal Catchment Management Authorities, and
- The maximum dbhob which may be thinned for each genus in coastal Catchment Management Authorities.

Thinning in non-coastal Catchment Management Authorities is not restricted by genus.

Table 5.8 Coastal Thinning Genera Database.

Genus	Maximum dbhob that may be thinned
Eucalyptus	30
Corymbia	30
Angophora	30
Melaleuca	20
Casuarina	20
Allocasuarina	20
Callitris	20
Acacia	20

5.4.1 The improve or maintain test

Thinning is to be regarded as improving or maintaining environmental outcomes if, in relation to each vegetation zone:

- the area over which thinning takes place is no more than 80% of the area of each vegetation zone; and
- the number of stems to be retained in each stem diameter class for the vegetation type is greater than or equal to the benchmark stem densities for the stem diameter class for the vegetation type; and

- the total number of stems to be retained (for all stem diameter classes) for the vegetation type is greater than or equal to the total of all benchmark stem densities for the vegetation type; and
- thinning is undertaken by removing individual trees and shrubs with no or minimal disturbance to native groundcover, soil and non-target plants (e.g. by means such as chemical treatment of individual plants, ringbarking or grubbing), and
- within riparian buffer distances (as set out in Table 3.1 in Chapter 3) thinning is only undertaken by removing individual trees and shrubs with no disturbance to native groundcover, soil and non-target plants, and
- the numbers of stems retained for each stem diameter class are retained at that density on each one hectare of the proposal area, and
- thinning is not undertaken in patches of less than one hectare in area that are not linked to adjoining vegetation.

5.4.2 The Assessment

Vegetation types with different stem density benchmarks must be assessed separately. If the area proposed to be thinned contains vegetation types with different stem density benchmarks, the area must be divided into relatively homogenous vegetation zones, each comprising one or more vegetation types with the same stem density benchmarks in the same broad condition state. Each zone must be separately assessed.

Stem densities must be assessed in each vegetation zone. In each vegetation zone, 0.1 ha plots must be established in accordance with the *BioMetric* Operational Manual, with a minimum of one plot and a maximum of 10 plots per vegetation zone. In each plot, the stems are classified into one of the following stem diameter classes: 0-10cm dbhob, >10-20cm dbhob, and >20-30cm dbhob. The number of stems per plot in each stem diameter class is recorded. The numbers of stems per plot are used to predict the number of trees (or equivalent spacings between trees) for the vegetation type in each stem diameter class in the vegetation zone. Plotless methods of assessing the number of stems in the stem diameter classes, such as nearest neighbour techniques, may be used instead of plots.

The maximum number of existing stems in each diameter class that can be removed is calculated by comparing stem densities in the zone by diameter class, with benchmark stem densities by diameter class. For all vegetation types, the stems to be removed from each stem diameter class must not reduce the number of retained stems to below the benchmark number of stems for each stem diameter class and the total number of stems to be removed (for all stem diameter classes) must not reduce the number of retained stems to below the total of all benchmark stem densities.

Stems can be thinned to the benchmark values of stem densities for each diameter class up to 30cm dbhob (or as identified in the coastal thinning genera database). That is, thinning may be permitted while:

- $Observed\ stems_{ij}$ are greater than $Benchmark\ stems_{j}$; and
- $Retained\ stems_{ij}$ are greater than or equal to $Benchmark\ stems_{j}$;

otherwise:

- thinning proposals must be assessed as for other clearing proposals;

where:

- $Observed\ stems_{ij}$ is the number of stems currently present in the *j*th diameter class within the *i*th vegetation zone,

- *Retained stems*$_{ij}$ is the number of stems retained in the *j*th diameter class within the *i*th vegetation zone,
- *Benchmark stems*$_{j}$ is the benchmark number of stems for the vegetation type in the vegetation zone on the site for the *j*th diameter class.

If two or more stem diameter classes (≤30cm dbhob) are in the same age cohort, then one density benchmark for the combined stem density classes in that age cohort can be calculated from the sum of the density benchmarks for the stem diameter classes in the age cohort. The stem retention requirements can then be met by retaining more larger stems and clearing more smaller stems in the combined stem density class, provided the total number of stems retained is greater than or equal to the benchmark number of stems for the combined stem diameter classes for the vegetation type.

If the number of stems in a stem diameter class (one or more of 0-10cm dbhob, >10-20cm dbhob, >20-30cm dbhob) is fewer than the number of benchmark stems for that stem diameter class, then the shortfall number(s) of stems must be retained in the adjacent smaller or larger stem diameter class in addition to the required benchmark number of stems for that stem diameter class. If there are insufficient stems within the adjacent stem diameter class, then any remaining shortfall must be retained in the next smaller or larger stem diameter class. The number of retained stems less than or equal to 30cm dbhob must never be less than the total number of benchmark stems for the three stem diameter classes; 0-10cm dbhob, >10-20cm dbhob, >20-30cm dbhob.

5.5 Improve or maintain test for Threatened Species

For the purpose of Chapter Sections 5.5, 5.6, 5.7 and 5.8, 'Threatened Species' refers to:

1. the following entities listed under the NSW *Threatened Species Conservation Act 1995:*
   a. species listed as 'critically endangered', 'endangered', 'vulnerable' or flora species listed as 'presumed extinct',
   b. ecological communities listed as 'critically endangered' or 'endangered', and
   c. 'endangered populations'.

and

2. the following entities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999;*
   a. species listed as 'critically endangered', 'endangered' or 'vulnerable', and
   b. ecological communities listed as 'critically endangered' or 'endangered'.

The *Threatened Species Assessment Tool* is a computer software program that assists in applying this Environmental Outcomes Assessment Methodology to all known and predicted Threatened Species likely to be affected by a clearing proposal. The *Threatened Species Assessment Tool* interrogates the Threatened Species Profile Database in the process of assessing whether a clearing proposal and any proposed offsets passes the improve or maintain test. The Threatened Species Profile Database is a database held by the NSW Department of Environment, Climate Change and Water and approved by the Director General of the NSW Department of Environment, Climate Change and Water. This database is updated as relevant new information is obtained, in accordance with Chapter 2 of this Environmental Outcomes Assessment Methodology.

Broadscale clearing will improve or maintain environmental outcomes for Threatened Species if:

- no Threatened Species (flora) and Threatened Species (ecological communities) are confirmed present within the area to be cleared; and

- no Threatened Species (fauna) are known or are predicted as likely to occur within the area to be cleared; or
- the clearing proposal is not likely to cause a loss of any individuals of any Threatened Species confirmed present or predicted as likely to occur, nor likely to cause a loss to the area of habitat component or key habitat features for Threatened Species known or predicted as likely to occur within the area to be cleared; or
- Threatened Species are identified, known or predicted as likely to occur within the area to be cleared and the clearing causes a loss to any individuals of any of these Threatened Species or their habitat components or key habitat features, but the loss is offset by equivalent or greater gains for these Threatened Species from management actions applied in perpetuity to offsets, as specified in a Property Vegetation Plan.

5.6 Identify whether any Threatened Species are known or are predicted as likely to occur

1. A Threatened Species is predicted as likely to occur on the area proposed to be cleared if the:
   a) Threatened Species Profile Database indicates that the Threatened Species is known or predicted as likely to occur in the Catchment Management Authority Area (CMA) sub-region (See Appendix A) and is associated with any of the vegetation types within the area to be cleared; and
   b) area proposed to be cleared is within any specified geographic constraints for the Threatened Species as defined in the Threatened Species Profile Database (for some Threatened Species the extent of their distribution within a CMA sub-region is known to be limited to within certain geographic areas. In such circumstances the prediction of a Threatened Species within a CMA sub-region can be limited to specified parts of the CMA sub-region); and
   c) Threatened Species is likely to be able to use vegetation in the assessed condition category. The Threatened Species Profile Database indicates whether the Threatened Species is likely to occur in one or more of three vegetation condition categories (Threatened Species only likely to occur in vegetation in moderate to good condition do not need to be considered further if the vegetation on the area proposed to be cleared is low condition or paddock trees). The condition categories are:
      i) **Paddock trees** condition defined as: native vegetation having an over-storey percent foliage cover less than 25% of the lower percent foliage cover benchmark for the vegetation type and the groundcover is either crop, ploughed, fallow or almost exclusively perennial or annual exotic pasture (90% or more of cover is exotic species),
      ii) **Low condition** vegetation defined as per Section 5.2.2,
      iii) **Moderate to Good condition** vegetation defined as not meeting either paddock trees or low condition definition;

   and
   d) cover of native vegetation remaining in the landscape is greater than or equal to the minimum cover class for that Threatened Species (fauna) as identified in the Threatened Species Profile Database. The landscape is defined as the area of land within a 1.79 km radius (1000ha) of the area to be cleared; and
   e) vegetation in the area to be cleared is part of a patch of vegetation greater than or equal to the minimum patch-size class specified for that Threatened Species (fauna) as defined in the Threatened Species Profile Database; and
   f) the vegetation in the area to be cleared contains:
      i) either important breeding or foraging or shelter habitat components for Threatened Species (fauna) as defined in the Threatened Species Profile Database. Where no specific details are specified for important breeding,

foraging or shelter habitat components within the Threatened Species Profile Database then the Threatened Species (fauna) is predicted as likely to occur in vegetation types with which it is associated, or

ii) contains essential habitat features for Threatened Species (flora) as identified in the Threatened Species Profile Database. Where no specific details are specified for essential habitat features within the Threatened Species Profile Database then the Threatened Species (flora) is predicted to occur in vegetation types with which it is associated.

2. A visual inspection of the area proposed to be cleared must be undertaken prior to approving the Property Vegetation Plan.

3. The visual inspection must:
   a) Determine whether there is any important breeding, foraging or shelter habitat components for Threatened Species (fauna) occurring on the land where a Threatened Species (fauna) is predicted as likely to occur; and
   b) Determine whether there are any essential habitat features for Threatened Species (flora) occurring on the land where a Threatened Species (flora) is predicted as likely to occur; and
   c) Assess the condition of the vegetation and specifically consider whether the identified subject Threatened Species (fauna) is likely to occupy 'Paddock Trees condition' or 'Low condition' vegetation; and
   d) Specifically consider whether each Threatened Species (flora) that is predicted to occur is actually present; and
   e) Include in the assessment any additional Threatened Species that are located in the proposal area; and
   f) Be undertaken in accordance with any requirements in the *Threatened Species Assessment Tool* Operational Manual; and
   g) Where the Threatened Species Profile Database indicates a particular Threatened Species (flora) is not identifiable at the time of assessment, but the proposal would not impact upon that Threatened Species (flora) if present, then the assessment may continue rather than be deferred to an appropriate time to identify the Threatened Species (flora).

4. The Threatened Species Profile Database includes the following information for each Threatened Species:
   a) A description and, where available, a series of photographs;
   b) A description of its distribution in NSW;
   c) Known or predicted occurrence in each Catchment Management Authority area sub-region;
   d) Habitat and ecology;
   e) Threats;
   f) Management actions that are relevant to each Threatened Species and the predicted response to each of these by each Threatened Species (expressed as percentage improvement in population or site carrying capacity) when vegetation is either in 'Low condition' or 'Moderate to Good condition'. Differing levels of response may be provided depending on the condition of the vegetation;
   g) Vegetation types with which each Threatened Species is associated;
   h) Geographical constraints to the presence of the Threatened Species;
   i) Minimum surrounding vegetation cover class (cover within 1000 ha assessment circle), minimum patch-size class, important breeding, foraging and shelter habitat components (fauna), and essential habitat features (flora);
   j) The time of year when the Threatened Species is identifiable (used to identify appropriate time for inspection of flora);

k) Ability of each Threatened Species to sustain a temporary reduction in local population or temporary loss of habitat component;
l) Ability of each Threatened Species to occupy 'Paddock Trees condition' or 'Low condition' vegetation; and
m) For each Threatened Species that is likely to occupy 'Paddock Trees condition', the specified number of equivalent habitat trees that must be managed in an offset for each paddock tree cleared.

5.7 Loss of Threatened Species, habitat components or key habitat features

If the proposal will result in loss of individuals of the Threatened Species, or an area of its habitat component or key habitat features, an offset will be needed in order for the clearing to improve or maintain environmental outcomes for Threatened Species.

Key habitat features should be used as a measure of loss when the feature(s) is/are largely the only habitat component present and likely to be used by a Threatened Species (fauna) on the site. Generally, key habitat features should only be used to measure loss for the clearing of vegetation in low condition.

The expected loss of a Threatened Species, or its habitat component or its key habitat features is to be determined in accordance with the following process:

1. determine the unit of measure of this loss for each habitat component (breeding, foraging and shelter) that is present (e.g. number of individuals of flora species or of an endangered population of flora, area of habitat of fauna and ecological communities measured by hectares, or key habitat features for fauna measured by number of each feature such as number of hollow-bearing trees). The same unit of measure must also be used for assessing any offset required for that Threatened Species;
2. estimate the expected loss for each Threatened Species that is confirmed present or predicted as likely to be present in each vegetation zone;
3. if there is more than one vegetation zone within the area proposed to be cleared then the total loss for each Threatened Species is calculated by adding the losses in each vegetation zone, and the same unit of loss must be used for each vegetation zone;
4. where the units of loss for the three habitat components of fauna within a vegetation zone include both area and key habitat features, the loss estimate for that vegetation zone is to be measured in area.

5.8 Can any likely loss be offset?

Offsets can only be used in relation to a Threatened Species where the local population can sustain the level of likely temporary loss of individuals of the Threatened Species, its three habitat components (important breeding, foraging or shelter) or its key habitat features as specified in the Threatened Species Profile Database, whilst the gains are being achieved on the offset area(s).

