Managing grazing on riparian land

Decision support tool and guidelines

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Front cover: Fenced riparian land, Loddon River, NW Victoria.
Photo courtesy: North Central Catchment Management Authority

Contents

1 Introduction 1

1.1 Grazing and riparian management 1
1.2 Purpose of this publication 1
1.3 How DEPI developed this publication 2
1.4 Acknowledgements 2

2 Decision support tool 4

2.1 Step 1: Assess the project site 5
2.2 Step 2: Identify the site's vegetation state 6
2.3 Step 3: Assess and choose a grazing management option 10
2.4 Step 4: Implement the chosen option 11
2.4.1 Maintain the existing livestock grazing regime 11
2.4.2 Control the livestock grazing regime 11
2.4.3 Exclude livestock grazing 13
2.4.4 Exclude livestock grazing and revegetate 13
2.5 Step 5: Monitor and evaluate the site 14

3 Grazing management options by vegetation state 15

3.1 Pre-European 15
3.1.1 Characteristics 15
3.1.2 Grazing management options 15
3.1.3 Grazing management options decision tree 16
3.2 Quality Remnant 16
3.2.1 Characteristics 16
3.2.2 Grazing management options 17
3.2.3 Grazing management options decision tree 18
3.3 Modified Remnant 20
3.3.1 Characteristics 20
3.3.2 Grazing management options 20
3.3.3 Grazing management options decision tree 23
3.3.4 Controlled grazing guidelines to maintain *Modified Remnant* 25
3.4 Young Overstorey 28
3.4.1 Characteristics 28
3.4.2 Grazing management options 28
3.4.3 Grazing management options decision tree 30
3.4.4 Controlled grazing guidelines to improve *Young Overstorey* to *Modified Remnant* 33
3.5 Native Grassy 38
3.5.1 Characteristics 38
3.5.2 Grazing management options 38
3.5.3 Grazing management options decision tree 41
3.5.4 Controlled grazing guidelines for *Native Grassy* 44

3.6 Mature Overstorey 48
3.6.1 Characteristics 48
3.6.2 Grazing management options 48
3.6.3 Grazing management options decision tree 50
3.6.4 Controlled grazing guidelines to maintain *Mature Overstorey* 51
3.7 Single-Aged Young Overstorey 56
3.7.1 Characteristics 56
3.7.2 Grazing management options 56
3.7.3 Grazing management options decision tree 57
3.8 Shrubby 59
3.8.1 Characteristics 59
3.8.2 Grazing management options 59
3.8.3 Grazing management options decision tree 61
3.9 Exotic Pasture/Herbaceous 62
3.9.1 Characteristics 62
3.9.2 Grazing management options 62
3.9.3 Grazing management options decision tree 64
3.9.4 Controlled grazing guidelines to maintain *Exotic Pasture/Herbaceous* 65
3.10 Exotic Woody 67
3.10.1 Characteristics 67
3.10.2 Grazing management options 67
3.10.3 Grazing management options decision tree 68
3.10.4 Controlled grazing guidelines to maintain *Exotic Woody* 70
3.11 Revegetation 72
3.11.1 Characteristics 72
3.11.2 Grazing management options 72

4 References 74

5 Appendix A: Representative photos for vegetation states 75

5.1 Quality Remnant 75
5.2 Modified Remnant 76
5.3 Young Overstorey 77
5.4 Native Grassy 78
5.5 Mature Overstorey 79
5.6 Single-Aged Young Overstorey 80
5.7 Shrubby 81
5.8 Exotic Pasture/Herbaceous 82
5.9 Exotic Woody 83
5.10 Revegetation 84

6 Appendix B: Grazing management options field assessment sheet 85

7 Appendix C: Grazing management record sheet 88

1 Introduction

1.1 Grazing and riparian management

As part of its Waterway Management Program, the Victorian State Government each year allocates millions of dollars to riparian protection and improvement projects. These projects involve catchment management authorities (CMAs) working collaboratively with landholders (including Crown frontage licensees) to undertake works such as fencing, revegetation, weed management and providing infrastructure to support off-stream stock watering. Other programs, such as Landcare, also support riparian projects.

However, excessive growth of pasture grass and weeds can become a problem on some fenced and revegetated riparian land from which grazing is excluded. Landholders can form a view that fenced-off sites are weed-infested, and as a result can be reluctant to participate in CMA programs to protect and improve riparian sites. They may also want to continue grazing to manage excessive grass and weed growth.

Grazing can also have other environmental benefits. For example, short-duration, intense, livestock grazing can help to open up a dense indigenous grass ground layer, which can allow the establishment of many indigenous herbs and forbs.

While grazing—controlled and uncontrolled—can manage excessive weed growth and promote indigenous herb growth in some situations, it can also be a major degrading factor on riparian land. For example:

- using grazing to reduce weeds and excessive grass growth can compact the soil and increase nutrient levels, which in turn may exacerbate weed invasion
- grazing may further degrade the vegetation the riparian programs are trying to protect.

1.2 Purpose of this publication

Publications are available with general guidance about factors to consider when establishing a controlled grazing regime, if it is decided to do so. Typically, they discuss the timing, duration and intensity of grazing. However, they do not provide information to use on-ground; they do not consider whether grazing should occur at all; and they do not indicate what the grazing regime should be. This publication intends to fill these gaps by providing more detailed on-ground advice about using controlled grazing as a riparian management tool.

This publication provides CMAs—and other waterway and natural resource managers interested or involved in riparian management—with a user-friendly, objective, robust and defensible decision support tool to help them determine the impact, suitability and acceptability of controlled grazing on riparian land (land that adjoins a waterway, such as a creek, river, lake or wetland). Specifically, the publication addresses the management of riparian land that forms a narrow strip—20–40 m from the waterway—within the broader agricultural landscape. The publication should be useful when:

- developing protection and improvement projects for riparian land
- entering into landholder agreements (that define the roles and responsibilities of all parties) to implement management activities to protect or improve a riparian project site
- deciding about Crown land water frontage[1] licence applications, renewals and transfers.

If you identify controlled grazing as an acceptable or beneficial management option, this publication also provides guidelines about when and how to use it, as well as factors to consider.

1 Crown land water frontage is any strip of Crown land that runs alongside a river or stream: it can be from 20 to 100 metres or more wide.

1.3 How DELWP developed this publication

In 2008, the then Department of Sustainability and Environment (DSE)—now the Department of Environment, Land, Water and Planning (DELWP)—commissioned Water Technology to investigate the use of controlled grazing as a riparian management tool. Water Technology reviewed the impacts of grazing on riparian land (Water Technology, 2009) and developed a generic riparian state-and-transition model that forms the basis for the decision-making approach explained in this publication.

In 2011, DSE commissioned Riverness Pty Ltd to adapt and field trial Water Technology's work, to develop a practical on-ground riparian management tool. In the same year, DSE also published *Vegetation Work Standards*[2], which has subsequently been updated and published as the *Output Delivery Standards*[3].

These standards include guidance about:

- ecological grazing as a way (by managing biomass) of maintaining or enhancing the cover and diversity of native plants
- using livestock to reduce weed cover.

This publication takes account of the guidance about ecological grazing.

In 2016, this publication underwent a minor revision in response to a 2015 evaluation of these guidelines and decision support tool. The main changes were the revision of the grazing management options field assessment sheet (Appendix B) and the addition of a grazing management record sheet for landholders (Appendix C). A field companion was also developed[4].

1.4 Acknowledgements

This publication is the result of a collective effort, in two phases from 2008 to 2012, by several authorities and individuals.

The 2008–2009 phase

DELWP would like to acknowledge the work of the consultant, Water Technology, and particularly Dr Steve Hamilton and Ms Sally Day.

In particular, the department thanks:

- the Project Steering Committee, comprising Kirsty Hopkins, Peter Vollebergh and Yvonne Ingeme (River Health, DSE, consecutive project managers), Natalie Ord (North East CMA), Tom O'Dwyer (Goulburn Broken CMA), Jon Leevers (North Central CMA), Anthony Costigan and Rick Lawson (Crown Land Management, DSE Bairnsdale) and James Todd (Biodiversity and Ecosystem Services, DSE)
- catchment management authorities for their comments on draft documents
- Christine Glassford (Goulburn Broken CMA) for practical advice during the field-based steering committee meeting.

[2] Department of Sustainability and Environment (2011)

[3] Department of Environment, Land, Water and Planning (2015)

[4] Department of Environment, Land, Water and Planning (2016)

The 2011–2012 phase

DELWP would like to acknowledge the work of the consultant, Riverness Pty Ltd, and particularly Mr Greg Peters.

In particular, the department thanks:

- the Project Steering Committee, comprising Peter Vollebergh (River and Wetland Health, DSE, Project Manager), Adam Bester (Glenelg Hopkins CMA), Peter Kelly (Mallee CMA), Adrian Martins (North Central CMA), Veronica Lanigan (North East CMA), Jacqui Norris (Wimmera CMA), Sam Marwood (Natural Resources, DSE) and Angela Robb (Biodiversity and Ecosystem Services, DSE).
- catchment management authorities and Melbourne Water for:
- responding to surveys
- assisting in field trials to test the decision support tool and guidelines
- commenting on draft reports, and contributing valuable hands-on knowledge and experience applying controlled grazing techniques
- staff of DSE and the then Department of Primary Industries for providing technical advice and for reviewing draft reports.

The department also thanks the members of the Riparian Technical Working Group for their input, in both phases, from the start to finish of the project.

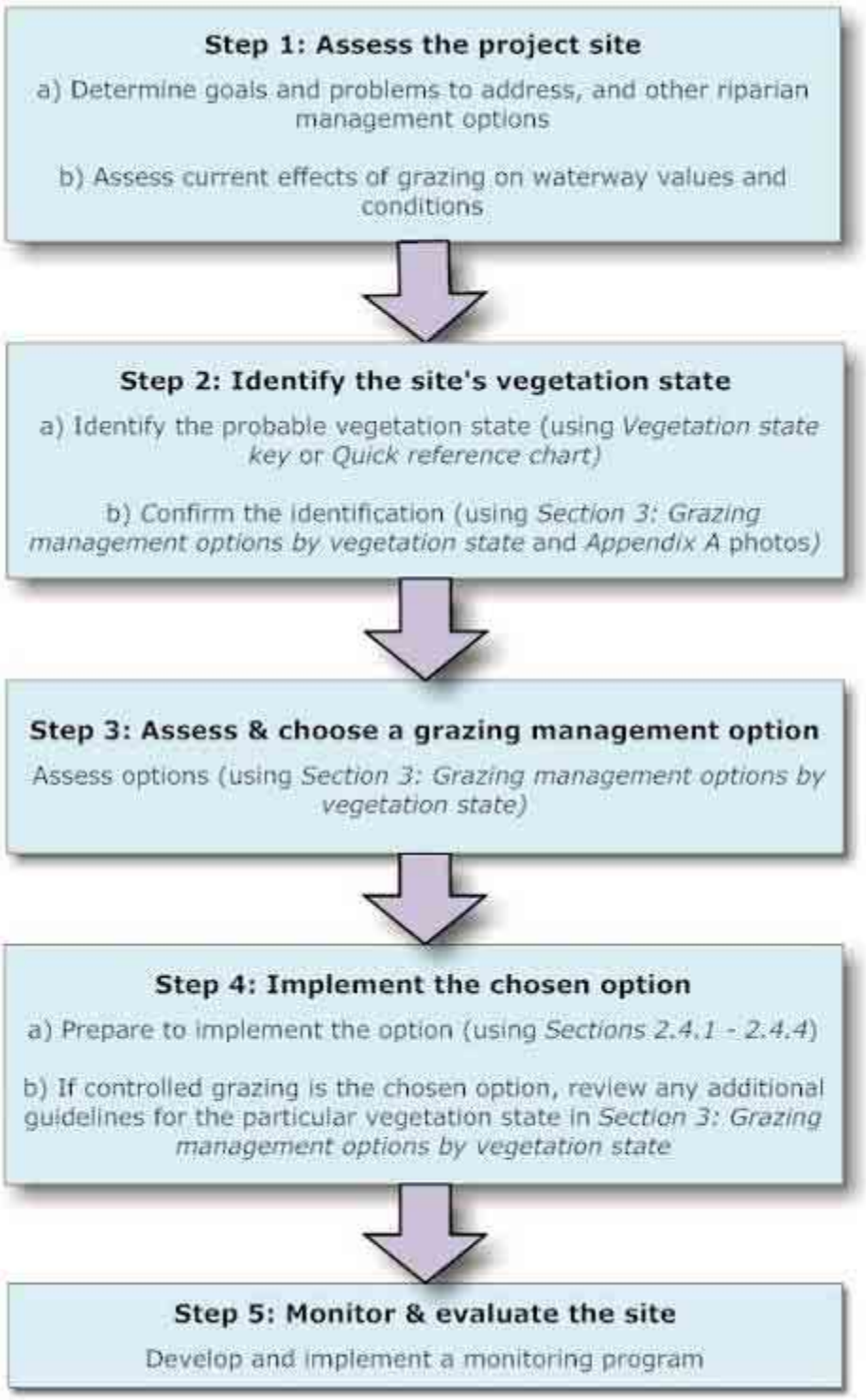
The 2016 revision

DELWP would like to acknowledge the work of the consultant, Riverness Pty Ltd, and particularly Ms Bron Gwyther. The department also would like to thank David Nichols (Glenelg Hopkins CMA) for his contribution to the updated field assessment sheet and grazing management record sheet as well as catchment management authorities for participating in the evaluation that led to the revision.

2 Decision support tool

Figure 2.1 shows the five steps to determine the most suitable grazing management option for a riparian project site.

Figure 2.1 - Five-step grazing management decision support tool



2.1 Step 1: Assess the project site

In this step, you gain information about the project site. This will help you decide if some form of livestock grazing is a viable management option, and, if so, how site characteristics could shape your implementation of the option.

First, determine:

- the goal (or ecological objective) for the site
- the problems you are seeking to address
- other riparian management options and methods (as well as, or in place of, grazing) to determine if they would:
  - be effective in treating the problems
  - be practical in treating the problems
  - create risks to either on-site or off-site values.

Second, assess the current effects of grazing on waterway values and conditions (including water quality, aquatic macrophytes, terrestrial flora and/or fauna species, streambank stability and riparian width).

You can use the *Grazing management options field assessment sheet* (Appendix B) to document this information.

The likely effects of grazing on waterway values and conditions are important considerations when deciding a management option. The decision trees in this publication take terrestrial threatened species and streambank stability into account, for each particular vegetation state. Before using the decision support tool, you should also consider the impact of grazing on water quality and aquatic macrophytes, and the width of the project site.

At some sites, these values and conditions may be so important for site goals that you must exclude grazing and protect the waterway from stock, regardless of whether maintaining or implementing a controlled grazing regime would otherwise be tolerable, acceptable or even beneficial.

Water quality

If water quality is a major issue, you should exclude livestock from a site, irrespective of the potential impacts on other values. The manure and urine of livestock directly contribute large quantities of phosphorus and nitrogen to rivers and streams. They are also a major source of pathogens, which increase the risk of human diseases if upstream of drinking water off-takes and pose health risks for animals that drink downstream. Animal wastes that foul tributary streams above the catchments of dams and reservoirs can also greatly increase treatment costs for downstream users. Also, streambanks with bare soil and compacted walking tracks and pads resulting from overgrazing—severe and repeated grazing during a plant's active growing period that results in it producing less vegetation, and ultimately dying—contribute large amounts of soil and nutrients to rivers and streams during heavy rainfall.

Aquatic macrophytes

If livestock grazing will have a high impact on aquatic macrophytes, you should exclude it unless you can isolate vulnerable stream edges from other areas of the project site. Aquatic macrophytes are likely to only make a small contribution to riparian land vegetation cover. As such, you would not normally consider them when identifying the project site's vegetation state or deciding on management actions. However, aquatic macrophytes at the stream edge are often important to the aquatic objectives of a site (for example, its water quality or the habitat it provides for invertebrates and fish). They are also very palatable and are often grazed heavily by livestock.

Threatened species

If an action statement[5] for a threatened species lists grazing as a threatening process, you should exclude livestock grazing. If there is no action statement for a threatened species, you should take a precautionary approach and exclude grazing from the site. Livestock grazing can threaten the structure of vegetation, and the survival and recruitment of most plant species. If the project site has threatened terrestrial flora and/or fauna species (which you may find out about by direct observation or from sources such as the *Victorian Biodiversity Atlas*[6]), you should take account of the relevant action statements under the *Flora and Fauna Guarantee Act 1988*.

Eroding streambanks

If livestock are eroding streambanks, and you cannot isolate these streambanks from other areas of the site, you should exclude livestock grazing. While streambanks erode naturally as streams meander across the landscape, streambank erosion has increased markedly in many places since European settlement. This is due to:

- extensive clearing of deep-rooted, natural vegetation from catchments, for agricultural and urban development
- the widespread removal of native riparian vegetation from streambanks, either through deliberate clearing for development or through the combined effects of livestock grazing and fire.

Width of the project site

If you decide that the project site is too narrow or too wide for livestock movement or controlled grazing, you should exclude it. For example, moving livestock might excessively trample fenced riparian land that is less than 10 m wide. Land wider than 100 m might end up with both overgrazed and over-rested[7] plants, the area being too large to control livestock movement.

If you think some form of livestock grazing might be an acceptable management option, go to Step 2.

2.2 Step 2: Identify the site's vegetation state

In this step, you identify the site as having one of 11 vegetation states, based on the attributes of the vegetation.

The states are:

- pre-European
- Quality Remnant
- Modified Remnant
- Young Overstorey
- Native Grassy
- Mature Overstorey
- Single-aged Young Overstorey

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[5] For action statements under the *Flora and Fauna Guarantee Act 1988*, see http://www.depi.vic.gov.au/environment-and-wildlife/threatened-species-and-communities/flora-and-fauna-guarantee-act-1988/action-statements.

[6] The *Victorian Biodiversity Atlas* holds distribution and abundance data for Victoria's native and naturalised species, based on millions of records from structured surveys and general observations. It also holds species-attribute data including origin, conservation status and certain ecological parameters. The atlas is a web-based information system and is accessible to all, free of charge. It has replaced the Flora Information System, the *Atlas of Victorian Wildlife*, the Aquatic Fauna Database and the VROTPop system.

[7] Over-resting is the prolonged absence of grazing. When land is over-rested, old plant material accumulates and there is less light penetration. As a result, plants can die, or have reduced growth.

- Shrubby
- Exotic Pasture/Herbaceous
- Exotic Woody
- Revegetation.

These states reflect the typical structural and compositional attributes of riparian land (that is, tree canopy, sub-canopy shrub species and ground layer).

First, identify the site's probable vegetation state by using either the *Vegetation state key* (Figure 2.2) or *Quick reference chart* (Figure 2.3). To use the *Vegetation state key*:

- start at 1 and consider the options for each description
- choose the description that best matches the site
- note the name of the vegetation state for the description you choose, or, if the key refers you to another number …
- go to the number and continue in the same way until you have identified the site's vegetation state.

As you become more familiar with the key and the states, you can use the *Quick reference chart* (Figure 2.3).

If you identify that the site has two or more vegetation states, use, for assessment purposes, the state most sensitive to livestock grazing[8].

Second, confirm that you identified the correct vegetation state. To do this:

- look up the vegetation state you identified in *Section 3: Grazing management options by vegetation state* and confirm that the typical characteristics match what you observe at that site (Section 3 describes the typical vegetation characteristics—overstorey, shrub layer and ground cover—and management and disturbance history of each of the 11 states)
- look at the photographs in Appendix A to confirm your identification.

If you identified the site as *Pre-European* or *Quality Remnant*, you should also confirm your identification against the ecological vegetation class (EVC) benchmark[9]. A *Pre-European* site should meet the EVC benchmark. The vegetation structure and composition of a *Quality Remnant* site should be close to the EVC benchmark.

When you confirm that your vegetation state identification is correct, go to Step 3. If you cannot confirm it:

- review the choices you made using either the *Vegetation state key* or *Quick reference chart*
- identify another state which could broadly apply to the site
- try to confirm that state, using the information in Section 3 and the photographs.

Record the identified vegetation state on the *Grazing management options field assessment sheet* (Appendix B).

[8] Exceptions to this advice are:

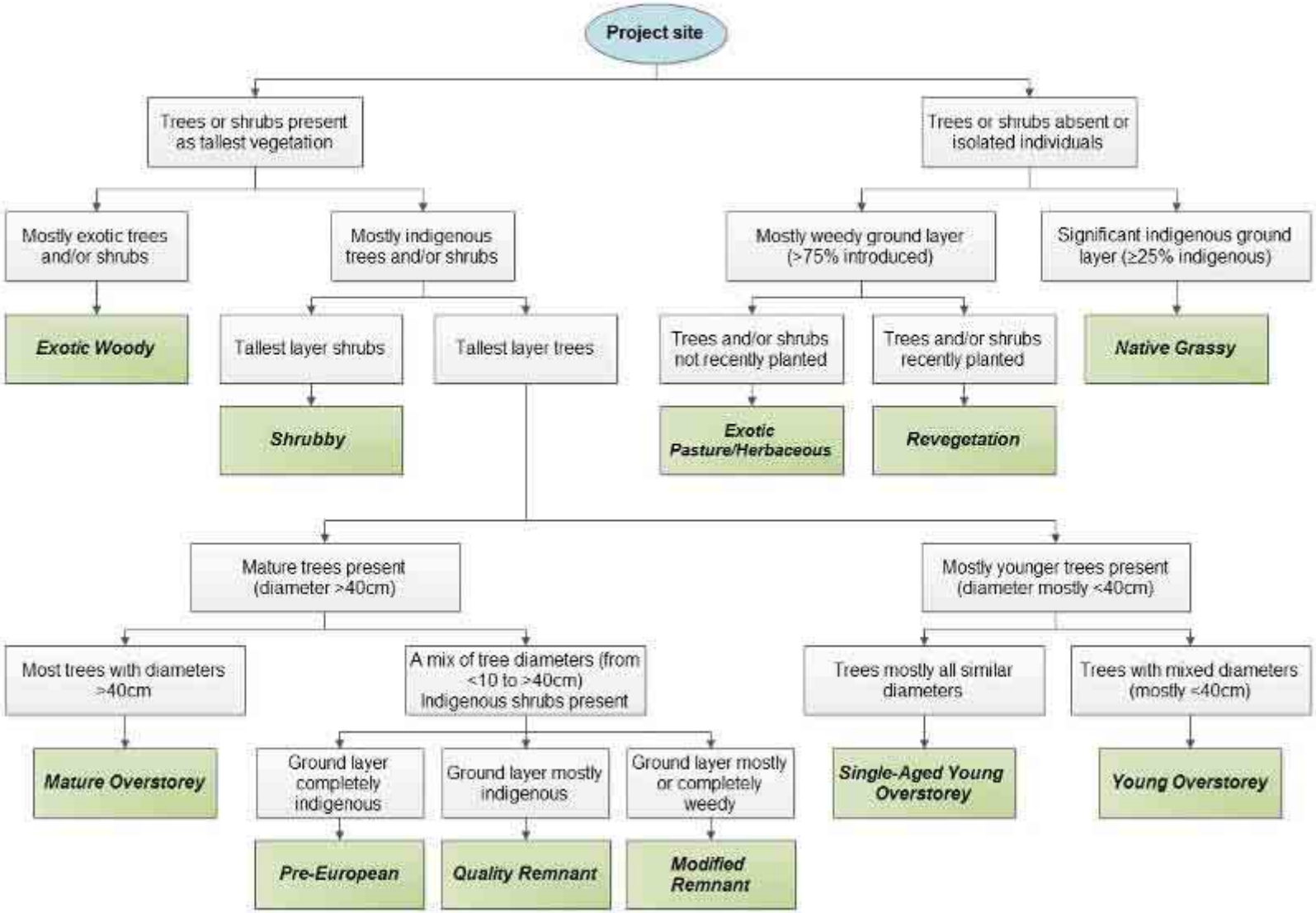
- where one vegetation states covers almost all the project area, you might use that vegetation state
- where vegetation states can be isolated from each other (for example, by fencing), you should assess each vegetation state independently.

[9] For EVC information, see http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/evc-benchmarks.

Figure 2.2 - Vegetation state key

1	Presence or absence of trees and/or shrubs	
	a. There are no trees and/or shrubs, or only isolated individuals, or they were recently planted	(Go to 2)
	b. Trees and/or shrubs are the tallest vegetation	(Go to 3)
2	Ground layer composition	
	a. Indigenous ground cover is <25% (the ground layer is completely or mostly composed of introduced species, including annual grasses)	(Go to 4)
	b. Indigenous groundcover is ≥25%	NATIVE GRASSY
3	Tallest vegetation layer composition	
	a. The tallest vegetation layer is mostly exotic trees and/or shrubs (for example, willow, poplar, gorse, hawthorn or blackberry)	EXOTIC WOODY
	b. The tallest vegetation layer is mostly indigenous trees and/or shrubs	(Go to 5)
4	Presence of recently planted trees and/or shrubs	
	a. There are no recently planted trees and/or shrubs	EXOTIC PASTURE/HERBACEOUS
	b. Trees and/or shrubs were recently planted	REVEGETATION
5	Tallest indigenous vegetation layer	
	a. Shrubs are the tallest vegetation layer (note: their distribution may be patchy)	SHRUBBY
	b. Trees are the tallest vegetation layer	(Go to 6)
6	Presence of mature trees (diameters are mostly >40 cm)	
	a. There are mature trees throughout the site	(Go to 7)
	b. There are no mature trees, or only isolated individuals	(Go to 8)
7	Age distribution of mostly mature tree layer	
	a. There is a mix of tree diameters (from saplings of <10 cm to trees >40 cm)	(Go to 9)
	b. All or most trees are mature (with diameters mostly >40 cm)	MATURE OVERSTOREY
8	Age distribution of younger tree layer (diameters are mostly <40 cm)	
	a. Trees have more-or-less the same diameter	SINGLE-AGED YOUNG OVERSTOREY
	b. There is a mix of tree diameters	YOUNG OVERSTOREY
9	Ground layer composition	
	a. The ground layer is completely indigenous and there are no introduced species	PRE-EUROPEAN
	b. The ground layer includes significant indigenous cover (≥25% cover, including litter layer), with some weeds (<75% cover)	QUALITY REMNANT
	c. The ground layer is completely or mostly weedy (introduced species ground cover is >75%), possibly with some patches of indigenous plants (0-25% cover, including litter layer)	MODIFIED REMNANT

Figure 2.3 - Quick reference chart



2.3 Step 3: Assess and choose a grazing management option

In this step, you assess the grazing management options available for the site's vegetation state, and choose the most suitable option.

