



CLEARING PERMIT

Granted under section 51E of the Environmental Protection Act 1986

Purpose Permit number:	CPS 9225/1
Permit Holder:	Commissioner of Main Roads Western Australia
Duration of Permit:	From 4 August 2021 to 4 August 2036

ADVICE NOTE

Allocation of offset site

In 2016 Main Roads Western Australia provided funding to the Department of Biodiversity, Conservation and Attractions to acquire five lots in Lake Clifton as an environmental offset for a historical project, comprising 965 hectares. The entirety of the offset was not required for the project and the offset balance was banked. Main Roads Western Australia has allocated 11.6 hectares of this pre-impact offset site for this project. The offset site is considered to be representative of the 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' ecological community.

Revegetation and rehabilitation offset

The Project Revegetation Plan referred to in condition 10 of this permit is intended to facilitate the revegetation and rehabilitation of 7.1 hectares of native vegetation within the conservation estate managed by the Department of Biodiversity Conservation and Attractions, that comprises significant foraging habitat for Carnaby's cockatoo (*Calyptorhynchus latirostris*) on the Swan Coastal Plain.

The permit holder is authorised to clear native vegetation subject to the following conditions of this permit.

PART I – CLEARING AUTHORISED

1. Clearing authorised (purpose)

The permit holder is authorised to clear native vegetation for the purpose of installing a principle shared path, noise walls and on-ramps along the eastern side of the Mitchell Freeway.

2. Land on which clearing is to be done

Lot 10878 on Deposited Plan 216749 (Crown Reserve 39386), Kingsley
Lot 12169 on Plan 14761 (Crown Reserve 44143), Kingsley
Mitchell Freeway road reserve (PIN 393042), Kingsley

Mitchell Freeway road reserve (PIN 1352819), Woodvale
Mitchell Freeway road reserve (PIN 1352821), Woodvale
Mitchell Freeway road reserve (PIN 1357612), Kingsley
Mitchell Freeway road reserve (PIN 1357613), Kingsley
Mitchell Freeway road reserve (PIN 11494311), Kingsley
Mitchell Freeway road reserve (PIN 11494312), Kingsley
Mitchell Freeway road reserve (PIN 11754451), Kingsley
Camarino Drive road reserve (PIN 1352815), Woodvale
St Johns Court road reserve (PIN 1357577), Kingsley
Twickenham Drive road reserve (PIN 1357549), Kingsley
Twickenham Drive road reserve (PIN 1357570), Kingsley
Twickenham Drive road reserve (PIN 1357575), Kingsley
Twickenham Drive road reserve (PIN 1357606), Kingsley

3. Clearing authorised

The permit holder must not clear more than 3.02 hectares of native vegetation within the area cross-hatched yellow in Figures 1-4 of Schedule 1.

4. Period within which clearing is authorised

The permit holder must not clear any native vegetation after 4 August 2026.

PART II – MANAGEMENT CONDITIONS

5. Avoid, minimise, and reduce impacts and extent of clearing

In determining the native vegetation authorised to be cleared under this permit, the permit holder must apply the following principles, set out in descending order of preference:

- (a) avoid the clearing of native vegetation;
- (b) minimise the amount of native vegetation to be cleared; and
- (c) reduce the impact of clearing on any environmental value.

6. Weed and dieback management

When undertaking any clearing authorised under this permit, the permit holder must take the following measures to minimise the risk of introduction and spread of *weeds* and *dieback*:

- (a) clean earth-moving machinery of soil and vegetation prior to entering and leaving the area to be cleared;
- (b) ensure that no known dieback or weed-affected soil, *mulch*, *fill*, or other material is brought into the area to be cleared; and
- (c) restrict the movement of machines and other vehicles to the limits of the areas to be cleared.

7. Directional clearing

The permit holder must conduct clearing activities in a slow, progressive manner in one direction, to allow fauna to move into adjacent native vegetation ahead of the clearing activity.

8. Fauna management – black cockatoo breeding habitat

- (a) Within 72 hours prior to undertaking any clearing authorised under this permit within the combined areas cross-hatched yellow on Figures 1-4 of Schedule 1, the permit holder must engage a *fauna specialist* to inspect all *black cockatoo habitat tree/s* identified in the Mitchell Freeway Widening Southbound and PSP Mitchell Freeway Gaps Hodges Drive to Reid Highway Biological Survey (Astron, 2020) for *evidence* of current or past breeding use by Carnaby's black cockatoo (*Calyptorhynchus latirostris*).
- (b) Where a *black cockatoo habitat tree* with no *evidence* of current or past use by Carnaby's black cockatoo is identified in accordance with condition 8(a), that tree must only be cleared within 72 hours after the inspection.
- (c) Where a *black cockatoo habitat tree* is identified within the combined areas cross-hatched yellow on Figures 1-4 of Schedule 1 and that tree shows *evidence* of current or past breeding use by Carnaby's black cockatoo under condition 8(a), and clearing of that tree cannot be avoided, that tree must be monitored by a *fauna specialist* to determine when it is no longer in use for that breeding season.
- (d) Any *black cockatoo breeding tree* with *evidence* of current breeding use by Carnaby's black cockatoo must not be cleared whilst it is in use for that breeding season as determined by the *fauna specialist* under condition 8(c).
- (e) Where a *black cockatoo habitat tree* is cleared, the permit holder must install at least three artificial black cockatoo nest hollows for every suitable hollow identified in a *black cockatoo habitat tree* cleared.
- (f) Each artificial black cockatoo nesting hollow required by condition 8(e) must be installed prior to commencement of the next black cockatoo breeding season following clearing of the related *black cockatoo habitat tree/s*.
- (g) The artificial black cockatoo nest hollow/s required by condition 8(e) of this permit must:
 - (i) be installed in consultation with, and on land vested with, the Department of Biodiversity, Conservation and Attractions;
 - (ii) be designed and placed in accordance with the specifications detailed in Schedule 3; and
 - (iii) be monitored and maintained in accordance with the specifications detailed in Schedule 4, for a period of at least ten years.
- (h) Within two months of completing the clearing authorised under this permit within the combined areas cross-hatched yellow on Figures 1-4 of Schedule 1, the permit holder must provide the results of the *fauna specialist's* inspection in a report to the CEO.

- (i) The *fauna specialist's* inspection report must include the following;
 - (i) the location of any fauna species listed in condition 8(a), if identified, recorded using a GPS unit set to GDA94, expressing the geographical coordinates in Eastings and Northings or decimal degrees;
 - (ii) the name and amount of each fauna species identified;
 - (iii) the methodology, used to inspect the permit area;
 - (iv) a photo of the *black cockatoo habitat tree/s* identified; and
 - (v) a description of the *black cockatoo habitat tree/s* identified, including the:
 - (A) species of *black cockatoo habitat tree/s*; and
 - (B) condition of the *black cockatoo habitat tree/s*.

9. Offset – land allocation

Prior to commencing the clearing authorised under this permit, the permit holder must fund the purchase of 11.6 hectares of native vegetation within the area cross-hatched red on Figure 5 of Schedule 2 to be ceded to the Department of Biodiversity Conservation and Attractions for conservation.

10. Offset – revegetation and rehabilitation

- (a) Within 6 months of clearing commencing, the permit holder must submit a Project Revegetation Plan to the *CEO* for approval for the *revegetation and rehabilitation* of 7.1 hectares of land within Neerabup National Park or another location in the conservation estate within 20 kilometres of the application area, identified in liaison with DBCA. The Project Revegetation Plan shall be developed in accordance with *A Guide to Preparing Revegetation Plans for Clearing Permits* (Department of Water and Environmental Regulation (DWER) 2018).
- (b) The Project Revegetation Plan must be prepared by an *environmental specialist*.
- (c) The Project Revegetation Plan must include the following:
 - (i) the location/s of the revegetation and rehabilitation area/s as required under condition 10(a) of this permit;
 - (ii) *site preparation*;
 - (iii) *weed control*;
 - (iv) *regeneration, direct seeding or planting*, at an *optimal time*;
 - (v) a *vegetation establishment period*;
 - (vi) *revegetation success completion criteria* based on selected *reference sites*, including but not limited to target weed cover, target vegetation condition, target density and target structure;
 - (vii) remedial actions to be undertaken if *completion criteria* are not met;
 - (viii) ongoing maintenance and monitoring of the area to be *revegetated and rehabilitated*;
 - (ix) timeframes for completion of the activities; and
 - (x) management commitments that will be achieved.
- (d) If the *CEO*, having had regard to conditions 10(b) and 10(c) of this permit, does not approve the Project Revegetation Plan, the permit holder must revise and resubmit the Project Revegetation Plan within 1 month of the date of the *CEO's* decision.

- (e) If the *CEO*, having had regard to conditions 10(b) and 10(c) of this permit, does not approve a revised Project Revegetation Plan submitted in accordance with condition 10(d) of this permit, the permit holder must again revise and resubmit the Project Revegetation Plan in accordance with condition 10(d) of this permit.
- (f) The permit holder must obtain the approval of the *CEO*, prior to implementing the Project Revegetation Plan.
- (g) The permit holder must implement the Project Revegetation Plan within 12 months of the date of approval by the *CEO*.

PART III - RECORD KEEPING AND REPORTING

11. Records that must be kept

The permit holder must maintain records relating to the listed relevant matters in accordance with the specifications detailed in Table 1.

Table 1: Records that must be kept

No.	Relevant matter	Specifications
1.	In relation to the authorised clearing activities generally	<ul style="list-style-type: none"> (a) the species composition, structure, and density of the cleared area; (b) the location where the clearing occurred, recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings; (c) the date that the area was cleared; (d) the size of the area cleared (in hectares); (e) actions taken to avoid, minimise, and reduce the impacts and extent of clearing in accordance with condition 5; (f) actions taken to minimise the risk of the introduction and spread of weeds and dieback in accordance with condition 6; and (g) actions taken to undertake directional clearing in accordance with condition 7; and (h) actions taken in accordance with condition 9.
2.	In relation to black cockatoo fauna management pursuant to condition 8	<ul style="list-style-type: none"> (a) the time/s and date/s of inspection/s of the suitable <i>black cockatoo habitat tree</i> by the <i>fauna specialist</i>; (b) a description of the inspection methodology employed by the <i>fauna specialist</i>; (c) the species name of any fauna determined by the <i>fauna specialist</i> to be occupying the suitable <i>black cockatoo habitat tree</i>; (d) where the suitable <i>black cockatoo habitat tree</i> is determined by the <i>fauna specialist</i> to be occupied by <i>black cockatoo species</i>: <ul style="list-style-type: none"> (i) the time and date that it was determined to be no longer occupied; and

No.	Relevant matter	Specifications
		(ii) a description of the evidence by which it was determined to be no longer occupied; and (e) the time and date that the suitable <i>black cockatoo habitat tree</i> was cleared.
3.	In relation to the installation of artificial black cockatoo nest hollows pursuant to condition 8	(a) the date that each artificial black cockatoo nest hollow was installed; (b) the total number of artificial hollows installed. (c) the location where each artificial black cockatoo nest hollow was installed recorded using a GPS unit set to GDA94, expressing the geographical coordinates in Eastings and Northings or decimal degrees; (d) a photo of each installed artificial black cockatoo nest hollow; (e) the dates each artificial black cockatoo nest hollow installed was monitored; (f) a description of the monitoring methods employed for each artificial black cockatoo nest hollow installed; (g) a description of the monitoring observations for each artificial black cockatoo nest hollow installed; (h) the date/s each artificial black cockatoo nest hollow installed was maintained; and (i) a description of the maintenance activities undertaken for each artificial black cockatoo nest hollow installed.
4.	In relation to the <i>revegetation</i> and <i>rehabilitation</i> of areas pursuant to condition 10	(a) a description of the <i>revegetation</i> and <i>rehabilitation</i> activities undertaken; (b) the size of the area <i>revegetated</i> and <i>rehabilitated</i> ; (c) the date/s on which the <i>revegetation</i> and <i>rehabilitation</i> was undertaken; (d) the boundaries of the area <i>revegetated</i> and <i>rehabilitated</i> (recorded digitally as a shapefile); and (e) other actions taken in accordance with condition 10.

12. Reporting

- (a) The permit holder must provide to the *CEO*, on or before 30 June of each calendar year, a written report containing:
 - (i) the records required to be kept under condition 11; and
 - (ii) records of activities done by the permit holder under this permit between 1 January and 31 December of the preceding calendar year.
- (b) If no clearing authorised under this permit has been undertaken, a written report confirming that no clearing under this permit has been undertaken, must be provided to the *CEO* on or before 30 June of each calendar year.
- (c) The permit holder must provide to the *CEO*, no later than 90 calendar days prior to the expiry date of the permit, a written report of records required under

condition 11, where these records have not already been provided under condition 12(a).

DEFINITIONS.

In this permit, the terms in Table have the meanings defined.

Table 2: Definitions

Term	Definition
black cockatoo breeding trees	means <i>black cockatoo habitat trees</i> that exhibit <i>evidence</i> of current or past breeding use by <i>black cockatoo species</i> .
black cockatoo habitat trees	means trees that have a diameter, measured at 130 centimetres from the base of the tree, of 50 centimetres or greater (or 30 centimetres or greater for <i>Eucalyptus salmonophloia</i> or <i>Eucalyptus wandoo</i>) that contain hollows suitable for breeding by Carnaby's black cockatoo.
CEO	Chief Executive Officer of the department responsible for the administration of the clearing provisions under the <i>Environmental Protection Act 1986</i> .
clearing	has the meaning given under section 3(1) of the EP Act.
completion criteria	means a measurable outcome based on suitable <i>reference sites</i> , used to determine <i>revegetation/rehabilitation</i> success.
condition	a condition to which this clearing permit is subject under section 51H of the EP Act.
department	means the department established under section 35 of the <i>Public Sector Management Act 1994</i> (WA) and designated as responsible for the administration of the EP Act, which includes Part V Division 3.
dieback	means the effect of <i>Phytophthora</i> species on native vegetation.
direct seeding	means a method of re-establishing vegetation through the establishment of a seed bed and the introduction of seeds of the desired plant species.
environmental specialist	means a person who holds a tertiary qualification in environmental science or equivalent, and has a minimum of two (2) years work experience relevant to the type of environmental advice that an environmental specialist is required to provide under this permit, or who is approved by the CEO as a suitable <i>environmental specialist</i> .
EP Act	<i>Environmental Protection Act 1986</i> (WA)
evidence	means showing chew marks or scratchings on the habitat tree representative of the species being surveyed, the presence of the species entering or leaving the habitat tree, and/or the presence of chicks/young.
fauna specialist	means a person who holds a tertiary qualification specialising in environmental science or equivalent, and has a minimum of 2 years work experience in fauna identification and surveys of fauna native to the region being inspected or surveyed, or who is approved by the CEO as a suitable fauna specialist for the bioregion, and who holds a valid fauna licence issued under the <i>Biodiversity Conservation Act 2016</i> .
fill	means material used to increase the ground level, or to fill a depression.
mulch	means the use of organic matter, wood chips or rocks to slow the movement of water across the soil surface and to reduce evaporation.
optimal time	means the period from April to July for undertaking <i>planting</i> and <i>direct seeding</i> .

Term	Definition
planting	means the re-establishment of vegetation by creating favourable soil conditions and <i>planting</i> seedlings of the desired species.
native vegetation	has the meaning given under section 3(1) and section 51A of the EP Act.
reference sites	means nearby sites used to provide baseline data for planning a <i>revegetation</i> project. Measurements from fixed reference points or plots where biodiversity components are measured are used to set measurable completion criteria for <i>revegetation</i> projects. The <i>reference sites</i> must contain the following values: <ul style="list-style-type: none"> a) Suitable foraging habitat for Carnaby's cockatoo (<i>Calyptorhynchus latirostris</i>), and b) Vegetation in a Very Good (Keighery, 1994) or better condition.
regeneration/ed/ing	means re-establishment of vegetation from in situ seed banks and propagating material (such as lignotubers, bulbs, rhizomes) contained either within the topsoil or seed-bearing mulch.
rehabilitation/ed/ing	means actively managing an area containing native vegetation in order to improve the ecological function of that area.
revegetation/ed/ing	means the re-establishment of a cover of local provenance native vegetation in an area using methods such as natural <i>regeneration</i> , direct seeding and/or <i>planting</i> , so that the species composition, structure and density is similar to pre-clearing vegetation types in that area.
site preparation	means management of existing site topsoil and preparation of the finished soil surface, for example by ripping or tilling the soil surface and respreading site topsoil and chipped native vegetation.
vegetation establishment period	means a period of at least two summers after the <i>revegetation</i> during which time replacement and infill <i>revegetation</i> works may be required for areas in which <i>revegetation</i> has been unsuccessful, and involves regular inspections of <i>revegetation</i> sites to monitor the success of <i>revegetation</i> .
weeds	means any plant – <ul style="list-style-type: none"> (a) that is a declared pest under section 22 of the <i>Biosecurity and Agriculture Management Act 2007</i>; or (b) published in a Department of Biodiversity, Conservation and Attractions species-led ecological impact and invasiveness ranking summary, regardless of ranking; or not indigenous to the area concerned.

END OF CONDITIONS



Meenu Vitarana
A/MANAGER

NATIVE VEGETATION REGULATION

*Officer delegated under Section 20
of the Environmental Protection Act 1986*

12 July 2021

Schedule 1

The boundary of the area authorised to be cleared is shown in the map below (Figures 1-4).