Note: For the purposes of assessing whether a temporary loss can be sustained, a local population is defined as the total population of the Threatened Species (or the relevant habitat component or key habitat features) within one of the following areas, as specified in the Threatened Species Profile Database. The area used to assess the total local population is primarily based on the home range of the Threatened Species (fauna):

- a 0.2 km radius (10 ha) of the centre of the area to be cleared; or
- a 0.55 km radius (100 ha) of the centre of the area to be cleared; or
- a 1.79 km radius (1000 ha) of the centre of the area to be cleared.

A loss of individuals of the Threatened Species, or of its habitat components or its key habitat features can only be offset by a corresponding gain in individuals of the Threatened Species, or of its habitat components or its key habitat feature, within the same or another suitable vegetation type that is associated with the Threatened Species in the Threatened Species Profile Database.

The Property Vegetation Plan must include management actions for appropriate offset area(s) that will achieve the required gain.

The Threatened Species Profile Database identifies the management actions that can be undertaken to provide gains for Threatened Species. This includes an estimate of the percentage increase in population that can be expected in response to each management action, as measured by either an increase in the number of individuals, or area of habitat components or key habitat feature.

An offset area must:

a) support the same or a similar vegetation type to that being cleared – the offset cannot be used as an offset for a Threatened Species if it does not contain a vegetation type that is known to be used by the subject Threatened Species (as recorded in the Threatened Species Profile Database); or
b) contain a key habitat feature that would support the Threatened Species; or
c) be occupied by a sufficient population of the Threatened Species (flora), or support a sufficient area of Threatened Species (ecological communities) as confirmed by site inspection; and
d) contain the vegetation in a condition suitable to support the subject Threatened Species (fauna); and
e) retain all native vegetation, remnant native vegetation and regrowth (as defined in the *Native Vegetation Act* 2003) unless otherwise specified within the Property Vegetation Plan; and
f) be in perpetuity.

The assessment must determine the population, area of habitat component or number of the key habitat features that each offset area contains for each affected Threatened Species.

The gain for each Threatened Species in each vegetation zone is determined by the following formula for vegetation in 'Moderate to Good condition' or 'Low condition' (but not 'Paddock Tree condition'):

$$\textbf{Gain}^{\textbf{Action}\,i} = \textbf{Expected increase}^{\textbf{Action}\,i} \times \textbf{Amount}^{\textbf{Vegetation Zone}\,k}$$

Where:

- **Gain** is the increase in the population or area of habitat component or the number of a key habitat feature of each Threatened Species in response to the application of Action*i*;
- **Expected increase** is the percentage increase in population or carrying capacity (when the increase is applied to area of habitat component or key habitat feature) expected in response to Action*i* for the Threatened Species, as specified in the Threatened Species Profile Database;
- **Amount** is the number of individuals or area of habitat component or number of the key habitat feature for the Threatened Species that are contained within the proposed offset Vegetation Zone *k*.

The value of actions is additive, so that total gain achieved for each Threatened Species on an offset area is the sum of gains for all actions agreed to be applied on that offset area.

If there is more than one vegetation zone within the area proposed as an offset, then the total gain for each Threatened Species is calculated by adding the gains in each vegetation zone.

If total gain for each Threatened Species known or predicted as likely to occur in the area proposed as an offset is equal to or greater than the total loss then the proposal improves or maintains environmental outcomes for Threatened Species.

If total gain for each Threatened Species known or predicted as likely to occur in the area proposed as an offset is less than the total loss then the proposal does not improve or maintain environmental outcomes for Threatened Species.

For vegetation in 'Paddock Tree condition', the proposal improves or maintains environmental outcomes for Threatened Species if the required number of equivalent habitat trees (as specified in the Threatened Species Profiles Database) are contained within the area proposed as an offset and the offset area is managed to achieve over-storey cover to within benchmark. Where the proposed offset over-storey cover is already within benchmark, then any additional offset requirements must be met (as specified in the Threatened Species Profiles Database).

5.9 Definitions

Age cohort. Trees or shrubs within a vegetation community that recruited within the same event. An age cohort may fall within one or more stem diameter classes under Section 5.4.2.

Benchmarks or benchmark value or vegetation benchmarks. Quantitative measures of the range of variability in condition attributes of vegetation communities where there is relatively little evidence of modification by humans since European (post 1750) settlement. Benchmarks are available by vegetation class (*sensu* Keith 2004) at http://www.environment.nsw.gov.au/projects/BiometricTool.htm, and can also be obtained from reference sites or scientific literature or expert knowledge provided that the data has been certified by an accredited expert as set out in section 2.4.3.

Catchment Management Authority area. The area of operation of a Catchment Management Authority, as described in Schedule 2 of the *Catchment Management Authorities Act 2003.*

Catchment Management Authority area Subregion. Subregions of Catchment Management Authority areas as set out in Appendix A of the Environmental Outcomes Assessment Methodology, Native Vegetation Regulation 2005.

Cover of vegetation remaining in the landscape. The percentage of native vegetation remaining within a 1.79 km radius (1000 ha) of the site to be cleared. In any parts of the area where the woody cover is below benchmark cover, then the cover figure is appropriately reduced. See also **percent cover of native vegetation.**

Database. See Chapter Section 2.4.1 of this Environmental Outcomes Assessment Methodology.

Dbhob. Stem diameter at breast height over bark, i.e. at 1.3 metres above the ground.

Endangered population. 'Endangered population' within the meaning of the NSW *Threatened Species Conservation Act 1995.*

Essential habitat feature. A habitat attribute (as specified in the Threatened Species Profile Database) that must be present for a Threatened Species (flora) to be predicted as likely to occur.

Fallow. Land that is normally ploughed and cropped but does not contain a crop at the time of assessment. The land must have been ploughed and cropped within the last three years.

Grassland vegetation. Herbaceous native vegetation in the Grasslands vegetation formation described in Keith (2004).

Groundcover. Any type of herbaceous vegetation as defined in the *Native Vegetation Act 2003*.

Ground stratum. All native vegetation below one metre in height.

Ground stratum cover. Percent foliage cover of the relevant category of ground stratum native vegetation (grasses, shrubs, other).

Habitat component. The component of habitat that is used by Threatened Species (fauna) for the purposes of either breeding, foraging or shelter.

Herbfield vegetation. Herbaceous native vegetation that does not contain an over-storey or mid-storey and where the ground cover is dominated by non-grass species.

Indigenous. 'Indigenous' within the meaning of section 6(2) of the *Native Vegetation Act 2003*.

Key habitat feature. A clearly defined habitat component, such as a tree species with hollows of a specified entrance diameter, which is the only (or the primary) habitat component within a site likely to be used by a particular Threatened Species (fauna). Key habitat features should generally only be considered when measuring the loss of a Threatened Species in vegetation in low condition or existing as paddock trees.

Landscape value. Measure of native vegetation cover, connectivity and adjacency of native vegetation. On offset sites Landscape Value may also include riparian areas and any additional Site Value contribution.

Management action. An action listed either in this Environmental Outcomes Assessment Methodology (for biodiversity) or the Threatened Species Profile Database (for Threatened Species) that is predicted to improve one or more of the site condition variables (for biodiversity) or the habitat condition or population size (for Threatened Species) within an offset area.

Mitchell Landscape. Mitchell Landscape area as defined in Mitchell, P.B. (2002). NSW ecosystems study: background and methodology. Unpublished report to the NSW National Parks and Wildlife Service, Hurstville; and in Mitchell, P.B. (2003). NSW ecosystems database mapping unit descriptions. Unpublished report to the NSW National Parks and Wildlife Service, Hurstville. Updated in *Editing Mitchell Landscapes, Final Report.* A report prepared by Ecological Australia for the NSW Department of Environment and Climate Change (unpublished, 2008).

Non-woody vegetation. Herbaceous vegetation that is grassland, wetland or herbfield vegetation.

Offset site. An area (or areas) to which specified management actions are applied in perpetuity to achieve gains in biodiversity, including Threatened Species, in order to balance losses in biodiversity associated with clearing on another site(s).

Over-abundant native herbivore. Native herbivores that are in densities or numbers likely to cause detrimental effects on vegetation condition or other biodiversity values (where biodiversity values are defined as in the *Threatened Species Conservation Act 1995* 4A (1)).

Patch. An area of native vegetation that is more than 100 metres (or more than 30 metres in grassland, wetland or herbfield vegetation types) away from other native vegetation.

Patch-size class. Classes of connected areas of native vegetation that are required to be present in order to have a high probability of the areas supporting particular Threatened Species (fauna). For fauna recorded in the Threatened Species Profile Database as only likely to use 'Moderate to Good condition' vegetation, patch-size class refers to all contributing connected vegetation that is in 'Moderate to Good condition'. For species likely to use both 'Moderate to Good' and 'Low condition' vegetation, patch-size class refers to any contributing connected vegetation that is in 'Low condition' or better.

Percent cover of native vegetation. Percentage cover of native vegetation of an area assessed in accordance with Chapter Section 5.3.3.

Plot. Area in which some of the 10 site attributes that make up the Site Value score are assessed in a vegetation zone.

Ploughed. Soil that has been cultivated in preparation for sowing seed or planting.

Predicted response. The percent increase in a population or increase in habitat carrying capacity expected in response to each relevant management action for a Threatened Species, as specified in the Threatened Species Profile Database. The predicted response values are estimated on the basis of offsets being appropriately managed in perpetuity.

Reference site. Relatively unmodified sites used to obtain local benchmark information when benchmarks in the vegetation benchmark database are too broad or otherwise not relevant for the particular vegetation type and/or local situation.

Regional value. The percentage of a vegetation type's original extent that has been cleared in the Catchment Management Authority area adjusted with a generic species-area relationship.

Riparian area. Area in riparian buffer distances as defined in Table 3.1 from Chapter 3 (see below). Refer to Chapter 3 for definitions of types of streams and wetlands.

Table 3.1 Definition of riparian buffer distances.

Location	**Size of stream/wetland**			
	Minor watercourses, flood runners and effluents	Minor creeks & lagoons	Minor rivers, minor wetlands & major creeks	Major rivers & important wetlands
Coast & tablelands	10 m	20 m	30 m	40 m
Western slopes & plains	20 m	40 m	60 m	100 m
Estuarine areas	50 m from the astronomical high tide mark (where no obvious bank)			

Site. General term for one or more clearing zones and for one or more offset zones. Clearing zones and offset zones can be on the same land. Also used in the context of reference site.

Site value. Quantitative measure of structural, compositional and functional condition of native vegetation, measured by site attributes.

Stem density. Number of stems per hectare, measured in plots or by plotless methods.

Threatened Species (ecological communities). Any ecological community that is listed as 'critically endangered' or 'endangered' under the NSW *Threatened Species Conservation Act 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Threatened Species (fauna). Any species of fauna or a population of fauna that is listed as 'critically endangered', 'endangered' or 'vulnerable' under the NSW *Threatened Species Conservation Act 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Threatened Species (flora). Any species of plant or a population of a plant that is listed as 'critically endangered', 'endangered', 'vulnerable' or 'presumed extinct' under the NSW *Threatened Species Conservation Act 1995* or listed as 'critically endangered', 'endangered' or 'vulnerable' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Vegetation class. An intermediate level of vegetation classification as defined in Keith (2004).

Vegetation community. A generic term for vegetation type or combination of types up to vegetation class.

Vegetation formation. As defined in Keith. (2004).

Vegetation type. The finest level of classification of native vegetation used in the Environmental Outcomes Assessment Methodology. Vegetation types are assigned to vegetation classes, which in turn are assigned to vegetation formations.

Vegetation zone. A relatively homogenous area within a clearing, thinning or offset site that is the same vegetation type and broad condition. A zone may not contain vegetation that is a mix of low and not low condition. A vegetation zone may comprise one or more discontinuous areas.

Wetland vegetation. Herbaceous native vegetation in the Freshwater Wetland vegetation formation described in Keith (2004), and is consistent with the definition of wetland in the *Native Vegetation Act 2003.*

Woody native vegetation. Native vegetation that contains an over-storey and sometimes a mid-storey that predominantly consist of trees and/or shrubs.

Note: References

EcoLogical Australia (undated). Editing Mitchell Landscapes, Final Report. A report prepared by EcoLogical Australia for the NSW Department of Environment and Climate Change.

Gibbons, P., Briggs, S.V., Ayers, D., Seddon, J., Doyle, S., Cosier, P., McElhinny, C., Pelly, V. and Roberts, K. (2009). An operational method to assess impacts of land clearing on terrestrial biodiversity. Ecological Indicators 9, 26-40.

Keith, D. (2004). Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT. NSW Department of Environment and Conservation, Hurstville, NSW.

Mitchell, P.B. (2002). NSW ecosystems study: background and methodology. Unpublished report to the NSW National Parks and Wildlife Service, Hurstville;

Mitchell, P.B. (2003). NSW ecosystems database mapping unit descriptions. Unpublished report to the NSW National Parks and Wildlife Service, Hurstville;

Threatened Species are identified in accordance with the list published by the NSW Department of Environment, Climate Change and Water at:
http://www.environment.nsw.gov.au/threatenedspecies/index.htm

Mitchell Landscapes and vegetation types are identified in accordance with the lists published by the NSW Department of Environment, Climate Change and Water at:
http://www.environment.nsw.gov.au/projects/BiometricTool.htm

6 Soil Assessment

6.1 Introduction

This Environmental Outcomes Assessment Methodology defines the circumstances in which broadscale clearing is to be regarded as improving or maintaining environmental outcomes for land degradation under the *Native Vegetation Act 2003* including for the purposes of agreeing to a Property Vegetation Plan.

The Land and Soils Capability (LSC) tool assesses the following land degradation hazards:

- areas that are very susceptible to environmental harm arising from clearing of native vegetation;
- water erosion;
- wind erosion;
- earth mass movement;
- acid sulfate soils;
- salinity (see Chapter 4);
- shallow and rocky soils; or
- soil structure.