Record the assessment process on the *Grazing management options field assessment sheet* (Appendix B).

Section 3: Grazing management options by vegetation state provides information, advice and guidelines about the four grazing management options considered in this publication:

- maintain the existing livestock grazing regime
- control the livestock grazing regime (to specified times of the year, duration and grazing intensities)
- exclude livestock grazing from all or part of the project site
- exclude livestock grazing and implement other interventions (including weed management and revegetation).

To assess grazing management options and choose the most suitable one:

- read through the grazing management options in Section 3 for the project site's vegetation state (which you determined in Step 2.2)
- consider the predicted outcome for each option (that the structure and state of the vegetation will degrade, stay as it is, or improve)
- consider the acceptability of each option
- use the decision tree for the vegetation state. It takes account of the effects of grazing on threatened terrestrial species and streambank erosion, particularly when more than one option is beneficial or acceptable[10].

Table 2.1 shows the rationale for each of the four levels of acceptability of the grazing management options in Section 3.

Table 2.1 - Level of acceptability of grazing management options

Acceptability of grazing management option	Rationale
Not acceptable	It is highly likely the quality of the vegetation would decline to a lower-quality state
Tolerable*	There is a risk the structure and composition, or structure only, of the vegetation would decline but still stay in the same state: a tolerable option is never the preferred option
Acceptable	It is most likely there would be little or no change to the structure and composition of the vegetation (which includes that vegetation that is highly degraded can't degrade further)
Beneficial	The quality of the vegetation remains as it is now (for *Quality Remnant* and *Pre-European* states only), or it improves to a higher-quality state

*** Tolerable options only apply to project sites where threatened species or streambank erosion restrict you from implementing acceptable or beneficial grazing management options. For example, you might exclude livestock from a Native Grassy project site with threatened fauna, even if controlled grazing would otherwise be acceptable.**

[10] If grazing is not applicable or not acceptable, there is no decision tree.

Remember also that in Step 1 you may have identified that the site goals put such importance on values and conditions (such as water quality) that you must exclude grazing and protect the waterway from stock, overriding their potential impact on threatened species, streambank erosion or vegetation impacts.

2.4 Step 4: Implement the chosen option

In this step, you use the information in sections 2.4.1 to 2.4.4 below to assist you to implement your chosen grazing management option.

2.4.1 Maintain the existing livestock grazing regime

If there is an existing livestock grazing regime, you should talk with the landholder to determine what it is.

Grazing will usually be uncontrolled (that is, continuous) at most sites. However, some sites may currently have controlled livestock grazing, to maintain and improve the vegetation. This is often the case for high-quality sites, where there is low-intensity grazing.

2.4.2 Control the livestock grazing regime

In this publication, 'control' means permitting a known population of livestock to graze in a defined area, at a specified time, for a specified duration. It does not include 'control' in an abstract or unquantified sense (such as some undefined type of oversight of the way livestock graze).

There are additional controlled grazing guidelines in Section 3 for the vegetation states for which controlled grazing is a beneficial, acceptable or tolerable option. The additional guidelines provide specific controlled grazing information for those states.

If implementing a controlled grazing regime, you should record specific information (such as the livestock type and the duration and frequency of grazing) on the *Grazing management options field assessment sheet* (Appendix B), to help managers to monitor and evaluate the project site.

Type of grazing animal

Controlled grazing may include using a particular type of grazing animal.

Most grazing animals tend to graze selectively, preferring some species and avoiding others. This is often detrimental to the most palatable, accessible and actively growing plant species.

There are substantial and well-known differences in how cattle and sheep graze, and the pressure this puts on riparian land. You need to know the particular impacts of the grazing animals you have in mind, and consider these when considering options. For example:

- the grazing pressure by one cow is equivalent to that of eight sheep, 11 goats, 12 kangaroos or 133 rabbits
- sheep are more selective grazers than cattle
- sheep prefer to graze and bed on upland areas, whereas cattle will enter wet lowland areas
- sheep graze closer to the ground than cattle (which inhibits trees and shrubs regenerating)
- sheep tend to compact the soil more, but pug it less, than cattle
- cattle are easier to muster than sheep, so fencing for them is simpler and cheaper.

Optimum grazing times and grazing exclusion periods

Controlled grazing may involve excluding grazing at particular times. The optimum time for controlled grazing is when:

- the soil moisture is relatively low (to avoid or minimise soil impacts)
- indigenous plants are likely to be dormant—usually from late summer to early winter[11] — as grazing at this time won't affect their flowering and seed set.

Excluding grazing during the growth phase of native plants

When native plants are entering their annual growth phase, heavy grazing can make them less able to set seed, send out new growth and develop healthy root systems. Healthy root systems not only bind the soil but also ensure plants get moisture in dry periods, and recycle nutrients.

You should avoid controlled grazing when native plants are in flower or setting seed. This is usually in spring and early summer, but you need to understand the life-cycle characteristics of the particular riparian plant species at the project site (and especially the life cycles of important functional groups and endangered species), and plan accordingly.

Excluding grazing for weather or seasonal reasons

You should be flexible when using controlled grazing: seasonal conditions will vary from year to year and affect the species composition and vegetation structure of a project site.

Irrespective of the time of year, you should not use controlled grazing when:

- the soil is very moist (typically in winter, although possibly at any time of year, including after heavy rain: bringing livestock onto a site when the soil is very moist will result in pugging and soil compaction)
- the soil is very dry (such as during a drought): when the soil is very dry, the ground layer may be too sparse, leading to overgrazing and soil erosion.

You should also not use controlled grazing after floods or wildfire: these events usually trigger native plants to germinate.

Excluding grazing where there are juvenile plants

If there has been natural regeneration or replanting, you should not use controlled grazing until plants are beyond browsing height (normally after 3–5 years).

You should not use controlled grazing if there are short-statured, understorey species on the site: livestock are likely to trample and kill them.

You should also consider the propensity of livestock to rub the trunks of trees or shrubs, snapping their stems or ring barking them (such as cattle and horses do with stringybark eucalypts).

[11] However, species go into, and come out of, dormancy at different times. In addition, some native species such as wallaby grass (Danthonia sp.) can be active in winter.

Grazing intensity

Controlled grazing may include controlling grazing intensity, which is a function of the stocking rate and the duration of grazing. The optimum level of each depends on the particular characteristics of the project site.

To determine the optimum grazing intensity, you need to consider the site's species. For example:

- many species within genera such as *Austrostipa* (spear grasses), *Austrodanthonia* (wallaby grasses), *Microleana* (weeping grass), *Chloris* (windmill grasses), *Juncus* (rushes) and *Carex* (sedges) can tolerate moderately intense grazing
- species such as *Joycea* (wallaby grass) and many *Acacia* (wattles) can tolerate low-intensity grazing
- orchids, lilies, saltbushes and grasses such as *Poa* and *Themeda* (kangaroo grass) can decline rapidly with even low-intensity grazing.

However, you should also consider the overall species composition of the project site: livestock have different grazing preferences, and plants have different growth phases.

Monitoring

Undertaking controlled grazing should include monitoring the effects of grazing. Advice about doing this is in *2.5 Step 5: Monitor and evaluate the site*.

Animal hygiene

Controlled grazing must consider measures to ensure adequate animal hygiene.

Entering a project site

Where there are weeds in paddocks but not on the project site, you should ensure that livestock do not graze on the site until any weed seeds they ingested in the paddocks have passed through their systems.

Also, you should not use sheep for controlled grazing on a site until after they are shorn, to ensure they do not bring weed seeds onto the site: sheep carry many kinds of weed seeds in their coats.

Exiting a project site

After controlled grazing, you should keep livestock in a controlled area (such as a stock containment area) until they have passed any weed seeds they ingested, to stop them introducing weeds to other locations.

Supplementary feeding

You should not use, or allow to be stored, supplementary feed sources (such as bales) on a project site.

2.4.3 Exclude livestock grazing

This option requires you to permanently exclude livestock from the site, and not undertake other management activities.

2.4.4 Exclude livestock grazing and revegetate

This option requires you to permanently exclude livestock from the site, and revegetate it. Revegetation is a management action to re-establish indigenous vegetation, including:

- site preparation (for example, controlling weeds and pest animals)
- establishing native vegetation by allowing for natural regeneration and/or direct seeding and/or seedling planting.

DELWP's *Output Delivery Standards*[12] provide guidance about revegetation techniques.

[12] Department Environment, Land, Water and Planning (2015)

2.5 Step 5: Monitor and evaluate the site

Before implementing your chosen grazing management option, you should develop a monitoring program to assess the extent to which the option achieves your desired outcomes.

You should base the type, elements and frequency of the monitoring program on the vegetation quality and condition of the project site, with higher-quality sites (for example, *Quality Remnant, Modified Remnant* and *Native Grassy*) generally requiring a more rigorous program than lower-quality sites. This is because these sites are more likely to degrade if the grazing regime is wrong, and the consequences of degradation are higher (due to their higher quality).

Grazing livestock prefer younger plants to older plants, and annual and perennial grassy weeds to most indigenous species. Therefore, if implementing controlled grazing, you should monitor the project site and remove livestock before they start to graze key indigenous species.

Over time, for sites where you choose controlled grazing, you should collate a set of regionally specific controlled grazing reference photos. These will help staff of your organisation and landholders to determine when to remove livestock and when to consider restocking a site, to undertake controlled grazing.

You should also reassess the site after some time, to ensure the grazing management option you selected still suits the site's vegetation state (which may have changed).

You should provide the landholder with copies of Appendix C: Grazing management record sheet. They should complete this form for each grazing event.

3 Grazing management options by vegetation state

3.1 Pre-European

3.1.1 Characteristics

By definition, riparian land in the *Pre-European* vegetation state has not been directly or indirectly disturbed by European settlement (including by livestock grazing). It has only been disturbed by natural flooding regimes, natural and Aboriginal fire, and by grazing by native animals. There is little riparian land in a *Pre-European* state remaining in Victoria.

Table 3.1 shows typical *Pre-European* vegetation state characteristics.

Table 3.1 - Typical *Pre-European* vegetation state characteristics

Overstorey	Shrub layer	Ground cover
• Overstorey is intact and multi-aged (structurally, to EVC benchmark) • Overstorey species and life forms are diverse (to EVC benchmark) • There are no introduced plants	• Shrub layer is intact and multi-aged (structurally, to EVC benchmark) • Understorey species and life forms are diverse (to EVC benchmark) • There are no introduced plants	• Groundcover is dominated by graminoids (sedges or tussock grasses such as *Poa labillardieri*), with a diversity of herbs and forbs • There are no introduced plants • There is a well-established and undisturbed litter layer overlaying well-structured and fertile soil

In *Step 2: Identify the site's vegetation state*, if you identified the vegetation state of your site as *Pre-European*, make sure you confirm your identification by checking the site's EVC[13]. This is to ensure that the vegetation structure and composition meet the benchmark. If the site does not reach the benchmark, it is highly likely it is *Quality Remnant.*

3.1.2 Grazing management options

Maintain the existing livestock grazing regime

There will not have been grazing on sites with a *Pre-European* vegetation state.

Maintaining the existing livestock grazing regime for *Pre-European* is NOT APPLICABLE.

Control the livestock grazing regime

Introducing livestock under a controlled grazing regime to sites with a *Pre-European* vegetation state would result in a decline to *Quality Remnant* or *Modified Remnant* in two years or less from:

- disturbance of the soil and litter layer
- loss of vegetation cover and litter layer
- possible weed invasion.

[13] For EVC information, see http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/evc-benchmarks.

Implementing a controlled livestock grazing regime for *Pre-European* is NOT ACCEPTABLE.

Exclude livestock grazing

Continuing to exclude livestock grazing maintains the integrity of the vegetation in its *Pre-European* state.

Exclude livestock grazing and revegetate

As the vegetation state is *Pre-European* condition, you gain nothing by revegetating.

Excluding livestock grazing and revegetating for *Pre-European* is NOT APPLICABLE.

Summary

Table 3.2 summarises the predicted outcomes and acceptability of each of the management options for this vegetation state.

Table 3.2 - Predicted outcomes and acceptability of options

Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Not applicable	
Control the livestock grazing regime	Site degrades to Quality Remnant or Modified Remnant	Not acceptable
Exclude livestock grazing	Site remains *Pre-European*	Beneficial
Exclude livestock grazing and revegetate	Not applicable	

3.1.3 Grazing management options decision tree

As grazing is not applicable or not acceptable, there is no grazing management options decision tree.

3.2 Quality Remnant

3.2.1 Characteristics

Sites in the *Quality Remnant* vegetation state are likely to be the best remaining natural riparian land in Victoria. These sites will never have experienced significant soil disturbance (such as cultivation or soil improvement, for example by adding fertilisers).

The structure and composition of vegetation on these sites will be close to the EVC benchmark condition, and European settlement will have only indirectly disturbed it. Typical disturbances will have been:

- minor pest plant and animal invasion
- minor soil disturbance
- altered flooding and fire regimes (including fire exclusion)
- modified native animal grazing
- probably some infrequent and low-intensity livestock grazing.

Table 3.3 shows typical *Quality Remnant* vegetation state characteristics.

Table 3.3 - Typical *Quality Remnant* vegetation state characteristics

Overstorey	Understorey (shrub layer and ground cover)
• Overstorey is largely intact, with multi-age classes represented	• Understorey is probably not in *Pre-European* state (with subtle changes in composition due to land use changing since European settlement), but still largely unmodified • Species that are promoted by, or tolerate, post-European settlement disturbance are likely to be more abundant (e.g. *Carex spp*) while disturbance-intolerant species (e.g. *Poa labillardieri*) are likely to be less-abundant • There are some introduced species (which are not dominant, and probably minor components of the flora)

In *Step 2: Identify the vegetation state*, if you identified the vegetation state of your site as *Quality Remnant*, make sure you confirm your identification by checking the site's EVC. This is to ensure that the vegetation structure and composition are close to the EVC benchmark. If the site's vegetation structure and composition are not close to the benchmark, it is highly likely the site is *Modified Remnant.*

3.2.2 Grazing management options

Maintain the existing livestock grazing regime

While excluding livestock is usually the best option for *Quality Remnant*, these sites may have a history of low-intensity grazing, with minimal soil disturbance. If so, continuing low-intensity grazing is likely to result in little or no change to the structure and composition of the vegetation. However, *Quality Remnant* sites are likely to be the best riparian land in Victoria, so any grazing needs to be carefully and continuously managed, to ensure it does not harm sensitive indigenous species.

Maintaining the existing livestock grazing regime for *Quality Remnant* is acceptable, if continued low-intensity grazing is likely to result in little or no change to the structure and composition of the vegetation. However, any grazing must be carefully and continuously managed, to ensure it does not harm sensitive indigenous species.

Control the livestock grazing regime

Higher-intensity grazing increases the risk of a *Quality Remnant* degrading to a *Modified Remnant* from:

- further disturbance of the soil and litter layer
- loss of vegetation diversity, biomass and cover
- likely increases in weed diversity, biomass and cover
- a significant reduction in indigenous species recruitment.

Grazing at a more intense level than the level that maintained the vegetation state as *Quality Remnant* is NOT ACCEPTABLE.

In some situations, short-duration, intense livestock grazing may help open up a dense indigenous graminoid[14] ground layer, which can exclude many indigenous herbs and forbs. Due to the grazing habits of livestock, there is a higher risk of degradation in *Quality Remnant* sites with ≥25% indigenous groundcover. With such sites, you should get expert botanical advice to identify grazing-sensitive indigenous species, degradation of which would be a signal to remove stock during a controlled grazing regime.

[14] Graminoids are grass or grass-like plants, usually distinguished by long, strap-like leaves.

Exclude livestock grazing

Excluding livestock grazing will typically result in:

- little change in the composition and structure of the vegetation
- the diversity, cover and biomass (both indigenous and introduced) of plant species being maintained or increased.

If there has been little soil disturbance over time, there may be a significant, dormant indigenous soil seed bank on the site. Previously known, or low abundance, species might be recruited—and quickly—if you exclude grazing and the right environmental conditions occur (such as a drought or a wetter-than-average season).

Exclude livestock grazing and revegetate

While *Quality Remnant* vegetation is not in *Pre-European* condition, it is still largely unmodified. As such, there is usually little (if any) advantage in revegetating, as the site would probably remain as *Quality Remnant*.

Excluding livestock grazing and revegetating for *Quality Remnant* is NOT APPLICABLE.

Summary

Table 3.4 summarises the predicted outcomes and acceptability of each of the four grazing management options assessed for this vegetation state.

Table 3.4 - Predicted outcomes and acceptability of options

Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site remains *Quality Remnant*, with little or no change to its structure and composition	Acceptable
Control the livestock grazing regime	Site may degrade	Not acceptable*
Exclude livestock grazing	Site remains *Quality Remnant*, with potential recruitment of previously known, or low abundance, species	Beneficial
Exclude livestock grazing and revegetate	Not applicable	

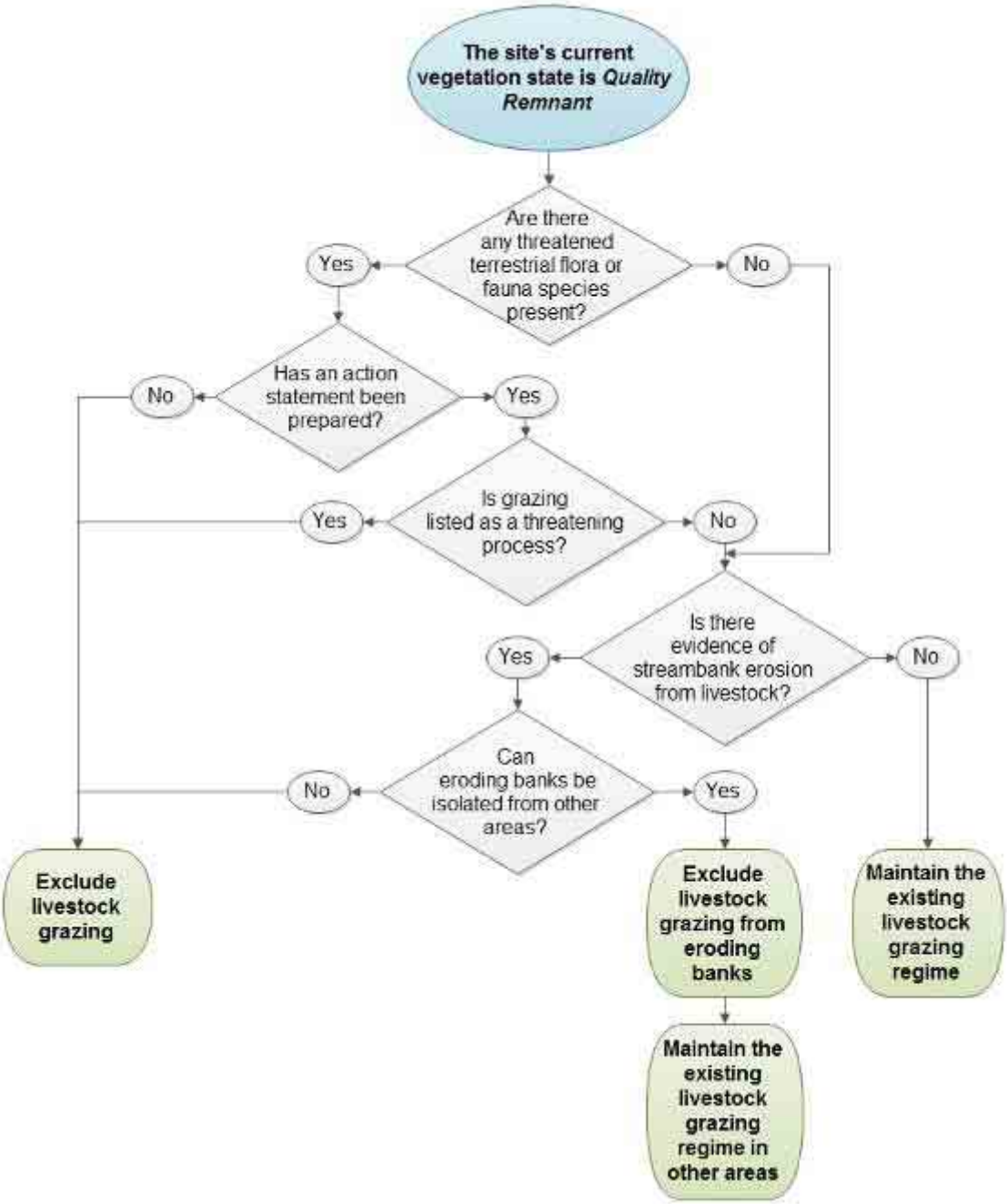
*** Occasionally, short-duration, intense, livestock grazing may be acceptable (for example, to open up a dense indigenous graminoid ground layer that is shading and outcompeting smaller indigenous herbs and forbs). You should seek expert botanical advice if considering this option if the indigenous groundcover is ≥ 25%.**

3.2.3 Grazing management options decision tree

Figure 3.1 provides a decision tree to use when considering grazing management options for *Quality Remnant* sites. It takes account of:

- the guidance above, about the acceptability of grazing on vegetation condition and state
- possible effects on threatened terrestrial flora and/or fauna species and streambank stability.

Figure 3.1 - Grazing management options decision tree for *Quality Remnant*



3.3 Modified Remnant

3.3.1 Characteristics

Modified Remnant is a weedier version of *Quality Remnant*. *Modified Remnant* vegetation typically has a low–to–moderate intensity livestock grazing history, with some soil disturbance. It has probably not been cultivated or fertilised.

Table 3.5 shows typical *Modified Remnant* vegetation state characteristics.

Table 3.5- Typical *Modified Remnant* vegetation state characteristics

Overstorey	Shrub layer	Ground cover
• Overstorey is usually older in profile, but areas often still contain several overstorey age classes (different and smaller-diameter classes) • There has often been no recent tree recruitment • There may be some individuals of exotic overstorey species (e.g. willows or poplars)	• Introduced species dominate the shrub layer • Indigenous shrubs are still evident, even if sparsely distributed and old • Shrub recruitment may be evident	• Introduced species dominate the ground cover, especially aggressive colonising weeds (such as annual grasses, blackberry, cocksfoot and phalaris) • There may be some indigenous ground layer: if so, it may maintain a reasonable diversity of indigenous species (however, the distribution will likely be patchy)

3.3.2 Grazing management options

Grazing management options will differ depending on whether the site has less than 25% indigenous species ground cover, or 25% or greater indigenous species ground cover. You can best assess this in summer.

Maintain the existing livestock grazing regime

Sites with <25% indigenous species ground cover

Table 3.6 shows the likely impacts of maintaining the existing livestock grazing regime. The predicted outcome is that the site will remain as *Modified Remnant*, with reduced recruitment opportunities.

Table 3.6 - Likely impacts of maintaining the existing livestock grazing regime on *Modified Remnant* vegetation, sites with <25% indigenous species ground cover

Attribute	Impact		
	Negative	Neutral	Positive
Vegetation composition		✓	
Vegetation structure		✓	
Plant recruitment	✓		
Ground layer		✓	

A negative impact on plant recruitment is highly likely with maintained grazing.

Little change is likely in the composition or structure of the vegetation if the site is currently grazed and has a considerable grazing history: most grazing-sensitive indigenous plant species (such as palatable herbs and forbs) will already have been lost. Any remaining indigenous ground layer species will tolerate the existing regime. If areas have not been heavily grazed, the structure, species composition, cover and biomass of indigenous plants will decline rapidly.

Grazing on *Modified Remnant* sites, irrespective of their grazing history, will reduce plant recruitment. There will be a rapid (less than one-year) loss of any tree and shrub seedlings or resprouts. If there are significant areas of indigenous ground layer vegetation, intense grazing will have a negative impact on both plant biomass and vegetation structure.

An ongoing grazing regime is likely to continue a ground layer dominated by introduced annual grasses and other species. To reduce biomass, high-intensity grazing for short periods may be needed.

Maintaining the existing livestock grazing regime for *Modified Remnant* with <25% indigenous species ground cover is NOT ACCEPTABLE: there is a high likelihood of impact to plant recruitment.

Sites with ≥25% indigenous species ground cover

The predicted outcome is that the site degrades to either a lesser-quality *Modified Remnant* state (that is, with reduced indigenous ground cover) or to a *Mature Overstorey* state (due to further disturbance of the soil and litter layer, loss of vegetation cover and likely weed invasion).

However, in some sites, the greater proportion of indigenous ground cover may be due its history of lower-intensity grazing and minimal soil disturbance.

Maintaining the existing livestock grazing regime for *Modified Remnant* with ≥25% indigenous species ground cover is usually NOT ACCEPTABLE: there is a high likelihood of degradation. However, at some sites, the existing grazing regime may be acceptable.

