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Manual

Fauna Sensitive Transport Infrastructure Delivery Chapter 7: Construction

June 2024

Queensland Government

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Key Points

In the context of Fauna Sensitive Transport Infrastructure Delivery (FSTID), construction includes:

- The initial construction of the road, railway, or other associated transport infrastructure.
- Upgrades and repairs to transport infrastructure.
- The decommissioning, demolition, and/or removal of transport infrastructure.

This chapter describes ecological management processes during construction and outlines management plans which document processes and procedures for compliance by all contractors on a construction site. The detail in this chapter applies after a project has been planned and approved (Chapter 5), and each stage should be considered for all projects and implemented where required. These stages include:

- Preparing to commence construction.
- Establishing the construction site, including the setting and fencing of exclusion zones.
- Clearing vegetation and habitat.
- Fauna management during construction.
- Monitoring and reporting.

Contents

Tables

Figures

Case Studies

1 Introduction

Construction is defined as any work on or in the vicinity of a construction site carried out in connection with the construction, alteration, conversion, fitting-out, commissioning, renovation, repair, maintenance, de-commissioning, demolition or dismantling of any structure[1]. In this manual, construction specifically includes:

- All site works for the initial construction of the transport infrastructure, including early works and relocation of public utilities.
- Upgrades, re-alignment, widening, and repairs to transport infrastructure.
- Installation of environmental assets to existing roads or railways, such as fauna exclusion fencing, wildlife crossing structures, or fauna signage.
- Site decommissioning, rehabilitation, and revegetation after construction is completed.

In this manual, routine maintenance and retrofits are not considered construction because they are typically minor in scale and funded through a maintenance budget and are discussed in Chapter 8.

The commencement of construction is a significant milestone for a project and is often the culmination of many years of planning, design, consultation, and approvals. The construction phase is a critical step in Fauna Sensitive Transport Infrastructure Delivery (FSTID) because it is when the planning and designs are realised. It is also a high-risk stage for FSTID because even seemingly small changes to the design of a structure, or omission of a step or feature, can render the chosen mitigation measures (Chapter 6) ineffective. Additionally, when not correctly managed, construction can lead to fauna injury and mortality.

Construction commences after the planning and design of the project is completed and all approvals have been obtained (Chapter 5) and ceases once the transport infrastructure is operational and handed back to Transport and Main Roads to manage (Figure 1). However, in some instances the transport infrastructure may be opened to traffic prior to the completion of construction while minor works are still being completed.

Transport and Main Roads construction contractors can be engaged in a number of different ways which vary according to the size and complexity of the project.

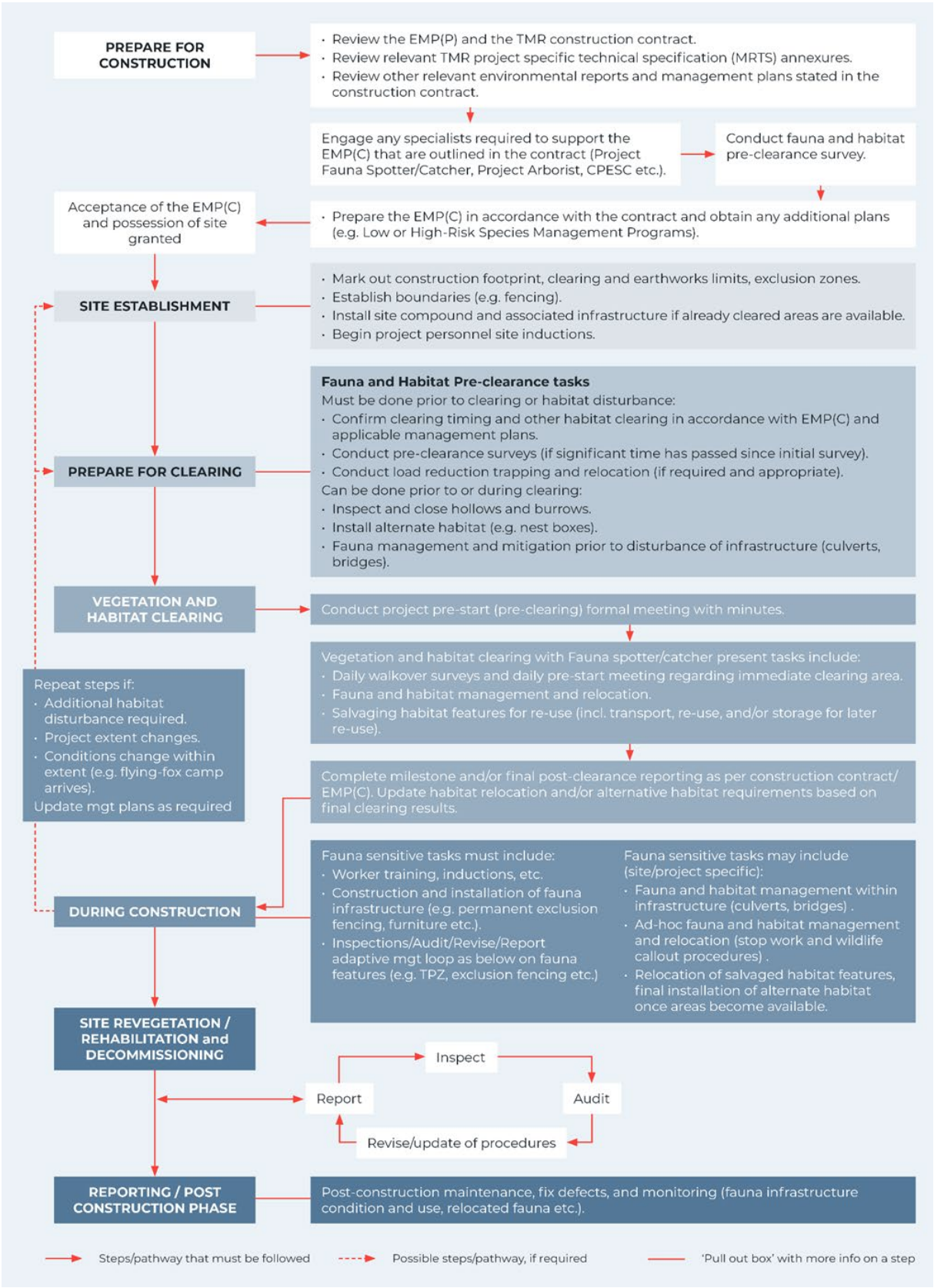
This chapter provides guidance to departmental staff and construction contractors on the management of fauna during construction. The details of this chapter can be applied irrespective of the way in which the contractors are engaged. It is also expected that all approvals have been obtained and plans have been prepared. Refer to Chapter 5 to ensure all necessary planning and design steps have been completed.

[1] (Commonwealth of Australia 2005)

The chapter is organised into the following sections, which correspond to the typical sequence of events in construction and are visually displayed in Figure 1:

- Roles and responsibilities (Section 2).
- Potential impacts of construction to fauna (Section 3).
- Preparing for construction and obtaining the Environmental Management Plan (Construction) (EMP(C)) (Section 3.5).
- Site establishment, including establishing exclusion zones and fencing (Section 5).
- Preparing to commence clearing (Section 6).
- Clearing of vegetation and habitat (Section 7).
- Fauna management during construction (Section 8).
- Site rehabilitation and revegetation (Section 9).

Figure 1 – Flow chart showing the major steps in construction



1.1 A note on early works and main works

Certain construction tasks may be removed from the main contract and undertaken as early works when:

- The works need to be conducted at a specific time of year, such as habitat clearing when a threatened species of fauna is absent from the site, pre-clearing reduction of fauna or habitat, or the installation of replacement or supplementary habitat.
- The timing of works are largely outside of Transport and Main Roads control, such as relocating or removing powerlines, pipelines, or telephone cables.
- Certain large or complicated tasks are required before the main contract can commence, such as preloading, surcharging, staging, and ground modification of significant earthworks embankments or fills.

Just as for the main works, early works can only commence when all statutory approvals and management plans are in place. In exceptional situations some minor early works can progress depending on the type of approvals obtained and discussions with the regulators.

All steps outlined in this chapter must be applied to both early works and main works.

2 Roles and responsibilities

Clear delineation of key roles and responsibilities is critical during construction to manage risk, ensure compliance, and minimise ecological impacts.

During construction, responsibility for biodiversity and environmental management is delegated from Transport and Main Roads to the construction contractor through the contract. The EMP(C) specifies all environmental-specific roles and the responsibilities of personnel, including sub-contractors (e.g. fauna spotter / catchers). There is further discussion of the preparation of the EMP(C) in Section 4.5.

The construction contractor is also responsible for revegetation, habitat restoration and site decommissioning as per the approvals and the EMP(C) (Section 9).

3 Ecological impacts of construction

Construction can cause fauna injury and mortality in numerous ways which are summarised in Table 3. Construction impacts are a specific subset of the many ecological impacts described in Chapter 4.

Construction impacts should have been considered in the overall impact assessment process but impacts need to be reviewed prior to construction starting as part of the development of the EMP(C).

Table 3 – Summary of potential ecological impacts of construction

Activity	Impact	Native fauna potentially affected
• Vegetation removal activities (e.g. direct interaction with falling trees and construction plant).	• Injury or mortality of fauna.	• All species in the clearing area.
• Vehicle / machinery collisions with fauna. Worsened by increased vehicle activity at and around construction sites and habitat clearing flushing fauna into high-risk areas	• Injury or mortality of fauna.	• All species in the construction area.

Activity	Impact	Native fauna potentially affected
• Interactions with construction sites, e.g. trapped in open pits and trenches.	• Injury or mortality of fauna.	• All species in the construction area.
• Disturbance due to noise, light, vehicle movements.	• Habitat degradation and indirect habitat loss.	• All species; notably nocturnal species from night works and species reliant on acoustic communication (e.g. birds, bats, frogs).
• Disruption to normal movement patterns due to temporary or permanent barriers.	• Barrier or filter to fauna movement.	• All species.
• Changes to water volume or quality due to erosion and sedimentation, turbidity, flooding, ponding, etc.	• Injury or mortality of fauna, habitat degradation and indirect habitat loss.	• Frogs, fish, turtles, aquatic invertebrates, platypus.
• Tree and shrub clearing, including of: – Hollow-bearing trees and dead standing trees. – Arboreal termitaria. – Arboreal and terrestrial bird nests. – Burrows. – Possum dreys. – Fissures and peeling bark.	• Direct habitat loss, habitat degradation and indirect habitat loss.	• Tree-dependent bats. • Hollow-nesting and canopy-nesting birds. • Arboreal species. • Invertebrates. • Small woodland birds.
• Removal and/or destruction of natural features, such as understorey, groundcover, hollow logs, log piles, leaf litter, rock piles, termite mounds, sub-soil cracks and fissures, weeds that provide shelter. • Removal and/or destruction of anthropogenic features, such as built structures including culverts, drains, pipes and tunnels, rubbish piles, topsoil mounds, and other debris. • Permanent or temporary draining of wetlands and swamplands.	• Direct habitat loss, habitat degradation and indirect habitat loss.	• Ground-dwelling and semi-aquatic reptiles. • Small and medium ground-dwelling mammals. • Insectivorous bats. • Reptiles. • Platypus. • Frogs. • Invertebrates. • Fish.