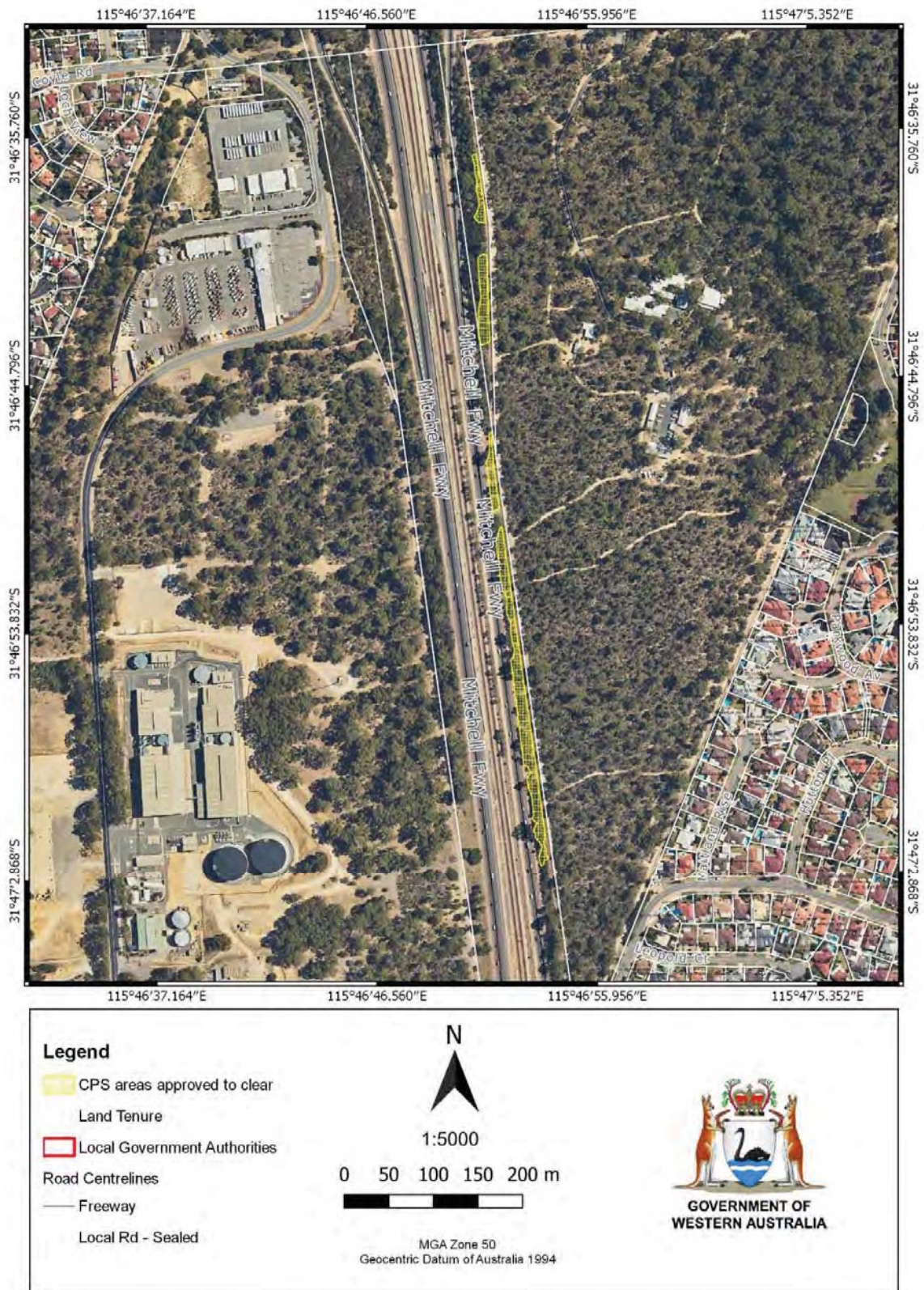


Figure 1: Map of the boundary of the area within which clearing may occur

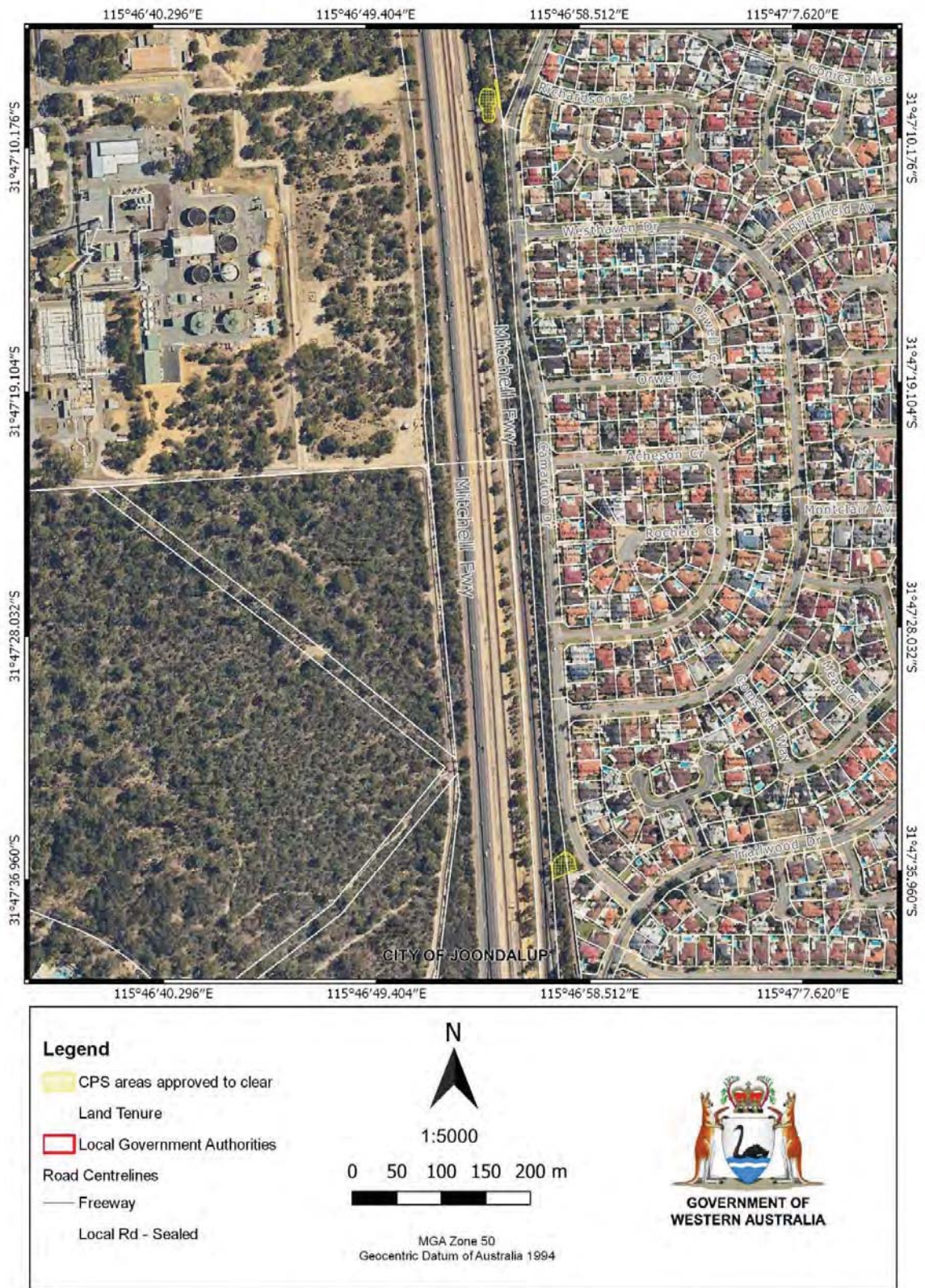


Figure 2: Map of the boundary of the area within which clearing may occur

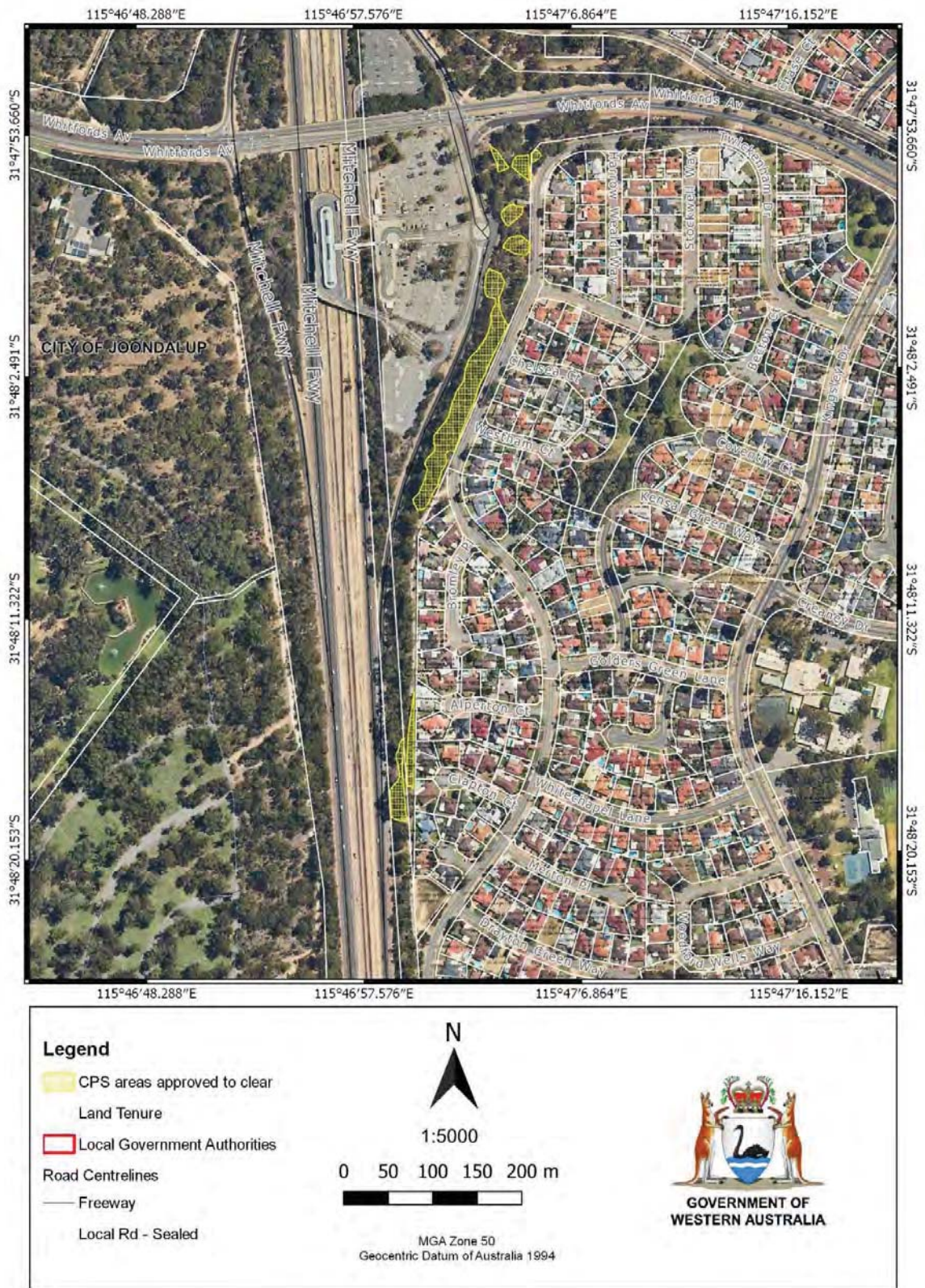


Figure 3: Map of the boundary of the area within which clearing may occur

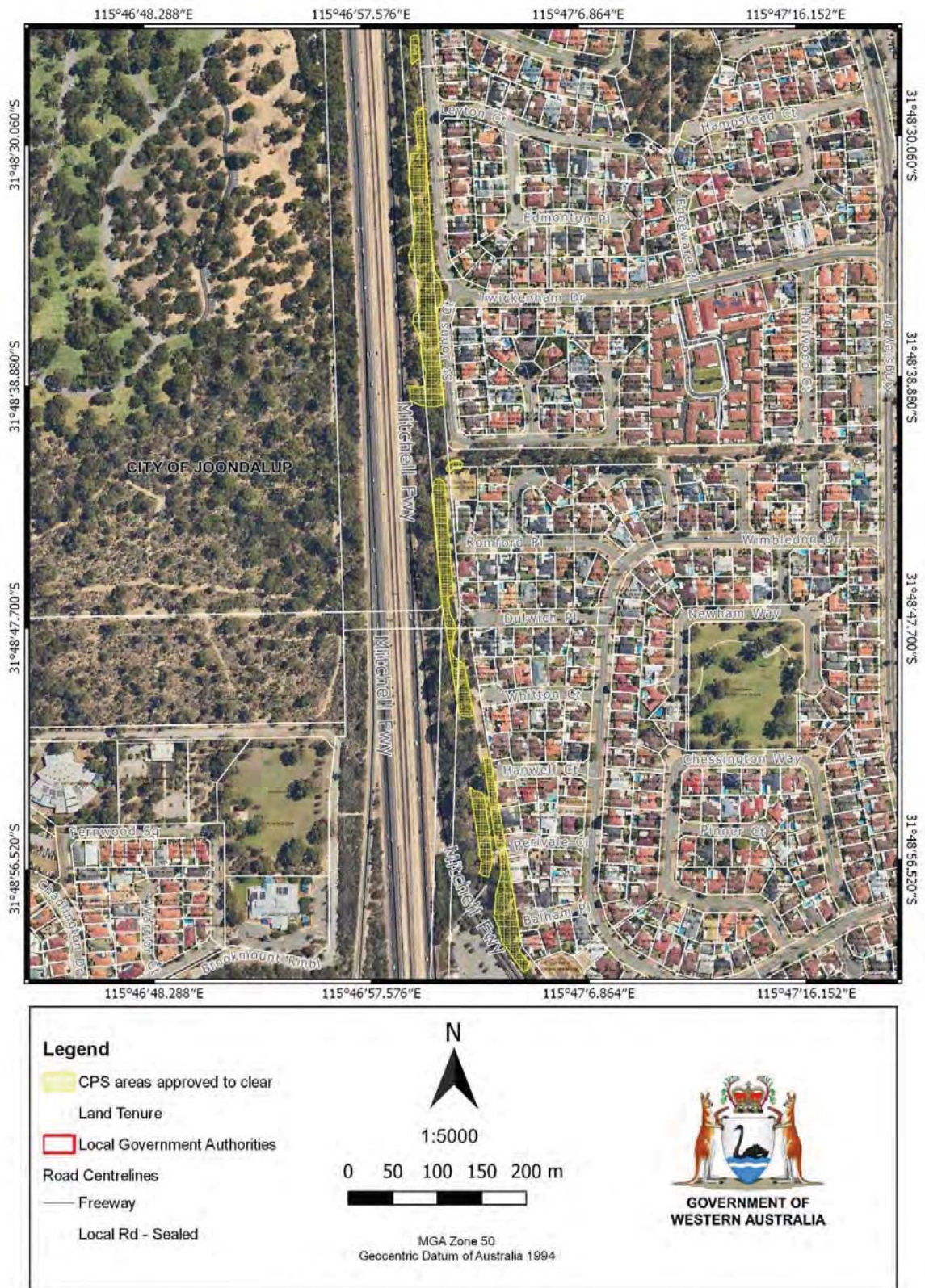


Figure 4: Map of the boundary of the area within which clearing may occur

Schedule 2

The boundary of the area within which specific offset conditions apply is shown in the map below (Figure 5).

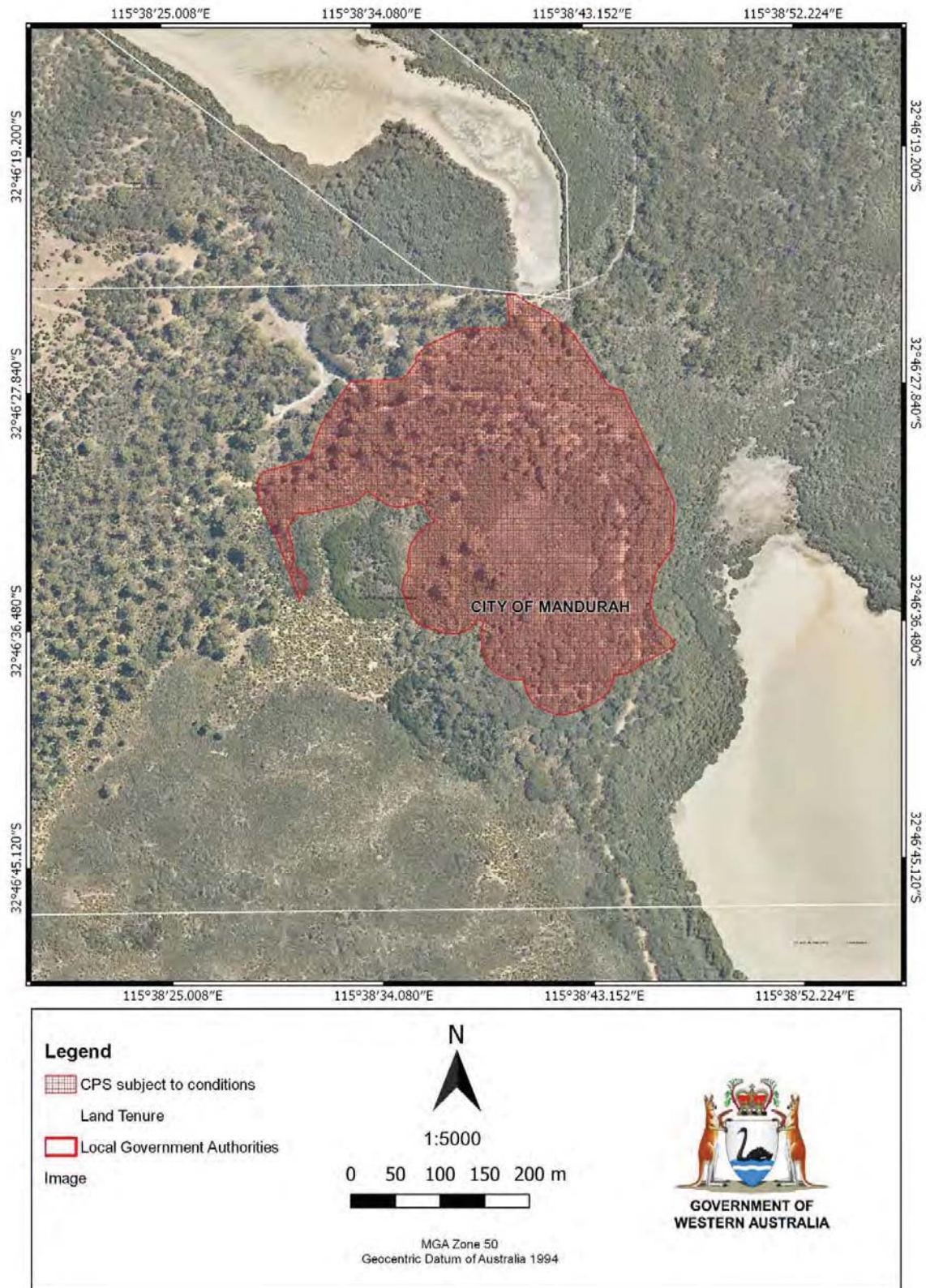


Figure 5: Map of the boundary of the area within which specific offset conditions apply.

Schedule 3

How to design and place artificial hollows for Carnaby's cockatoo

Artificial hollows for Carnaby's cockatoo



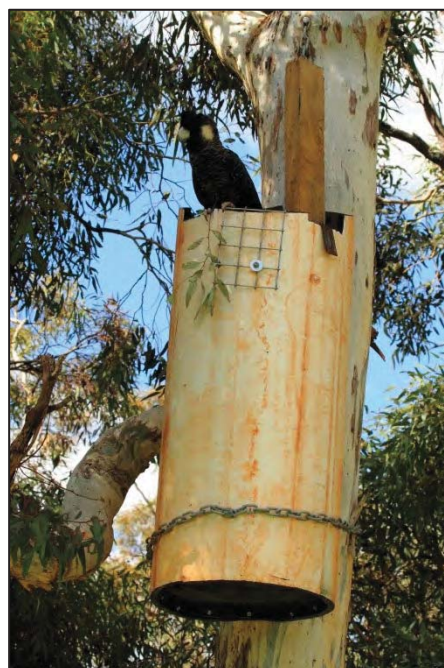
How to design and place artificial hollows for Carnaby's cockatoo

Artificial hollows can be used to help conserve the threatened Carnaby's cockatoo by enabling the cockatoos to breed in areas where natural hollows are limited.

A wide variety of artificial hollow designs have been used with mixed success. Evidence suggests that, while the hollow must meet some basic requirements, other factors such as proximity to existing breeding areas may be more important in determining the success of artificial hollows. Before using this information sheet to construct or install an artificial hollow, you should refer to the criteria listed in the separate information sheet; *When to use artificial hollows for Carnaby's cockatoo*.

This information sheet contains broad guidelines for the design and placement of artificial hollows for Carnaby's cockatoo.

Below are three examples of successful artificial hollows used by Carnaby's cockatoo for nesting. Artificial hollows made from a natural log with cut side entrance (left), white industrial pipe with top entrance (centre) and natural log with natural side entrance (right).



Photos by Christine Groom (left and right) and Rick Dawson (centre)

Walls

The walls of the artificial hollow need to be constructed from a material that is;

- Durable enough to withstand exposure to elements for an extended period of time (i.e. 20+ years).
- Able to simulate the thermal properties of a natural tree hollow.
- Not less than 380 mm in internal diameter.
- Preferably 1.2 m deep overall and 1m deep to top of substrate/nesting material.

Successful artificial hollows have been constructed from sections of salvaged natural hollow, black and white industrial pipe. When using non-natural materials care must be taken to ensure there are no toxic residues and that the materials are safe to ingest.

Base

The base of the artificial hollow must be;

- Able to support the adult and nestling(s).
- Durable enough to last the life of the nest.
- Free draining.
- At least 380 mm in diameter.
- Covered with 200 mm of sterile, dry, free draining material such as charcoal, hardwood woodchips or wood debris.

Do not use:

- Saw dust or fibre products that will retain moisture.

Example materials that could be used for artificial hollow bases include heavy duty stainless steel, galvanised or treated metal (e.g. Zinalume ®), thick hardwood timber slab or marine ply (not chipboard or MDF). The base material must be cut to size to fit internally with sharp or rough edges ground away or curled inwards and fixed securely to the walls.



Carnaby's cockatoo eggs in an artificial hollow.
Photo by Rick Dawson

Entrance

The entrance of the artificial hollow must;

- Have a diameter of at least 270 mm).
- Preferably be top entry which will minimise use by non-target species.

Top entry hollows are unattractive to nest competitors such as feral bees, galahs and corellas. Side entry hollows have been successful in areas where feral bees are not a problem and where galahs and corellas are deterred.

Ladder

For artificial hollows made of non-natural materials, or of processed boards, it is necessary to provide a ladder to enable the birds to climb in and out of the hollow easily.

The ladder must be;

- Securely mounted to the inside of the hollow.
- Made from an open heavy wire mesh such as WeldMesh™ with mesh size of 30 - 50 mm, or heavy chain.

Do not use:

- A material that the birds can chew.
- Galvanized because the birds may grip or chew the ladder and ingest harmful compounds.

If using mesh for the ladder, the width will depend on the curvature of the nest walls. A minimum width of about 60 - 100 mm is recommended.

