NSW GOVERNMENT

Transport
Roads & Traffic
Authority

# Biodiversity Guidelines

Protecting and managing biodiversity on RTA projects

Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects
Revision 0/September 2011

The RTA produces documents in hard copy and electronic format. This document is an uncontrolled copy. Updates will be made to these Guidelines as required and listed in an amendments page at the front of the controlled electronic version available on the RTA intranet Environment Branch page.

The information contained in these Guidelines is for general information only and is not intended to constitute legal advice. The RTA accepts no responsibility for any loss arising out of reliance on any information contained in this document.

## Acknowledgements

These Guidelines were prepared by RTA Environment Branch.

NGH Environmental consultancy drafted the Guidelines.

The RTA would like to acknowledge the assistance of all who provided comments on and photographs for these Guidelines.

Cover: Eucalypt woodland in South West Region (Photo: RTA)

# Contents

# How to use these Guidelines

## Who will use these Guidelines?

The *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (these Biodiversity Guidelines) are intended for RTA project managers, staff and contractors (including ecologists and landscape designers). They are a tool to help minimise impacts on biodiversity during construction projects and maintenance works.

Refer to these Biodiversity Guidelines when preparing environmental specifications for contracts and for the development of construction environmental management plans, including flora and fauna management sub-plans.

These Biodiversity Guidelines will also assist when preparing a preliminary environmental investigation or environmental assessment under the *Environmental Planning and Assessment Act 1979* (NSW). They provide good practice management measures for inclusion in the biodiversity chapters of environmental assessments.

These Biodiversity Guidelines do not cover requirements of biodiversity surveys and assessments that need to be undertaken during the planning and assessment phase of a project.

Regional RTA environmental staff are the first point of contact for advice on the management of biodiversity issues associated with a project. The RTA's biodiversity specialists in Environment Branch are available to provide specialist advice to assist regional environmental staff and project managers and to clarify information contained in these Biodiversity Guidelines or to provide advice on biodiversity surveys and assessment.

**These Biodiversity Guidelines should be used or referred to whenever RTA projects or maintenance works have the potential to impact on biodiversity.**

**This may include, but is not limited to, clearing of native vegetation, removal of hollow-bearing trees and working in aquatic habitats and riparian zones.**

## How were these Guidelines developed?

These Biodiversity Guidelines were developed in consultation with the NSW Office of Environment and Heritage (OEH), NSW Department of Primary Industries (DPI) (Fisheries), biodiversity specialists and RTA staff including project managers, construction personnel and designers. Consultation was facilitated through a number of workshops carried out in 2009. NGH Environmental consultancy was engaged to draft the document. Further review and amendments to the document were made by RTA's environmental policy staff to ensure ease of use and clarity.

**FIGURE 1:** Clearing of native vegetation has the potential to impact on biodiversity. When clearing native vegetation, refer to *Guide 4: Clearing of vegetation and removal of bushrock* (Photo: RTA).

## What documents support these Guidelines?

**These Biodiversity Guidelines describe best practice biodiversity management measures to be implemented during RTA road projects and maintenance works.**

The Biodiversity Guidelines have been prepared as one part of a planned series of RTA guidelines relevant to biodiversity. Other guidelines being released in 2011/12 in this series will include:

- Wildlife connectivity guidelines.
- Guidelines for biodiversity offsets.
- Management of microbats in bridges and other structures.

These Biodiversity Guidelines should be used in conjunction with other relevant RTA documents including standard specifications, key procedures, policies and other relevant best practice guidelines.

**FIGURE 2:** A Common Green Tree Frog (*Litoria caerula*), found in a hollow-bearing tree on the Sapphire to Woolgoolga Project, Northern Region NSW (Photo: Laurenne O'Brien).

# What do these Guidelines include?

The **Introduction** outlines the strategic setting, objectives and purpose of these Guidelines and highlights the importance of early planning,

The **individual guides** are for managing specific aspects of biodiversity. This information has been grouped so that relevant information for a particular project can be easily accessed.

At the end of each guide there is a **summary** of its key features. These summaries can serve as a quick reference tool once the details of the specific guide are understood.

Table 1 provides a quick reference to the Biodiversity Guidelines.

**TABLE 1:** BIODIVERSITY GUIDELINES QUICK REFERENCE GUIDE.

| | Guide | Outline | Page |
|---|---|---|---|
| **1** | **Pre-clearing process** | Guidance for the pre-clearing process that should be conducted before any clearing takes place to minimise the impact on native flora and fauna. | 9 |
| **2** | **Exclusion zones** | Guidance for determining and establishing exclusion zones to prevent damage to native vegetation and fauna habitats and prevent the distribution of pests, weeds and disease. | 15 |
| **3** | **Re-establishment of native vegetation** | Guidance for the re-establishment of native vegetation through managing site conditions, material sourcing and procurement, and seed and plant stock installation and establishment. | 23 |
| **4** | **Clearing of vegetation and removal of bushrock** | Guidance for minimising the impact of habitat removal, such as vegetation clearing and bush rock removal, on native flora and fauna. | 31 |
| **5** | **Re-use of woody debris and bushrock** | Guidance for maximising the re-use of woody debris and bushrock to minimise loss and/or damage to native flora and fauna habitats. | 39 |
| **6** | **Weed management** | Guidance for preventing or minimising the spread of noxious and environmental weed species on all RTA project sites and during maintenance works. | 44 |
| **7** | **Pathogen management** | Guidance for preventing the introduction and/or spread of disease causing agents such as bacteria and fungi. | 51 |
| **8** | **Nest boxes** | Guidance for works that involve the removal of hollow-bearing trees. Guidance for minimising the impact of hollow loss by providing supplementary fauna habitat in the form of artificial hollows (nest boxes). | 59 |
| **9** | **Fauna handling** | Guidance for minimising impacts on fauna as a result of being handled by humans and prevent injury to people handling fauna. | 67 |
| **10** | **Aquatic habitats and riparian zones** | Guidance for limiting impacts on aquatic flora and fauna and their habitats, and to ensure the movement of fish up and downstream is maintained at all times during works in a waterway. | 73 |

# Introduction

## Background

**Biodiversity is the variety of life forms, including flora and fauna, the genes they contain and the ecosystems in which they live. Australian ecosystems contain many species found nowhere else in the world. Road reserves often contain important biodiversity that is rare in the surrounding landscape.**

The RTA Corporate Plan: Blueprint Update (2011) is the guiding document that outlines key initiatives at a strategic level over a four year period. In this plan the RTA has committed to developing green partnerships, specifically to 'protect biodiversity and preserve heritage'. In this plan, the RTA also commits to reducing its footprint and in relation to biodiversity the plan states, 'We will... reduce the impact of road projects on the natural and social environment.' These Biodiversity Guidelines respond to the RTA's corporate commitments by addressing biodiversity management during the planning, construction, operation and maintenance of projects.

In managing biodiversity, the RTA should aim to:

1. **Avoid and minimise impacts first.**
2. **Mitigate impacts where avoidance is not possible.** Examples of options for mitigation are provided in these Biodiversity Guidelines.
3. **Offset where residual impacts cannot be avoided.**

## Objective

**These Biodiversity Guidelines aim to provide assistance and guidance to RTA staff and contractors in the management of biodiversity throughout a project and during maintenance works. These Guidelines aim to improve biodiversity outcomes by minimising potential impacts on flora, fauna and habitats and assisting the RTA to meet statutory obligations under NSW and Commonwealth environmental legislation and policies.**

These aims could be achieved through early planning for implementing best practice biodiversity management consistently across all RTA projects and maintenance works.

**FIGURE 3:** Projects can have potential impacts on biodiversity including woodland birds such as this Brown Treecreeper (*Climacteris picumnus*) (Photo: David Nelson).

## Impacts of RTA projects on biodiversity

These Biodiversity Guidelines aim to minimise potential impacts on biodiversity from RTA projects and maintenance works. The types of impacts to biodiversity that could typically occur during construction projects and maintenance are:

- Loss of native vegetation (potentially including threatened species and ecological communities).
- Loss of habitat for native flora and fauna.
- Direct mortality of native fauna.
- Loss of connectivity for flora and fauna.
- Loss of foraging resources for foraging and nesting fauna.
- Fragmentation of vegetation resulting in edge effects, isolation and barrier effects.
- Disturbance effects from noise, light and wind turbulence.
- Water quality changes as a result of works in or adjacent to aquatic habitats and alterations to flow.
- Invasion and spread of weeds and pest fauna species.
- Spread of pathogens.

## Planning for biodiversity management

The success of biodiversity management during projects depends strongly on carefully planning the works. Proper and thorough planning and design at the earliest stages of the project allows project managers to foresee any logistical or timing issues that may arise. This is essential for avoiding or minimising impacts to biodiversity as it will allow enough time for biodiversity impacts to be considered adequately and to gather required resources.

In some cases, timing is an essential consideration for appropriate mitigation. In these cases, early planning for biodiversity management may prevent additional costs to the project. For example, some fauna breeding season requirements may dictate the timing of clearing and could delay the project if not identified and accounted for at the planning stage.

Ensure any modifications to the project are consistent with conditions of approval, statement of commitments and legislation. Ensure any additional impacts to biodiversity are adequately assessed.

Figure 4 provides an overview for planning and implementing biodiversity management measures.

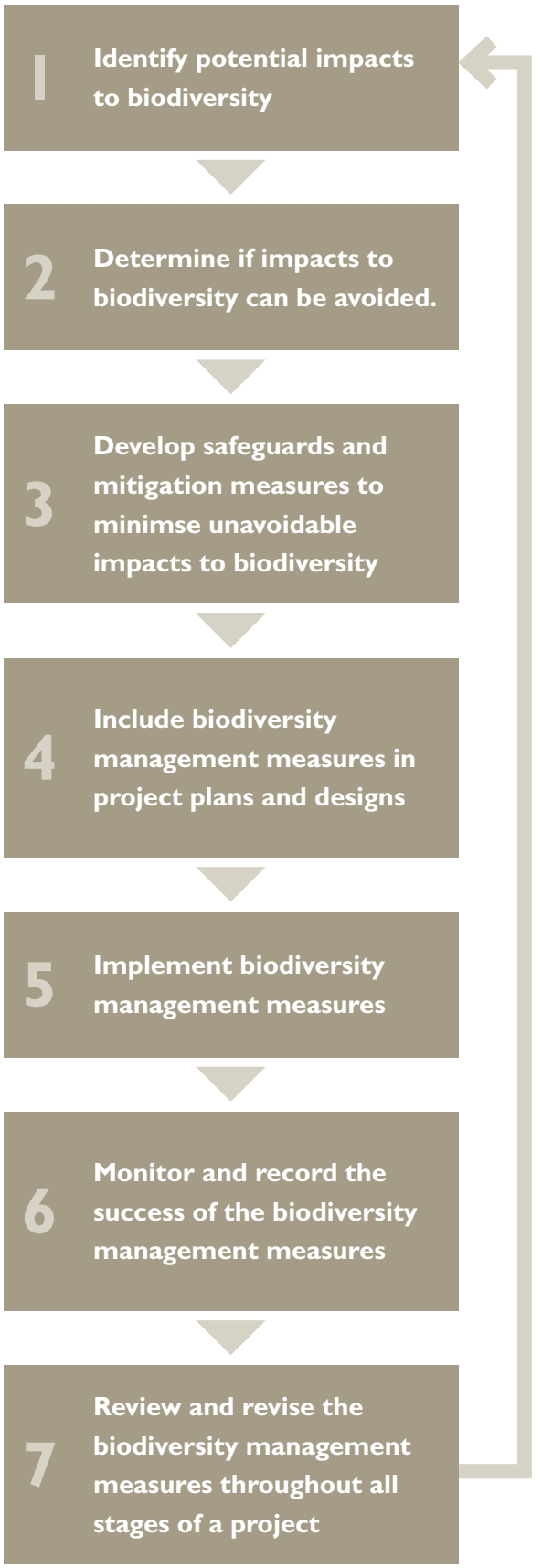



**FIGURE 4:** Planning and implementing biodiversity management measures for road projects.

Consider the following during the earliest stages of a project or works:

- The duration, season and timing of environmental impacts (eg breeding, birthing, torpor or wet/dry seasons).
- Threatened flora and fauna species or populations that may be impacted.
- The need for resources such as ecologists, wildlife carers, special equipment or materials.
- The need to consider biodiversity issues in the development of the road and urban design and landscaping plans.
- The needs to clearly outline in contract and tender documents, the roles and responsibilities for biodiversity management measures.
- The use of environmental management plans and operational procedures to manage impacts on site and reduce the risk of environmental harm. This would include the timing, implementation methods, and monitoring and review process.

## When is a specialist required?

These Biodiversity Guidelines provide best practice guides for minimising the impacts that RTA projects and maintenance works may potentially have on biodiversity. They do not replace the need for specialist input.

Specialist input may be required during any phase of a project or maintenance works. Each guide in these Biodiversity Guidelines outlines when specialist advice is recommended. **All references to specialists are highlighted in bold.**

**Project managers and/or environment managers should seek specialist advice when:**

- **Native vegetation is being cleared or impacted by the project.**
- **Threatened species occur or have the potential to occur in the area.**
- **Fauna habitat features (eg hollow-bearing trees or bushrock) are being removed, re-used or relocated.**
- **Re-establishment of native vegetation is required.**
- **Pathogens are known to occur in the area.**
- **Nest boxes have been recommended as a habitat replacement measure.**
- **Works are being carried out in aquatic habitats or riparian zones.**

# Guide 1: Pre-clearing process

## Background

**The pre-clearing process provides a final check for any threatened flora or fauna species that may have moved into the area since undertaking previous surveys. This is particularly important where the season or prevailing weather conditions influence whether a species is found in an area.**

The pre-clearing process should be guided by information gathered during flora and fauna surveys conducted in the environmental assessment phase of the project.

Clearing associated with construction and maintenance works results in the loss of vegetation and fauna habitat. Impacts on native flora and fauna, including threatened species, can be minimised by:

- Conducting the pre-clearing process.
- Implementing staged habitat removal (see *Guide 4: Clearing of vegetation and removal of bushrock*).

'Clearing of native vegetation', 'loss of hollow-bearing trees', 'bushrock removal' and 'removal of dead wood and dead trees' are Key Threatening Processes listed under the *Threatened Species Conservation Act 1995* (NSW) (TSC Act). 'Land clearance' is listed as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)(EPBC Act).

## Objective

**The objective of this guide is to provide guidance for the pre-clearing process that should be conducted before any clearing takes place to minimise the impact on native flora and fauna.**

The pre-clearing process should be implemented before clearing begins to:

- Confirm the location of biodiversity features identified during the environmental assessment process.
- Check for the presence of flora and fauna species and habitat on a site immediately before clearing begins.
- Provide input into determining appropriate exclusion zones (see *Guide 2: Exclusion zones*).
- Locate nearby habitat suitable for the release of fauna that may be encountered during the pre-clearing process or habitat removal.
- Inform planning and procedures for the staged habitat removal process (see *Guide 4: Clearing of vegetation and removal of bushrock*).
- Ensure that the location of any threatened flora species, threatened ecological communities and habitat are mapped.
- Determine any additional management measures that may need to be incorporated into the Construction Environmental Management Plan (CEMP).

**FIGURE 1.1:** The pre-clearing process should provide information on the presence of fauna habitat such as this Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) nest (Photo: Lester Piggott).

# Application of this guide

This guide is applicable where:

1. Threatened flora populations have been identified to occur or potentially occur in the area during the environmental assessment process.
2. Hollow-bearing trees, including standing dead trees with hollows are to be removed.
3. Substantial stands of vegetation providing potential threatened fauna habitats are to be impacted.
4. Bushrock is to be removed.
5. Potential roosting habitat for microbats (eg in bridges or culverts) is to be disturbed or removed.

## Specialist input requirements

Use qualified **ecologists** with experience in fauna handling to conduct flora and fauna searches as part of the pre-clearing process.

Use a **licensed wildlife carer** or **ecologist** to carry out any fauna handling in accordance with *Guide 9: Fauna handling*.

# Management requirements

### The pre-clearing process:

1. **Review the environmental assessment** and associated documentation for the project to identify known locations of biodiversity features such as threatened flora and fauna (and their habitat), threatened populations and communities that need to be considered during the pre-clearing process.
2. **Identify nearby habitat that would be suitable for the release of fauna** that may be encountered during the pre-clearing process or habitat removal. Consult with an **ecologist** to determine suitable habitat. In some circumstances (eg when threatened species are likely to be encountered) consultation with the Office of Environment and Heritage (OEH) may also be required. Mark the pre-determined habitat identified for fauna release on a map.
3. **The project manager and/or environment manager should develop an unexpected threatened species finds procedure** for projects and maintenance works. An unexpected threatened species finds procedure is provided on page 12. This should be part of the Construction Environmental Management Plan (CEMP), flora and fauna management sub-plan or Environmental Work Method Statement (EWMS). Follow the unexpected threatened species finds procedure if additional threatened species or communities are identified that have not been considered in the environmental assessment.
4. **The project manager and/or environment manager should incorporate biodiversity management measures identified during the pre-clearing process into the project CEMP and/or designs.**
5. The project manager and/or environment manager should engage an **ecologist** to undertake the following procedure in the weeks before clearing begins:
   a. Confirm the locations of biodiversity features identified in the environmental assessment.
   b. Identify any fauna that have the potential to be disturbed, injured or killed as a result of clearing activities (eg nesting birds).
   c. Check for the presence of threatened flora and fauna species that were identified in the environmental assessment as likely to occur. This check should be:
      - Conducted by licensed **ecologists** experienced in fauna handling and the identification of local flora and fauna species.
      - If possible, undertaken during optimal weather conditions, season and time of day/night for identifying targeted flora and fauna species.

**FIGURE 1.2:** Surveying for birds' nests during the pre-clearing process (Photo: Alex Cockerill).

d. If not already available, record the details for all hollow-bearing trees, trees containing threatened fauna and threatened flora, including (where applicable):
   - GPS location.
   - Species.
   - Type of habitat feature (eg nest, bushrock).
   - Size of hollow (eg small, medium, large).
   - Type of hollows (eg branch, limb, trunk).

e. Provide input and mark habitat features to be protected during construction. Use suitable methods (eg flagging tape) to mark:
   - All hollow-bearing trees or habitat features.
   - Any trees found to contain threatened fauna.
   - The location of any threatened flora.

**FIGURE 1.3:** A habitat tree marked with flagging tape to indicate it will be retained during the first stage of staged habitat removal (Photo: Josie Stokes).

f. Confirm the location of pre-determined habitat identified for the release of any fauna encountered on site.

g. Submit any updated maps/plans, pre-determined habitat for the release of fauna, habitat features and recommended clearing procedures to the project manager and/or environment manager (or equivalent).

6. The following procedure should be followed 24 hours before clearing:

   a. **Licensed wildlife carers and/or ecologists** should capture and/or remove fauna that have the potential to be disturbed, injured or killed as a result of clearing activities. Relocate captured fauna into pre-determined habitat identified for fauna release (see *Guide 9: Fauna handling*).

   b. **The project manager and/or environment manager should inform clearing contractors of any changes to the sequence of clearing if required**. Carry out staged habitat removal as outlined in *Guide 4: Clearing of vegetation and removal of bushrock* where fauna habitat features (such as hollow-bearing trees, habitat trees and bushrock) have been identified and marked.

# Unexpected threatened species finds procedure

## Purpose

This procedure details the actions to be taken when a threatened flora or fauna species is unexpectedly encountered on site.