3.1 Injury and mortality of fauna due to WVC and construction activities

The types of vehicles and traffic conditions experienced during construction present a different type of risk of WVC to those experienced during operation of the road or railway (Chapter 4). Where nearby roads need to remain open to traffic during construction there are frequently increased rates of fauna movement as well as changes to traffic patterns and drivers may be distracted by changed conditions, potentially resulting in increased rates of WVC. Large construction equipment has limited visibility so fauna that enter active construction areas are unlikely to be seen and more likely to be involved in WVC with plant.

Direct mortality can also occur during clearing of habitat. If fauna are sheltering in various habitat features and they do not disperse in response to the increased noise and vibration associated with construction they can be injured as the habitat is cleared. Even where fauna do disperse in response to disturbance, they are at increased risk of predation and the stress of moving can increase susceptibility to disease and still result in mortality.

Wildlife may be injured or experience stress when they are exposed to construction activities and when forced into smaller areas of habitat after clearing.

3.2 Barrier or filter to fauna movement

The removal of vegetation and habitat during construction can create a barrier or filter to the movement of some species of fauna. In addition, the fencing installed around construction sites to exclude the public and can often inhibit the movement of fauna. Fencing may also be installed to specifically exclude fauna from the construction site to prevent interactions with construction vehicle and personnel. Animals may also get trapped inside the construction fence, increasing the risk of fauna injury and mortality and exacerbating barrier effects.

The timing and duration of construction will factor into the level of impact the barrier has on the fauna in the area. Large projects that take many months or years will have a greater impact on fauna than shorter projects, as will projects that occur during periods of intense fauna movement, such as annual breeding or migration. The impacts of short construction projects can be significant if they inhibit daily movement, such as access to food or water source.

3.3 Direct loss of habitat

Habitat provides a place for fauna to forage, breed, move through the landscape, take shelter, and avoid predators. Habitat can include native and non-native vegetation, natural and anthropogenic elements, and built structures (Table 3). A habitat tree is a tree providing shelter to fauna, such as hollows, peeling bark, roost, or site for a nest or drey. Critical habitat and critical features are those that are vital to the continued survival of fauna, such as breeding habitat or food sources during times of year when food is naturally scarce. For example, tree hollows are vital for the central greater glider (*Petauroides armillatus*) and certain forest types with winter-flowering resources are critical for grey-headed flying-foxes (*Pteropus poliocephalus*).

Habitat features can be intentionally or inadvertently damaged, destroyed or removed during construction from the movement of machinery, vehicles, and personnel (Chapter 4).

Figure 3.3 – Large trees with hollows are critical habitat features and should be avoided wherever possible

Source: © Matt Head (left and middle) © State of Queensland (right)

3.4 Habitat degradation and indirect habitat loss

The quality of habitat can be temporally or permanently degraded by construction activities, including:

- Dust coating vegetation used as a food source by fauna.
- Construction noise, light and vibrations disturbing fauna.
- Sediment-laden run-off from construction sites entering waterways and impacting aquatic habitats.
- Rubbish entering adjacent terrestrial habitat and waterways.

3.5 Disturbance

The constructure process will change the timing and scale of noise generated in the project area with increased noise levels during the day and changes to how noise is transmitted through the area in response to bulk earthworks.

Construction areas often have lighting for security and safety reasons. Some construction activities are conducted at night to reduce traffic impacts, which will also result increased levels of light at night.

4 Preparing for construction

4.1 Review the contract

The project must be constructed in a manner that is consistent with the contract between Transport and Main Roads and the construction contractor.

Construction contractors must review the construction contract (include all relevant specifications and annexures) and this chapter to ensure that all FSTID aspects of the project are identified, incorporated into the EMP(C), and implemented. Aspects to consider include:

- Relevant conditions of approval from Commonwealth and/or State Governments.

- Location of the construction footprint and exclusion zones and method to define them (e.g. type of fencing).
- Specific habitat clearing procedures, such as timing (time of day, season), method, staging, and direction.
- Specific actions relevant to certain species, such as Koalas or other threatened species.
- The number / type / location / timing of installation of replacement and supplementary habitats, which may need to be installed well in advance of clearing if fauna take time to find and utilise them.
- Details of any mandated or recommended fauna monitoring.

4.2 Engage specialists

Specialists are required to develop and implement the EMP(C) and they can be employees or sub-contractors of the construction contractor. The review of the contract and conditions of approval (Section 4.1) will inform which specialists are required. Typical specialists and their roles are specified in Table 4.2.

Table 4.2 – Specialists typically required to inform the EMP(C)

SPECIALIST	TASK REQUIRED TO INFORM THE EMP(C)
Fauna spotter / catcher, Ecologist	• Undertake pre-clearance surveys to confirm site conditions, specifically the type, location, and condition of species and habitats present. Specific surveys are required at this stage because this level of detail is typically not collected during the planning and design phase and conditions are likely to have changed since those surveys were undertaken. • Plan the habitat re-use, habitat reduction, and fauna reduction aspects of the EMP(C)
Species experts	• Some projects may require input from a species expert in an advisory role similar to that of an ecologist, especially where threatened species or their habitat are impacted.
Arborist	• Identify the number, type, and location of hollow-bearing trees (this can also be completed by a fauna spotter / catcher). • Identify and delineate tree protection zones. • Specify how large and hollow-bearing trees are to be felled, removed, transported, and stored. • Input into the hollow replacement program, specifically identifying which trees are to have carved hollows installed (Chapter 6).
Aquatic ecologists	• For dewatering, fish salvage.

4.2.1 Fauna spotter / catchers

The fauna spotter / catcher must be suitably qualified and experienced, which is defined as:

A person with formal qualifications and/or experience in identification of native animals and wildlife ecology. A person is considered to be suitably qualified and experienced if they meet one or more of the following criteria (DES 2016):

- *An ecological consultant with experience in conducting surveys for native animal breeding places.*
- *A person who possesses a degree in natural science or similar with experience in conducting surveys for native animal breeding places.*

The fauna spotter / catcher must also hold or be endorsed under a DES approved Rehabilitation (Spotter Catcher) Permit, which differs from a Rehabilitation (Carer) Permit.

The fauna spotter / catcher may have multiple qualifications or experience which would mean they were suitable for a variety of tasks but where they are not competent other technical specialists should be engaged.

4.3 Pre-clearance surveys

A pre-clearance survey is an ecological assessment undertaken prior to the removal or disturbance of any vegetation, habitat (e.g. waterbodies, soil), habitat features (e.g. fallen logs, rocks etc.), or structures (e.g. culverts and bridges) to determine the scale of clearing work and ensure the clearing is well planned, organised, and adequately resourced. These surveys reduce the potential for wildlife injury and mortality using non-invasive or small-scale manual techniques.

A pre-clearance survey should:

- Review the planning documents, Species Management Plan (SMP) / Fauna Management Plan, and conditions of approval to identify priority species and habitats and ensure they are considered in the pre-clearance survey.
- Carefully inspect the site to identify and record the location and extent of all habitat, including the:
  - GPS location.
  - Type of habitat feature (e.g. nest, hollow, log pile, burrow, etc.).
  - Species the habitat feature is suitable for.
  - Number or extent of the feature.
- Use flagging tape or spray paint to physically mark all habitat features.
- Inspect bridges, culverts, and other built structures for the presence or likely presence of fauna.
- Inspect water sources, such as dams and other aquatic habitats, as well as riparian habitat, to determine the presence or likely presence of aquatic fauna including fish, frogs, turtles, and eels.
- Be undertaken during optimal weather conditions, season, and time of day / night for priority flora and fauna species, as per the relevant approval documents.

Transport and Main Roads may require that a pre-clearing survey report is submitted and approved by the department prior to clearing commencing. All data collected for pre-clearing surveys needs to be in the formats described in the contract specifications and annexures. Clearing timelines should consider the possibility that pre-clearing surveys may identify unexpected species or situations that may delay clearing until they can be resolved, such as the occurrence of a threatened species. Pre-clearing survey reports range from a summary of findings to fully detailed reports, depending on the scale of the project, threatened species present, and other complexities. At a minimum, these reports should detail:

- The species and habitats detected, likely present, or possibly present.
- An assessment of the scale of the fauna spotter / catcher works required during clearing (e.g. the number of staff required, roles and responsibilities, duration etc.).
- Any methods to be adopted for clearing to prevent or minimise fauna injury or mortality.
- The approved locations and methods for the release of any fauna to be relocated during clearing.
- Updated maps / plans identifying the location of habitat, habitat features, release areas, and recommended clearing procedures.
- Confirm or recommend locations for environmental exclusion zones and fauna exclusions fencing.

Pre-clearance surveys should be conducted approximately one month before clearing commences to reduce the risk of new species or habitat features appearing (e.g. new bird nests) before clearing. However, there should be sufficient time to undertake the pre-clearance survey and modify the clearance procedure, particularly where the clearing area is large (> 10 hectares) or is linear and spanning many kilometres (> 5 kilometres). Where a large construction site takes several months or more to clear vegetation, additional pre-clearance inspections should be completed immediately prior to clearing each section to ensure any additional species and habitat features are recorded and flagged. Additional pre-clearance surveys may also be required where habitat material such as vegetation stockpiles or soil stockpiles are left undisturbed for sufficient time for fauna to inhabit them.

Pre-clearance surveys differ to ‘site walk-overs’ which are conducted on the morning of clearing. Site walk-overs are rapid, and focussed just on areas to be cleared that day (Section 6.1).

Note that fauna relocation is not usually undertaken during the pre-clearance surveys, but immediately prior to clearing to prevent fauna coming back or new fauna moving in (Section 6.3). The stages of pre-clearing and clearing works are detailed in Table 7.

The construction contractor does not need to have an approved EMP(C) or possession of the project site to conduct preclearance surveys. It is actually preferable that pre-clearance surveys are completed prior to the initial drafting and submission of the EMP(C) as this avoids the need for revision and delays to clearing later in the project schedule. Transport and Main Roads Project Managers and Contract Administrators need to factor in the time for preclearance surveys when preparing schedules related to the award of contracts and the start of construction.

Figure 4.3 – Spotter / catcher in an elevated work platform inspecting hollows in a tree

Source: © State of Queensland

4.4 Plan for habitat re-use

Much habitat (e.g. standing and fallen hollow logs, bush rock, leaf litter, topsoil etc.) that is cleared for construction has immense value for fauna and should be carefully extracted, transported, and stored for later re-use. Wherever possible, the 'value' of the re-use should be prioritised for the benefit it can provide fauna—especially threatened fauna—sometimes referred to as 'highest and best use'. For example, mulch is valuable but hollow logs generally have higher ecological value than mulch. Selling of the timber, mulch, and rocks by the contractor should not occur.

Management measures for the re-use of habitat must be consistent with the requirements MRTS04 *General Earthworks* (Clause 7.2.5) and documented in the EMP(C). The EMP(C) should state how the habitat features shall be removed, transported, stored, and re-used, including:

- Specific details of when the habitat feature is to be collected, such as timing of when seed-set usually occurs or collection of tree hollows when hollow-dependent threatened species are unlikely to be using tree hollows for breeding.
- Any specific methods for clearing to avoid damaging the feature, such as the use of arborists to fell hollow-bearing trees and lower limbs to the ground.
- Methods to transport the features to a storage area or the re-use area.