The Land and Soils Capability class that any associated hazards fall within determines whether a proposal is considered to improve or maintain environmental outcomes:

- Land and Soils Capability classes 1 & 2: the proposal is regarded as improving or maintaining environmental outcomes;
- Land and Soils Capability classes 3 to 6: will not improve or maintain environmental outcomes unless the on-site management actions specified in Appendix B or Appendix C for each applicable hazard and class are undertaken;
- Land and Soils Capability classes 7 & 8: will not improve or maintain environmental outcomes and the impacts cannot be offset by management actions.

The process for assessing clearing and offset proposals in respect of land degradation is the same, except where otherwise stated.

The Land and Soils Capability Tool also assesses biodiversity, salinity or water quality offset proposals that involve soil disturbance in order to determine whether the offsets will improve or maintain environmental outcomes in relation to land degradation.

Where a proposal has several hazards the decision as to whether clearing or offset proposals will improve or maintain environmental outcomes is based on the most significant land degradation risk arising from the proposal, ie the hazard with the highest class.

6.2 Land and soil capability classification

The land and soil capability classification is based on the Rural Land Capability system defined by Emery (1985). However, the proposed land and soil capability system places additional emphasis on soil limitations and explicitly incorporates them into the classification.

All parts of the landscape are classified within eight capability classes, designated by numerals 1 to 8, the sequence indicating progressively greater land and soil limitations. These limitations usually restrict the type and diversity of land use activities that can be undertaken without significant land and soil degradation occurring. Although this system is intended primarily to address agricultural activities, it can be used to provide a general indication of the capability of the land for other land use practices, including forestry and

urban development. Increasing the degree of constraint imposed by specific limitations, which progressively limit the range of alternative land uses and management practices that are practicable and appropriate, achieves this.

6.3 The improve or maintain test for land degradation

The Land and Soils Capability Tool requires 4 key actions:

- identify the land and soils capability zone; these are areas of land that have relatively uniform physical characteristics in relation to slope, rockiness, soil type, soil drainage, landform or salt outbreak;
- identify the relevant catchment hazard area;
- establish slope; and
- establish rainfall.

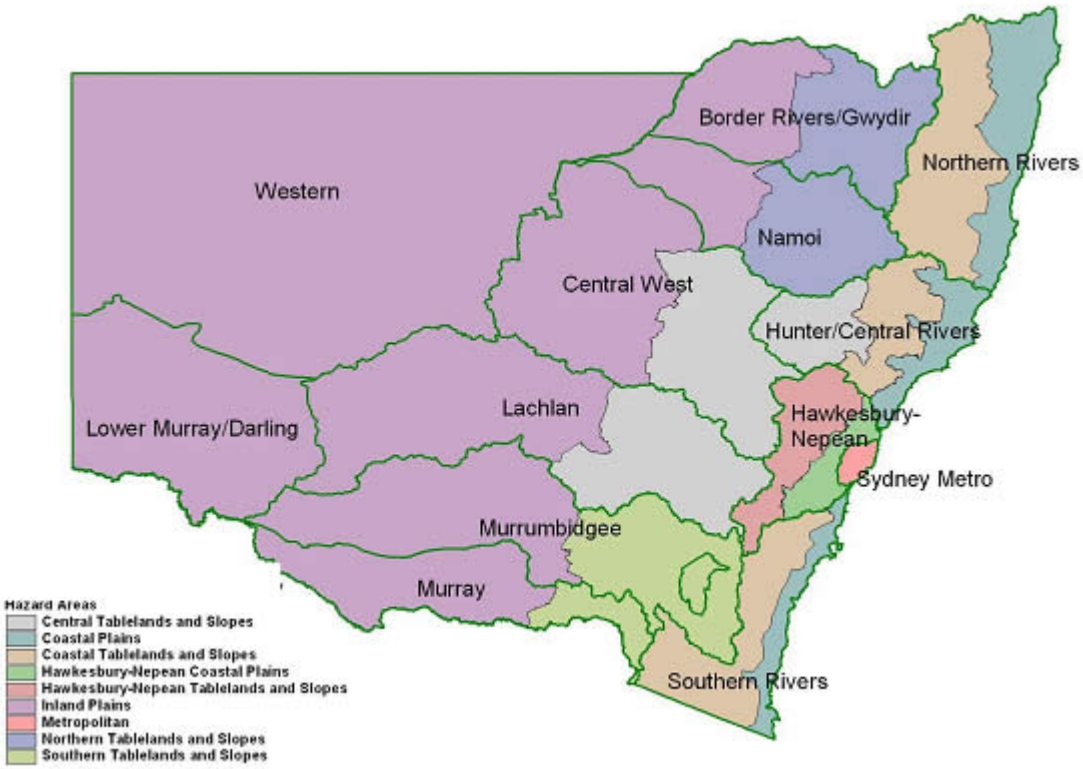
6.3.1 Identify Land and Soils Capability Zone

Land and soils capability zones are areas of land that have relatively uniform physical characteristics in relation to slope, rockiness, soil type, soil drainage, landform or salt outbreak. The proposal must improve or maintain environmental outcomes for all Land and Soils Capability zones it includes in order to pass the 'improve or maintain' test.

6.3.2 Identify the relevant Catchment Hazard Area

To simplify the assessment process, Catchment Management Authority areas have been divided into Catchment Hazard Areas based on common climatic, soil and geomorphic characteristics. These Catchment Hazard Areas are shown in Figure 6.1.

Figure 6.1: Map of Catchment Hazard Areas



In some catchment hazard areas certain hazards are not significant and are deemed to improve or maintain environmental outcomes. For example, acid sulfate soils are only assessed for coastal plains. The hazards assessed for each area are shown in Table 6.1.

Table 6.1 Required Hazard Assessment by Catchment Hazard Areas

Catchment Hazard Areas	What Hazards are assessed?							
	Sensitive terrain	Water erosion hazard	Wind erosion hazard	Salinity hazard (Chapter 4)	Shallow & rocky soil hazard	Earth mass movement hazard	Soil structure hazard	Acid sulfate soil hazard
Coastal Tableland and Slopes	✓*	✓		✓	✓	✓		
Northern Tableland and Slopes	✓	✓	✓	✓	✓	✓		
Central Tableland and Slopes	✓	✓	✓	✓	✓	✓		
Southern Tablelands and Slopes	✓	✓	✓	✓	✓	✓		
Coastal Plains excluding Hawkesbury/Nepean	✓	✓	✓		✓	✓		✓
Coastal Plains - Hawkesbury/Nepean only	✓	✓	✓	✓	✓	✓		✓
Inland Plains	✓	✓	✓	✓	✓		✓	

*Ticked cell indicates hazard is assessed in the Catchment Hazard Area

6.3.3 Slope

Slope is used to assess water erosion hazard and mass movement hazard.

Average slope may be either:

- estimated visually in the field by experienced landscape assessors;
- measured using an Abney level or clinometer; or
- estimated from a topographic map or Digital Elevation Model.

The slope classes available as options in the Land and Soils Capability Tool vary between different Catchment Areas to reflect local conditions and the specific criteria required for hazard assessments.

6.3.4 Rainfall

Rainfall is one factor used to assess water erosion hazard, wind erosion hazard, soil structure decline and earth mass movement hazard.

Average annual rainfall requires the selection of the appropriate 100 mm class using information provided by the Australian Bureau of Meteorology. This must relate to the locality if this is available, or, where this is not available, to a nearby town with a similar climate.

6.4 Assessing clearing on sensitive terrain

- sensitive terrains are areas of the landscape that are very susceptible to environmental harm arising from clearing of native vegetation. They are defined in Table 6.2.
- clearing of native vegetation on sensitive terrain located in a Catchment Area ticked in Table 6.3 is regarded as not improving or maintaining environmental outcomes.
- it is not possible to offset the impacts of the clearing of sensitive terrain.
- sensitive terrain is not assessed in respect of proposals for biodiversity or salinity offsets.

Table 6.2 Definitions of Sensitive Terrain.

Sensitive Terrain	Definition
Foredune to beach	Elongated, moderately inclined to very steep, single or compound ridge generally less than 15 metres high, built up by the wind from predominantly sand sized particles derived from an adjacent coastal beach.
Derelict mine site	Surface workings of former mining sites, whether remediated or unremediated, which may contain toxic soil, rock or spoil materials.
High run-on area	Areas of the inland plains that have large up-slope catchments and are subject to very high run-on volumes in times of rainfall.
Lakebed within 200 m of shoreline	Beds of ephemeral or fluctuating lakes, whether fresh or saline, of the inland plains. The near-shore areas of these lakebeds are often susceptible to wind erosion and environmental degradation.
Lunette	Occurs mainly in the inland plains and is an elongated, gently recurved, low ridge consisting of sand or pelletised silt and clay which has been built up by wind action on the north eastern or eastern margin of a ephemeral freshwater or saline lake or closed depression. A lunette typically has a wave-modified slope towards the lake or depression.
Flow line	Occurs in the Slopes and Tablelands where surface water flow or seepage is initially concentrated in drainage depressions and is not yet in clearly defined streams.
Sand Dune	Occurs mainly in the inland plains and coastal plains and is a moderately inclined to very steep, sub-parallel linear ridge or hillock built up from sand sized particles by wind action.

Table 6.3 Applicability of Sensitive Terrain in Catchment Hazard Areas.

	Sensitive Terrain						
Catchment Hazard Area	**Foredune to Beach**	**Derelict Mine Site**	**High Run-on Area**	**Lakebed**	**Lunette**	**Flow Line**	**Sand Dune**
Northern Tablelands and Slopes		✓*				✓	
Central Tablelands and Slopes		✓				✓	
Southern Tablelands and Slopes		✓				✓	
Coastal Tablelands and Slopes		✓				✓	
Coastal Plains	✓	✓				✓	✓
Inland Plains		✓	✓	✓	✓		✓

*Ticked cell indicates hazard is assessed in the Catchment Hazard Area

6.5 Assessing water erosion hazard

- Water erosion hazard is the susceptibility of land to soil erosion by moving water.
- Rainfall erosivity and water availability for plant growth are factors that affect soil erosion. These vary significantly between different parts of the State. The Land and Soils Capability Tool uses different classes in different Catchment Areas to account for differences in these factors. These are set out in Table 6.4.
- The severity of existing water erosion is classed by the Land and Soils Capability Tool as either: nil, low, moderate, high, very high, or extreme, according to the definitions of these categories contained in Table 6.5.
- If the existing erosion is classed as **nil, low or moderate**, the Land and Soils Capability Tool assigns the land and soils capability class indicated in Table 6.4 (based on slope).
- Land and soils capability classes 4 and 5 are not differentiated from each other by slope, but by whether the soils have high natural fertility (class 4) or relatively low natural fertility (class 5).
- If the existing erosion is classed as **high**, the Land and Soils Capability Tool automatically assigns water erosion hazard to land and soils capability class 6, except for land and soils capability zones in the Coastal Tablelands and Slopes Catchment Hazard Area, which are automatically assigned to class 7.
- If the existing erosion is classed as **very high**, the Land and Soils Capability Tool automatically assigns water erosion hazard to land and soils capability class 7.
- If the existing erosion is classed as **extreme**, the Land and Soils Capability Tool automatically assigns water erosion hazard to land and soils capability class 8.

Table 6.4 Slope Class (%) for each land and soils capability class used to determine Water Erosion Hazard in the Catchment Areas.

	Land and soils capability class determined by slope (%)					
Catchment Area	**I**	**2**	**3**	**4 & 5**	**6**	**7 & 8**
Northern Tablelands and Slopes	**< 1**	**1 – <2**	**2 - <8**	**8 - <25**	**25 - 33**	**> 33**
Inland Plains	**< 1**	**1 - <3**	**3 – <10**	**10 - <25**	**25 - 33**	**> 33**
Central Tablelands and Slopes	**< 1**	**1 – <2**	**2 - <8**	**8 - <25**	**25 - 33**	**> 33**
Southern Tablelands and Slopes	**<1.5**	**1.5 - <5**	**5 – <12**	**12 - <25**	**25 - 33**	**> 33**
Coastal Tablelands and Slopes	**< 1**	**1 – <2**	**2 - <8**	**8 - <25**	**25 - 50**	**> 50**
Coastal Plains	**< 1**	**1 - <2**	**2 - <8**	**8 - 25**	**25 - 33**	**> 33**

Table 6.5 Definitions of Existing Erosion Classes

Class	Definition
Nil	No sheet or gully erosion present.
Low	Minor sheet and gully erosion present.
Moderate	Moderate sheet and gully erosion present – gullies restricted to major flow lines.
High	Severe sheet and gully erosion present – rills clearly evident, subsoil and C horizons clearly exposed in many areas, clearly evident depositional areas adjacent to fences and roads - gullies are deep and active in 2nd order streams showing branching into lower parts of 1st order flow lines.
Very high	Severe sheet erosion present causing bare ground and scalding – subsoil and C horizons or bare rock exposed in many areas - clearly evident areas of deposition on lower slopes, adjacent to fences and roads - gullies are active and strongly branched, extending high into 1st order flow lines – gullies often show tunnelling.
Extreme	Majority of the area is bare and scalded, usually extensive areas of active rilling and gullying present – gullies may occupy the majority of the area.

6.6 Assessing wind erosion hazard

- Wind erosion hazard is the susceptibility of land to the erosion of soil particles by wind.
- Soil erosion by wind is of particular concern in coastal regions and inland dryland farming areas.
- The criteria used by the Land and Soils Capability Tool to assess wind erosion hazard are:
  - wind erodibility of soil;
  - wind erosive power as indicated on a map in the Land and Soils Capability Tool;
  - exposure to prevailing winds;
  - average annual rainfall.
- The relationship between the criteria in determining the class is shown in Table 6.6.
- Wind erodibility of soil is assessed in the following classes:
  - low: loams, clay loams, or clays (all with greater than 13% clay);
  - moderate: fine sandy loams or sandy loams (all with 6 – 13% clay);
  - high: loam sands or loose sands (all with less than 6% clay).
- Exposure to prevailing winds is assessed in the following classes:
  - low exposure: sheltered locations in valleys or in the lee of hills;
  - moderate exposure: intermediate situations - not low or high exposure locations;
  - high exposure: hilltops or exposed coastal locations.