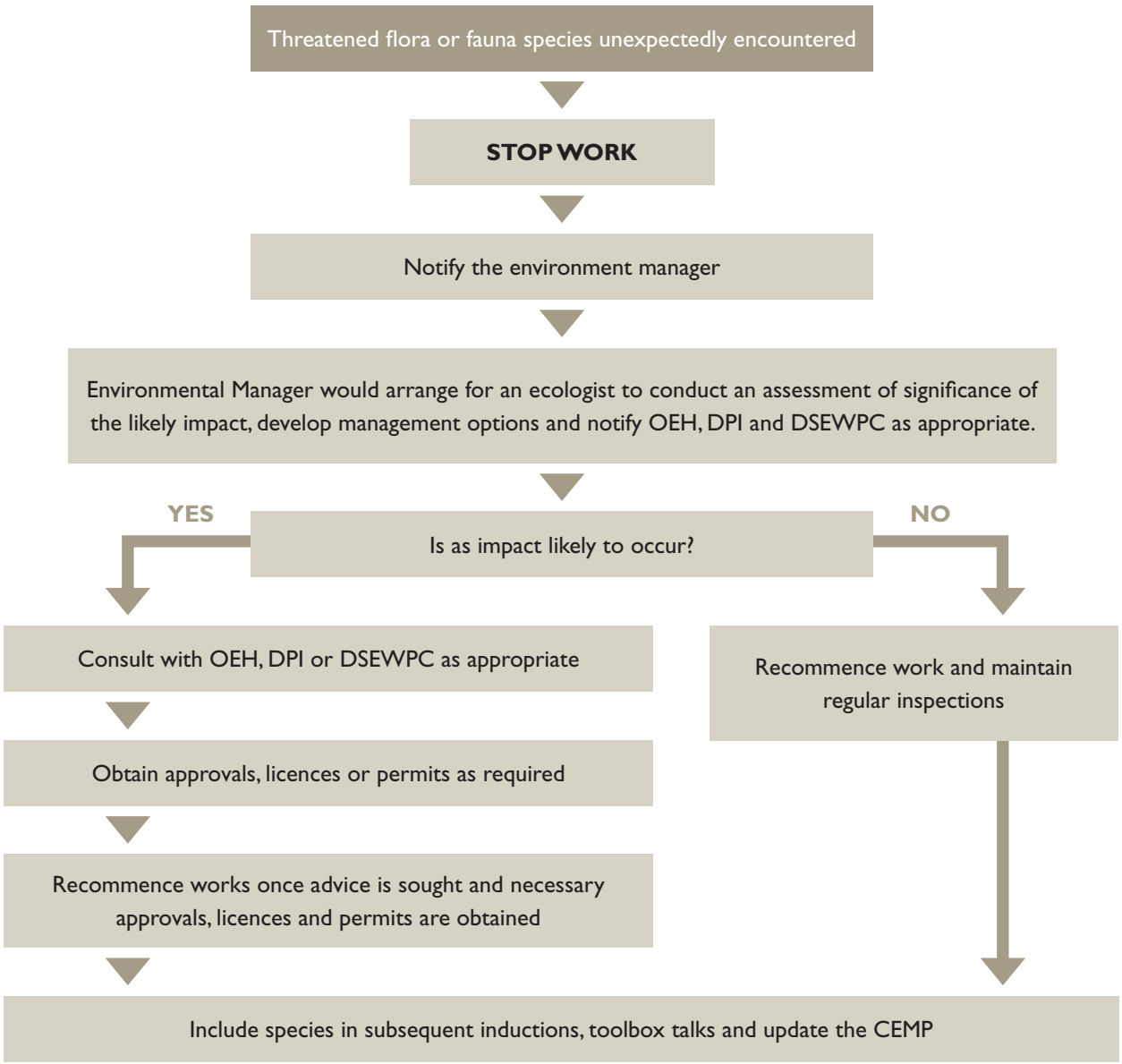
## Induction/Training

Photos and descriptions of threatened species occurring or likely to occur would be included in the Construction Environmental Management Plan (CEMP) and/or the flora and fauna management sub-plan. All personnel are to be inducted on the potential threatened species occurring on site and the unexpected threatened species finds procedure.

## Scope

This procedure is applicable to all activities that have the potential impact upon threatened flora and fauna species.

## Procedure



## Supporting documents

1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. *RTA Environmental Protection (Management Plan) QA Specification G35* (Accessed via the RTA intranet TechInfo page, Techdocs).
3. *RTA Environmental Protection (Management System) QA Specification G36* (Accessed via the RTA intranet TechInfo page, Techdocs).

# Biodiversity Guide 1 – Pre-clearing process

## Objective

The objective of this guide is to provide guidance for the pre-clearing process that should be conducted before any clearing takes place to minimise the impact on native flora and fauna.

## Application of this guide

This guide is applicable where:

1. Threatened flora populations have been identified to occur or potentially occur in the area during the environmental assessment process.
2. Hollow-bearing trees, including standing dead trees with hollows are to be removed.
3. Substantial stands of vegetation providing potential threatened fauna habitats are to be impacted.
4. Bushrock is to be removed.
5. Potential roosting habitat for microbats (eg in bridges or culverts) is to be disturbed or removed.

## Management requirements

- Review the environmental assessment and associated documentation for the project to identify known locations of biodiversity features.
- Consult with an **ecologist** to determine the location of suitable nearby habitat for the release of fauna that may be encountered during the pre-clearing process or habitat removal. Mark the pre-determined habitat identified for fauna release on a map.
- Develop an unexpected threatened species finds procedure.
- Incorporate biodiversity management measures identified during the pre-clearing process into the project CEMP and/or designs.
- In the weeks before clearing:
  a. Confirm the locations of biodiversity features.
  b. Identify fauna that have the potential to be disturbed as a result of clearing activities.
  c. Ensure an **ecologist** checks for the presence of threatened flora and fauna species that were identified in the environmental assessment as likely to occur. Undertake these checks during optimal conditions for the target species where possible.
  d. Record the details for all hollow-bearing trees, trees containing threatened fauna and threatened flora.
  e. Mark habitat features to be protected during construction.
  f. Confirm the location of pre-determined habitat identified for the release of any fauna encountered on site.
  g. Submit and updated maps/plans, pre-determined habitat for the release of fauna, habitat features and recommended clearing procedures to the project manager and/or environment manager (or equivalent).
- Twenty-four hours before clearing:
  a. **Licensed wildlife carers** and/or **ecologists** should capture and/or remove fauna that have the potential to be disturbed as a result of clearing activities.
  b. Relocate fauna into pre-determined habitat identified for fauna release.
  c. All fauna handling should be carried out by **licensed wildlife carers** and/or **ecologists** and in accordance with *Guide 9: fauna handling*.
  d. Inform clearing contractors of any changes to the sequence of clearing if required.
  e. Carry out staged habitat removal as outlined in *Guide 4: Clearing of vegetation and removal of bushrock* where fauna habitat features have been identified and marked.

# Guide 2: Exclusion zones

## Background

**An exclusion zone is a designated 'no-go' area that is clearly identified and appropriately fenced to prevent damage to native vegetation and fauna habitats and prevent the distribution of pests, weeds and disease. Exclusion zones may also be used to define approved clearing limits for a project.**

Ecological features that have been identified for retention during the development phase of a project may require protection during the implementation phase. This could include:

- Vegetation outside of the assessed and approved clearing limits.
- Threatened flora.
- Threatened ecological communities.
- Hollow-bearing trees.
- Aquatic habitats.
- Areas of bushrock.
- Areas that are infected by pathogens or areas that need to be protected from pathogens.
- Conservation areas.
- Other habitat features identified during the environmental assessment and approval phase as being of ecological significance.

Such features can be inadvertently damaged or cleared during the construction process if not protected. Damage can result from movement of machinery, vehicles and personnel and may be direct (clearing outside approved limits) or indirect (spread of weeds into conservation zones, soil compaction in root zones).

Exclusion zones may not necessarily be for a biodiversity asset. They can also include areas that need to be protected to stop the spread of certain features such as pathogens and weeds, or to prevent access to contaminated land or heritage sites.

## Objective

**The objective of this guide is to provide guidance for determining and establishing exclusion zones to prevent damage to native vegetation and fauna habitats and prevent the distribution of pests, weeds and disease.**

## Application of this guide

This guide is applicable where areas within or adjacent to the work site require exclusion. Exclusion zones may be for significant vegetation, threatened species, weeds, pathogens or habitat features.


**FIGURE 2.1:** Exclusion fencing showing an environmentally sensitive area on the Hunter Expressway (Photo: Josie Stokes).

## Specialist input requirements

Use a **qualified surveyor** to mark out exclusion zones and clearing limits. The correct establishment of exclusion zones can be critical for the project to avoid breaches of conditions of approval.

# Management requirements

## Determining exclusion zones

The project manager and/or environment manager should undertake the following general steps before construction begins:

1. **Review background information** including:
    - Environmental assessments and accompanying flora and fauna reports.
    - Conditions of approval.
    - Project or Construction Environmental Management Plans (CEMP).
    - Project or contract specifications.
    - Updated maps/plans showing pre-determined habitat for the release of fauna and habitat features that were provided to the project manager and/or environment manager (or equivalent) by an **ecologist** as part of the pre-clearing process.
2. **Select exclusion fence type** considering:
    - The risk of the excluded area being intruded upon including:
        - Sensitivity of what is being excluded.
        - Accessibility to the excluded area.
        - The limitations of fencing options.
        - The type and number of plant and equipment.
    - The area to be fenced.
    - Cost.
    - The risk of fauna being trapped, injured or isolated (eg barbed wire fencing should not be installed in a designated wildlife crossing zone).
3. **Mark exclusion zones on a suitable plan**. Suitable plans should:
    - Be based on up to date plans for the project such as design drawings issued 'for construction'.
    - Include an aerial photograph image underlay.
    - Show construction chainages or similar distance markers used in construction.
    - Be clearly labelled, including the type of the exclusion fence to be used and any other information relevant to the installation and maintenance of the exclusion zone.
    - State what is being excluded. In some circumstances the reason for exclusion may not be able to be identified on plans or signs due to security and/or cultural sensitivity eg rare orchids.
    - Be displayed in prominent places in site sheds, included in environmental management plans and provided in the site induction.
    - Outline any procedures that must be followed for access into exclusion zones.

Table 2.1 presents a list of potential fencing options for the project manager and/or environment manager to choose from. Note, this list is not exhaustive, and other options may be suitable considering the risk of intrusion and the sensitivity of the excluded area.


DANGER
LOOK UP
OVERHEAD
POWERLINES
DANGER
CONSTRUCTION
SITE
DO NOT ENTER
THIS PROTECTIVE EQUIPMENT
MUST BE WORN
ON THIS SITE

**TABLE 2.1:** OPTIONS FOR FENCING OF EXCLUSION ZONES.

| Fencing Type Option | | Description |
|---|---|---|
| Type 1 |  <br>**FIGURE 2.2:** Chain wire fencing (Photo: Angie Radford). | Chain wire fencing for high risk and highly sensitive sites. |
| Type 2 |  <br>**FIGURE 2.3:** Split polypipe covering the upper strand of barbed wire prevents entanglement of fauna (Photo courtesy of www.wildlifefriendlyfencing.com). | Stock fencing or similar can be used where permanent protection is desired (eg boundary fencing).<br><br>Barbed wire should not be installed in a designated wildlife crossing zone (eg near glider poles or rope canopy bridges). |
| Type 3 |  <br>**FIGURE 2.4:** Para-web material and signage to mark out exclusion zone (Photo: Josie Stokes). | Para-web material and star pickets are most commonly used for temporary fencing of specific and small areas (eg individual trees, small pockets of vegetation), or where there is high/moderate risk of intrusion. |
| Type 4 |  <br>**FIGURE 2.5:** Reflective spinning tape (Photo: Angie Radford). | Capped star pickets and reflective spinning tape (helicopter tape) is typically used for larger areas with moderate/low risk of intrusion. |
| Type 5 |  <br>**FIGURE 2.6:** Mulch berm (Photo: Angie Radford). | Where the risk of intrusion is low, earth bunding, mulch berms, sediment fencing or flagging tape may be used.<br><br>It may not be suitable for exclusion zones but is often used to delineate areas. |

| Fencing Type Option | Advantages | Disadvantages |
|---|---|---|
| Type 1 | • Allows for a greater degree of protection due to the sturdiness of the fencing.<br>• It greatly reduces the risk of intrusion into environmentally sensitive areas. | • Vegetation may need to be cleared which increases the construction footprint.<br>• Installation may not be possible before works begin, which increases the risk of entering exclusion zones (thus a temporary fence type may be needed in the interim).<br>• Fauna may become trapped inside due to its low permeability. If this occurs, fauna would need to be trapped and removed by a **licensed wildlife carer** and/or **ecologist** in accordance with *Guide 9: Fauna handling*.<br>• Relatively high cost. |
| Type 2 | • Allows a permanent fence to be in place after the project is complete.<br>• Allows protection due to the sturdiness and of the fencing.<br>• It reduces the risk of intrusion into environmentally sensitive areas. | • Vegetation may need to be cleared which increases the construction footprint.<br>• Risk of injury and death to fauna if they become entangled in barbed wire.<br>• To avoid the risk of injury and death to fauna barbed wire should not be used. If this is not possible (eg on private, grazing property) then split polypipe should be used to cover the upper strand of the barbed wire (see Figure 2.3).<br>• Moderate to high cost. |
| Type 3 | • Highly visible.<br>• Relatively easy and quick to install (where substrates are not rocky).<br>• Moderate cost. | • Does not physically prevent intrusion.<br>• Not as strong as Type 1 or 2 fencing and therefore more easily damaged. |
| Type 4 | • Can be installed quickly and easily (where substrates are not rocky).<br>• Low cost. | • Moderate visibility and may be overlooked.<br>• Not as strong as Type 1 or 2 fencing and therefore more easily damaged. |
| Type 5 | • Can be installed quickly and easily (where substrate is not rocky for sediment fencing).<br>• Low cost. | • Low visibility and may be easily overlooked, or driven over in the case of earth bunding.<br>• Confusion may arise between different types of flagging tape/ sediment fencing in an area. |

## Establishing the exclusion zone

The following general guidance should be given to the contractor by the project manager and/or environment manager when establishing exclusion zones:

- Allow enough lead time to establish exclusion zones before clearing. Marking of exclusion zones could be carried out during the pre-clearing process or at the same time as the marking out of the construction footprint.
- Mark out exclusion zones with temporary markings such as pegs or paint and **where possible use a qualified surveyor.**
- Ensure that any trees to be felled to establish exclusion zones are felled so as to fall away from the exclusion zone.
- Place the exclusion zone fencing outside the tree protection zone (in accordance with Australian Standard *AS 4970-2009 Protection of trees on development sites*).
- Erect signs to inform personnel of the purpose of the fencing. Signs should be clearly visible from a distance of at least 20 metres and be general in nature, such as 'Exclusion Zone' or 'Environmental Protection Zone'.
- Store materials or equipment outside the exclusion zone in accordance with the Australian Standard *AS 4970-2009 Protection of trees on development sites*.


**FIGURE 2.7:** The tree dripline is an alternative to calculating the tree protection zone. The tree dripline is the area directly under tree branches (Photo: Josie Stokes).

## Tree protection zone and the tree dripline

The tree protection zone (TPZ) represents the area around a tree that should not be disturbed. Disturbing the TPZ may damage the root system and the health of the tree.

The Australian Standard *AS 4970-2009 Protection of trees on development sites* contains further information on tree protection and calculating the TPZ.

A practical way of determining the TPZ is through identifying the tree dripline. The tree dripline is the area directly under the branches of the tree (see Figure 2.7). The tree dripline is an important zone to protect, as this is where the tree gets most of its nutrients and water.

The tree dripline may be also used as a guide for protecting trees where an exclusion zone is not being established. Avoid stockpiling materials and equipment and parking vehicles and machinery within the dripline of any tree.

**FIGURE 2.8:** An example of poor practice. Equipment, vehicles and stockpiles should be outside the tree dripline or tree protection zone of trees (Photo: Rebecca Murray).

**FIGURE 2.9:** An example of good practice. This stockpile has been established away from the tree dripline and has appropriate erosion and sediment controls in place (Photo: Dylan Chresby).

## Maintenance

The project manager and/or environment manager should ensure the following is undertaken:

- Regular inspections of exclusion zones and repairs to fencing are made where required. Additional checks should be undertaken following storms where there is a higher risk of material falling on fencing. Where possible, inspections of exclusion zones should form part of regular site environmental checks.
- Regular assessments of the adequacy and location of exclusion zones by including this as an auditable item in the project audit schedule.
- Maintenance of exclusion fencing until the risk to disturbance within the excluded zone has been eliminated through other means. Removal of fencing should be undertaken in consultation with **environmental staff.**
- Communication of the importance of exclusion zones, and any changes to the zones, to all site staff (eg in toolbox talks). Carry out formal inductions (including visitor inductions) regarding the location and purpose of exclusion zones on site.
- Reporting of any breaches of the exclusion zone through the RTA's environmental incident reporting procedure.

## Supporting documents

1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works
3. *Australian Standard 4970 (2009) Protection of Trees on Development Sites.*
4. *RTA Clearing and Grubbing QA Specification G40* (Accessed via the RTA intranet TechInfo page, Techdocs).
5. *RTA Environmental Protection (Management Plan) QA Specification G35* (Accessed via the RTA intranet TechInfo page, Techdocs).
6. *RTA Environmental Protection (Management System) QA Specification G36* and RTA Guide NG36 – Environmental Protection (Accessed via the RTA intranet TechInfo page, Techdocs).

# Biodiversity Guide 2 – Exclusion zones

## Objective

The objective of this guide is to provide guidance for determining and establishing exclusion zones to prevent damage to native vegetation and fauna habitats and prevent the distribution of pests, weeds and disease.

## Application of this guide

This guide is applicable where areas within or adjacent to the work site require exclusion. Exclusion zones may be for significant vegetation, threatened species, weeds, pathogens or habitat features.

## Management requirements:

- Review background documents such as environmental assessments and accompanying flora and fauna reports, conditions of approval, project or Construction Environmental Management Plans (CEMP), project or contract specifications and updated maps/plans that were developed as part of the pre-clearing process.
- Select exclusion fence type considering:
  - The risk of the excluded area being intruded upon.
  - The area to be fenced.
  - Cost.
  - The risk of fauna being trapped, injured or isolated.
- Mark exclusion zones on a suitable plan. Plans should:
  - Be based on up to date plans for the project.
  - Include an aerial underlay.
  - Include construction chainages or similar distance markers used in construction.
  - Be clearly labelled.
  - State what is being excluded.
  - Be displayed in prominent places in the site shed.
  - Outline any procedures that must be followed for access into exclusion zones.
- Allow enough lead time to establish exclusion zones before clearing.
- Mark out exclusion zones with temporary markings such as pegs or paint and where possible use a **qualified surveyor**.
- Ensure that any trees to be felled to establish exclusion zones are felled so as to fall away from the exclusion zone.
- Place exclusion zone fencing outside tree protection zones.
- Erect signs to inform personnel of the purpose of exclusion zone fencing.
- Store materials or equipment outside exclusion zones.
- Avoid stockpiling materials and equipment and parking vehicles and machinery within the dripline of any tree.
- Ensure all exclusion zones are regularly inspected and repairs to fencing are made where required.
- Carry out regular assessments of the adequacy and location of exclusion zones by including this as an auditable item in the project audit schedule.
- Maintain exclusion fencing until the risk to disturbance within the excluded zone has been eliminated through other means. Removal of fencing should be undertaken in consultation with **environmental staff.**
- Communicate the importance of exclusion zones, and any changes to the zones, to all site staff and visitors (eg in toolbox talks and inductions).
- Ensure that any breaches of the exclusion zone are reported through the RTA's environmental incident reporting procedure.

# Guide 3: Re-establishment of native vegetation

## Background

**Re-establishment of native vegetation can be achieved through revegetation. Revegetation is the process of replanting or re-establishing the native vegetation that has been disturbed or removed. Revegetation serves a number of purposes as part of RTA projects including visual screening, air quality improvements, erosion and sediment control, carbon sequestration as well as biodiversity offsets and recovery.**

All revegetation works should be based on sound ecological principles and be undertaken in accordance with the RTA's Landscape Guideline. Consultation and collaboration between **ecological and landscape design specialists** is recommended.

## Objective

**The objective of this guide is to ensure good biodiversity outcomes, where native vegetation re-establishment is required, by managing site conditions, material sourcing and procurement, and seed and plant stock installation and establishment.**

Positive biodiversity outcomes may be achieved through well planned and designed native revegetation and landscaping that:

- Has no net loss of native vegetation.
- Uses the re-establishment of native vegetation as part of mitigation and offset commitments.
- Ensures revegetation is representative of the natural ecological community of the area.
- Focuses on vegetation that provides habitat and fauna connectivity.

## Application of this guide

This guide is applicable to all RTA projects where native vegetation is required to be planted or re-established. Note that if the revegetation works form part of a biodiversity mitigation or offset package then additional arrangements regarding long-term protection of the revegetated area would be required.

## Specialist input requirements

**Experienced, licensed seed collectors** to carry out all seed collection. It is highly recommended that any seed collection contractors employed by the RTA adopt the *Florabank Model Code of Practice* to ensure best practice seed collection.

**Ecologists and landscape architects** should work together on the preparation of revegetation and landscape management plans and specifications.

## Management requirements

When re-establishing native vegetation the project manager and/or environment manager should engage **specialists** to undertake the following process:

### 1. Identify areas for the re-establishment of native vegetation:

- Where possible, retaining native vegetation (by minimising the road construction footprint) is in preference to clearing and revegetation.
- Clearly identify the locations of areas to be revegetated on landscape plans.
- **Ecologists and landscape architects** should work together on the preparation of revegetation and landscape management plans and specifications.

## 2. Carry out native seed collection:

- Allocate sufficient time for the collection of seed. This could involve collecting seed up to 12 months in advance of the revegetation works.
- Seed should first be collected from all areas that are to be cleared as part of the road project. By selecting a seed source that is from plants growing in similar environmental conditions nearby, the plants should be naturally adapted to local conditions and more likely to survive and prosper.
- Carry out all seed collection in accordance with *RTA Seed Collection QA Specification R176* and the Florabank Guidelines and Model Code of Practice. Experienced and **licensed seed collectors** should carry out the seed collection.
- Where the seed resources from areas to be cleared are not sufficient or available, additional seed may need to be collected from the region for the revegetation works. Selection of suitable seed collection sites is critical to ensure the genetic diversity of plant seed collected and the environmental conditions at planting and collection sites are matched.