Control the livestock grazing regime

Sites with <25% indigenous species ground cover

The predicted outcome is that the site remains *Modified Remnant*, provided there is some recruitment of indigenous woody and/or groundcover species. You can use livestock grazing to achieve this, as it can control the ground layer biomass.

Sites with ≥25% indigenous species ground cover

Livestock can greatly affect sites with grazing-sensitive indigenous plants, although low-intensity grazing will have a less-rapid impact. Occasionally, short-duration, intense, livestock grazing may help open up a dense indigenous graminoid[15] ground layer, which can exclude many indigenous herbs and forbs. However, any high-intensity grazing must be carefully and vigilantly managed, including by getting expert botanical advice to identify grazing-sensitive indigenous species, degradation of which would be a signal to remove stock during a controlled grazing regime.

Implementing a controlled livestock grazing regime for *Modified Remnant* with ≥25% indigenous species ground cover is usually NOT ACCEPTABLE. However, at some sites, controlled grazing may be acceptable.

Exclude livestock grazing

Sites with <25% indigenous species ground cover

Table 3.7 shows the likely impacts of excluding livestock grazing on sites with <25% indigenous species ground cover. The predicted outcome is that the site remains *Modified Remnant,* with some risk of degradation in the vegetation structure.

[15] Graminoids are grass or grass-like plants, usually distinguished by long, strap-like leaves.

Table 3.7 - Likely impacts of excluding livestock grazing on *Modified Remnant* vegetation, sites with <25% indigenous species ground cover

Attribute	Impact		
	Negative	Neutral	Positive
Vegetation composition		✓	
Vegetation structure	✓		

Excluding livestock grazing is likely to result in little change in the composition of the vegetation, irrespective of the proportions of introduced and indigenous species cover.

If the site is mostly or fully introduced species at ground level, then less grazing pressure is likely to result in fewer recruitment opportunities. Less grazing pressure risks increasing the biomass of these exotic species, with a commensurate increase in their foliage cover and influence. This would reduce the regeneration prospects of any indigenous herb or forb species that happen to remain at ground level.

Excluding livestock grazing for *Modified Remnant* with <25% indigenous species ground cover is TOLERABLE.

Sites with ≥25% indigenous species ground cover

Table 3.8 shows the likely impacts of excluding livestock grazing on sites with ≥25% indigenous species ground cover. The predicted outcome, especially on sites with high percentages of indigenous species ground cover, is that the site improves to *Quality Remnant* over 10–20 years through unassisted patterns of recruitment[16], or through assisted recruitment by controlling herbaceous weeds.

Table 3.8 - Likely impacts of excluding livestock grazing on *Modified Remnant* vegetation, sites with ≥25% indigenous species ground cover

Attribute	Impact		
	Negative	Neutral	Positive
Vegetation composition		✓	
Vegetation structure			✓

There is likely to be little change in the composition of the vegetation, irrespective of the proportions of introduced and indigenous species cover.

If there are significant areas of indigenous ground layer, these areas will benefit from reduced grazing pressure, with an increase in biomass and greater likelihood of flowering, seeding and resprouting success; and eventually, recruitment.

Exclude livestock grazing and revegetate

Sites with <25% indigenous species ground cover

The predicted outcome is that the site remains *Modified Remnant*, with an increase in vegetation structure. This will require you to reduce ground layer weed cover (for example, by chemical control or slashing), and possibly to replant indigenous shrub species.

[16] Unassisted recruitment of some species may require specific environmental conditions, such as flooding. Such conditions can be infrequent (10-30 years), and the site might only improve in the longer term.

Sites with ≥25% indigenous species ground cover

For sites with a high cover of indigenous ground flora, the predicted outcome is that the site improves to *Quality Remnant* over time, if you exclude livestock and control herbaceous weeds. However, this outcome will only result for sites at the upper end of indigenous species groundcover.

Summary

Tables 3.9 and 3.10 summarise the predicted outcomes and acceptability of each of the options assessed for this vegetation state.

Table 3.9 - Predicted outcomes and acceptability of options, sites with <25% indigenous species ground cover

Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site remains *Modified Remnant*, with reduced recruitment opportunities	Not acceptable
Control the livestock grazing regime	Site remains *Modified Remnant:* grazing controls ground layer biomass and enable recruitment of indigenous groundcover and/or woody species	Acceptable
Exclude livestock grazing	Site remains *Modified Remnant*, with some risk of degradation in vegetation structure	Tolerable
Exclude livestock grazing and revegetate	Site remains *Modified Remnant*, with an increase in vegetation structure	Acceptable

Table 3.10 - Predicted outcomes and acceptability of options, sites with ≥25% indigenous species ground cover

Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site degrades to either: • a lesser-quality version of this state (with less indigenous ground cover) or • Mature Overstorey	Not acceptable*
Control the livestock grazing regime	Site may degrade to a lesser-quality version of this state	Not acceptable**
Exclude livestock grazing	Site improves to *Quality Remnant* through unassisted patterns of recruitment	Beneficial
Exclude livestock grazing and revegetate	Site improves to *Quality Remnant* through assisted control of herbaceous weeds	Beneficial

*** Occasionally, the existing grazing regime is acceptable, most notably where a high level of indigenous ground cover is the result of current grazing practices.**

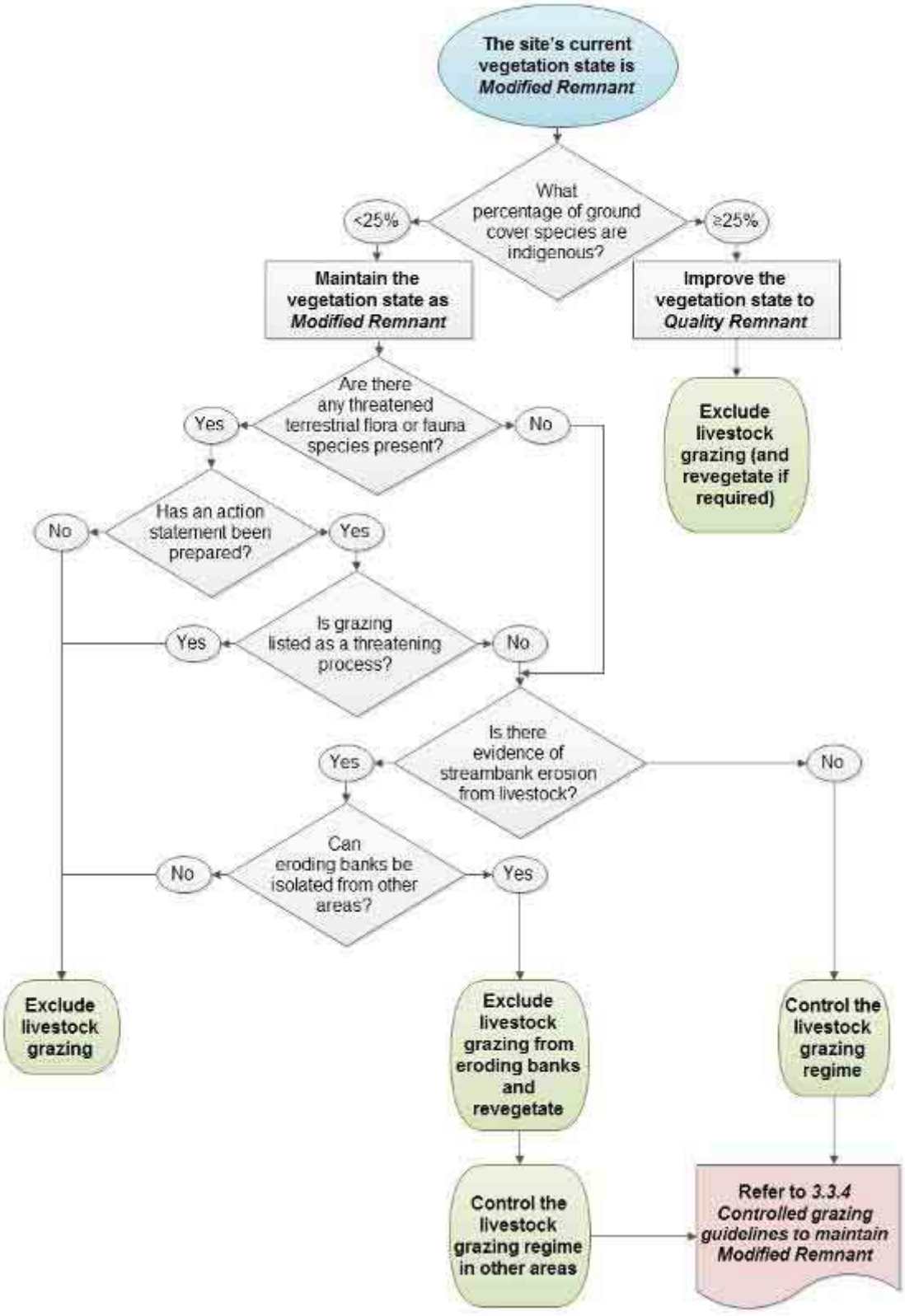
**** Occasionally, short-duration, intense livestock grazing may be acceptable (for example, to open up a dense indigenous graminoid ground layer that is shading and outcompeting smaller indigenous herbs and forbs. You should seek expert botanical advice if considering this option).**

3.3.3 Grazing management options decision tree

Figure 3.2 provides a decision tree to use when considering grazing management options for *Modified Remnant* sites. It takes account of:

- the guidance above, about the acceptability of grazing on vegetation condition and state
- possible effects of grazing on threatened terrestrial flora and/or fauna species and streambank stability.

Figure 3.2 - Grazing management options decision tree for *Modified Remnant*



3.3.4 Controlled grazing guidelines to maintain *Modified Remnant*

If you decided to use controlled grazing, you should consider the guidelines below (as well as the guidelines in *2.4.2 Control the livestock grazing regime*). Figures 3.3 and 3.4 provide decision trees to use to plan your implementation of the guidelines.

Background

Controlled grazing of a *Modified Remnant* site can help:

- reduce weed cover, diversity and biomass
- recruit herbaceous species
- increase the cover, diversity and biomass of indigenous species
- reduce the amount of seed produced by annual grasses
- increase the proportion of perennials while suppressing annual grasses.

In some situations, controlled grazing can help recruit and consolidate native plant species by helping to maintain or shift the vegetation composition toward its EVC benchmark. However, such an outcome requires more than just improving the vegetation state of a site: benchmark sites are well-connected within the landscape, are essentially weed-free, and have diverse and abundant indigenous life forms, resulting in a structurally diverse ecosystem.

The most common impediments to improving higher-quality *Modified Remnant* vegetation toward the EVC benchmark are:

- a dense indigenous graminoid ground layer that shades and outcompetes smaller indigenous herbs and forbs
- introduced herbaceous species, especially aggressive colonising weeds (such as the annual grasses, blackberry, cocksfoot and phalaris) that compete with indigenous ground covers for nutrients, moisture and light.

Short-duration, intense livestock grazing can help address these impediments by opening up the dense indigenous graminoid ground layer and/or reducing herbaceous weed cover.

Timing of controlled grazing of sites with <25% indigenous species ground cover

The optimum time for controlled grazing to reduce herbaceous weed cover is when plants' stems have elongated, but before their seed heads emerge. This usually happens in late winter through early spring. Controlled grazing at this time reduces competition and create gaps in the following seasons for native plant seeds to germinate. *A Guide to Native Pasture Management*[17] refers to such a controlled grazing regime as 'optimised deferred grazing'.

You should then exclude livestock from early spring to late summer, which is when native plants tend to flower and set seed.

[17] Department of Primary Industries (2011)

Figure 3.3 - Controlled grazing decision tree for *Modified Remnant* (Part A)

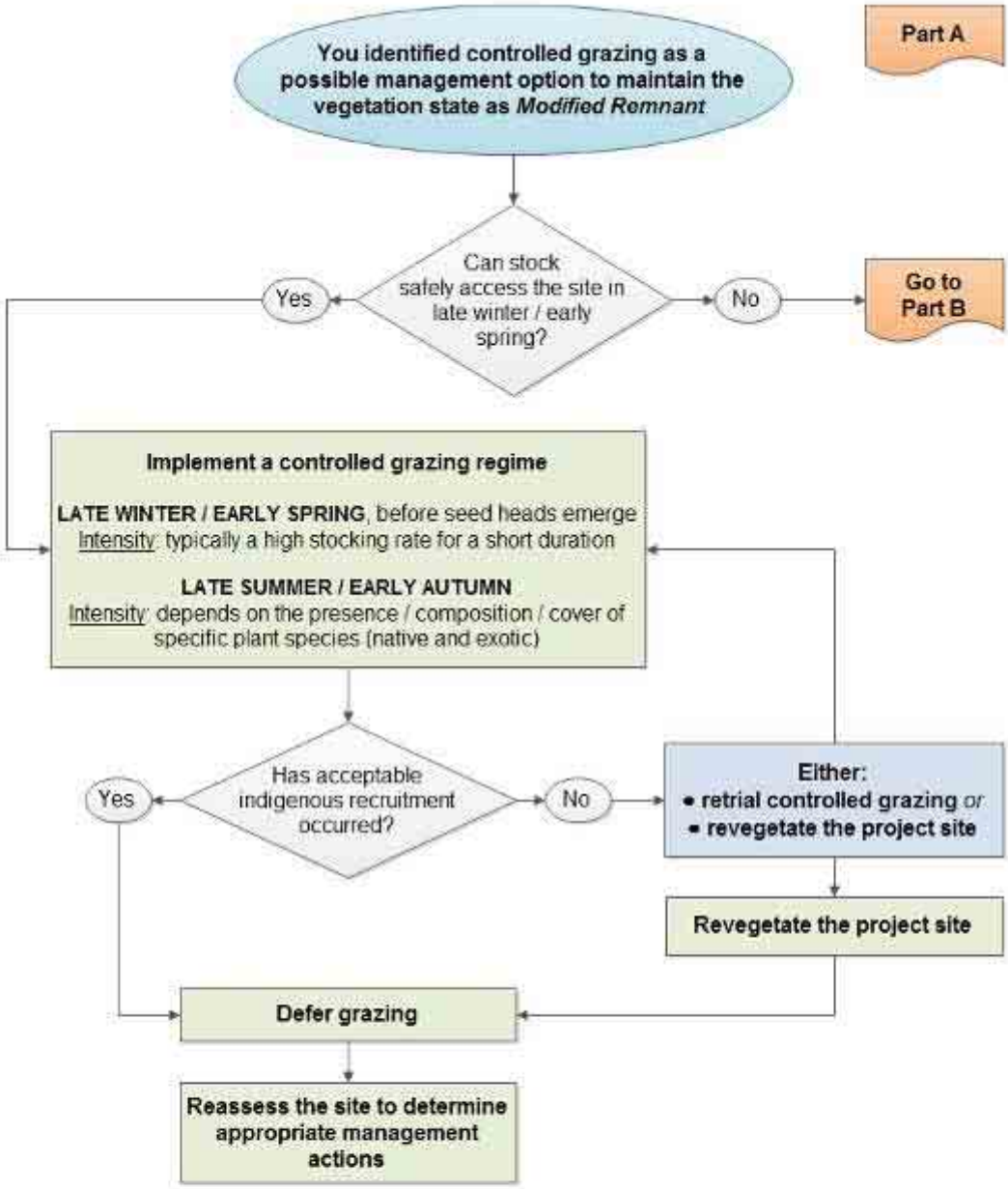
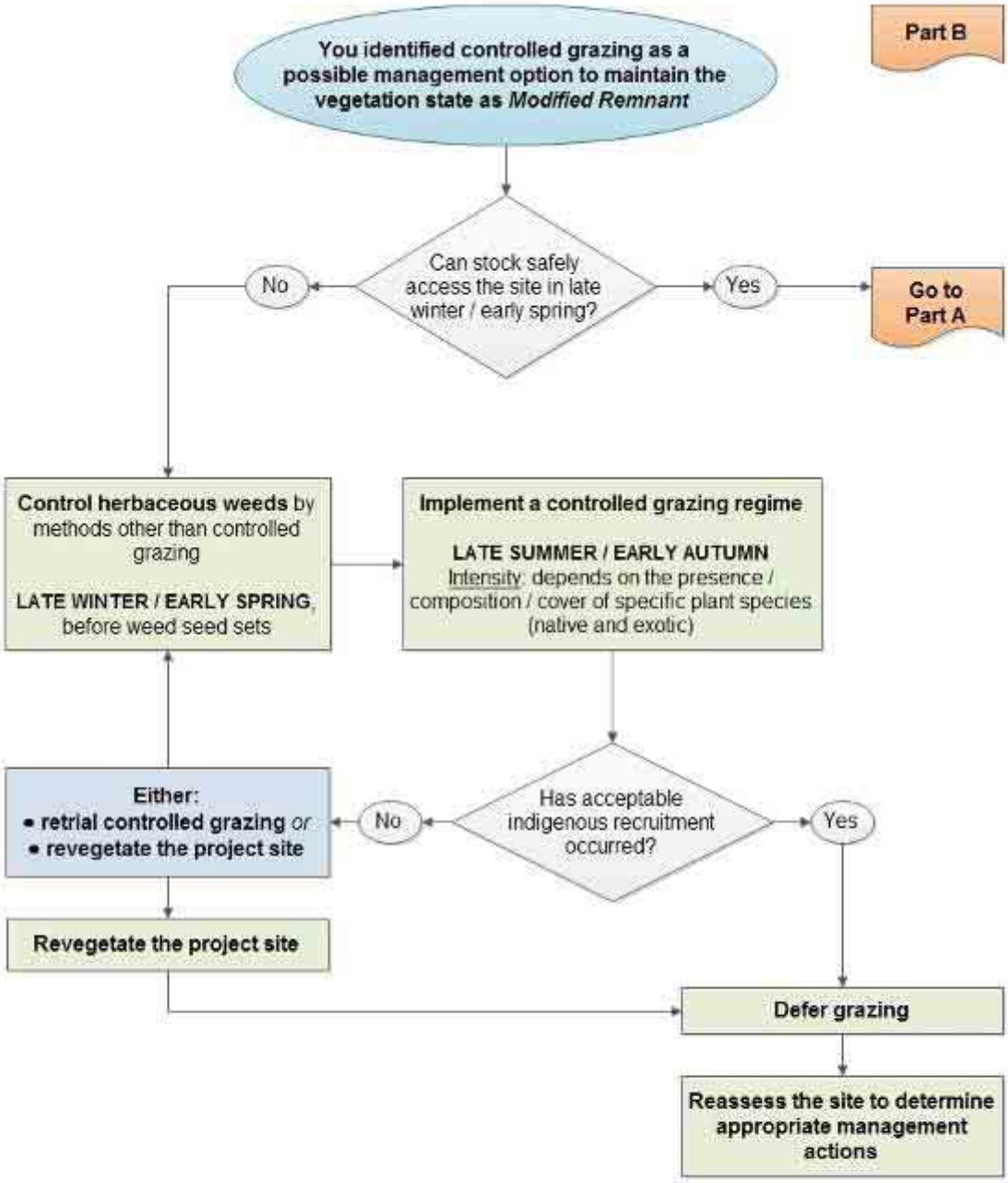


Figure 3.4 - Controlled grazing decision tree for *Modified Remnant* (Part B)



3.4 Young Overstorey

3.4.1 Characteristics

Riparian sites in the *Young Overstorey* vegetation state are most likely to have had significant low-to-moderate intensity livestock grazing, with some soil disturbance, but probably not to have been cultivated or fertilised.

Table 3.11 shows typical *Young Overstorey* vegetation state characteristics.

Table 3.11 - Typical *Young Overstorey* vegetation state characteristics

Overstorey	Shrub layer	Ground cover
• Overstorey is well-treed • Overstorey has a younger profile and is multi-aged, but with no evidence of recent recruitment • There are some older (larger diameter) individuals, but they are isolated and/or scattered • There may be individuals of exotic overstorey species	• A shrub layer is unlikely, due to direct clearance, the death of mature plants, and/or the continual loss of recruits through grazing	• Ground cover may have a reasonable diversity of indigenous species, mostly grazing-tolerant, but is likely to be patchy with low abundance • Introduced species are likely to be the dominant vegetation

3.4.2 Grazing management options

Maintain the existing livestock grazing regime

Table 3.12 shows the likely impacts of maintaining the existing livestock grazing regime. The predicted outcome is that the site remains *Young Overstorey. Young Overstorey* sites tend to have a history of livestock grazing, so further grazing is unlikely to change the existing vegetation condition much in the short-to-medium term, although it is likely to grow to *Mature Overstorey* over 20–30 years.

Table 3.12 - Likely impacts of maintaining the existing livestock grazing regime on *Young Overstorey* vegetation

Attribute	Impact		
	Negative	Neutral	Positive
Vegetation composition		✓	
Vegetation cover		✓	
Vegetation structure		✓	
Vegetation recruitment		✓	

The vegetation composition, cover and structure are unlikely to change as introduced annual/perennial species are still likely to dominate at ground level.

Given the grazing history (and commensurate soil disturbance), continued livestock grazing is unlikely to further reduce the recruitment of indigenous species.

Control the livestock grazing regime

The predicted outcome is that the site improves to higher-quality *Modified Remnant* over 20–30 years, provided there is some natural recruitment of tree and shrub species, to provide a more multi-aged stand. To achieve this, you would need to exclude livestock for periods of time.

Exclude livestock grazing

Table 3.13 shows the likely impacts of excluding livestock grazing. Like *Modified Remnant*, introduced species dominate *Young Overstorey*. This is likely due in part to soil disturbance, and to long-term grazing reallocating and increasing nutrients. If you exclude livestock, there is likely to be little change in the composition of species, with introduced annual and perennial plants still likely to dominate at ground level. The predicted outcome is the site will remain *Young Overstorey* in the short-to-medium term, growing to *Mature Overstorey* over 20–30 years.

Table 3.13 - Likely impacts of excluding livestock grazing on *Young Overstorey* vegetation

Attribute	Impact		
	Negative	Neutral	Positive
Vegetation composition		✓	
Vegetation structure	✓		

A structural change to the vegetation is likely with reduced grazing pressure, based on an increase in the biomass of introduced species (and an increase in the number of vegetation layers), and a commensurate increase in their projective foliage cover. Such a change would reduce the prospects for regeneration of indigenous species.

Exclude livestock grazing and revegetate

The predicted outcome is the site improves to the higher-quality *Modified Remnant* over 20–30 years as existing trees grow, some tree species are recruited, and there is appropriate planting and weed management. Planting and assisted recruitment of a range of understorey species is unlikely to lead to further improvement to *Quality Remnant*, unless ground layer weeds are significantly reduced.

Natural regeneration

Where there is a soil seed bank, annual and perennial weeds must be controlled and reduced if tree and understorey species are to be recruited and regenerated.

Replanting

If natural regeneration has not succeeded, or will not succeed, on the site (such as if there is no seed bank), you will need to replant it.

Replanting will only succeed if herbaceous weeds are controlled before and after plants become established, to ensure the weeds do not outcompete them.

Summary

Table 3.14 summarises the predicted outcomes and acceptability of each of the options for this vegetation state.

Table 3.14 - Predicted outcomes and acceptability of options

Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site remains *Young Overstorey*, growing to *Mature Overstorey* over 20–30 years	Acceptable
Control the livestock grazing regime	Site improves to the higher-quality *Modified Remnant* over 20–30 years, provided there is some natural recruitment of tree and shrub species	Beneficial
Exclude livestock grazing	Site remains *Young Overstorey*, growing to *Mature Overstorey* over 20–30 years	Acceptable
Exclude livestock grazing and revegetate	Site improves to the higher-quality *Modified Remnant* over 20–30 years through assisted natural recruitment and/or replanting	Beneficial

3.4.3 Grazing management options decision tree

Figure 3.5 and Figure 3.6 provide a decision tree to use when considering grazing management options for *Young Overstorey* sites. They take account of:

- the guidance above, about the acceptability of grazing on vegetation condition and state
- possible effects on threatened terrestrial flora and/or fauna species and streambank stability.