- Specific storage instructions, such as a secure location that prevents stealing of logs for firewood and optimal duration of storage (e.g. seed in mulch may lose viability if stored for extended periods of time).
- Details of the re-use, including on- or off-site, specific location of re-use, and timing of when the re-use is to be installed.
- Details of any permits or other approvals required for the re-use, such as DAF permits for re-snagging waterways with tree root balls.
- Instructions or considerations to reduce the spread of weeds, diseases, or pathogens.

Habitat elements that are not able to be re-used on the project may be used as habitat in other areas or be re-purposed by the community for 'community-building' activities and the local community and local government should be engaged in determining such uses. For example, reclaimed timber may be used by local 'men's sheds' for nest boxes or furniture, other resources could be used by First Nations peoples, and branches with leaves from Koala fodder trees could be used by local wildlife parks. Marketable timber is a resource defined in Clause 7.2.3 of MRTS04 *General Earthworks*.

Reuse of timber and other habitat elements is discussed in Chapter 6.

4.5 Prepare the Environmental Management Plan (Construction)

The EMP(C) describes how the construction contractor will manage the environmental impacts of the project during construction. The Transport and Main Roads contract describes the specific requirements that need to be address in the EMP(C). The EMP(C) is prepared by the construction contractor and their specialists. The EMP(C) details the mitigation measures and operational procedures that are to be implemented during construction to reduce risks to ecological and environmental factors.

The environmental management details in the EMP(C) should be developed from the following project-specific documentation:

- The Review of Environmental Factors, which contains:
  - Relevant ecological assessment reports (terrestrial and aquatic).
  - Other environmental reports where applicable (e.g. noise, hydrology, erosion, and sediment control etc.).
- The Contractor's construction methodology.
- Additional detailed investigations and impact assessment completed by the Contractor (pre-clearance surveys described in Section 4.3).
- Technical Specifications and their annexures.
- Approval documents at both the Commonwealth and Queensland State level, with the specific project conditions stipulated in the contract.

Where possible, the people who prepare the EMP(C) should be the same people who are responsible for implementing it. The EMP(C) must be assessed by the Contract Administrator and 'deemed suitable' before any on-site construction works can commence.

If pre-clearance surveys are not completed prior to the initial drafting and submission of the EMP(C) then the EMP(C) must be revised after these have been completed to ensure that project specific measures are documented in the EMP(C).

Any changes to the EMP(C) also need to be 'deemed suitable' by the Contract Administrator so allowance needs to be made in the construction schedule for an additional review if the Contractor choses to delay pre-clearance surveys until after the initial approval of the EMP(C).

The EMP(C) must include a list of all environmental approvals, standards, and guidelines relevant to the project. The EMP(C) must also specify who can undertake certain tasks and the qualifications and experience they must hold.

Environmental approvals typically contain conditions that extend beyond the period of the construction contract, such as the operational phase. These can include long-term fauna or flora management programs, revegetation works, monitoring of Environmental Land and Infrastructure Assets and continued adaptive management, and any other approvals outlined in Annexure MRTS51.1 *Environmental Management*. If these are NOT included in the department's construction contract, they are not the responsibility of the construction contractor and are not included in the EMP(C).

The ecological mitigation measures within the EMP(C) and other relevant plans will determine:

1. What is required for site set-up prior to construction commencing.
2. Resource planning. E.g. how many ecologists or fauna spotter / catchers are needed at each construction stage? What specialised equipment is needed to install fauna exclusion fencing?
3. The sequence of construction staging.
4. Program duration and timeframes—when resources need to be on site.
5. Division of roles and responsibilities of the construction contractor and Transport and Main Roads for fauna management and conformance during construction.

The EMP(C) should specify the details of:

- Habitat re-use, including removal, transport, and storage of habitat elements (Section 4.4).
- Habitat reduction (Section 6.3.1).
- Fauna reduction (Section 6.3.2).
- Clearing of vegetation and habitat (Section 7).
- Fauna management during construction (Section 8).
- Site decommissioning and rehabilitation (Section 9).

5 Site establishment

5.1 Limit of clearing

Site works, including establishment of the construction, can only commence after the EMP(C) has been deemed suitable.

The first step in site works is the establishment of the construction site and the limit of clearing. The limit of clearing typically defines the site footprint and is the outer boundary of areas specified within the contract for clearing and ground disturbance (MRTS51 *Environmental Management*). All areas within the limit of clearing must have been subject to an ecological assessment.

The limit of clearing encompasses all on-site activities associated with the construction of a project, including:

- All vegetation and habitat removal.
- All associated infrastructure.
- Temporary and permanent access and maintenance tracks.
- Laydown and stockpiling areas.
- Site compounds.
- Re-alignment of Public Utilities Plant (PUP).
- Environmental exclusion zones (Section 5.2).
- All fencing.

The limit of clearing is the basis for the environmental impact assessment and the calculations of the loss of native vegetation and habitat and informs offset calculations. The limit of clearing as specified in the environmental approvals and contract is legally binding and must be re-assessed if there are any changes to the extent of works and they extend outside the limit of clearing. This re-assessment may include flora and fauna surveys, other site assessments, applying for additional statutory approvals, and an update of the EMP(C).

The limits of clearing, locations of significant habitat, exclusion zones, and areas requiring specific management must be included on project design drawings and all relevant maps in the EMP(C). This is critical as Transport and Main Roads construction contracts require the contractor to adhere to the limit of clearing and ensure that all staff and sub-contractors are aware of the management requirements.

The limit of clearing must be established by a licensed land surveyor and clearly marked by the contractor to ensure compliance.

5.2 Environmental exclusion zones

Environmental exclusion zones are established to physically separate construction personnel and machinery from environmentally sensitive areas for the duration of the contract or when there is risk of damage to the area. Access to exclusion zones is strictly limited to authorised persons and for specific purposes. Environmental exclusion zones related to FSTID are typically Tree Protection Zones (TPZs) (Section 5.2.1) and biodiversity exclusion zones (Section 5.2.2), and often they are combined.

The following activities are not permitted within environmental exclusion zones:

- Mechanical excavation.
- Stockpiling of building materials, debris, or soil.
- Vehicular traffic except on existing paved surfaces.
- Installation of service pits or hatches, man holes, or directional boring entry or exit pits.

- Severing of tree roots with a diameter greater than 30 millimetres.
- Geo-technical investigations.
- Alteration of soil levels.

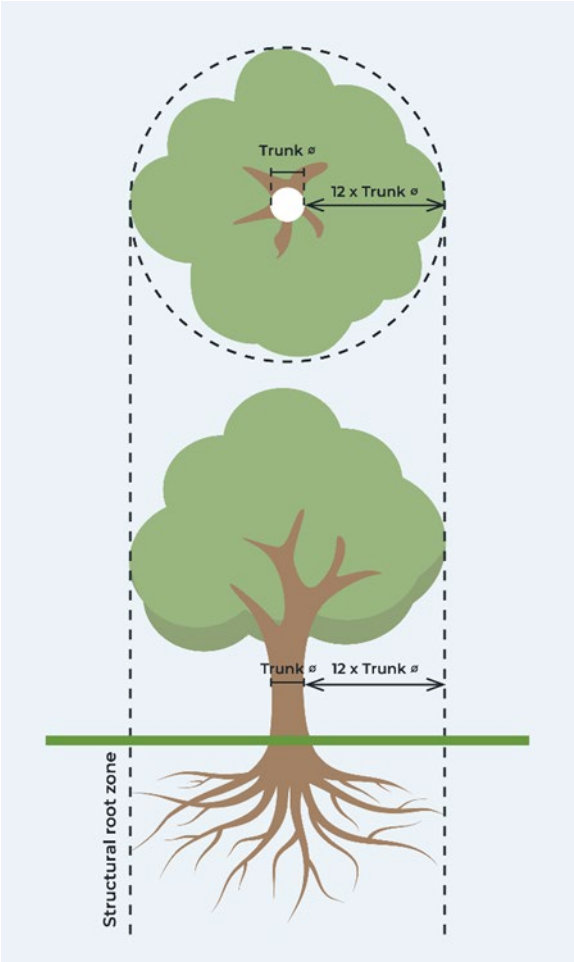
Plans for exclusion zones should be based on the contract and the pre-clearance survey report. The boundaries of exclusion zones must be established by licensed surveyors. Exclusion zones must be clearly identifiable and appropriately fenced or demarcated prior to construction commencing. Regular monitoring and maintenance of exclusion fencing is essential to ensure they remain intact and functional throughout construction.

5.2.1 Tree protection zones

A TPZ protects individual trees and groups of trees and their roots from physical damage and soil compaction from vehicles, machinery, and stockpiling. Wherever possible, TPZs for adjacent single trees should be merged into larger, contiguous TPZs for groups of trees. TPZs can be applied to any tree or group of trees, regardless if they are an indigenous, native, or introduced species.

The TPZ is 12 times the diameter of the trunk at breast height (measured at 1.4 metres above the ground) (Figure 5.2.1) and must be not less than 2 metres and not more than 15 metres, unless crown protection is also required. The dripline or canopy extent can be used as an approximate TPZ when the DBH is unable to be measured, such as during early planning when the tree is unable to be accessed. All TPZs for construction must be calculated and established in accordance with Australian Standard AS 4970 *Protection of trees on development sites*. The TPZ incorporates the Structural Root Zone which is required for tree stability. An arborist must calculate the TPZ and should also audit TPZ fencing once erected. All fencing, including for TPZs, must occur outside the structural root zone of trees.

Figure 5.2.1 – The tree protection zones (TPZ) is 12 x the DBH of the trunk.



5.2.2 Biodiversity exclusion zones

Biodiversity exclusion zones protect important ecological or biodiversity assets from damage or interference during construction. Biodiversity exclusion zones can be used to protect:

- Native vegetation.
- Fauna populations.
- Specific fauna habitat, such as wetlands, hollow-bearing trees, areas of rock, etc.
- Areas for fauna relocation.

Biodiversity exclusion zones can also be used for weed and hygiene control, such as protecting areas without weeds or pathogens and/or preventing the spread of weeds or pathogens from infected areas.

The set-up (location, timing, type of fence, or other method of demarcation) of different biodiversity exclusion zones is dependent on the specific aims of the zone. The aims of each zone should be specified in the EMP(C) and reflect the statutory approval conditions of the project that must be met.

5.3 Fencing

5.3.1 Role of fencing

Fencing is used to demarcate the limit of clearing, environmental exclusion zones, and other management zones at the construction site in accordance with the EMP(C). Fencing is used to:

- Prevent the entry of construction personnel and the public into environmental exclusion zones.
- Prevent the movement of fauna into construction zones and other high-risk areas, such as adjacent roads or railways with live traffic.
- Direct the movement of people and fauna around high-risk areas.

The role of the fencing should be clearly displayed on the fencing with signage (e.g. exclusion zone, environmental protection zone) that is clearly visible from a distance of at least 20 metres. Do not advertise the specific purpose (e.g. protection of rare orchid) if that raises the risk of illegal harvesting or collection.

5.3.2 Types of fencing

Fences are any structure or landform, such as stockpiles or embankments, that physically prevents or limits the movement of people, fauna, or stock. There are many types of fencing (Table 5.3.2) and the most effective type of fence for the intended purpose of the boundary should be selected. All fencing must be fit for purpose and properly installed and maintained. The type of fencing to be used in certain situations may be stipulated as a condition of approval or in the contract and this should be identified in the review of the contract (Section 4.1).