## 3. Procure native plants:

- Where possible, plants should be grown from local provenance seed. This can only be achieved if sufficient time has been made available after seed collection to allow for adequate growth for successful planting or there is an available supply of indigenous plants from a local nursery. The purpose of this is to ensure that plants are well suited to the area resulting in less maintenance, better plant health, better establishment and better compatibility with local flora and fauna species.
- Native plants may need to be specially grown and sourced for use in the revegetation works. These plants need to be appropriately selected in consultation with **landscape architects and biodiversity specialists.** Consideration should be given to a range of characteristics such as species, height and drought tolerance.
- Plants should be robust and of a sufficient size to handle planting operations and exposure to road microclimates. The pot size and rootball development can be a key factor in the plant survival rate (Figure 3.1).
- Where native plants grown from local provenance seed are not available, then native species grown from seed collected from the region are acceptable. However there needs to be a clear demonstration that local native seed sources for planting are not available. Consultation with **specialists** may be required if native plants of local provenance are not readily available.
- Use only plants that have been certified disease free for revegetation works (see *Guide 7: Pathogen management*). Nurseries usually obtain this certification from relevant bodies such as the Botanic Gardens Trust.


**FIGURE 3.1:** Different container sizes for planting. Note the deep rooted pot for the Forestry Tubestock which is preferable for trees. The shorter Hiko and Tubestock pots may also suitable for trees but are well suited for shrubs (Photo: John Chang).

## 4. Prepare the ground:

- The principal factor governing the quality of revegetation is the ground conditions. Creating the right ground conditions will significantly assist good biodiversity outcomes.
- In ideal circumstances, re-creating natural ground conditions by spreading soils that are collected from site (and appropriately stored in accordance with RTA's Stockpile Site Management Guideline) leads to natural regeneration of local species and the best revegetation outcome. Some projects or areas of projects have been able to achieve this outcome (Figure 3.2).

  Natural regeneration may not be possible due to drainage changes, differing light levels, wind exposure, soil damage, construction techniques and weed infestation. However, there are a number of principles that may help achieve the right ground conditions:

  - Collect local native topsoils and leaf litter and store for use in the revegetation works. Where possible avoid the need to import soils and ensure no weed infestation. See *Guide 6: Weed management*, the RTA Stockpile Site Management Guideline and the Blue Book for more information on weed management and stockpiling soils (Figure 3.3).
  - Consider the physical and chemical properties of the soils and their organic profile. Soil in areas to be revegetated should match surrounding soil conditions as closely as possible unless adjacent areas are weedy or contaminated.
  - Ensure areas to be revegetated have an appropriate level of natural drainage that is not impeded by surrounding underground or surface structures or prone to water logging. Isolated pockets of land surrounded by hard surfaces should be avoided.
  - Avoid compaction of soils in areas identified for revegetation. Where compaction has occurred, the soil should be loosened.

**FIGURE 3.2:** Natural regeneration occurred on Main Road 92 near Nowra, Southern Region after preparing ground with local soils and mulch (Photo: Gareth Collins).

**FIGURE 3.3:** Topsoil being stockpiled at Moree for re-use later in revegetation and landscaping works (Photo: Lester Piggott).

## 5. Seeding:

- Once collected, native seed needs to be sown in a manner to suit the species. Consider the soil type and depth, the moisture availability, aspect and the season in which the species should be planted.
- Ensure the seed receives adequate moisture to allow it to germinate before it is blown or washed off the road landscape. There are several seeding techniques that deal with moisture requirements in different ways. For further details see *Construction Quality Technical Direction 007, Quality Alert 7 – Hydroseeding, hydromulching and other slope stabilisation methods*. The different techniques are summarised in Table 3.1.

**FIGURE 3.4:** Revegetation on the Pacific Highway 'Karuah Bypass' involved preparing the ground with local soils and spraying with local seeds (Photo: Paul Murray).

**FIGURE 3.5:** Seeding with native species on Bonville bypass has been successful, especially adjacent to the existing state forest where moist, sheltered conditions occur (Photo: Gareth Collins).

**FIGURE 3.6:** Direct seeding taking place at the Hume Highway offsets property at Slate Hill (Photo: Josie Stokes).

**FIGURE 3.7:** An example of what hydromulch looks like close up (Photo Lester Piggott).

FIGURE 3.8: Strawmulching over a hydroseeded embankment. A tackifier (adhesive) is sprayed over the straw to bind it in place. The materials used must be appropriate to the local context, and consider fire risk, high wind and erosion profiles (Photo: Leigh Trevitt).

**TABLE 3.1:** TECHNIQUES FOR PLANTING NATIVE SEEDS.

| Technique | Description |
|---|---|
| **Hand sowing** | Distribution of seed by manually spreading onto prepared ground. Hand sowing is best suited to areas that are small and difficult to access or in ecologically sensitive areas. |
| **Direct seeding (Figure 3.6)** | Also called 'seed drilling', this is the application of seed mechanically into the ground by rotary or agricultural equipment. Direct seeding is best suited to areas that are even, linear and not steep eg road medians. |
| **Hydroseeding** | The spraying of seed and water onto the landscape providing a brief period of moist conditions and ensuring the seed is well spread out and carried to the ground. Hydroseeding is best suited to moist climates or seasons. Avoid using in hot, dry conditions. |
| **Hydromulching (Figure 3.7)** | The spraying of mulch combined with seeding and water. The mulch is usually coloured to identify its coverage. Hydromulching provides a longer period of moisture and helps the seed to stick to the ground. |
| **Strawmulching (Figure 3.8)** | A blanket of straw blown over hydroseeded areas. It requires a tackifier (adhesive), to bind the straw together. This may also be done using sugar cane toppings (as long as they have been inspected for 'hitchhikers' like cane toads). |
| **Seed impregnated erosion controls** | A soil stabilising product that incorporates native seed into the soil, conditioner or fabric. |

## 6. Planting:

When planting, the following general steps should be undertaken:

1. Planting operations should be in accordance with *RTA Landscape Planting QA Specification R179*.
2. Consider seasonal risks of frost, drought, flooding and sun exposure to avoid damaging plants and to encourage growth.
3. Ensure plant spacing follows the landscaping plan for the project, reflects local conditions and is dense enough to ensure plants achieve a timely coverage of the ground, which helps minimise erosion and/or weed invasion (Figure 3.9 and Figure 3.10).
4. Ensure the diversity and spacing of plants is representative of nearby vegetation communities in the area. Consider species composition and structure of the locality when developing landscaping plans.
5. Consider appropriate shade and drainage conditions when planting. This may include clustering species near mature plants or in the vicinity of existing stands rather than in exposed open conditions.
6. Provide mulching around plants for dry or potentially weedy sites to help retain moisture and suppress weeds. Mulch also aids soil stabilisation and protection. Inspect sugar cane mulch for the presence of Cane Toads (*Rhinella marinus*) or other 'hitchhikers' from outside areas. Catch any Cane Toads in accordance with *Guide 9: Fauna handling*.

**FIGURE 3.9:** Planting carried out in an exposed location. Weed competition is evident and the plants may fail (Photo: Paul Murray).

**FIGURE 3.10:** Planting with a diverse range of species that are representative of the nearby vegetation communities (Pacific Highway at Karuah)(Photo: Paul Murray).

### 7. Monitoring:

The project manager and/or environment manager should ensure the following:

- Inspection, monitoring and maintenance of revegetated areas is conducted in accordance with the landscape management and revegetation plans and maintenance specifications.
- Roles, responsibilities and the schedule for monitoring and maintenance activities are outlined in landscape management and revegetation plans and maintenance specifications.

**FIGURE 3.11:** Native plants being inspected just after planting (Main Road 92, Nowra to Nerriga) (Photo: Gareth Collins).

## Supporting documents


1. Department of Environment and Climate Change (DECC)(2008) *Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction*, Sydney (Blue Book).
2. Florabank (2000) Florabank Guidelines 1–10, Florabank, Yarralumla, ACT (www.florabank.org.au/default.asp?V_DOC_ID=755).
3. Mortlock, W, (1998) *Native Seed in Australia: Summary findings and draft recommendations*, Florabank, ACT.
4. Mortlock, W (1998, accessed 7 April 2011) Florabank Model Code of Practice, Florabank, Yarralumla, ACT (www.florabank.org.au and click on seed knowledge).
5. RTA (2011) Stockpile Site Management Guideline.
6. RTA (2008) Landscape Guideline: Guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seeding.
7. RTA CQTD07-2009 (Construction Quality Technical Direction 007), Quality Alert 7 – Hydroseeding, Hydromulching and other slope stabilisation methods.
8. *RTA Landscape Planting QA Specification R179* (Accessed via the RTA intranet TechInfo page, Techdocs).
9. *RTA Seed Collection QA Specification R176* (Accessed via the RTA intranet TechInfo page, Techdocs).

# Biodiversity Guide 3 – Re-establishment of native vegetation

## Objective

The objective of this guide is to ensure good biodiversity outcomes, where native vegetation re-establishment is required, by managing site conditions, material sourcing and procurement, and seed and plant stock installation and establishment.

## Application of this guide

This guide is applicable to all RTA projects where native vegetation is required to be planted or re-established. Note that if the revegetation works form part of a biodiversity mitigation or offset package then additional arrangements regarding long-term protection of the revegetated area would be required.

## Management requirements:

- Retain native vegetation by minimising the road construction footprint where possible rather than clearing and revegetating the area.
- **Ecologists and landscape architects** should work together on the preparation of revegetation plans and specifications that clearly identify the locations of areas to be revegetated.
- Allocate sufficient time for the collection of seed to be used in revegetation.
- Carry out all seed collection in accordance with *RTA Seed Collection QA Specification R176* and the Florabank Guidelines and Model Code of Practice.
- Use **experienced and licensed seed collectors** to carry out seed collection.
- Where possible, procured plants should be grown from local provenance seed.
- Consideration should be given to a range of characteristics such as species, height and drought tolerance when procuring native plants.
- Planting operations should be in accordance with *RTA Landscape Planting QA Specification R179*.
- Use only plants that have been certified disease free for revegetation works (refer to *Guide 7: Pathogen management*).
- Collect local native topsoils and leaf litter and store for use in revegetation works.
- Soils in areas to be revegetated should match surrounding soil conditions as closely as possible unless adjacent areas are weedy or contaminated.
- Ensure areas to be revegetated have an appropriate level of natural drainage.
- Avoid compaction of soils in areas identified for revegetation. Where compaction has occurred, the soil should be loosened.
- There are several seeding techniques that deal with moisture requirements in different ways. For further details refer to *Construction Quality Technical Direction 007, Quality Alert 7 – Hydroseeding, hydromulching and other slope stabilisation methods*.
- When planting consider seasonal risks of frost, drought, flooding and sun exposure to avoid damaging plants and to encourage growth.
- Ensure plant spacing and diversity follows the landscaping plan for the project, reflects local conditions and is dense enough to ensure plants achieve a timely coverage of the ground.
- Consider appropriate shade and drainage conditions when planting. Provide mulching around plants for dry or potentially weedy sites to help retain moisture and suppress weeds.
- Inspection, monitoring and maintenance of revegetated areas should be conducted in accordance with the landscape management plan. Outline the roles and responsibilities in landscape management and revegetation plans including the schedule for monitoring and maintenance activities.

# Guide 4: Clearing of vegetation and removal of bushrock

## Background

**Clearing of vegetation and removal of bushrock has the potential to displace, injure or kill native flora and fauna, including threatened species. Nocturnal fauna that shelter in tree hollows during the day and cryptic flora species (such as underground orchids) are at greatest risk during these activities.**

'The clearing of native vegetation', 'loss of hollow-bearing trees', 'removal of dead wood and dead trees', and 'bushrock removal' are Key Threatening Processes listed under the *Threatened Species Conservation Act 1995* (NSW) (TSC Act).

Bushrock is loose rock found on rock or soil surfaces. Many fauna species use bushrock for shelter and to hide from predators, find food, avoid extreme weather and escape bushfires. Bushrock removal results in disturbance and removal of habitat for native fauna as well as native flora that grow in rocky areas.

This guide supports the *RTA Clearing and Grubbing QA Specification G40* and provides additional guidance on undertaking clearing and grubbing works in an ecologically sensitive manner.

## Objective

**The objective of this guide is to minimise the impacts on biodiversity from loss of habitat as a result of the clearing process and to ensure that removal of bushrock is done in a way that minimises loss and damage of native fauna and flora habitat.**

This guide is intended to provide best practice recommendations for the following works:

- Clearing of native vegetation (including grasslands, native and exotic vegetation).
- Pruning (maintenance).
- Removal of identified habitat (eg hollow-bearing trees, bushrock).
- Grubbing of stumps.
- Stripping of topsoil.

## Application of this guide

This guide is applicable where native vegetation is to be cleared or pruned and bushrock or other habitat is to be removed.

**FIGURE 4.1:** Staged habitat removal taking place to minimise impacts on biodiversity (Photo: RTA).

## Specialist input requirements

An experienced and **licensed wildlife carer and/or ecologist** should be on site during habitat removal.

A **vet and/or wildlife carer** may need to be contacted to assist with injured fauna.

# Management requirements

### General requirements for clearing of vegetation and removal of bushrock

When undertaking the clearing of vegetation and removal of bushrock, the project manager and/or environment manager should ensure the following general steps are undertaken:

- The pre-clearing process is completed before any clearing begins (see *Guide 1: Pre-clearing process*).
- A clearing and grubbing plan is developed with reference to this guide.
- The requirements of the clearing and grubbing plan are communicated to site staff regularly.
- Clearing of vegetation and/or removal of bushrock does not go beyond the approved clearing limits for the project. Use exclusion zone fencing to improve the visibility of clearing limits (see *Guide 2: Exclusion zones*).
- Reference is made to *Guide 10: Aquatic habitats and riparian zones* where clearing of vegetation and/or removal of bushrock occurs within 50 metres of aquatic habitats or in riparian zones.
- The unexpected threatened species finds procedure is followed if a threatened species is encountered that has not previously been identified and assessed in the environmental assessment (see the unexpected threatened species finds procedure in *Guide 1: Pre-clearing process*.).

### Clearing of woody vegetation

The project manager and/or environment manager should communicate the following best practice methods to the clearing contractor:

- Carefully clear vegetation so as not to mix topsoil with debris and to avoid impacts to surrounding native vegetation.
- Document the selection of suitable work methods in the clearing and grubbing plan.
- Retain stumps in riparian zones and aquatic habitats to reduce the potential for bank erosion. Even dead stumps and root systems may act to reduce erosion during construction and operation periods.
- Separate woody vegetation into:
  - **Millable timber**, if there is an agreement with NSW State Forests.
  - **Secondary re-use** (see *Guide 5: Re-use of woody debris and bushrock*). Cleared native vegetation is a valuable resource both during works and in rehabilitation and revegetation works and therefore should not be disposed of unless absolutely necessary.
  - **Exotic (non-native) vegetation** that requires removal and disposal. Where noxious woody weeds are to be cleared, specific management measures may be needed (see *Guide 6: Weed management*).
- Stockpiles of cleared vegetation are kept under two metres high in accordance with the RTA's Stockpile Site Management Guideline.

**FIGURE 4.2:** Feathertail Glider (*Acrobates pygmaeus*) rescued by a licensed wildlife carer during staged habitat removal on Rotary Drive, Southern Region (Photo: Ian Chapple).

## Clearing of non-woody vegetation

The project manager and/or environment manager should communicate the following best practice methods to the clearing contractor:

- Non-woody vegetation (typically grasses and groundcover species) is incorporated into the stripping of topsoil to retain any organic materials and nutrients within the topsoil layer. In some circumstances soil may need to be treated before re-use on site eg acid sulfate soils (see RTA's Guideline for the Management of Acid Sulfate Materials).
- Topsoil removal is carried out with suitable care such that topsoil is not mixed with subsoils, particularly in areas where topsoil is thin. Topsoil should be stockpiled separately for re-use in site rehabilitation and revegetation. See RTA's Stockpile Site Management Guideline and the Blue Book.

## Staged habitat removal

The staged habitat removal process is to be used when identified habitat (eg hollow-bearing trees, habitat trees or bushrock) is to be removed. Staged habitat removal minimises direct impacts on fauna by providing them with an opportunity to vacate hollows and relocate naturally.

The pre-clearing process identifies habitat that requires staged removal (see *Guide 1: Pre-clearing process*).

The project manager and/or environment manager should ensure the following is undertaken for staged habitat removal:

1. **Staged habitat removal is conducted in at least two stages** (for example clearing non-habitat trees followed by habitat trees) so as to allow respite between the initial disturbance of the clearing process and the final removal of habitat.
2. **The works are timed to minimise the impact on flora and fauna**. Consider the seasonal impact of clearing on species identified in the environmental assessment or pre-clearing process or that are known to occur in the area. If possible, avoid clearing during times when these species are breeding.
3. **Contact vets and wildlife carers before works start** to ensure they are willing to assist treating injured animals if necessary. Provide their contact details to the site manager and clearly display them in the site office. Record all fauna fatalities or injuries and details of any relocated fauna.
4. **A licensed wildlife carer and/or ecologist should be on site during habitat removal**. Fauna encountered during the clearing process are handled in accordance with *Guide 9: Fauna handling*. Where necessary, relocate fauna to pre-determined habitat identified for fauna release. The location of these areas is confirmed during the pre-clearing process (see *Guide 1: Pre-clearing process*).
5. **Non-habitat vegetation is removed first** (eg shrubs, regrowth, ground cover and non-habitat trees). Allow fauna at least 24 hours to vacate remaining habitat. Ensure that a **wildlife carer and/or an ecologist** inspects trees before and after felling. Capture and relocate non-injured fauna that are found in any felled trees to pre-determined habitat identified for fauna release.
6. **Fell habitat trees carefully** using equipment that allows habitat trees to be lowered to the ground with minimal impact (eg claw extension). Do not fell trees towards exclusion zones. Relocate felled habitat trees in accordance with *Guide 5: Re-use of woody debris and bushrock*.
7. **Records are kept of the habitat removal process** as outlined in the *Reporting* section of this guide.

Figure 4.3 outlines the steps to be carried out for staged habitat removal.

## STAGED HABITAT REMOVAL PROCESS

**1. Contact vet and/or wildlife carers**

Contact with **vets and wildlife carers** should be made before works start to ensure they are willing to assist in treating injured animals if necessary. Their contact details should be given to the site manager and clearly displayed in the site office.

**2. An experienced and licensed wildlife carer and/or ecologist should be present**

An experienced and **licensed wildlife carer and/or ecologist** should be present on site during all habitat removal activities to capture and relocate fauna that may be encountered.

**3. Remove non-habitat vegetation**

Progressive habitat removal should take place around habitat identified and marked during the pre-clearing process. Remove non-hollow-bearing trees, undergrowth, feed-trees, regrowth and grass. Do not fell trees towards exclusion zones.

**4. Leave habitat for a minimum of 24 hours**

Identified habitat (eg hollow-bearing trees) should be left for at least 24 hours after removing non-habitat vegetation to allow fauna to escape. A **licensed wildlife carer and/or ecologist** should check hollow-bearing trees are not being used by fauna before felling. If necessary, fauna may need to be trapped and relocated to pre-determined habitat identified for fauna release.

**5. Remove habitat**

Fell habitat trees as carefully as possible to avoid injury to any fauna still remaining in trees. Use equipment that would allow the habitat trees to be lowered to the ground with minimal impact (eg claw extension). Do not fell trees towards exclusion zones.

**6. Inspect habitat**

An experienced and **licensed wildlife carer and/or ecologist** should inspect habitat once it is removed eg after a tree is felled. Animals that emerge should be captured, inspected for injury then relocated to pre-determined habitat identified for fauna release.

**7. Relocate habitat**

All hollows have the potential to support fauna and should be placed in adjacent habitat until the following day for further inspection by a **licensed wildlife carer and/or ecologist** to verify no fauna is present. If possible, the hollows could be permanently relocated in adjacent areas in accordance with *Guide 5: Re-use of woody debris and bushrock*. Inspect woody debris for fauna immediately before chipping to avoid injury or death to fauna that may be present.

**8. Reporting**

The project manager and/or environment manager should ensure that the outcomes of the clearing process are recorded. Reporting is usually the responsibility of an **ecologist or environment officer**. Reports are to be submitted to relevant personnel eg environment manager or RTA regional environmental staff.

FIGURE 4.3: Staged habitat removal process.

**FIGURE 4.4:** Tree removal using a claw extension to gently lower trees rather than dropping them. This machinery is suitable when removing habitat trees as it may reduce the impact on any fauna present inside the hollows (Photo: RTA).

**FIGURE 4.5:** Habitat tree left standing during the second stage of staged habitat removal (Photo: RTA).

## Managing the removal of bushrock from sites

The pre-clearing process identifies bushrock habitat requiring management during removal and/or relocation (see *Guide 1: Pre-clearing process*).

The project manager and/or environment manager should ensure the following is undertaken for the removal of bushrock:

- Minimise damage to the bushrock and avoid excessive soil disturbance.
- Time works to consider the seasonal requirements of flora and fauna species and minimise any potential impact.
- An experienced and **licensed wildlife carer and/or ecologist** is present to capture and relocate any fauna encountered.
- Follow the unexpected threatened species finds procedure if threatened species that have not been identified in the environmental assessment are detected (see the unexpected threatened species finds procedure in *Guide 1: Pre-clearing process*.).
- See *Guide 5: Re-use of woody debris and bushrock* for guidance on the re-use of bushrock for projects where there is surplus bushrock.