Table 6.6 Relationship between Wind Erodibility Class of Soil, Wind Erosive Power Exposure to Prevailing Winds, and Annual Rainfall for Land and Soils Capability Classes.

Average Annual Rainfall	Wind Erodibility Class of Soil	Wind Erosive Power	Exposure to Wind	Land and Soils Capability Class
> 500 mm	**low**	**low**	**low**	**1**
			moderate	**1**
			high	**2**
		moderate	**low**	**1**
			moderate	**2**
			high	**3**
		high	**low**	**2**

Average Annual Rainfall	Wind Erodibility Class of Soil	Wind Erosive Power	Exposure to Wind	Land and Soils Capability Class
			moderate	3
			high	4
	moderate	low	low	2
			moderate	3
			high	4
		moderate	low	2
			moderate	3
			high	4
		high	low	3
			moderate	4
			high	5
	high	low	low	3
			moderate	4
			high	5
		moderate	low	4
			moderate	5
			high	6
		high	low	5
			moderate	6
			high	7
300 – 500 mm	low	low	low	2
			moderate	2
			high	3
		moderate	low	2
			moderate	3
			high	4
		high	low	3
			moderate	4
			high	4
	moderate	low	low	3
			moderate	4
			high	5
		moderate	low	3
			moderate	4
			high	5
		high	low	3
			moderate	5
			high	6
	high	low	low	4

Average Annual Rainfall	Wind Erodibility Class of Soil	Wind Erosive Power	Exposure to Wind	Land and Soils Capability Class
			moderate	5
			high	7
		moderate	low	5
			moderate	6
			high	7
		high	low	6
			moderate	7
			high	7
200 – <300 mm	low	low	low	3
			moderate	3
			high	4
		moderate	low	3
			moderate	4
			high	5
		high	low	4
			moderate	5
			high	6
	moderate	low	low	4
			moderate	5
			high	6
		moderate	low	4
			moderate	5
			high	7
		high	low	4
			moderate	6
			high	8
	high	low	low	5
			moderate	6
			high	8
		moderate	low	6
			moderate	7
			high	8
		high	low	7
			moderate	8
			high	8
< 200 mm	low	low	low	8
			moderate	8
			high	8
		moderate	low	8

Average Annual Rainfall	Wind Erodibility Class of Soil	Wind Erosive Power	Exposure to Wind	Land and Soils Capability Class
			moderate	8
			high	8
		high	low	8
			moderate	8
			high	8
	moderate	low	low	8
			moderate	8
			high	8
		moderate	low	8
			moderate	8
			high	8
		high	low	8
			moderate	8
			high	8
	high	low	low	8
			moderate	8
			high	8
		moderate	low	8
			moderate	8
			high	8
		high	low	8
			moderate	8
			high	8

6.7 Assessing shallow and rocky soil hazard

- Shallow soils and rockiness reduce the land use capability of soils and land.
- The criteria used by the Land and Soils Capability Tool to assess shallow soil and rockiness hazard are:
  - estimated percentage exposure of rocky outcrops;
  - average soil depth; and
  - average annual rainfall.
  - The relationship between the criteria in determining the land and soils capability class is shown in Table 6.7.

Table 6.7 Relationship between Soil Depth, Rocky Outcrop, and Average Annual Rainfall for Assessment of Shallow and Rocky Soils.

Soil Depth cm	Rocky Outcrop % Coverage	Land and Soils Capability Class if <500 mm Av. Annual Rainfall	Land and Soils Capability Class if >500 mm Av. Annual Rainfall
>100	<30	1, 2	1, 2
50 – 100		4	1, 2
25 – <50		7, 8	4
<25		7, 8	7, 8
>100	30 - 50	4, 5	4, 5
50 – 100		4, 5	4, 5
25 – <50		7, 8	4, 5
<25		7, 8	7, 8
>100	50 – 70	6	6
50 – 100		6	6
25 – <50		7, 8	6
<25		7, 8	7, 8
>100	>70	7, 8	7, 8
50 – 100		7, 8	7, 8
25 – <50		7, 8	7, 8
<25		7, 8	7, 8

6.8 Assessing earth mass movement hazard

- The criteria used by the Land and Soils Capability Tool to assess earth mass movement hazard are:
  - existing evidence of earth mass movement;
  - slope class;
  - average annual rainfall;
  - soil saturation conditions;
  - nature of underlying soil materials.
- The relationship between the criteria in determining the Land and Soils Capability Class is shown in Table 6.8.

Table 6.8 Relationship between Existing Earth Mass Movement, Slope, Average Annual Rainfall, Subsurface Soil Saturation Conditions and Unconsolidated Substrates for Assessing Earth Mass Movement Hazard.

Is there existing earth mass movement?	Slope	Is the average annual rainfall > 900 mm?	Concentration or impedance of seepage flows?	Is the underlying material unconsolidated?	Land and Soils Capability Class
yes	<12%	not required	not required	not required	1
	12% or more	not required	not required	not required	8
no	< 12 %	not required	not required	not required	1
	12 – 25%	yes	yes	yes	7
				no	6
			no	yes	6
				no	3
		no	yes	yes	6
				no	3
			no	yes	3
				no	1
	> 25%	yes	yes	yes	8
				no	7
			no	yes	7
				no	6
		no	yes	yes	6
				no	6
			no	yes	6
				no	3

6.9 Assessing acid sulfate soils hazard

- The Land and Soils Capability Tool assesses acid sulfate soils hazard for Coastal Plains in the Northern Rivers Catchment Management Authority, the Southern Rivers Catchment Management Authority, the Hawkesbury Nepean Catchment Management Authority and the coastal subdivision of the Hunter and Central Rivers Catchment Management Authority.
- The criteria used by the Land and Soils Capability Tool to assess acid sulfate soils hazard are:
  - land elevation in metres above Australian Height Datum (AHD);
  - depth to potential or actual acid sulfate soil.
- The depth to acid sulfate soils is estimated from Department of Natural Resources Acid Sulfate Soil maps, or can be obtained through field testing in the relevant Land and Soils Capability zone;
- The relationship between the criteria in determining the land and soils capability class is shown in Table 6.9.

Table 6.9 Relationship between Criteria Determining Class for Acid Sulfate Soils Hazard.

Is land >10 m AHD?	Depth to Acid Sulphate Soils Hazard	Land and Soils Capability Class
Yes	NA	1
No	ASS not present	1
	>4m	3
	2 – 4m	4
	1 – <2m	5
	<1m	8

6.10 Assessing soil structure hazard

- Soil structure decline is only assessed by the Land and Soils Capability Tool for the inland plains of NSW and only if average annual rainfall is <600 mm;
- The criterion used by the Land and Soils Capability Tool to assess soil structure decline hazard is the nature of surface soils;
- Table 6.10 shows how the Class is determined.

Table 6.10 Relationship between Nature of Surface Soils and Classes for the Assessment of Soil Structural Decline Hazard in the Inland Plains of NSW (where annual rainfall <600 mm).

Nature of surface soils	Class
self-mulching clay surface soils; loose sands	1, 2
fine sandy loam and sandy loam surface soils	3
loam and clay loam surface soils, non sodic	3
mildly sodic, loam, clay loam and clay surface soils	4
sodic, light clay and medium clay surface soils	5, 6
strongly sodic, light clay and medium clay surface soils	7, 8

Note: References

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7 Invasive Native Scrub Assessment

7.1 Introduction

This Chapter applies to the clearing of species of invasive native scrub under the Native Vegetation Act 2003.

Regrowth that is not classified as "protected regrowth" under the *Native Vegetation Act 2003* may be cleared without approval under that Act. Clearing of any other vegetation, which is classified under the *Native Vegetation Act 2003* as "remnant vegetation" or "protected regrowth" requires approval from the local Catchment Management Authority. This includes clearing of invasive native species.

Where a proposal only involves clearing of invasive native species a shortened assessment process (within the Native Vegetation Assessment Tool) can be used. This assessment process is designed to maintain or create a mosaic of vegetation states across the landscape and does not require offsets.

Further information on supporting science and application of the Environmental Outcomes Assessment Methodology relating to clearing/thinning of native vegetation known as invasive native scrub under the *Native Vegetation Act 2003* is contained in:

- Operational Manual for the Native Vegetation Assessment Tool;
- Collation of Discussion Paper Submissions and Responses from the Invasive Native Scrub Team (http://www.nativevegetation.nsw.gov.au/methodology/).

7.2 Assessing invasive native species clearing proposals

This Chapter applies to the clearing of invasive native species.

Note:

There are two steps in assessing a proposal to clear invasive native species.

The first step is to determine whether the species proposed to be cleared may be assessed under this Chapter. This involves firstly, determining whether the species is listed in Table 7.1 as generally being invasive in the Catchment Management Authority area and/or the Interim Biogeographic Regionalisation of Australia ("IBRA") region where the proposal is located, and secondly, whether the behaviour of the species in the area of the proposal satisfies certain criteria relating to whether a species can be said to be an invasive native species.

If the species is not an invasive native species, then the clearing proposal may not be assessed under this Chapter.

The second step is assessing whether the clearing proposal satisfies all of the applicable criteria listed below. If the clearing proposal does satisfy all applicable criteria, the clearing is to be regarded as improving or maintaining environmental outcomes and it is not necessary to assess the clearing proposal against the other environmental values listed in the Assessment Methodology (that is, water quality, salinity, soils and biodiversity).

If the clearing proposal does not satisfy all of the applicable criteria, then the proposal may not be assessed under this Chapter.

Invasive native species for the purposes of this Chapter means a plant species that satisfies the following criteria:

1) The species is listed in Table 7.1 in respect of the Catchment Management Authority Area or the Catchment Management Authority Area and IBRA region to which the clearing proposal relates; **and**
2) In the opinion of the relevant Catchment Management Authority (or an officer of that Authority who is responsible for making this assessment), the species satisfies the following criteria for acting invasively:
   (a) the species is invading plant communities where it has not been known to occur previously, **or**
   the species is regenerating densely following natural or artificial disturbance, **and**
   (b) the invasion and/ or dense regeneration of the species is resulting in change of structure and/ or composition of a vegetation community, **and**
   (c) the species is within its natural geographic range.

For the purpose of assessing whether clearing for the purpose of controlling invasive native scrub will improve or maintain environmental outcomes, such clearing is divided into the following clearing types:

a) burning;
b) clearing of individual plants with no disturbance to groundcover (for example, chemical spot treatment or ringbarking);
c) clearing of individual plants with minimal disturbance to groundcover (for example, grubbing);
d) clearing of plants at paddock scale with nil to minimal disturbance to soil and groundcover (for example, chaining, slashing or roping);
e) clearing of plants at paddock scale with temporary disturbance to soil and groundcover (for example, bladeploughing); and
f) clearing of plants at paddock scale with longer-term disturbance to soil and groundcover (for example, short-term cropping).

Note:

The examples set out in brackets above are given by way of illustration only and do not limit techniques for clearing which fall within each method.

Proposed invasive native species clearing assessed under this Chapter is regarded as improving or maintaining environmental outcomes in relation to applications for consent or Property Vegetation Plans if it meets all of the following criteria which apply to the proposed clearing.

All of the following criteria apply to all proposed clearing, unless expressly stated to apply only to a specific type of clearing.

In the following criteria:

- "groundcover" means any type of herbaceous vegetation, native and non-native, living or dead;
- "native groundcover" means living, native herbaceous vegetation;
- "the extent of invasive native species on the property" means the extent of the areas on the property where invasive native species are currently present and areas on the property where they may not presently occur but where invasive native scrub management is required to prevent their spread or recurrence, as mapped by the relevant Catchment Management Authority. Non native vegetation areas and areas of native vegetation not impacted by invasive native scrub should not be included in the extent of invasive native scrub on the property;

- "non-invasive native species" and "non-invasive native vegetation" mean any native species that are not invasive native species, as defined above;
- "diameter at breast height" means the diameter of the stem at 1.3 metres above the ground;
- "erosion risk" means the intrinsic susceptibility of a parcel of land to the prevailing agents of erosion. It is dependent on a combination of climate, landform and soil factors (Houghton & Charman 1986);
- "derived vegetation community" for the purposes of this chapter means a vegetation community which has changed from structurally different vegetation community, for example, shrubland that has encroached into open woodland or grassland areas. Vegetation communities with mature trees of the same species as younger trees in the community are generally not derived communities;
- "high condition" is as defined as benchmark condition (by Chapter 5 of the Environmental Outcomes Assessment Methodology) for the vegetation type which corresponds to the threatened ecological community being treated.
- "density" or "densities" means the number of plants per hectare.

Purpose of the clearing

1) Clearing permitted by these provisions is for the purpose of re-establishing native vegetation or allowing natural regeneration of native species.

Native groundcover

2) After the clearing provisions of the consent or property vegetation plan end, native groundcover on the area where the clearing took place is maintained in perpetuity unless clearing is permitted by a property vegetation plan or consent under the *Native Vegetation Act 2003*.

Total areas which may be cleared

3) Total clearing of invasive native species does not exceed 80% of the extent of invasive native species on the property.

4) Where the following types of clearing are carried out
   - burning or
   - clearing of individual plants with no disturbance to groundcover

   (a) The clearing does not exceed 80% of the extent of the area of invasive native species on the property (as mapped by the relevant Catchment Management Authority).