Sacrificial chewing posts

For artificial hollows made of non-natural materials, or of processed boards, it is necessary to provide sacrificial chewing posts. The birds chew material to prepare a dry base on which to lay their egg(s).

The sacrificial chewing posts must:

- Be made of untreated hardwood such as jarrah, marri or wandoo
- Be thick enough to satisfy the birds' needs between maintenance visits.
- Extend beyond the top of the hollow as an aid to see whether the nest is being used.
- Be placed on the inside of the hollow.
- Be attached in such a way that they are easy to replace e.g. hook over the top of hollow or can slide in/out of a pair of U bolts fitted to the side of the hollow.

It is recommended that at least two posts are provided. Posts 70 x 50 mm have been used, but require replacing at least every second breeding season when the nest is active. Birds do vary in their chewing habits and therefore the frequency at which the chewing posts require replacement will also vary.



Bottom of an artificial hollow showing ladder that is fixed to the wall and a chewed sacrificial post which is 200 mm from the floor.

Photo by Rick Dawson

Mountings

The artificial hollows must be mounted such that:

- The fixings used will last the duration of the nest e.g. galvanized bracket or chain fixed with galvanized coach screws.
- It is secured by more than one anchor for security and stability.
- It is positioned vertically or near vertically.

Placement

Sites should be chosen within current breeding areas and where they can be monitored, but preferably not conspicuous to the general public. It is important that artificial hollows are placed where they will be accessible for future monitoring and maintenance. For more detail refer to the separate information sheet; *When to use artificial hollows for Carnaby's cockatoo*.

The height at which artificial hollows should be placed is variable. The average height of natural hollows in dominant tree species in the area is a good guide. Natural hollows used by Carnaby's cockatoos have been recorded as low as 2 m above the ground. If located on private property the hollows can be placed lower to the ground so they are accessible by ladder or a rope and pulley system can be used. Where public access is possible artificial hollows should be placed at least 7 m high (i.e. higher than most ladders) and on the side of the tree away from public view to reduce the chance of interference or poaching.

Carnaby's cockatoo show no preference for aspect of natural hollows, however, it may still be beneficial to place artificial hollows facing away from prevailing weather and where they receive the most shade and protection.

Artificial hollows to be placed in trees require:

- Accessibility of the tree for a vehicle, elevated work platform or cherry picker.
- A section of trunk 2-3 m long suitable for attaching the hollow

If necessary, artificial hollows may be placed on poles, but this may result in excessive exposure to sun during very hot weather. When erected on poles there should be:

- A hinge at the bottom of the pole that can be secured when the pole is in the upright position.
- Access for a vehicle to assist raising the pole.

Safety

Care needs to be taken when placing artificial hollows to ensure safety is considered at all times. Artificial hollows are heavy and require lifting and manoeuvring into position up to 7 m above the ground.

Maintenance and monitoring

Once artificial hollows have been placed they require monitoring and maintenance to ensure they continue to be useful for nesting by Carnaby's cockatoo. It is important to monitor artificial hollows to determine use by Carnaby's cockatoo, other native species as well as pest species. By undertaking monitoring the success of the design and placement of artificial hollows can be determined and areas for improvement identified for future placement of artificial hollows.

Monitoring can also assess whether any maintenance is required. Without regular maintenance artificial hollows are unlikely to achieve their objective (that is, they will fail to provide nesting opportunities for threatened cockatoos). Therefore it is important to continue a regime of regular maintenance while the artificial hollow is required. It may be several (to many) decades until a natural replacement hollow is available.

For further advice on monitoring and maintenance of artificial hollows please refer to the separate information sheet; *How to monitor and maintain artificial hollows for Carnaby's cockatoo*.



Carnaby's cockatoo female prospecting an artificial hollow.
Photo by Rick Dawson



Example fixing for artificial hollow
Photo by Christine Groom

Acknowledgements

This information sheet is a joint initiative of Birdlife Australia, the Western Australian Museum and the Department of Parks and Wildlife. Many individuals have contributed to its preparation. Special acknowledgement is made for the contributions of Ron Johnstone from the WA Museum, Alan Elliott from the Serpentine-Jarrahdale Land care Centre and Denis Saunders. This updated version was compiled by Rick Dawson Department of Parks and Wildlife).

Other information sheets in the series: Artificial hollows for Carnaby's cockatoo

- *How to design and place artificial hollows for Carnaby's cockatoo*
- *How to monitor and maintain artificial hollows for Carnaby's cockatoo*

Information sheets available on the *Saving Carnaby's cockatoo* webpage:

<http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals/208-saving-carnaby-s-cockatoo>

Schedule 4

How to monitor and maintain artificial hollows for Carnaby's cockatoo

Artificial hollows for Carnaby's cockatoo



How to monitor and maintain artificial hollows for Carnaby's cockatoo

It is important to monitor and maintain artificial hollows after they have been erected. Monitoring ensures that the effectiveness of the artificial hollow can be determined. It also means that problems with pest species or any maintenance requirements can be identified and resolved.

Without regular maintenance, artificial hollows are likely to fail to achieve their objective (that is, they will fail to provide nesting opportunities for threatened cockatoos). Therefore it is important to continue a regime of regular maintenance while the artificial hollow is required. It may be several (to many) decades until a natural replacement hollow is available.

Monitoring should be undertaken in order to detect:

- Use by Carnaby's cockatoo
- Maintenance requirements
- Use by other native species
- Use by pest species (e.g. feral bees, galahs, corellas etc.)



Carnaby's cockatoo female prospecting an artificial hollow.
Photo by Rick Dawson

How do I monitor artificial hollows?

Before undertaking monitoring of artificial hollows for Carnaby's cockatoo it is recommended that you seek advice from BirdLife Australia, the WA Museum or the Department of Parks and Wildlife. It is also important to contact Parks and Wildlife, Wildlife Licensing Section, to determine if a scientific licence is required (wildlifelicencing@dpaw.wa.gov.au).

Monitoring artificial hollows requires keen observation and naturalist skills. It is often not possible to observe evidence of breeding directly (i.e. nestlings or eggs) and inferences must be made based on observation. There are many techniques available to monitor artificial hollows. A combination of several is likely to achieve the best results.

Looking for signs of use

Cobwebs covering the entrance to the hollow will indicate that the hollow has not been used recently. This would also apply to other light debris that may have fallen to cover the opening partially. Signs of recent use or interest in the hollow include evidence of chewing.

Observing parent behaviour around the hollow

The behaviour of parent birds around a hollow will indicate an approximate age of young in the nest.

Parent behaviour	Approximate age/stage of young
Prospecting for hollow	Unborn
Male only seen out of hollow	Egg or very young nestling (< 3 - 4 weeks)
Both parents seen entering/exiting the hollow	Nestling(s) have hatched (> 3 - 4 weeks)

Observing feeding flocks

Flocks of all male birds indicate that the females are incubating eggs. When flocks are mixed it suggests the birds have either not laid yet or that the nestlings have hatched and no longer require brooding (approximately 3 - 4 weeks old).

Tapping

When females are sitting on eggs they will usually respond to tapping at the base of their tree (or pole) by appearing at the entrance or flying from the hollow opening. This is not a guarantee of breeding activity, but an indication that it is possibly occurring in the hollow.

Observing insect activity around nest

The faecal matter produced by nestlings in a nest attracts insects, especially flies and ants. The type and number of these insects will help indicate how old any nestlings present may be. Factors such as temperature and humidity will also affect insect activity and so observations of insect activity should only be used as supporting evidence for other indications of age/use. Blowflies around a nest usually indicate that a death has occurred.

Listening for nestlings

With experience it is possible to determine if one or two nestlings are present and a broad estimate of age based on the type and loudness of noises they make.

Looking inside the nest

This can be achieved either with the aid of a telescopic pole and camera or mirror, or with the use of a ladder or other climbing equipment. This method can obtain the most detailed monitoring information for artificial hollows. However it is also the most time consuming and difficult to organise. Special equipment is likely to be needed depending on the height and positioning of artificial hollows. There are also safety issues associated with ladder or rope climbing options to reach nests to undertake observations.

How often should I monitor artificial hollows?

The minimum frequency of monitoring and the techniques used will be determined by the aims of the monitoring and the resources available. It is important to limit disturbance to breeding birds and this should be considered when determining the techniques used and frequency.

How do I maintain artificial hollows?

Artificial hollows require maintenance to ensure they continue to have the greatest chance of them being used by Carnaby's cockatoos. Periodic maintenance checks should be undertaken at least every two years, preferably annually. These checks should be undertaken prior to the breeding season which is between July and January with breeding occurring later in this period in southern areas. It is important to maintain a regime of regular maintenance as long as the artificial hollow is required. It may take several (to many) decades until a natural replacement hollow is available.

Maintenance checks should assess the following as a minimum:

- Condition of chewing posts (if present)
- Condition of attachment points
- Condition of hollow bases
- Stability of tree or pole used to mount the artificial hollow



Artificial hollow base needing repair.
Photo by Christine Groom

Repairing hollows

Any problems identified during maintenance checks should be addressed, and any repairs required done, as soon as possible. If breeding is currently occurring, maintenance may need to be delayed if it is likely to disturb the parents or nestling. Likely maintenance needs include replacement of chewing posts (frequently) or nest bases (occasionally) and repairing of any cracks (infrequently). Maintenance concerns regarding the security of attachment points or the stability of the tree or pole should be addressed as a priority for safety reasons.

For artificial hollows known to be used, spare chewing posts should be taken into the field when undertaking maintenance checks.

Monitoring of artificial hollows:

Monitoring aim	Frequency of visits	Monitoring techniques
To determine possible use by Carnaby's cockatoo	At least once during peak breeding season (i.e. between September and December)	<ul style="list-style-type: none"> • Observing behaviour of adults around hollow • Tapping to see if female will flush from hollow (best undertaken between 10am and 3pm when females most likely to be sitting) • Listening for nestlings • Looking for evidence of chewing • Looking inside nest
To confirm use by Carnaby's cockatoo	At least two visits during peak breeding season (i.e. between September and December)	<p>To observe at least two of the following:</p> <ul style="list-style-type: none"> • Breeding behaviour of adults around hollow or evidence of chewing • Female flushed from hollow • Noises from nestlings in hollow <p>Or to observe:</p> <ul style="list-style-type: none"> • Nestlings or eggs in nest
To determine nesting success by Carnaby's cockatoo	The more visits, the better. Preferably fortnightly visits between July and December. As a minimum, at least 3 visits spread throughout breeding season.	<ul style="list-style-type: none"> • Looking inside nest to observe eggs or nestlings.
To determine use by any species	As often as possible.	<ul style="list-style-type: none"> • Inspection from ground as a minimum. • Looking inside nest for detailed observations.
To determine maintenance requirements	At least every two years and preferably annually if hollow fitted with sacrificial chewing posts, can be longer if without.	<ul style="list-style-type: none"> • A basic maintenance check can be undertaken from the ground. A ladder or elevated work platform will be required for a comprehensive check and to replace sacrificial chewing posts

Acknowledgements

This information sheet is a joint initiative of Birdlife Australia, the Western Australian Museum and the Department of Parks and Wildlife. Many individuals have contributed to its preparation. The updated version was compiled by Rick Dawson (Department of Parks and Wildlife) with assistance from Denis Saunders.

Other information sheets in the series: Artificial hollows for Carnaby's cockatoo

- *How to design and place artificial hollows for Carnaby's cockatoo*
- *How to monitor and maintain artificial hollows for Carnaby's cockatoo*

Information sheets available on the *Saving Carnaby's cockatoo* webpage:

<http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals/208-saving-carnaby-s-cockatoo>



Clearing Permit Decision Report

1 Application details and outcome

1.1. Permit application details

Permit number:	CPS 9225/1
Permit type:	Purpose permit
Applicant name:	Commissioner of Main Roads Western Australia
Application received:	2 March 2021
Application area:	3.02 hectares of native vegetation
Purpose of clearing:	Construction of a principal shared path
Method of clearing:	Mechanical
Property:	Lot 10878 on Deposited Plan 216749 (Crown Reserve 39386) Lot 12169 on Plan 14761 (Crown Reserve 44143) Mitchell Freeway road reserve (PINs 393042, 1352819, 1352821, 1357612, 1357613, 11494311, 11494312, 11754451) Camarino Drive road reserve (PIN 1352815) St Johns Court road reserve (PIN 1357577) Twickenham Drive road reserve (PINs 1357549, 1357570, 1357575, 1357606)
Location (LGA area):	City of Joondalup
Localities (suburb/s):	Kingsley, Woodvale

1.2. Description of clearing activities

The vegetation proposed to be cleared is distributed across 14 separate areas within two patches of remnant vegetation along the eastern side of Mitchell Freeway, between Ocean Reef Road and Hepburn Avenue (see Figures 1-4, Section 1.5). The proposed clearing is to facilitate:

- Upgrades to the existing and installation of a new Principal Shared Path (PSP), to provide a continuous PSP along this section of Mitchell Freeway,
- Construction of noise walls from Ocean Reef Road to Hepburn Avenue,
- Construction of drainage basin modifications,
- Upgrades to the Ocean Reef Road and Whitfords Avenue on-ramps,
- Relocation of services in the verge as required, and
- Construction of new emergency stopping bays.

1.3. Decision on application

Decision:	Granted
Decision date:	12 July 2021
Decision area:	3.02 hectares of native vegetation, as depicted in Section 1.5, below.

1.4. Reasons for decision

This clearing permit application was submitted, accepted, assessed and determined in accordance with sections 51E and 51O of the *Environmental Protection Act 1986* (EP Act). The Department of Water and Environmental Regulation (DWER) advertised the application for 21 days and one submission was received. Consideration of matters raised in the public submission is summarised in Appendix B.

In making this decision, the Delegated Officer had regard for the site characteristics (see Appendix C), relevant datasets (see Appendix H.1), the findings of a biological survey (see 0), the clearing principles set out in Schedule 5 of the EP Act (see 0), relevant planning instruments and any other matters considered relevant to the assessment (see Section 3). The Delegated Officer also took into consideration that the purpose of the proposed clearing is to facilitate the Mitchell Freeway Principal Shared Path Gaps Project which is part of a COVID-19 response project that aims to:

- improve the efficiency of the Perth bicycle network through a continuous PSP,
- minimise safety risks associated with the interaction of pedestrians and cyclists with vehicles through a continuous PSP,
- construct noise walls to improve the amenity of the residential properties adjacent to the Mitchell Freeway, and
- upgrade the Ocean Reef Road and Whitfords Avenue on-ramps to the Mitchell Freeway and construct new emergency stopping bays, to facilitate safe and efficient use of the freeway.

The assessment identified that the proposed clearing will result in the loss of 3.02 hectares of native vegetation that includes:

- 2.93 hectares of native vegetation that is representative of the federally listed Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain (Tuart Woodlands) TEC and the state-listed Tuart Woodlands PEC,
- two trees with two hollows of suitable size for nesting by Carnaby's cockatoo,
- 3.02 hectares of significant foraging habitat for Carnaby's cockatoo, and
- the potential introduction and spread of weeds into adjacent vegetation, including local conservation areas and adjacent conservation significant ecological communities.

After consideration of the available information, as well as the applicant's minimisation and mitigation measures (see Section 3.1), the Delegated Officer determined that some of the impacts of the proposed clearing, including direct impacts to individual fauna and the potential to facilitate the introduction of weeds and dieback, can be minimised and managed to be unlikely to lead to an unacceptable risk to environmental values through permit conditioning. However, impacts to the Tuart Woodlands TEC/PEC and foraging and breeding habitat for Carnaby's cockatoos remained significant even after the application of minimisation and mitigation measures and constituted a significant residual impact.

The Delegated Officer determined that the allocation of 11.6 hectares of a banked offset site (Lake Clifton - Crown Reserve 53178) was sufficient to counterbalance the significant residual impacts to the Tuart Woodlands TEC/PEC (see Section 4). The revegetation and rehabilitation of 7.1 hectares of native vegetation within land managed by the Department of Biodiversity, Conservation and Attractions (DBCA) that comprises significant foraging habitat for Carnaby's cockatoo on the Swan Coastal Plain, was considered sufficient to counterbalance the significant residual impacts to foraging habitat for Carnaby's cockatoo (see Section 4). The Delegated Officer also considered that a condition to install artificial nesting hollows within DBCA managed land at a rate of 3:1 for each suitable hollow proposed to be cleared was sufficient to mitigate the loss of two trees containing two suitably sized hollows for breeding by Carnaby's cockatoos (see Section 4).

The Delegated Officer decided to grant a clearing permit subject to conditions to:

- avoid, minimise, and reduce the impacts and extent of clearing,
- take hygiene steps to minimise the risk of the introduction and spread of weeds,
- undertake slow, progressive one directional clearing to allow terrestrial fauna to move into adjacent habitat ahead of the clearing activity,
- engage a fauna specialist to inspect habitat trees for the presence of Carnaby's cockatoos prior to clearing, to ensure individual black cockatoos area not impacted during the clearing process. Clearing of trees where these species have been identified is not permitted, until the fauna specialist has verified that the hollow/s are no longer being utilised for nesting,
- install, at a rate of 3:1 for each suitable hollows proposed to be cleared, artificial black cockatoo nesting hollows within land managed by DBCA, to mitigate impacts associated with the loss of two trees containing two suitably sized hollows for breeding by Carnaby's cockatoos,

- allocate 11.6 hectares of a banked offset site (Lake Clifton - Crown Reserve 53178) that is representative of the Tuart Woodlands TEC/PEC, to counterbalance the residual impacts to the ecological community, and
- revegetate and rehabilitate 7.1 hectares of suitable foraging habitat for Carnaby's cockatoo from a Degraded to Good (Keighery, 1994) condition within DBCA managed land, to mitigate the loss of 3.02 hectares of significant foraging habitat for the species.

1.5. Site maps

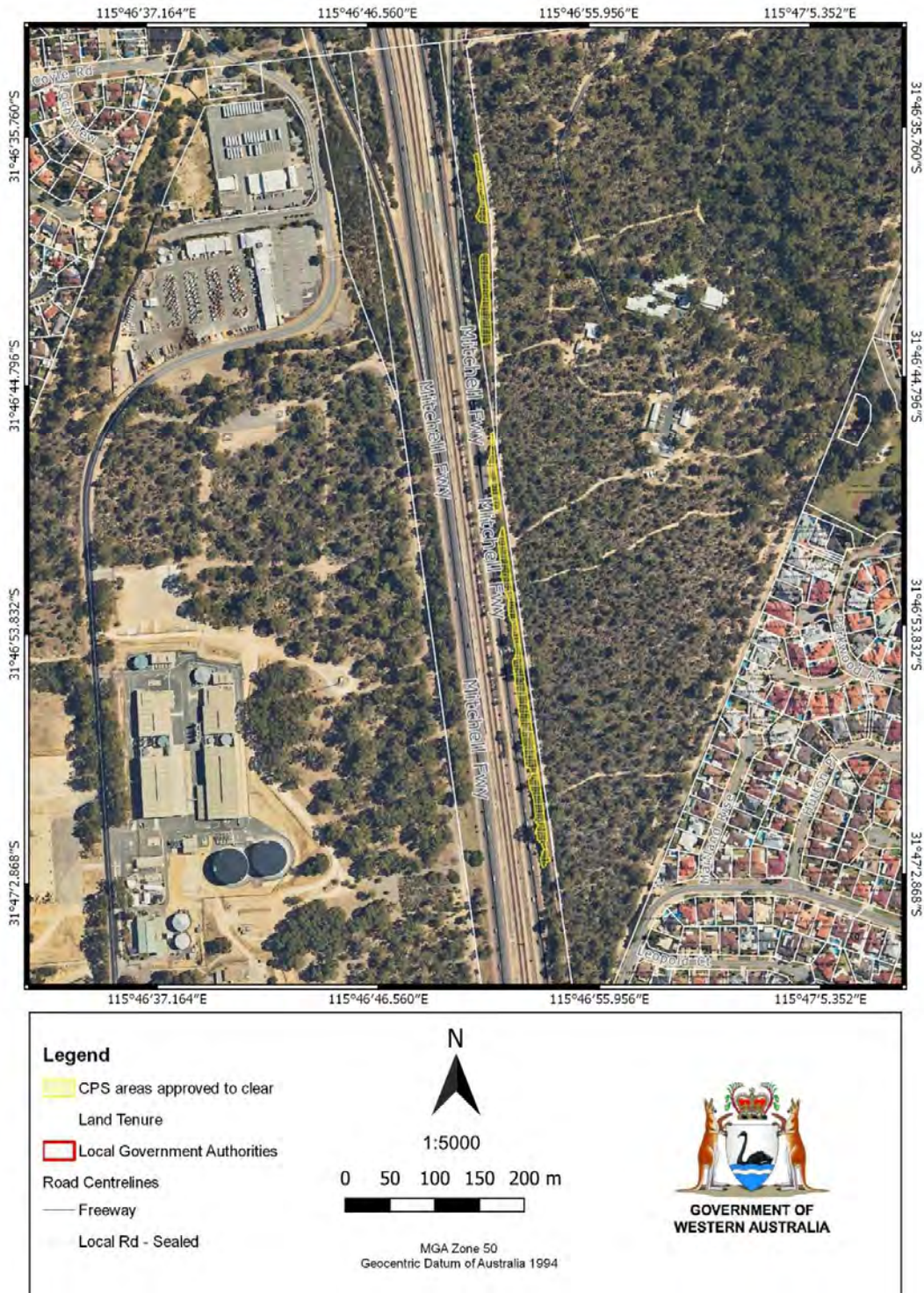


Figure 1. The areas cross-hatched yellow indicate the areas authorised to be cleared under the granted clearing permit.