**FIGURE 4.6:** An example of sandstone bushrock habitat (Photo: Paul Rossington).

## Reporting

The project manager and/or environment manager should ensure that the outcomes of the clearing process are recorded. Reporting is usually the responsibility of an **ecologist or environment officer**. Reports are to be submitted to relevant personnel eg environment manager or RTA regional environmental staff.

Include the following information in reports for vegetation clearing and bushrock removal:

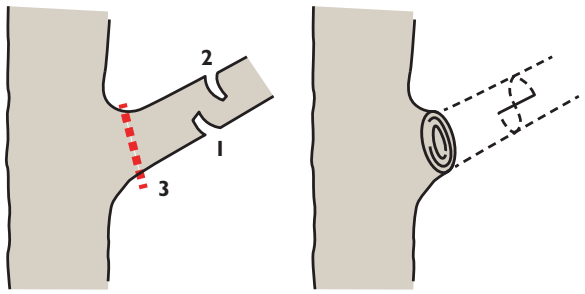
- Habitat feature type and location.
- Number of hours between first and second stage of habitat removal.
- Fauna species present.
- Fauna species captured.
- Fauna species relocated.
- Release location.
- Condition/behaviour of animal upon release.
- Fauna injured or killed.

## Pruning

The project manager and/or environment manager should ensure that the Australian Standard *AS 4373 Pruning of amenity trees* is followed for all pruning works. Ways to minimise impact to vegetation include:

- The use of appropriate tools such as chainsaws and vehicle mounted saws. Do not use heavy machinery for pruning and trimming.
- Using the three-cut method as this avoids bark injury below the prune (Figure 4.7).
- If possible, retaining limbs bearing hollows on the tree. If they cannot be retained then place the hollow-bearing limb in adjacent undisturbed vegetation to provide fauna habitat. Consider the receiving environments when placing hollow-nearing limbs in accordance with *Guide 5: Re-use of woody debris and bushrock*.

**THREE-CUT METHOD**




**STEP 1:** The under cut.

**STEP 2:** The upper cut to remove the branch.

**STEP 3:** The final cut.

**FIGURE 4.7:** The three-cut method (adapted from *AS 4373 Pruning of amenity trees*).

**FIGURE 4.8:** An **ecologist** using a torch to check the limb of a felled habitat for any fauna (Photo: John O'Donnell)

# Supporting documents


1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works.
3. *Australian Standard 4373 (2007) Pruning of Amenity Trees.*
4. *Australian Standard 4970 (2009) Protection of Trees on Development Sites.*
5. Department of Environment and Conservation (DEC) (1999, accessed 7 April 2011) Scientific Committee Final Determination: key threatening process – bushrock removal (access via www.environment.nsw.gov.au by clicking on threatened species and key threatening processes).
6. Department of Environment and Conservation (DEC) (2003, accessed 7 April 2011) Scientific Committee Final Determination: key threatening process- Removal of dead wood and dead trees (Access via www.environment.nsw.gov.au by clicking on threatened species and key threatening processes).
7. National Parks and Wildlife Service (1999, accessed 7 April 2011) Threatened species information: Bushrock Removal Fact Sheet (www.environment.nsw.gov.au/resources/nature/bushrock.pdf).
8. RTA (2005) Guideline for the Management of Acid Sulfate Materials.
9. RTA 2004, *Design Construction and Ten Year Maintenance of Pacific Highway Upgrade* (Appendix 5 – Provisions for Fauna) (unpublished report).
10. RTA (2011) Stockpile Site Management Guideline.
11. *RTA Clearing and Grubbing QA Specification G40* (Accessed via the RTA intranet TechInfo page, Techdocs).
12. *RTA Environmental Protection (Management Plan) QA Specification G35* (Accessed via the RTA intranet TechInfo page, Techdocs).
13. *RTA Environmental Protection (Management System) QA Specification G36* (Accessed via the RTA intranet TechInfo page, Techdocs).
14. *RTA Soil and Water Management (Soil and Water Management Plan) QA Specification G38* (Accessed via the RTA intranet TechInfo page, Techdocs).
15. *RTA Soil and Water Management (Erosion and Sediment Control Plan)QA Specification G39* (Accessed via the RTA intranet TechInfo page, Techdocs).

# Biodiversity Guide 4 – Clearing of vegetation and removal of bushrock

## Objective

The objective of this guide is to minimise the impacts on biodiversity from loss of habitat as a result of the clearing process and to ensure that removal of bushrock is done in a way that minimises loss and damage of native fauna and flora habitat.

## Application of this guide

This guide is applicable where native vegetation is to be cleared or pruned and bushrock or other habitat is to be removed.

## Management requirements:

- The pre-clearing process should be completed before any clearing begins (see *Guide 1: Pre-clearing process*).
- Develop a clearing and grubbing plan with reference to the Biodiversity Guidelines and communicate the requirements of the plan to site staff regularly.
- Document the selection of suitable work methods in a clearing and grubbing plan.
- Ensure clearing of vegetation and/or removal of bushrock does not go beyond the approved clearing limits for the project.
- Follow the unexpected threatened species finds procedure if a threatened species is encountered that has not previously been identified and assessed in the environmental assessment.
- Carefully clear vegetation so as not to mix topsoil with debris and to avoid impacts to surrounding native vegetation.
- Retain stumps in riparian zones and aquatic habitats to reduce the potential for bank erosion.
- Separate woody vegetation into millable timber (if there is an agreement with NSW State Forests), secondary re-use (see *Guide 5: Re-use of woody debris and bushrock*) or exotic (non-native) vegetation.
- Keep stockpiles of cleared vegetation under two metres high in accordance with the RTA's Stockpile Site Management Guideline.
- Non-woody vegetation (typically grasses and groundcover species) should be incorporated into the stripping of topsoil to retain any organic materials and nutrients within the topsoil layer.
- The staged habitat removal process is to be used when identified habitat (eg hollow-bearing trees, habitat trees or bushrock) is to be removed.
- Make contact with **vets and wildlife carers** before works start to ensure they are willing to assist treating injured animals if necessary.
- Consider the seasonal impact of clearing on species identified in the environmental assessment or pre-clearing process or that are known to occur in the area.
- A **licensed wildlife carer or ecologist** should be on site during habitat removal.
- Undertake bushrock removal in a way that minimises damage to the bushrock, avoids excessive soil disturbance and avoids climatic seasons when species are utilising this resource.
- Record the outcomes of the clearing process.
- The Australian Standard *AS 4373 Pruning of amenity trees* should be followed for all pruning works.

# Guide 5: Re-use of woody debris and bushrock

## Background

**Woody debris consists of trees and wood, whether living or dead. Woody debris is defined as pieces of wood at least 100 millimetres in diameter and at least 500 millimetres long (Gibbons et al. 2005). Bushrock is loose rock occurring on rock or soil surfaces. Many fauna species use woody debris and bushrock for shelter, basking, to hide from predators, find food and avoid extreme weather.**

**FIGURE 5.1:** Reptile species such as the Tree Skinks (*Egernia striolata*) and Basalt Snake-Lizard (*Delma plebeia*) use woody debris as a habitat resource (Photo: Lukas Clews).

Sometimes woody debris and bushrock needs to be removed from a site. When this occurs, consideration should be given to finding suitable locations for re-use of this important habitat feature in nearby areas.

'Loss of hollow-bearing trees' and the 'removal of dead wood and dead trees' are Key Threatening Processes under the *Threatened Species Conservation Act 1995* (NSW) (TSC Act). Dead wood and dead trees provide essential habitat for a wide range of native fauna and are important to the functioning of many ecosystems.

'Bushrock removal' is also a Key Threatening Process under the TSC Act. Bushrock removal results in disturbance and removal of habitat for native fauna as well as native flora that grow in rocky areas. Numerous threatened species are identified as being adversely affected by bushrock removal (eg reptiles and frogs).

**FIGURE 5.2:** Woody debris can be used as nesting habitat by birds (Photo: Lester Piggott).

## Objective

**The objective of this guide is to provide guidance for maximising the re-use of woody debris and bushrock to minimise loss and/or damage to native flora and fauna habitats.**

## Application of this guide

This guide is applicable where:

- Native woody vegetation, including hollows and dead trees, is available to be re-used following clearing.
- Bushrock is available to be re-used following removal.

## Specialist input requirements

Use an **ecologist** to determine the relocation sites and densities for placement of woody debris and bushrock.

## Management requirements

### General requirements for the re-use of woody debris and bushrock

The project manager should ensure contract specifications state that woody debris and bushrock is to be re-used on site (eg for habitat improvement) where possible.

Table 5.1 shows how woody debris is classified and suggests possible uses. Re-use of woody debris greater than 100 millimetres in diameter, and bushrock is encouraged. However, it is important that the project manager and/or environment manager engages an **ecologist** to provide advice on the re-use of woody debris and bushrock to ensure it does not have a negative impact on the receiving environment. In existing areas of high quality habitat there may already be enough suitable hollows, fallen logs or bushrock, so adding surplus woody debris may cause a fire hazard or unnecessary disturbance.

Where woody debris is to be mulched the project manager and/or environment manager should ensure that weeds are separated from native vegetation (see *Guide 6: Weed management*) and that the amount of clearing and grubbing is not extended to make up for mulch shortfalls.

**TABLE 5.1:** THE CLASSIFICATION OF WOODY DEBRIS AND POSSIBLE USES

| Size | Possible uses |
|---|---|
| **Logs > 500 millimetres in diameter** | Habitat improvement such as re-snagging creeks and rivers (in consultation with **DPI**) or millable timber (if there is an agreement with **NSW State Forests**). |
| **Logs between 100–500 millimetres in diameter** | Erosion and sediment control, replacement of habitat features, habitat improvement (eg perching sites for woodland birds, timber piles for reptiles and frogs) or fauna furniture for use in underpasses. |
| **Debris < 100 millimetres in diameter** | Mulched/chipped and re-used on site eg revegetation, erosion and sediment control. |

**FIGURE 5.3:** Woody debris being relocated for fauna habitat as part of the Pacific Highway upgrade near Bulahdelah (Photo: Tony Compton).


**FIGURE 5.4:** The RTA provided trees felled for the Hume Highway duplication project for the Murray River Resnagging project. Large logs were transported by truck from the road works site (Photo: M Casey, DPI).

## Relocation of woody debris and bushrock

The project manager and/or environment manager should ensure the following best practice methods are undertaken when relocating woody debris and bushrock:

1. Removal, stockpiling, transportation and relocation of woody debris and/or bushrock is carried out in a manner that minimises disturbance to native vegetation (including the canopy, shrubs, dead trees, fallen timber and groundcover species) or bushrock.
2. The spread of any weeds or pathogens that may be in the soil is avoided when relocating woody debris and bushrock from stockpiles.
3. An **ecologist** is engaged to provide advice on positioning woody debris and bushrock in designated relocation areas
4. Topsoil disturbance is kept to a minimum and is not heaped up against woody debris or bushrock because of the potential to provide habitat for rabbits.
5. Woody debris is placed evenly across the site.

## Stockpiling of woody debris and bushrock

Bushrock, woody debris and mulch obtained from woody debris, can all be stockpiled for later re-use. The project manager and/or environment manager should ensure stockpiles are managed in accordance with RTA's Stockpile Site Management Guideline, *RTA Environmental Protection (Management System) QA Specification G36* and *RTA Vegetation QA Specification R178*.

Mulch obtained from woody debris has the potential to contain tannins. Tannins are naturally occurring plant compounds that discolour water and may potentially impact on soil or water pH. Tannin generation is common in vegetation communities such as coastal floodplain forests or where high tannin generating plant species occur eg *Melaleuca* and *Acacia* species. The project manager and/or environment manager should consider the potential impacts of tannins leaching from stockpiled mulch and/or mulch used for erosion and sediment control or landscaping. The project manager and/or environment manager should ensure a mulch tannin management plan is developed where tannins are likely to be generated.

**FIGURE 5.5:** A Pink-tongued Skink (*Cyclodomorphus gerrardii*) basking on woody debris that has been stockpiled to be relocated at a later time (Photo: Tony Compton).

**FIGURE 5.6:** Woody debris placement for the Woomargama Bypass, South West Region (Photo: Josie Stokes).

## Supporting documents


1. Department of Environment and Conservation (2007) *Hume Highway Duplication Coarse Woody Debris Relocation Criteria* (unpublished report).
2. Department of Environment and Climate Change (DECC)(2008) *Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction,* Sydney (Blue Book).
3. Department of Environment and Conservation (DEC) (1999, accessed 7 April 2011) Scientific Committee Final Determination: key threatening process – Bushrock removal (Access via www.environment.nsw.gov.au by clicking on threatened species and key threatening processes).
4. Department of Environment and Conservation (DEC) (2003, accessed 7 April 2011) Scientific Committee Final Determination: key threatening process – Removal of dead wood and dead trees (Access via www.environment.nsw.gov.au by clicking on threatened species and key threatening processes).
5. Gibbons, P, Ayers, D, Seddon, J, Doyle, S, and Briggs, S (2005) *BioMetric Version 1.8.: A Terrestrial Biodiversity Assessment Tool for the NSW Property Vegetation Plan Developer, Operational Manual* Department of Environment and Conservation (NSW), (unpublished report).
6. National Parks and Wildlife Service (1999, accessed 7 April 2011) Threatened species information: Bushrock Removal Fact Sheet (www.environment.nsw.gov.au/resources/nature/bushrock.pdf).
7. RTA (2011) Stockpile Site Management Guideline.
8. *RTA Environmental Protection (Management System) QA Specification G36* (Accessed via the RTA intranet TechInfo page, Techdocs).
9. *RTA Vegetation QA Specification R178* (Accessed via the RTA intranet TechInfo page, Techdocs).

# Biodiversity Guide 5 – Re-use of woody debris and bushrock

## Objective

The objective of this guide is to provide guidance for maximising the re-use of woody debris and bushrock to minimise loss and/or damage to native flora and fauna habitats.

## Application of this guide

This guide is applicable where:

- Native woody vegetation, including hollows and dead trees, is available to be re-used following clearing.
- Bushrock is available to be re-used following removal.

## Management requirements:

- Contract specifications should state that woody debris and bushrock is to be re-used on site (eg for habitat improvement) where possible.
- Engage an **ecologist** to provide advice on the re-use of woody debris and bushrock to ensure it does not have a negative impact on the receiving environment.
- Separated weeds from native vegetation.
- Do not extend the amount of clearing and grubbing to make up for mulch shortfalls.
- Carry out removal, stockpiling, transportation and relocation of woody debris and/or bushrock in a manner that minimises disturbance to native vegetation (including the canopy, shrubs, dead trees, fallen timber and groundcover species) or bushrock.
- Avoid the spread of any weeds or pathogens that may be in the soil when relocating woody debris and bushrock from stockpiles.
- Engage an **ecologist** to provide advice on positioning woody debris and bushrock in designated relocation areas
- Keep topsoil disturbance to a minimum.
- When relocating woody debris, place it evenly across the site.
- Manage stockpiles in accordance with RTA's Stockpile Site Management Guideline, *RTA Environmental Protection (Management System) QA Specification G36* and *RTA Vegetation QA Specification R178*.
- Prepare a mulch tannin management plan for the project where tannins are likely to be generated.

# Guide 6: Weed management

## Background

**A 'weed' is a plant growing in a terrestrial or aquatic area where it is not wanted. This can include seeds, flower heads or woody material. A plant that is considered a weed may not always be classed as a weed by everyone in all regions. Weeds are plants that may threaten agricultural productivity, have detrimental effects on the natural environment or impact on human health. Weeds may be native or introduced plant species.**

The construction of road projects and maintenance works has the potential to introduce and promote the spread of weed species. The *Noxious Weeds Act 1993* (NSW) has provisions for the control of certain weeds and the RTA is required to control noxious weeds under this Act.

There are currently six Key Threatening Processes listed under the *NSW Threatened Species Conservation Act 1995* (NSW) (TSC Act) that relate to the invasion and establishment of weeds:

- Invasion and establishment of exotic vines and scramblers.
- Invasion and establishment of Scotch Broom (*Cytisus scoparius*).
- Invasion of native plant communities by Bitou Bush & Boneseed.
- Invasion of native plant communities by exotic perennial grasses.
- Invasion of native plant communities by African Olive (*Olea europaea L. subsp. cuspidata*).
- Invasion, establishment and spread of Lantana (*Lantana camara*).

Weeds are often classed into broad groups depending on their characteristics and impacts. The main groups of weeds are provided in Table 6.1.

**TABLE 6.1:** CLASSIFICATION OF WEEDS IN NSW.

| Classification | Description |
|---|---|
| Weeds of National Significance (WONS) | Listed under the National Weeds Strategy (see www.weeds.gov.au/weeds/lists/wons.html). |
| National Environmental Alert List Weeds | Identified under the National Weeds Strategy (see www.weeds.gov.au/weeds/lists/alert.html). |
| Noxious | Require control under the *Noxious Weeds Act 1993* (NSW). Noxious weed declarations, their control class and control requirements are different for each Local Government Area (see www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed). |
| Environmental | Represent a threat to the conservation values of natural ecosystems. |
| Agricultural | Represent a threat to agricultural production. |

## Objective

**The objective of this guide is to prevent or minimise the spread of noxious and environmental weed species on all RTA project sites and during maintenance works.**

## Application of this guide

This guide is applicable where RTA activities disturb vegetation, soil or aquatic environments.

This guide outlines weed management requirements for environmental and noxious weeds during construction but also provides best practice methods for weed management during maintenance works.

## Specialist input requirements

**Use an ecologist or person trained in weed management and identification** to conduct the site weed assessment before works begin and assist in developing the weed management plan.

## Management requirements

### General requirements for weed management for projects and maintenance works

The project manager and/or environment manager should ensure the following best practice methods for weed management are undertaken:

- Mow/slash areas infested with weeds before they seed. This may reduce the propagation of new plants.
- Program works from least to most weed infested areas.
- Clean machinery, vehicles and footwear before moving to a new location.
- Securely cover loads of weed-contaminated material to prevent weed plant material falling or blowing off vehicles.
- Dispose of weed-contaminated soil at an appropriate waste management facility.
- Remove weeds immediately onto suitable trucks and dispose of without stockpiling.
- Separate weeds from native vegetation where native vegetation is to be used for mulch. Dispose of weeds to an appropriate waste management facility. Do not use weeds for mulch.
- Send samples of topsoil being imported onto site to a **National Association of Testing Authorities (NATA)** approved soil laboratory to ensure it contains no weed seeds or propagules (vegetative parts of plants such as buds or offshoots that can grow into new individuals)(see *Guide 3: Re-establishment of native vegetation*).

**FIGURE 6.1:** The weed Singapore Daisy (*Sphagneticola trilobata*) on the Pacific Highway – Banora Point Upgrade project. Once confined to Queensland, this weed has spread down the NSW coast and invaded rainforest edges and disturbed areas such as roadsides of the Northern Region (Photo: Tammie Tribe).

## Site weed assessment

The project manager and/or environment manager should engage an **ecologist or person trained in weed identification and management** to undertake a site weed assessment including:

1. Identifying and describing or mapping weed infested areas within the site and adjacent areas. A weed assessment may have been done as part of the environmental assessment. Other useful resources for the identification of weeds can be found in the *Supporting Documents* section of this guide. Weed identification and description/mapping will provide an understanding of the scale of weed occurrences and any associated management issues.
2. Identifying and recommendations for managing any Weeds of National Significance (WONS), National Environmental Alert Weeds and/or noxious weeds located within the site or adjacent areas in consultation with the **weeds officer** at the relevant local council. Many of these weeds have legislative control requirements and most have separate weed management guides (see www.weeds.gov.au/publications/guidelines/index.html).
3. Identifying surrounding land uses and consultation with surrounding landholders where required.

## Weed management plan

The project manager and/or environment manager should ensure a weed management plan is developed for the site with consideration of the resources available to implement the plan. The *Introductory Weed Management Manual* (Natural Heritage Trust 2004) provides guidance for developing weed management plans.

The requirements of the weed management plan would be incorporated into relevant plans for the project (eg landscape management plan, Construction Environmental Management Plan (CEMP) or work method statements).

The detail of the weed management plan would vary for each site but should include:

- Type and source of the weed/s.
- Weed management priorities and objectives.
- Sensitive environmental areas within or adjacent to the site.
- Location of weed infested areas.
- Mechanical weed control methods such as slashing or mowing, as well as a range of herbicides to avoid the development of herbicide resistance.
- Measures to prevent the spread of weeds.
- A monitoring program to measure the success of weed management.
- Communication strategies to improve contractor awareness of weeds and weed management.

## Weed control methods

Weed control methods include mechanical, physical and chemical techniques. The *Introductory Weed Management Manual* (Module 2) (Natural Heritage Trust 2004) and *Noxious and Environmental Weed Control Handbook* (DPI 2007) provide examples of weed control methods.

In order to effectively control weeds it is important to have an understanding of the types of weeds present and their growth cycles and flowering times. Reference should be made to the Department of Primary Industries (DPI) Calender of Growth Cycle and Control Times for different regions across NSW (see www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/management/calendar).

### Herbicide use

The use of herbicides is controlled in NSW by the *Pesticides Act 1999*. The project manager and/or environment manager should ensure that pesticides (including herbicides) are only be applied by **personnel trained and competent in chemical use**.