Figure 3.5 - Grazing management options decision tree for *Young Overstorey* (Part A)

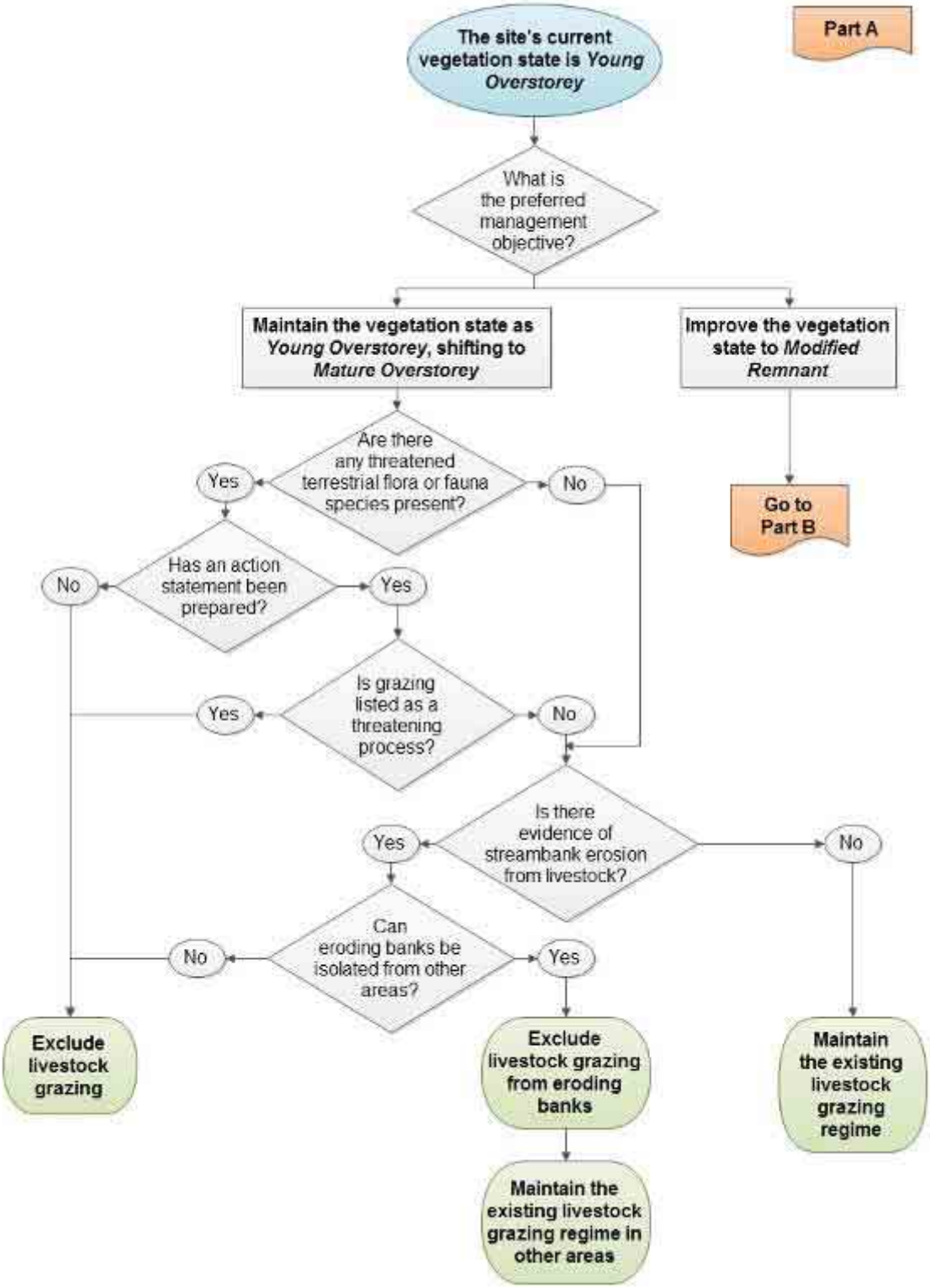
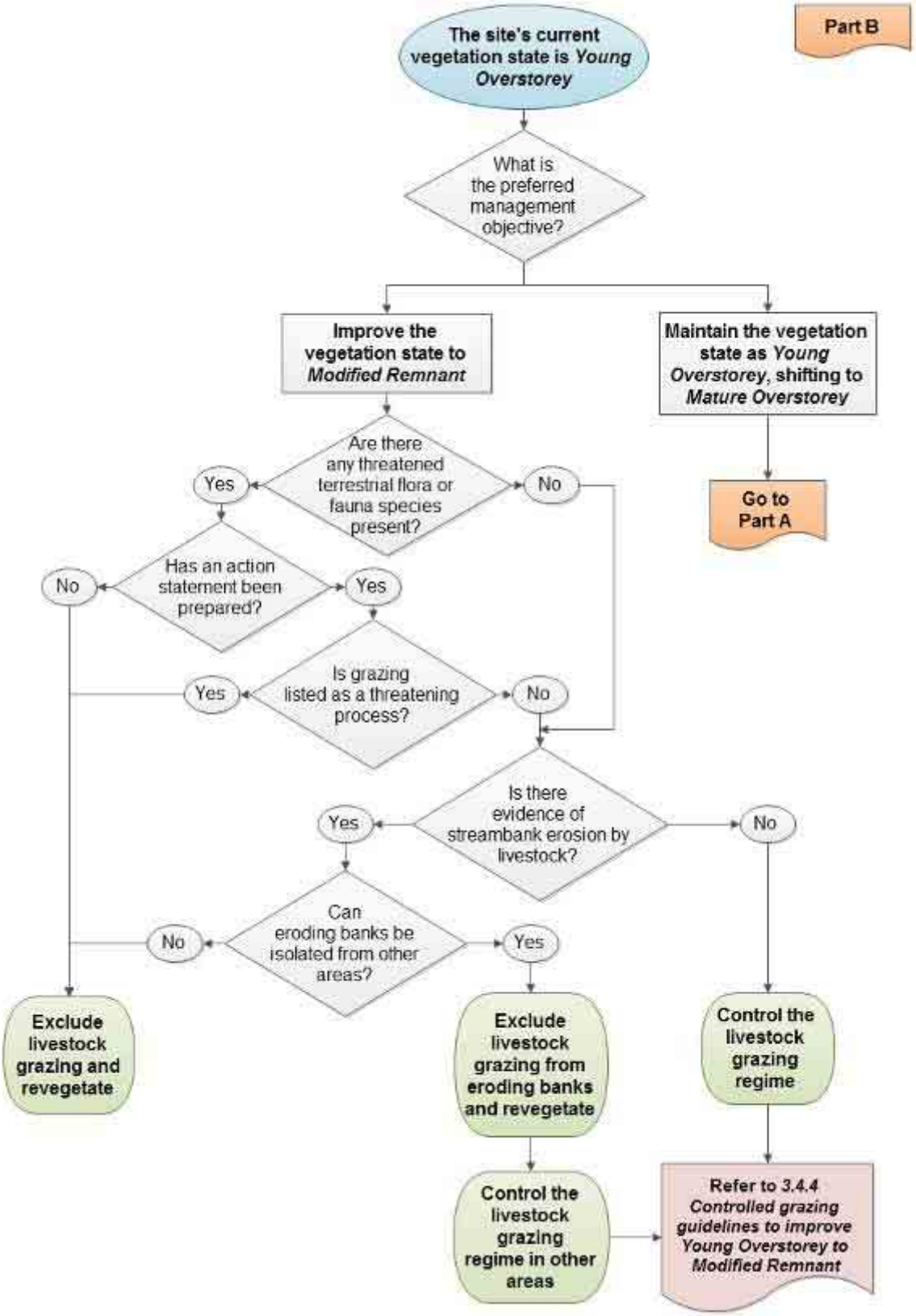


Figure 3.6 - Grazing management options decision tree for *Young Overstorey* (Part B)



3.4.4 Controlled grazing guidelines to improve *Young Overstorey* to *Modified Remnant*

If you decided to use controlled grazing, you should consider the guidelines below (as well as the guidelines in *2.4.2 Control the livestock grazing regime*). Figures 3.7 to 3.11 provide decision trees to use to plan your implementation of the guidelines.

Background

Controlled grazing of a *Young Overstorey* site can help:

- create conditions for recruitment of indigenous trees, shrubs and herbaceous species
- develop multi-age stands of overstorey and understorey species, and make the vegetation structure more diverse
- reduce the cover, diversity and biomass of weeds
- increase the cover, diversity and biomass of indigenous species
- ensure the survival and longevity of indigenous overstorey and understorey species, which can complete their natural life cycle without being disturbed
- retain and enhance the soil seed bank
- minimise soil disturbance.

Where there is an appropriate source of tree and/or shrub seed, the most common impediments to natural regeneration which can be overcome by controlled grazing are:

- predation of young plants by livestock
- competition from weeds.

Young Overstorey sites can improve to *Modified Remnant* in the long-term, if some tree species can be recruited through natural regeneration. Natural regeneration is the process of reintroducing vegetation to a site by allowing seed, suckers or lignotubers to grow. The success of this depends on:

- the proximity of mature trees and shrubs
- there being no (or intermittent) livestock grazing
- there being no history of cultivation
- little or no use of phosphorus
- a low proportion of improved/introduced pastures.

Siting of riparian fencing

When deciding where to locate riparian fencing, you should bear in mind that:

- remnant vegetation seedlings won't establish immediately under the parent tree canopy
- regeneration is unlikely beyond 60m of a remnant
- any fencing for regeneration should be at least two canopy widths from the base of the tree.

Initial livestock exclusion (deferment)

In some places, natural regeneration will easily occur—provided there is an appropriate seed source—if there is no grazing pressure. Therefore, after you fence a site, consider excluding livestock for at least two years, to let unassisted natural regeneration occur.

Excluding livestock is unlikely to result in natural regeneration if a project site has a high proportion of introduced pasture (typical for *Young Overstorey*). This is due to direct competition for nutrients, moisture and light; smothering; and a lack of germination gaps. In these circumstances, controlled grazing in the early stages, to reduce herbaceous weed cover, helps natural regeneration.

Protecting isolated regeneration

Before starting controlled grazing, you should protect any clumps or areas of natural regeneration with temporary fencing (such as electrical tape).

Timing of controlled grazing to reduce herbaceous weed cover

The optimum time for controlled grazing to reduce herbaceous weed cover is when plants' stems have elongated, but before their seed heads emerge. This usually happens in late winter through early spring. Controlled grazing at this time reduces competition and create gaps in the following seasons for native plant seeds to germinate.

Where conditions (such as wet soil) limit the use of controlled grazing, you should control herbaceous weed cover using other methods (such as with chemicals or by slashing).

Livestock exclusion periods

The key to controlling herbaceous weeds to promote natural regeneration is to time grazing with the critical stages in the weed life cycle. As native plants tend to flower and set seed during spring and early summer, you should exclude livestock from sites from early spring to late summer, depending on seasonal variations.

You should also exclude livestock from sites once you consider that the extent of regeneration of indigenous trees/shrubs is acceptable, in terms of the number, diversity and density of individuals, and/or the area of natural regeneration. Do not return livestock until saplings are established and above browsing height. This usually takes 3–5 years.

Timing of controlled grazing to reduce perceived fire risk

Where there is a perceived fire risk, you should consider low-intensity grazing (for example, for a few weeks and at a low stocking rate) at the end of the growing season in early summer, to control long grass.

Low-intensity grazing at the right time can also help natural regeneration. Grazing before eucalypts emerge (and possibly for some time afterwards, when seedlings are inconspicuous) can create bare ground. When seedlings are more advanced, livestock may prefer them. As such, you should only use controlled grazing to reduce a perceived fire risk when seedlings are inconspicuous, or when plants are above browsing height.

Where natural regeneration does not occur

Some sites won't support natural regeneration. This might be due to factors other than livestock grazing and competitive weeds, such as:

- predation of young plants by other vertebrate animals (including rabbits, hares and wildlife), insects and other invertebrates
- poor seed supply (due to factors such as harvesting by ants; predation by other insects, birds and mammals; lack of fire; and lack of pollinators)
- poor soil conditions for germination (due to factors such as soil compaction, loss of topsoil and changes to soil chemistry)
- natural hazards and controls (such as wildfire, flood, wind, drought, temperature extremes and time of the year).

Where natural regeneration does not occur, you may need to consider:

- controlling herbaceous weeds by other methods
- controlling other vertebrate animals
- revegetating the site using tube stock or direct seeding.

Figure 3.7 - Controlled grazing decision tree for *Young Overstorey* (Precursor)

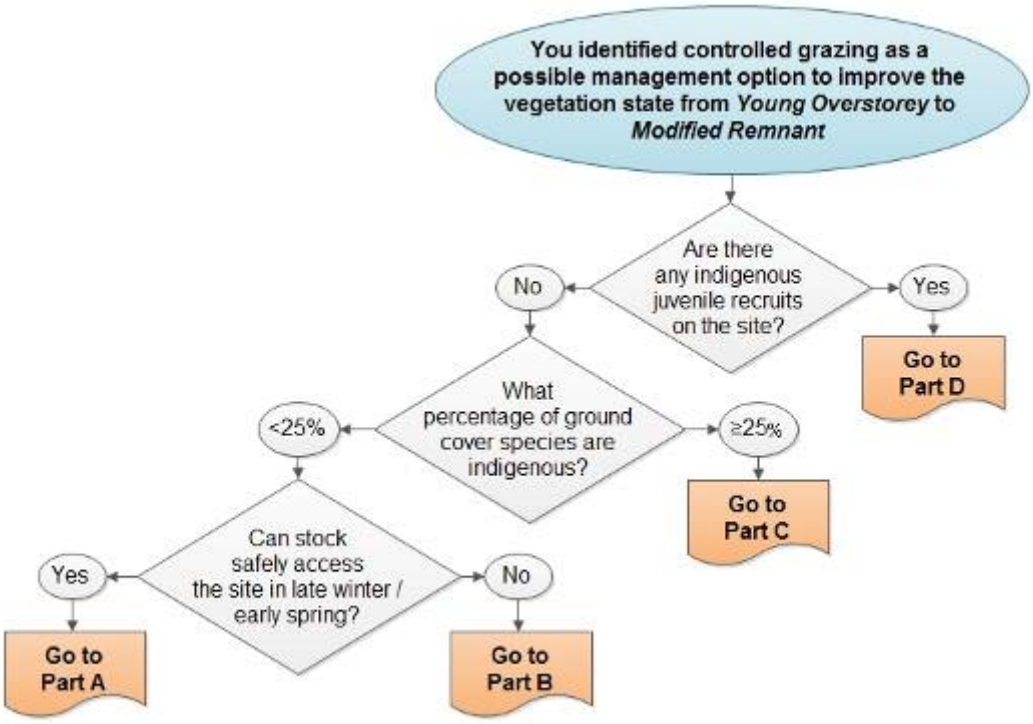


Figure 3.8 - Controlled grazing decision tree for *Young Overstorey* (Part A)

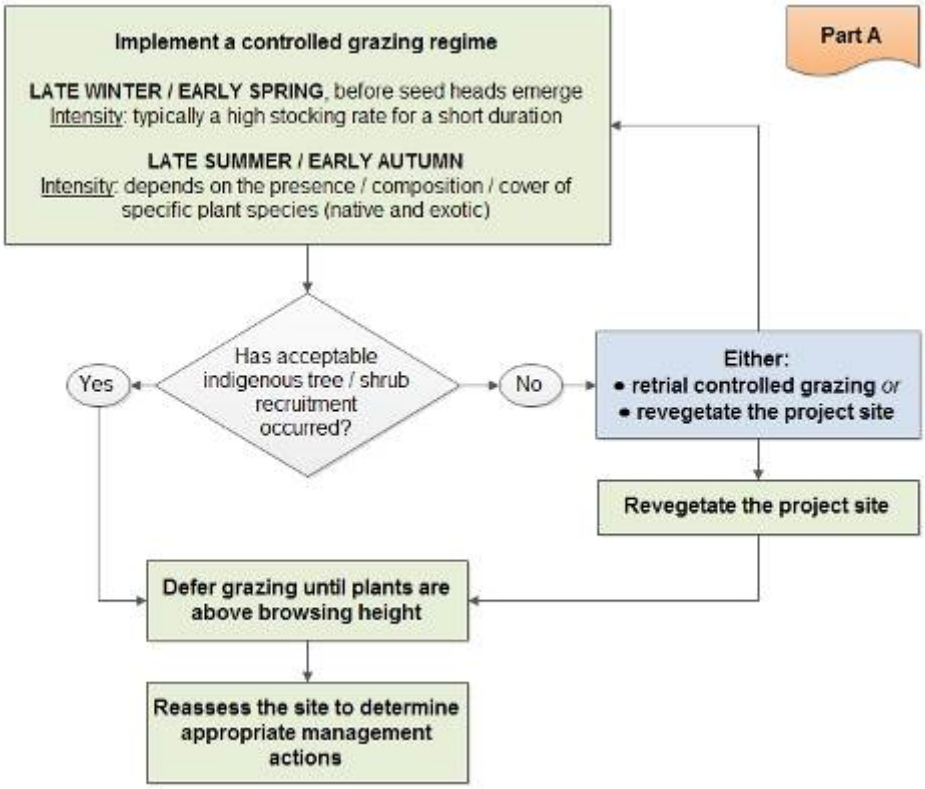


Figure 3.9 - Controlled grazing decision tree for *Young Overstorey* (Part B)

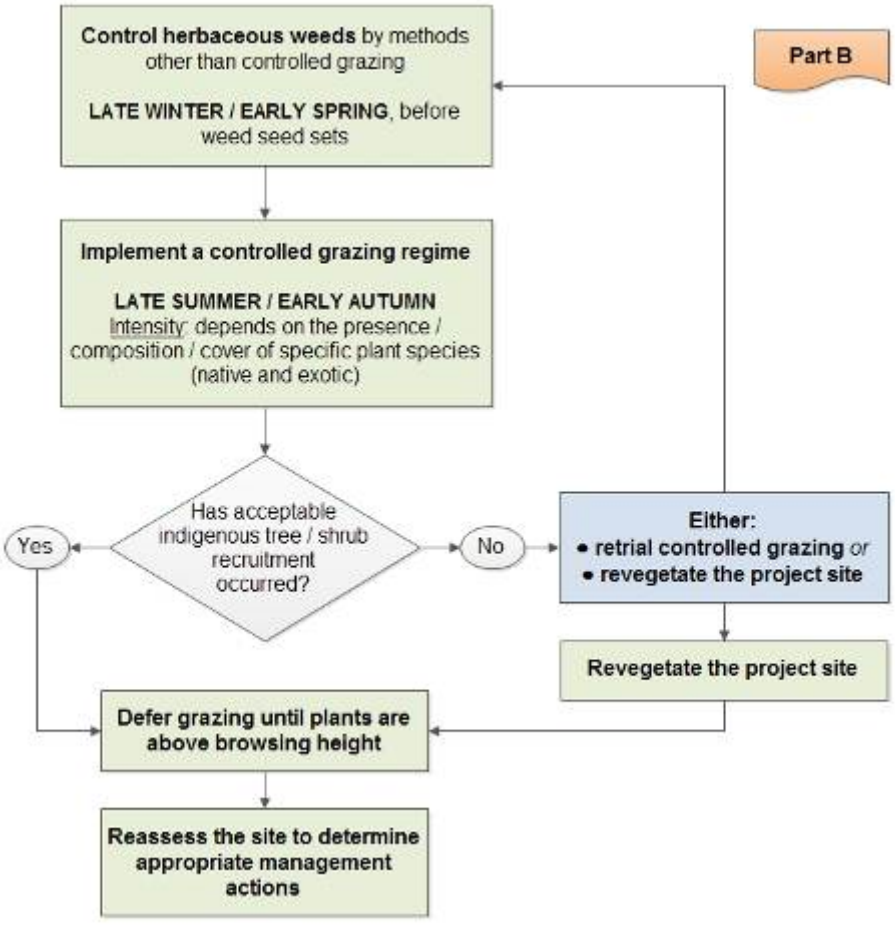


Figure 3.10 - Controlled grazing decision tree for *Young Overstorey* (Part C)

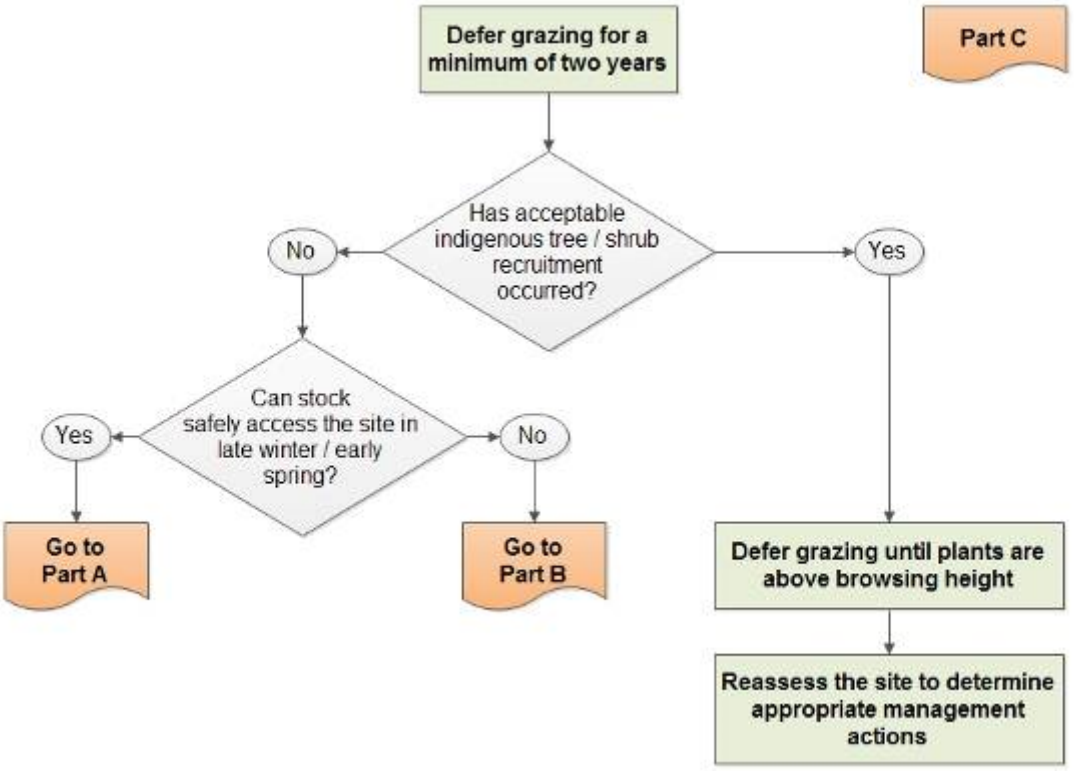
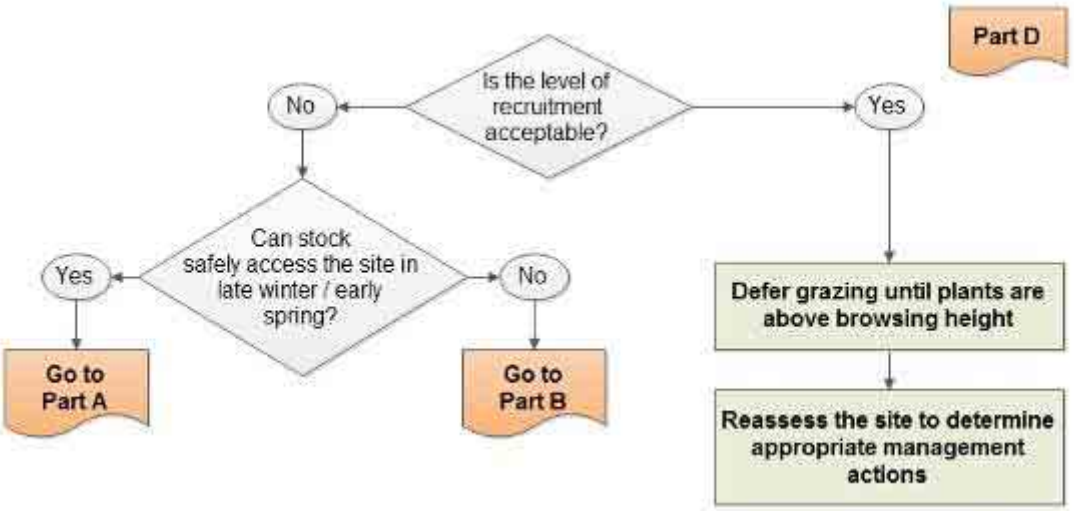


Figure 3.11 - Controlled grazing decision tree for *Young Overstorey* (Part D)



3.5 Native Grassy

3.5.1 Characteristics

Sites in the *Native Grassy* vegetation state have only been lightly grazed for much of their history. They are either naturally treeless, or were originally treed but the overstorey has been progressively cleared over time, with the shrub layer either cleared or progressively lost due to grazing pressure.

For naturally treeless sites (where the dominant strata is the graminoid[18] layer), the understorey may be diverse and strongly indigenous. The ongoing presence of tussocky graminoid species suggests that *Native Grassy* sites have had minimal soil disturbance, and have not been cultivated or fertilised.

Table 3.15 shows typical *Native Grassy* vegetation state characteristics.

Table 3.15 - Typical *Native Grassy* vegetation state characteristics

Overstorey	Shrub layer	Ground cover
• There is no overstorey OR • Individuals are isolated/scattered	• There is no shrub layer OR • Individuals are isolated/scattered	• Ground cover is predominantly indigenous tussocky graminoids (grasses, rushes and sedges)* • There is low abundance/diversity of introduced species • There may be some indigenous herbs and forbs between tussocks

*** Many of these species are tolerant to livestock grazing, or promoted by it.**

3.5.2 Grazing management options

Grazing management options will differ depending on whether the site is naturally treeless, or was originally treed. You will need to know the site's EVC to determine whether the site is naturally treeless or originally treed.[19]

Maintain the existing livestock grazing regime

Naturally treeless sites

If the condition of naturally treeless grassy sites reflects their history of low-intensity grazing and minimal soil disturbance, the predicted outcome of continued low-intensity grazing is little or no change to the existing *Native Grassy* vegetation structure and composition.

Originally treed sites

With no change in livestock grazing practices, the predicted outcome is the site will remain *Native Grassy*. This outcome is less-than-ideal for sites that were originally treed, as grazing inhibits the establishment of indigenous woody species.

Although maintaining the existing grazing regime will result in little or no change to *Native Grassy* vegetation structure and composition, it will not help establish indigenous woody species, so this option is TOLERABLE.

[18] Graminoids are grass or grass-like plants, usually distinguished by long, strap-like leaves.

[19] For EVC information, see http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/evc-benchmarks.

Control the livestock grazing regime

Naturally treeless sites

The predicted outcome is the site remains *Native Grassy*. On some sites, short-duration, intense, livestock grazing can help to open up a dense indigenous graminoid ground layer, which can allow the establishment of many indigenous herbs and forbs.

However, due to the grazing habits of livestock, there is a risk of degradation in *Native Grassy* sites with ≥25% indigenous groundcover. At such a site, grazing may result in greater soil disturbance and increased loss of indigenous grass biomass from tussocks. This would open up inter-tussock spaces, creating conditions for weeds to invade. Over time, the site could degrade to the lesser-quality *Exotic Pasture/Herbaceous* state, due to the higher weed cover, diversity and biomass. Therefore, high-intensity grazing must be carefully and vigilantly managed to protect sensitive indigenous species. With such sites, you should get expert botanical advice to identify grazing-sensitive plants, degradation of which would be a signal to remove stock during a controlled grazing regime.