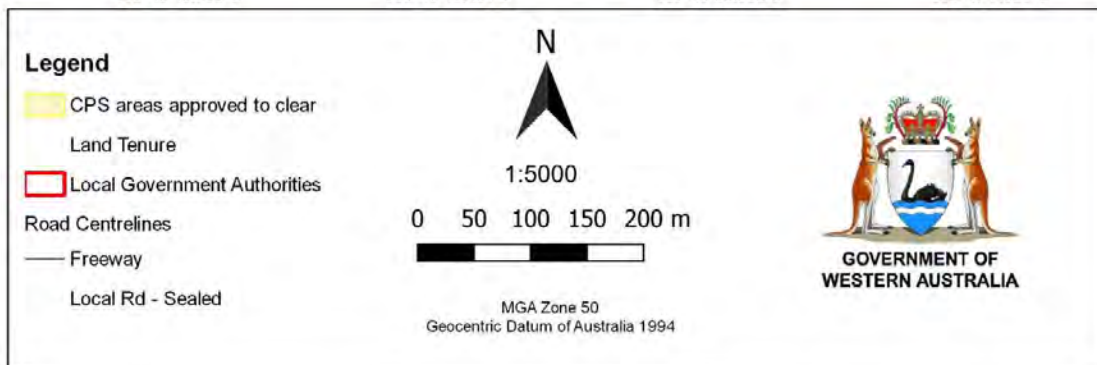
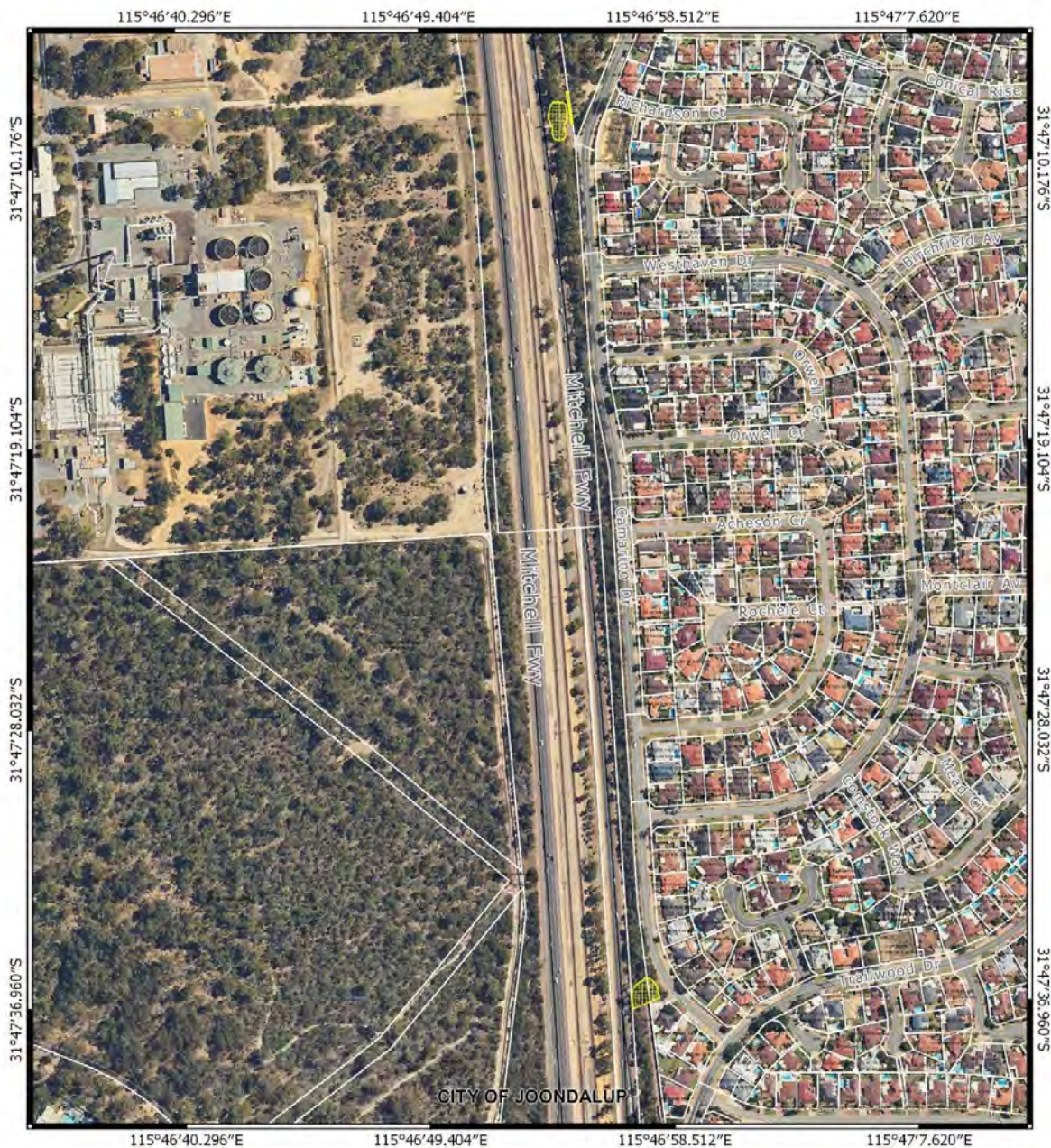


Figure 2. The areas cross-hatched yellow indicate the areas authorised to be cleared under the granted clearing permit.

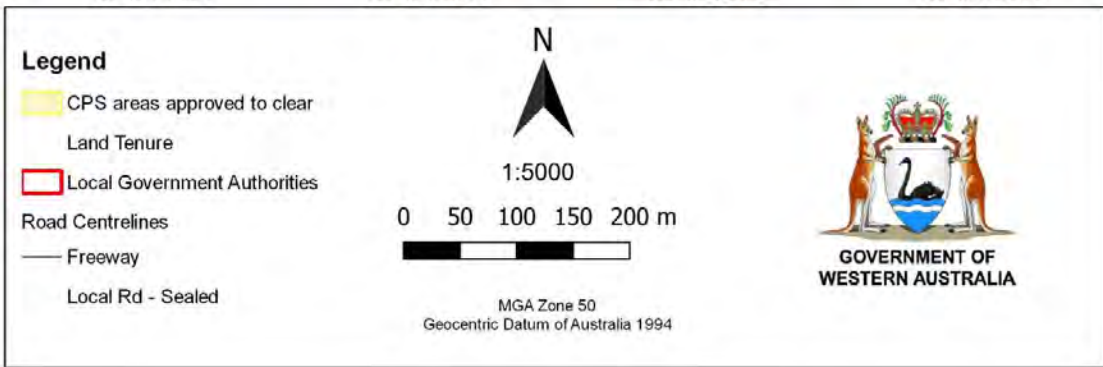
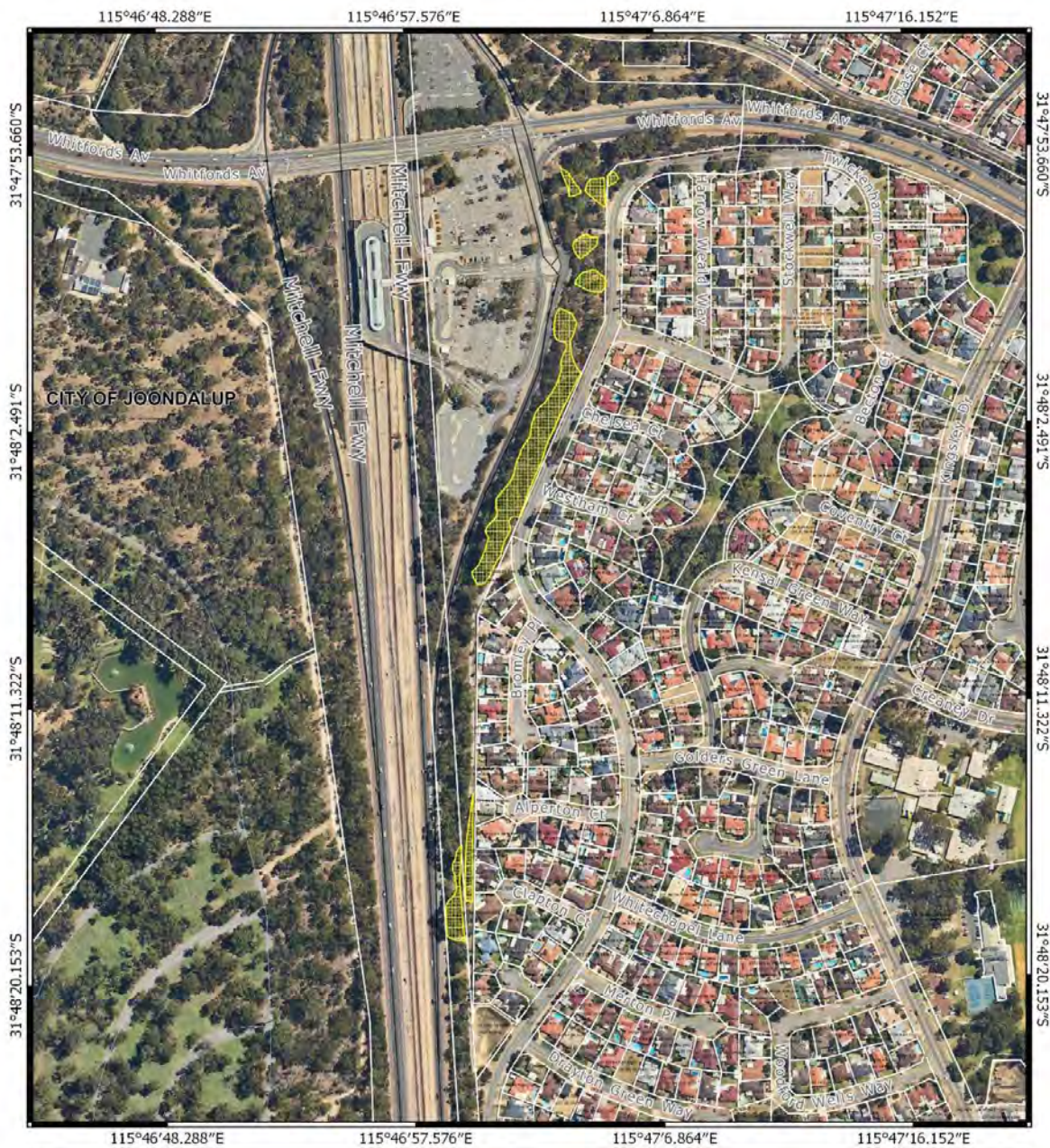


Figure 3. The areas cross-hatched yellow indicate the areas authorised to be cleared under the granted clearing permit.

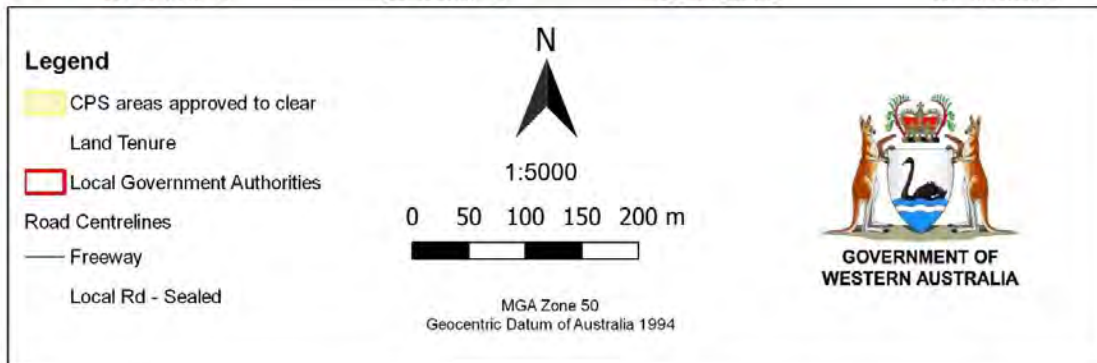
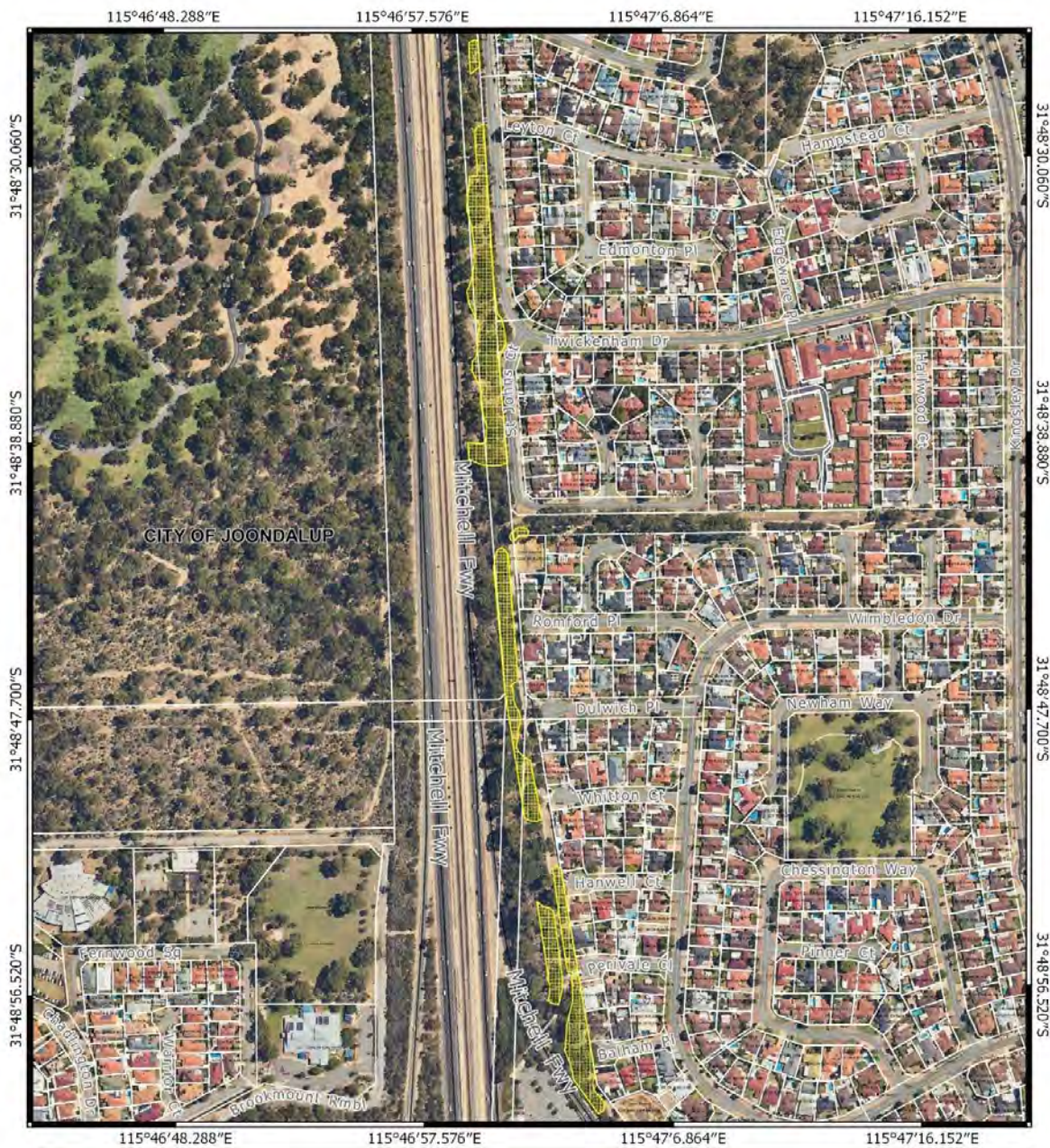


Figure 4. The areas cross-hatched yellow indicate the areas authorised to be cleared under the granted clearing permit.

2 Legislative context

The clearing of native vegetation in Western Australia is regulated under the EP Act and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (Clearing Regulations).

In addition to the matters considered in accordance with section 51O of the EP Act (see Section 1.4), the Delegated Officer has also had regard to the objects and principles under section 4A of the EP Act, particularly:

- the precautionary principle
- the principle of intergenerational equity
- the polluter pays principle
- the principle of the conservation of biological diversity and ecological integrity.

Other legislation of relevance for this assessment include:

- *Biodiversity Conservation Act 2016* (WA) (BC Act)
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)

Relevant policies considered during the assessment include:

- *Environmental Offsets Policy* (2011)

The key guidance documents which inform this assessment are:

- *A guide to the assessment of applications to clear native vegetation* (DER, December 2013)
- *Procedure: Native vegetation clearing permits* (DWER, October 2019)
- *Environmental Offsets Guidelines* (August 2014)
- Technical guidance – *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016a)
- Technical guidance – *Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA, 2016b)

3 Detailed assessment of application

3.1. Avoidance and mitigation measures

Supporting documentation was submitted by the applicant, demonstrating that design and management measures had been implemented to avoid and minimise the clearing proposed to be undertaken, which are summarised in Table 1 below (MRWA, 2021a). The applicant has advised that the design of the proposal was altered substantially during the design phase of the project, to avoid significant environmental values where possible, including 2.84 hectares of threatened and priority ecological communities, 30 potential breeding trees for black cockatoo species, and high-quality vegetation within Woodvale Nature Reserve (MRWA, 2021c).

In addition to the elements discussed above and in Table 1, the applicant advised that the following avoidance and minimisation measures will be employed:

- A project specific Construction Environmental Management Plan (CEMP) will be developed for the project, including measures to manage vegetation clearing and indirect impacts to vegetation during construction works,
- The clearing area will be demarcated prior to the commencement of native vegetation clearing,
- The project design will be refined as practicable to avoid the clearing of potentially suitable breeding trees for black cockatoo species, based on diameter at breast height (DBH),
- Vegetation will be pruned as opposed to cleared, where possible, and
- Additional project facilities, for example the site office, material storage areas, construction vehicles and machinery, and access tracks will be located in previously disturbed or permanently cleared areas, to avoid the need for additional clearing (MRWA, 2021a).