The application of herbicide should ensure the safety of users and other people, and minimise risks to the broader environment. The National Heritage Trust (2004) *Introductory Weed Management Manual* and the 'Pesticides and Chemicals' section of the Office of Environment and Heritage (OEH) website (www.environment.nsw.gov.au/pesticides/index.htm) provides further information on using herbicides appropriately.

CropLife Australia (the main industry body for Australian plant science) has grouped herbicides according to the way they work on plants ('mode of action') and the potential for resistance to them.

Each herbicide has a mode of action letter printed on the product label and herbicides with similar modes of action are put into the same group. CropLife Australia regularly revises the modes of action and resistance management strategies. These are available at www.croplifeaustralia.org.au

The RTA has obligations to notify the community of proposed pesticide use (including herbicides) in accordance with the NSW Pesticides Regulation 2009 (see the *RTA's Pesticide Use Notification Plan*).

The following should be considered when using herbicides:

- **The type and dose of herbicide** – choose the right herbicide for the weed species. Refer to manufacturer's label for target weeds, application rates and 'mode of action' groups.
- **Application method** – consider the type of weed to be treated, label instructions, resources available and weed management objectives.
- **Risks** – consider associated risks with each type of application method (eg spray drift), surrounding land uses (eg schools), suitable Personal Protective Equipment (PPE), weather and proximity to areas of environmental sensitivity.
- **Timing** – some control methods may not be effective at certain times of the year and weeds should be targeted when their growth cycle stage provides the best opportunity for control.
- **Herbicide resistance** – at sites where the same herbicide (eg glyphosate) has been sprayed on weeds repeatedly, the weeds may develop resistance to that particular chemical. These weeds may no longer be controlled by that herbicide. Some examples of glyphosate resistant weeds include Annual Rye Grass (*Lolium rigidum*) and Feathertop Rhodes Grass (*Chloris virgata*). Further information on the management of glyphosate resistant weeds is available at www.glyphosateresistance.org.au

### Exclusion zones

Areas that are infested with weeds should be identified, mapped and marked as an exclusion zone with fencing and signage to limit access by personnel and vehicles (see *Guide 2: Exclusion zones*). This will minimise the spread of weeds. Maps of infested areas should be provided to contractors and highlighted during inductions.

### Topsoil management

Topsoil management needs to be planned so as to minimise the spread of weeds originating from the topsoil, while making best use of the native seed bank. Topsoil recovered from areas of low weed infestation can be re-used onsite with treatment but should be stockpiled separately. Soil disturbance within weed infested areas should be minimised. Refer to RTA's Stockpile Site Management Guideline, the Blue Book, *RTA Environmental Protection (Management System) QA Specification G36* and *RTA Vegetation QA Specification R178* for further guidance on stockpile management.

### Integrated weed management

Weed management is most effective through an integrated approach that utilises a variety of control techniques (eg mechanical and chemical). The suitability of certain control techniques for a site will vary depending upon the target weed species and the desired outcomes for the site. An integrated and strategic approach may sometimes require cooperation with adjacent landholders in order to provide adequate long-term control.

## Weed disposal

All weed plant material and topsoil containing weed plant material should be disposed of to an appropriate waste management facility. Contact the local council for a list of disposal facilities within the local area. Topsoil from areas of high weed infestation may be disposed of on site by burial. The depth of burial will depend on the weed species and conditions at the site. Specific information on the disposal of weeds according to species can be found on the DPI website (www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds).

## Control of aquatic weeds

Aquatic weeds may need to be controlled when they interfere with the use of a particular aquatic environment or when there is a statutory obligation.

The best option for controlling aquatic weeds in a body of water is through integrated management which combines a number of techniques such as physical removal, chemical control, biological control or booms and barriers.

For more information on aquatic weed control techniques, refer to *NSW DPI Primefact 30: Aquatic weed management in waterways and dams*.

**FIGURE 6.2:** Salvinia (*Salvinia molesta*) treatment within Pola Creek on the Kempsey Bypass Project. Salvinia weevils were also introduced to the waterway to manage Salvinia (Photo: Sarah Wain).

**FIGURE 6.3:** Paterson's Curse (*Echium plantagineum*) in the road reserve along Hume Highway, South Western region (Photo: Leigh Trevitt).

## Supporting documents


1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works
3. Ainsworth, N and Bowcher, A (2005) *Guidelines for Herbicide Use near Water*, Cooperative Research Centres (CRC) for Australian Weed Management, South Australia.
4. Department of Primary Industries (DPI) Calender of Growth Cycle and Control Times for different regions across NSW (www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/management/calendar).
5. Department of Primary Industries (DPI) Weeds Training Program (www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/training#clm).
6. Department of Primary Industries (DPI) Weeds website (www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds).
7. Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Weed Identification Tool (www.weeds.gov.au/cgi-bin/weedidtool.pl).
8. Ensbey, R (2009, accessed 7 April 2011) *Noxious and Environmental Weed Control Handbook: A guide to weed control in non-crop, aquatic and bushland situations*, 4th ed, Industry and Investment NSW, Orange, NSW (www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/noxious-enviro-weed-control).
9. Gorham, P (2008, accessed 7 April 2011) *Primefact 30: Aquatic weed management in waterways and dams*, Industry and Investment NSW (www.dpi.nsw.gov.au/primefacts).
10. Natural Heritage Trust (2004, accessed 7 April 2011) *Introductory Weed Management Manual*, Natural Heritage Trust (with the CRC for Australian Weed Management and the Commonwealth Department of Environment and Heritage), ACT (www.weedscrc.org.au/documents/manual.pdf).
11. Office of Environment and Heritage (updated 14 April 2011) 'Pesticides and Chemicals' NSW Government Office of Environment and Heritage (www.environment.nsw.gov.au/pesticides/index.htm).
12. RTA (2007) Pesticide Use Notification Plan (www.rta.nsw.gov.au/environment/biodiversity/pesticideplan.html).
13. *RTA Environmental Protection (Management Plan) QA Specification G35* (Accessed via the RTA intranet TechInfo page, Techdocs).
14. *RTA Environmental Protection (Management System) QA Specification G36* (Accessed via the RTA intranet TechInfo page, Techdocs).
15. *RTA Vegetation QA Specification R178* (Accessed via the RTA intranet TechInfo page, Techdocs).

# Biodiversity Guide 6 – Weed management

## Objective

The objective of this guide is to prevent or minimise the spread of noxious and environmental weed species on all RTA project sites and during roadside maintenance.

## Application of this guide

This guide is applicable where RTA activities disturb vegetation, soil or aquatic environments.

This guide outlines weed management guidelines for environmental and noxious weeds during construction but also provides some general principles for works during maintenance works.

## Management Requirements:

- Use an **ecologist or person trained in weed management** and identification to undertake a site weed assessment to identify and describe or map weed infested areas within the site and adjacent areas.
- Identify and manage any Weeds of National Significance (WONS), National Environmental Alert Weeds and/or noxious weeds located within the site or adjacent areas in consultation with the weeds officer at the relevant local council.
- Identify surrounding land uses and consult with surrounding landholders where required.
- Develop a weed management plan for the site.
- Refer to the Department of Primary Industries (DPI) Calender of Growth Cycle and Control Times for different regions across NSW (see www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/management/calendar).
- The application of herbicide should ensure the safety of users and other people, and minimise risks to the broader environment.
- The RTA has obligations to notify the community of proposed pesticide use (including herbicides) in accordance with the NSW Pesticides Regulation 2009 (see the *RTA's Pesticide Use Notification Plan*).
- Map and mark areas that are infested with weeds as an exclusion zone with fencing and signage to limit access by personnel and vehicles.
- Use mechanical weed control methods such as slashing or mowing, as well as a range of herbicides to avoid the development of herbicide resistance (eg glyphosate resistance).
- Mow/slash areas infested with weeds before they seed. This may reduce the propagation of new plants.
- Program works from least to most weed infested areas.
- Clean machinery, vehicles and footwear before moving to a new location.
- Securely cover loads of weed-contaminated material to prevent weed plant material falling or blowing off vehicles.
- Dispose of weed-contaminated soil at an appropriate waste management facility.
- Remove weeds immediately onto suitable trucks and dispose of without stockpiling.
- Separate weeds from native vegetation where native vegetation is to be used for mulch. Do not use weeds for mulch.
- Send samples of topsoil being imported onto site to a **National Association of Testing Authorities (NATA)** approved soil laboratory to ensure it contains no weed seeds or propagules (vegetative parts of plants such as buds or offshoots that can grow into new individuals).
- Minimise soil disturbance within weed infested areas. Topsoil recovered from areas of low weed infestation can be re-used onsite with treatment but should be stockpiled separately.
- All weed plant material and topsoil containing weed plant material should be disposed of to an appropriate waste management facility.
- For more information on aquatic weed control techniques, refer to *NSW DPI Primefact 30: Aquatic weed management in waterways and dams*.

# Guide 7: Pathogen management

## Background

**Pathogens are agents that cause disease in flora and fauna and are usually living microorganisms such as a bacterium, virus, or fungus. Some pathogens are restricted to certain areas, and others are widespread across Australia. The severity of infection can also differ between areas.**

Pathogens can be spread on footwear, vehicles and machinery, particularly during wet weather or in wet conditions. Strict precautions are necessary to prevent the spread of some pathogens. Some pathogens cannot be eradicated from infected sites so controlling their introduction and spread is a high priority.

Several pathogens in NSW have the potential to impact on the environment and biodiversity. These may be introduced and spread during the construction of road projects and roadside maintenance works. They include:

- Phytophthora (*Phytophthora cinnamomi*).
- Chytrid fungus (*Batrachochytrium dendrobatidis*).
- Myrtle rust (*Uredo rangelli*).
- Fusarium wilt/Panama disease (*Fusarium oxysporum*).

**Phytophthora** is a soil-borne fungus that causes tree death (dieback) where infestation occurs. Phytophthora attacks the roots of a wide range of native plant species causing them to rot. 'Dieback caused by Phytophthora' is listed as a Key Threatening Process under the *Environmental Protection and Biodiversity Conservation Act 1999* (Cwlth)(EPBC Act) and the *Threatened Species Conservation Act 1995* (NSW)(TSC Act). Spores can be dispersed over relatively large distances by surface and sub-surface water flows. Infected soil/root material may be dispersed by vehicles (eg earth moving equipment) animals and bushwalkers.

**FIGURE 7.1:** Dieback in Grass-tree (*Xanthorrhoea australis*) (Photo: K McDougall, OEH).

**Chytridiomycosis** (Chytrid) is an infectious disease that affects amphibians worldwide. The disease is caused by the fungus *Batrachochytrium dendrobatidis*. In Australia, chytrid has impacted on native frog species, causing the extinction of one species of frog and suspected to have caused the extinction of three others. 'Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis' is listed as a Key Threatening Process under the EPBC and TSC Acts. Chytrid is a water-borne fungus that may be spread as a result of handling frogs or through cross contamination of water bodies.

**FIGURE 7.2:** A Great Barred Frog (*Mixophyes fasciolatus*) displaying symptoms of chytrid such as lethargy, emaciation, half closed eyes and accumulation of sloughed skin over the body (Photo: Lee Berger, CSIRO).

**FIGURE 7.3:** A Common Green Tree Frog (*Litoria caerula*) with chytrid symptoms, including redness on the underside of the body and legs (Photo: K Gillet, OEH).

**Myrtle rust** is a plant disease caused by the introduced fungus *Uredo rangelli*. It was first detected on the Central Coast (NSW) in April 2010 and has since spread along the east coast from Wollongong to Tweed Heads. Myrtle rust attacks the young leaves, shoot tips and stems of Myrtaceous plants (eg Bottle Brush, Tea Tree, Lilly Pilly and Turpentine) eventually killing the plant. Myrtle rust is an air-borne fungus that may be spread by moving infected plant material, contaminated clothing (especially hats), equipment and vehicles.

The 'Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae' is listed as a *Key Threatening Process under the TSC Act*. Myrtle rust is included in this Key Threatening Process.

**FIGURE 7.4:** Leaves infected with Myrtle rust (Photos: courtesy of Department of Primary Industries).

**Fusarium wilt** (or Panama disease) is an introduced plant disease caused by the fungus *Fusarium oxysporum*. It is widespread in banana plantations in the Northern Rivers region of NSW, but is also known from a few plantations in Coffs Harbour and Woolgoolga. Fusarium wilt is spread when spores are moved in soil by water, workers, vehicles, animals or movement of infected plant material. Plants affected by Fusarium wilt show unusual patterns of frond (leaves) death and will eventually die. There is no cure or control mechanism but it can be kept out of a plantation through best practice hygiene protocols.

**FIGURE 7.5:** Banana plantations near Coffs Harbour showing yellow leaves, a symptom of Panama Disease (Photos: Josie Stokes).

## Objective

**The objective of this guide is to provide guidance for preventing the introduction and/or spread of disease causing agents such as bacteria and fungi.**

## Application of this guide

This guide is applicable wherever pathogens are known or suspected to occur on or adjacent to RTA projects and during maintenance works.

## Specialist input requirements

Testing from a **National Association of Testing Authorities (NATA) approved laboratory** may be required to confirm the presence of pathogens in the soil and/or water.

Advice from **Department of Primary Industries (DPI)** or the **Office of Environment and Heritage (OEH)** regarding the most practical hygiene management measures may be required if pathogens are present.

## Management requirements

The project manager and/or environment manager should consider the potential for pathogens to occur on site or in the area at an early stage (eg in the environmental assessment). This includes considering the potential risk for the project to contribute to the spread of pathogens. Pathogen management is ongoing throughout the period in which works are being carried out.

Industry response to pathogens and quarantine areas is dynamic. The project manager and/or environment manager should check the DPI website (www.industry.nsw.gov.au) for the most up-to-date hygiene protocols for each pathogen and for the most recent locations of contamination. Table 7.1 provides best practice hygiene protocols to help prevent the introduction or spread of pathogens.

The project manager and/or environment manager should ensure the risk of spreading pathogens and the mitigation measures required on site are regularly communicated to staff and contractors eg during inductions and toolbox talks.

**TABLE 7.1:** BEST PRACTICE HYGIENE PROTOCOLS TO PREVENT THE INTRODUCTION OR SPREAD OF PATHOGENS ON RTA PROJECT SITES AND DURING MAINTENANCE WORKS.

| Best Practice Hygiene Protocols | Phytophthora (*Phytophthora cinnamomi*) | Chytrid (*Batrachochytrium dendrobatidis*) |
|---|---|---|
| Test for presence if determined in REF or environmental assessment | • Soil test by a **NATA approved laboratory.** | • Water test by a **NATA approved laboratory**. |
| Work programs | • Minimise work during excessively wet or muddy conditions.<br>• Programming of works should always move from uninfected areas to infected areas. | • Minimise work during excessively wet or muddy conditions.<br>• Programming of works should always move from uninfected areas to infected areas. |
| Restrict access | • Set up exclusion zones with fencing and signage to restrict access into contaminated areas. | • Set up exclusion zones with fencing and signage to restrict access into contaminated areas. |
| Inductions | • All personnel (including visitors) to be inducted on Phytophthora management measures for the site. | • All personnel (including visitors) to be inducted on chytrid management measures for the site. |
| Vehicles and machinery | • Provide vehicle wash down facility.<br>• Restrict vehicles to designated tracks, trails and parking areas.<br>• Provide parking and turn-around points on hard, well-drained surfaces. | • Provide vehicle wash down facility.<br>• Restrict vehicles to designated tracks, trails and parking areas.<br>• Provide parking and turn-around points on hard, well-drained surfaces. |
| Personnel and equipment | • Provide boot wash down facility.<br>• Restrict personnel to designated tracks and trails. | • Provide boot wash down facility.<br>• Disinfect with cleaning products containing benzalkonium chloride or 70 per cent methylated spirits in 30 per cent water.<br>• Disinfect hands or change gloves between the handling of individual frogs and between each site.<br>• Only handle frogs when necessary. Use the 'one bag-one frog' approach. |
| New material | • Use a certified supply of plants and soil that is disease-free. | • n/a |
| Disposing of material | • Retain all potentially affected materials within the contaminated area.<br>• Ensure stockpiles of mulch, topsoil and fill material are separated to avoid potential contamination and spread. | • To avoid cross contamination, generally avoid transferring water between two or more separate waterbodies. |
| Further information | • National best practice guidelines for management of Phytophthora for biodiversity conservation in Australia (O'Gara et al. 2005). | • Hygiene protocol for the control of disease in frogs, Information Circular Number 6 (Wellington and Haering 2008). |

| Best Practice Hygiene Protocols | Fusarium wilt (eg Panama disease) | Myrtle rust (*Uredo rangelli*) |
|---|---|---|
| **Test for presence if determined in REF or environmental assessment** | • Contact **DPI** before carrying out the works in former banana sites to see if and where Fusarium wilt is present. | • Before carrying out works in bushland, consult:<br>(a) The DPI Myrtle Rust Management Zone map (www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust/zones) to determine reporting required and whether you are working in a high risk area, and<br>(b) Local offices of **OEH/NPWS** for additional rust records and risk assessments.<br>• Photograph potentially infected plants and send to: biosecurity@industry.nsw.gov.au for confirmation. |
| **Work programs** | • No earth work should occur during heavy rainfall or after extended rainfall.<br>• Programming of works should always move from uninfected areas to infected areas. | • Programming of works should always move from uninfected areas to infected areas. |
| **Restrict access** | • Set up exclusion zones with fencing and signage to restrict access into contaminated areas. | • Set up exclusion zones with fencing and signage to restrict access into contaminated areas. |
| **Inductions** | • All personnel (including visitors) to be inducted on Fusarium wilt management measures for the site. | • All personnel (including visitors) to be inducted on Myrtle rust management measures for the site. |
| **Vehicles and machinery** | • Provide vehicle wash down facility.<br>• All vehicles to be washed with Truckwash® and then disinfected with Castrol Farmcleanse® (or equivalent).<br>• For medium-long term projects, install a concrete wash down bay which will capture the water in a trench or bunded area. Water used for wash downs must not be used for dust control. | • Provide vehicle wash down facility.<br>• All vehicles and machinery to be washed with Truckwash® (or equivalent).<br>• Restrict vehicles to designated tracks, trails and parking areas.<br>• For medium-long term projects, install a concrete wash down bay which will capture the water in a trench or bunded area. Water used for wash downs must not be used for dust control. |
| **Personnel and equipment** | • Provide boot wash down facility.<br>• Remove mud/dirt from footwear and equipment and disinfect with Castrol Farmcleanse® (or equivalent). | • Personnel working in an infected site should shower and launder clothes (especially hats) before moving to another bushland site.<br>• Provide boot wash down facility.<br>• Footwear and equipment to be cleaned of soil/mud then sprayed with 70 per cent methylated spirits in 30 per cent water. |
| **New material** | • Ensure that new soil being brought onto the site is disease-free. | • Use a certified supply of plants and soil that is disease-free (the Australian Nursery Industry *Myrtle Rust Management Plan* (McDonald 2011) provides best practice Myrtle rust management that is to be expected from suppliers). |
| **Disposing of material** | • Run-off water must not be used for dust control or irrigation and it is not to be released.<br>• Topsoil from potentially infected plantations must only be stockpiled and used within contaminated areas of the plantation. | • Plant material should be buried on site if possible.<br>• Do not dispose of waste at another bushland site.<br>• Buried material sites must be mapped to prevent re-exposure, especially if located near utility easements.<br>• If material cannot be buried advice should be sought from **DPI.** |
| **Further information** | • Fusarium wilt management procedures should be included in the Construction Environmental Management Plan (CEMP) or associated plans. | • DPI handout prepared for Myrtle rust response 2010–11: *Preventing spread of Myrtle Rust in bushland*. Information on managing Myrtle rust can be obtained from: www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust<br>• The OEH Interim management plan for Myrtle rust in bushland (2011). |

## Examples of pathogen management on RTA projects

The following photos provide best practice examples of hygiene protocols applied to RTA projects across NSW. This includes handheld boot and vehicle wash down, truck wash down bays, secure disposal of cleared vegetation and disposable suits for personnel on high risk sites.

**FIGURE 7.6:** Vehicle wash down to prevent the spread of pathogens at Bulahdelah, Hunter Region (Photo: Angie Radford).

**FIGURE 7.7:** Wheel wash bay used at Tempe Reserve during construction of the Airport Link, Sydney Region. Most trucks drove through the wheel wash, but some vehicles needed to be scrubbed to ensure materials were not transported from site. The water depth was approximately 400mm, with a cattle grate underwater for solids to settle under (Photo: Leigh Trevitt).

**FIGURE 7.8:** Wheel wash bay used at Sassafras during upgrades on Main Road 92 (Nowra to Nerriga) Southern Region. Vehicles drive onto the grid and are washed down. Water is contained under the grid (Photo: Julian Watson).

**FIGURE 7.9:** Boot wash down to prevent the spread of the Pathogen chytrid on shoes on the Sapphire to Woolgoolga project, Northern Region (Photo: Josie Stokes).


**FIGURE 7.10:** Pythopthora management measures on the Main Road 92 near Nowra, Southern Region (Photo: Scott Fayers).

**FIGURE 7.11:** Removed vegetation was securely wrapped in black plastic bags before disposal to prevent the spread of the pathogen Myrtle rust on the M2 Upgrade, Sydney region (Photo: Nicholas Francesconi).