5) Where the following types of clearing are carried out:
   - clearing of individual plants with minimal disturbance to groundcover or
   - clearing plants at a paddock scale with nil to minimal disturbance to soil and groundcover.

   a) The clearing does not exceed 60% of the extent of invasive native species on the property, except as set out in 5 b) below.
   b) Up to a further 20% of the extent of invasive native species on the property is cleared only if the Catchment Management Authority is satisfied that land that was initially cleared by either of these types of clearing has achieved a groundcover of greater than 50% (or higher percentage as determined by the CMA) and the groundcover consists of greater than 75% (or higher percentage as determined by the CMA) native groundcover.

c) Groundcover is maintained in perpetuity on land initially cleared by this type of clearing from the date the Catchment Management Authority is satisfied the land is at the groundcover set out in paragraph 5 (b) unless clearing is permitted by a property vegetation plan or consent under the *Native Vegetation Act 2003*.
d) If clearing plants at a paddock scale with nil to minimal disturbance to soil and groundcover is carried out with clearing plants at a paddock scale with temporary disturbance to soil and groundcover and/ or clearing of plants at paddock scale with longer-term disturbance to soil and groundcover the total clearing must not exceed 60% of the extent of invasive native species on the property except as set out in paragraph 5 b).
e) The CMA must certify in writing that it is satisfied as to the matters set out in paragraph 5 b) before the further clearing referred to in that paragraph can take place.

Note:

Criterion 5 d) means that if clearing type d is undertaken in combination with clearing type e and/or f the total initial clearing cannot exceed 60% of the extent of invasive native species on the property.

Due to the other retention requirements within this Chapter the clearing by clearing types d-f may be limited to 72% of the extent of invasive native species on the property in total over the period of the Property Vegetation Plan.

6) Where the following type of clearing is carried out:
- Clearing plants at a paddock scale with temporary disturbance to soil and groundcover.

a) The clearing does not exceed 40% of the extent of invasive native species on the property, except as set out in 6 b) below.
b) Up to a further 40% of the extent of invasive native species on the property is cleared only if the Catchment Management Authority is satisfied that land that was initially cleared by this type of clearing has achieved a groundcover of greater than 50% (or higher percentage as determined by the CMA) and the groundcover consists of greater than 75% (or higher percentage as determined by the CMA) native groundcover.
c) Groundcover is maintained in perpetuity on land initially cleared by this type of clearing from the date the Catchment Management Authority is satisfied the land is at the groundcover set out in set out in paragraph 6 (b) unless clearing is permitted by a property vegetation plan or consent under the *Native Vegetation Act 2003*.
d) If both clearing plants at paddock scale with temporary disturbance to soil and groundcover and clearing of plants at paddock scale with longer-term disturbance to soil and groundcover are to be carried out, then criterion 8 also applies.
e) The CMA must certify in writing that it is satisfied as to the matters set out in paragraph 6 b) before the further clearing referred to in that paragraph can take place.

7) Where the following type of clearing is carried out:
- Clearing of plants at paddock scale with longer-term disturbance to soil and groundcover.

a) The clearing does not exceed 20% of the extent of invasive native species on the property, except as set out in 7 b) below.
b) Up to a further 60% of the extent of invasive native species on the property is cleared only if the Catchment Management Authority is satisfied that for each further 20% (up to a maximum of 80%) of the extent of invasive native species on the property, land that was initially cleared by this type of clearing has achieved a groundcover of greater than 50% (or higher percentage as determined by the CMA) and the

groundcover consists of greater than 75% (or higher percentage as determined by the CMA) native groundcover.

c) Groundcover is maintained in perpetuity on land cleared by this type of clearing from the date the Catchment Management Authority certifies in writing that the land is at the groundcover set out in set out in paragraph 7 b) unless clearing is permitted by a property vegetation plan or consent under the *Native Vegetation Act 2003*.
d) The clearing at any one time does not exceed 20% of the invasive native species extent on the property.
e) If both clearing plants at paddock scale with temporary disturbance to soil and groundcover and clearing of plants at paddock scale with longer-term disturbance to soil and groundcover are to be carried out, then criterion 8 also applies.
f) The CMA must certify in writing that it is satisfied as to the matters set out in paragraph 7 b) before the further clearing referred to in that paragraph can take place.

8) Where both of the following types of clearing are carried out:
   - clearing plants at a paddock scale with temporary disturbance to soil and groundcover and
   - clearing of plants at paddock scale with longer-term disturbance to soil and groundcover.

   a) The clearing does not exceed 40% of the extent of invasive native species on the property except as set out in 8 b) below.
   b) Up to a further 40% of the extent of invasive native species on the property is cleared only if the Catchment Management Authority is satisfied that land that was initially cleared by either of these types of clearing has achieved a groundcover of greater than 50% (or higher percentage as determined by the CMA) and the groundcover consists of greater than 75% (or higher percentage as determined by the CMA) native groundcover.
   c) Groundcover is maintained in perpetuity on land initially cleared by this type of clearing from the date the Catchment Management Authority is satisfied the land is at the groundcover set out in set out in paragraph 8 b) unless clearing is permitted by a property vegetation plan or consent under the *Native Vegetation Act 2003*.
   d) The clearing at any one time does not exceed 40% of the invasive native species extent on the property.
   e) The CMA must certify in writing that it is satisfied as to the matters set out in paragraph 8 b) before the further clearing referred to in that paragraph can take place.

Note:

For example, using this type of clearing, if the extent of invasive native species on a property is 1,000 ha, then the landholder may initially clear 20% of this area, that is, 200 ha. Once the Catchment Management Authority is satisfied that this 200 ha has achieved a groundcover of more than 50% cover and that cover consists of more than 75% native vegetation, then the landholder may clear a further 20% of the extent of invasive native species on the property, that is, a further 200 ha.

Once the Catchment Management Authority is satisfied that the second parcel of 200 ha has achieved the groundcover and percentage of native groundcover described above, then the landholder may clear a further 200 ha and so on, until the landholder has cleared 800 ha, which is the maximum area permitted to be cleared (that is, 80% of 1,000 ha). In this example at any one time, no more than 200 ha may be cleared.

The landholder must not re-clear any areas cleared under these provisions that have achieved the necessary level of groundcover unless another consent or Property Vegetation Plan is obtained.

Restrictions on which methods of clearing may be used

8A) The clearing type that is used (being a type described in Chapter Section 7.2 (a) to (f)) is a type which is permitted for the species being cleared, according to Table 7.1

9) The method of clearing is limited to burning, clearing of individual plants with no disturbance to groundcover or clearing of individual plants with minimal disturbance to groundcover where:
   a) non-invasive native trees and shrubs represent more than 50% of total number of individual trees and shrubs; or
   b) skeletal/ rocky soils, dunefields or lunettes occur on the area where the proposed clearing is to take place, or

   vegetation is a threatened ecological community or threatened population within the meaning of the *Threatened Species Conservation Act 1995* except, if the threatened ecological community is not in high condition and the clearing does not include the key species in the threatened ecological community (species in the title of the listing under the *Threatened Species Conservation Act 1995)* of the threatened ecological community, then the method of clearing of plants at paddock scale with nil to minimal disturbance to soil and groundcover may also be used, but to clear the understorey or groundcover only.

10) For methods other than burning, clearing of individual plants with no disturbance to groundcover and clearing of individual plants with minimal disturbance to groundcover, no land of slope greater than 18 degrees is cleared.

11) For the method of clearing of plants at paddock scale with longer-term disturbance to soil and groundcover, no vegetation is cleared on land:
   a) with a soil profile less than 1m in depth; or
   b) of a medium erosion risk; or
   c) of a high erosion risk.

12) For the method clearing of plants at a paddock scale with temporary disturbance to soil and groundcover, no vegetation is cleared on land of a high erosion risk.

13) For methods other than burning, any invasive native species that has a stem or trunk with a diameter at breast height ("dbh") greater than the dbh specified in the column headed "Maximum dbh allowed to be cleared" in Table 7.1 is not cleared except as set out in 13A and 13C.

13A) The relevant Catchment Management Authority may vary the measurement in the column "Maximum dbh allowed to be cleared" in Table 7.1 by up to 5 centimetres if, in the judgement of the Catchment Management Authority, the variation is appropriate for the land to be cleared.

13B) Any native vegetation other than the invasive native species referred to in 13 with a stem or trunk diameter at breast height greater than 20cm is not cleared except as set out in 13C.

13C) Accidental clearing of invasive native species with a stem or trunk dbh greater than the maximum dbh allowed to be cleared and non-invasive native species with a stem or trunk greater than 20cm dbh is limited to 1% of the total number of trees and shrubs in the area to be cleared.

14) For methods other than burning or clearing of individual plants with no disturbance to groundcover, no clearing is undertaken within the riparian buffer distances, as set out in

Table 3.1of the Environmental Outcomes Assessment Methodology. Rivers and important wetlands are defined by Section 3.3 of the Environmental Outcomes Assessment Methodology. Other watercourses, lagoons and wetlands are to be defined by Section 3.3 of the Environmental Outcomes Assessment Methodology or as defined by the Catchment Management Authority.

15) [Note: this criterion has been removed. See criterion 17A.]

Non-native vegetation

16) For methods of clearing plants at paddock scale with temporary disturbance to soil and groundcover, and clearing of plants at paddock scale with longer term disturbance to soil and groundcover, the clearing does not result in the introduction into the cleared area of any non-native perennial vegetation other than the species listed in Table 7.2 (where in the judgement of the Catchment Management Authority the species listed in Table 7.2 is non-persistent in the area the species is proposed to be introduced)

17) For methods other than clearing plants at a paddock scale with temporary disturbance to soil and groundcover and clearing of plants at paddock scale with longer term disturbance to soil and groundcover, the clearing does not result in the introduction into the cleared area of any non-native vegetation.

Retention of native vegetation

17A) For methods of clearing of individual plants with no disturbance to groundcover and clearing of individual plants with minimal disturbance to groundcover:
   a) Plants of the species listed in Table 7.1 as requiring retention are to be retained at the densities specified in Table 7.1, except
      I) Where the vegetation is a derived vegetation community; or
      II) As set out in criterion 17A (b);
   b) Where more than one species is present, the total retention requirement for all species does not exceed 20 stems per hectare. If there is more than one species present, the stems retained must reflect the proportion of total individuals for each species present and stems are to be retained for a range of size classes present less than the dbh specified in Table 7.1; and,
   c) Stems retained must represent the proportion of size classes present prior to clearing; and,
   d) The relevant Catchment Management Authority may use its judgement to vary the number of stems per hectare that must be retained as specified by Table 7.1. However, the number of stems per hectare may not be varied to a ratio less than 1 stem under the maximum dbh allowed to be cleared in Table 7.1 to every 1 stem over the maximum dbh allowed to be cleared in Table 7.1, present per hectare for each species present to which this criterion applies. Any such variation does not affect the other requirements of this criterion.

Note:

For the purposes of criterion 17A, the number of plants per hectare means the number of plants on a one hectare area.

18) For the methods of clearing plants at a paddock scale with nil to minimal disturbance to soil and groundcover, clearing plants at a paddock scale with temporary disturbance to soil and groundcover and clearing of plants at paddock scale with longer-term disturbance to soil and groundcover:
   a) a minimum of 20% of the native vegetation on the area to be cleared is retained; and,

b) if more than 500 hectares is to be cleared, then a minimum of 20% of the native vegetation on that area must be retained on each 500 hectare area within or between cleared areas; and
c) the 20% retained native vegetation may not be cleared by any other method; and
d) The retained native vegetation may include invasive native species; and
e) The native vegetation retained for the purposes of this criterion may be included in the calculation of the uncleared area extent of invasive native species on the property for the purposes of criterion 3 to 8.

Note:

1. The 20% retention may be retained in patches or buffers.
2. The intention of this criterion is that, for example, if 750 ha are to be cleared, then the 750 ha area is to be divided into a 500 ha "envelope" and a 250 ha "envelope." At least 100 ha must be retained on the 500 ha envelope and at least 50 ha must be retained on the 250 ha envelope. It is not permissible to retain, for example, 150 ha on the 500 ha envelope and retain nothing on the 250 ha envelope.

18A) For the methods of clearing plants at a paddock scale with nil to minimal disturbance to soil and groundcover, clearing plants at a paddock scale with temporary disturbance to soil and groundcover and clearing of plants at paddock scale with longer-term disturbance to soil and groundcover, if plants of the species listed in Table 7.1 as requiring retention are present:
a) a minimum of 10% of the area of native vegetation on the area to be cleared is retained in patches; and
I) if more than 100 hectares is to be cleared, then a minimum of 10% of the area of native vegetation on that area must be retained on each 100 hectare area; and
II) the areas retained as required by this criterion are additional to the areas retained for the purposes of criteria 3 to 8 and 18;
or
b) plants are retained individually as specified in 17A).

Requirements on how the clearing is to be carried out

The clearing is carried out in accordance with the methods set out below:

19) If clearing by the method of burning:
a) clearing of non-invasive native species is to the minimum extent necessary to clear the invasive native species; and
b) the clearing does not result in soil surface disturbance.

20) If clearing by the method of clearing of individual plants with no disturbance to groundcover:
a) the clearing does not result in soil surface disturbance; and
b) non-invasive native trees and shrubs cleared comprise no more than 1% of the total number of individual trees and shrubs cleared; and
c) any clearing of groundcover is incidental in extent; and
d) the clearing is limited to clearing of individual plants of invasive native species.

21) If clearing by the method of clearing of individual plants with minimal disturbance to soil and groundcover:
a) disturbance to soil surface is to the minimum extent necessary to clear individual plants; and
b) non-invasive native trees and shrubs cleared comprise no more than 1% of the total number of individual trees and shrubs cleared and;

c) the clearing of groundcover is to the minimum extent necessary; and;
d) the clearing is specific to individual plants of invasive native species.