The applicant has advised that, while undertaking clearing, the following mitigation measures will be implemented to manage indirect impacts of the clearing and will be included in the project specific Construction Environmental Management Plan (CEMP):

- Vegetation management:
 - Vegetation to be retained will be clearly marked with flagging tape,
 - Threatened and priority ecological communities outside of the application area will be marked and identified as no-go areas for contractors,
 - Laydown areas, stockpile areas and vehicle turn around points will be located in areas cleared for permanent works,

- No clearing will be undertaken for temporary construction activities,
- Weed and dieback management:
 - Declared Pests within the clearing area will be treated prior to clearing according to their Control Codes and advice from Department of Primary Industries and Regional Development (DPIRD), with the aim of eradication where possible but as a minimum prevent off site movement,
 - Weeds of National Significance (WoNS) within the clearing area will be treated prior to clearing according to the weed control management outlined by Weeds Australia (<http://weeds.ala.org.au/>) with the aim of controlling off-site movement,
 - Topsoil containing Declared Pests or WoNS will not be reused in landscaping or revegetation,
 - All heavy plant and machinery will be inspected by the contractor prior to entry at the work site and be confirmed to be clean and free of vegetation and soil material,
 - Movement of machines and other vehicles will be restricted to the limits of the areas cleared with the project area or on designated tracks outside the project area,
 - The entire clearing area will be assumed Infested and managed in accordance with the Department of Biodiversity Conservation and Attractions (DBCAs) Management Guidelines (CALM 2003) including the establishment of a Clean on Entry/Exit point,
 - Phosphite will be applied in infested areas to dieback susceptible species within 30 metres of potential infested areas identified as a result of unauthorised access or drainage, in accordance with DBCA guidance,
 - Movement of machines and other vehicles will be restricted to the limits of the areas cleared within the project area or on designated tracks outside the project area,
- Fauna habitat management:
 - Construction site drainage will be directed away from adjacent black cockatoo habitat,
 - A pre-clearing fauna assessment will be undertaken by a suitably experienced expert to determine if hollows are being used by black cockatoos,
 - A suitably experienced expert will be on site during clearing of breeding habitat for black cockatoos,
 - Where the pre-clearing fauna assessment identifies any black cockatoo occupation of nest hollows, the tree with the nest hollow will not be cleared until after the completion of the breeding season,
 - No vegetation within 10 metres of the tree would be cleared until after the completion of the breeding season,
 - Any black cockatoos showing signs of injury or illness will be promptly referred to an experienced wildlife veterinarian or approved wildlife rehabilitation facility,
 - Revegetation designs shall not include foraging or breeding plant species within 10 metres of the Mitchell Freeway,
 - Black cockatoo habitat not required to be cleared will be marked and identified as no-go areas for contractors, demarcated on relevant drawings and provided to the Construction Contractor Representative,
- Waste management:
 - Construction wastes will be appropriately stored and handled to minimise discharge, spills or leaks,
 - All construction wastes will be disposed off-site at an appropriately licensed waste facility,
- Fire management:
 - Movement of machines and other vehicles will be restricted to the limits of the areas cleared or on designated tracks,
 - Compliance with Department of Fire and Emergency Services (DFES) and Local Government Authority restrictions to reduce fire risks (e.g., restricted vehicle movements and hot works),
 - Vehicles and large plant/equipment will be fitted with fire extinguishers and restricted to designated cleared areas unless involved in clearing operations, and
- Training:
 - Site inductions will include environmental management requirements for clearing, such as weed/dieback management, managements of impacts to threatened and priority ecological communities and black cockatoo habitat (MRWA, 2021c).

Table 1. Avoidance and minimisation measures employed by the applicant during design and management of the project (MRWA, 2021a).

Design or Management Measure	Applied to Current Design	Discussion and Justification
Steepen batter slopes	Yes	Batters will be steepened beyond standard practice to ensure that clearing does not extend outside the proposed footprint. Retaining walls will be used to minimise clearing where steepening batters is impractical.
Installation of safety barriers	Yes	Installation of safety barriers is required in order to comply with road safety requirements.
Alignment to one side of existing road	Yes	All widening works will be confined to the eastern side of the current road alignment and will utilise existing disturbed areas where possible. The PSP will be upgraded in-situ rather than being relocated.
Alternative alignment to follow existing road (or) to preferentially locate within pasture or a degraded area	Yes	Widening of the on-ramps will utilise previously disturbed verges. It is not possible to realign the freeway or PSP upgrades due to residential developments.
Installation of kerbing	No	Freeway surfacing with Open Graded Asphalt may prevent kerbing from being effective.
Simplification of design to reduce number of lanes and/or complexity of intersections	No	Road design has been simplified as far as possible, however is bound by the necessity to provide sufficient capacity for metering on the ramp.
Preferential use of existing cleared areas for access tracks, construction storage and stockpiling	Yes	Cleared areas will be used for access tracks, construction storage and stockpiling, with no vegetation to be removed for temporary works.
Drainage modification	No	The Project will modify the existing drainage for this section of Hepburn Avenue and Mitchell Freeway to increase basin capacity.
Other design treatment	No	No other design treatment is appropriate for the required work. The Project involves the widening and upgrade of an existing major road alignment. No design alternatives exist to achieve the same outcome while reducing clearing requirements.

After consideration of avoidance and mitigation measures, it was determined that an offset to counterbalance the significant residual impacts to the Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain threatened and priority ecological community and significant foraging and breeding habitat for *Calyptorhynchus latirostris* (Carnaby's cockatoo) was necessary. In accordance with the Government of Western Australia's *Environmental Offsets Policy* and *Environmental Offsets Guidelines*, these significant residual impacts have been addressed through the conditioning of environmental offset requirements on the permit. The nature and suitability of the offset provided are summarised in Section 4.

3.2. Assessment of impacts on environmental values

In assessing the application, the Delegated Officer has had regard for the site characteristics (see Appendix C) and the extent to which the impacts of the proposed clearing present a risk to biological, conservation, or land and water resource values.

The assessment against the clearing principles (see **Error! Reference source not found.**) identified that the impacts of the proposed clearing present a risk to biological values (flora, fauna and ecological communities), and significant remnant vegetation and conservation areas. The consideration of these impacts, and the extent to which they can be managed through conditions applied in line with sections 51H and 51I of the EP Act, is set out below.

3.2.1. Biological values (ecological communities) - Clearing Principle (a)

Assessment

According to available databases and with consideration of the site characteristics of the proposed clearing area (see Appendix C), two state-listed priority ecological communities (PECs) are considered likely to occur within the application area; the "Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain" (Tuart Woodlands) PEC and the "Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region" (Banksia WL SCP) PEC. Both communities are federally listed threatened ecological communities (TECs) under the EPBC Act.

Tuart Woodlands TEC/PEC

The approved conservation advice for the federally-listed Tuart Woodlands TEC, notes that the defining characteristic of this community is the presence of at least two living tuart trees in the uppermost canopy layer, with a gap of no more than 60 metres between the outer edges of the canopy of adjacent tuart trees (DoEE, 2019). Further, the patch boundary for an occurrence of the Tuart Woodlands is defined as 30 metres beyond the outer canopy of the established tuart trees (≥ 15 cm diameter at breast height (DBH)), including dead tuart trees (DoEE, 2019). The key diagnostic criteria for the Tuart Woodlands also includes thresholds for patch size and condition, where a patch

smaller than 0.5 hectares that meets the defining characteristics is not part of the nationally listed community, a patch greater than 5 hectares that meets the defining characteristics in any condition is part of the nationally listed community, and a patch between 0.5 and 5 hectares that meets the defining characteristics may be part of the listed community, dependent on condition (DoEE, 2019). The descriptions, area and condition thresholds that apply to the federally listed TEC also apply to the Tuart Woodlands PEC (DBCA, 2021).

A biological survey undertaken in accordance with the *Technical guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016a) conducted by Astron Environmental Services Pty Ltd (Astron, 2020) identified that the application area intersects two patches of remnant vegetation that meet the key diagnostic criteria and thresholds for patch size and condition to be considered part of the federally-listed Tuart Woodlands TEC and state-listed Tuart Woodlands PEC (Astron, 2020). The application proposes to clear approximately 0.63 hectares within a 35.2 hectare patch of the Tuart Woodlands in the northern section of the application area between Ocean Reef Road and Whitfords Avenue and approximately 2.3 hectares within a separate 9.4-hectare patch in the southern section between Whitfords Avenue and Hepburn Avenue (Astron, 2020). In total, the application proposes to clear 2.93 hectares of Tuart Woodlands in Good to Completely Degraded (Keighery, 1994) condition (Astron, 2020).

It is noted that the application proposes to clear portions of poor condition Tuart Woodland within larger patches of the TEC/PEC, where 2.88 hectares (approximately 98 per cent) of the Tuart Woodlands proposed to be cleared is in Degraded to Completely Degraded (Keighery, 1994) condition (Astron, 2020). It is also acknowledged that the proposed clearing will not result in the loss of entire patches of Tuart Woodland, with the application area representing approximately 1.9 per cent of the northern patch of Tuart Woodland, 24.5 per cent of the southern patch, and 0.4 per cent of the mapped Tuart Woodland in the local area (Astron, 2020). However, the proposed clearing is likely to expose the retained Tuart Woodland adjacent to the application area to a greater risk of disturbance, through edge effects such as weed invasion and anthropogenic disturbance through use of the PSP. The proposed clearing is also likely to reduce vegetation connectivity within the patches of Tuart Woodland, particularly in the southern patch where the clearing area represents 24.5 per cent of the total patch, which may reduce the overall ecological function of the TEC/PEC.

It is also estimated that around 80 to 86 per cent of the Tuart Woodlands TEC has been lost as a result of clearing for agriculture, grazing, logging, mining and urban development since European settlement (DoEE, 2019). Further, the approved conservation advice for the Tuart Woodlands TEC acknowledges that, due to the degree of historical clearing of the ecological community, the high level of disturbance to existing occurrences of the community, and the ongoing risk of degradation, the community is likely to be completely lost if it is not protected and restored (DoEE, 2019). Based on the approved conservation advice and the above assessment, the loss of 2.93 hectares of Tuart Woodlands TEC/PEC is considered to represent a significant residual impact.

Banksia WL SCP TEC/PEC

With respect to the Banksia WL SCP state-listed PEC and federally listed TEC, the key diagnostic criteria for the community includes the presence of at least one of the four diagnostic *Banksia* species, and distinct low woodland to forest structure comprising a canopy co-dominated by *Banksia attenuata* or *Banksia menziesii*, where the emergent tree layer often includes marri, jarrah or tuart, over a diverse shrub or herbaceous understorey (TSSC, 2016). The community typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands, and is also common on sandy colluvium and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau (TSSC, 2016).

Previously, occurrences of the Banksia WL SCP PEC were determined from the composition and location of the vegetation, where no specific patch size or condition thresholds applied (DBCA, 2017). However, the description, area and condition thresholds have since been updated and are now aligned with those that apply to the federally listed Banksia WL SCP TEC (DBCA, 2021). The thresholds for patch size and condition for the Banksia WL SCP TEC/PEC state that a patch should meet at least Good (Keighery, 1994) condition to be considered part of the listed community, and minimum patch size is dependent on vegetation condition and its overall contribution to beta diversity, connectivity, and function of the ecological community across the landscape (TSSC, 2016).

The biological survey was undertaken prior to the updated listing advice for the Banksia WL SCP PEC (MRWA, 2021c). This survey identified that the Jarrah Woodland 2 vegetation type exhibited similarities in composition to the Banksia WL SCP PEC and was inferred to be representative of this community (Astron, 2020). The biological survey identified that approximately 0.42 hectares of vegetation representative of the Banksia WL SCP PEC persists within the application area (Astron, 2020). However, since the listing advice for the Banksia WL SCP PEC was updated, a review of the biological survey identified that the areas previously considered to be representative of the Banksia WL SCP PEC, no longer meet the minimum patch size and condition thresholds to comprise part of the listed community (MRWA, 2021c). The greater patches of vegetation in which the application area occurs are in predominantly Degraded to Completely Degraded (Keighery, 1994) condition (Astron, 2020), and do not meet the minimum

condition of Good (Keighery, 1994) to be considered representative of the Banksia WL SCP TEC or PEC under the updated listing advice. The portion of Good (Keighery, 1994) condition vegetation within the application area is located in the southern patch and has a total area of approximately 0.05 hectares (Astron, 2020), which is below the minimum patch size for Good (Keighery, 1994) condition vegetation to be considered part of the Banksia WL SCP TEC/PEC. Given the above and the updated listing advice, the vegetation within the application area is not considered to be representative of the Banksia WL SCP TEC/PEC. It should be noted, however, that portions of the Jarrah Woodland 1 vegetation type that were originally inferred to represent the Banksia WL SCP PEC are now considered to be representative of the Tuart Woodland TEC/PEC, given the composition of the vegetation and that the greater patch of Tuart Woodland meets the condition and size thresholds for this community (MRWA, 2021a). Impacts to the Tuart Woodlands TEC/PEC are assessed above.

Based on the updated listing advice, the survey identified that the closest occurrence of the Banksia WL SCP TEC/PEC is directly adjacent to the application area within Woodvale Nature Reserve, separated from the application area by an existing PSP and firebreak (MRWA, 2021a; Astron, 2020). It is noted that the application area is likely to be within the buffer zone of this occurrence. The approved conservation advice for the Banksia WL SCP TEC states that the areas considered critical to the survival of the ecological community includes all patches that meet the key diagnostic characteristics and condition thresholds, plus the buffer zone where this comprises surrounding native vegetation (TSSC, 2016). As a portion of the application area lies within the buffer zone of an occurrence of the Banksia WL SCP, the clearing of this area may pose a risk to the continuation of the community by exposing the adjacent vegetation to a greater risk of disturbance through edge effects such as weed invasion and anthropogenic disturbance through use of the PSP and may result in indirect impacts to the overall ecological function of the community. However, given the application area is separated from the occurrence of the Banksia WL SCP by an existing PSP and firebreak, it is not considered likely that the proposed clearing will significantly increase the risk of degradation to the adjacent vegetation and the impacts are expected to be manageable with conditions.

Conclusion

Based on the above assessment, the proposed clearing will result in the loss of 2.93 hectares of native vegetation that is consistent with the federally listed Tuart Woodlands TEC and the state-listed Tuart Woodlands PEC. For the reasons set out above, it is considered that the impacts of the proposed clearing on the Tuart Woodlands TEC/PEC constitutes a significant residual impact. The applicant proposed to allocate 11.6 hectares of a banked offset site to address this impact, as outlined under Section 4.

Based on the above assessment, the Delegated Officer also determined that the proposed clearing may facilitate the spread of weeds and dieback into adjacent retained vegetation in the local area, including adjacent occurrences of the Tuart Woodlands TEC/PEC and the Banksia WL SCP TEC/PEC. It is considered that this impact can be managed to be environmentally acceptable by taking steps to minimise the risk of the introduction and spread of weeds and dieback and does not constitute a significant residual impact.

The applicant may have notification responsibilities under the EPBC Act for impacts to the Tuart Woodlands TEC as set out in the EPBC Act approved conservation advice for the ecological community (DoEE, 2019). It is understood that the applicant has referred the project to the federal Department of Water, Agriculture and the Environment (DAWE), who are considering the project under EPBC 2020/8833.

Conditions

To address the above impacts, the following management measures will be required as conditions on the clearing permit:

- Dieback and weed control, which ensures protocols are put in place to limit the introduction and transportation of dieback- and weed-affected materials, and
- Offset – land allocation, which requires the allocation of 11.6 hectares of a banked offset site that is representative of the Tuart Woodlands TEC/PEC.

3.2.2. Biological values (flora) - Clearing Principles (a) and (c)

Assessment

A review of available databases indicates that a total of 24 rare flora species have been recorded within the local area (see Appendix C). These species were listed under the state BC Act and/or Commonwealth EPBC Act, or as Priority (P) species by the Department of Biodiversity Conservation and Attractions (DBCA).

Of the conservation significant flora species recorded within the local area, the following have the potential to be found within the application area based on habitat preferences (see Appendix C.3):

- *Acacia benthamii* (P2)
- *Amanita preissii* (P3)
- *Austrostipa mundula* (P3)

- *Baeckea* sp. Limestone (N. Gibson & M.N. Lyons 1425) (P1)
- *Caladenia huegelii* (T)
- *Conostylis bracteata* (P3)
- *Eucalyptus argutifolia* (T)
- *Hibbertia leptotheca* (P3)
- *Jacksonia sericea* (P4)
- *Pimelea calcicola* (P3)
- *Sarcozona bicarinata* (P3)
- *Stylidium paludicola* (P3)
- *Styphelia filifolia* (P3)
- *Thelymitra variegata* (P2)

A targeted flora survey undertaken in accordance with the *Technical guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016a) conducted by Astron (2020) over seven days between September 2019 and April 2020 did not identify any state or federally listed threatened flora species within the application area or within the greater survey area, which included remnant vegetation within road reserves on the eastern side of Mitchell Freeway, ranging from just north of Hodges Drive to Reid Highway (Astron, 2020). Three priority flora species were recorded within the greater survey area: *Jacksonia sericea*, *Ricinocarpos tuberculatus* (P2), and *Grevillea olivacea* (P4), however only one record of *Grevillea olivacea* was identified within the application area itself (Astron, 2020).

Jacksonia sericea is a low spreading shrub that produces orange flowers between December and February and is typically associated with sandy soils in low Eucalyptus and Banksia woodland (Western Australian Herbarium, 1998-). The targeted flora survey identified 17 individuals within the greater survey area, however 16 of these individuals occur more than 2 kilometres north of the application area, adjacent to Hodges Drive, and the remaining individual occurs in remnant vegetation approximately 300 to 400 metres in-between two portions of the application area, adjacent to Camarino Drive (Figure, 5; Astron, 2020). No individuals were recorded within the application area itself during the targeted survey and it is not expected that the proposed clearing will result in impacts to individuals (Astron, 2020). Further, *Jacksonia sericea* is locally abundant and is known from 35 records within a 10-kilometre radius of the application area (Western Australian Herbarium, 1998-). Given the above and the highly disturbed nature of the area proposed to be cleared, while the vegetation within the application area may provide suitable habitat for *Jacksonia sericea*, it is not considered likely to provide significant habitat or to be essential for the continuation of the species.

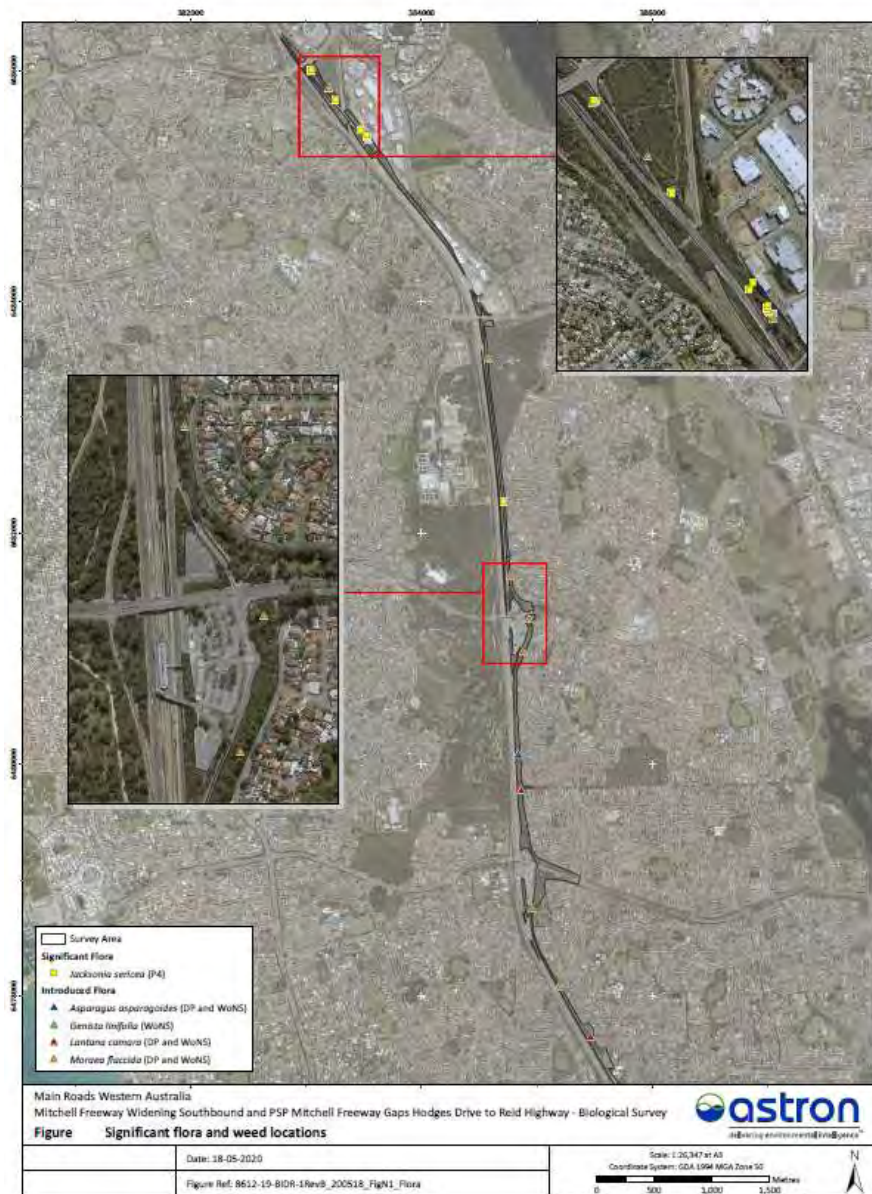


Figure 5. Locations of *Jacksonia sericea* within the greater survey area (Astron, 2020).