Temporary fencing should be installed according to the Australian Standard for Temporary Fencing (AS 4687:2007 *Temporary Fencing and Hoardings*), with necessary adjustments to cater for the additional function of fauna management. Fauna exclusion fencing is described in Section 5.3.3.

Most fencing used during construction is temporary and is installed and removed as required during the project. The early installation of permanent fencing should be considered where this will improve ecological outcomes and is cost-effective. For example, installing the permanent fauna exclusion fence on the project boundary prior to construction may remove the need for temporary fencing, reduce vegetation and habitat clearing, and be cost-effective. The design or placement of permanent fencing must not be compromised by the needs of construction fencing, and is described in Chapter 6.

Unless also doubling as fauna exclusion fencing, the fencing for environmental exclusion zones should allow movement of fauna, such as with a gap > 300 millimetres between the ground and the bottom of the fence, a height below 1.2 metres for kangaroos to jump over, etc.

Wherever possible, construction fencing should perform multiple functions, such as excluding fauna and providing security, or excluding fauna and protecting construction teams from live traffic. This can be cost-effective by reducing the number of fences to be installed and maintained, as well as potentially reduce the extent of vegetation to be cleared.

The type of fencing to be used should be specified in the EMP(C) and is influenced by:

- The value and sensitivity of the area to be protected.
- The amount of traffic or public activity in the area and the likelihood and consequences of the exclusion zone being breached.

- The need to prevent or direct fauna movement, especially on longer-term projects (e.g. > 1 year).
- Maintenance requirements of the fence.
- The opportunity to combine multiple fences.

The pre-clearance survey report may include recommendations for the types and locations of fencing to be used.

Table 5.3.2 – Types of fencing typically used during construction

FENCING TYPE AND TYPICAL USE	DESCRIPTION	PROS	CONS
Type 1 – Chain mesh  Source: © State Queensland	• For high-risk and highly sensitive contexts. • May be permanent or temporary.	• Effective at excluding people from construction site. • Can also be used as fauna exclusion fence for larger species. With addition of panel along the top, can be used for Koala. With panel at bottom, also useful for reptiles, amphibians etc. • Long lifespan.	• May require vegetation clearing. • High installation cost.
Type 2 – Stock fencing  Source: © State Queensland	• Multiple strands of plain or barbed wire, electric OR large mesh fencing, typically 1.2 metres in height. • May be permanent or temporary.	• May require vegetation clearing. • Effective at stock control, less effective at people control. • Moderately priced. • Can be replaced with permanent fence after construction. • Long lifespan.	• Barbed wire can snag animals.
Type 3 – Para-webbing  Source: © State Queensland	• 1.2 metres high. • Moderate risk contexts. • Temporary.	• Highly visible. • Quick, simple, and cheap to install. • Limited vegetation clearing required.	• Easily broken–may require maintenance. • Limited lifespan. • Need to be removed so plastic doesn't degrade and enter the environment. • May trap / entangle wildlife including koalas.

FENCING TYPE AND TYPICAL USE	DESCRIPTION	PROS	CONS
Type 4 – Flagging tape or bunting  Source: © State Queensland	• Single strand of flagging tape, bunting, etc. • Low-risk situations. • Temporary.	• Cheap and quick to install. • No vegetation clearing required.	• Not very secure—easily breached. • Limited lifespan. • Need to be removed so plastic doesn't degrade and enter the environment.
Type 5 – Physical structures  Source: © State Queensland	• Include noise and light walls, retaining walls, crash barriers (photo). • May be permanent or temporary. • Effective at containing construction equipment, personnel, etc	• Visible. • Can be multi-purpose. • Quick to install. • Long lifespan.	• May affect animal movement—consider use carefully. • May increase the risk of wildlife-vehicle collisions if fauna become trapped in the road corridor.
Type 6 – Low-profile / natural structures	• Mulch strips, drainage ditches. • Low-risk situations only. • Psychological barrier only.	• Low cost to install. • Natural - removal not required. • Quick to install.	• May be damaged by extreme weather. • Easily breached – psychological / visual barrier only. • Short lifespan.
Fauna exclusion fences Many types – see Chapter 6	• Specific to certain species. • Koala fence. • Kangaroos. • Reptiles and amphibians etc.	• Depending on design, effective at directing movement of target fauna.	• May be expensive. • Ideal if it can be permanently installed.

5.3.3 Fauna exclusion fencing

The most effective approach to avoid and minimise stress, injury, and mortality of fauna during construction is through the installation of fences to exclude fauna from the construction site. Fauna exclusion fencing may also be needed along access roads and tracks to the construction site to reduce the risk of WVC.

Fauna exclusion fencing is site and species-specific, and the design should be based on:

- Purpose or objective of the fencing.
- Stage of construction and whether fence is permanent or temporary.

- Target species as prescribed in EMP(C) and approval documents, or species particularly at risk of harm.
- Season and weather conditions—does the fencing need to withstand flooding or strong winds?
- Duration of works—for longevity and maintenance of the fence and target species that may change seasonally.
- Potential impacts to landscape connectivity. For example, how will fauna be impacted if the project and fencing is a barrier to movements during construction? Is access to specific habitats or features (e.g. new or existing crossing structures) required during construction?
- Water bodies or waterways—is frog-specific fencing needed to prevent frogs moving into site at night?

Fauna that breach fencing and enter construction zones should ideally be able to leave via escape mechanisms without requiring human intervention. Possible escape mechanisms include jump-outs, Koala escape poles and one-way gates and are described in Chapter 6. If breaches happen frequently and fauna are unable to exit via escape mechanisms, a fauna spotter / catcher should be called to assist.

Design guidelines for temporary fencing are given in Table 5.3.3. Refer to Chapter 6.12 for permanent fencing.

Figure 5.3.3(a) – Temporary fence for growling grass frog (Litoria raniformis)

Source: © Austin O'Malley

Figure 5.3.3(b) – Temporary fence for amphibians, made of silt fencing

Source: © Jake Urlus, Tactecol

Figure 5.3.3(c) – Plant-hire fencing with panel at top to inhibit climbing by koala

Source: © State of Queensland

Table 5.3.3 – General design guidelines for temporary fauna exclusion fencing

DESIGN ELEMENT	SPECIFICATIONS AND CONSIDERATIONS
Target species	• Proven for many target species when designed accordingly, including most terrestrial species such as macropods, koala, reptiles, and amphibians. • Not effective for gliders as they can glide above the fence from adjacent trees and many arboreal species can climb over. • Consider unintended impacts of fencing and other structures (e.g. crash barriers) to other species, such as entanglement and restriction of movement where restriction of movement is not required.
Design	• Fauna exclusion fencing is typically installed to prevent fauna from accessing the construction footprint, haul roads and other areas of danger. • The height, length, design, and construction materials are species- and site-specific. • General design principles: – Barbed-wire should never be used near wildlife crossing structures, particularly those for arboreal species, as gliders frequently get entangled and die[2]. Barbed wire should be avoided wherever possible and should not be used in areas of habitat for gliders, flying-foxes, and wetland birds. – Fauna fences are typically installed on both sides of the construction zone. Fencing on a single side may be appropriate if the source area for the target species is only on one side of the construction zone. – Consider placement and strength of fence in areas subject to flooding. – Where possible, fauna fencing should aim to maximise the area of wildlife habitat behind the fence, minimise the extent of vegetation clearing, enable maintenance and be integrated with other fencing to save costs and avoid unnecessary parallel fencing. – Design fencing for multiple species where possible. – Fauna fencing should ‘encircle’ the construction zone to prevent animals from entering at fence-ends. Where not feasible, typically include a ‘return;’ an angled section of fence (the last 10–20 metres of fencing) to encourage wildlife to turn back towards their habitat rather than move around the fence end and into the construction zone. • Fence length: – Depends on the size of the construction area, project duration and distribution and movement of the target species. An experienced ecologist should be consulted. – The fence should be long enough to prevent target species from accessing the construction zone. This typically corresponds with the occurrence of habitat and/or distribution of the target species along the project. The fence will need to extend further if the target species is willing to pass through ‘non-habitat’. • Gates and fencing breaks:

[2] (van der Ree 1999)

DESIGN ELEMENT	SPECIFICATIONS AND CONSIDERATIONS
	– Intentional breaks in fencing are required to allow vehicles and workers to access the construction zone, side roads, tracks, and driveways. Such breaks are vulnerable points in fencing systems and may allow fauna to access the danger zone and should be avoided where possible, and shut when not required, for example when no works are happening during the weekend. – Where necessary, breaks in fencing can be treated with gates, wildlife grids (i.e. modified cattle grids), or wrap-around fencing. – Gates are problematic if left open, poorly designed, or not maintained. All gaps between the gate and fencing and the gate and the ground should be avoided. – Cattle grids can be effective if the target species avoids walking on them. A small number of monitoring studies have been completed, and while the reports show variable results for koalas[3], the overall conclusion is that they are a major deterrent for the species and some other species. Grid width and spacing of bars may need modifying for other species and further trials and research are urgently needed. – Fencing can also be extended along the intersecting road (i.e. wrap-around fencing) in the form of a long return—see notes on fence length to inform this.
Landscape position and landscaping	• Fencing is required wherever the target species or its habitat occurs and where the target species can access construction areas or other danger zones. • The fence needs to be accessible—ideally from within the construction zone—for inspection and maintenance. • Vegetation should be managed to prevent fauna from climbing over the fence. Clearing requirements vary according to vegetation type, fence height, the target species, and their climbing ability.
Escape mechanisms	• Ensure appropriate escape mechanisms (e.g. one-way gates, escape ramps, and drop-down poles) are installed where wildlife fencing is continuous for lengths that exceed the typical home range of the species and/or where fencing will be in place for extended periods of time. See Chapter 6 for more details.
Maintenance	• Fauna exclusion fencing should be checked weekly in accordance with MRTS51 *Environmental Management*, after floods or storms, and when fauna are repeatedly encountered in the construction zone.

See Tables 13.2(a) to 13.2(f) for permanent fencing design guidelines.

5.3.4 Fence failure, inspections, maintenance, and reporting

The effectiveness of fencing can be compromised by:

- The incorrect type of fencing or materials.
- Fencing in the wrong place.
- Poor installation, including gaps underneath fences and gaps between or under gates (Figure 5.3.3(d) and Figure 5.3.3(e)).

[3] (DPIE 2020, Sandpiper 2023)

- Inadequate inspections and maintenance, which results in ineffective fences over time.
- Breaks in fencing required to access the construction site or private property driveways, which fauna can use to access the construction zone.
- Unintended consequences of other actions that add additional barriers to fauna movement or trap fauna, such as the use of concrete or water-filled crash barriers.

Failure of fencing can create reportable incidents on a construction site and can constitute breaches of conditions of approval. Fencing that is poorly constructed or maintained can create risk to the operation of the site and injury and mortality of fauna.

Fencing should be inspected regularly and maintained throughout construction to ensure it remains effective.

The Contractor's Environmental Representative should ensure the following is undertaken:

- Weekly inspections (as per MRTS51 *Environmental Management*) of all fencing and associated infrastructure (e.g. cattle grids, escape mechanisms).
- Additional inspections following storms, high winds, or other events that may damage fences.
- Reporting of all damage to fencing and breaches of exclusion zones through an environmental incident reporting system.
- Prompt repairs to fencing.
- Adaptive management of fencing and escape mechanisms if fauna mortality or injury occurs, informing future projects.
- Removal of fencing after construction has been completed in consultation with Transport and Main Roads.