**FIGURE 7.12:** Disposable suits were worn on the M2 Upgrade Sydney Region when contractors were working in a positively identified Myrtle rust site adjacent to a critically endangered ecological community of Blue Gum High Forest. This level of hygiene is recommended when working in Myrtle rust sites that are adjacent to highly sensitive ecological areas (eg endangered populations and endangered ecological communities) (Photo: Donald Cheong).

## Supporting documents


1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works.
3. Department of Environment and Climate Change (April 2008), Statement of Intent 1. Infection of native plants by *Phytophthora cinnamomi*, New South Wales Department of Environment and Climate Change, Sydney.
4. Gollnow, B, Carnegie, A, Horwood, M and Driessen, S (2010, accessed 7 April 2011) PrimeFacts 1017 (2nd Edition) Myrtle Rust – *Uredo rangelli*, Industry and Investment NSW (www.dpi.nsw.gov.au/primefacts).
5. Industry and Investment NSW (November 2010, accessed 7 April 2011) *Preventing spread of Myrtle Rust in bushland: Handout prepared for Myrtle Rust response 2010–11*, Industry and Investment NSW, Gosford (www.dpi.nsw.gov.au/primefacts).
6. McDonald, J (2011) *Australian Nursery Industry Myrtle Rust* (*Uredo rangelli*) Management Plan, Nursery and Garden Industry Australia, Sydney (www.ngia.com.au).
7. Newley, P (August 2010, accessed 7 April 2011) PrimeFacts 1029 Panama Disease in Bananas, Industry and Investment NSW (www.dpi.nsw.gov.au/primefacts).
8. O'Gara, E, Howard, K, Wilson, B and Hardy, J (2005) *Management of Phytophthora cinnamomi for Biodiversity Conservation in Australia: Part 2 National Best Practice Guidelines,* A report funded by the Commonwealth Government Department of the Environment and Heritage by the Centre for Phytophthora Science and Management, Murdoch University, Western Australia.
9. Suddaby, T and Liew, E (2008) Best Practice *Management Guidelines for Phytophthora cinnamomi within the Sydney Metropolitan Catchment Management Authority Area,* Royal Botanic Gardens Trust, Sydney.
10. Threat Abatement Plans or Strategies and Priority Actions as issued and updated from time to time by
11. Threat Abatement Plans or Strategies and Priority Actions as issued and updated from time to time by OEH online (www.environment.nsw.gov.au).
12. Wellington, R and Haering, R (2008) *Hygiene Protocol for the control of disease in frogs: Threatened Species Management Information Circular No. 6,* Department of Environment and Climate Change, Sydney South.

# Biodiversity Guide 7 – Pathogen management

## Objective

The objective of this guide is to provide guidance for preventing the introduction and/or spread of disease causing agents such as bacteria and fungi.

## Application of this guide

This guide is applicable wherever pathogens are known or suspected to occur on or adjacent to RTA projects and during maintenance works.

## Management Requirements:

- Consideration for the potential for pathogens on site or in the area should be given at an early stage (eg in the environmental assessment).
- Pathogen management is ongoing throughout the period in which works are being carried out.
- Check the **Department of Primary Industries (DPI) website (www.industry.nsw.gov.au)** for the most up-to-date hygiene protocols for each pathogen and for the most recent locations of contamination.
- Ensure the risk of spreading pathogens and the mitigation measures required on site are regularly communicated to staff and contractors eg during inductions and toolbox talks.
- Advice from **DPI or the Office of Environment and Heritage (OEH)** regarding the most practical hygiene management measures may be required if pathogens are present.
- Programming of works should move from uninfected areas to infected areas.
- Ensure vehicles and footwear are free of soil before entering or exiting the site (ie directed to wash down area before entering or exiting the site).
- Provide vehicle and boot wash down facilities.
- Testing from a **National Association of Testing Authorities (NATA)** approved laboratory may be required to confirm the presence of pathogens in the soil and/or water.
- Set up exclusion zones with fencing and signage to restrict access into contaminated areas.
- Restrict vehicles to designated tracks, trails and parking areas.

# Guide 8: Nest boxes

## Background

**Nest boxes can be used to provide supplementary breeding habitat and shelter for hollow-dependant fauna where hollows have been removed. When designed, built, installed and monitored correctly nest boxes can provide an alternative to natural fauna habitat.**

Approximately 20 per cent of native fauna species rely on tree hollows for roosting, nesting and breeding (Franks and Franks 2006). The 'loss of hollow-bearing trees' is listed as a Key Threatening Process under the *Threatened Species Conservation Act 1995* (NSW) (TSC Act). It results in a reduction of habitat for bats, birds and arboreal mammals, some of which are threatened species in NSW.

## Objective

**The objective of this guide is to provide guidance on minimising the impact of hollow loss by providing supplementary fauna habitat in the form of artificial hollows (nest boxes).**

## Application of this guide

This guide is applicable to any project where hollow-bearing trees are to be removed and nest boxes are used to mitigate habitat loss or when roost boxes are required to manage microbats in bridges.

## Specialist input requirements

The nest box strategy, including the design, placement and monitoring, should be developed in consultation with an **ecologist**. It is recommended that an **ecologist** is on site during the installation of nest boxes.

## Management requirements

The project manager and/or environment manager should check if the environmental assessment for the project identifies whether nest boxes are required to mitigate habitat loss. Where nest boxes are required, the project manager and/or environment manager should engage an **ecologist** to develop a nest box strategy.

Consider the following when developing a nest box strategy:

- The target species.
- The tree hollow preferences of native hollow-dependant fauna known or likely to occur in the locality.
- The sizes, types and quantities of potential tree hollows to be removed.
- The sizes, types and quantities of tree hollows existing in adjacent areas.
- The design, materials and quantity of nest boxes required.
- Whether the nest boxes are required to fill a short term gap in the availability of hollows (eg during construction) or to compensate for the long term reduced availability of hollows.
- Monitoring and maintenance of the nest boxes.

The project manager and/or environment manager should consult with an **ecologist** to assist in the implementation of the nest box strategy including installation and monitoring of nest boxes.

## Design of nest boxes

The project manager and/or environment manager should ensure an **ecologist** is engaged to certify that the nest boxes are designed and built to suit the target species in accordance with the nest box strategy.

### Types of nest boxes

The type of nest box used will depend on the target species. The following figures show examples of different types of nest boxes that may be used.

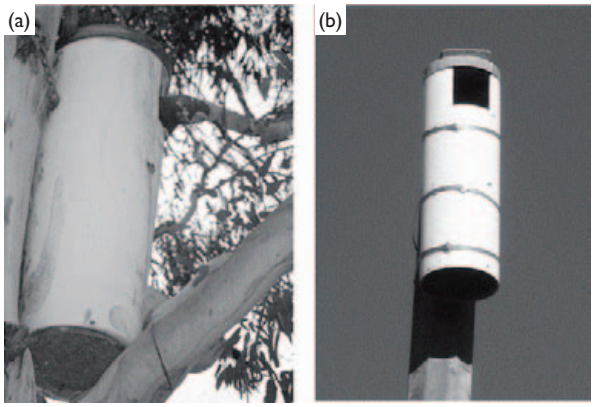



**FIGURE 8.1:** (a) and (b): Polyvinyl chloride (PVC) artificial hollow installed for Glossy-black Cockatoos (*Calyptorhynchus lathami*) (Source: Goldingay and Stevens 2009).

**FIGURE 8.2:** A wedge-shaped nest box for microbats (Photo: Christine Spits).

**FIGURE 8.3:** Eastern Long-eared Bats (*Nyctophilus bifax*) in a nest box with shade cloth on the inner wall (Photo: Alan and Stacey Franks).

### Dimensions

Table 8.1 provides a summary of the recommended dimensions for target species. Further species specific guidance can be found in Grant (1997) and Franks and Franks (2006). The entrance size should be no bigger than that required for the target species.

**TABLE 8.1:** RECOMMENDED NEST BOX DIMENSIONS FOR SELECTED TARGET SPECIES (FRANKS AND FRANKS 2006).

| Target species/ nest box type | Entrance diameter (mm) | Internal dimensions (mm) | Depth/ height of chamber (mm) | Height above ground (m) | Additional comments |
|---|---|---|---|---|---|
| Microbat species | 30 (hole)<br>20 (slot) | n/a | 400 | 3–5 | Bottom opening<br>Hang shadecloth or denim inside. |
| Eastern Pygmy Possum (*Cercartetus nanus*) | 30 | 150 x 150 | 300 | 3–6 | |
| Owlet Night-jar (*Aegotheles cristatus*) | 65 | 150 x 150 | 300 | 3–6 | Short, horizontal spout entrance for sunning |
| Cockatoo species | 200 | 300 x 400 | 1200 | 8–10 | Ferocious chewer; angled spout entrance; next box should be made from PVC (not wood). |
| Brown Treecreeper (*Climacteris picumnus*) | 60 | 150 x 150 | 350 | 2–4 | Rough bark on front |
| Brush-tailed Phascogale (*Phascogale tapoatafa*) | 50 | 150 x 200 | 300 | 3–6 | |
| Squirrel Glider (*Petaurus norfolcensis*) | 45 | 150 x 250 | 300 | 3–6 | Position entrance to face tree<br>2–5 boxes per colony |
| Yellow-bellied Glider (*Petaurus australis*) | 80 | 250 x 300 | 400 | 6–8 | Will use several den sites |
| Large Forest Owls | 100–150 | 400 x 400 | 600–750 | 4–6 | Short horizontal spout entrance |

### Material selection and design considerations

Materials used for the nest boxes will vary depending on the type of nest box. Materials could include plantation timber, cypress pine or polyvinyl chloride (PVC) piping. Hardwoods should be used on the outer faces. Salvaged timber can be used for entrance spouts and front faces of nest boxes (Figure 8.4 and Figure 8.5). Attaching an aluminium angle around the edge of the nest box lid may discourage chewing.

The lid should overhang the front and sides of the nest box by at least 25 millimetres to prevent water damage. To prevent temperature extremes inside the nest box and reflection from the sun, do not use metal lids or plates on the roof of the nest box lid. For monitoring and maintenance purposes, consider using a hinged lid.

After assembly, paint the outside of the nest box with non-toxic, dark-coloured, outdoor, water-based acrylic paint. Avoid using toxic substances. To assist with drainage, drill three small holes in the base of the nest box.

Non-toxic woodchips, wood shavings or sawdust could be placed into possum, glider and bird nest boxes to provide extra insulation in cold climates.

FIGURE 8.4: An artificial hollow designed for rosella species with a perch. Rough bark has been attached to the front of the next box to assist birds with grip (Photo: Alan and Stacey Franks www.hollowloghomes.com).

FIGURE 8.5: Entrance spout made from salvaged timber (Photo: Alan and Stacey Franks www.hollowloghomes.com).

## Installation

The project manager and/or environment manager should engage an **ecologist** to be on site during the installation of nest boxes. The **ecologist** would provide advice on attaching nest boxes to trees, height, density, location and aspect of nest boxes and the timing of nest box installation. Best practice methods for the installation of nest boxes are provided in the sections following.

### Attaching nest boxes to trees

The preferred method of attaching nest boxes to trees is the Habisure© system illustrated in Figure 8.6. This method allows for tree growth and minimises damage to the tree. Figure 8.7 illustrates a method for installing a nest boxes where there is no opposite branch to support it. Nest boxes installed using this method would need to be checked and loosened more often than nest boxes installed using the method in Figure 8.6. Bolting nest boxes to trees is not recommended as this can damage the tree and bolts rust quickly requiring maintenance or replacement.

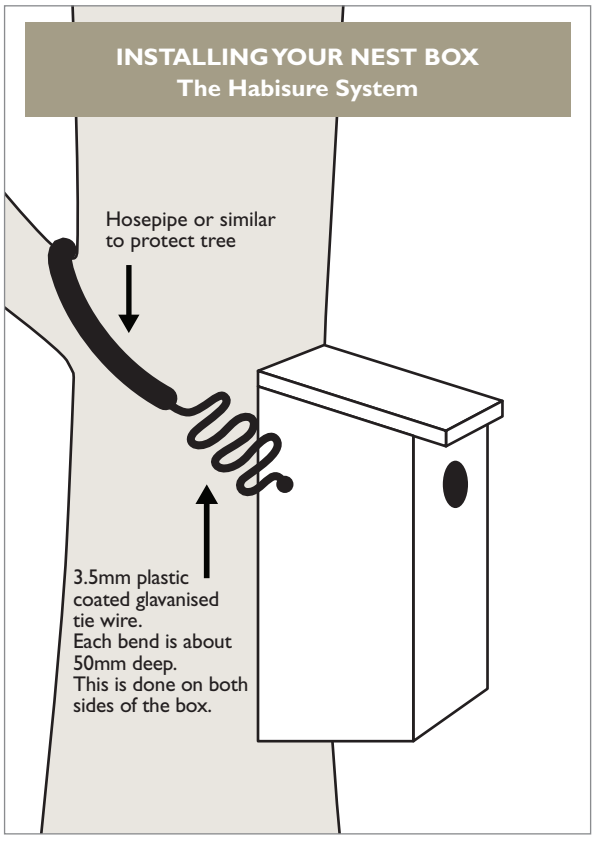



FIGURE 8.6: The Habisure© system is the preferred method for attaching nest boxes to trees (Franks and Franks 2006).

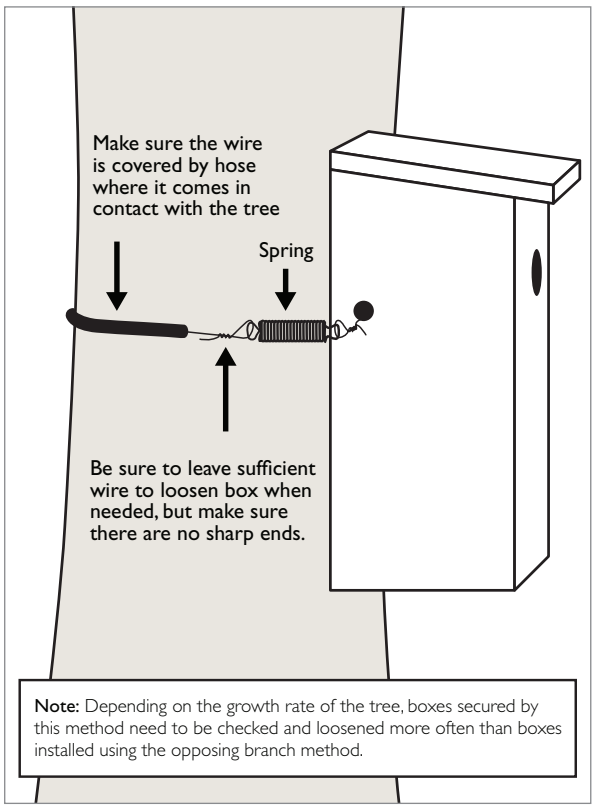



FIGURE 8.7: An alternative method for attaching nest boxes to trees where there is no opposite branch (Franks and Franks 2006).

### Height

Place nest boxes according to the recommended height for the target species (See Table 8.1) and as high as possible to avoid predation but low enough to allow monitoring and maintenance. Nest boxes can be placed at varying heights within an area of habitat.

### Density

The density and quantity of each nest box type should reflect the proportion of tree hollow types being removed, the proportion of tree hollow types to be retained in adjacent habitat, the availability of adjacent food resources and the assemblage of hollow-dependant fauna known or likely to occur in the project locality.

This information is usually collected during ecological surveys for the environmental assessment or pre-clearing process.

Usually a ratio of 1:1 (hollows to nest boxes) is recommended however the nest box strategy would be developed in consultation with an **ecologist** to meet the specific objectives and needs for the target species and location.

The spacing of nest boxes is usually determined by the hollow use and home range size of the target species, however the **ecologist** would provide specific advice for the project with consideration to available habitat within the area. The recommended spacing of nest boxes types for target species is provided in Table 8.2.

**TABLE 8.2:** RECOMMENDED SPACING OF SAME TYPE NEST BOXES.

| Nest box type | Recommended spacing (m) |
|---|---|
| Microbat species | 50 |
| Eastern Pygmy Possum (*Cercartetus nanus*) | 20–40 |
| Owlet Night-jar (*Aegotheles cristatus*) | 50 |
| Cockatoo species | 200 |
| Brown Tree creeper (*Climacteris picumnus*) | 50 |
| Brush-tailed Phascogale (*Phascogale tapoatafa*) | 200 |
| Squirrel Glider (*Petaurus norfolcensis*) | 60–100 |
| Yellow-bellied Glider (*Petaurus australis*) | 180–200 |
| Large Forest Owls | >500 |

Gibbons and Lindenmayer 2002; Gibbons and Lindenmayer 1997.

### Location

The project manager and/or environment manager should ensure an **ecologist** is present on site to provide advice on location for the installation of nest boxes.

The **ecologist** should consider the following when installing nest boxes:

- Install nest boxes as close as possible to the location of the original hollow-bearing tree.
- Install nest boxes for gliders and possums on rough-barked trees (which are likely to be easier to climb than smooth-barked trees).
- Install nest boxes in close proximity to potential food resources of the target species.
- Install nest boxes for insectivorous bats (microbats) near water sources and within or adjacent to potential flyways.
- Do not install nest boxes on trees with existing hollows (as the presence of other hollow-dependent fauna may act as a deterrent).
- Do not install nest boxes in areas with a high density of Common Mynas (*Acridotheres tristis*) if practical. Mynas nest high in the canopy so consideration should be given to installing nest boxes lower in the canopy.

### Aspect

Orientate nest boxes between northwest and east to avoid hot afternoon sun and the dominant direction of severe storms. Additionally, place nest boxes so they are not facing lights from adjacent development.

### Timing of nest box installation

It is recommended that approximately 70 per cent of nest boxes be installed up to one month before the start of any clearing to provide alternative shelter for hollow-dependant fauna displaced during clearing.

The remainder of nest boxes would be installed once the actual abundance and density of tree hollows removed has been confirmed, and before completion of the project.

**FIGURE 8.8:** Nest box installation being carried out on the Sapphire to Woolgoolga project in Northern Region (Photo: RTA).

### Identification

It should be possible to identify nest boxes without using a ladder. Aluminium identification tags can be placed just above eye level on the recipient tree.

Following installation of each nest box, record the nest box identification number, nest box type, GPS location, species and diameter at breast height of the host tree, nest box height and orientation.

### Monitoring and maintenance

The project manager and/or environment manager should ensure the following is undertaken for monitoring and maintenance of nest boxes:

1. Monitor each nest box for a period of time that reflects the overall objective of next box placement. As a guide this could be once a year for the first two years, skip the third year and check again in the fourth year then review the need for further monitoring following this. The project manager and/or environment manager should ensure nest boxes are checked by an **ecologist** every six months during the construction phase of the project, preferably with a camera on the end of an extendable pole. This will minimise disturbance to any native fauna that may be occupying the nest boxes.
2. Monitor to nest boxes to coincide with nesting seasons for target species. For each recoded nest box, monitoring data should include:
    - The name of the observer.
    - Date.
    - Prevailing weather conditions.
    - Assessment of nest box condition (eg structural integrity, evidence of rot or termite activity, condition of fastenings etc).
    - Evidence of fauna activity and presence of pest activity such as European Honey Bees (*Apis mellifera*), Common Mynas (*Acridotheres tristis*), Common Starlings (*Sternus vulgaris*), ants, termites etc.
3. Carry out maintenance inspections in conjunction with monitoring events. Maintenance works could include repairing nest boxes, reattaching nest boxes to trees and removing pests. Appropriate pest management techniques should be applied where required. This may include modification to nest box design to exclude pest species or relocation of nest boxes to alternative sites in adjacent habitat. Advice on the removal of pest species from nest boxes can be obtained from **biodiversity specialists in RTA's Environment Branch**.
4. If a nest box needs to be removed from the site for repair, then an alternative nest box should be installed in the same location upon removal of the damaged nest box.
5. Carry out ongoing monitoring and maintenance of nest boxes in accordance with the nest box strategy for the project.

## Supporting documents


1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works.
3. Beyer, GL and Goldingay, RL (2006) The value of nest boxes in the research and management of Australian hollow-using arboreal marsupial, *Wildlife Research*, 33, 161– 74.
4. Department of Environment, Climate Change and Water (undated) *Hume Highway Duplication Nest Box Criteria* (unpublished report).
5. Franks, A and Franks, A (2006) *Nest Boxes For Wildlife: A Practical Guide,* Blooming Books, Melbourne.
6. Gibbons, P and Lindenmayer, D (1997) *Conserving Hollow-dependent fauna in timber- production forests*, Environmental Heritage Monograph Series No. 3, NSW National Parks and Wildlife Service, Hurstville.
7. Gibbons, P and Lindenmeyer, D (2002) *Tree Hollows and Wildlife Conservation in Australia*. CSIRO Publishing.
8. Goldingay, RL and Stevens, JR (2009). Use of artificial tree hollows by Australian birds and bats. Wildlife Research, 36, 81-97.
9. Grant, J (1997) *The Nest Box Book*, Gould League, Victoria.
10. RTA (2004) *Nest box use by Australian Fauna: A Literature Review* (unpublished report).

# Biodiversity Guide 8 – Nest boxes

## Objective

The objective of this guide is to provide guidance on minimising the impact of hollow loss by providing supplementary fauna habitat in the form of artificial hollows (nest boxes).