22) If clearing by method of clearing of plants at a paddock scale with nil to minimal disturbance to soil and groundcover:
a) disturbance to soil surface is to the minimum extent necessary; and
b) non-invasive trees and shrubs comprise less than 10% of the total number of individual trees and shrubs cleared; and
c) the clearing of groundcover is to the minimum extent necessary.

23) If clearing by method of clearing plants at a paddock scale with temporary groundcover and soil disturbance:
a) non-invasive trees and shrubs comprise less than 10% of the total number of individual trees and shrubs cleared; and
b) the clearing of groundcover is to the minimum extent necessary; and
c) disturbance to soil surface is limited to the minimum extent necessary to control the invasive native species; and
d) the introduction of non-persistent non-native perennial vegetation listed in Table 7.2 (the species listed in Table 7.2 must also in the judgement of the Catchment Management Authority, be non-persistent in the area where the species is proposed to be introduced) and annual non-native vegetation, is limited to the clearing activity; and
e) any non-native vegetation introduced is not harvested.

24) If clearing by method of clearing of plants at paddock scale with longer-term disturbance to soil and groundcover:
a) the non-invasive trees and shrubs comprise less than 20% of the total number of individual trees and shrubs cleared; and
b) the clearing of groundcover is to the minimum extent necessary to control the invasive native species; and
c) the preparation and sowing of land with annual non-native vegetation and/ or non-persistent non-native perennial vegetation listed in Table 7.2 (the species listed in Table 7.2 must also, in the judgement of the Catchment Management Authority, be non-persistent in the area where the species is proposed to be introduced) is limited to three occasions in 15 years from the date of granting of consent or approval of the Property Vegetation Plan.

Key

In Table 7.1:
"n/a" means not applicable.

In the column headed "Clearing type permitted" and Note (1), the letters "a" to "f" correspond with the clearing types, that is:
a: burning;
b: clearing of individual plants with no disturbance to groundcover (for example, chemical spot treatment or ringbarking);
c: clearing of individual plants with minimal disturbance to groundcover (for example, grubbing);
d: clearing of plants at paddock scale with nil to minimal disturbance to soil and groundcover (for example, chaining, slashing or roping);
e: clearing of plants at paddock scale with temporary disturbance to soil and groundcover (for example, bladeploughing); and
f: clearing of plants at paddock scale with longer-term disturbance to soil and groundcover (for example, short-term cropping).

Table 7.1. Invasive Native Scrub Species Database

The species listed are consistent with the following criteria:

(a) the species invades plant communities where it has not been known to occur previously, **or**
the species regenerates densely following natural or artificial disturbance, **and**

(b) the invasion and/ or dense regeneration of the species results in change of structure and/ or composition of a vegetation community, **and**
the species is within its natural geographic range.

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Border Rivers/Gwydir--BBS	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Border Rivers/Gwydir--BBS	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Border Rivers/Gwydir--BBS	Cassinia arcuata (Sifton Bush)	none prescribed	No	n/a	All
Border Rivers/Gwydir--BBS	Eremophila mitchellii (Budda, False Sandalwood)	none prescribed	No	n/a	All
Border Rivers/Gwydir--BBS	Olearia elliptica (Sticky Daisy Bush, Peach Bush)	none prescribed	No	n/a	All
Border Rivers/ Gwydir--BBS	Cassinia laevis	None prescribed	No	n/a	All
Border Rivers/ Gwydir--BBS	Cassinia quinquefaria	None prescribed	No	n/a	All
Border Rivers/ Gwydir--BBS	Dodonea viscosa subsp. angustissima (Narrowleaf Hopbush)	None prescribed	No	n/a	All
Border Rivers/ Gwydir--BBS	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	None prescribed	No	n/a	All
Border Rivers/Gwydir--BBS	Vachellia farnesiana (Mimosa)	None prescribed	No	n/a	All
Border Rivers/Gwydir--DRP	Acacia stenophylla (River Cooba, Black Wattle)	None prescribed	No	n/a	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Border Rivers/Gwydir--DRP	Acacia salicina (Cooba)	None prescribed	No	n/a	All
Border Rivers/Gwydir--DRP	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Border Rivers/Gwydir--DRP	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Border Rivers/Gwydir--DRP	Eremophila bignoniiflora (Eurah)	none prescribed	No	n/a	All
Border Rivers/Gwydir--DRP	Eremophila maculata (Spotted Fuschia)	none prescribed	No	n/a	All
Border Rivers/Gwydir--DRP	Eremophila longifolia (Emu Bush)	none prescribed	No	n/a	All
Border Rivers/Gwydir--DRP	Eremophila mitchellii (Budda, False Sandalwood)	none prescribed	No	n/a	All
Border Rivers/Gwydir--DRP	Eucalyptus camaldulensis (River Red Gum)	20 (Total under 20cm dbh)	Yes	20cm	All
Border Rivers/Gwydir--DRP	Eucalyptus coolabah (Coolibah)	20 (Total under 20cm dbh)	Yes	20cm	All
Border Rivers/Gwydir--DRP	Eucalyptus largiflorens (Black Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Border Rivers/ Gwydir--DRP	Dodonea viscosa subsp. angustissima (Narrowleaf Hopbush)	None prescribed	No	n/a	All
Border Rivers/ Gwydir--DRP	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	None prescribed	No	n/a	All
Border Rivers/Gwydir--DRP	Vachellia farnesiana (Mimosa)	None prescribed	No	n/a	All
Border Rivers/Gwydir--NAN	Acacia deanei (Deane's Wattle)	none prescribed	No	n/a	All
Border Rivers/Gwydir--NAN	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Border Rivers/Gwydir--NAN	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Border Rivers/Gwydir--NAN	Cassinia arcuata (Sifton Bush)	none prescribed	No	n/a	All
Border Rivers/Gwydir--NAN	Leptospermum brevipes (Grey Teatree, Teatree)	none prescribed	No	n/a	All
Border Rivers/Gwydir--NAN	Olearia elliptica (Sticky Daisy Bush, Peach Bush)	none prescribed	No	n/a	All
Border Rivers/ Gwydir--NAN	Cassinia quinquefaria	None prescribed	No	n/a	All
Border Rivers/ Gwydir--NAN	Cassinia laevis	None prescribed	No	n/a	All
Border Rivers/ Gwydir--NAN	Dodonea viscosa subsp. angustissima (Narrowleaf Hopbush)	None prescribed	No	n/a	All
Border Rivers/ Gwydir--NAN	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	None prescribed	No	n/a	All
Border Rivers/Gwydir--NAN	Vachellia farnesiana (Mimosa)	None prescribed	No	n/a	All
Border Rivers/Gwydir--NET	Leptospermum brevipes (Grey Teatree, Teatree)	none prescribed	No	n/a	All
Border Rivers/ Gwydir--NET	Cassinia laevis	None prescribed	No	n/a	All
Border Rivers/ Gwydir--NET	Cassinia quinquefaria	None prescribed	No	n/a	All
Central West--All	Acacia aneura (Mulga)	20 (Total under 20cm dbh)	Yes	20cm	All
Central West--All	Acacia deanei (Deane's Wattle)	none prescribed	No	n/a	All
Central West--All	Acacia stenophylla (Black Wattle)	none prescribed	No	n/a	All
Central West--All	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Central West--All	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Central West--All	Cassinia arcuata (Sifton Bush)	none prescribed	No	n/a	All
Central West--All	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	none prescribed	No	n/a	All
Central West--All	Dodonea viscosa subsp. angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Central West--All	Eremophila bignoniiflora (Eurah)	none prescribed	No	n/a	All
Central West--All	Eremophila longifolia (Emu Bush)	none prescribed	No	n/a	All
Central West--All	Eremophila mitchellii (Budda, False sandalwood)	none prescribed	No	n/a	All
Central West--All	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Central West--All	Eucalyptus coolabah (Coolibah)	20 (Total under 20cm dbh)	Yes	20cm	All
Central West--All	Eucalyptus largiflorens (Black Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Central West--All	Eucalyptus populnea (Bimble box, Poplar Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Central West--All	Maireana microphylla (Eastern Cotton Bush)	none prescribed	No	n/a	All
Central West--All	Nitraria billardierei (Dillon Bush)	none prescribed	No	n/a	All
Central West--All	Senna form taxon 'artemisoides' (Silver Cassia)	none prescribed	No	n/a	All
Central West--All	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All
Central West--All	Sclerolaena birchii (Galvanised Burr)	none prescribed	No	n/a	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Central West--All	Sclerolaena muricata (Black Rolypoly)	none prescribed	No	n/a	All
Central West--All	Acacia homalophylla (Yarran)	none precribed	No	n/a	All
Central West--All	Geijera parviflora (Wilga)	20 (Total under 20cm dbh)	No	n/a	All
Central West--All	Acacia salicina (Cooba or Native Willow)	None prescribed	Yes	20cm	a-e
Central West--All	Eucalyptus camaldulensis (River Red Gum)	20 (Total under 20cm dbh)	Yes	20cm	a-c
Central West--All	Vachellia farnesiana (Mimosa)	none prescribed	No	n/a	All
Hawkesbury/Nepean--All	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Hawkesbury/Nepean--All	Cassinia arcuata (Sifton Bush)	none prescribed	No	20cm	All
Hawkesbury/Nepean--All	Kunzea ericoides (Burgan)	none prescribed	No	n/a	All
Hawkesbury/Nepean--All	Kunzea parvifolia (Violet Kunzea)	none prescribed	No	n/a	All
Hunter and Central Rivers--All	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Lachlan--All	Acacia deanei (Deane's Wattle)	None prescribed	No	n/a	All
Lachlan--All	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Lachlan--All	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Lachlan--All	Cassinia arcuata (Sifton Bush)	none prescribed	No	n/a	All
Lachlan--All	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Lachlan--All	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	none prescribed	No	n/a	All
Lachlan--All	Eremophila bowmanii subsp. bowmanii (Silver Turkey Bush)	none prescribed	No	n/a	All
Lachlan--All	Eremophila longifolia (Emu Bush)	none prescribed	No	n/a	All
Lachlan--All	Eremophila mitchellii (Budda, False Sandalwood)	none prescribed	No	n/a	All
Lachlan--All	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Lachlan--All	Senna form taxon 'artemisoides' (Silver Cassia)	none prescribed	No	n/a	All
Lachlan--All	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All
Lachlan	Sclerolaena birchii (Galvanised Burr)	None prescribed	No	n/a	All
Lachlan	Sclerolaena muricata (Black Rolypoly)	None prescribed	No	n/a	All
Lower Murray /Darling--All	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Lower Murray /Darling--All	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	none prescribed	No	n/a	All
Lower Murray /Darling--All	Eremophila mitchellii (Budda, False Sandalwood)	none prescribed	No	n/a	All
Lower Murray /Darling--All	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Lower Murray /Darling--All	Senna form taxon 'artemisoides' (Silver Cassia)	none prescribed	No	n/a	All
Lower Murray /Darling--All	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Murray--All	Acacia paradoxa (Kangaroo Thorn)	none prescribed	No	n/a	All
Murray--All	Eucalyptus camaldulensis (River Red Gum)	20 (Total under 20cm dbh)	Yes	20cm	All
Murray--All	Eucalyptus largiflorens (Black Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Murray--All	Sclerolaena muricata (Black Rolypoly)	none prescribed	No	n/a	All
Murray--All	Nitraria billardierei (Dillon Bush)	none prescribed	No	n/a	All
Murrumbidgee--All	Acacia aneura (Mulga)	20 (Total under 20cm dbh)	Yes	20cm	All
Murrumbidgee--All	Acacia stenophylla (River Cooba, Black Wattle)	none prescribed	No	n/a	All
Murrumbidgee--All	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Murrumbidgee--All	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Murrumbidgee--All	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	none prescribed	No	n/a	All
Murrumbidgee--All	Eremophila mitchellii (Budda, False Sandalwood)	none prescribed	No	n/a	All
Murrumbidgee--All	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Murrumbidgee--All	Eucalyptus camaldulensis (River Red Gum)	20 (Total under 20cm dbh)	Yes	20cm	All
Murrumbidgee--All	Senna form taxon 'artemisoides' (Silver Cassia)	none prescribed	No	n/a	All
Murrumbidgee--All	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All
Murrumbidgee	Sclerolaena birchii (Galvanised Burr)	None prescribed	No	n/a	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Namoi--All	Acacia deanei (Deane's Wattle)	none prescribed	No	n/a	All
Namoi--All	Bursaria spinosa (Blackthorn)	none prescribed	No	n/a	All
Namoi--All	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Namoi--All	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Namoi--All	Cassinia arcuata (Sifton Bush)	none prescribed	No	n/a	All
Namoi--All	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Namoi--All	Eucalyptus coolabah (Coolibah)	20 (Total under 20cm dbh)	Yes	20cm	All
Namoi--All	Eucalyptus largiflorens (Black Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Namoi--All	Olearia elliptica (Sticky Daisy Bush, Peach Bush)	none prescribed	No	n/a	All
Namoi--All	Leptospermum brevipes (Grey Teatree, Teatree)	none prescribed	No	n/a	All
Namoi--All	Acacia stenophylla (Black Wattle or River Cooba)	20 (Total under 20cm dbh)	Yes	20cm	All
Namoi--All	Cassinia laevis (Cough Bush)	None prescribed	No	n/a	All
Namoi--All	Cassinia quinquefaria	None prescribed	No	n/a	All
Namoi--All	Casuarina cristata (Belah)	20 (Total under 20cm dbh)	Yes	20cm	a-c
Namoi--All	Dodonea viscosa subsp. angustissima (Narrowleaf Hopbush)	None prescribed	No	n/a	All
Namoi--All	Dodonea viscosa subsp. mucronata	None prescribed	No	n/a	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Namoi--All	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	None prescribed	No	n/a	All
Namoi--All	Eremophila bignoniiflora (Eurah)	None prescribed	No	n/a	All
Namoi--All	Eremophila longifolia (Emu Bush)	None prescribed	No	n/a	All
Namoi--All	Eremophila mitchellii (Budda, False Sandalwood)	None prescribed	No	n/a	All
Namoi--All	Sclerolaena birchii (Galvanised Burr)	None prescribed	No	n/a	All
Namoi--All	Sclerolaena muricata (Black Rolypoly)	None prescribed	No	n/a	All
Namoi--All	Vachellia farnesiana (Mimosa)	none prescribed	No	n/a	All
Southern Rivers--All	Kunzea ericoides (Burgan)	none prescribed	No	n/a	All
Southern Rivers--All	Kunzea parvifolia (Violet Kunzea)	none prescribed	No	n/a	All
Southern Rivers--All	Acacia mearnsii (Black Wattle)	none prescribed	No	n/a	All
Southern Rivers--All	Bursaria spinosa (Blackthorn)	none prescribed	No	n/a	All
Southern Rivers--All	Cassinia arcuata	none prescribed	No	n/a	All
Western--BBS	Acacia aneura (Mulga)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--BBS	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Western--BBS	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Western--BBS	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Western--BBS	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	none prescribed	No	n/a	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Western--BBS	Eremophila mitchellii (Budda, False Sandalwood)	none prescribed	No	n/a	All
Western--BBS	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Western--BBS	Eucalyptus coolabah (Coolibah)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--BBS	Eucalyptus largiflorens (Black Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--BBS	Eucalyptus populnea (Bimble Box, Poplar Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--BBS	Senna form taxon 'artemisoides' (Silver Cassia)	none prescribed	No	n/a	All
Western--BBS	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All
Western--BBS	Casuarina cristata (Belah)	20 (Total under 20cm dbh)	Yes	20cm	a-c
Western--BBS	Eremophila bignoniiflora (Eurah)	None prescribed	No	n/a	All
Western--BBS	Geijera parviflora (Wilga)	20 (Total under 20cm dbh)	n/a	20cm	a-c
Western--BBS	Vachellia farnesiana (Mimosa)	none prescribed	No	n/a	All
Western--BHC	Acacia aneura (Mulga)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--BHC	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Western--BHC	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Western--BHC	Senna form taxon 'artemisioides' (Silver Cassia)	none prescribed	No	n/a	All
Western--BHC	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All
Western--BHC	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	None prescribed	No	n/a	All
Western--BHC	Eremophila mitchellii (Budda)	None prescribed	No	n/a	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Western--DRP	Acacia aneura (Mulga)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--DRP	Acacia stenophylla (Black Wattle)	none prescribed	No	n/a	All
Western--DRP	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Western--DRP	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Western--DRP	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Western--DRP	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	none prescribed	No	n/a	All
Western--DRP	Eremophila longifolia (Emu Bush)	none prescribed	No	n/a	All
Western--DRP	Eremophila mitchellii (Budda, False Sandalwood)	none prescribed	No	n/a	All
Western--DRP	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Western--DRP	Eucalyptus coolabah (Coolibah)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--DRP	Eucalyptus largiflorens (Black Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--DRP	Eucalyptus populnea (Bimble Box, Poplar Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--DRP	Senna form taxon 'artemisoides' (Silver Cassia)	none prescribed	No	n/a	All
Western--DRP	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All
Western--DRP	Casuarina cristata (Belah)	20 (Total under 20cm dbh)	Yes	20cm	a-c
Western--DRP	Eremophila bignoniiflora (Eurah)	None prescribed	No	n/a	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Western--DRP	Muehlenbeckia cunninghammi (Lignum)**	None prescribed	No	n/a	a
Western--DRP	Sclerolaena birchii (Galvanised Burr)	None prescribed	No	n/a	All
Western--DRP	Sclerolaena muricata (Black Rolypoly)	None prescribed	No	n/a	All
Western--DRP	Vachellia farnesiana (Mimosa)	none prescribed	No	n/a	All
Western--CC	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Western--CC	Eremophila duttonii (Harlequin Fuchsia Bush)	none prescribed	No	n/a	All
Western--CC	Eremophila mitchellii (Budda, False Sandalwood)	none prescribed	No	n/a	All
Western--CC	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Western--CC	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All
Western--CP	Acacia aneura (Mulga)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--CP	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Western--CP	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Western--CP	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Western--CP	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	none prescribed	No	n/a	All
Western--CP	Eremophila longifolia (Emu Bush)	none prescribed	No	n/a	All
Western--CP	Eremophila mitchellii (Budda, False Sandalwood)	none prescribed	No	n/a	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Western--CP	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Western--CP	Eucalyptus populnea (Bimble Box, Poplar Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--CP	Senna form taxon 'artemisoides' (Silver Cassia)	none prescribed	No	n/a	All
Western--CP	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All
Western--CP	Acacia homalophylla (Yarran)	none prescribed	No	n/a	All
Western--CP	Geijera parviflora (Wilga)	20 (Total under 20cm dbh)	No	20cm	All
Western--CP	Eucalyptus intertexta (Red Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--CP	Sclerolaena birchii (Galvanised Burr)	None prescribed	No	n/a	All
Western--ML	Acacia aneura (Mulga)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--ML	Acacia stenophylla (Black Wattle)	None prescribed	No	n/a	All
Western--ML	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Western--ML	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Western--ML	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Western--ML	Eremophila duttonii (Harlequin Fuchsia Bush)	none prescribed	No	n/a	All
Western--ML	Eremophila gilesii (Green Turkey-bush)	none prescribed	No	n/a	All
Western--ML	Eremophila longifolia (Emu Bush)	none prescribed	No	n/a	All
Western--ML	Eremophila mitchellii (Budda, False Sandalwood)	none prescribed	No	n/a	All

Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Western--ML	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Western--ML	Eucalyptus populnea (Bimble Box, Poplar Box)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--ML	Senna form taxon 'artemisoides' (Silver Cassia)	none prescribed	No	n/a	All
Western--ML	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All
Western--ML	Acacia homalophylla (Yarran)	none prescribed	No	n/a	All
Western--ML	Geijera parviflora (Wilga)	20 (Total under 20cm dbh)	No	20cm	All
Western--ML	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	None prescribed	No	n/a	All
Western--ML	Eremophila bowmanii subsp. bowmanii (Silver Turkey Bush)	None prescribed	No	n/a	All
Western--ML	Muehlenbeckia florulenta (Lignum)**	None prescribed	No	n/a	a
Western--MDD	Acacia aneura (Mulga)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--MDD	Callitris glaucophylla (White Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Western--MDD	Callitris endlicheri (Black Cypress)	20 (Total under 20cm dbh)	No	20cm	All
Western--MDD	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Western--MDD	Eremophila mitchellii (Budda, False Sandalwood)	none prescribed	No	n/a	All
Western--MDD	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Western--MDD	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All

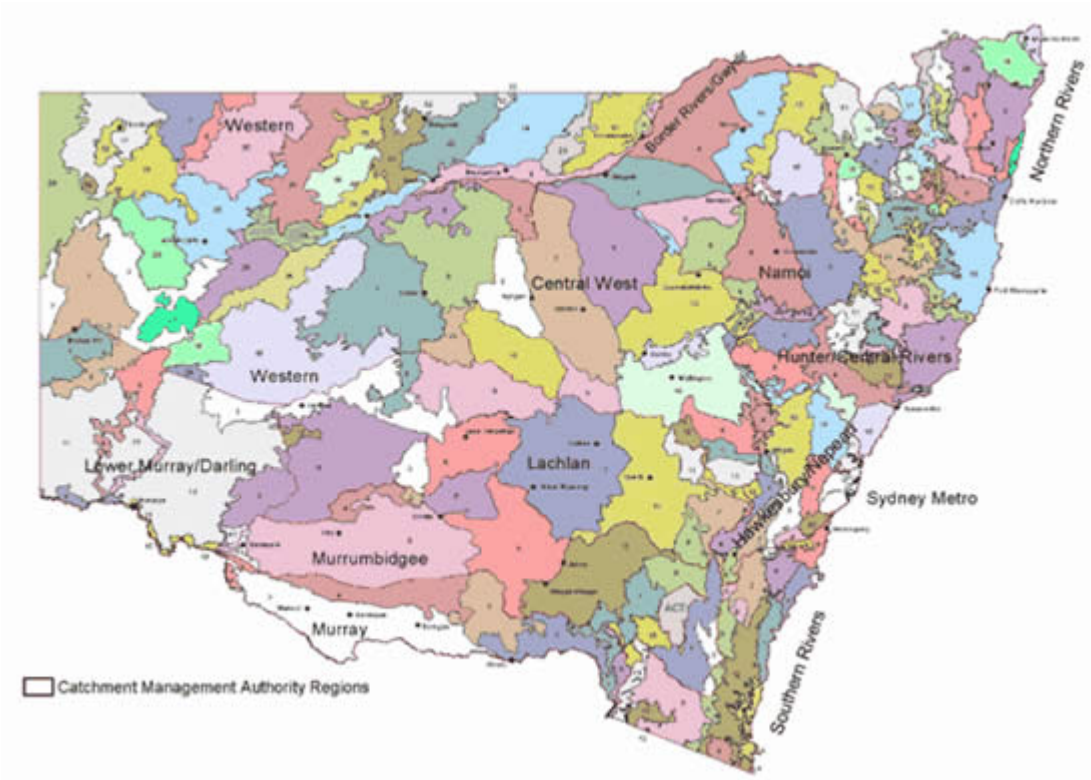
Catchment Management Authority – IBRA region	Invasive Native Species	Retention requirements			INS type of clearing permitted
		Number of plants per hectare to be retained	Retention required by criterion 18A (clearing types d-f only)	Maximum dbh allowed to be cleared	
Western--MDD	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	None prescribed	No	n/a	All
Western--MDD	Senna form taxon ‘artemisoides’(Silver Cassia)	None prescribed	No	n/a	All
Western--SSD	Acacia aneura (Mulga)	20 (Total under 20cm dbh)	Yes	20cm	All
Western--SSD	Dodonea viscosa subsp angustissima (Narrowleaf Hopbush)	none prescribed	No	n/a	All
Western--SSD	Eremophila sturtii (Turpentine)	none prescribed	No	n/a	All
Western--SSD	Senna form taxon 'artemisoides' (Silver Cassia)	none prescribed	No	n/a	All
Western--SSD	Senna form taxon 'filifolia' (Punty Bush)	none prescribed	No	n/a	All
Western--SSD	Dodonea viscosa subsp. spatulata (Broadleaf Hopbush)	None prescribed	No	n/a	All
Note (1): For clearing types (d), (e) and (f), 20cm. For all other clearing types, no maximum dbh is applicable.					

Table 7.2. Non-persistent and Non-native Perennial Species Database

Non-persistent non-native perennial vegetation species
Medicago sativa (Lucerne)

APPENDICES

Appendix A. Sub-regions of NSW Catchment Management Authority Areas



Sub-regions of NSW Catchment Management Authority Areas Key to map	
Border Rivers/Gwydir	
1	Beardy River Hills
2	Binghi Plateau
3	Bundarra Downs
4	Castlereagh-Barwon
5	Deepwater Downs
6	Eastern Nandewars
7	Glenn Innes-Guyra Basalts
8	Inverell Basalts
9	Kaputar
10	Moredun Volcanics
11	Nandewar, Northern Complex
12	Northeast Forest Lands
13	Northern Basalts
14	Northern Outwash
15	Peel
16	Severn River Volcanics
17	Tenterfield Plateau
18	Tingha Plateau
19	Yarrowyck-Kentucky Downs

Central West	
1	Bathurst
2	Bogan-Macquarie
3	Canbelego Downs
4	Capertee
5	Castlereagh-Barwon
6	Hill End
7	Kerrabee
8	Liverpool Range
9	Lower Slopes
10	Nymagee-Rankins Springs
11	Oberon
12	Orange
13	Pilliga
14	Pilliga Outwash
15	Talbragar Valley
16	Upper Slopes
17	Wollemi
Hawkesbury/Nepean	
1	Bathurst
2	Bungonia
3	Burragorang
4	Capertee
5	Crookwell
6	Cumberland
7	Kanangra
8	Monaro
9	Moss Vale
10	Oberon
11	Pittwater
12	Sydney Cataract
13	Wollemi
14	Yengo
Hunter/Central Rivers	
1	Barrington
2	Comboyne Plateau
3	Ellerston
4	Hunter
5	Karuah Manning
6	Kerrabee
7	Liverpool Range
8	Macleay Hastings
9	Mummel Escarpment
10	Pilliga
11	Tomalla
12	Upper Hunter
13	Walcha Plateau
14	Wollemi
15	Wyong
16	Yengo

Lachlan	
1	Barnato Downs
2	Crookwell
3	Darling Depression
4	Kanangra
5	Lachlan
6	Lachlan Plains
7	Lower Slopes
8	Murrumbateman
9	Nymagee-Rankins Springs
10	Oberon
11	Orange
12	South Olary Plain, Murray Basin Sands
13	Upper Slopes
Lower Murray/ Darling	
1	Barrier Range
2	Barrier Range Outwash, Fans and Plains
3	Darling Depression
4	Great Darling Anabranch
5	Lachlan
6	Menindee
7	Murray Scroll Belt
9	Pooncarie-Darling
10	Robinvale Plains
11	South Olary Plain, Murray Basin Sands
Murray	
1	Bondo
2	Lower Slopes
3	Murray Fans
4	Murrumbidgee
5	New South Wales Alps
6	South Olary Plain, Murray Basin Sands
7	Upper Slopes
Murrumbidgee	
1	Bondo
2	Darling Depression
3	Kybeyan - Gourock
4	Lachlan
5	Lachlan Plains
6	Lower Slopes
7	Monaro
8	Murrumbateman
9	Murrumbidgee
10	New South Wales Alps
11	South Olary Plain, Murray Basin Sands
12	Upper Slopes
Namoi	
1	Castlereagh-Barwon
2	Eastern Nandewars