Figure 5.3.3(d) – Gaps under and between gates are weak points in fence systems and can allow animal movement.

Source: © Rodney van der Ree, WSP.

Figure 5.3.3(e) – Gap between fence and bridge abutment that animals may pass through are to be avoided

Source: © Rodney van der Ree, WSP.

6 Preparing for clearing of vegetation and habitat

6.1 Confirm the ecological site conditions have not changed

A considerable amount of time may have passed between the ecological surveys conducted to inform the impact assessment and the pre-clearing ecological surveys conducted by the fauna spotter / catchers to inform the EMP(C). Additional follow-up surveys are required when the ecological conditions have changed to assess the adequacy of the proposed clearing protocols.

The assessment of changed conditions and the need for follow-up surveys is confirmed by the Contractor Environmental Representative in consultation with Transport and Main Roads and the fauna spotter / catcher. The follow-up surveys are conducted by the fauna spotter / catcher.

Typical triggers for follow-up surveys include:

- More than one month between pre-clearing surveys and clearing commencing.
- Seasonal changes that may trigger the arrival of migratory species.
- Extreme weather at the site or nearby that could result in the arrival of new species.
- Changed conditions (e.g. flooding, wildfire) that could affect the movement of fauna from the site during clearing.

6.2 Confirm the Environmental Management Plan (Construction) is fit for purpose

The results of the follow-up site surveys are used to confirm that the EMP(C) remains fit for purpose and that clearing can proceed as planned.

The following details in the EMP(C) should be assessed and confirmed:

- Habitat re-use (Section 4.4).
- Habitat reduction (Section 6.3.1).

- Fauna reduction (Section 6.3.2).
- Staging, timing, and direction of clearing (Section 7.5).
- Expected fauna responses, including open fences for flushing, wildlife carers on notice, etc.

The construction contractor, fauna spotter / catcher, and clearing contractor must meet and confirm all the details of the clearing procedures, including:

- Vegetation removal plans and sequencing or staging.
- Clearing methods and machinery to be used.
- Communication methods between fauna spotter / catcher and machinery operators.
- 'Stop works' protocols.
- Fauna species-specific requirements.

Minutes of this meeting should be taken to ensure there is no uncertainty or ambiguity about any of the clearing methods and procedures.

6.3 Undertake pre-clearing habitat and fauna reduction

Pre-clearing habitat and fauna reduction are specific, targeted actions to reduce the amount of habitat and the occurrence of fauna in areas to subsequently be cleared of vegetation and habitat. It differs from broadscale habitat and vegetation clearing because it is restricted to specific habitat features and species of fauna, and is conducted by or under the supervision of fauna spotter / catchers or ecologists.

6.3.1 Habitat reduction

Reducing the amount or quality of specific habitat features prior to clearing is recommended to reduce the occurrence and abundance of fauna within the construction footprint. Known as habitat reduction or habitat decommissioning, it is undertaken in the weeks or months prior to clearing and involves the removal and/or disturbance of unused habitat.

The details of habitat reduction must be specified in the EMP(C) and is typically undertaken for:

- Tree hollows.
- Nests.
- Burrows.
- Nest boxes and other artificial structures.

A suitably qualified specialist, such as a fauna spotter / catcher or ecologist, should be engaged to undertake habitat reduction and decommissioning. The general procedure is described below but should be refined with specialists for each project depending on the habitat features and priority species.

1. Use the results of the impact assessment and pre-clearing surveys to develop a decommissioning plan, which includes the location of each habitat feature, likely species using the feature, and the timing and method of inspection and decommissioning.
2. Inspect the feature (e.g. with camera or by visual inspection) to confirm presence or absence of fauna.

3. Fill unoccupied hollows, burrows, and crevices (e.g. in culverts in bridges) and remove unoccupied nest boxes and other artificial structures.
4. Habitat features that are occupied, or for which occupation cannot be confirmed, should be left in-situ and not decommissioned. Further monitoring of features occupied by high-priority species can occur if staged clearing (described in Section 7.5) presents a high risk of injury and mortality.
5. Exclusion zones should be established around habitat features in use—e.g. for breeding—by high-priority species. The exclusion zone should be large enough to prevent accidental damage to the feature and provide a buffer to construction activities. These features should only be removed after fledging or weaning of young has occurred, and after the approval of the fauna spotter / catcher or ecologist.

6.3.2 Fauna reduction

Reducing the abundance of fauna within areas to be cleared prior to clearing commencing minimises the number of animals that are potentially impacted by the vegetation and habitat clearing. Where beneficial and feasible, the removal and relocation of fauna prior to clearing is recommended because:

- It is not done under the often rushed and stressful conditions of clearing, reducing the likelihood of injury to fauna spotter / catchers working amongst machinery and fallen trees.
- The risk of injury and mortality of fauna is significantly lower than that experienced during clearing.
- There is sufficient time to capture and relocate fauna.

The methods to reduce the abundance of fauna are species- and context-specific and are described in Table 6.3.2. Methods to relocate fauna need to be consistent with any SMP's that apply to the work (Section 4.3). The timing of fauna reduction is also species-specific and can occur from days to weeks or months prior to clearing. The effectiveness of fauna reduction relies on:

- The ability to prevent relocated fauna from returning to the site and other fauna entering the site, such as through fencing or immediate habitat reduction.
- Having suitable areas where relocated fauna can be released into, such as adjacent to the construction site or further away. The relocation sites should contain suitable habitat, have capacity to receive and support the relocated species, and provide equal or better survival outcomes than the site being cleared, etc.
- The likelihood of survival of relocated fauna into new areas. Some species are extremely sensitive to being translocated and have very low survival rates and/or require specific release protocols such as inclusion of shelter, soft-release, etc.

Fauna spotter / catchers and/or specialists should be engaged to develop and implement the fauna reduction plans.

Table 6.3.2 – Summary of methods to achieve fauna reduction

METHOD	DESCRIPTION
Flushing	Walking through habitat and vegetation to disperse fauna prior to vegetation clearance. Flushing should be co-ordinated and performed to flush animals away from the area to be cleared and away from other sources of danger, such as roads with traffic. Multiple fauna spotter / catchers and temporary fauna exclusion fencing may be required. Flushing is also required on the day of habitat clearing to provide a final check for any wildlife that may have recently moved into the area.
Dispersal	Similar to flushing except it involves the moving of groups of birds or large macropods, and is done immediately prior to clearing. Dispersal of flying-fox camps and other breeding places (e.g. microbat roosts and fairy martin nests) are not permitted under the *Nature Conservation Act* 1992 (NC Act). Any interference with flying-fox camps, roosts or colonies requires a damage mitigation permit held by a suitably qualified person, must follow relevant codes of practise, and can only be done for certain species at certain times of the year (see Chapter 10).
Active searching	Targeted searches for fauna, including inspection of habitat elements (e.g. peeling and lifting of bark, logs, rocks, and other shelter) to detect and capture and relocate fauna to specified release areas. Active searching can be undertaken independently or concurrently with flushing.
Targeted trapping	Trapping (see Appendix for survey methods) and relocation of fauna to specified release areas. Often used for fish, but can also be used for small mammals, arboreal mammals, amphibians, and reptiles.

6.4 Replacement and supplementary habitats

Replacement habitat can be installed to replace or offset the loss of specific habitats that are removed or destroyed during construction.

Supplementary habitat is additional habitat that is provided to increase the population size or make the population more resilient and reduce the likelihood of negative impacts during construction.

Replacement and supplementary habitats can be the same physical things, but the reason for their installation and the calculation of how many habitat elements to install differs. For example, the number and placement of artificial hollows as replacement habitat is based on the number of hollows or hollow-bearing trees removed. In contrast, the number and placement of artificial hollows as supplementary habitat will be based on the number of individuals likely to be impacted and consideration of where the species is most likely to benefit from the intervention.

Replacement and supplementary habitats are described in Chapter 6 and typically include:

- Artificial hollows for arboreal marsupials, microbats, and birds, such as nest boxes, carved hollows, 3D-printed hollows, and salvaged log hollows (Figure 6.4(a)).
- Insect hotels for invertebrates (Figure 6.4(b)).
- Hollow logs, rocks, and piles of branches and leaf litter placed on the ground for reptiles, small mammals, and invertebrates Figure 6.4(c).
- Artificial substrate on the ground (e.g. roof tiles – Figure A3(b) in Appendix) or attached to tree trunks, typically for reptiles.
- Shelters and hides for small mammals, birds, reptiles, invertebrates, and amphibians.

The EMP(C) should specify where and when they need to be installed, how many are required, how long they need to remain operational for, and if or when they can be removed. Replacement and supplementary habitats are increasingly being installed prior to clearing, with the exact timing dependent on the target species. The timing of installation is based on when the target species will require the habitat and if there are any acclimatisation periods that should be accounted for. A percentage of replacement hollows (e.g. 50–70% of the total number required) are often required to be installed prior to clearing with the remainder installed shortly after clearing, with an allowance for more to be installed after the total number being cleared has been tallied. In most cases, they will remain in place until they naturally degrade or collapse and when the revegetation has matured and provides sufficient structure and cover for fauna.

There is ongoing research testing the efficacy of different types of supplementary habitat, including artificial hollows for birds (Chapter 9), microbats (Chapter 11), and arboreal species (Chapter 14) as well as various other artificial structures. Where appropriate, transport projects should develop and/or test new and emerging techniques in an adaptive management framework and contribute to the body of evidence on this topic. Chapter 3 provides relevant information on conducting applied research.

Figure 6.4(a) – Carved hollow in river red gum, used by brown tree-creeper

Source: © Rodney van der Ree, WSP

Figure 6.4(b) – Bee hotel. Streetscape Biodiversity Project, Clowes Street South Yarra, Melbourne

Source: © Jess Baumann, WSP

Figure 6.4(c) – Habitat logs made from salvaged logs and placed in dry creek bed in revegetation area

Source: © Nic McCaffrey, WSP

7 Clearing of vegetation and habitat

Vegetation and habitat clearing can only occur within the limit of clearing and in accordance with other approvals, which are defined in the EMP(C).

For the purposes of this manual, clearing of vegetation and habitat is:

- Broadscale (as opposed to pre-clearing habitat reduction).
- Conducted by clearing contractors, often with large machinery such as bulldozers and excavators.
- Results in the removal of all, or almost all, vegetation and habitat features within the clearing footprint.

Clearing commences after site establishment (Section 5) and according to the steps and procedures in Table 7.

Table 7 – Summary of vegetation and habitat removal stages

ACTION	DESCRIPTION	TIMING	RESPONSIBILITY
Stage 1: Pre-clearing: fauna management—reducing the risk of mortality and injury to fauna			
Pre-clearance surveys and procedures (Section 4.3)	An environmental assessment carried out prior to the removal of any vegetation or modification within the construction footprint and Limit of Clearing.	Prior to vegetation removal.	Ecologist / fauna spotter / catcher.
Install habitat refuge elements (Section 6.4)	Artificial structures that provide shelter for fauna (e.g. nest boxes). Usually installed outside of the Limit of Clearing.	Deployed prior to vegetation removal.	Ecologist / fauna spotter / catcher.
Habitat reduction	Targeted removal of specific habitat features such as shelter and breeding places where possible (e.g. peeling bark or vacant bird nests), and decommissioning of non-removable features (such as blocking vacant hollow and burrow entrances).	Prior to vegetation removal.	Ecologist / fauna spotter / catcher.
Fauna reduction	Targeted removal and relocation by capture, flushing, or dispersal to adjacent habitats prior to clearing.	Prior to vegetation removal.	Ecologist/ fauna spotter / catcher.