## Application of this guide

This guide is applicable to any project where hollow-bearing trees are to be removed and nest boxes are used to mitigate habitat loss or when roost boxes are required to manage microbats in bridges.

## Management requirements:

- Where nest boxes are required, an **ecologist** should be engaged to develop a nest box strategy.
- Consult with an **ecologist** to assist in the implementation of the nest box strategy including installation and monitoring of nest boxes.
- An **ecologist** should certify that the nest boxes are designed and built to suit the target species in accordance with the nest box strategy.
- The entrance size of nest boxes should be no bigger than that required for the target species.
- The nest box lid should overhang the front and sides of the nest box by at least 25 millimetres to prevent water damage. For monitoring and maintenance purposes, consider using a hinged lid. Do not use metal lids or plates on the roof of the nest box lid.
- Paint the outside of the nest box with non-toxic, dark-coloured, outdoor, water-based acrylic paint. Avoid toxic substances.
- To assist with drainage, drill three small holes in the base of the nest box.
- Non-toxic woodchips, wood shavings or sawdust could be placed into possum, glider and bird nest boxes to provide extra insulation in cold climates.
- An **ecologist** should be on site during the installation of nest boxes.
- The preferred method of attaching nest boxes to trees is the Habisure© system. Bolting nest boxes to trees is not recommended.
- The density and quantity of each nest box type should reflect the proportion of tree hollow types being removed, the proportion of tree hollow types to be retained in adjacent habitat, the availability of adjacent food resources and the assemblage of hollow-dependant fauna known or likely to occur in the project locality.
- The location of nest boxes should be as close as possible to the original hollow-bearing tree, consider the type of bark preferred by the target species, be in close proximity to food or other resources, not be installed on trees with existing hollows or where there is a high density of Common Mynas (*Acridotheres tristis*).
- Orientate nest boxes between northwest and east and so they are not facing lights from adjacent development.
- Install approximately 70 per cent of nest boxes up to one month before the start of any clearing. The remainder of nest boxes would be installed before completion of the project.
- Record the nest box identification number, nest box type, GPS location, species and diameter at breast height of the host tree, nest box height and orientation.
- Undertake ongoing monitoring and maintenance of nest boxes in accordance with the nest box management strategy for the project.
- If a nest box needs to be removed from the site for repair, then an alternative nest box should be installed in the same location upon removal of the damaged nest box.

# Guide 9: Fauna handling

## Background

**Handling of fauna may be necessary when they are encountered on a project and need to be relocated or, if injured, taken to a vet or wildlife carer. The careful handling of fauna is essential to minimise stress or further injury on the animal, to prevent the spread of diseases and to avoid injury to fauna handlers.**

Fauna should only be handled when absolutely necessary. It is preferable to avoid fauna handling unless the life of the animal is at risk. Fauna handling should be undertaken either by a **licensed fauna ecologist or wildlife carer** skilled in handling the type of fauna encountered.

FIGURE 9.1: A tree skink (*Egernia striolata*) being handled by a licensed ecologist with gloves (Photo: Lukas Clews).

## Objective

**The objective of this guide is to minimise impacts on fauna as a result of being handled by humans and prevent injury to people handling fauna.**

## Application of this guide

This guide is applicable whenever it is necessary to handle fauna.

## Specialist input requirements

Use a **licensed fauna ecologist or wildlife carer** with specific animal handling experience to carry out any animal handling.

## Management requirements

Allow fauna to leave an area without intervention as much as possible. The project manager and/or environment manager should ensure that fauna handling is only carried out by people who are appropriately licensed (eg a **fauna ecologist or wildlife carer**).

The project manager and/or environment manager should ensure that an **animal rescue agency/wildlife care group or vet** has been contacted before works start to check they are willing and available to be involved in fauna rescue and assist with injured animals. The project manager and/or environment manager should ensure the contact details of the **animal rescue agency/wildlife care group or vet** are provided to the site manager, displayed in the site office and included in the Construction Environmental Management Plan (CEMP) or other relevant management plans for the project.

The project manager and/or environment manager should ensure that project inductions include the procedure to be followed if fauna are found or injured on site. The procedure should include that fauna handling is to be avoided. However, the project manager and/or environment manager should ensure the best practice methods outlined below are communicated to the contractor in circumstances where the handling of fauna is completely unavoidable.

The project manager or site manager should ensure that personnel do not feed any wildlife that may be encountered on construction sites (especially birds and lizards). The project manager should include this in project inductions and erect relevant signs informing personnel not to feed the wildlife around the work site.

## Injured fauna

Contact the nominated **animal rescue agency/wildlife care group or vet** if an animal is injured. Keep the injured animal in a box in a quiet, warm, dark place until transferred. If the animal is dangerous, carefully place a box over the top of it if possible, or section off the area and wait for an experienced and **licensed fauna ecologist or wildlife carer** to arrive.

## Snakes

- Avoid handling snakes. Snakes should be left alone and allowed to vacate the area of their own accord.
- If a snake must be handled to remove the risk of harm to the snake or people then handling should only be done by a **licensed fauna ecologist or wildlife carer** with skills and experience in snake handling.
- Never deliberately kill a snake as all snakes are protected under the *National Parks and Wildlife ACT 1974* (NSW).

**FIGURE 9.2:** Snakes, like this non-venomous Green Tree Snake (*Dendrelaphis punctulata*) on the Sapphire to Woolgoolga project, should be left alone and allowed to vacate the area (Photo: Laurenne O'Brien).

**FIGURE 9.3:** A non-venomous Carpet Python (*Morelia spilota*) being removed by a licensed ecologist with skills and experience in snake handling. This was during staged habitat removal at the Sapphire to Woolgoolga project in Northern Region (Photo: Laurenne O'Brien).

## Amphibians

Follow the *Hygiene Protocol for the control of disease in frogs* (Wellington and Haering 2008) for all frog handling. Key points include:

- Wear disposable gloves when handling frogs.
- Place only one frog in each plastic bag.
- Do not re-use plastic bags.
- Disinfect any handling equipment and boots when moving between waterbodies.
- Wash hands thoroughly with disinfectant after handling frogs from one waterbody.
- Frogs or tadpoles/spawn should not be moved between catchments.

*Guide 7: Pathogen management* provides further information on managing diseases in frogs.

**FIGURE 9.4:** A threatened Green-thighed Frog (*Litoria brevipalmata*) being handled using disposable gloves on the Herons Creek to Stills Road project in Northern Region NSW (Photo: Josie Stokes).

**FIGURE 9.5:** An endangered Giant Barred Frog (*Mixophyes iteratus*) being relocated from the Sapphire to Woolgoolga project corridor in a plastic bag (Photo: Laurenne O'Brien).

## Fish

- Fish should only be handled by experienced **aquatic ecologists**.
- Handle fish with dip nets with knotless or rubber netting and/or with wet hands or wet gloves.
- Avoid contact with gills and eyes.
- Keep fish in water whenever possible. If fish need to be transferred between water bodies they should not be left out of the water for more than a few seconds.
- Fill containers used for transferring fish between sites with water from the source. Keep water oxygenated and at the same temperature as the source.
- Fish should not be moved between catchments.

## Mammals

- Wear gloves when handling mammals (including bats) to protect against bites and scratches.
- Transfer small mammals to a small cloth bag after capture and before release. Larger mammals may require a large pillow case or hessian bag.
- If handling bats, the **licensed fauna ecologist or wildlife carer** must be vaccinated against the Australian Bat *Lyssavirus* (ABL) which is a form of rabies.

**FIGURE 9.6:** Microbats such as the Lesser Long-Eared Bat (*Nyctophilus geoffroyi*) should only be handled by licensed and experienced wildlife carers and/or ecologists who have been vaccinated against the Australian Bat *Lyssavirus* (ABL) (Photo: Nathan Cooper).

## Fauna release

- Release fauna into pre-determined habitat identified for fauna release. This habitat would have been identified by an **ecologist** and marked on maps for the project during the pre-clearing process (see *Guide 1: Pre-clearing process*).
- Release fauna into similar habitats, as near as possible to their capture location.
- Release nocturnal fauna at or after dusk.
- Arboreal fauna should be slowly released from their bag onto the trunk of a tree.
- Select trees with rough or peeling bark and hollows for bats and gliders.

**FIGURE 9.7:** A Squirrel Glider (*Petaurus norfolcensis*) on a tree with rough bark. Trees with rough or peeling barks should be selected for the release of bats and gliders (Photo: David Nelson).

## Temporary fauna fencing

Temporary fauna fencing may be required on projects to reduce the chances of road kill/injury from public traffic or construction machinery especially where:

- There is a high risk of mobile threatened fauna species entering the works area.
- There is a known history of threatened species roadkill.

**FIGURE 9.8:** Temporary frog fencing installed for the Sapphire to Woolgoolga project to prevent the endangered Giant Barred Frog (*Mixophyes iteratus*) from entering construction areas (Photo: Josie Stokes).

### Monitoring

The project manager and/or environment manager should ensure that details of fauna captured and relocated are recorded. Include the following information:

- Species.
- Location and time captured.
- Location and time released.
- Behaviour and condition upon release.
- Details of any injury or deaths that occurred.
- Contact details and location of **licensed wildlife carer or vet** if the animal was transferred into their care.

The project manager and/or environment manager should ensure that any injury to or death of a threatened species is reported to the **RTA's environmental staff**.

## Supporting documents


1. Department of Environment, Climate Change and Water (September 2009) Statement of Intent 2: Infection of frogs by amphibian chytrid causing the disease chytridiomycosis, NSW Department of Environment, Climate Change and Water, Sydney.
2. NSW Health (Updated 15 January 2008, accessed 7 April 2011) 'Rabies and bat lyssavirus infection: Infectious disease fact sheet' NSW Health, (www.health.nsw.gov.au/factsheets/infectious/rabiesbatinfection.html).
3. NSW Health (Updated 19 December 2007, accessed 7 April 2011) 'Leptospirosis: Infectious disease fact sheet' NSW Health, (www.fwahs.health.nsw.gov.au/factsheets/infectious/leptospirosis.htm).
4. Wellington, R and Haering, R (2008) *Hygiene Protocol for the control of disease in frogs: Threatened Species Management Information Circular No. 6*, Department of Environment and Climate Change, Sydney South.


# Biodiversity Guide 9 – Fauna handling

## Objective

The objective of this guide is to minimise impacts on fauna as a result of being handled by humans and prevent injury to people handling fauna.

## Application of this guide

This guide is applicable whenever it is necessary to handle fauna.

## Management Requirements:

- Allow fauna to leave an area without intervention as much as possible.
- Use a licensed fauna ecologist or wildlife carer with specific animal handling experience to carry out any fauna handling.
- Contact an **animal rescue agency/wildlife care group or vet** before works start to ensure they are willing and available to be involved in fauna rescue and assist with injured animals.
- The contact details of the **animal rescue agency/ wildlife care group or vet** should be provided to the site manager, displayed in the site office and included in the Construction Environmental Management Plan (CEMP) or other relevant management plans for the project.
- Include the procedures to follow if fauna is found or injured on site in project inductions.
- Follow the best practice methods outlined below in circumstances where the handling of fauna is completely unavoidable:
  - Contact the nominated **animal rescue agency/ wildlife care group or vet** if an animal is injured. Keep the injured animal in a box in a quiet, warm, dark place until transferred. If an injured animal is dangerous, carefully place a box over the top of it if possible, or section off the area and wait for an **experienced and licensed fauna ecologist or wildlife carer** to arrive.
  - Never deliberately kill a snake as all snakes are protected under the *National Parks and Wildlife Act 1974* (NSW).
  - If a snake must be handled to remove the risk of harm to the snake or people then handling should only be done by a **licensed fauna ecologist or wildlife carer** with skills and experience in snake handling.
  - Follow the *Hygiene Protocol for the control of disease in frogs* (Wellington and Haering 2008) for all frog handling.
  - Fish should only be handled by experienced **aquatic ecologists**.
  - Wear gloves when handling mammals (including bats) to protect against bites and scratches.
  - If handling bats, the handler must be vaccinated against the Australian Bat *Lyssavirus* (ABL) which is a form of rabies.
  - Release fauna into pre-determined habitat identified for fauna release.
  - Release fauna into similar habitats, as near as possible to their capture location. Release nocturnal fauna at dusk.
- Temporary fauna fencing may be required on projects to reduce the chances of road kill/injury from public traffic or construction machinery.
- Keep records of fauna captured and relocated.
- Report any injury to or death of a threatened species to the RTA's environmental staff.
- The project manager or site manager should ensure that personnel do not feed any wildlife that may be encountered on construction sites (especially birds and lizards). The project manager should include this in project inductions and erect relevant signs informing personnel not to feed the wildlife around the work site.

# Guide 10: Aquatic habitats and riparian zones

## Background

**Aquatic habitats include all areas of land submerged by water, permanently or intermittently, and include both artificial and natural bodies of water. It includes wetlands, rivers, creeks, lakes, dry river beds and estuaries.**

Riparian zones are those vegetated lands immediately next to aquatic habitats and include riverbank vegetation.

The distance the riparian zone extends from a waterway varies greatly depending on factors such as the nature of the waterway and the local geology and landform. However, it is generally accepted to be 50 metres from the top of the highest ('bankfull') bank of a waterway or the edge of a wetland where aquatic vegetation changes to terrestrial vegetation (Department of Primary Industries (Fisheries) 2012).

Aquatic habitats and riparian zones have an important ecological role in providing habitats and resources for a large number of terrestrial and aquatic flora and fauna. Even heavily disturbed and weed infested riparian zones can play an important ecological role.

Construction and maintenance works within aquatic habitats and riparian zones can disturb aquatic habitats, alter flow or obstruct fish passage and can also impact downstream aquatic biodiversity. Damage can be caused by the movement of machinery, vehicles and personnel and through unsuitable clearing procedures during construction.

The 'Degradation of native riparian vegetation', 'Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands', and the 'Removal of large woody debris (snags) from rivers and streams' are listed as *Key Threatening Processes under the Fisheries Management Act 1994* (NSW)(FM Act).

Construction or maintenance works within aquatic habitats and/or riparian zones may require consultation with the **regional Fisheries Conservation Manager** of the NSW Department of Primary Industries (DPI) (Fisheries).

Some activities may require permits including temporary or permanent obstruction of fish passage, use of explosives in a waterway or harm to vegetation including saltmarsh, mangroves and seagrass.

**FIGURE 10.1:** Even disturbed aquatic habitat and riparian zones can provide important resources for flora and fauna (Photo: Lester Piggott).

## Objective

**The objective of this guide is to provide guidance for limiting impacts on aquatic flora and fauna and their habitats, and to ensure the movement of fish up and downstream is maintained at all times during works in a waterway.**

## Application of this guide

This guide is applicable to all RTA construction and maintenance sites where works are in an aquatic habitat or within the riparian zone (50 metres from the highest bank of a waterway or the edge of a wetland).

**FIGURE 10.2:** The Murray River, Albury (Photo: Josie Stokes).

## Specialist input requirements

Consult with the regional **Fisheries Conservation Manager**. Contact details for regional Fisheries Conservation Managers in each catchment area can be found on the DPI website (www.dpi.nsw.gov.au/fisheries/habitat/contacts).

## Management requirements

Aquatic habitats and riparian zones are sensitive environmental areas and any activities in these areas should be avoided as much as practicable. If activities are required in these areas, existing guidelines that detail design and management measures are:

- Department of Primary Industries (Fisheries) (2012) *Policy and Guidelines for Fish Habitat Conservation and Management.*
- Department of Environment and Climate Change (DECC)(2008) *Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction,* Sydney (Blue Book).
- Fairfull, S and Witheridge, G (2003) *Why do fish need to cross the Road? Fish passage requirements for waterway crossings*, NSW Fisheries, Cronulla.

The environmental assessment may have identified special requirements that constrain the timing of work such as periods of threatened fish migrations, or periods where flooding is identified as a risk.

The project manager and/or environment manager should ensure that the sensitivity of aquatic habitats and riparian zones and the measures in place to protect them are regularly communicated to all staff eg during inductions and toolbox talks.

### Establish exclusion zones within aquatic habitats and riparian zones

The project manager and/or environment manager should ensure that aquatic habitats and riparian zones where works are not required are protected by exclusion zones. The following general guidance should be given to the contractor by the project manager and/or environment manager when establishing exclusion zones within aquatic habitats and riparian zones:

1. Mark out and manage exclusion zones according to *Guide 2: Exclusion zones.*
2. Exclusion fencing should not be installed in the waterway, within 3 metres of the top of the bank or in sensitive areas (eg saltmarsh or mangroves). Exclusion fencing should be used outside these sensitive areas.
3. Identify the construction footprint within the waterway on a map and include in relevant plans such as a Construction Environmental Management Plan (CEMP). The location of aquatic habitat features within or adjacent to the footprint should be clearly identified on the map (eg snags, aquatic vegetation, seagrass beds and gravel beds).

## Accessing the waterway

The project manager and/or environment manager should ensure that:

- Access to the waterway minimises the removal of riparian vegetation.
- Access to the waterway is restricted to the minimum amount of bank length required for the construction activity.
- Vehicles and machinery are kept away from the banks of a waterway where possible.
- Refuelling of vehicles and plant, and chemical storage and decanting does not take place within 50 metres of aquatic habitats or riparian zones.
- Boats or other water craft are used in a manner so as to avoid boat wash that could cause erosion of the banks and propeller damage to seagrass beds.

## Clearing of riparian and aquatic vegetation

See *Guide 4: Clearing of vegetation and removal of bushrock* when vegetation clearing is required. In addition, the project manager and/or environment manager should ensure that the following is considered:

- Clearing is avoided within the riparian zone during periods when flooding is likely to occur.
- Works are undertaken in accordance with any permit issued under the FM Act for the harm or removal of saltmarsh, mangroves and seagrass.
- Clearing does not allow vegetation/trees to fall into the waterway.
- Retaining the roots and stumps of trees on the bank of a waterway in order to maintain bank stability. Cut trees off between 300 and 600 millimetres above the ground level.
- Consulting with **DPI (Fisheries)** before clearing to identify any trees proposed to be removed that could potentially be used for re-snagging of a waterway (see *Guide 5: Re-use of woody debris and bushrock*).
- Managing Willows (*Salix* species) and other weed species in accordance with *Guide 6: Weed management.*


**FIGURE 10.3:** Snag timber from the Hume Highway Duplication project was placed in the Murray River and now provides habitat for threatened native fish species such as Murray Cod (*Maccullochella peelii peelii*) and Trout Cod (*Maccullochella macquariensis*) (Photo: J Fredrickson, DPI).

## Removal/relocation of snags

Snags are branches, trunks and whole trees that fall into rivers and streams. DPI (Fisheries) defines snags greater than 3 metres in length or 300 millimetres in diameter as being key fish habitat for native fish. Snags form essential habitat for aquatic and terrestrial flora and fauna.

Snags may need to be removed and/or relocated before undertaking works. Only the minimum number of snags should be disturbed. The project manager and/or environment manager should ensure the hierarchy below (low to high impact) is followed when snags need to be disturbed:

1. **Lopping** – protruding limbs are cut and allowed to sink to the river bed.
2. **Realignment** – the snag is rotated from its existing position.
3. **Relocation** – the snag is physically moved from one location in the waterway to another location. Relocation of snags should be undertaken so as to cause the least disturbance to the bed or nearby sensitive aquatic habitat.
4. **Removal** – the snag is completely pulled from the water.

The project manager and/or environment manager should ensure that **DPI (Fisheries)** are consulted where snags are proposed to be lopped, realigned, relocated and/or removed.

**FIGURE 10.4:** Snags are an important part of Australian rivers, providing aquatic habitat and stabilising river bed and banks (Photo: J Fredrickson, DPI).

### Site rehabilitation

The project manager and/or environment manager should ensure that the following is considered during site rehabilitation:

- Stabilising the banks of the waterway through revegetation and/or armouring according to available landscape plans.
- Banks are protected from stock and/or human access.
- Appropriate fencing is used during rehabilitation and maintenance.
- Temporary stabilisation techniques are used while long-term measures such as the revegetation are establishing (techniques are described in the Blue Book).
- Removing temporary works, flow diversion barriers and sediment control barriers within aquatic habitats as soon as practicable and in a manner that does not promote future channel erosion.

## Supporting documents


1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works.
3. Department of Environment and Climate Change (DECC) (2008) *Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction*, Sydney (Blue Book).
4. Department of Primary Industries (Fisheries) (2012) *Policy and Guidelines for Fish Habitat Conservation and Management* (Eds. S Fairfull and S McGirr) Department of Primary Industries, Wollongbar.
5. Fairfull, S and Witheridge, G (2003) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*. NSW Fisheries, Cronulla.
6. Gorham, P (2008, accessed 7 April 2011) Primefact 30: Aquatic weed management in waterways and dams, Industry and Investment NSW (www.dpi.nsw.gov.au/primefacts).
7. *RTA Environmental Protection (Management Plan) QA Specification G35* (Accessed via the RTA intranet TechInfo page, Techdocs).
8. *RTA Environmental Protection (Management System) QA Specification G36* (Accessed via the RTA intranet TechInfo page, Techdocs).

# Biodiversity Guide 10 – Aquatic habitats and riparian zones

## Objective

The objective of this guide is to provide guidance for limiting impacts on aquatic flora and fauna and their habitats, and to ensure the movement of fish up and downstream is maintained at all times during works in a waterway.