Ricinocarpos tuberculatus is an erect shrub with white flowers occurring between September and October and is typically associated with sandy soils in rocky hillsides and granite outcrops, often in *Acacia* dominated shrubland (Western Australian Herbarium, 1998-). The natural range of *Ricinocarpos tuberculatus* is approximately 130 kilometres east of the application area, from Beverley to Bruce Rock (Western Australian Herbarium, 1998-). *Grevillea olivacea* is an erect, non-lignotuberous shrub that produces red to red-pink flowers between June and September and typically occurs within calcareous sands over limestone in open shrubland or heath (Western Australian Herbarium, 1998-). The natural range of *Grevillea olivacea* is approximately 100 kilometres north of the application area, from Dandaragan to Greater Geraldton (Western Australian Herbarium, 1998-). Given these species have been identified well outside of their natural range and are known to be cultivated and planted in the metropolitan area, occurrences of these species within the greater survey area were considered to have been the result of planting rather than a natural occurrence (Astron, 2020). No occurrences of *Ricinocarpos tuberculatus* were identified within the application area during the targeted survey and no impacts to individuals are expected to result from the proposed clearing, with the closest individual located in remnant vegetation approximately 250 to 300 metres in-between two portions of the application area, adjacent to Camarino Drive (Astron, 2020). One record of *Grevillea olivacea* was identified within the application area during the targeted survey and this individual is expected to be impacted by the clearing (Astron, 2020). However, given this individual is not suspected to be naturally occurring, that the application area is well outside of the natural range of *Grevillea olivacea*, and noting the high degree of disturbance within the

application area, the proposed clearing is not considered likely to constitute significant habitat or to be critical for the continuation of the species.

No other threatened or priority flora species listed above were identified within the application area or greater survey envelope during the targeted survey (Astron, 2020). The targeted flora survey was undertaken by an experienced botanist over four days between September and October 2020 and an additional three days between March and April 2020, comprising a combination of 11 quadrats and 41 relevés in areas of remnant vegetation (Astron, 2020). It is considered that the survey would have identified any of the threatened and priority flora listed above, should they have occurred within the application area.

It should be noted that *Amanita preissii*, *Caladenia huegelii*, and *Eucalyptus argutifolia* were not specifically targeted in the flora survey, as Astron's desktop assessment did not identify these species as occurring within a 5 kilometre radius of the survey area (Astron, 2020). *Amanita preissii* is a mycorrhizal fungus that is approximately 120 millimetres tall, predominantly white with cream gills and multiple ochre scales and rings, and typically occurs within sandy soils and leaf litter in Eucalyptus woodland (Western Australian Herbarium, 1998-). *Caladenia huegelii* is a perennial herb with green, cream and red flowers, associated with woodlands over low heath or shrub, dominated by *Eucalyptus* spp., *Agonis flexuosa* (peppermint) or *Banksia* spp., within brown to grey sandy soils (Western Australian Herbarium, 1998-). *Caladenia huegelii* flowers from September to October, and outside of this period, persists as an underground tuber (Western Australian Herbarium, 1998-). *Eucalyptus argutifolia* is a mallee eucalypt with white flowers occurring between March and April and is typically associated with brown to grey sandy soils over limestone in mixed heath or woodland (Western Australian Herbarium, 1998-). Noting the habitat preferences and ecology of *Amanita preissii*, *Caladenia huegelii*, and *Eucalyptus argutifolia*, the timing of the targeted flora survey and the methods undertaken in accordance with the *Technical guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016a), it is considered that these species would have been identified should they have occurred within the application area, even though they were not specifically targeted. Therefore, it is not considered likely that the application area comprises significant habitat for these species.

Noting the flora survey did not identify the other species considered likely to occur within the application area based on habitat preference as listed above (and as noted in Appendix C.3), the proposed clearing is not likely to have a significant impact on these flora species.

Conclusion

Based on the above assessment, the proposed clearing is not considered likely to represent significant habitat for any threatened or priority flora species or to be critical for the continuation of these species. For the reasons set out above, it is considered that impacts to conservation significant flora species are unlikely to result from the proposed clearing and that this does not constitute a significant residual impact.

Conditions

No flora management conditions required.

3.2.3. Biological values (fauna) - Clearing Principle (b)

Assessment

A review of available databases indicates that a total of 52 conservation significant fauna species have been recorded within the local area (see Appendix C). These species were listed under the state BC Act and/or Commonwealth EPBC Act, as Priority species by DBCA, or are migratory species listed under International Agreements.

Of the conservation significant fauna species recorded within the local area, the following have the potential to be found within the application area based on habitat preferences (see Appendix C.4):

- *Calyptorhynchus banksii naso* (Forest red-tailed black cockatoo)
- *Calyptorhynchus baudinii* (Baudin's cockatoo)
- *Calyptorhynchus latirostris* (Carnaby's cockatoo)
- *Falco peregrinus* (Peregrine falcon)
- *Hylaeus globuliferus* (Woolybush bee)
- *Idiosoma sigillatum* (Swan Coastal Plain shield-backed trapdoor spider)
- *Isodon fusciventer* (Quenda)
- *Neelaps calonotos* (Black-striped burrowing snake)

Black cockatoo species

The forest red-tailed black cockatoo, Baudin's cockatoo, and Carnaby's cockatoo, collectively known as black cockatoo species, are known to nest in hollows of live and dead trees, including marri (*Corymbia calophylla*), jarrah (*Eucalyptus marginata*), karri (*Eucalyptus diversicolor*), wandoo (*Eucalyptus wandoo*), tuart, flooded gum (*Eucalyptus*

rudis), and other *Eucalyptus* spp. (Commonwealth of Australia, 2012). 'Breeding habitat' for black cockatoos includes trees of these species that either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to develop a nest hollow, where suitable DBH for nest hollows is 500 millimetres for most tree species (Commonwealth of Australia, 2012). While breeding, black cockatoos also generally forage within a 6 to 12 kilometre radius of their nesting site (Commonwealth of Australia, 2012). According to available datasets, mapped potential black cockatoo feeding habitat is recorded within a 12-kilometre radius of the application area, including within the application area itself, making it a suitable location for breeding if appropriate hollows are present.

The application area is mapped outside of the modelled breeding range for all three black cockatoo species (Commonwealth of Australia, 2012). However, Carnaby's cockatoos have been observed breeding in a combination of natural and artificial hollows within the Edith Cowan University Campus (Kirkby, 2020), with confirmed breeding sites located approximately two kilometres north of the application area and also outside of the modelled breeding range (DBCA, 2007-). It has also been noted that the breeding range of Carnaby's cockatoo has shifted in the last 10-30 years, with increased records in the jarrah-marri forests of the Darling Scarp and the tuart forests of the Swan Coastal Plain (Johnstone and Kirkby, 2008). Given the proximity of the application area to confirmed breeding sites and the shifting breeding range of the species, it is considered possible for Carnaby's cockatoos to utilise the application area for breeding, where suitable hollows persist. In regard to the forest red-tailed black cockatoo and Baudin's cockatoo, these species have a tendency to favour breeding trees within or on the edges of intact forests in the south-west (DEC, 2008). Further, the closest confirmed breeding site is approximately 30 kilometres south-east of the application area for Baudin's cockatoo and approximately 40 kilometres east of the application area for the forest red-tailed black cockatoo (DBCA, 2007-). Given the above, it is not considered likely that the application area will comprise potential breeding habitat for Baudin's cockatoo or the forest red-tailed black cockatoo.

A targeted black cockatoo habitat assessment undertaken in accordance with the *Technical guidance – Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA, 2016b) and the referral guidelines for three threatened black cockatoo species (Commonwealth of Australia, 2012) was conducted over four days between September 2019 and March 2020 (Astron, 2020). The survey area for this assessment included remnant vegetation within road reserves on the eastern side of Mitchell Freeway, ranging from just north of Hodges Drive to Reid Highway, including the length of the application area (Astron, 2020). The black cockatoo habitat assessment identified that 107 habitat trees of suitable DBH to provide breeding habitat were present within the application area, of which eight trees were identified to contain hollows (Astron, 2020). A second black cockatoo habitat assessment was subsequently undertaken over two days in June 2020 to inspect the habitat trees for suitable breeding hollows (Kirkby, 2020). This assessment identified that two trees within the application area, designated Tree 190 (a dead stag) and Tree 290 (a tuart), contained two hollows, one per tree, of suitable size for use as breeding habitat by black cockatoos (Kirkby, 2020). Both hollows exhibited chew marks at their entrance, but it could not be confirmed whether these were made by black cockatoos or another parrot species (Kirkby, 2020). The remaining hollows within the application area were not considered to be of suitable size for use as breeding habitat, given either the entrance size of the hollow was too small for a black cockatoo or the internal hollow was too shallow for nesting (Kirkby, 2020).

Noting the above, the application area may contain two suitable breeding hollows for Carnaby's cockatoo. The loss of breeding hollows and reduced nest availability through land clearing and destruction of habitat has been identified as one of the key threats to Carnaby's cockatoo, contributing to increased competition for hollows and reduced breeding rates and reproductive success (DPAW, 2013). Studies have shown that it may also take up to 200 years for a Eucalypt to develop suitable nest hollows for black cockatoo species (Saunders et al., 1982; Rose, 1993; Whitford and Williams, 2002), which represents a significant time lag between the loss and replacement of breeding habitat (EPA, 2019). Given the above, the loss of two suitable breeding hollows is considered to represent a significant impact to Carnaby's cockatoo.

It is acknowledged that the potential breeding trees within the application area and greater survey area may also represent suitable roosting habitat for black cockatoo species. According to available databases, the application area also occurs within one kilometre of two confirmed roost sites (DBCA, 2007-). However, no evidence of roosting was observed during either of the black cockatoo habitat assessments (Astron, 2020; Kirkby, 2020). Further, roosting is typically noted to occur within suitable trees close to an important water source and within an area of quality foraging habitat (Commonwealth of Australia, 2012). As the application area does not transect any watercourses and contains sparsely distributed foraging habitat, as discussed below, it is not considered likely that the application area contains significant roosting habitat for any black cockatoo species.

Black cockatoo species are noted to forage on a range of plant species, with the primary foraging resources varying between species (Commonwealth of Australia, 2012). Carnaby's cockatoos forage on the seeds, nuts and flowers of a variety of plants, including Proteaceous species (*Banksia*, *Hakea* and *Grevillea*), as well as *Allocasuarina* and *Eucalyptus* species, marri and a range of introduced species (Valentine and Stock, 2008). On the Swan Coastal Plain, it is noted that *Banksia* species (predominantly *Banksia attenuata*, *Banksia menziesii* and *Banksia sessilis*) are the most important natural food source for Carnaby's cockatoo, followed by marri (Groom, et al., 2014). Forest red-tailed black cockatoos feed predominantly on the seeds of marri and jarrah, which comprise approximately 90 per cent of their diet (DEC, 2008). Baudin's cockatoos primarily feed on the seeds of marri, but may also forage on the seeds of jarrah and Proteaceous species (DEC, 2008). Given the application area contains jarrah, marri, *Banksia* spp., and sheoak (*Allocasuarina fraseriana*), and occurs within the predicted occurrence range for both the forest red-tailed black cockatoo and Carnaby's cockatoo, the application area is likely to provide suitable foraging habitat for these species. The application area occurs 15 kilometres east of the predicted occurrence range for Baudin's cockatoo (Commonwealth of Australia, 2012) and is not considered likely to provide foraging habitat for this species.

The black cockatoo habitat assessment identified that both the Tuart Woodland 2 and Jarrah Woodland 2 vegetation units contained suitable foraging species for Carnaby's cockatoo and were likely to comprise foraging habitat for this species (Astron, 2020). The Jarrah Woodland 2 vegetation unit was also considered to comprise potential foraging habitat for the forest red-tailed black cockatoo, given the abundance of preferred foraging species (Astron, 2020). In total, the black cockatoo habitat assessment identified that the application area includes 3.02 hectares of foraging habitat for Carnaby's cockatoo and 0.63 hectares of foraging habitat for the forest red-tailed black cockatoo (Astron, 2020). Further, during the botanical surveys undertaken in September 2019, two individual Carnaby's cockatoos were observed foraging on *Banksia prionotes* and jarrah trees, and evidence of foraging on marri nuts by forest red-tailed black cockatoos was also observed within the survey area (Figures 6-7; Astron, 2020). During the black cockatoo habitat assessment, seven individual Carnaby's cockatoos were observed and evidence of foraging by Carnaby's cockatoos on marri fruit was recorded in three separate locations throughout the survey area in March 2020 (Astron, 2020). Foraging evidence from the forest red-tailed black cockatoo on marri and sheoak fruit were also recorded at three locations during the March 2020 survey (Figures 8-9; Astron, 2020). Noting the above, it is considered likely that the application area is being utilised for foraging by both Carnaby's cockatoo and the forest red-tailed black cockatoo.



Figure 6. Carnaby's cockatoo individual foraging on *Banksia prionotes* during black cockatoo habitat assessment (Astron, 2020).

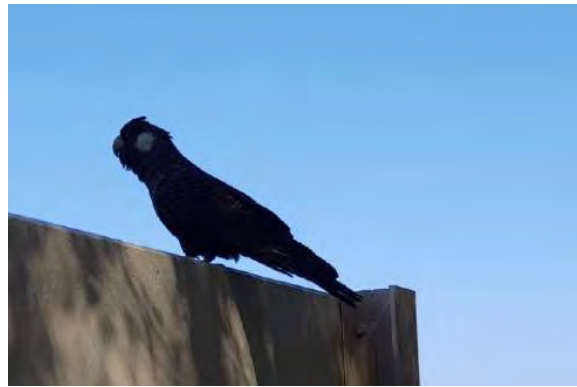


Figure 7. Carnaby's cockatoo individual observed during black cockatoo habitat assessment (Astron, 2020).



Figure 8. Evidence of foraging on marri nuts by forest red-tailed black cockatoo, observed during black cockatoo habitat assessment (Astron, 2020).



Figure 9. Evidence of foraging on sheoak seeds by red-tailed black cockatoo, observed during black cockatoo habitat assessment (Astron, 2020).

The black cockatoo habitat assessment noted that the foraging habitat present within the application area was unlikely to represent high quality foraging habitat, as defined in the referral guidelines for black cockatoo species (Commonwealth of Australia, 2012), given the altered and disturbed condition of the vegetation and the sporadic and isolated distribution of suitable foraging species (Astron, 2020). It is also acknowledged that, according to available databases, there is approximately 4600 hectares of potential black cockatoo foraging habitat remaining in the local area, of which the application area comprises approximately 0.065 per cent. A number of conservation reserves also persist within 10 kilometres of the application area, including Woodvale Nature Reserve, Lake Joondalup Nature Reserve, and Neerabup National Park, which are likely to provide larger areas of higher quality foraging habitat for black cockatoo species. However, maintaining foraging habitat irrespective of size and understorey condition has been noted as particularly important within the Perth Metropolitan Region, due to the role of these feeding areas in the survival of young birds and the maintenance of the population between breeding seasons, coupled with the lack of habitat remaining in this region and its connectivity values for migrating birds (Commonwealth of Australia, 2012). Accordingly, the referral guidelines for black cockatoo species acknowledges that foraging habitat within 12 kilometres of a breeding site and within 6 kilometres of a night roost are of particular importance for the species (Commonwealth of Australia, 2012). Remnant vegetation is also relatively sparse within the local area and, according to available databases, potential foraging habitat for black cockatoos in the local area is limited to a subset of these remaining remnants. Given the above, despite the degraded nature of the vegetation, the application area may still constitute significant foraging habitat for Carnaby's cockatoo and the forest red-tailed black cockatoo in a highly cleared landscape, where it is in close proximity to roosting and breeding sites.

In regard to the forest red-tailed black cockatoo, critical habitat for the species is defined as all marri, karri and jarrah forests, woodlands and remnants in the south-west of Western Australia receiving more than 600 millimetres of annual average rainfall (DEC, 2008). As the application area includes remnant jarrah woodland on the Swan Coastal Plain and evidence of foraging by forest red-tailed black cockatoos was observed during the black cockatoo habitat assessment, the application area may meet the definition of critical habitat for the forest red-tailed black cockatoo. However, it is noted that the jarrah woodland within the application area is in poor condition and is likely to provide 0.63 hectares of low quality foraging habitat for the forest red-tailed black cockatoo, comprising approximately 0.012 per cent of all mapped foraging habitat in the local area. Further, according to available databases, while the application area occurs within one kilometre of potential roost sites, the application area occurs approximately 40 kilometres from the closest confirmed breeding site for the forest red-tailed black cockatoo and is unlikely to support breeding individuals (DBCA, 2007-). It is also noted that the application area itself is not likely to provide potential breeding habitat, given it is outside of the modelled breeding range for the forest red-tailed black cockatoo (Commonwealth of Australia, 2012). Given the above, the extent and quality of foraging habitat proposed to be cleared, and the presence of larger, higher quality remnants of potential foraging habitat in the local area, it is not considered likely that the 0.63 hectares of foraging habitat within the application area is significant for the ongoing maintenance of the forest red-tailed black cockatoo.

In regard to Carnaby's cockatoo, critical habitat includes any habitat that provides for feeding, watering, regular night roosting and potential for breeding (DPAW, 2013). As the application area includes 3.02 hectares of suitable foraging habitat and potential breeding trees, it is likely to comprise critical habitat for Carnaby's cockatoo. The application area is also located within one kilometre of potential roost sites and within two kilometres of confirmed breeding sites at the Edith Cowan University Campus (Kirkby, 2020), meaning the application area may support the foraging of breeding individuals. While it is acknowledged that the application area comprises approximately 0.065 per cent of all mapped foraging habitat in the local area, it is noted that potential foraging habitat within 12 kilometres of the confirmed breeding sites has been historically cleared and is highly disturbed and fragmented. The loss or degradation of foraging habitat within 12 kilometres of nesting sites is also considered to pose the greatest risk to Carnaby's cockatoo, according to the species' recovery plan (DPAW, 2012). Further, the clearing of foraging habitat on the Swan Coastal Plain is identified as a key threatening process for Carnaby's cockatoo, with the main factor limiting population growth of Carnaby's cockatoo being adult survival, related directly to bottlenecks in food resources on the Swan Coastal Plain and the ongoing removal of food resources (EPA, 2019; Williams, et al., 2017; Groom, 2015; Stock, et al., 2013, DPAW, 2012). Therefore, the loss of 3.02 hectares of foraging habitat within close proximity to a breeding site is considered to represent a significant risk to critical Carnaby's cockatoo habitat.

Noting that the local area is highly modified and that a large degree of historical clearing has occurred, the application area may also provide an ecological linkage for black cockatoo species moving through the local area. Given both Carnaby's cockatoos and forest red-tailed black cockatoos were observed within the greater survey area during the black cockatoo habitat assessment (Astron, 2020), it is likely that these species are using the application area as an ecological linkage. However, noting the application area comprises 0.05 per cent of all remnant vegetation in the local area and is adjacent to larger remnants of native vegetation including Woodvale Nature Reserve and Bush Forever Site 303, it is unlikely that the proposed clearing of 3.02 hectares will significantly reduce the capacity of the remaining vegetation within the local area to act as an ecological linkage. Therefore, it is not considered likely that the proposed clearing will result in significant impacts to black cockatoo species migrating through the local area.

Peregrine falcon

The peregrine falcon typically nests on rocky ledges in tall, vertical cliff faces and gorges, or in tall trees associated with drainage lines, and can hunt in a range of habitat types including timbered watercourses, riverine environments, wetlands, plains, open woodlands, and pylons and spires of buildings (DAWE, 2021). A desktop assessment and fauna likelihood analysis undertaken by Astron (2020), noted that the application area may provide suitable foraging habitat for the peregrine falcon, given its woodland structure and proximity to existing records (Astron, 2020). However, noting that the peregrine falcon is a highly mobile species with a large home range that does not rely on specialist niche habitats, it is unlikely that the application area represents significant habitat for the species. Further, noting that the application area is highly disturbed and is adjacent to larger intact remnants of native vegetation including Woodvale Nature Reserve and Bush Forever Site 303, it is unlikely that the peregrine falcon would be reliant on the application area for foraging in the local area.