ACTION	DESCRIPTION	TIMING	RESPONSIBILITY
Stage 2: Clearing: staged removal and clearing supervision			
Flushing and active searching	The act of searching and walking through habitat and vegetation to disperse fauna likely to be present into adjacent habitat. Fencing to exclude flushed animals from danger, for example the construction site or road, may be required.	Each morning prior to clearing commencing for the day.	Fauna spotter / catcher.
Staged clearing	Step by step removal of habitat features or strata within one construction stage / Limit of Clearing area	During staged vegetation removal and throughout construction phase.	Fauna spotter / catcher.
Salvage and relocation	Salvage is the capture and removal of wildlife from the construction site during habitat or vegetation clearing. See Section 7.4.	During staged vegetation removal and throughout construction phase.	Fauna spotter / catcher.
Vegetation and habitat re-establishment	Section 9.	Following removal.	Construction contractor or as otherwise agreed with Transport and Main Roads.

7.1 Ensure all pre-clearing works are completed

Ensure the following is completed before the clearing of vegetation and habitat commences:

- Pre-clearing survey completed (Section 6.1).
- EMP(C) updated (if required) (Section 6.2).
- All clearing procedures and protocols understood by construction contractor, clearing contractor, fauna spotter / catcher.
- Any fauna reduction, habitat reduction, and/or installation of replacement or supplementary habitat has been completed (Section 6.3).

7.2 Day of clearing site walk-over

On each day of clearing, the fauna spotter / catcher must complete a walk-over of the area to be cleared during that day to confirm no fauna have moved into the clearing front overnight. This is particularly important for endangered and highly mobile species such as Koalas and flying-foxes.

Note that the site walk-over is not the same intensity as the pre-clearance survey and is intended to be a relatively rapid assessment of the site, whilst being cognisant of cryptic species that could be present.

7.3 Daily pre-start meeting

A pre-start meeting with the fauna spotter / catcher team, Contractor's Environmental Representative, Site Manager, and machinery operators should be held prior to commencing clearing. Pre-start

meetings should occur at the start of clearing, as well as each morning of clearing in case there are any new conditions or changes to the procedures. Fauna and habitat management points to be discussed should include:

- Site clearing limits and exclusion zones.
- Relevant pre-clearance report results and prominent habitat features requiring management.
- Staged clearing plan, clearing direction, and any clearance or grubbing plans, including the extraction, transportation, and storage of habitat features to be re-used.
- Confirmation of communication protocols.
- Stop Work procedures.
- Protocols for when fauna are encountered.
- Any other specific concerns or management procedures deemed relevant by the fauna spotter / catchers.

7.4 Fauna salvage and relocation during clearing

Salvage is the capture and removal of wildlife from the construction site during vegetation and habitat clearing and relocation to a safe area of suitable habitat. The fauna spotter / catcher should undertake salvage and is required to be present during all habitat and vegetation removal.

Fauna salvage is the last resort option, as habitat reduction (Section 6.3.1) and fauna reduction (Section 6.3.2) will have ideally reduced populations already. The objective is to avoid fauna handling and enable fauna to move of their own accord away from the construction area. Key considerations to avoid fauna handling and stress to fauna include:

- Where there is connectivity to adjacent retained habitat, allow fauna to leave an area with the minimum intervention. This method should particularly be applied to species at risk of capture myopathy (capture-induced stress which can be fatal) such as macropods and some birds including owlet nightjars.
- Where there is no adjacent habitat for fauna to safely escape into, all attempts should be made to capture and relocate all fauna.
- 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 handling should be undertaken by licensed fauna ecologist or fauna spotter / catcher skilled in handling the type of fauna likely to be encountered.
- The relocation sites should be in the nearest suitable habitat as identified by the fauna spotter / catcher or in the pre-clearance report.
- Avoid clearing vegetation and habitat during extreme weather as this places additional stress on wildlife.

Species ecological traits and habitat preferences should be considered for release (Table 7.4). Ensure relocation and release occurs at the appropriate time of day for the animal and in appropriate habitat.

Any injury or death of fauna during clearing is a fauna incident (Section 8.3).

Table 7.4 – Summary of fauna relocation and release criteria

CATEGORY OF FAUNA	RELEASE TIME AND LOCATION / HABITAT	RESPONSIBLE RELEASE PARTY
Diurnal adult	• Daytime, while avoiding hottest part of the day. • Suitable adjacent habitat.	Fauna spotter / catcher.
Nocturnal adult	• Dusk. • Suitable adjacent habitat.	Fauna spotter / catcher.
Semi-aquatic fauna, amphibians	• Day or night. • Release into suitable aquatic habitat.	Fauna spotter / catcher.
Hollow dependent adult	• Dusk or night. • Place on trunk of tree that has a hollow or pre-erected nest box that has been confirmed as being vacant. • Place animal inside nest box during the day if away from construction (to avoid noise and vibration). The entrance/exit is blocked with a towel or rag which is removed at dusk. Ensure nest box does not overheat while entrance is blocked.	Fauna spotter / catcher.
Diurnal juvenile / back young / pouch young	• Daytime. • Released with the parent. • If orphaned, give to wildlife carer/rescue agency.	Fauna spotter / catcher. Wildlife carer.
Nocturnal juvenile / back young / pouch young	• Dusk. • Released with the parent. • If orphaned, given to wildlife carer/ rescue agency.	Fauna spotter / catcher. Wildlife carer.
Injured, distressed or in need of care	• Captured and given to a registered wildlife carer, a rescue agency such as the RSPCA, or a veterinary clinic.	Fauna spotter / catcher. Wildlife carer. Veterinarian.
Deceased	• Removed from road alignment/construction site and preferably buried on site in an area that will be filled (not cut). • All exotic fish species must be disposed above the high-water mark.	Fauna spotter / catcher or Contractor's Environmental Representative.

Case Study 7.1 – Clearing habitat for the Wallum Froglet

- Wallum froglet (*Crinia tinnula*)—a vulnerable species under the *Queensland NC Act* 1992—occurs within the construction footprint.
- Peak breeding season for the wallum froglet is from June to August.
- Wallum froglet habitat has been mapped within the paperbark swampland.

The Impact Management Plan for the High-risk SMP states that one of the minimisation and mitigation measures is avoiding clearing during the June to August peak breeding season.

Construction may be staged around the clearing of this sensitive habitat. Initial vegetation clearing should focus on clearing and grubbing areas with other vegetation types. The direction of the associated earthworks and other construction activities should consider that the paperbark swampland will not be available for clearing and grubbing until at least September and the staging of works must plan for this.

It must also be ensured that staged clearing does not create fragmented and isolated patches of habitat, leaving fauna with no adjacent retained habitat to disperse into. Directional clearing (Section 7.5) may be stipulated in relevant fauna and flora management plans and programs or the EMP(C).

7.5 Staging, timing, and direction of clearing

Vegetation and habitat clearing should be co-ordinated, systematic, and organised to minimise impacts to fauna, and be undertaken as specified in the EMP(C). Considerations include:

- Avoid clearing at times of year or day when high-risk or threatened fauna species are present.
- Avoid undertaking clearing at sensitive times of year when species are breeding, when young and dependant animals are present, or when species may be in torpor and at high risk of mortality if disturbed (e.g. microbats in cold climates). Appendix D in the TfNSW *Microbat Management Guidelines*[4] provide a useful starting point to plan the timing of works in relation to the breeding and presence of threatened microbats.
- Where practicable, undertake clearing as close as possible to when construction is scheduled to occur. This will protect soil from erosion and reduce the intensity of impacts to fauna by allowing fauna to gradually relocate into adjacent habitat and replacement habitats.
- Undertake clearing on large projects in a strategic and sequential manner. For long linear projects this usually means starting at one end and moving forward. This approach must be followed when clearing koala habitat and is described in the *Koala Conservation* Policy 2023.

[4] Microbat management guidelines (nsw.gov.au)

- For large sites (greater than three hectares), undertake clearing in stages, ensuring not more than the following is cleared in any one stage (i.e. per day):
  - 50% of the site's area for a clearing site with an area of six hectares or less.
  - 3% of the site's area, or three hectares, whichever is the greatest, for a clearing site greater than six hectares.
- Ensure no clearing occurs between 6pm–6am on the following day.
- Clearing at a pace that allows sufficient time for fauna to leave the site without human intervention and/or for the fauna spotter / catcher to safely capture and relocate fauna.
- Clearing commences at the furthest point from retained habitat and progresses towards the retained habitat, thus maintaining linkages with adjacent areas and allowing fauna to depart the site.
- No habitat tree in which wildlife is present and/or with a crown overlapping a tree in which a wildlife is present, is cleared.
- Do not undertake clearing during extreme weather, which increases the risk of injury or death to fauna.

7.6 Ground disturbance

Some reptiles undergo brumation (a mild form of hibernation) in colder months and may burrow underground or take shelter under rocks and logs, and in soil cracks. Other species may also live in similar places, such as amphibians, small mammals, and invertebrates. Projects likely to encounter such species must develop a clearing and grubbing plan prior to ground disturbance. This plan should include pre-clearance active searches where logs and bush rocks are checked and removed prior to vegetation clearance (Section 6.3) as well as salvage during clearing.

Prior to soil disturbance, hydraulic excavators or rubber wheeled graders with wide-toothed buckets should scrape the topsoil in a systematic manner. Fauna spotter / catchers follow alongside the machinery, notifying the driver if any reptiles or other species are unearthed. Fauna spotter / catchers salvage the animals according to either the fauna injury plan or relocation plan.

7.7 Dewatering

Dewatering is the removal of water from an area to create a dry work space and allow construction to occur. Dewatering may be required within waterways, drainage features, dams, and seasonally inundated or permanent wetlands. Temporary waterway barrier works may be required to dewater an area. Any temporary waterway barrier works must be authorised under the *Planning Act* 2016 via assessable or accepted development.

Dewatering is complicated and this section is a simplified description of the tasks involved. All dewatering activities should be completed under the advice and supervision of an aquatic fauna spotter / catcher team qualified and experienced in aquatic fauna salvage, management, and relocation. The aquatic fauna spotter / catcher team should have extensive proven experience in successful fish salvage and relocation during de-watering projects.

A minimum of two aquatic fauna spotter / catchers is required, with the need for additional workers determined during the pre-clearance survey and being dependent on the volume (size and depth) of the waterbody. Additional aquatic fauna spotter / catchers will be required to relocate fish where the

dedicated release site is more than a ten minute drive away to ensure the waterway being dewatered is not left unattended for an extended period.

Prior to dewatering commencing, a suitable release site will be determined by the aquatic fauna spotter / catchers.

All aquatic fauna salvage will follow the Department of Agriculture and Fisheries (DAF) *Fish Salvage Guidelines*[5]. All native, uninjured, aquatic and semi-aquatic fauna will be relocated to the pre-determined suitable location, including crustaceans, fish, amphibians and tadpoles, and reptiles such as turtles. All invasive species must be humanely euthanised in accordance with the *Guidelines for fish salvage* and the *Code of Practice – Care of sick, Injured or Orphaned Protected Animals in Queensland*. Euthanised animals should be removed from site, and where that is not possible, they must be buried above the high-water line to prevent pathogens or eggs re-entering the waterbody.