3	Kaputar
4	Liverpool Plains
5	Liverpool Range
6	Northern Basalts
7	Peel
8	Pilliga
9	Pilliga Outwash
10	Walcha Plateau
Northern Rivers	
1	Armidale Plateau
2	Carrai Plateau
3	Cataract
4	Chaelundi
5	Clarence Lowlands
6	Clarence Sandstones
7	Coffs Coast & Escarpment
8	Comboyne Plateau
9	Dalmorton
10	Ebor Basalts
11	Glenn Innes-Guyra Basalts
12	Guy Fawkes
13	Macleay Gorges
14	Macleay Hastings
15	Murwillumbah (Qld - Southeast Hills and Ranges)
16	Nightcap
17	Northeast Forest Lands
18	Richmond - Tweed (Qld - Scenic Rim)
19	Rocky River Gorge
20	Round Mountain
21	Stanthorpe Plateau
22	Upper Manning
23	Walcha Plateau
24	Washpool
25	Wongwibinda Plateau
26	Woodenbong
27	Yuraygir
Southern Rivers	
1	Bateman
2	Bungonia
3	Burragorang
4	East Gippsland Lowlands (EGL)
5	Ettrema
6	Illawarra
7	Jervis
8	Kybeyan - Gourock
9	Monaro
10	Moss Vale
11	New South Wales Alps
12	South East Coastal Ranges
13	South East Coastal Plains

Western	
1	Barnato Downs
2	Barrier Range
3	Barrier Range Outwash, Fans and Plains
4	Bogan-Macquarie
5	Boorindal Plains
6	Bulloo Dunefields
7	Bulloo Overflow
8	Canbelego Downs
9	Castlereagh-Barwon
10	Central Depression
11	Central Downs - Fringing Tablelands and Downs
12	Core Ranges
13	Core Ranges
14	Culgoa-Bokhara
15	Darling Depression
16	Kerribree Basin
17	Louth Plains
18	Menindee
19	Moonie - Barwon Interfluve, Collarenebri Interfluve
20	Mootwingee Downs
21	Narrandool
22	Nebine Plains, Block Range
23	Nymagee-Rankins Springs
24	Paroo Overflow
25	Paroo Sand Sheets, Cuttaburra-Paroo
26	Paroo-Darling Sands
27	Scopes Range
28	South Olary Plain, Murray Basin Sands
29	Strzelecki Desert, Western Dunefields
30	Urisino Sandplains
31	Warrambool-Moonie
32	Warrego Plains
33	Warrego Sands
34	West Warrego - Tablelands and Downs
35	White Cliffs Plateau
36	Wilcannia Plains

Appendix B. Management Actions Specified by the Clearing Module of the LSC Tool for Assessed Land Degradation Hazards to Pass the Improve or Maintain Test.

Hazard	Class	Management Action
Salinity	3	Run the Salinity Benefits Index Tool to ensure no net disbenefit
Salinity	3	Run the Salt Mobilisation Tool to ensure no net disbenefit
Salinity	4	Run the Salinity Benefits Index Tool to ensure no net disbenefit
Salinity	4	Run the Salt Mobilisation Tool to ensure no net disbenefit
Salinity	5	Run the Salinity Benefits Index Tool to ensure no net disbenefit
Salinity	5	Run the Salt Mobilisation Tool to ensure no net disbenefit
Salinity	6	Run the Salinity Benefits Index Tool to ensure no net disbenefit
Salinity	6	Run the Salt Mobilisation Tool to ensure no net disbenefit
Water Erosion	3	Use conservation farming practices &/or erosion control earthworks
Water Erosion	3	If cropping: no burning of stubble, use controlled traffic, minimal cultivation, adequate fertiliser, direct seeding
Water Erosion	3	If cropping very long slopes in the Border Rivers / Gwydir, Namoi or Central West CMAs: use strip cropping
Water Erosion	3	If grazing: use suitable pasture rotations & manage grazing to maintain groundcover and pasture composition
Water Erosion	3	If cropping or grazing: use soil ameliorants where required (gypsum, lime)
Water Erosion	4	If cropping: use conservation farming practices
Water Erosion	4	If cropping: no burning of stubble, use controlled traffic, minimal cultivation, adequate fertiliser, direct seeding
Water Erosion	4	If grazing: use suitable pasture rotations & adequate fertiliser & manage grazing to maintain groundcover and pasture composition
Water Erosion	4	If cropping or grazing: use soil ameliorants where required (gypsum, lime)
Water Erosion	5	No cultivation or cropping
Water Erosion	5	If grazing: use suitable pasture rotations & adequate fertiliser & manage grazing to maintain groundcover and pasture composition
Water Erosion	5	Use earthworks to control erosion and intercept sediment
Water Erosion	6	No cultivation or cropping
Water Erosion	6	If clearing or thinning in the Coastal Tablelands and Slopes: no soil disturbance and no removal of cut or fallen timber
Water Erosion	6	If grazing: use controlled grazing, suitable pasture rotations, adequate fertiliser & maintain groundcover
Wind Erosion	3	Use conservation farming practices
Wind Erosion	3	If cropping: no burning of stubble, maintain 50% groundcover, minimal cultivation with reduced speed of implements, adequate fertiliser, direct seeding
Wind Erosion	3	If grazing: use controlled grazing, minimal cultivation to establish pasture and suitable pasture rotations
Wind Erosion	3	If cropping or grazing: install wind breaks
Wind Erosion	4	Use conservation farming practices
Wind Erosion	4	If cropping: limited to 3 years in 10

Hazard	Class	Management Action
Wind Erosion	4	If cropping: no burning of stubble, maintain 50% groundcover, minimal cultivation with reduced speed of implements, adequate fertiliser, direct seeding
Wind Erosion	4	If grazing: use controlled grazing, minimal cultivation to establish pasture and suitable pasture rotations
Wind Erosion	4	If cropping or grazing: install wind breaks
Wind Erosion	5	No cultivation or cropping
Wind Erosion	5	If grazing: manage pasture to maintain groundcover, including use of adequate fertiliser
Wind Erosion	6	No cultivation or cropping
Wind Erosion	6	If grazing: manage to maintain groundcover, including use of adequate fertiliser
Soil Structure Decline	3	Use conservation farming practices
Soil Structure Decline	3	If cropping: no stubble burning (retain and incorporate stubble), and use controlled traffic, minimal cultivation, direct seeding, adequate fertiliser, adequate soil ameliorant (lime), & recommended rotation and length of pasture phases
Soil Structure Decline	3	If grazing: use controlled grazing, manage pasture to maintain groundcover and biomass to protect soil structure, adequate soil ameliorant (lime)
Soil Structure Decline	4	Use conservation farming practices
Soil Structure Decline	4	If cropping: limited to 3 years in 10
Soil Structure Decline	4	If cropping: no stubble burning (maintain 50% groundcover), controlled traffic, reduced speed of cultivation, minimal cultivation, direct seeding, adequate fertiliser, adequate soil ameliorant (lime)
Soil Structure Decline	4	If grazing: use controlled grazing, suitable pasture rotations, manage pasture to maintain groundcover and biomass to protect soil structure, use adequate fertiliser & soil ameliorant (lime)
Soil Structure Decline	5	No cultivation or cropping
Soil Structure Decline	5	If grazing: manage pasture to maintain groundcover and biomass to protect soil structure, use adequate fertiliser & soil ameliorant (lime)
Soil Structure Decline	6	No cultivation or cropping
Soil Structure Decline	6	If grazing: manage pasture to maintain groundcover and biomass to protect soil structure, use adequate fertiliser & soil ameliorant (lime)
Shallow & Rocky Soils	4	No cropping
Shallow & Rocky Soils	4	If grazing: manage pasture to maintain ground cover, including use of adequate fertiliser
Shallow & Rocky Soils	5	No cultivation or cropping
Shallow & Rocky Soils	5	If grazing: manage pasture to maintain ground cover, including use of adequate fertiliser

Hazard	Class	Management Action
Shallow & Rocky Soils	6	No cultivation or cropping
Shallow & Rocky Soils	6	If grazing: manage pasture to maintain ground cover, including use of adequate fertiliser
Acid Sulfate Soils	3	No soil disturbance or drainage deeper than 3 metres
Acid Sulfate Soils	4	No soil disturbance or drainage deeper than 1 metre
Acid Sulfate Soils	5	No soil disturbance or drainage deeper than 0.5 metre
Earth Mass Movement	3	No concentration of surface or subsurface water flow
Earth Mass Movement	3	No excavation batters >2.5 metres without geotechnical design & batter angles <3:1
Earth Mass Movement	3	Maintain groundcover to maximise water use & bind soil
Earth Mass Movement	6	No concentration of surface or subsurface water flow
Earth Mass Movement	6	No excavation batters >1.5 metres without geotechnical design & batter angles <3:1
Earth Mass Movement	6	Subsurface drainage required
Earth Mass Movement	6	Maintain groundcover, especially deep-rooted plants, to maximise water use & bind soil

Appendix C. Management Actions Specified by the Offsets Module of the LSC Tool for Assessed Land Degradation Hazards to Pass the Improve or Maintain Test.

Hazard	Class	Management Action
Water Erosion	4	If establishing perennial pastures, use only direct seeding with minimal soil disturbance
Water Erosion	4	If planting trees for native vegetation regeneration, all cultivation or deep ripping must follow the contour
Water Erosion	5	If establishing perennial pastures, use only broadcast seeding without cultivation or soil disturbance
Water Erosion	5	If planting individual trees or broadcast seeding for native vegetation regeneration, deep ripping or extensive soil disturbance should not be used
Water Erosion	6	If establishing perennial pastures, use only broadcast seeding without cultivation or soil disturbance
Water Erosion	6	If planting individual trees or broadcast seeding for native vegetation regeneration, deep ripping or extensive soil disturbance should not be used
Water Erosion	7	Regeneration of native vegetation only to be undertaken by fencing and natural regeneration or broadcast seeding
Water Erosion	8	Regeneration of native vegetation only to be undertaken by fencing and natural regeneration or broadcast seeding
Wind Erosion	4	If establishing perennial pastures, use only direct seeding with minimal soil disturbance
Wind Erosion	4	If planting trees for native vegetation regeneration, all cultivation or deep ripping must follow the contour
Wind Erosion	5	If establishing perennial pastures, use only broadcast seeding without cultivation or soil disturbance
Wind Erosion	5	If planting individual trees or broadcast seeding for native vegetation regeneration, deep ripping or extensive soil disturbance should not be used
Wind Erosion	6	If establishing perennial pastures, use only broadcast seeding without cultivation or soil disturbance
Wind Erosion	6	If planting individual trees or broadcast seeding for native vegetation regeneration, deep ripping or extensive soil disturbance should not be used
Wind Erosion	7	Regeneration of native vegetation only to be undertaken by fencing and natural regeneration or broadcast seeding
Wind Erosion	8	Regeneration of native vegetation only to be undertaken by fencing and natural regeneration or broadcast seeding
Soil Structure	4	If establishing perennial pastures, use only direct seeding with minimal soil disturbance
Soil Structure	4	If planting trees for native vegetation regeneration, all cultivation or deep ripping must follow the contour
Soil Structure	7	Regeneration of native vegetation only to be undertaken by fencing and natural regeneration or broadcast seeding
Soil Structure	8	Regeneration of native vegetation only to be undertaken by fencing and natural regeneration or broadcast seeding

Hazard	Class	Management Action
Rockiness & Shallow Soils	4	If establishing perennial pastures, use only direct seeding with minimal soil disturbance
Rockiness & Shallow Soils	4	If planting trees for native vegetation regeneration, all cultivation or deep ripping must follow the contour
Rockiness & Shallow Soils	5	If establishing perennial pastures, use only broadcast seeding without cultivation or soil disturbance
Rockiness & Shallow Soils	5	If planting individual trees or broadcast seeding for native vegetation regeneration, deep ripping or extensive soil disturbance should not be used
Rockiness & Shallow Soils	6	If establishing perennial pastures, use only broadcast seeding without cultivation or soil disturbance
Rockiness & Shallow Soils	6	If planting individual trees or broadcast seeding for native vegetation regeneration, deep ripping or extensive soil disturbance should not be used
Rockiness & Shallow Soils	7	Regeneration of native vegetation only to be undertaken by fencing and natural regeneration or broadcast seeding
Rockiness & Shallow Soils	8	Regeneration of native vegetation only to be undertaken by fencing and natural regeneration or broadcast seeding
Acid Sulfate Soils	4	If establishing perennial pastures, use only direct seeding with minimal soil disturbance
Acid Sulfate Soils	4	If planting trees for native vegetation regeneration, all cultivation or deep ripping must follow the contour
Acid Sulfate Soils	5	If establishing perennial pastures, use only broadcast seeding without cultivation or soil disturbance
Acid Sulfate Soils	5	If planting individual trees or broadcast seeding for native vegetation regeneration, deep ripping or extensive soil disturbance should not be used
Acid Sulfate Soils	7	Regeneration of native vegetation only to be undertaken by fencing and natural regeneration or broadcast seeding
Acid Sulfate Soils	8	Regeneration of native vegetation only to be undertaken by fencing and natural regeneration or broadcast seeding
Salinity	3	Run the Salinity Benefits Index Tool to ensure no net disbenefit
Salinity	4	Run the Salinity Benefits Index Tool to ensure no net disbenefit
Salinity	5	Run the Salinity Benefits Index Tool to ensure no net disbenefit
Salinity	6	Run the Salinity Benefits Index Tool to ensure no net disbenefit
Salinity	7	Run the Salinity Benefits Index Tool to ensure no net disbenefit
Salinity	8	Run the Salinity Benefits Index Tool to ensure no net disbenefit