Implementing a controlled livestock grazing regime for naturally treeless *Native Grassy* sites is acceptable. However, more intense grazing than the historical intensity which maintained the site as naturally treeless is NOT ACCEPTABLE.

Originally treed sites

Where there is a source of tree and/or shrub seed, excluding livestock for periods of time can help create the conditions required for regeneration. The predicted outcome would then be the site improves to *Shrubby*, *Single-Aged Young Overstorey* or *Young Overstorey*, depending on seed source availability. Due to the grazing habits of livestock, there is a higher risk of degradation of *Native Grassy* sites with ≥25% indigenous groundcover. Therefore, high-intensity grazing must be carefully and vigilantly managed to protect sensitive indigenous species. With originally treed *Native Grassy* sites, you should get expert botanical advice to identify grazing-sensitive plants, degradation of which would be a signal to remove stock during a controlled grazing regime.

Exclude livestock grazing

Naturally treeless sites

Table 3.16 shows the likely impacts of excluding livestock grazing. The predicted outcome is the site remains *Native Grassy,* with some degradation in vegetation structure.

Table 3.16 - Likely impacts of excluding livestock grazing on *Native Grassy* vegetation

Attribute	Impact		
	Negative	Neutral	Positive
Vegetation composition		✓	
Vegetation structure	✓		
Recruitment		✓	

There is likely to be little change to vegetation composition. Indigenous graminoid species are still likely to dominate and the cover of introduced species could reduce as a consequence.

A structural change is likely with reduced grazing pressure, based on an increase in the biomass of both indigenous and introduced species and a commensurate increase in their projective foliage cover.

If there is a soil seed bank of other groundcover species, these species could be recruited if you exclude grazing. Working against this is the possible loss of inter-tussock space, with increased retained plant biomass.

Excluding livestock grazing from naturally treeless *Native Grassy* sites is TOLERABLE.

Originally treed sites

The predicted outcome is the site remains *Native Grassy*, with some degradation in vegetation structure.

Should a suitable seed bank be available, there may be:

- natural recruitment of shrub species, resulting in the site improving to *Shrubby* in 2–5 years
- episodic recruitment of tree species (for example, following a flood event), resulting in the site improving to the higher-quality *Single-Aged Young Overstorey* in 2–5 years
- multiple recruitment events, resulting in the site improving to *Young Overstorey* in 20–50 years.

The loss of inter-tussock spaces from excluding grazing means that natural recruitment is unlikely.

Excluding livestock grazing from originally treed *Native Grassy* sites is TOLERABLE.

Exclude livestock grazing and revegetate

Naturally treeless sites

The predicted outcome is the site degrades to *Revegetation*, compromising the natural structure of the grassland.

Excluding livestock grazing and revegetating naturally treeless *Native Grassy* sites is NOT ACCEPTABLE: broad-scale revegetation of a naturally treeless site with indigenous woody species will degrade the site.

Originally treed sites

Excluding livestock will result in the loss of inter-tussock spaces, and natural recruitment of indigenous woody species is therefore unlikely. Replanting is more likely to improve the vegetation state, with a predicted outcome that the site improves to *Shrubby*, *Single-Aged Young Overstorey* or *Young Overstorey*, depending on the species planted and the number of planting events.

Summary

Tables 3.17 and 3.18 summarise the predicted outcomes and acceptability of each of the options for this vegetation state.

Table 3.17 - Predicted outcomes and acceptability of options, naturally treeless sites

Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site remains *Native Grassy*, with little or no change to vegetation structure and composition	Acceptable
Control the livestock grazing regime	Site remains *Native Grassy*, with potential improvements in vegetation structure and composition	Acceptable*
Exclude livestock grazing	Site remains *Native Grassy*, with some degradation in vegetation structure	Tolerable
Exclude livestock grazing and revegetate	Site degrades to *Revegetation*, compromising the natural structure of the grassland	Not acceptable

*** However, more intense grazing than the historical intensity which maintained the site as naturally treeless is not acceptable. You should seek expert botanical advice if considering this option.**

Table 3.18 - Predicted outcomes and acceptability of options, originally treed sites

Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site remains *Native Grassy*, but grazing inhibits the establishment of indigenous woody species	Tolerable
Control the livestock grazing regime	Site improves to *Shrubby*, *Single-Aged Young Overstorey* or *Young Overstorey*, depending on seed source availability	Beneficial*
Exclude livestock grazing	Site remains *Native Grassy*, with some degradation in vegetation structure	Tolerable
Exclude livestock grazing and revegetate	Site improves to *Shrubby*, *Single-Aged Young Overstorey* or *Young Overstorey*, depending on the species planted and the number of planting events	Beneficial

*** You should seek expert botanical advice if considering this option.**

3.5.3 Grazing management options decision tree

Figures 3.12 and 3.13 provide a decision tree to use when considering grazing management options for *Native Grassy* sites. They take account of:

- the guidance above, about the acceptability of grazing on vegetation condition and state
- possible effects on threatened terrestrial flora and/or fauna species and streambank stability
- whether the site is naturally treeless or originally treed (you will need to know the site's EVC for this).

Figure 3.12 - Grazing management options decision tree for Native Grassy (Part A)

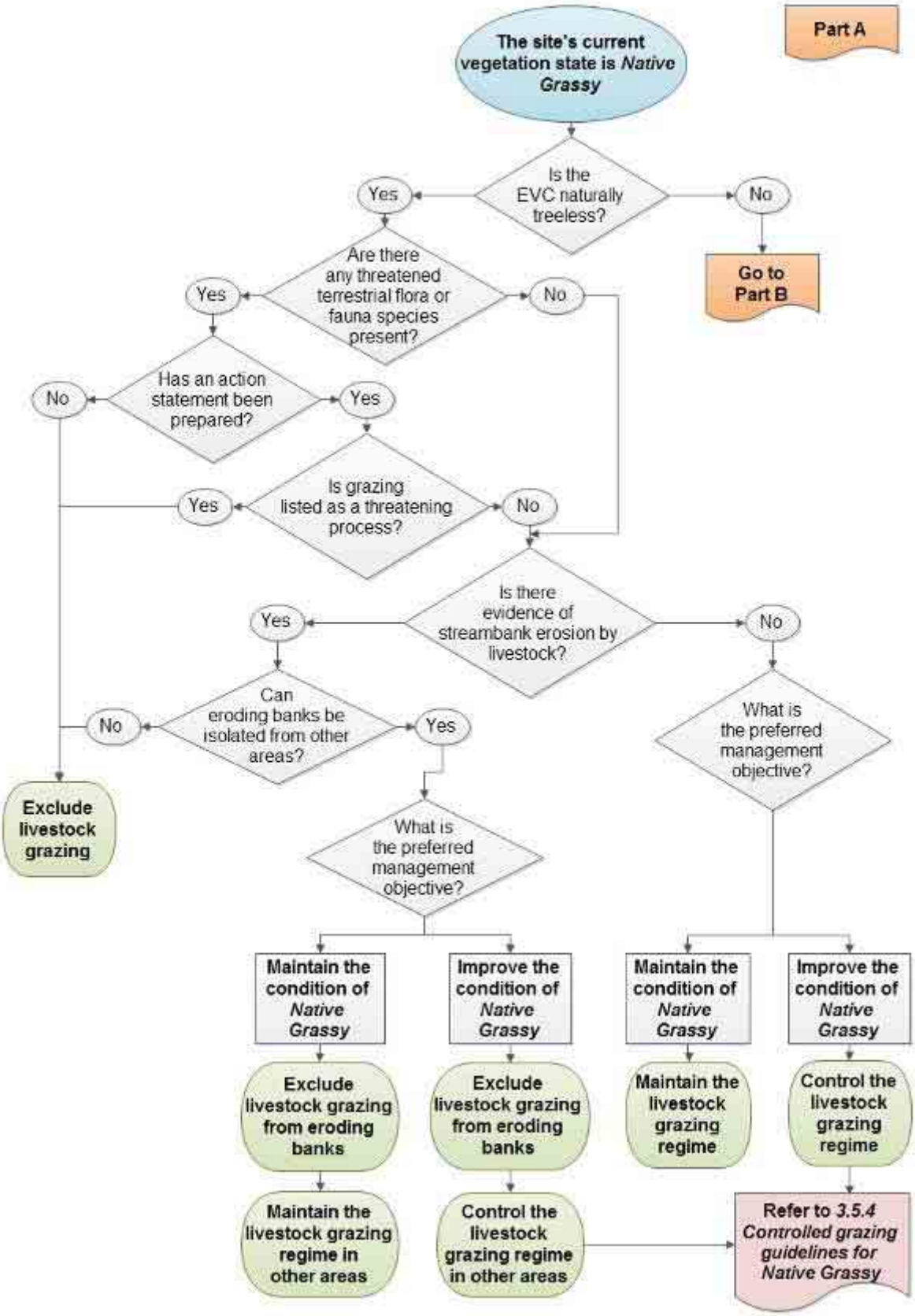
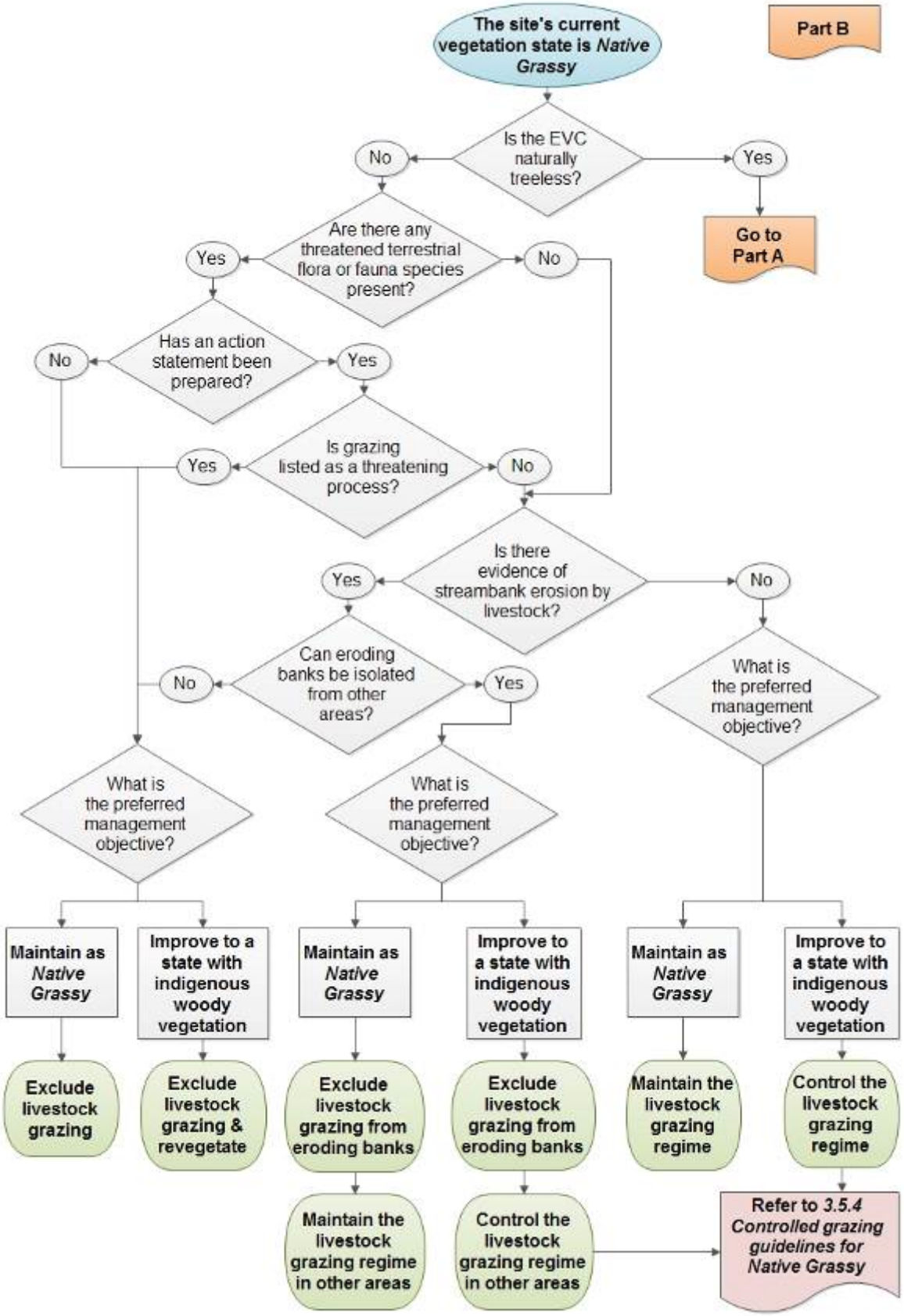


Figure 3.13 - Grazing management options decision tree for *Native Grassy* (Part B)



3.5.4 Controlled grazing guidelines for *Native Grassy*

If you decided to use controlled grazing, you should consider the guidelines below (as well as the guidelines in *2.4.2 Control the livestock grazing regime*). Figures 3.14 and 3.15 provide decision trees to use to plan your implementation of the guidelines.

Background

Controlling grazing of a naturally treeless *Native Grassy* site can help:

- recruit herbaceous species
- reduce the cover, diversity and biomass of weeds
- increase the cover, diversity and biomass of indigenous species
- reduce the amount of seed that annual grasses produce
- increase the indigenous groundcover composition by increasing the proportion of perennials, while suppressing annual grasses.

Controlled grazing of an originally treed *Native Grassy* site can help:

- recruit indigenous woody and herbaceous species
- develop multi-age stands of overstorey and understorey species, and make the vegetation structure more diverse
- reduce the cover, diversity and biomass of weeds
- increase the cover, diversity and biomass of indigenous species
- ensure the survival and longevity of indigenous overstorey and understorey species, which can complete their natural life cycle without disturbance
- retain and enhance the soil seed bank
- minimise soil disturbance.

The most common impediments to improving *Native Grassy* sites are:

- a dense indigenous graminoid ground layer that shades and outcompetes smaller indigenous herbs and forbs
- predation of young plants by livestock.
- Short-duration, intense livestock grazing help address these impediments by:
- controlling the impact of livestock
- opening up the dense indigenous graminoid ground layer
- creating the conditions for trees and shrubs to regenerate.

Ecological grazing standards may apply to sites assessed as *Native Grassy*. You should refer to DELWP's *Output Delivery Standards*[20] for further information.

Initial livestock exclusion (for originally treed sites only)

In some situations, natural regeneration of woody species will occur easily—provided there is an appropriate seed source—if you exclude grazing. As such, after you fence a site, you should consider excluding livestock for at least two years to create the opportunity for unassisted natural regeneration.

[20] Department of Environment, Land, Water and Planning (2015)

Timing of controlled grazing

Naturally treeless sites

Heavy grazing when indigenous graminoids are entering their annual growth phase can damage or substantially weaken the vegetation by reducing its ability to set seed and send out new growth.

Therefore, you should not use controlled grazing in spring and early summer, when native plants are in flower or setting seed.

You should use controlled grazing when most native plants are dormant (which is from late summer to early winter, and provided the ground is neither too wet nor too dry), ensuring that the total vegetation cover remains above 70%.

Originally treed sites

Using controlled grazing reduces grazing pressure, allowing shrubs and trees to regenerate naturally. As such, the same grazing regimes apply as for naturally treeless sites.

Protecting isolated regeneration (for originally treed sites only)

Before using controlled grazing, you should protect any clumps or areas of natural woody regeneration with temporary fencing (such as with electrical tape).

Where natural regeneration does not occur (for originally treed sites only)

Some sites won't support natural regeneration. This may be due to factors besides livestock grazing, such as:

- predation of young plants by other vertebrate animals (including rabbits, hares and wildlife), insects and other invertebrates
- poor seed supply (due to factors such as harvesting by ants; predation by other insects, birds and mammals; lack of fire; and lack of pollinators)
- poor soil conditions for germination (due to factors such as soil compaction, loss of topsoil and changes to soil chemistry)
- natural hazards and controls (such as wildfire, flood, wind, drought, temperature extremes and time of the year).

Where natural regeneration of woody vegetation does not occur, you may need to consider:

- controlling graminoids by other methods (such as slashing)
- controlling other vertebrate animals
- revegetating the site using tube stock.

Figure 3.14 - Controlled grazing decision tree for *Native Grassy* (naturally treeless sites)

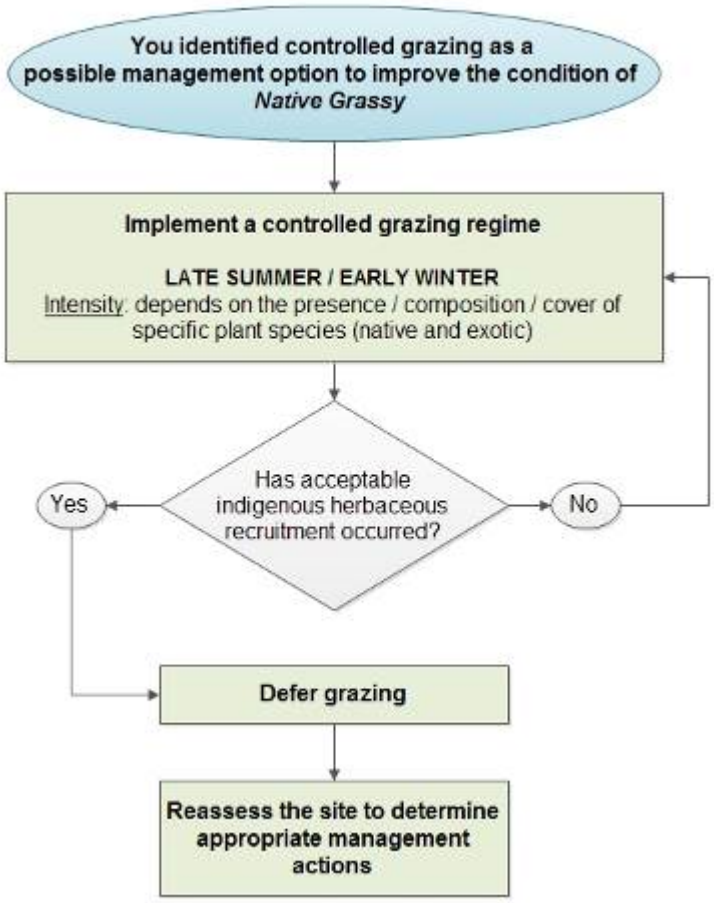
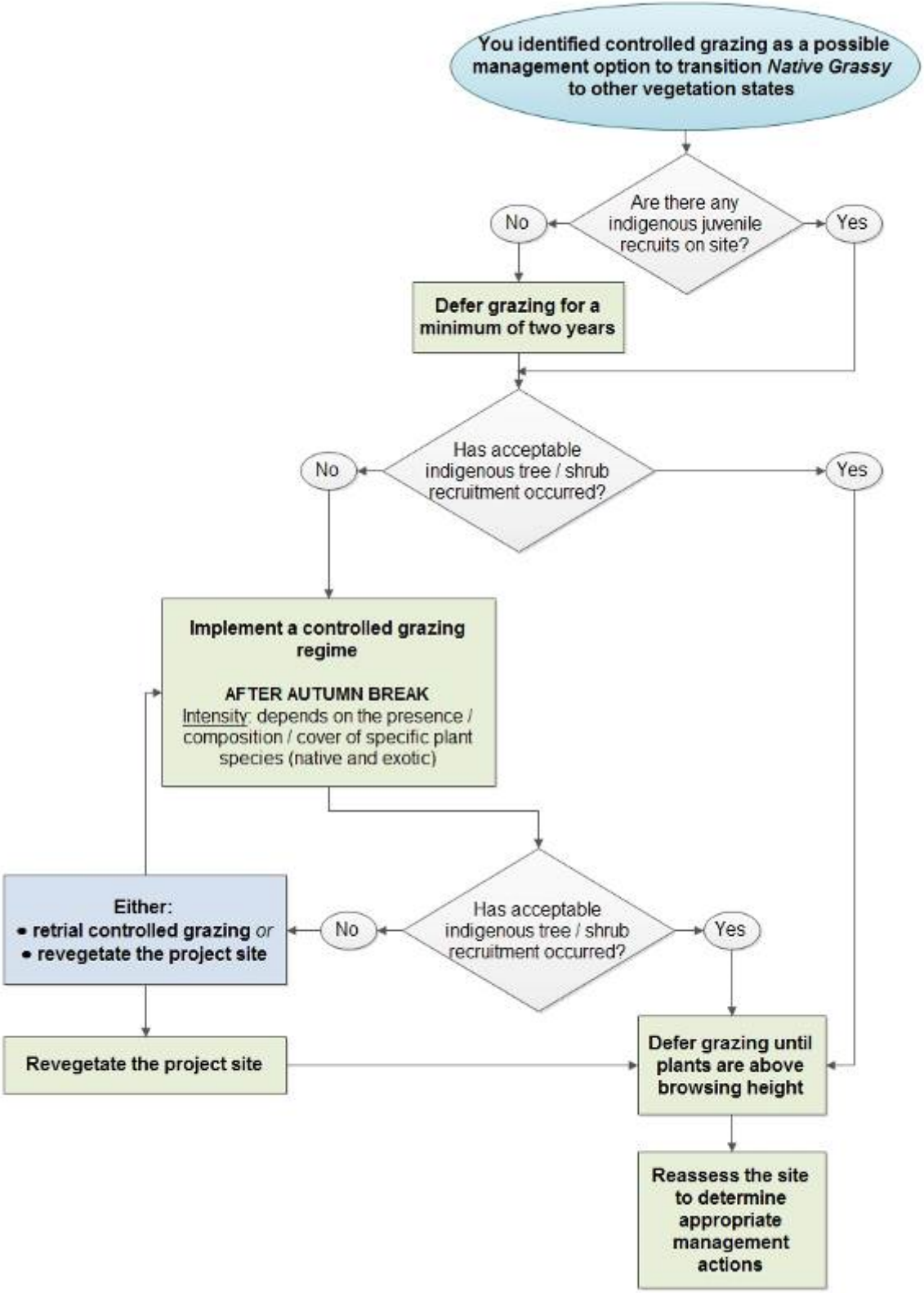


Figure 3.15 - Controlled grazing decision tree for *Native Grassy* (originally treed sites)



3.6 Mature Overstorey

3.6.1 Characteristics

Sites in the *Mature Overstorey* vegetation state will have had moderate-to-high-intensity livestock grazing, which will have significantly disturbed the soil. Younger and smaller-diameter trees would have been progressively cleared over time, with grazing preventing juvenile plants from becoming established.

Table 3.19 shows typical *Mature Overstorey* vegetation state characteristics.

Table 3.19 - Typical *Mature Overstorey* vegetation state characteristics

Overstorey	Shrub layer	Ground cover
• Overstorey is usually older age classes, with no recent recruitment* • There may be some exotic overstorey individuals	• There is no shrub layer, or only isolated individuals, and no shrub recruitment*	• Introduced annual/perennial species usually dominate the ground cover • There may be some indigenous ground cover, but it is likely to be very patchy and in low abundance

*** You can categorise the site as *Mature Overstorey* even if there are some isolated/scattered younger individuals.**

3.6.2 Grazing management options

Maintain the existing livestock grazing regime

The predicted outcome is the site remains *Mature Overstorey*. Continued livestock grazing will result in little or no change in the composition or structure of the vegetation.

Most grazing-sensitive indigenous plant species (such as the palatable indigenous herbs and forbs) have already been lost, due to a significant grazing history. As a result, there will be no effective indigenous soil seed bank of these species. Introduced grasses are likely to dominate the site, with no indigenous species recruitment evident.

With no recruitment, the mature overstorey will eventually be lost through dieback or disturbance within 20–50 years, and the predicted outcome is the site degrades to the lesser-quality *Exotic Pasture/Herbaceous*.

Maintaining the existing livestock grazing regime for *Mature Overstorey* is NOT ACCEPTABLE: the vegetation state will most likely degrade within 20–50 years.

Control the livestock grazing regime

The predicted outcome is the site remains *Mature Overstorey* in the long-term, provided the grazing regime includes periods of livestock removal, so some tree species can be recruited to provide a more multi-aged stand.

Exclude livestock grazing

Table 3.20 shows the likely impacts of excluding livestock grazing.

The predicted outcome for sites hydrologically connected to a river is to remain *Mature Overstorey*. Natural recruitment will be limited to disturbance events (such as floods).

The predicted outcome for sites no longer hydrologically connected to a river is to degrade to the lesser-quality *Exotic Pasture/Herbaceous*. Such sites will not have natural recruitment and the mature overstorey will eventually be lost through dieback or disturbance within 20–50 years.

Table 3.20 - Likely impacts of excluding livestock grazing on *Mature Overstorey* vegetation

Attribute	Impact		
	Negative	Neutral	Positive
Vegetation composition		✓	
Vegetation structure	✓		

With grazing excluded, there is likely to be little change in the composition of the vegetation, with introduced annual/perennial groundcover species still likely to dominate.

A structural change to the vegetation is likely with reduced grazing pressure, based on an increase in the biomass of introduced groundcover species, and a commensurate increase in their projective foliage cover. Such a change would reduce the prospects for regeneration of indigenous woody species and any indigenous herbs or forbs that remain at ground level, or that have seed in the soil.

Exclude livestock grazing and revegetate

The predicted outcome is the site improves to higher-quality *Modified Remnant* over 20–50 years if the ground layer conditions for establishing indigenous trees, shrubs, herbs and forbs are enhanced. This requires ground layer weed cover to be significantly reduced.

Natural regeneration

Where there is a soil seed bank, annual and perennial weeds must be controlled and reduced if tree and understorey species are to be recruited and regenerated.

Replanting

If natural regeneration has not succeeded, or will not succeed, on the site (such as if there is no seed bank) you will need to replant it.