## Application of this guide

This guide is applicable to all RTA construction and maintenance sites where works are in an aquatic habitat or within the riparian zone (50 metres from the highest bank of a waterway or the edge of a wetland).

## Management requirements:

- Avoid activities in aquatic habitats and riparian zones as much as practicable.
- The sensitivity of aquatic habitats and riparian zones and the measures in place to protect them should be regularly communicated to all staff eg during inductions and toolbox talks.
- Protect aquatic habitats and riparian zones where works are not required with exclusion zones. Exclusion fencing should be used outside sensitive areas (eg saltmarsh or mangroves).
- The location of aquatic habitat features within or adjacent to the footprint should be clearly identified on environmental management plans.
- Access the waterway so that riparian vegetation removal is minimised and restricted to the minimum amount of bank length required for the construction activity.
- Keep vehicles and machinery away from the banks of a waterway where possible.
- Refuelling of vehicles and plant, and chemical storage and decanting should not take place within 50 metres of aquatic habitats.
- Use boats or other water craft in a manner so as to avoid boat wash that could cause erosion of the banks and propeller damage to seagrass beds.
- Avoid clearing within the riparian zone during periods when flooding is likely to occur.
- A permit is required under the *Fisheries Management Act 1994* (NSW)(FM Act) for the harm or removal of saltmarsh, mangroves and seagrass.
- Ensure that any clearing undertaken does not allow the vegetation/trees to fall into the waterway.
- Retain the roots of trees on the bank of a waterway in order to maintain bank stability.
- Consult with **Department of Primary Industries (DPI)(Fisheries)** before clearing to identify any trees proposed to be removed that could potentially be used for re-snagging of a waterway.
- Only the minimum number of snags should be disturbed.
- **DPI (Fisheries)** must be consulted before works commence where snags require lopping, realignment, relocation and/or removal.
- During rehabilitation, stabilise the banks of the waterway through revegetation and/or armouring according to available landscape plans.
- Protect banks from stock and/or human access using appropriate fencing during the rehabilitation and maintenance period of the work site.
- Remove all temporary works, flow diversion barriers and sediment control barriers within aquatic habitats as soon as practicable and in a manner that does not promote future channel erosion.

# References


1. Ainsworth, N and Bowcher, A (2005) Guidelines for Herbicide Use near Water, Cooperative Research Centres (CRC) for Australian Weed Management, South Australia.
2. *Australian Standard 4373 (2007) Pruning of Amenity Trees.*
3. *Australian Standard 4970 (2009) Protection of Trees on Development Sites.*
4. Beyer, GL and Goldingay, RL (2006) The value of nest boxes in the research and management of Australian hollow-using arboreal marsupial, *Wildlife Research*, 33, 161–174.
5. Department of Environment and Climate Change (April 2008) Statement of Intent 1. Infection of native plants by *Phytophthora cinnamomi*, New South Wales Department of Environment and Climate Change, Sydney.
6. Department of Environment and Climate Change (DECC)(2008) *Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction*, Sydney (Blue Book).
7. Department of Environment and Conservation (2007) *Hume Highway Duplication Coarse Woody Debris Relocation Criteria* (unpublished report).
8. Department of Environment and Conservation (DEC) (1999, accessed 7 April 2011) Scientific Committee Final Determination: key threatening process – Bushrock removal (Access via www.environment.nsw.gov.au by clicking on threatened species and key threatening processes).
9. Department of Environment and Conservation (DEC) (2003, accessed 7 April 2011) Scientific Committee Final Determination: key threatening process – Removal of dead wood and dead trees (Access via www.environment.nsw.gov.au by clicking on threatened species and key threatening processes).
10. Department of Environment, Climate Change and Water (September 2009) Statement of Intent 2: Infection of frogs by amphibian chytrid causing the disease chytridiomycosis, NSW Department of Environment, Climate Change and Water, Sydney.
11. Department of Environment, Climate Change and Water (undated) *Hume Highway Duplication Nest Box Criteria* (unpublished report).
12. Department of Primary Industries (DPI) (2012) *Policy and Guidelines for Fish Habitat Conservation and Management* (Eds. S Fairfull and SMcGirr) DPI, Wollongbar.
13. Ensbey, R (2009, accessed 7 April 2011) *Noxious and Environmental Weed Control Handbook: A guide to weed control in non-crop, aquatic and bushland situations*, 4th ed, Industry and Investment NSW, Orange, NSW (www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/noxious-enviro-weed-control).
14. Fairfull, S and Witheridge, G (2003) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*, NSW Fisheries, Cronulla.
15. Florabank (2000) Florabank Guidelines 1–10 , Florabank, Yarralumla, ACT (www.florabank.org.au/default.asp?V_DOC_ID=755).
16. Franks, A and Franks, S (2006) Nest Boxes For Wildlife: A Practical Guide, Blooming Books, Melbourne.
17. Gibbons, P and Lindenmayer, D (1997) *Conserving Hollow-dependent fauna in timber- production forests*, Environmental Heritage Monograph Series No. 3, NSW National Parks and Wildlife Service, Hurstville.
18. Gibbons, P and Lindenmayer, D (2002) *Tree Hollows and Wildlife Conservation in Australia*, CSIRO Publishing.
19. Gibbons, P, Ayers, D, Seddon, J, Doyle, S, and Briggs, S (2005) *BioMetric Version 1.8.: A Terrestrial Biodiversity Assessment Tool for the NSW Property Vegetation Plan Developer*, Operational Manual Department of Environment and Conservation (NSW), (unpublished report).
20. Goldingay, RL and Stevens, JR (2009) Use of artificial tree hollows by Australian birds and bats, *Wildlife Research*, 36, 81-97.

21. Gollnow, B, Carnegie, A, Horwood, M and Driessen, S (2010, accessed 7 April 2011) PrimeFacts 1017 (2nd Edition) Myrtle Rust – *Uredo rangelli*, Industry and Investment NSW (www.dpi.nsw.gov.au/primefacts).

22. Gorham, P (2008, accessed 7 April 2011) Primefact 30: Aquatic weed management in waterways and dams, Industry and Investment NSW (www.dpi.nsw.gov.au/primefacts).

23. Grant, J (1997) *The Nest Box Book*, Gould League, Victoria.

24. Industry and Investment NSW (November 2010, accessed 7 April 2011) *Preventing spread of Myrtle Rust in bushland: Handout prepared for Myrtle Rust response 2010–11*, Industry and Investment NSW, Gosford (www.dpi.nsw.gov.au/primefacts).

25. Landcom (2004) *Managing Urban Stormwater: Soils and Construction*, Volume 1, 4th Edition (reprinted July 2006).

26. McDonald, J (2011) *Australian Nursery Industry Myrtle Rust (Uredo rangelli) Management Plan*, Nursery and Garden Industry Australia, Sydney (www.ngia.com.au).

27. Mortlock, W (1998) *Native Seed in Australia: Summary findings and draft recommendations*, Florabank, ACT.

28. Mortlock, W (1998, accessed 7 April 2011) Florabank Model Code of Practice, Florabank, Yarralumla, ACT (www.florabank.org.au and click on *seed knowledge*).

29. National Parks and Wildlife Service (1999, accessed 7 April 2011) Threatened species information: Bushrock Removal Fact Sheet (www.environment.nsw.gov.au/resources/nature/bushrock.pdf).

30. Natural Heritage Trust (2004, accessed 7 April 2011) *Introductory Weed Management Manual*, Natural Heritage Trust (with the CRC for Australian Weed Management and the Commonwealth Department of Environment and Heritage), ACT (www.weedscrc.org.au/documents/manual.pdf).

31. Newley, P (August 2010, accessed 7 April 2011) PrimeFacts 1029 Panama Disease in Bananas, Industry and Investment NSW (www.dpi.nsw.gov.au/primefacts).

32. NSW Health (Updated 15 January 2008, accessed 7 April 2011) 'Rabies and bat lyssavirus infection: Infectious disease fact sheet' NSW Health, (www.health.nsw.gov.au/factsheets/infectious/rabiesbatinfection.html).

33. NSW Health (Updated 19 December 2007, accessed 7 April 2011) 'Leptospirosis: Infectious disease fact sheet' NSW Health, (www.fwahs.health.nsw.gov.au/factsheets/infectious/leptospirosis.htm).

34. O'Gara, E, Howard, K, Wilson, B and Hardy, J (2005) *Management of Phytophthora cinnamomi for Biodiversity Conservation in Australia: Part 2 National Best Practice Guideline*, A report funded by the Commonwealth Government Department of the Environment and Heritage by the Centre for Phytophthora Science and Management, Murdoch University, Western Australia.

35. Office of Environment and Heritage (accessed 2 May 2011, updated 14 April 2011) 'Chemicals and Pesticides' New South Wales Government Environment, Climate Change and Water (www.environment.nsw.gov.au/pesticides/index.htm).

36. RTA (2004) *Design Construction and Ten Year Maintenance of Pacific Highway Upgrade* (Appendix 5 – Provisions for Fauna) (unpublished report).

37. RTA (2004) *Nest box use by Australian Fauna: A Literature Review* (unpublished report).

38. RTA (2005) Guideline for the Management of Acid Sulfate Materials.

39. RTA (2007) Pesticide Use Notification Plan (www.rta.nsw.gov.au/environment/biodiversity/pesticideplan.html).

40. RTA (2008) Landscape Guideline: Guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seeding.

41. RTA (2011) Stockpile Site Management Guideline.

42. *RTA Clearing and Grubbing QA Specification G40* (Accessed via the RTA intranet TechInfo page, Techdocs).

43. RTA CQTD07-2009 (Construction Quality Technical Direction 007), Quality Alert 7 – Hydroseeding, Hydromulching and other slope stabilisation methods.

44. RTA Environmental Impact Assessment Guidelines (Accessed via the RTA intranet environment page, environment policies, procedures and guidelines).

45. *RTA Environmental Protection (Management Plan) QA Specification G35* (Accessed via the RTA intranet TechInfo page, Techdocs).

46. *RTA Environmental Protection (Management System) QA Specification G36* (Accessed via the RTA intranet TechInfo page, Techdocs).

47. *RTA Landscape Planting QA Specification R179* (Accessed via the RTA intranet TechInfo page, Techdocs).

48. *RTA Seed Collection QA Specification R176* (Accessed via the RTA intranet TechInfo page, Techdocs).

49. *RTA Soil and Water Management (Erosion and Sediment Control Plan) QA Specification G39* (Accessed via the RTA intranet TechInfo page, Techdocs).

50. *RTA Soil and Water Management (Soil and Water Management Plan) QA Specification G38* (Accessed via the RTA intranet TechInfo page, Techdocs).

51. *RTA Vegetation QA Specification R178* (Accessed via the RTA intranet TechInfo page, Techdocs).

52. Suddaby, T and Liew, E (2008) *Best Practice Management Guidelines for Phytophthora cinnamomi within the Sydney Metropolitan Catchment Management Authority Area*, Royal Botanic Gardens Trust, Sydney.

53. Thackway, R and Cresswell, ID (1995) *An Interim Biogeographic Regionalisation of Australia*, Australian Nature Conservation Agency, Canberra.

54. Wellington, R and Haering, R (2008) *Hygiene Protocol for the control of disease in frogs: Threatened Species Management Information Circular No. 6*, Department of Environment and Climate Change, Sydney South.

# Useful websites

1. **Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC)**

   www.environment.gov.au

   This site provides information on Australian biodiversity and legislation by clicking on the *Biodiversity* link. It includes flora and fauna databases and resources, species information and threats, and access to threat abatement plans or strategies and priority actions for species conservation.

2. **Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Weeds in Australia**

   www.weeds.gov.au/cgi-bin/weedidtool.pl

   This site provides information about weeds in Australia including species information and weed management. This site also provides a search tool that may assist in identifying weeds. However, the tool only provides information on plant species that are on a national weed list, or are legislated against in a state or territory.

3. **Department of Primary Industries (DPI) Calender of Growth Cycle and Control Times for different regions across NSW**

   www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/calendar

   This website provides calendars of weed growth and control times throughout NSW. A PDF is available for download for each region.

4. **Department of Primary Industries (DPI) Weeds Training Program**

   www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/training#clm

   The NSW Weeds Training Program provides relevant, high quality, nationally accredited training in a wide range of weed management subjects. This website provides an overview of courses available and information on how to register for courses.

5. **Department of Primary Industries (DPI) Weeds website**

   www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds

   This website provides information on weeds such as species information (including control techniques), maps, noxious weeds declarations, legislation and policy information and contact details for DPI invasive species officers and training coordinators.

6. **Department of Primary Industries Myrtle rust zone map**

   www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust/zones

   This website provides a map of the red and green Myrtle rust management zones. Red zones indicate where Myrtle rust is considered to be widely distributed while green zones are considered to be relatively free of the disease.

7. Florabank

www.florabank.org.au

Florabank is an initiative of the Australian Government, Greening Australia and CSIRO. This website provides information on native seeds and seed collection. The Florabank Model Code of Practice and Florabank Guidelines (1-10) are available by clicking on the *Seed Knowledge* link.

8. NSW Office of Environment and Heritage (OEH)

www.environment.nsw.gov.au

This site provides information on NSW biodiversity and legislation by clicking on the Nature *Conservation* link. It includes the NSW Wildlife database, species information and threats, and access to threat abatement plans or strategies and priority actions for species conservation.

This website also contains information relating the safe use and disposal of pesticides and chemicals including the legislation that applies to the use of pesticides and chemicals by clicking on the *Environmental Issues* link.

# Acronyms and abbreviations

| | |
|---|---|
| **CEMP** | Construction Environmental Management Plan |
| **DEC** | NSW Department of Environment and Conservation (now Office of Environment and Heritage) |
| **DECC** | NSW Department of Environment and Climate Change (now Office of Environment and Heritage) |
| **DECCW** | NSW Department of Environment, Climate Change and Water (now Office of Environment and Heritage) |
| **DSEWPC** | Commonwealth Department of Sustainability, Environment, Water, Population and Communities |
| **DPI** | NSW Department of Primary Industries |
| **EPA** | Environment Protection Authority |
| **EPBC Act** | *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) |
| **FM Act** | *Fisheries Management Act 1994* (NSW) |
| **I&I** | Industry and Investment NSW (now Department of Primary Industries) |
| **NATA** | National Association of Testing Authorities |
| **OEH** | NSW Office of Environment and Heritage (formerly known as DEC, DECC, DECCW) |
| **TPZ** | Tree protection zone |
| **TSC Act** | *Threatened Species Conservation Act 1995* (NSW) |
| **WONS** | Weeds of national significance |

# Glossary

| | |
|---|---|
| **Arboreal** | Species that live in or are frequently found in trees eg squirrel gliders. |
| **Arborist** | A specialist in maintaining trees eg trimming, felling and treatment of disease. |
| **Aquatic habitats** | Aquatic habitats include all areas of land submerged by water, permanently or intermittently, and include both artificial and natural bodies of water. It includes wetlands, rivers, creeks, lakes, dry river beds and estuaries. |
| **Berm** | A constructed horizontal ledge (eg an earth bank, cutting, or mulch) that may be used to delineate areas or stabilise exposed ground. |
| **Biodiversity** | The variety of life forms, including flora and fauna, the genes they contain and the ecosystems in which they live. |
| **Blue Book** | *Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction* (DECC 2008). This is a component of the 4th edition of *Managing urban stormwater: Soils and construction, Volume 1* (Landcom 2004). Volume 2D should be read in conjunction with Volume 1. |
| **Carbon sequestration** | Capture and storage of carbon from the atmosphere eg by planting trees that will use atmospheric carbon for growth. |
| **Communities** | Ecological communities, which are naturally occurring groups of plants and animals. Their species composition can be determined by factors such as soil type, position in the landscape, climate and water availability. |
| **Conditions of approval** | Requirements that are placed on a permit or project approval. |
| **Connectivity** | Elements of the landscape that permit movement of organisms or genetic flows across the landscape by linking otherwise isolated areas. |
| **Construction footprint** | The area directly impacted by construction activities. |
| **Critical habitat** | Critical habitats are areas of land that are declared to be crucial to the survival of particular threatened species, populations and ecological communities under the *Threatened Species Conservation Act 1995* (NSW) or the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth). |
| **Endangered** | Defined under the *Threatened Species Conservation Act 1995* (NSW) as a species, population or ecological community which is likely to become extinct or is in immediate danger of extinction. |
| **Fauna** | All animals. |
| **Flora** | All plants. |
| **Fragmentation** | Describes the result of removal (usually by clearing) of large parts of a natural area, resulting in the retention of only small parts (fragments or remnants) of habitat. |

| | |
|---|---|
| **Glider poles** | Wooden poles installed to assist gliding animal species (such as squirrel gliders) to cross roads. Animals glide between poles as they would between trees. |
| **Ground cover** | A low growing woody or herbaceous plant. |
| **Grubbing** | Digging or grinding for the purpose of removing stumps, roots and other sub-surface vegetative material. |
| **Habitat** | The locality or natural home in which a plant, an animal or a group of closely associated organisms lives. |
| **Hydromulching** | Broadcasting of seed under pressure by spraying a slurry of water, seed and fertiliser in addition to mulch, binder and green dye. Executed in one operation. |
| **Hydroseeding** | Broadcasting of seed under pressure by spraying a slurry of water, seed and fertiliser. |
| **Identified habitat** | Habitat (eg hollow-bearing trees, bushrock, feed trees) that has been identified by an ecologist during the environmental assessment or pre-clearing process that requires mitigation eg exclusion fencing. |
| **Key threatening processes** | Processes listed under the *Threatened Species Conservation Act 1995* (NSW) or the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) that adversely affect threatened species, populations or ecological communities, or that could cause species, populations or ecological communities to become threatened. |
| **Local provenance** | Plants whose native origin is close to where they are going to be planted (for example in the same local area). |
| **Microbat** | A small, insect-eating, flying mammal. |
| **Microclimates** | The climate of a localised area (eg under a log) with environmental conditions such as humidity and temperature that may differ to the surrounding area. |
| **Median** | The central reservation which separates carriageways from traffic travelling in the opposite direction. This can be vegetated or non-vegetated. |
| **Mulch** | Shredded vegetation used for soil stabilisation and moisture conservation. |
| **Offset** | Measures carried out offsite that aim to replace biodiversity values lost on a site by damaging or removing all or part of an ecosystem or habitat. |
| **Pathogens** | Bacteria, viruses or fungi that can cause disease. |
| **Pest** | Animal and plant species that are considered damaging to the environment, agriculture or health. |
| **Re-snagging** | Replacement of wood snags in a waterway. |
| **Ramsar** | An intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. |
| **Riparian** | The area of land immediately adjacent to a watercourse. |

| | |
|---|---|
| **Rootball** | The main mass of roots and soil at the base of a tree or shrub. |
| **Rope canopy bridge** | Rope structures installed over roads that assist animals that live in trees (such as possums) cross a road. Animals climb on the rope as they would on the branches of trees. |
| **Shrub** | A woody perennial plant (smaller than a tree) that usually has several stems arising at or near the ground giving the plant a bushy appearance. |
| **Snag** | Large (>500 millimetres in diameter) woody debris from trees and shrubs, including whole fallen trees, broken branches and exposed roots that have fallen or washed into a waterway and are now wholly or partially submerged by water. |
| **Statement of commitments** | Details of additional actions or measures that will be carried out as part of a project. |
| **Soil compaction** | The compression of soil such that air and water is pushed out of the spaces between soil particles making it more dense. This may occur from driving heavy machinery over the soil for example. |
| **Species** | A level of biological classification comprising one or more populations of individuals capable of interbreeding to produce fertile offspring. |
| **Staged habitat removal** | Removal of habitat in stages. For example the removal of non-habitat first (eg shrubs), leaving the habitat stand for 24 hours, then removing habitat (eg hollow bearing trees). Staged habitat removal reduces the potential impacts of activities such as clearing on fauna. |
| **Stockpile** | The temporary storage of material or plant for construction projects and maintenance works eg mulch. |
| **Terrestrial** | Refers to environments other than aquatic or marine environments. It includes subterranean environments. |
| **Threatened ecological communities** | Communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) or the *Threatened Species Conservation Act 1995* (NSW). They can be listed as critically endangered, endangered or vulnerable. |
| **Torpor** | A period of inactivity and temporary hibernation for fauna. |
| **Tree dripline** | The area directly under the branches (canopy, crown) of a tree. This area requires protection as it is where the roots of the tree are located. |
| **Tree protection zone** | The calculated distance from the trunk set aside for the protection of a tree's roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by development. |
| **Tributary** | A creek or river that flows into a larger creek or river. |
| **Weed** | A plant that requires some form of action to reduce its effects on the economy, the environment, human health and/or amenity. See to Table 6.1 for further information on the classification of weeds in NSW. |
| **Wildlife crossing zone** | An area with several constructed or designed features that assist animals to cross roads safely eg rope canopy bridges, vegetation, underpasses. |

**© Roads and Traffic Authority of New South Wales**

The information is intended as a guide only and is subject to change at any time without notice.

For further enquiries
**www.rta.nsw.gov.au | 13 22 13**

September 2011
RTA/Pub. 11.408
ISBN 978-1 921766-02-2