Invertebrates

The habitat preferences of the woolybush bee are not well known. The species is thought to favour the flowers of *Adenanthos cygnorum* for feeding but has also been recorded on *Banksia attenuata*, and is thought to be associated with a variety of habitats in which these species are present (Houston, 2018). As *Banksia attenuata* is present within the application area, it is considered to contain suitable habitat for the woolybush bee. Therefore, the proposed clearing may result in the loss of some habitat for the species. However, given that the application area contains 3.02 hectares of degraded roadside vegetation across a six kilometre long, linear footprint, and that its primary foraging species, *Adenanthos cygnorum*, is absent, it is unlikely that the application area is significant for the continuation of the woolybush bee. Further, the species is considered to be highly mobile and is likely to have access to larger remnants of suitable habitat in the local area, including the adjacent *Banksia* woodland within Woodvale Nature Reserve. Given the above, it is not considered likely that the woolybush bee is reliant on the application area for foraging or that the application area comprises significant habitat for the species.

The Swan Coastal Plain shield-backed trapdoor spider is associated with *Banksia* woodland and heathland in sandy soils on the Swan Coastal Plain and is largely restricted to bushland remnants in the Greater Perth region (Rix et al., 2018). Given the application area includes remnant woodland in the Perth Metropolitan Area, occurs on sandy soils, and is in close proximity to an existing record, it is possible that the application area provides suitable habitat for the Swan Coastal Plain shield-backed trapdoor spider. However, the application area comprises primarily tuart and jarrah woodland with a sparse mid-storey of *Banksia attenuata* (Astron, 2020), and is unlikely to represent the preferred

habitat of the Swan Coastal Plain shield-backed trapdoor spider. It is likely that larger remnants of higher quality vegetation would provide more favourable habitat for this species in the local area, such as the adjacent Woodvale Nature Reserve, which includes surveyed Banksia woodland (Astron, 2020). Further, the application area is highly disturbed from adjacent land uses, is in predominantly Degraded to Completely Degraded (Keighery, 1994) condition, and is likely to be too poor in condition to support a significant population of the Swan Coastal Plain shield-backed trapdoor spider. Noting the above, the application area is unlikely to constitute significant habitat for the Swan Coastal Plain shield-backed trapdoor spider.

Ground-dwelling fauna

Quenda are ground-dwelling marsupials, typically associated with forest or woodlands near watercourses, where understorey consists of dense scrub and leaf litter is abundant (DEC, 2012). One deceased individual, the result of vehicle strike, was recorded within the greater survey area during biological surveys, located within planted vegetation approximately 228 metres south of Woodvale Nature Reserve (Astron, 2020). Quenda diggings were also identified at two other locations within the greater survey area; however, no observations of quenda were recorded within the application area itself (Astron, 2020). Given the above, it is likely that the application area contains suitable habitat for quenda. While the suitability of habitat for quenda is acknowledged, it is noted that the application area contains 3.02 hectares of degraded roadside vegetation across a long, linear footprint and that native understorey is sparse and highly disturbed throughout the application area. Further, the application area is adjacent to larger remnants of suitable habitat for quenda including Woodvale Nature Reserve, and it is expected that individuals will be able to disperse into this vegetation at the time of clearing, given the application of slow, progressive directional clearing. Given the extent of the proposed clearing, the condition of the vegetation and the proximity of the application area to suitable habitat, the application area is not considered likely to comprise significant habitat for quenda.

The black-striped burrowing snake is associated with deep sandy soils in Banksia and jarrah woodland on the Swan Coastal Plain (ALA, 2021). Therefore, it is considered that the Jarrah Woodland 2 vegetation unit may provide suitable habitat for this species within the application area. However, the biological survey identified that the Jarrah Woodland 2 vegetation unit is in predominantly Degraded to Completely Degraded (Keighery, 1994) condition, mostly devoid of native understorey species and is likely to be too poor in condition to support the black-striped burrowing snake (Astron, 2020). Further, the application area is adjacent to larger remnants of vegetation such as Woodvale Nature Reserve, which are likely to provide more suitable habitat for the species. Given the above, the application area is unlikely to constitute significant habitat for the black-striped burrowing snake.

Ecological linkage

The northern portion of the application area forms part of a north south regionally significant ecological linkage (Conceptual Linkage) defined by the Gngangara Sustainability Strategy (2009). Conceptual linkages are proposed ecological linkages based on past studies and new linkages across the landscapes with less than 60 percent native vegetation retained or on core landscapes that are predominantly over private property (Brown et al., 2009). This linkage provides value as a north-south ecological linkage within a highly fragmented landscape, particularly between Lake Joondalup (Bush Forever Site 299), Woodvale Nature Reserve (Bush Forever Site 407) and Bush Forever Site 303; and therefore, is likely to facilitate the movement of fauna between these areas.

It is noted that the existing Mitchell Freeway has already severed part of this linkage, resulting in the separation of Woodvale Nature Reserve and Bush Forever Site 303. Further, it is noted that the extent of clearing proposed within the mapped conceptual linkage is approximately 0.473 hectares of Degraded to Completely Degraded (Keighery, 1994) vegetation on the western edge of a bushland remnant, bordering the existing Mitchell Freeway. Given the location of existing infrastructure, and the location and extent of the northern portion of the application area, it is not considered likely that the application area is significantly contributing to the function of the conceptual linkage. Therefore, the proposed clearing is unlikely to significantly reduce connectivity within the conceptual linkage or to significantly impact the ecological function of the conceptual linkage. While the clearing proposed will not significantly impact the conceptual linkage, it is acknowledged that the clearing within the northern portion of the application area will create a wider barrier for fauna movement, particularly between Woodvale Nature Reserve and remnant vegetation within the road reserves east of the Mitchell Freeway. However, given the presence of existing infrastructure and the extent of the proposed clearing, it is not considered that the movement of fauna between remnant vegetation and Woodvale Nature Reserve will be significantly impacted.

Whilst outside of the mapped conceptual linkage, it is also acknowledged that the clearing proposed in the southern portion of the application area will result in the fragmentation and loss of roadside remnant vegetation. Noting that this portion persists within a highly cleared landscape, the proposed clearing is likely to reduce vegetation connectivity

and limit fauna movement within and between the roadside remnants in the southern portion of the application area. However, the vegetation in this area consists of a mosaic of planted and native vegetation in Degraded to Completely Degraded condition and has already been severely fragmented by existing land uses (Astron, 2020). Further, the vegetation in the southern portion of the application area is isolated from larger remnants of vegetation in the local area and includes a thin strip of vegetation between the existing Mitchell Freeway to the west, Whitfords Avenue to the north, Hepburn Avenue to the south, and residential properties to the east. There is also a larger remnant of native vegetation on the western side of the Mitchell Freeway, which is more likely to be utilised as an ecological linkage in the local area, given the constrained nature of vegetation in the eastern road reserves. Noting the isolation of the vegetation and the presence of a more suitable linkage to the west, it is unlikely that the southern portion of the application area acts as a significant ecological linkage in the local area. The applicant has also advised that roadsides will be landscaped through the replanting of similar vegetation within the road reserve following construction under the Mitchell Freeway Principal Shared Path Gaps Project, which is likely to maintain some connectivity throughout the road reserve (MRWA, 2021c). Given the above, it is not considered likely that the proposed clearing will significantly impact fauna movement in the local area.

Conclusion

Based on the above assessment, the proposed clearing will result in:

- The loss of two trees with two suitably sized nesting hollows for Carnaby's cockatoo; and
- The loss of 3.02 hectares of significant foraging habitat for Carnaby's cockatoo.

For the reasons set out above, it is considered that potential direct impacts to fauna resulting from the proposed clearing can be managed through directional clearing and fauna management conditions.

However, for the reasons set out above, it is considered that the impacts of the proposed clearing to significant breeding and foraging habitat for Carnaby's cockatoo constitutes a significant residual impact. The applicant proposed to install artificial nesting hollows at a 3:1 ratio for each suitable hollow proposed to be cleared and to revegetate and rehabilitate 7.1 hectares of suitable foraging habitat for Carnaby's cockatoo from a Degraded to Good (Keighery, 1994) condition within DBCA managed land to address this impact, as outlined under Section 4.

The applicant may have notification responsibilities under the EPBC Act for impacts to Carnaby's cockatoo and its habitat, as set out in the EPBC Act referral guidelines for these species. It is understood that the applicant has referred the project to the federal Department of Water, Agriculture and the Environment (DAWE), who are considering the project under EPBC 2020/8833.

Conditions

To address the above impacts, the following management measures will be required as conditions on the clearing permit:

- Directional clearing, which requires slow, progressive, one directional clearing to allow terrestrial fauna to disperse ahead of the clearing activity should they occur on site at the time of clearing,
- Fauna management (black cockatoos), which requires inspection of habitat trees by a fauna specialist for the presence of Carnaby's cockatoos prior to clearing. The applicant will not be permitted to clear trees where Carnaby's cockatoo has been identified, until a fauna specialist has verified that the hollow/s are no longer being utilised for nesting,
- Fauna management (install black cockatoo nesting hollow), which requires the installation of artificial black cockatoo nesting hollows at a 3:1 ratio within land managed by DBCA, and
- Offset – revegetation and rehabilitation, which requires the revegetation and rehabilitation of 7.1 hectares of suitable foraging habitat for Carnaby's cockatoo from a Degraded to Good (Keighery, 1994) condition within DBCA managed land.

3.2.4. Significant remnant vegetation and conservation areas - Clearing Principles (e) and (h)

Assessment

The national objectives and targets for biodiversity conservation in Australia has a target to prevent clearance of ecological communities with an extent below 30 per cent of that present pre-1750, below which species loss appears to accelerate exponentially at an ecosystem level (Commonwealth of Australia, 2001). Noting that the current vegetation extent for the mapped Swan Coastal Plain vegetation complex (Karrakatta Complex - Central and South) and vegetation extent within the local area fall below the 30 per cent threshold (see Appendix C.2), the application area is considered to be a remnant within an extensively cleared landscape. Noting that the application area includes vegetation that comprises significant breeding and foraging habitat for Carnaby's cockatoo, contributes to vegetation connectivity and ecological linkages in the local area, and is representative of the Tuart Woodlands TEC/PEC, the application area is considered to be a significant remnant of vegetation.

However, the Environmental Protection Authority (EPA) recognises the Perth Metropolitan Region to be a constrained area, within which a minimum 10 per cent representation threshold for ecological communities is recommended (EPA, 2008). The current vegetation extent for the Swan Coastal Plain IBRA Bioregion, the Karrakatta Complex - Central and South, and the local area are all above the 10 per cent threshold for constrained areas (see Appendix C.2). Further, the proposed clearing area comprises less than 0.05 per cent of vegetation remaining in the local area and within the Karrakatta Complex - Central and South, and less than 0.001 per cent of current vegetation extent for the Swan Coastal Plain IBRA Bioregion. It is also noted that the application area comprises long, linear remnants of native vegetation in Good to Completely Degraded (Keighery, 1994) condition, within a highly urbanised and developed local area, which are likely to be subject to ongoing disturbance and degradation. While the application area contributes to foraging values for Carnaby's black cockatoo and represents the Tuart woodland TEC, noting the above, the proposed clearing is not considered likely to have a significant impact on vegetation extent within the extensively cleared local area.

As discussed under Section 3.2.3, the northern portion of the application area forms part of a north south regionally significant ecological linkage (Conceptual Linkage) defined by the Gnangara Sustainability Strategy (2009) and the southern portion of the application area contributes to ecological linkage values within a highly cleared landscape. Given the location and extent of the clearing, the proposed clearing is not considered likely to significantly impact the function of the conceptual linkage in the northern portion of the application area. The proposed clearing is considered likely to reduce vegetation connectivity within road reserves on the eastern side of Mitchell Freeway, particularly in the southern portion of the application area where the proposed clearing is likely to result in fragmentation of remnant vegetation. However, given the condition of the vegetation and the isolation and fragmentation from existing land uses, it is unlikely that the application area acts as a significant ecological linkage or that the proposed clearing will significantly impact vegetation connectivity in the local area.

It is also noted that the northern portion of the application area, between Ocean Reef Road and Whitfords Avenue, is adjacent to Woodvale Nature Reserve. The application area also occurs within 100 metres of Bush Forever Site 303, which runs along its length to the west. However, as the application area is separated from the Bush Forever Site by the Mitchell Freeway, it is not expected that the proposed clearing will result in impacts to this area.

While no clearing of vegetation is proposed to occur within Woodvale Nature Reserve and the application area is separated from the reserve by an existing PSP and firebreak, it is acknowledged that the proposed clearing has the potential to facilitate the spread of weeds and dieback to the adjacent nature reserve and other retained remnant vegetation in the local area. A weed and dieback management condition is considered to minimise this risk, and it is not considered likely that the proposed clearing will have a significant impact on the environmental values of any adjacent or nearby conservation area.

Conclusion

Based on the above assessment, the proposed clearing is unlikely to result in significant impacts to vegetation extent within an extensively cleared area or to impact significant ecological linkages but may facilitate the spread of weeds and dieback into adjacent retained vegetation in the local area, including an adjacent conservation area. For the reasons set out above, it is considered that the impacts of the proposed clearing can be managed to be environmentally acceptable by taking steps to minimise the risk of the introduction and spread of weeds and dieback and does not constitute a significant residual impact.

Conditions

To address the above impacts, the following management measure will be required as a condition on the clearing permit:

- Dieback and weed control, which ensures protocols are put in place to limit the introduction and transportation of dieback- and weed-affected materials.

3.3. Relevant planning instruments and other matters

The clearing permit application was advertised on the Department of Water and Environmental Regulation's website on 5 March 2021, inviting submissions from the public within a 21-day period. One submission was received in relation to this application (see Appendix B).

The City of Joondalup (the City) advised that, given the proposed clearing predominantly consists of degraded vegetation, the City had no objections to the proposed works or any further comments on the application (City of Joondalup, 2021).

The Mitchell Freeway Principal Shared Path Gaps Project (Ocean Reef Road to Hepburn Avenue) is currently being assessed separately by the Commonwealth Department of Agriculture, Water and the Environment (DAWE) under the EPBC Act (reference 2020/8833 - Mitchell Freeway Principal Shared Path Gaps Project Ocean Reef Road to

Hepburn Avenue). On 11 December 2020, DAWE determined that the project is a controlled action that requires assessment and approval under the EPBC Act. DAWE is yet to finalise a decision on the referral. It is noted that the EPBC Act referral includes planted vegetation that does not require assessment under the EP Act.

It is acknowledged that the application area intersects the Perth Coastal and Gwelup Underground Water Pollution Control Area, a Priority 3 Public Drinking Water Source Area (PDWSA) proclaimed under the *Metropolitan Water Supply Sewerage and Drainage Act 1909*. However, it is noted that the application area does not intersect any of the Wellhead Protection Zones (WHPZs) associated with the PDWSA or occur within 500 metres of them (DWER, 2021). Further, development for road infrastructure is considered to be a compatible land use within Priority 3 PDWSA's (DoW, 2016). Noting the above and the condition and extent of the proposed clearing, no impacts to water quality within the Perth Coastal and Gwelup Underground Water Pollution Control Area are expected to result from the proposed clearing (DWER, 2021). DWER's Water Source Protection Planning Branch advised that it had no objections to the proposal but advised that the applicant should follow best management practices outlined in the following water quality protection notes:

- [WQPN 81: Tracks and trails near sensitive water resources](#)
- [WQPN 44: Roads near sensitive water resources](#)
- [WQPN 10: Contaminant spills – emergency response](#)
- [Brochure: Construction depots](#) (DWER, 2021).

No Aboriginal sites of significance have been mapped within the application area. It is the permit holder's responsibility to comply with the *Aboriginal Heritage Act 1972* (WA) and ensure that no Aboriginal Sites of Significance are damaged through the clearing process.

4 Suitability of offsets

Through the detailed assessment outlined in Section 3.2 above, the Delegated Officer has determined that the following significant residual impacts remain after the application of the avoidance and mitigation measures summarised in Section 3.1:

- The loss of 2.93 hectares of native vegetation that is representative of the federally listed Tuart Woodlands TEC and the state-listed Tuart Woodlands PEC,
- The loss of two trees with two hollows of suitable size for nesting by Carnaby's cockatoo, and
- The loss of 3.02 hectares of significant foraging habitat for Carnaby's cockatoo.

The applicant proposed an environmental offset consisting of three components:

- The allocation of 11.6 hectares of a banked offset site (Lake Clifton - Crown Reserve 53178, see Figure 10) that contains native vegetation representative of the Tuart Woodlands TEC/PEC,
- The installation of artificial nesting hollows for black cockatoo species within DBCA managed land, at a rate of 3:1 for each suitable hollow proposed to be cleared, and
- The revegetation and rehabilitation of 7.1 hectares of native vegetation within DBCA managed land that comprises significant foraging habitat for Carnaby's cockatoo on the Swan Coastal Plain (MRWA, 2021b).

Allocation of Lake Clifton (Crown Reserve 53178) banked offset

In 2016 Main Roads Western Australia provided funding to DBCA to acquire five lots in Lake Clifton as an environmental offset for a historical project, comprising a total of 965 hectares (MRWA, 2021b). The entirety of the offset was not required for the project and the offset balance was banked (MRWA, 2021b). Portions of the Lake Clifton banked offset site have been utilised as offsets for other projects, however a number of areas remain banked for future offset sites, including the 11.6 hectares proposed to offset the residual impacts to the Tuart Woodlands TEC under CPS 9225/1 (Figure 10; MRWA, 2021b).



Figure 10. Location of the proposed 11.6-hectare offset site (area cross-hatched red) within the Lake Clifton banked offset site (MRWA, 2021b).

It should be noted that an area of vegetation within the Lake Clifton banked offset site is also being proposed to offset the residual impacts of the proposal under EPBC 2020/8833, which is currently being assessed by DAWE. The clearing amount being assessed under EPBC 2020/8833 includes non-native vegetation and therefore, has a larger offset requirement (MRWA, 2021b). The applicant has advised that the supporting documentation and offset proposal have been developed to ensure both the EP Act and EPBC Act offset requirements are met (MRWA, 2021b).

The environmental values of the Lake Clifton banked offset site have been confirmed through a biological assessment undertaken by AECOM in 2016 and a subsequent targeted Tuart Woodlands TEC survey undertaken by AECOM in 2020 (MRWA, 2021b). The environmental values identified within the 11.6-hectare banked offset area during these assessments are summarised in Table 1.

Table 2. Lake Clifton banked offset site environmental values (AECOM, 2016; AECOM, 2020).

Environmental Value	Description of Environmental Value
Vegetation types	<p>A biological survey undertaken by AECOM in 2016 identified that the following vegetation associations are present within the 11.6-hectare offset area:</p> <ul style="list-style-type: none"> AfXpHh, described as low to mid open to closed forest of <i>Agonis flexuosa</i>, <i>Eucalyptus gomphocephala</i> and occasional <i>Banksia grandis</i> over <i>Xanthorrhoea preissii</i>, <i>Templetonia retusa</i> and occasional <i>Banksia sessilis</i> var. <i>cygnorum</i> tall open shrubland over <i>Hibbertia hypericoides</i> and <i>Macrozamia riedlei</i> sparse to open low shrubland, ArMsTd, described as <i>Acacia rostellifera</i>, <i>Spyridium globulosum</i> and <i>Clematis linearifolia</i> tall shrubland over <i>Melaleuca systema</i>, <i>Phyllanthus calycinus</i> and <i>Acanthocarpus preissii</i> mid heathland to open heathland over low sparse to closed forbland of <i>Trachyandra divaricata</i>, <i>Solanum nigrum</i> and <i>Geranium molle</i>, and MrGtTd, described as <i>Melaleuca raphiophylla</i> and <i>Melaleuca cuticularis</i> low closed forest over <i>Gahnia trifida</i>, <i>Juncus kraussii</i> subsp. <i>australiensis</i> and <i>Lepyrodia drummondiana</i> mid to tall sedgeland over <i>Trachyandra divaricata</i>, <i>Geranium molle</i> and <i>Lysimachia arvensis</i> low isolated forbs (Figure 11; AECOM, 2016).
Vegetation condition	<p>The biological survey identified that the offset area is in Excellent (Keighery, 1994) condition (Figure 12; AECOM, 2016), described as vegetation structure intact, with disturbance affecting individual species, where weeds are non-aggressive species (Keighery, 1994).</p>
Conservation communities	<p>significant</p> <p>The targeted Tuart Woodlands TEC survey identified that the offset area exceeds the minimum patch size threshold and meets the key diagnostic criteria to be considered part of the federally listed TEC (Figure 13; AECOM, 2020). As such, the offset area includes 11.6 hectares of native vegetation that is representative of the Tuart Woodlands TEC and PEC (AECOM, 2020). The 11.6-hectare patch of Tuart Woodlands TEC is considered to be in High condition (Figure 14; AECOM, 2020).</p>
Flora	<p>No conservation significant flora species were identified within the offset area during the biological survey (AECOM, 2016). However, one threatened and one priority flora species were recorded within the greater Lake Clifton banked offset site (AECOM, 2016)</p>
Black cockatoo habitat	<p>Carnaby's cockatoo individuals were recorded on five occasions during the biological survey, including records of calls heard in close proximity to the site, individuals flying over Lake Clifton, and individuals foraging on <i>Banksia sessilis</i> within the offset area (AECOM, 2016).</p> <p>The biological survey included estimates of the quality of foraging habitat present within the offset site, using parameters broadly consistent with the Commonwealth of Australia's draft referral guidelines for black cockatoo species. This assessment identified that the offset area includes approximately 8 hectares of Valued to Low quality foraging habitat for Carnaby's cockatoo (Figure 15; AECOM, 2016).</p> <p>The biological survey determined that the offset area provides approximately 5.5 hectares of Valued breeding habitat for black cockatoo species, defined as habitat that contained scattered Tuarts (with a DBH > 500 cm and potentially suitable breeding hollows) at a moderate density across a vegetation unit (Figure 16; AECOM, 2016).</p> <p>No confirmed black cockatoo roost sites were observed during the biological survey, but one potential roost site was identified (AECOM, 2016).</p>

Other fauna habitats

Two broad fauna habitats were identified within the offset area during the biological survey:

- *Agonis flexuosa* and Tuart forest, described as containing an open Tuart overstorey over an open to closed *Agonis flexuosa* layer over an open shrub layer,
- Mid to tall shrubland/heathland, described as an open to closed shrub or scrub layer with a moderately open groundcover layer, and
- Wetlands and riparian vegetation, described as natural wetlands, constructed pond and associated riparian zones (AECOM, 2016).