Replanting will only succeed if herbaceous weeds are controlled before and after plants become established, to ensure the weeds do not outcompete the plants at ground level.

Summary

Table 3.21 summarises the predicted outcomes and acceptability of each of the options for this vegetation state.

Table 3.21 - Predicted outcomes and acceptability of options

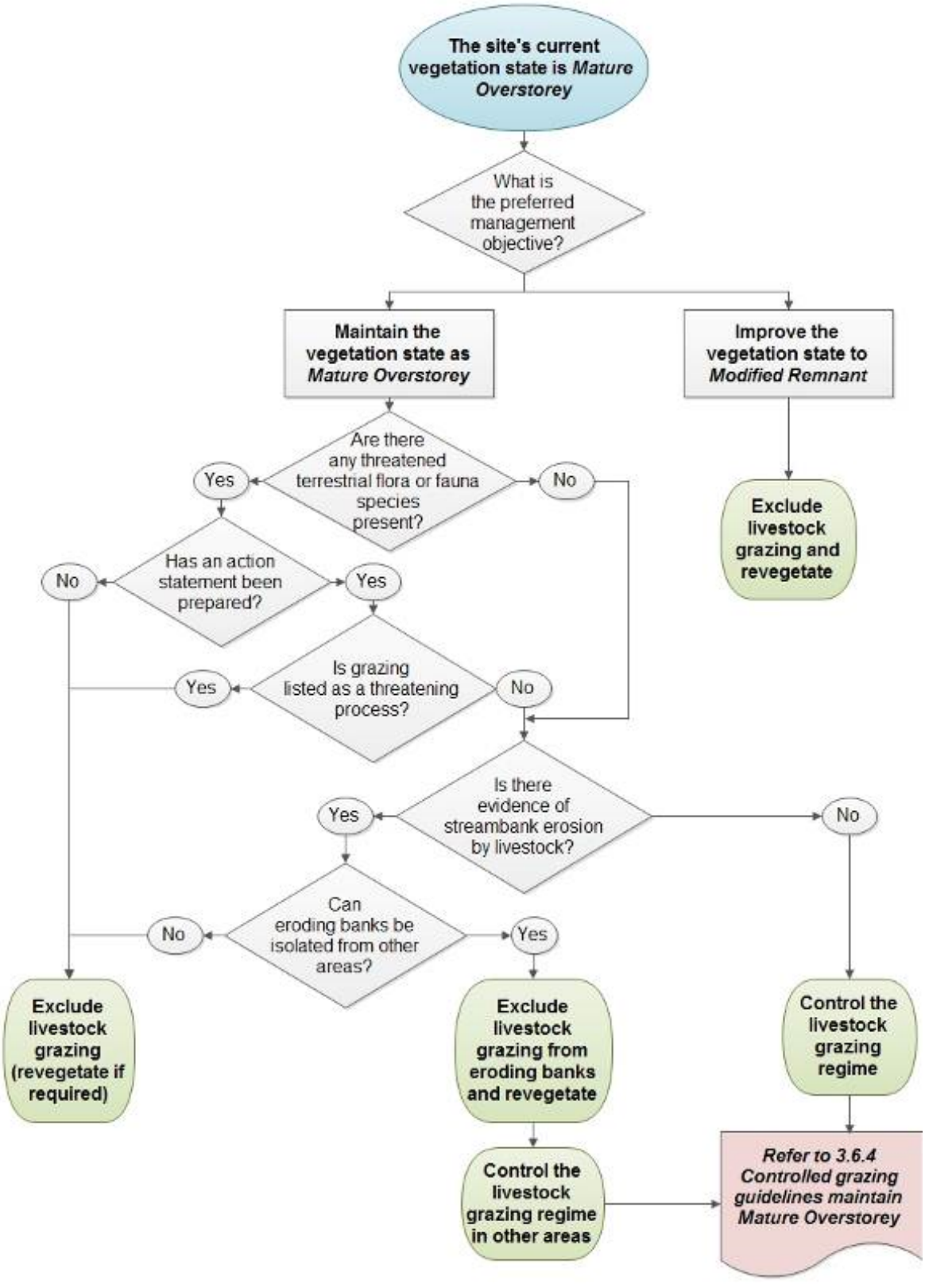
Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site remains *Mature Overstorey* for 20–50 years before degrading to *Exotic Pasture/Herbaceous*	Not acceptable
Control the livestock grazing regime	Site remains Mature Overstorey	Acceptable
Exclude livestock grazing	Site hydrologically connected to a river remains *Mature Overstorey* Site no longer hydrologically connected to a river degrades to the lesser-quality *Exotic Pasture/Herbaceous*	Acceptable Not Acceptable
Exclude livestock grazing and revegetate	Site improves to the higher-quality *Modified Remnant* over 20–50 years	Beneficial

3.6.3 Grazing management options decision tree

Figure 3.16 provides a decision tree to use when considering grazing management options for *Mature Overstorey* sites. It takes account of:

- the guidance above, about the acceptability of grazing on vegetation condition and state
- possible effects on threatened terrestrial flora and/or fauna species and streambank stability.

Figure 3.16 - Grazing management options decision tree for *Mature Overstorey*



3.6.4 Controlled grazing guidelines to maintain *Mature Overstorey*

If you decided to use controlled grazing, you should consider the guidelines below (as well as the guidelines in *2.4.2 Control the livestock grazing regime*). Figures 3.17 to 3.21 provide decision trees to use to plan your implementation of the guidelines.

Background

Controlled grazing of a *Mature Overstorey* site can:

- create conditions which can lead to the recruitment of indigenous woody and herbaceous species
- develop multi-age stands of overstorey and understorey species and make the vegetation structure more diverse
- reduce the cover, diversity and biomass of weeds
- increase the cover, diversity and biomass of indigenous species
- ensure the survival and longevity of indigenous overstorey and understorey species, which can complete their natural life cycle without being disturbed
- retain and enhance the soil seed bank
- minimise soil disturbance.

Sites can remain as *Mature Overstorey* in the long-term if some tree species can be recruited through natural regeneration. Natural regeneration is the process of reintroducing vegetation to a site by allowing seed, suckers or lignotubers to grow. The success of this process depends on:

- the proximity of mature trees and shrubs
- there being no (or intermittent) livestock grazing
- there being no history of cultivation
- little or no use of phosphorus
- a low proportion of improved/introduced pastures.

Where there is an appropriate source of tree and/or shrub seed, the most common impediments to natural regeneration of a *Mature Overstorey* site are:

- predation of young plants by livestock
- competition from weeds.

Controlled grazing can help address these impediments by:

- controlling the impact of livestock
- reducing herbaceous weed cover
- creating the conditions for regenerating trees and shrubs.

Siting of riparian fencing

When deciding where to locate riparian fencing, you should bear in mind that:

- remnant vegetation seedlings won't establish immediately under the parent tree canopy
- regeneration is unlikely beyond 60m of a remnant
- any fencing for regeneration should be at least two canopy widths from the base of the tree.

Initial livestock exclusion

In some places, natural regeneration will easily occur—provided there is an appropriate seed source—if there is no grazing pressure. Therefore, after you fence a site, consider excluding livestock for at least two years, to let unassisted natural regeneration occur.

Excluding livestock is unlikely to result in natural regeneration if the project site has a high proportion of introduced pasture (typical for *Mature Overstorey*). This is due to direct competition for nutrients, moisture and light; smothering; and a lack of germination gaps. In these circumstances, controlled grazing in the early stages, to reduce herbaceous weed cover, helps natural regeneration.

Protecting isolated regeneration

Before starting controlled grazing, you should protect any clumps or areas of natural regeneration with temporary fencing (such as with electrical tape).

Timing of controlled grazing to reduce herbaceous weed cover

The optimum time for controlled grazing to reduce herbaceous weed cover is when plants' stems have elongated, but before their seed heads emerge. This usually happens in late winter through early spring. Controlled grazing at this time reduces competition and creates gaps in the following seasons for native plant seeds to germinate.

Where conditions (such as wet soil) limit the use of controlled grazing, you should control herbaceous weed cover using other methods (such as with chemicals, and by slashing).

Livestock exclusion periods

The key to controlling herbaceous weeds to promote natural regeneration is to time grazing with the critical stages in the weed life cycle. As native plants tend to flower and set seed during spring and early summer, you should exclude livestock from sites from early spring to late summer, depending on seasonal variations.

You should also exclude livestock from sites once you consider that the extent of recruitment of indigenous trees/shrubs is acceptable, in terms of the number, diversity and density of individuals, and/or the area of natural regeneration. Do not return livestock until saplings are established and above browsing height. This usually takes 3–5 years.

Timing of controlled grazing to reduce perceived fire risk

Where there is a perceived fire risk, you should consider low-intensity grazing (for example, for a few weeks and at a low stocking rate) at the end of the growing season in early summer, to control long grass.

Low-intensity grazing at the right time can also help natural regeneration. Grazing before eucalypts emerge, and possibly for some time afterwards, when seedlings are inconspicuous, can create bare ground. Livestock may prefer the seedlings when they are more advanced. As such, you should only use controlled grazing to reduce a perceived fire risk when seedlings are inconspicuous, or above browsing height.

Where natural regeneration does not occur

Some sites won't support natural regeneration. This might be due to factors other than livestock grazing and competitive weeds, such as:

- predation of young plants by other vertebrate animals (including rabbits, hares and wildlife), insects and other invertebrates
- poor seed supply (due to factors such as harvesting by ants; predation by other insects, birds and mammals; lack of fire; or lack of pollinators)

- poor soil conditions for germination (due to factors such as soil compaction, loss of topsoil or changes to soil chemistry)
- natural hazards and controls (such as wildfire, flood, wind, drought, temperature extremes and time of the year).

Where natural regeneration does not occur, you may need to consider:

- controlling herbaceous weeds by other methods (such as herbicides)
- controlling other vertebrate animals
- revegetation using tube stock or direct seeding.

Figure 3.17 - Controlled grazing decision tree for *Mature Overstorey* (Precursor)

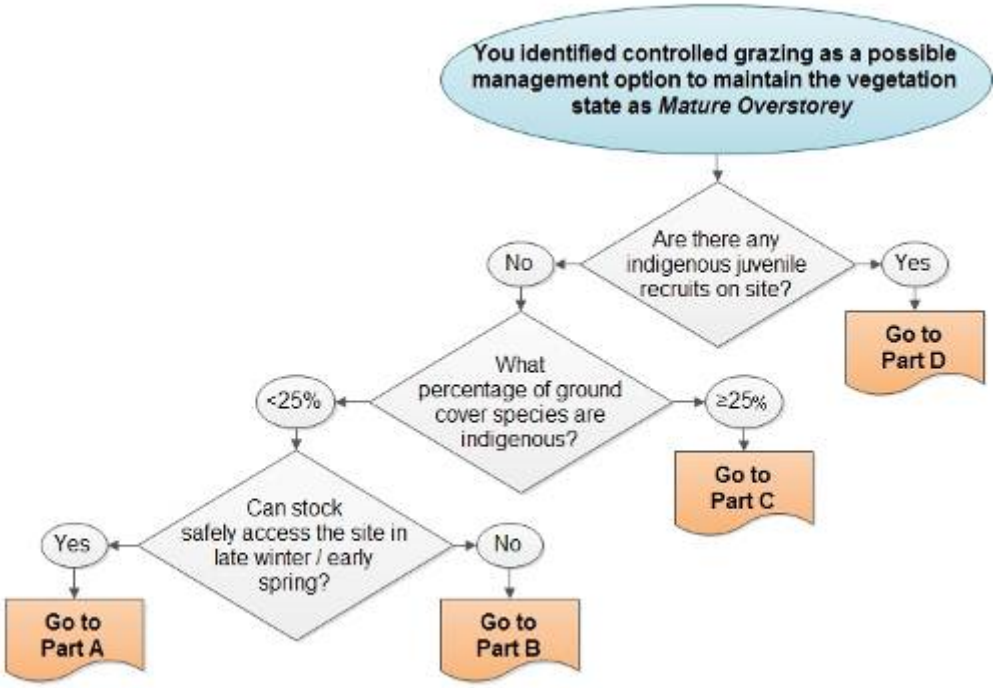


Figure 3.18 - Controlled grazing decision tree for *Mature Overstorey* (Part A)

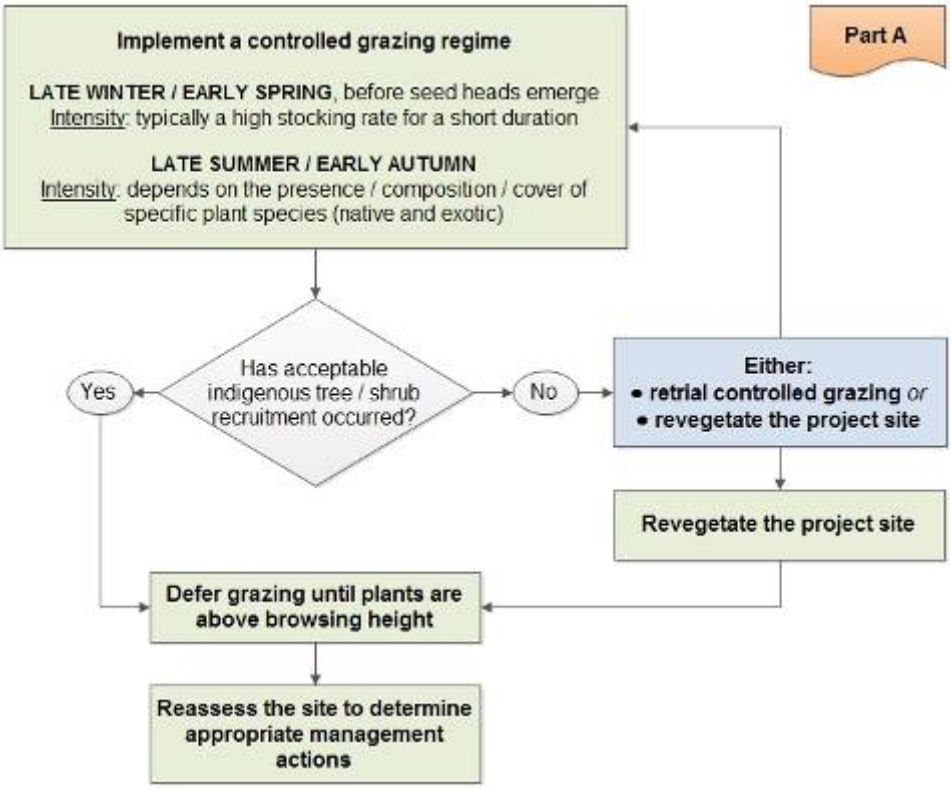


Figure 3.19 - Controlled grazing decision tree for *Mature Overstorey* (Part B)

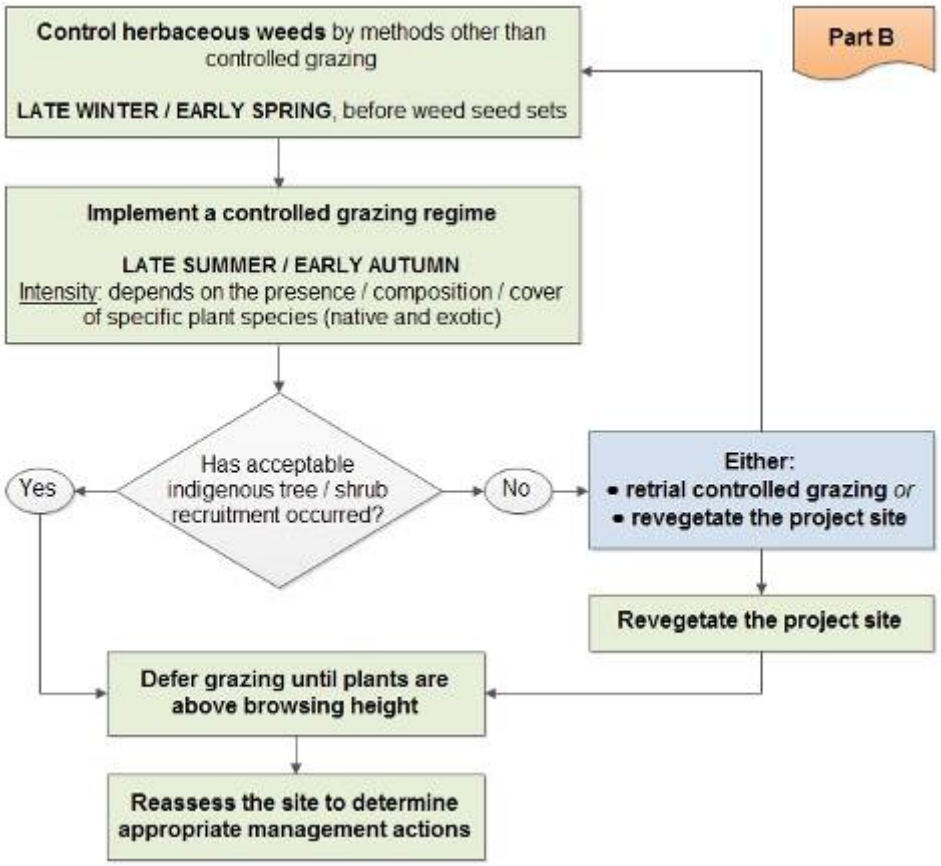


Figure 3.20 - Controlled grazing decision tree for *Mature Overstorey* (Part C)

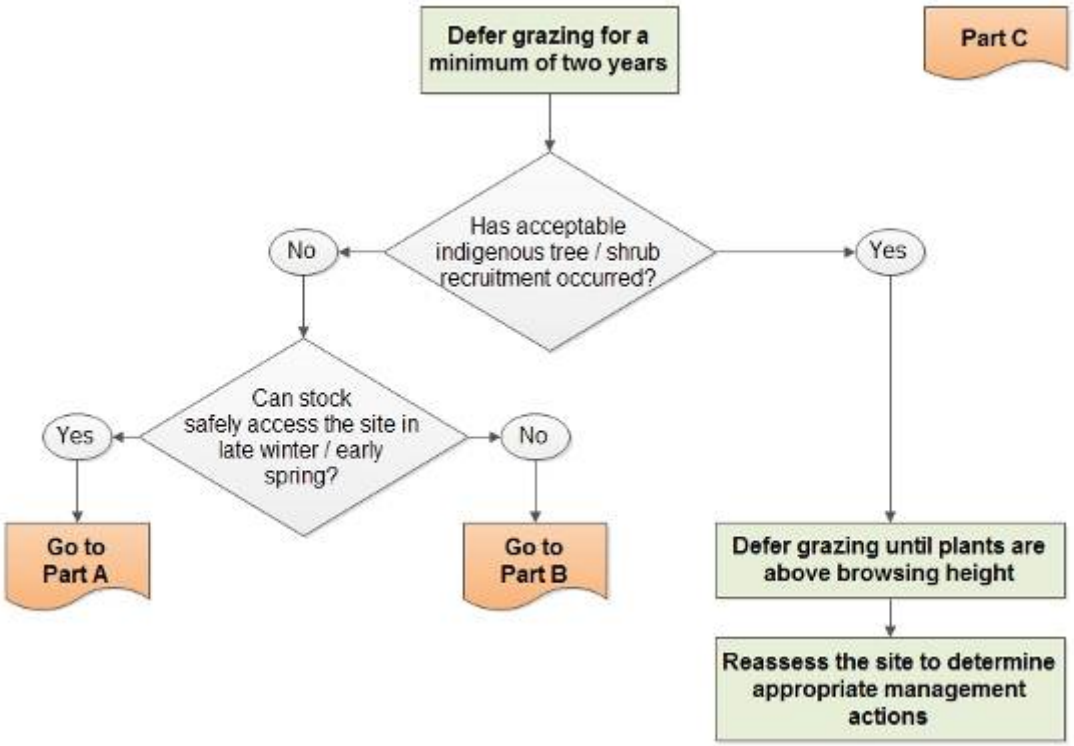
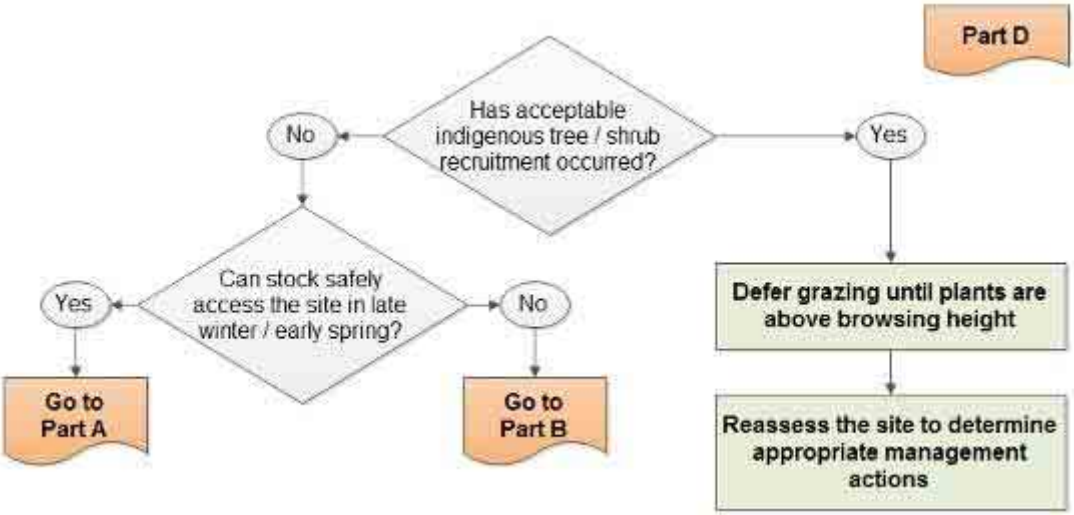


Figure 3.21 - Controlled grazing decision tree for *Mature Overstorey* (Part D)



3.7 Single-Aged Young Overstorey

3.7.1 Characteristics

A riparian site in the *Single-Aged Young Overstorey* vegetation state is mostly comprised of younger overstorey individuals, beyond grazing height. This is due to a recent, single-event recruitment, or to revegetation that has now grown beyond grazing height.

Table 3.22 shows typical *Single-Aged Young Overstorey* vegetation state characteristics.

Table 3.22 - Typical *Single-Aged Young Overstorey* vegetation state characteristics

Overstorey	Understorey (shrub layer and ground cover)
• Overstorey is comprised of mostly younger individuals • Tree stems may be very dense, depending on the time since recruitment—there may not have been enough time for natural thinning – or site circumstances* • There could be exotic overstorey individuals	• Understorey may have some indigenous and introduced species, but their abundance will depend on the density of the overstorey

*** You can categorise the site as *Single-Aged Young Overstorey* even if there are some isolated/scattered older individuals (with larger diameters).**

3.7.2 Grazing management options

Maintain the existing livestock grazing regime

In most instances of *Single-Aged Young Overstorey*, the tree density is very high. Consequently, there is little plant production at ground level, so grazing productivity is likely to be poor. This low plant production is due to shading and to intense competition for nutrients and water, once individuals grow to 2–3 metres high.

The predicted outcome is the site remains *Single-Aged Young Overstorey* long-term, with little change in the composition and structure of the vegetation, until there is natural thinning.

Control the livestock grazing regime

As there are limited grazing opportunities for livestock due to the high tree density, there is usually little, if any, advantage with controlled grazing**.**

Implementing a controlled livestock grazing regime for *Single-Aged Young Overstorey* is NOT APPLICABLE.

Exclude livestock grazing

The predicted outcome is the site remains *Single-Aged Young Overstorey*, until there is natural thinning. Given that the density of tree stems is likely to be high, the already sparse and low-cover ground layer is unlikely to change substantially, even if you exclude grazing.

Exclude livestock grazing, thin stands and revegetate

With ecological thinning, weed control and revegetation, the predicted outcome is the site improves to *Young Overstorey*, then to *Mature Overstorey,* over 20–50 years. The actual timeframe depends on the composition of the ground layer with thinning, and whether there are further recruitment events of overstorey species.

Thinning will increase the amount of light reaching the ground, which will in turn help increase the ground layer plant cover.

Single-Aged Young Overstorey is dense, and there is little plant production at ground level due to shading and to intense competition for nutrients and water. As such, you may need to control weeds after the canopy opens.

Thinning and weed control will increase the available light, nutrients and water. This will enable revegetation, either by natural recruitment or replanting.

Summary

Table 3.23 summarises the predicted outcomes and acceptability of each of the options for this vegetation state.