Other considerations prior to dewatering include:

- Does the project have an Aquatic Fauna Salvage and Relocation Management Plan?
- What species are present and have suitable capture techniques been identified?
- Are in-stream barriers being created during construction?
- Are pumps being used to de-water? Is the size of the pump and hose adequate to empty the waterbody? Is the intake located in the deepest part of the waterbody and does a sump need to be cut in? Will the intake of a pump require a protective cage or mesh to prevent fauna being ingested?
- The following are specific guidelines that are best-practice for screening pumping infrastructure.
  - https://researchoutput.csu.edu.au/en/publications/the-practical-guide-to-modern-fish-protection-screening-in-austra
  - https://www.dpi.nsw.gov.au/fishing/habitat/rehabilitating/fish-friendly-programs/fish-friendly-farms
- Where will discharge be disposed, and does it meet the requirements outlined in the EMP(C) and conditions of approval?
- Season—are frogs, fish, turtles, or other species breeding or could turtle nests be present around wetlands? Has removal during these times been approved?
- Weather—could extreme heat cause high rate of mortality of aquatic fauna? Could rain events make conditions unsafe for workers to re-fill the waterbody?
- Have suitable sites for the relocation of fauna or disposal of pest fish been identified?

Steps for salvage and relocation of aquatic fauna:

- Remove riparian vegetation such as groundcovers, sedges, and rushes first. Follow pre-clearance and staged removal processes.

[5] DAF 2024

- Remove as many fish and aquatic animals (e.g. turtles, amphibians) as possible prior to dewatering via nets and traps. This may be done in the days immediately prior to dewatering.
- Incrementally lower water levels by approximately 25% per day and continue to remove aquatic fauna at each interval.
- Once all water is removed, exit the waterbody to allow any hidden fauna such as turtles and frogs to emerge. Survey from the bank to detect remaining fauna.
- Follow aquatic fauna handling procedures and relocate fauna appropriately, including disposal of pest fauna.

7.8 Removal of built infrastructure

Many species of fauna utilise built infrastructure for roosting, nesting, and sheltering, including:

- Microbats in culverts and bridges (Chapter 11).
- Swallows and fairy martins building mud-nests on bridges and culverts.
- Pardalotes and bee-eaters nesting in road batters, old soil stockpiles, and banks under bridges.

Built infrastructure must be inspected during the pre-clearing surveys and follow-up inspections (Sections 4.3 and 6.1). Where possible, these types of sites should be inspected (see Appendix) and closed off prior to construction if unoccupied (Section 6.3).

Follow these steps if they are still in use when clearing or construction is about to commence:

Microbats

Where colonial breeding bats are present, an Impact Management Plan under a high-risk SMP is required and mitigation measures outlined below should be implemented by the fauna spotter / catcher.

1. Establish if alternative roosts are available nearby (generally < 10-15 kilometres). This requires confirmation that alternative roost habitat is available for selection by displaced individuals. Bats roosting in bridges and culverts may prefer artificial roosts over tree roosts[6], so confirmation that surrounding culverts and bridges provide roost habitat is required. This must include the identification of other roosting individuals or evidence of bat occupancy and may require an assessment by a species expert.
2. If during breeding season and non-flying young are observed, delaying disturbance is the preferred management action. Young, furless pups that cannot fly and become separated from their mother have a low survival rate in care facilities due to the lack of research on dietary requirements of many species of bats. The older a pup is the higher its likelihood of survival. Bats display rapid growth and a week or two delay could contribute to higher survival rates of displaced young, and lower impacts to reproductive success of a local population. If disturbance cannot be delayed, artificial habitat (clusters of multi-chambered bat boxes) must be provided for large-footed myotis a minimum of two weeks prior to disturbance to provide an opportunity for displaced females to relocate young.

[6] (Gorecki et al. 2019)

3. If outside of breeding season and weather conditions are appropriate (warm, no rain), commence activity and clearing during the day approximately 50 metres from the structure to encourage bats to emerge at dusk. If bats are disturbed and exit the roost during the day, cease activity and recommence after bats have emerged that evening.
4. If bats have not vacated a structure and conditions are appropriate (warm, no rain), follow the mitigation measures outlined in the Impact Management Plan. This may include steps such as dismantling the structure at night after bats have left to forage, sealing microhabitat features such as lift holes and crevices after bats have left the roost for the night and roost occupancy can be visually confirmed, or installing lights after the dusk flyout to discourage them from returning.
5. The use of artificial habitat such as bat boxes during the removal of built infrastructure has been documented predominantly by the large-footed myotis and—to a lesser extent—other crevice and hollow roosting bats. There is no evidence to indicate that cave dependent species such as *Miniopterus spp.* use artificial habitat features like bat boxes and artificial hollows.

Small birds including swallows, fairy martins, pardalotes, and rainbow bee-eaters

Where colonial breeding birds are present, an Impact Management Plan under a high-risk SMP is required and mitigation measures outlined should be implemented by the fauna spotter / catcher.

7.9 Clearing reports

There are two reports that must be completed by the fauna spotter / catcher:

1. Daily summary reports of clearing that document:
    a. Number of days on site.
    b. Details of the area and types and numbers of habitats cleared.
    c. Details of animals found, treatments, relocation efforts, and other incidents.
    d. Recommendations for clearing procedures on subsequent days to improve ecological outcomes.
2. An end of clearing report is written by the Contractor's Environmental Representative and is a summary of the daily clearing reports and details:
    a. Total areas and numbers of habitat elements cleared (e.g. number of hollow-bearing trees felled).
    b. Locations of habitats removed.
    c. Details of re-used habitats, including quantity, type, re-use, and location of re-use.
    d. Records of relocated animals and details of any follow-up monitoring that may be required.
    e. A completed breeding place register form.
    f. Recommendations for future clearing projects.

8 Fauna management during construction

Fauna management during construction is guided by the EMP(C) and aims to reduce the potential for stress, injury, and mortality of fauna. A key focus of fauna management during construction is monitoring and auditing of established controls (e.g. fencing) and procedures and responding in a timely and appropriate manner when fauna are impacted.

8.1 Preventing interactions with fauna

The primary method to prevent interactions with fauna within the construction footprint is to exclude them with fauna exclusion fencing or other deterrents (Section 5.3.3).

Some wildlife may roost, den, or breed within the construction footprint, such as birds nesting in stockpiles, masked lapwing (*Vanellus miles*) and bush stone-curlews (*Burhinus grallarius*) nesting on access tracks or laydown areas, and common brushtail possums (*Trichosurus vulpecula*) denning in buildings. If the breeding site can be avoided, erect fencing and signage to notify personnel of the location. When the breeding site has been abandoned, fencing and signage can be removed and construction continue. If it can't be avoided, the nest and species should be relocated by the fauna spotter / catcher.

Additional measures to prevent wildlife injury and mortality during construction include:

- Do not leave trenches and other excavations open any longer than necessary to complete the works. When they must remain open overnight, cover them with plates or surround with temporary fauna exclusion fencing (Section 5.3.3). Where fencing or covering is not feasible, include escape mechanisms (e.g. ramped soil, sloping logs) in the open excavations and check each morning to rescue any trapped fauna.
- Ensure water bodies (e.g. sediment basins) have escape mechanisms and are checked each morning for trapped fauna.
- Avoid providing artificial food and water sources or shelter within the construction footprint that may attract fauna.
- If there are repeated incidents or high rates of fauna injury or mortality, investigate and implement additional controls, such as:
  - Installing more effective fencing, gates, or other exclusion techniques.
  - Implementing lower speed limits within the construction zone.
  - Providing alternative habitat outside the construction zone.
  - Engaging ecologists or fauna spotter / catchers to undertake additional surveys or investigations.
  - Install escape mechanisms on temporary fencing to allow fauna to exit the construction area.

During upgrade projects, the Contractor's Environmental Representative should undertake daily inspections of adjacent roads and railways for injured or dead fauna and ensure incidental observations are recorded by all personnel. These inspections can be 'drive-through' if the project is large or walked for smaller projects. Sections with high rates of WVC can be prioritised for daily checks. Collect dead animals promptly to reduce the risk of secondary collisions and mortality. Record

all injury and mortality events to enable accurate assessment of impacts, the development of appropriate solutions, and for conformance reporting.

8.2 Education of site personnel

Education of construction personnel through site inductions and daily toolbox sessions is essential to ensure conformance. All information given is to be clear, simple, informative, and provided via numerous techniques, such as posters and notices in site sheds and lunchrooms, regular toolbox sessions, guest speakers (e.g. wildlife encounters van) etc. Topics to address include:

- No intentional or unintentional feeding of fauna.
- No handling of fauna by unauthorised personnel.
- No 'shooing' of fauna (fauna should leave the construction footprint of their own volition or be relocated by the fauna spotter / catcher).
- How to identify priority and threatened species.
- What to do when priority and threatened species are detected. Personnel should be encouraged to report sightings and not be penalised.
- The risks of driving to and from the work site at dawn and dusk when wildlife are active.

Figure 8.2(a) – Koala and joey on bridge pylon during rehabilitation work.

Source: © State of Queensland

Figure 8.2(b) – Koala and joey leaving site of bridge rehabilitation works.

Source: © State of Queensland

8.3 Responding to fauna incidents

The response when fauna enter construction sites will vary depending on:

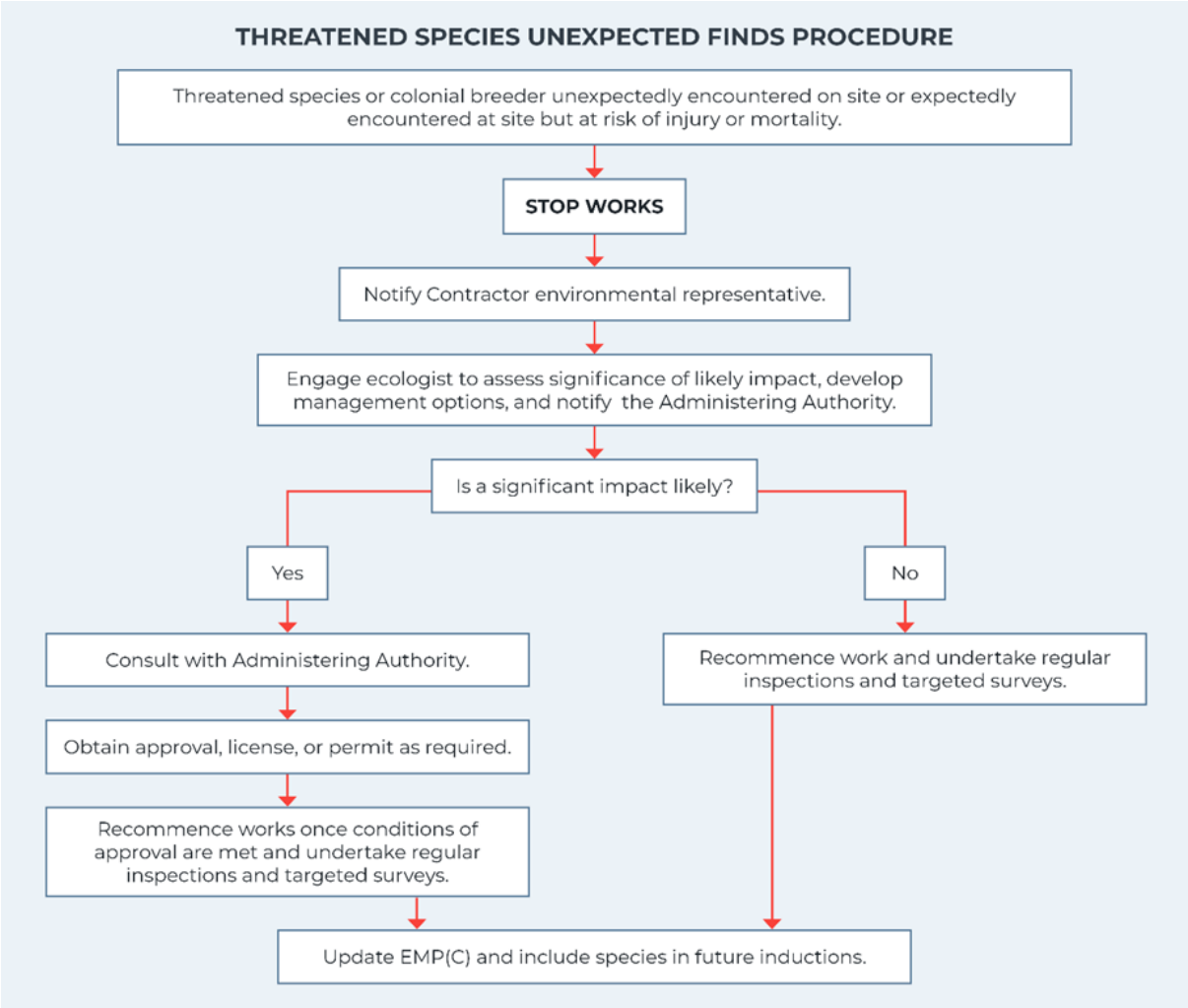
- The conservation status of the species (i.e. threatened species vs common species).
- The risk of injury to workers (e.g. a venomous snake vs a lizard or a large kangaroo vs a bird).
- Location within the construction and construction activity (as a measure of risk to the animal).
- Behaviour of the animal (e.g. commencing breeding, establishing a roost, transient, or temporary access).
- Number of individual animals within the site.

Incidents involving fauna will be classified as a threatened species unexpected find (Section 8.3.1) or a low-risk unexpected find (Section 8.3.2). The duration and spatial extent of a threatened species unexpected find and a low-risk unexpected find will vary depending on the species encountered (i.e. threatened or common), its location relative to risk of injury, the number of individuals, and the complexity of the appropriate response. For example, a stop works for a single individual of a common species may be restricted to the immediate area it was found in, and for as long as it takes for a fauna spotter / catcher to retrieve the animal and gather relevant information for an incident report. Stop Works may last for longer if there are many individuals, if they are threatened species or occur over a large area of the site.

8.3.1 Threatened species unexpected find procedure

An unexpected finds procedure must be implemented whenever a threatened species or colonial breeder is unexpectedly encountered on site OR when a threatened species or colonial breeder is expectedly encountered on site and at risk of injury or mortality due to construction activities. The procedure to follow is shown in Figure 8.3.1.

Figure 8.3.1 – Unexpected threatened species find procedure



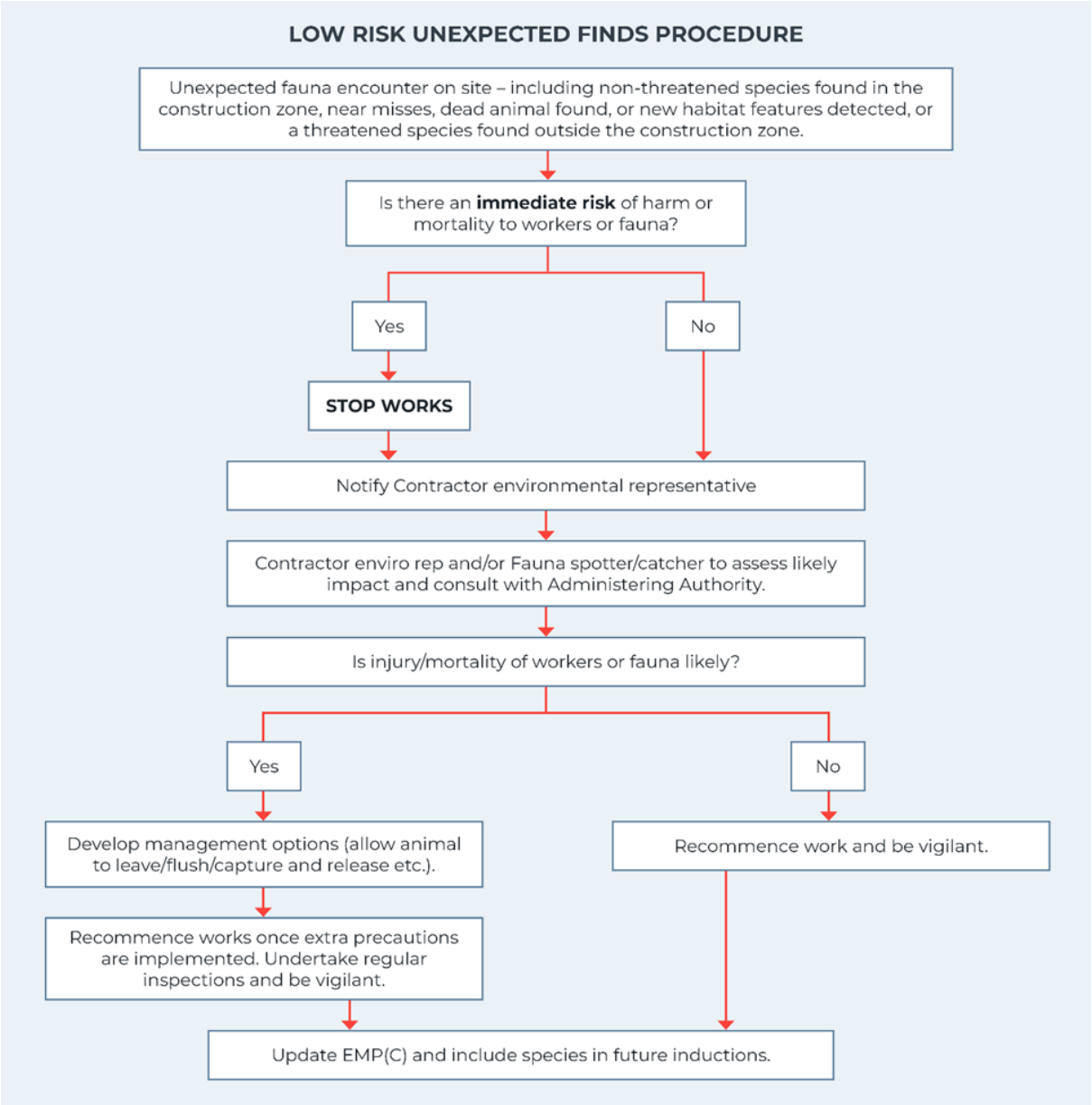
8.3.2 Low-risk unexpected find procedure

A ‘low-risk’ unexpected find procedure is implemented when:

- Fauna (other than threatened species) are found in the construction footprint (day or night) where active works are occurring and/or where potential harm to the animal or personnel is possible.
- Threatened species are found outside the construction zone but with potential to enter the construction zone.
- Fauna are stuck in fencing or other structures.
- New habitat features are observed within the construction footprint—such as a nest or burrow—pre- or post-habitat clearing.
- A near miss with any species occurs.

The low-risk unexpected finds procedure is outlined in Figure 8.3.2.

Figure 8.3.2 – Low-risk unexpected finds procedure



8.3.3 Unexpected finds reporting

All unexpected finds should be considered an incident and be reported as soon as possible, and include the following information:

- The circumstance of the incident and the steps taken to prevent further incidents.
- Date and time.
- Location.
- Information on injury if possible.
- Injury or mortality source if possible.
- If possible, the species, sex, age, class, and general health of each individual, and the number of individuals.

Reporting timeframes for unexpected finds will vary according to the sensitivity of the unexpected find and the condition of approval (e.g. under commonwealth or state legislation), and will be specified in the contract and EMP(C).

9 Revegetation, rehabilitation, and site decommissioning

The construction site and other areas impacted during construction should be rehabilitated and revegetated in order to improve air quality, suppress weed growth, provide visual screening and improve aesthetics, reduce erosion and control sediment, ameliorate the heat island effect, and provide habitat for fauna.

Site rehabilitation should ensure that all areas disturbed by construction activities are rehabilitated, leaving a stable environment that is conducive to the establishment of self-sustaining landscapes. Rehabilitation works includes:

- Removal of all temporary structures, machinery, construction material, rubbish, fencing, signage, and spoil.
- Earthworks and landscaping to re-establish contours and landforms that prevent erosion, prepare soil for planting, and improve access by fauna to crossing structures.
- Placement of logs, hollows, mulch, rocks, and other habitat features, including finalising the installation of replacement or supplementary habitats.
- Planting of fast-growing grasses to rapidly provide cover and prevent erosion.
- Planting and establishment of native vegetation in areas that were cleared, on slopes and batters, on wildlife crossing structures (e.g. vegetated land bridges), and on approaches to crossing structures.

The rehabilitation and revegetation of the construction site is critical to the immediate and long-term success of FSTID and should be completed to the highest possible standard. For example, inadequate ground preparation using the wrong species of plants, poor maintenance of plantings, and inadequate weed control can delay the growth of native vegetation and limit the use of the area by fauna. The rate of use of crossing structures by fauna is strongly influenced by the quality of the rehabilitation and revegetation.

Details of revegetation and planting media are outlined in Technical Specification MRTS16 *Landscape and Revegetation Works* and the Annexure MRTS16.1. The aim of rehabilitation is to provide an initial protective canopy cover using short lived annual grasses backed up by grass species that are likely to be durable and persistent.

Rehabilitation should occur progressively during construction and be undertaken as soon as possible after works in specific areas have been completed. Progressive rehabilitation reduces erosion and sedimentation risks and reduces consequential reworks and additional costs.

Captured stormwater that is used for landscaping shall be compliant with Clause 7.9 of MRTS16 *Landscape and Revegetation Works* quality requirements.

Site rehabilitation and revegetation should also consider the specific ecological needs of the target species for mitigation and a balance between restoring native ecosystems and supporting target species should be sought. For example, the use of fast-growing tall trees along a road to provide long-term canopy connectivity for gliders may require the use of tree species that are not indigenous to the locality. Revegetation should also consider climate change predictions to ensure plantings will survive future conditions.

After rehabilitation and revegetation, the construction site is handed back to Transport and Main Roads for ongoing management and maintenance. However, the rehabilitation and revegetation should be completed to a high enough standard before the construction is completed and handed back. In other words, ‘construction’ is not completed until the revegetation is established and self-sustaining.

Prior to the project being handed back to Transport and Main Roads, the Contractor must provide the department with detailed information of all environmental assets, including:

- The type and number of each asset, such as fauna fencing, crossing structures, and supplementary or replacement habitats.
- Details drawings of the environmental asset.
- The condition of each asset at hand-over.
- A GIS file showing each location.
- An inspection and maintenance schedule for the environmental asset

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