Table 3.23 - Predicted outcomes and acceptability of options

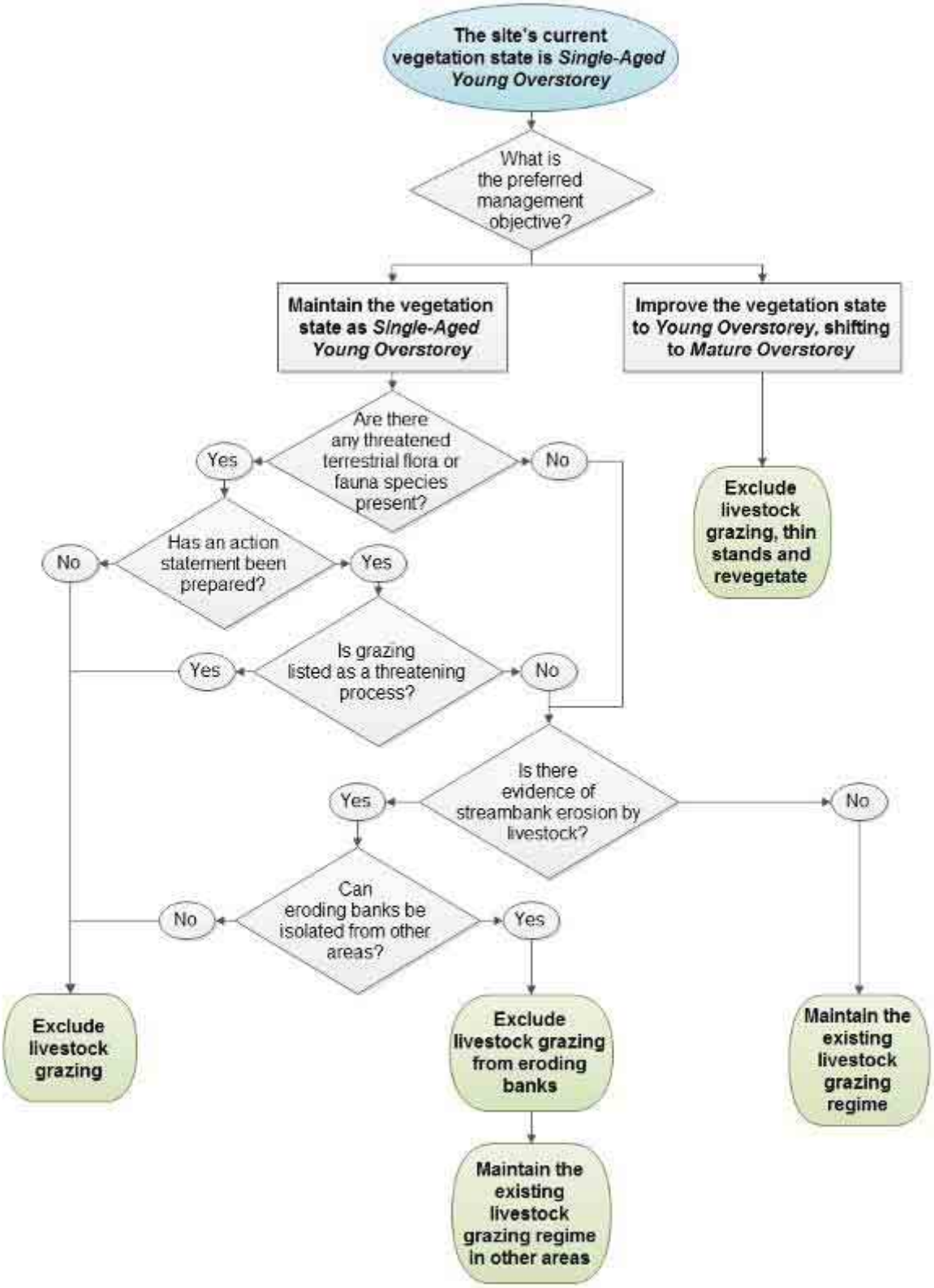
Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site remains *Single-Aged Young Overstorey* until there is natural thinning	Acceptable
Control the livestock grazing regime	Not applicable	
Exclude livestock grazing	Site remains *Single-Aged Young Overstorey* until there is natural thinning	Acceptable
Exclude livestock grazing, thin stands and revegetate	Site improves to *Young Overstorey*, then to *Mature Overstorey*, over 20–50 years	Beneficial

3.7.3 Grazing management options decision tree

Figure 3.22 provides a decision tree to use when considering options for a *Single-Aged Young Overstorey* site. It takes account of:

- the guidance above, about the acceptability of grazing on vegetation condition and state
- possible effects on threatened terrestrial flora and/or fauna species and streambank stability.

Figure 3.22 - Grazing management options decision tree for *Single-Aged Young Overstorey*



3.8 Shrubby

3.8.1 Characteristics

Sites in the *Shrubby* vegetation state are likely to have had major tree clearing and/or tree mortality, as well as periods of grazing pressure. The timing of grazing will have prevented the overstorey from regenerating, but will have allowed shrub recruitment, which was most likely episodic.

You will need to know the site's EVC to determine whether the site is naturally treeless or originally treed.[21]

Table 3.24 shows typical *Shrubby* vegetation state characteristics.

Table 3.24 - Typical *Shrubby* vegetation state characteristics

Overstorey	Shrub layer	Ground cover
• Overstorey usually has no trees, and no evidence of recruitment of tree species*	• A medium-to-tall shrub layer of only one or two species (from 1m high) dominates the shrub layer • There may be evidence of recent recruitment of these species, depending on the recent grazing regime • There may be areas which are naturally treeless (according to their EVC benchmark): if so, the understorey may be predominantly indigenous species	• The cover and abundance of the ground layer depends on the density of shrub stems • The ground layer is likely to comprise introduced species, especially grasses

*** You can categorise the site as *Shrubby* even if there are some isolated/scattered older individuals (with larger diameters).**

3.8.2 Grazing management options

Grazing management options will differ depending on whether the site is naturally treeless, or was originally treed. You will need to know the site's EVC to determine whether the site is naturally treeless or originally treed.

Maintain the existing livestock grazing regime

The shrub density is high on most *Shrubby* sites. Consequently, there is little other plant production at ground level among the shrub patches. This is due to shading and intense competition for nutrients and water, once individuals grow to 2–3 metres high. Grazing productivity is therefore likely to be marginal.

If you maintain grazing, there will be little natural recruitment, and relatively little change in the composition and structure of the vegetation until there is significant mortality in the shrub layer. This should be in less than 20 years, depending on the species.

Until then, with no change in livestock grazing practices, sites are highly likely to remain as *Shrubby*. However, after significant mortality (over 5–20 years), and with continued grazing, the predicted outcome is that the site will degrade to poor-quality *Exotic Pasture/Herbaceous*.

Maintaining the existing livestock grazing regime for *Shrubby* is NOT ACCEPTABLE: the vegetation condition is highly likely to decline with continued grazing.

[21] For EVC information, see http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/evc-benchmarks.

Control the livestock grazing regime

Grazing opportunities for livestock are limited to the edges of shrub stands and patches, due to high shrub density. However, this is also where shrub recruitment can occur. As such, the predicted outcome is that the site remains *Shrubby* and may degrade over time, with mortality in the existing shrub layer.

Implementing a controlled livestock grazing regime for *Shrubby* is NOT ACCEPTABLE: controlled grazing does not improve the vegetation state and may degrade it over time.

Exclude livestock grazing

Shrubby sites have high shrub density and little other plant production at ground level. Excluding grazing will not change this. However, the death of mature plants leads to gaps in the canopy, and excluding livestock creates opportunities for natural recruitment. This recruitment can lead to the *Shrubby* state becoming stable for up to 50 years, depending on the species. Excluding livestock also enables recruitment on the edges of shrub stands and patches, expanding the total area covered by shrubs. The predicted outcome is the site remains *Shrubby*, with an increase in the vegetated area.

If you exclude grazing, there is likely to be significant growth of annual/perennial weeds around the edges of shrub stands and in gaps in the canopy. You may need to manage weeds in these areas, so that recruitment can occur.

Exclude livestock grazing and revegetate

If overstorey species are planted, the predicted outcome is the site will improve to higher-quality *Modified Remnant* over 20–30 years. If only understorey species are planted, the predicted outcome is the site remains *Shrubby*, but with a greater diversity of species. For revegetation to be successful, you need to control herbaceous and woody weeds, particularly before plants are established.

Summary

Table 3.25 summarises the predicted outcomes and acceptability of each of the options for this vegetation state.

Table 3.25 - Predicted outcomes and acceptability of options

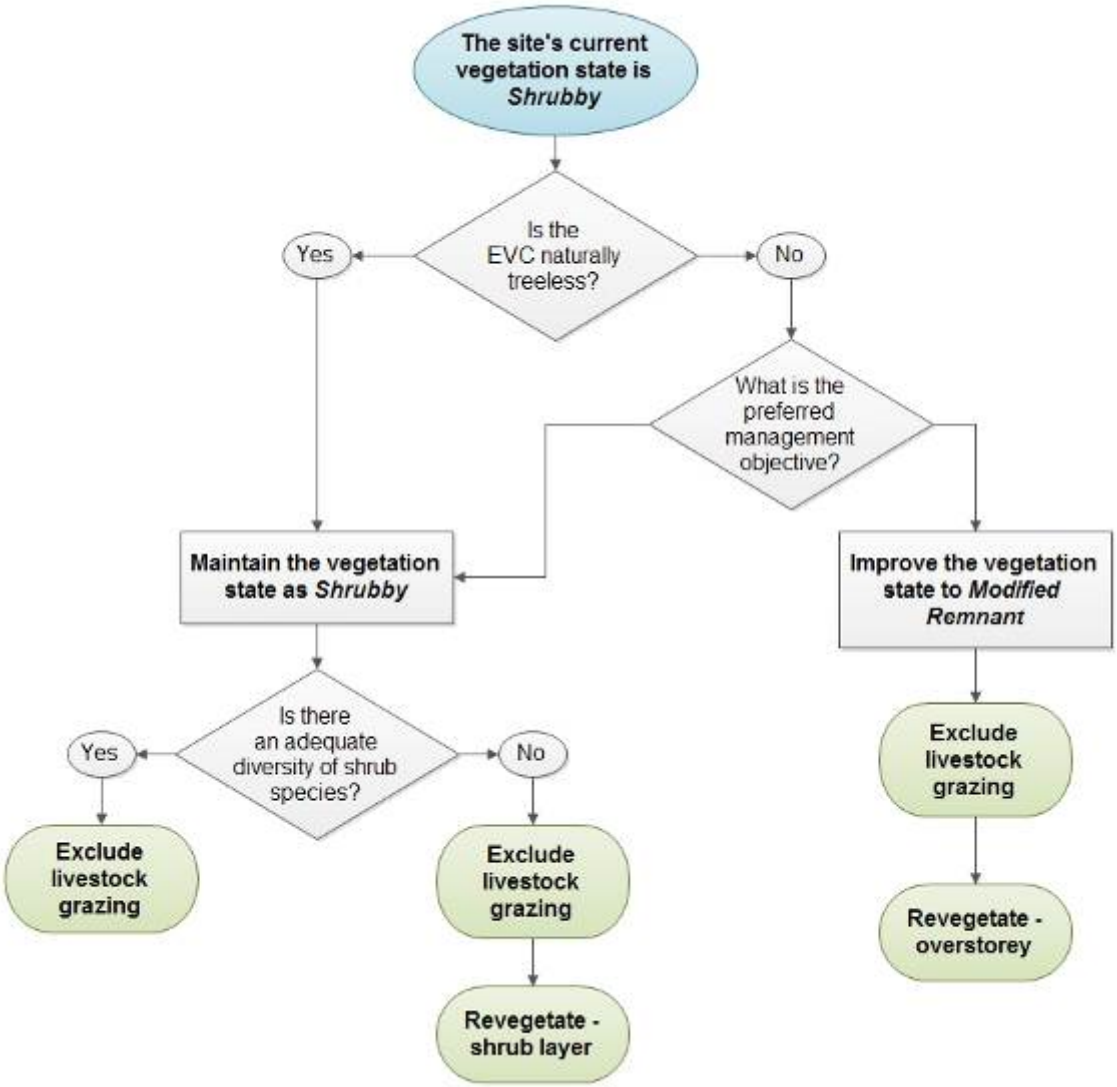
Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site degrades to poor-quality *Exotic Pasture/Herbaceous*	Not acceptable
Control the livestock grazing regime	Site remains *Shrubby* but possibly in a more degraded condition	Not acceptable
Exclude livestock grazing	Site remains *Shrubby,* and the vegetated area increases	Acceptable
Exclude livestock grazing and revegetate	Site improves to either: • Modified Remnant or • a more diverse *Shrubby* state	Beneficial

3.8.3 Grazing management options decision tree

Figure 3.23 provides a decision tree to use when considering grazing management options for a *Shrubby* site. It takes account of:

- the guidance above, about the acceptability of grazing on vegetation condition and state
- possible effects on threatened terrestrial flora and/or fauna species and streambank stability
- whether the site is naturally treeless or originally treed (you will need to know the site's EVC for this).

Figure 3.23 - Grazing management options decision tree for *Shrubby*



3.9 Exotic Pasture/Herbaceous

3.9.1 Characteristics

Sites in the *Exotic Pasture/Herbaceous* vegetation state will have experienced:

- the complete, or near complete, clearing of trees and other indigenous vegetation
- significant soil disturbance (such as by heavy grazing, cultivation or soil improvement, for example by adding fertilisers)
- enhanced soil fertility and diminished soil structure (as a consequence of clearing and soil disturbance).

Table 3.26 shows typical *Exotic Pasture/Herbaceous* vegetation state characteristics.

Table 3.26 - Typical *Exotic Pasture/Herbaceous* vegetation state characteristics

Overstorey	Shrub layer	Ground cover
• Most overstorey has been removed or is dead (as a result of a single event, progressive clearing and/or tree dieback • There may be some scattered trees	• No indigenous shrub layer remains (as living plants or dormant seed in the soil seed bank)	• No indigenous ground cover remains (as living plants or dormant seed in the soil seed bank) • There is a reduced litter layer • Introduced annual and/or perennial species dominate, whether they were sown for a productive purpose or are opportunistic colonisers

3.9.2 Grazing management options

Maintain the existing livestock grazing regime

The predicted outcome is the site remains *Exotic Pasture/Herbaceous*.

Table 3.27shows the likely impacts of maintaining the existing livestock grazing regime.

Table 3.27 - Likely impacts of maintaining the existing livestock grazing regime on *Exotic Pasture/Herbaceous* vegetation

Attribute	Impact		
	Negative	Neutral	Positive
Vegetation composition	✓		✓
Vegetation structure		✓	

The composition of the vegetation may alter due to year-to-year variations in seasonal conditions and to the dispersal characteristics of opportunistic species.

Control the livestock grazing regime

Sites are commonly highly degraded and dominated by introduced ground layer plants (such as annual grasses). They may have no, or very few, indigenous ground layer species.

Excluding livestock grazing will lead to greater ground layer plant biomass. In some instances, this increase will be unacceptable (for example, if it increases the perceived fire risk) and you may then need to use controlled grazing to maintain the existing vegetation structure.

The predicted outcome is the site remains *Exotic Pasture/Herbaceous*.

Exclude livestock grazing

Sites commonly have no indigenous soil seed bank and an insignificant number of indigenous overstorey individuals. Excluding grazing is unlikely to result in indigenous species being recruited. This is because there is no available material to propagate individuals, and due to dense vegetation cover at ground level.

Table 3.28 shows the likely impacts of excluding livestock grazing. The predicted outcome is the site remains *Exotic Pasture/Herbaceous*, with some decline in vegetation structure and an increase in ground layer plant biomass. In some instances, this increase will be unacceptable (for example, if it increases the perceived fire risk) and you may need to use controlled grazing to maintain the existing vegetation structure.

Table 3.28 - Likely impacts of excluding livestock grazing on *Exotic Pasture/Herbaceous* vegetation

Attribute	Impact		
	Negative	Neutral	Positive
Vegetation structure	✓		

As excluding grazing helps increase the ground layer plant biomass, the vegetation structure will vary according to how long grazing is excluded, and on whether the species composition is more annual or perennial.

Exclude livestock grazing and revegetate

The predicted outcome is the site improves to *Revegetation*, if it is replanted with a diverse range of overstorey and understorey species.

Revegetation will only succeed if herbaceous weeds are controlled before and after plants become established, to ensure the dominant introduced annuals/perennials do not outcompete them at ground level.

To further improve *Revegetation* sites to higher-quality states (such as *Modified Remnant, Young Overstorey* or *Single-Aged Young Overstorey*), the cover and dominance of ground layer weeds must be significantly reduced, then controlled: plant establishment does not necessarily result in plant recruitment.

Summary

Table 3.29 summarises the predicted outcomes and acceptability of each of the options for this vegetation state.

Table 3.29 - Predicted outcomes and acceptability of options

Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site remains Exotic Pasture/Herbaceous	Acceptable
Control the livestock grazing regime	Site remains Exotic Pasture/Herbaceous	Acceptable*
Exclude livestock grazing	Site remains Exotic Pasture/Herbaceous, with an increase in ground layer plant biomass	Acceptable*
Exclude livestock grazing and revegetate	Site improves to Revegetation state, with potential to improve to better-quality states	Beneficial

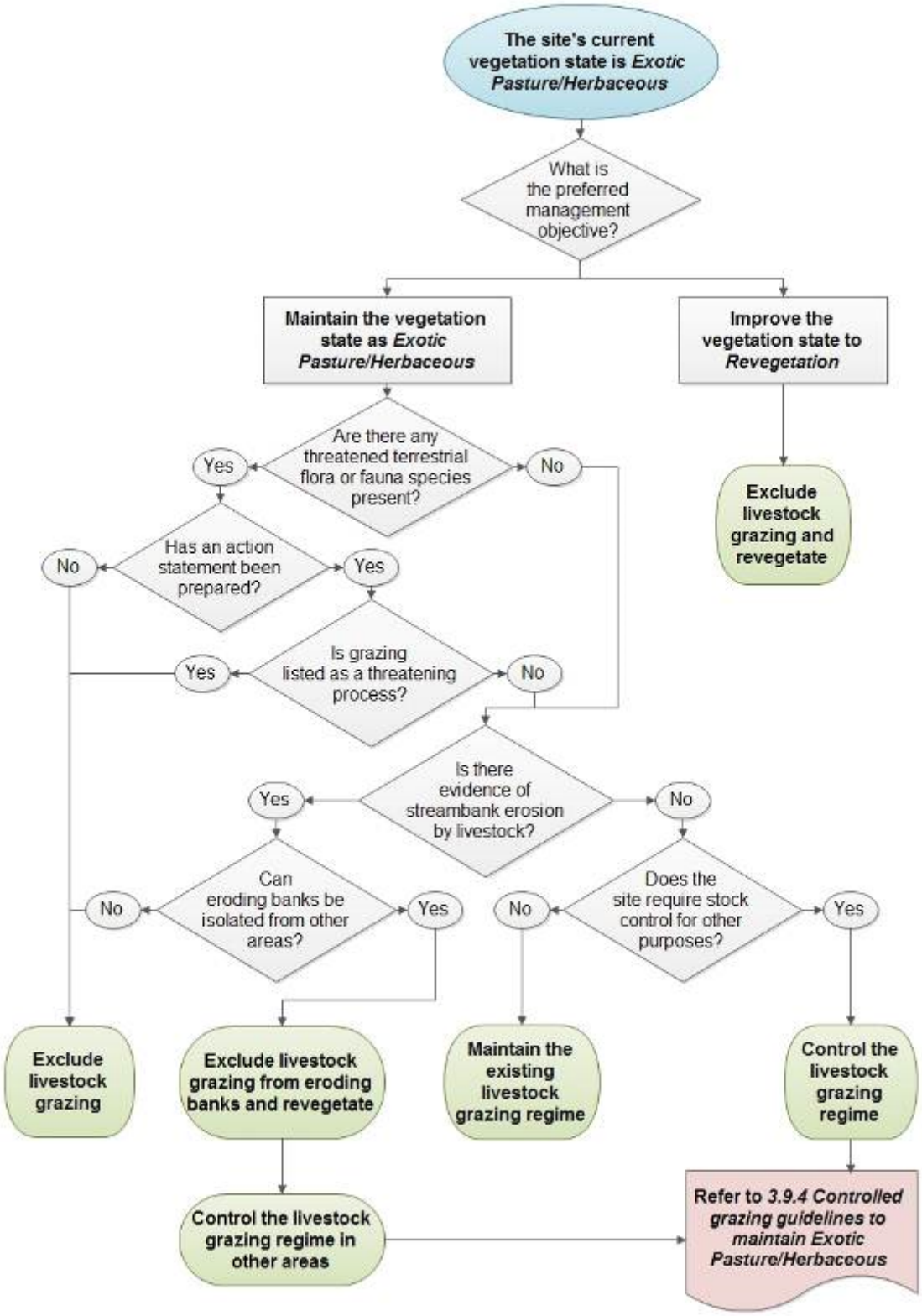
*** The degree of acceptability depends on the project objectives. For example, project objectives may include: protecting the quality of a downstream remnant by using livestock to control weed seed production in late winter through early spring or reducing the perceived fire risk.**

3.9.3 Grazing management options decision tree

Figure 3.24 provides a decision tree to use when considering grazing management options for *Exotic Pasture/Herbaceous* land. It takes account of:

- the guidance above, about the acceptability of grazing on vegetation condition and state
- possible effects on threatened terrestrial flora and/or fauna species and streambank stability.

Figure 3.24 - Grazing management options decision tree for *Exotic Pasture/Herbaceous*



3.9.4 Controlled grazing guidelines to maintain *Exotic Pasture/Herbaceous*

If you decided to use controlled grazing, you should consider the guidelines below (as well as the guidelines in *2.4.2 Control the livestock grazing regime*). Figure 3.25 provides a decision tree you can use to plan your implementation of the guidelines.

Background

Controlled grazing of *Exotic Pasture/Herbaceous* can ensure that:

- the cover, biomass, diversity and patterns of recruitment of indigenous and introduced species remain about the same
- the existing vegetation structure is maintained.

Timing of controlled grazing to maintain and control groundcover biomass

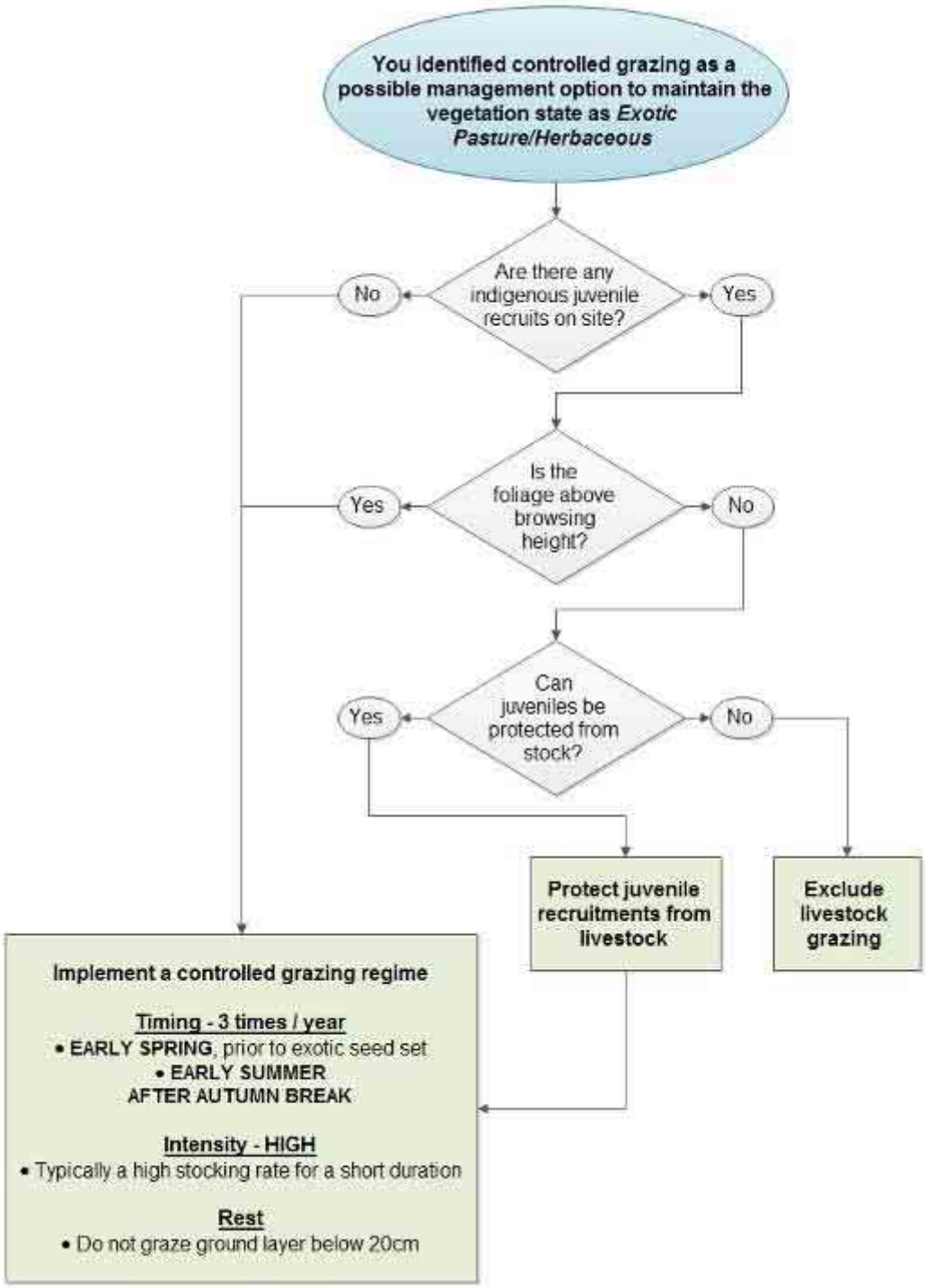
As ground level vegetation will have been mostly or completely introduced, you can use high-intensity grazing (typically a high stocking rate for a short duration) on about a four-month rotation (and being especially mindful of wet soil conditions) to:

- control weeds before their seeds set (in early spring)
- supplement feed and reduce perceived fire risks (in early summer)
- maintain the vegetation state (after the autumn break).

Minimum grass heights

Although grazing of the ground layer does not reduce biodiversity, it is very important for maintaining the herbaceous ground cover in riparian areas. It stabilises riverbanks, filters nutrients and sediments, and reduces the potential for soil to be directly scoured from the face of the bank and the floodplain. Its ability to do these things is a function of the height of the plants: plants are flattened during flood events, and the longer, leafy material directly protects the soil surface. Therefore, the herbaceous ground layer definitely must not be grazed below 10cm, and preferably not below 20cm.

Figure 3.25 - Controlled grazing decision tree for *Exotic Pasture/Herbaceous*



3.10 Exotic Woody

3.10.1 Characteristics

Sites in the *Exotic Woody* vegetation state are dominated by exotic tree and/or shrub species that were planted, or invaded the land, or both. They will have experienced:

- considerable clearing of trees and other indigenous vegetation
- significant soil disturbance (such as by heavy grazing, cultivation or soil improvement, for example by adding fertilisers)
- enhanced soil fertility (as a consequence of clearing and soil disturbance).

Table 3.30 shows typical *Exotic Woody* vegetation state characteristics.

Table 3.30 - Typical *Exotic Woody* vegetation state characteristics

Overstorey	Shrub layer	Ground cover
• The tallest layer/strata is exotic trees (such as willows and poplars) which dominate the site • There are no, or few, indigenous overstorey individuals remaining	• The tallest layer/strata is exotic shrubs (such as gorse and blackberry) which dominate the area	• Due to extensive shading and a deep exotic litter layer, there is little ground layer when the tallest layer is in leaf* • If present, the ground layer will be dominated by introduced species or large areas of a thick litter layer in winter, with the seasonal opening of the canopy

*** Not all dominant exotic species are deciduous.**

3.10.2 Grazing management options

Maintain the existing livestock grazing regime

Table 3.31 shows the likely impacts of maintaining the existing livestock grazing regime. The predicted outcome is the site remains *Exotic Woody.*

Table 3.31 - Likely impacts of maintaining the existing livestock grazing regime on *Exotic Woody* vegetation

Attribute	Impact		
	Negative	Neutral	Positive
Vegetation composition	✓		✓
Vegetation structure		✓	

The vegetation composition may change depending on seasonal conditions from year to year, and on the dispersal characteristics of opportunistic ground layer species.

Control the livestock grazing regime

Sites are commonly highly degraded and dominated by introduced ground layer plants (such as annual grasses). They may have no, or very few, indigenous ground layer species.

Excluding livestock grazing will lead to greater ground layer plant biomass, depending on the depth of the litter layer. In some instances, this increase will be unacceptable (for example, if it increases the perceived fire risk), and you may then need to use controlled grazing to maintain the existing vegetation structure.

The predicted outcome is the site remains *Exotic Woody*.

Exclude livestock grazing

Excluding livestock grazing will lead to greater ground layer plant biomass, depending on the depth of the litter layer. This may change the vegetation structure, depending on whether the species composition is more annual or perennial.

Sites commonly have no indigenous soil seed bank, and an insignificant number of indigenous overstorey individuals. Excluding grazing is unlikely to result in indigenous species being recruited. This is because there is no available material to propagate individuals, and dense vegetation cover at ground level.

The predicted outcome is the site remains *Exotic Woody*.

Control woody weeds THEN exclude livestock grazing and revegetate

If the exotic overstorey is controlled, *Exotic Woody* sites are predicted to change—rapidly, in less than a year—to *Exotic Pasture/Herbaceous*. If weeds are then controlled, grazing excluded and sites replanted, they will improve to a *Revegetation* state, particularly in the early stages of revegetation growth.

Revegetation will only succeed if woody and herbaceous weeds are controlled before and after plants become established, to ensure they are not outcompeted by the dominant overstorey and the introduced annuals/perennials at ground level.

To further improve these sites to higher-quality states (such as *Modified Remnant, Young Overstorey* or *Single-Aged Young Overstorey*), you must greatly reduce, then control, the cover and dominance of ground layer weeds: plant establishment does not necessarily result in plant recruitment.

Summary

Table 3.32 summarises the predicted outcomes and acceptability of each of the options for this vegetation state.

Table 3.32 - Predicted outcomes and acceptability of options

Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site remains *Exotic Woody*	Acceptable
Control the livestock grazing regime	Site remains *Exotic Woody*	Acceptable*
Exclude livestock grazing	Site remains *Exotic Woody,* with an increase in ground layer plant biomass	Acceptable*
Control woody weeds THEN exclude livestock grazing and revegetate	Site improves to *Revegetation* state, with potential to improve to higher-quality states	Beneficial

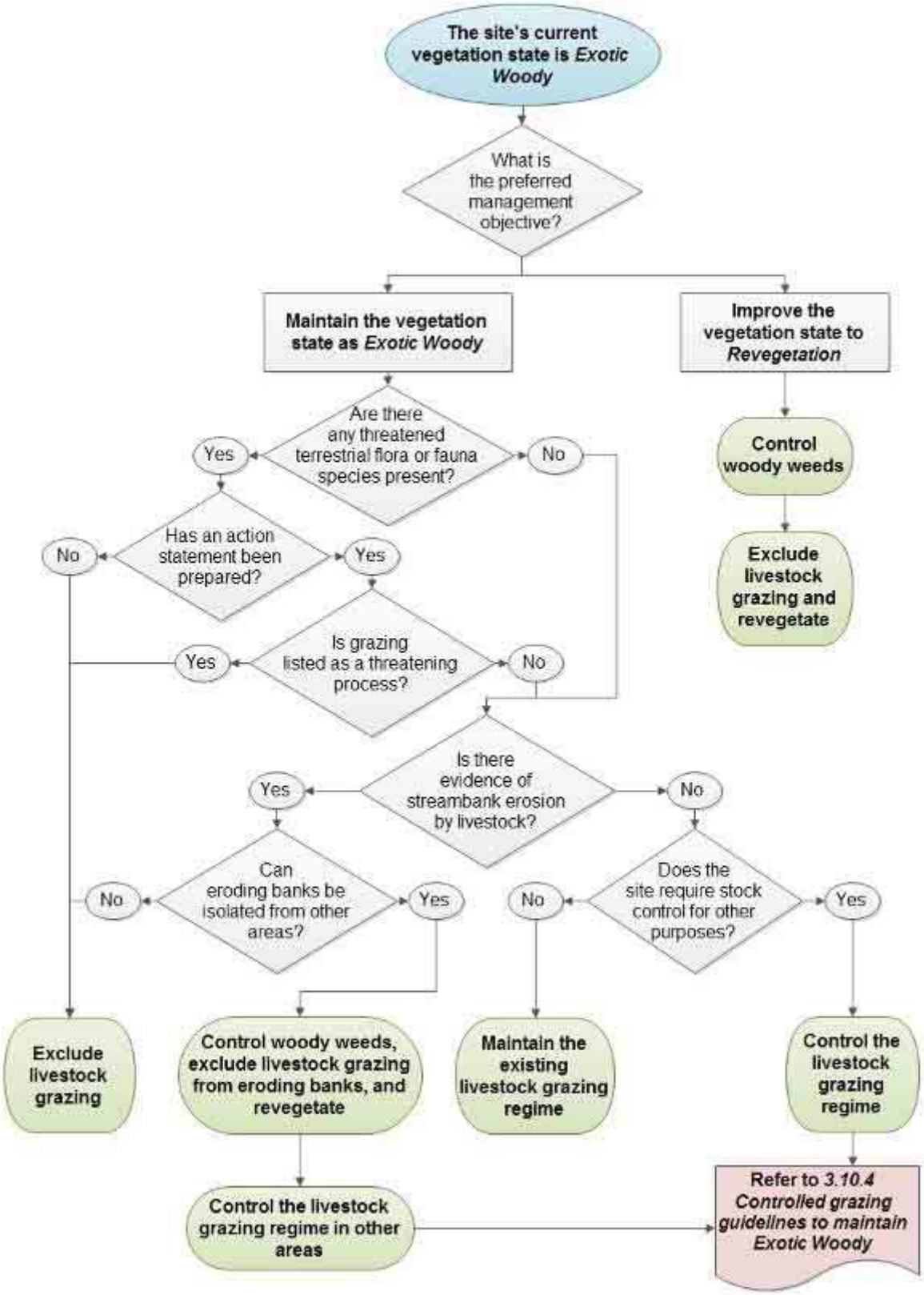
***The degree of acceptability depends on the project objectives. For example, project objectives may include: protecting the quality of a downstream remnant by using livestock to control weed seed production in late winter through early spring or reducing the perceived fire risk.**

3.10.3 Grazing management options decision tree

Figure 3.26 provides a decision tree to use when considering grazing management options for an *Exotic Woody* site. It takes account of:

- the guidance above, about the acceptability of grazing on vegetation condition and state
- possible effects on threatened terrestrial flora and/or fauna species and streambank stability.

Figure 3.26 - Grazing management options decision tree for *Exotic Woody* sites



3.10.4 Controlled grazing guidelines to maintain *Exotic Woody*

If you decided to use controlled grazing, you should consider the guidelines below (as well as the guidelines in *2.4.2 Control the livestock grazing regime*). Figure 3.27 provides a decision tree you can use to plan your implementation of the guidelines.

Background

Controlled grazing of *Exotic Woody* can ensure that:

- the cover, biomass, diversity and patterns of recruitment of indigenous and introduced species remain about the same
- the existing vegetation structure is maintained.

Timing of controlled grazing to maintain and control groundcover biomass

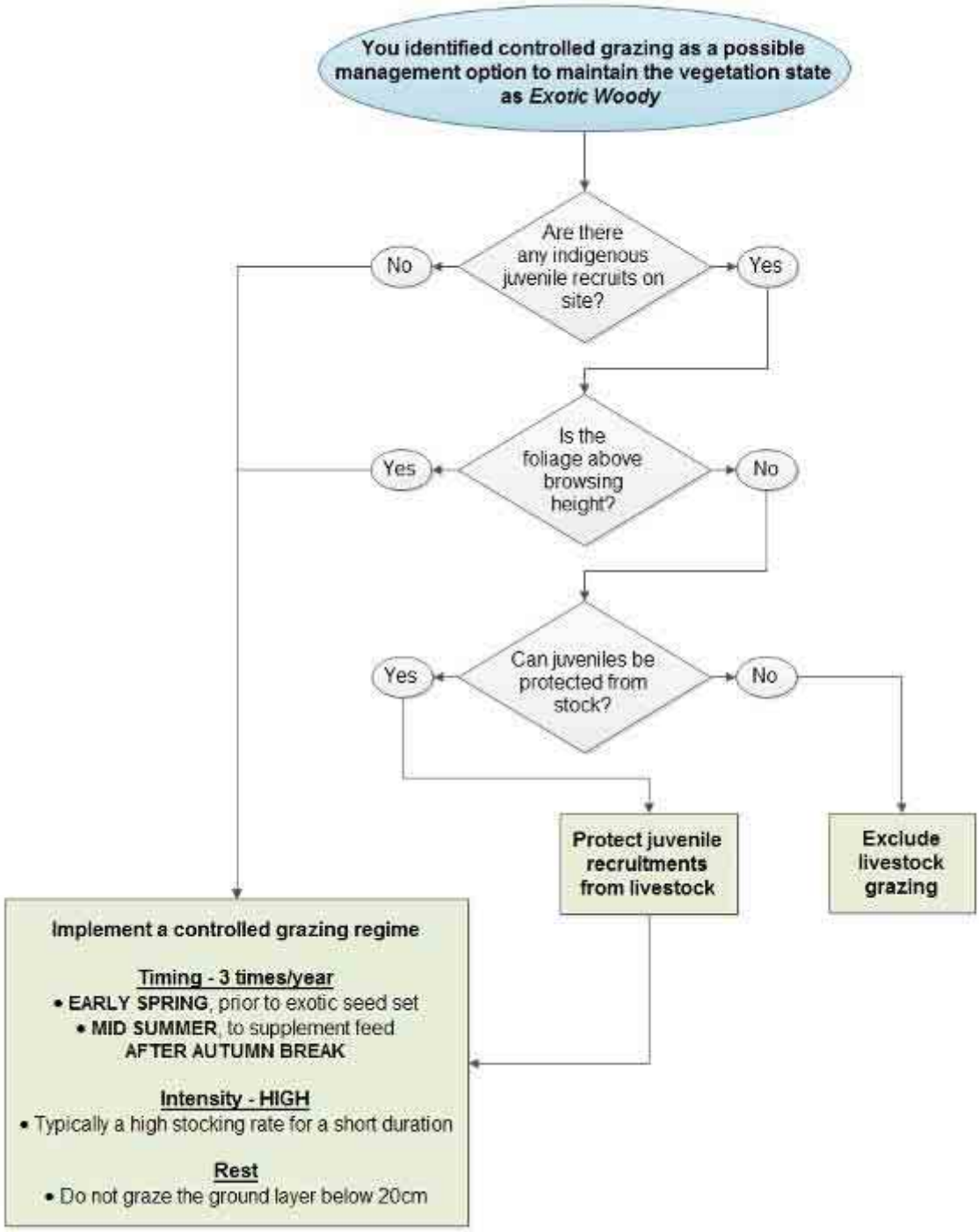
As ground-level vegetation will have been mostly or completely introduced, you can use high-intensity grazing (typically a high stocking rate for a short duration) on about a four-month rotation (and being especially mindful of wet soil conditions) to:

- control weeds before their seeds set (in early spring)
- supplement feed and reduce perceived fire risks (in early summer)
- maintain the vegetation state (after the autumn break).

Minimum grass heights

Although grazing of the ground layer does not reduce biodiversity, it is very important for maintaining the herbaceous ground cover in riparian areas. It stabilises riverbanks, filters nutrients and sediments, and reduces the potential for soil to be directly scoured from the face of the bank and the floodplain. Its ability to do these things is a function of the height of the plants: plants are flattened during flood events, and the longer, leafy material directly protects the soil surface. Therefore, the herbaceous ground layer definitely must not be grazed below 10cm, and preferably not below 20cm.

Figure 3.27 - Controlled grazing decision tree for *Exotic Woody*



3.11 Revegetation

3.11.1 Characteristics

This publication defines sites in the *Revegetation* state as having been *Exotic Pasture/Herbaceous* before revegetation works, rather than a revegetation of any other state. Accordingly, these sites will have experienced:

- the clearing of trees and other indigenous vegetation (with no effective indigenous soil seed bank for most species)
- significant soil disturbance (such as by heavy grazing, cultivation or soil improvement, for example by adding fertilisers)
- enhanced soil fertility (as a consequence of clearing and soil disturbance).

Table 3.33 shows typical *Revegetation* vegetation state characteristics.

Table 3.33 - Typical *Revegetation* vegetation state characteristics

Overstorey	Shrub Layer	Ground Cover
• Generally, revegetation of these sites is either even-aged or multi-age stands of planted overstorey	• A variety of woody understorey species may have been planted • Older plantings generally have fewer understorey species planted	• The ground layer is mostly introduced annual/perennial species

3.11.2 Grazing management options

Maintain the existing livestock grazing regime

You should not allow grazing on a *Revegetation* site until the planted individuals have grown beyond grazing height, normally between 3–5 years after planting. Planting short understorey species, then letting livestock eat them, is counterintuitive. Further, reintroducing continuous grazing after plants have grown beyond grazing height will make it very difficult to recruit new individuals.

The predicted outcome is that a site reverts to, and remains, poor-quality *Exotic Pasture/Herbaceous*.

Maintaining the existing livestock grazing regime for *Revegetation* is NOT ACCEPTABLE.

Control the livestock grazing regime

You should not allow grazing, including controlled grazing, on a *Revegetation* site until the planted individuals have grown beyond grazing height, which is normally between 3–5 years after planting.

You should reassess this option after the site transitions to another vegetation state (such as *Young Overstorey*).

The predicted outcome is that a site reverts to, and remains, poor-quality *Exotic Pasture/Herbaceous*.

Implementing a controlled livestock grazing regime for *Revegetation* is NOT ACCEPTABLE.

Exclude livestock grazing

Excluding grazing is the only possible management option for *Revegetation* sites.

The predicted outcome is the site improves within 5-10 years to higher-quality *Shrubby* or *Single-Aged Young Overstorey*, depending on the species planted.

You should reassess other options after the site transitions to an improved state.

Exclude livestock grazing and revegetate

This option does not apply.

Excluding livestock grazing and revegetating for *Revegetation* is NOT APPLICABLE: the site has already been revegetated.

Summary

Table 3.34 summarises the predicted outcomes and acceptability of each of the options for this vegetation state.

Table 3.34 - Predicted outcomes and acceptability of options

Grazing management option	Predicted outcome	Acceptability
Maintain the existing livestock grazing regime	Site degrades to poor-quality *Exotic Pasture/Herbaceous*	Not acceptable
Control the livestock grazing regime	Site degrades to poor-quality *Exotic Pasture/Herbaceous*	Not acceptable
Exclude livestock grazing	Site improves to *Shrubby* or *Single-Aged Young Overstorey*, depending on the species planted	Beneficial
Exclude livestock grazing and revegetate	Not applicable	

4 References

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5 Appendix A: Representative photos for vegetation states

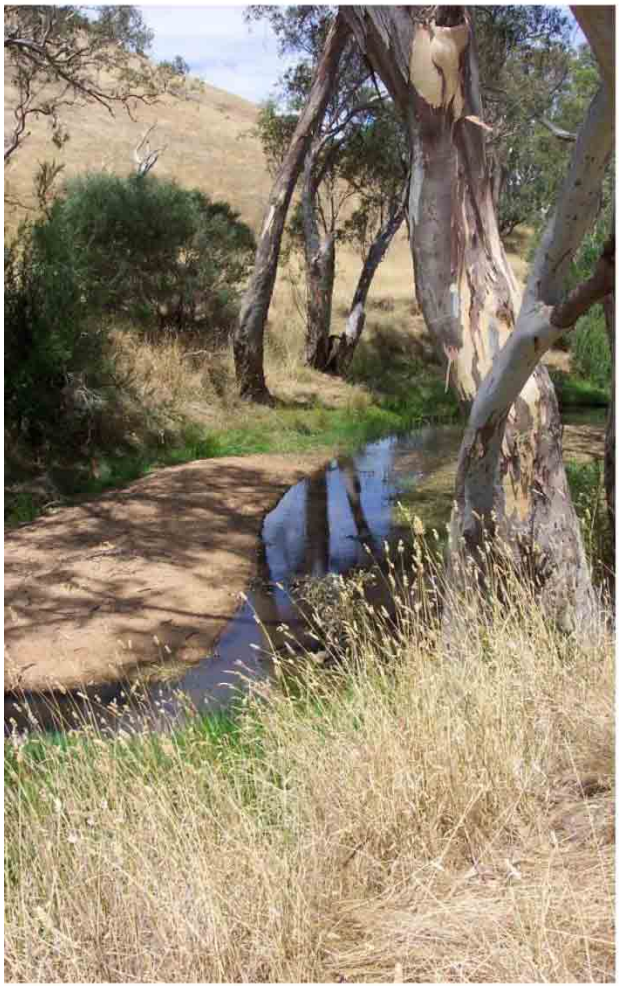
Over time, you should collate a set of regionally specific representative photos for vegetation states.

5.1 Quality Remnant




5.2 Modified Remnant





5.3 Young Overstorey

5.4 Native Grassy






5.5 Mature Overstorey







5.6 Single-Aged Young Overstorey






5.7 Shrubby

5.8 Exotic Pasture/Herbaceous






5.9 Exotic Woody

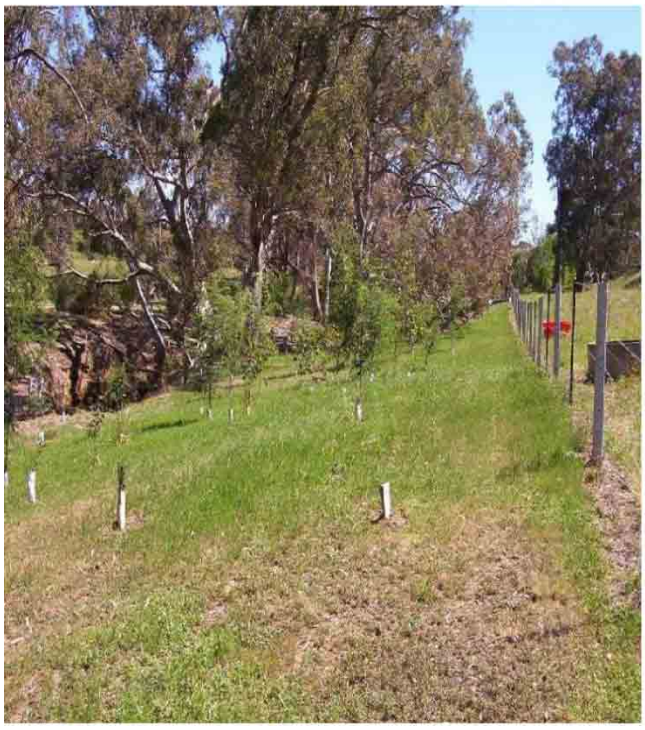





5.10 Revegetation








6 Appendix B: Grazing management options field assessment sheet (for agency field staff)

Grazing management options field assessment sheet

1. Background information

Landholder name	Project works name/number	Date of record

Property address	

2. ***What is the project site location?*** *(Use the start and end of the project site as minimum photo point locations: that is, 'end point, looking in')*

Mapping coordinates (eastings and northings)			
Start		Finish	
E	N	E	N

3. What is the grazing history of the project site? *(For example, the intensity and type of animal)*

4. What is the current grazing regime?

☐ Uncontrolled stock access ☐ Controlled stock access ☐ No stock access

If 'Controlled stock access', what are the rules? *(For example, the stocking rate, timing and frequency)*

How is the current grazing regime performing? *(For example, is the site condition improving or degrading? Has weed cover increased/decreased? Is there bare ground? Is there negligible livestock impact?)*

5. Which, if any, threatened terrestrial flora and fauna species are present?

Common name	Scientific name	Has an action statement been prepared?		Is grazing a listed threat?	
		☐ Yes	☐ No	☐ Yes	☐ No
		☐ Yes	☐ No	☐ Yes	☐ No
		☐ Yes	☐ No	☐ Yes	☐ No
		☐ Yes	☐ No	☐ Yes	☐ No

Other flora and/or fauna species of significance:

6. Are there bank instabilities?

Is there evidence of streambank erosion from livestock? ☐ Yes ☐ No

If yes, can eroding banks be isolated from other areas? ☐ Yes ☐ No

7. What is the current vegetation state?

☐ Pre-European ☐ Quality Remnant ☐ Modified Remnant ☐ Young Overstorey

☐ Native Grassy ☐ Mature Overstorey ☐ Single-Aged Young Overstorey ☐ Shrubby

☐ Exotic Pasture/Herbaceous ☐ Exotic Woody ☐ Revegetation

What percentage of groundcover is indigenous? ☐ < 25% ☐ ≥ 25%

If Native Grassy, what is the origin of the site? ☐ Naturally treeless ☐ Originally treed

8. What is the preferred management objective?

☐ Maintain the condition of the current vegetation state

☐ Improve the condition of the current vegetation state

9. For the current vegetation state, what is the level of acceptability of each grazing management option?

Option	Not acceptable	Tolerable	Acceptable	Beneficial
Maintain the existing livestock grazing regime	☐	☐	☐	☐
Control the livestock grazing regime	☐	☐	☐	☐
Exclude livestock grazing	☐	☐	☐	☐
Exclude livestock grazing and revegetate	☐	☐	☐	☐
Other option (describe):	☐	☐	☐	☐

ONLY complete the questions below if you identified controlled livestock grazing as a possible grazing management option.

10. What is the desired outcome from implementing the controlled livestock grazing regime?

☐ To open up the indigenous graminoid layer ☐ To reduce herbaceous weeds

☐ To create site conditions for regeneration of indigenous trees and shrubs

Other outcomes: _____

11. What factors affect the timing, stocking rate and/or duration of controlled grazing?

Can livestock safely access the site in late winter/early spring? ☐ Yes ☐ No

Other site-specific factors:

12. What is the initial controlled grazing regime?

	Late winter/ early spring	Early summer	Late summer/ early autumn	After autumn break	Late summer/ early winter	Deferred
Timing:	☐	☐	☐	☐	☐	☐
Type of animal:			Rate (animals/ha):			
Duration (days):						

What will be the effect of this timing on both native and introduced species?

13. How will the controlled grazing regime be monitored?

Will the landholder document the grazing episodes? ☐ Yes ☐ No

When will the site be reassessed? _____ /_____ /20_____

Is the landholder capable of effectively managing the controlled grazing episode?

Other comments/information relevant to the site:

7 Appendix C: Grazing management record sheet (for landholder use)

Grazing management record sheet

To be completed by the landholder for each grazing event

Background information

Landholder name	Project works name/number	Date of record
Property address		

*****Please attach the following (labelled) photos of the site*****

Before the grazing episode

Start of project site (looking into site): ☐ End of project site (looking into site): ☐

After the grazing episode

Start of project site (looking into site): ☐ End of project site (looking into site): ☐

Grazing regime

	Late winter/ early spring	Early summer	Late summer/ early autumn	After autumn break	Late summer/ early winter	Deferred
Timing:	☐	☐	☐	☐	☐	☐
Type of animal:			Rate (animals/ha):			
Duration (days):						

Before grazing

Ground cover rating *(immediately before controlled grazing)*

Bare ground (negligible cover)	25% or less ground cover (plants widely spaced with obvious bare ground)	50% ground cover (half of the area has ground cover)	75% ground cover (minimal bare ground)	100% ground cover (no bare ground visible)
☐	☐	☐	☐	☐

After grazing commences

Ground cover rating *(immediately after controlled grazing)*

Bare ground (negligible cover)	25% or less ground cover (plants widely spaced with obvious bare ground)	50% ground cover (half of the area has ground cover)	75% ground cover (minimal bare ground)	100% ground cover (no bare ground visible)
☐	☐	☐	☐	☐

Is there any evidence of perennial grass recruitment? ☐ Yes ☐ No

If yes, it is native or exotic? ☐ Native ☐ Exotic ☐ I'm not sure

Assessment of controlled grazing implementation

Was the controlled grazing successful?
Were there any adverse effects from the controlled grazing on native plants?
When is the next planned grazing episode (*i.e. 120 day rotation; after Autumn break etc.*)

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