As described above, these habitats are likely to provide suitable habitat for black cockatoo species but may also provide suitable habitat for other conservation significant fauna species including migratory waterbird species, quenda (*Isoodon obesulus fusciventer*) and western ringtail possums (*Pseudocheirus occidentalis*) (AECOM, 2016).

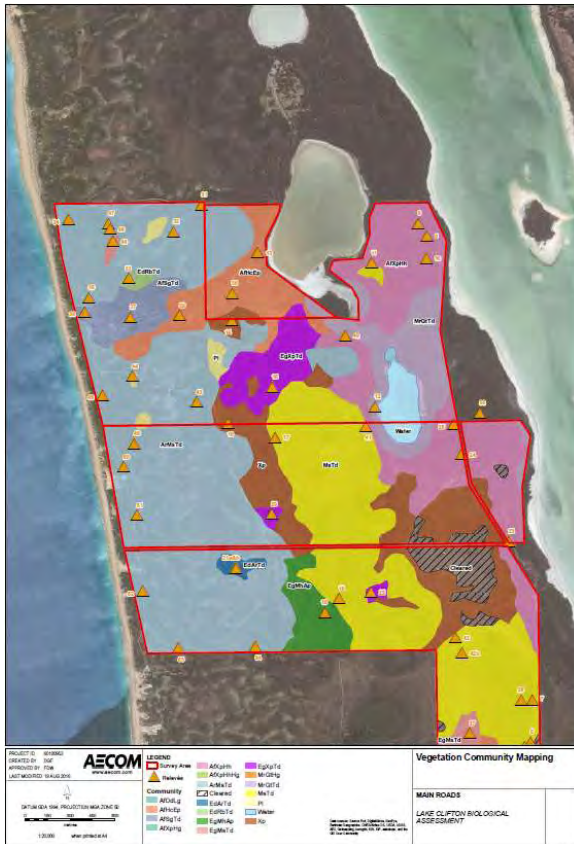


Figure 11. Vegetation community mapping within the Lake Clifton banked offset site (AECOM, 2016).

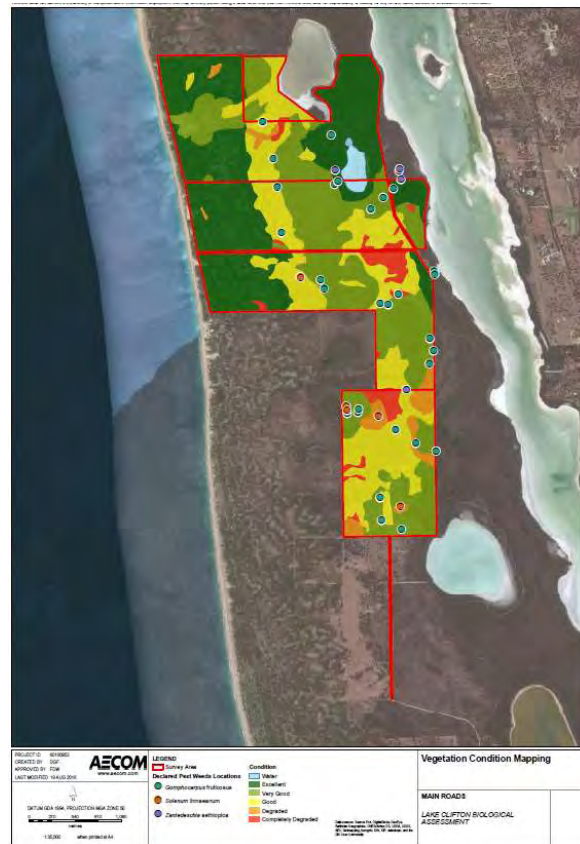


Figure 12. Vegetation condition mapping within the Lake Clifton banked offset site (AECOM, 2016).

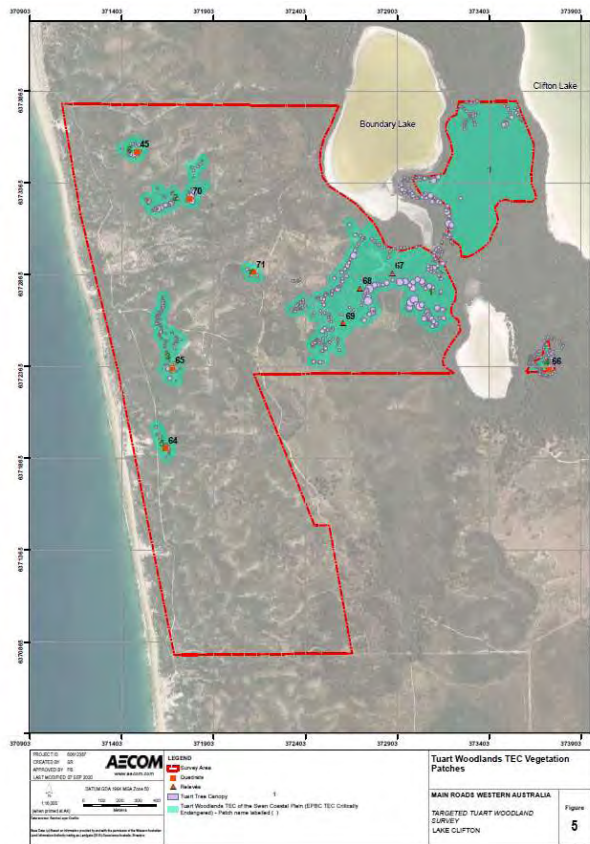


Figure 13. Tuart tree canopy and Tuart Woodlands TEC mapping within the Lake Clifton offset site (AECOM, 2020).

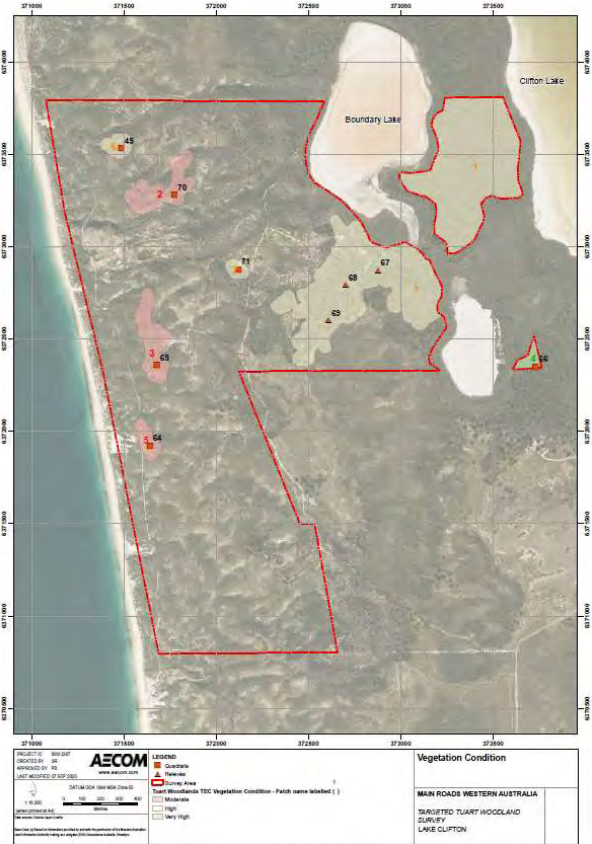


Figure 14. Tuart Woodlands TEC and condition mapping within the Lake Clifton banked offset site (AECOM, 2020).

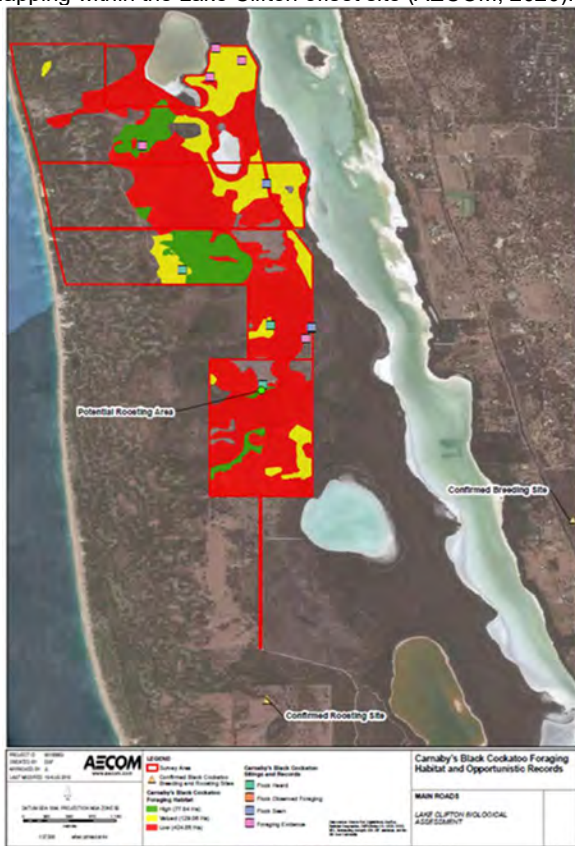


Figure 15. Carnaby's cockatoo foraging habitat and sightings within the Lake Clifton banked offset site (AECOM, 2016).



Figure 16. Black cockatoo breeding habitat recorded within the Lake Clifton banked offset site (AECOM, 2016).

Installation of artificial nesting hollows within DBCA managed estate

The applicant has committed to installing artificial nesting hollows at a ratio of 3:1, to mitigate impacts resulting from the loss of suitable nesting habitat for Carnaby's cockatoo (MRWA, 2021b). The applicant has advised that the design of the artificial hollows will be consistent with DBCA's guidelines (DPAW, 2015) and that the location of installation will be determined in consultation with DBCA (MRWA, 2021b).

The applicant has advised that appropriate trees for installation will be considered using the following parameters:

- Trees should be within DBCA-managed land to facilitate ease of access for monitoring and maintenance,
- Located in proximity to an existing nesting hollow,
- Located within or adjacent to foraging habitat,
- Located in proximity to water,
- Trees should be mature and well shaded, and
- Trees should be accessible with a cherry picker, without requiring additional disturbance, to allow installation of the artificial hollows (MRWA, 2021b).

The applicant has also advised that ongoing monitoring of the artificial nesting hollows will be undertaken, including annual surveys during the peak breeding season of Carnaby's cockatoos (September to October) and commencing from the first breeding season following the installation of the hollow (MRWA, 2021b). The applicant has advised that the surveys will be undertaken by a suitably qualified fauna specialist and that the results will be provided to DBCA (MRWA, 2021b). The annual surveys will aim to identify:

- If hollows are currently in use or show evidence of previous use,
- Maintenance requirements for artificial hollows, and
- Whether hollows are no longer to be used by Carnaby's Cockatoos, for example if they have been invaded by feral bees (MRWA, 2021b).

The applicant has advised that maintenance of the hollows will be scheduled outside of the breeding season and may include:

- Replacement of sacrificial chewing post,
- Replacement/repair of attachment points,
- Repairs to the base of hollows,
- Repairs of cracks in the artificial hollow. If cracks form that are too large to be repaired, the hollow may need to be replaced, and
- Removal of pest species, such as feral bees (MRWA, 2021b).

Revegetation and rehabilitation within DBCA managed estate

The applicant originally proposed to allocate 12 hectares of suitable foraging habitat at the Lake Clifton banked offset site to offset the residual impacts to 3.02 hectares of significant foraging habitat for Carnaby's cockatoo (MRWA, 2021a). In considering this proposal, the Delegated Officer noted that the Lake Clifton banked offset site occurs over 100 kilometres south of the application area. While Carnaby's cockatoos are highly mobile and can travel significant distances when migrating to southern breeding sites, the movement of flocks tend to be restricted during the non-breeding period, where daily flights are limited to foraging and drinking (Shephard and Warren, 2018). Further, both the *Carnaby's Cockatoo (Calyptorhynchus latirostris) Recovery Plan* (DPaW, 2013) and *EPA Advice: Carnaby's Cockatoo in Environmental Impact Assessment in the Perth and Peel Region* (EPA, 2019) emphasise the clearing of foraging habitat on the Swan Coastal Plain as a key threatening process for Carnaby's cockatoo. There are also significant pressures on the remaining Carnaby's cockatoo habitat on the Swan Coastal Plain, where much of the remaining habitat has been disturbed, degraded, and fragmented, or is at risk of future clearing for residential, industrial and infrastructural purposes.

The *WA Environmental Offsets Guidelines* (2014) state that "in determining the significance of an impact, it is important to consider the impacts in the regional context. In isolation, a project may not be considered to have a significant impact. However, when considered along with other projects, activities and threats in the region, the cumulative impacts may be significant". Given the above, the Delegated Officer considered that an appropriate environmental offset should take into account the flocks that currently utilise the food resources being impacted by the proposal and the existing threats to foraging habitat on the Swan Coastal Plain. Noting this, the Delegated Officer determined that an offset in closer proximity to the clearing area would better meet the requirements of the *WA Environmental Offsets Guidelines* (2014) and directly counterbalance the impacts to 3.02 hectares of significant foraging habitat for Carnaby's cockatoo.

In order to directly counterbalance the significant residual impacts of the clearing, the applicant proposed to undertake revegetation and rehabilitation of 7.1 hectares of native vegetation that comprises significant foraging habitat for Carnaby's cockatoo on the Swan Coastal Plain (MRWA, 2021b). The exact revegetation sites will be identified in direct consultation with DBCA and will be located within 20 kilometres of the application area and within conservation estate that is managed in perpetuity by DBCA. A radius of 20 kilometres was determined to be appropriate based on consideration of the distance to the impact site and the extent of conservation estate with opportunities for revegetation. The applicant will be required to develop and implement a comprehensive revegetation plan, that ensures that 7.1 hectares of significant foraging habitat for Carnaby's cockatoo is revegetated and rehabilitated from a Degraded (Keighery, 1994) condition to at least a Good (Keighery, 1994) condition. The requirement to provide a revegetation plan with specific completion criteria has been conditioned on the permit.

Conclusion

Noting the above, the proposed offset includes the following environmental values and qualities, relevant to this proposal:

- 11.6 hectares of Excellent (Keighery, 1994) condition native vegetation that is representative of the Tuart woodlands TEC,
- The installation, monitoring and maintenance artificial nesting hollows for black cockatoo species within DBCA managed land, at a ratio of 3:1 for each suitable hollow proposed to be cleared, and
- The revegetation and rehabilitation of 7.1 hectares of native vegetation from a Degraded to Good (Keighery, 1994) condition within DBCA managed land that comprises significant foraging habitat for Carnaby's cockatoo on the Swan Coastal Plain.

The Delegated Officer considers that the proposed offset is consistent with the *Environmental Offsets Policy* (2011) and the *Environmental Offsets Guidelines* (2014), and adequately counterbalances the significant residual impacts to the Tuart Woodlands TEC and Carnaby's cockatoo foraging and breeding habitat. The justification for the values used in the offset calculation is provided in Appendix F.

End

Appendix A. Additional information provided by applicant

Summary of comments	Consideration of comment
<p>The applicant provided the following additional supporting information on 19 May 2021:</p> <ul style="list-style-type: none"> • Clarification of TEC/PEC mapping between biological surveys and supporting documentation, • Additional avoidance, minimisation and mitigation measures, and • Submission of biological survey information and spatial data for the Lake Clifton offset site (MRWA, 2021c). 	<p>The additional supporting information provided was considered as follows:</p> <ul style="list-style-type: none"> • TEC/PEC extent and mapping was considered in the detailed assessment of impacts to biological values (see Section 3.2.1), • The avoidance, mitigation and management measures proposed by the applicant were considered in Avoidance and mitigation measures (see Section 3.1), and • Biological surveys and spatial data for the Lake Clifton offset site were considered in the assessment of suitability of offsets (see Section 4).

Appendix B. Details of public submissions

Summary of comments	Consideration of comment
<p>The proposal will result in residual impacts to the state-listed "Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region" (Banksia WL SCP) PEC. It is also not clear whether all impacted areas of the Banksia WL SCP PEC were adequately assessed (see next comment). These residual impacts should be offset in some manner, for example revegetation or improving the condition of adjacent, retained vegetation (Submission, 2021).</p>	<p>The applicant was requested to provide clarification as to the extent of the Banksia WL SCP PEC within the application area during the assessment of the application (MRWA, 2021c). This information identified that vegetation within the application area was not likely to be representative of the Banksia WL SCP PEC based on the flora and vegetation surveys provided and updated listing advice for this community (MRWA, 2021c; Astron, 2020).</p> <p>The potential for direct and indirect impacts to the Banksia WL SCP PEC were considered in the detailed assessment of the application under Section 3.2.1.</p>
<p>The accuracy of the vegetation assessment and mapping is questionable, particularly in regard to the Banksia WL SCP PEC. For example, some patches were listed as not assessed or mapped in the survey but appear in other figures as being in Completely Degraded (Keighery, 1994) condition. Aerial imagery also indicates that these patches do have intact structural vegetation (Submission, 2021).</p>	<p>The flora and vegetation surveys provided in support of this application (Astron, 2020) were undertaken in accordance with the <i>Technical guidance – Flora and Vegetation Surveys for Environmental Impact Assessment</i> (EPA, 2016a). A review of available imagery (aerial, street view and photographs) supports the finding of the biological survey that the patches of vegetation within the application area are in predominantly Degraded to Completely Degraded (Keighery, 1994) condition.</p> <p>DWER considers that survey effort was sufficient to accurately assess vegetation condition and composition.</p>
<p>Individuals of <i>Jacksonia sericea</i> (P4) will be impacted by the clearing, and this residual impact has not been considered (Submission, 2021).</p>	<p>The targeted flora survey undertaken by Astron in 2020 identified individuals of <i>Jacksonia sericea</i> within the greater survey area, however no individuals were identified within the proposed clearing area itself (Astron, 2020).</p>

Summary of comments	Consideration of comment
	The potential for impacts to <i>Jacksonia sericea</i> were considered in the detailed assessment of the application under Section 3.2.2.

Appendix C. Site characteristics

C.1. Site characteristics

Characteristic	Details
Local context	The area proposed to be cleared includes 14 separate areas of vegetation of between 0.027 hectares and 0.689 hectares in size, within two isolated patches of remnant native vegetation of 49.45 hectares (the northern patch) and 13.28 hectares (the southern patch) in area, in the intensive land use zone of Western Australia. The application area runs along the eastern side of Mitchell Freeway, between Ocean Reef Road and Hepburn Avenue. The proposed clearing area contributes to vegetation connectivity and linkage values along the eastern side of the Mitchell Freeway, in an area where vegetation has been extensively cleared. Spatial data indicates the local area (10-kilometre radius from the centre of the area proposed to be cleared) retains approximately 20.40 per cent of the original native vegetation cover.
Ecological linkage	<p>The northern portion of the application area is mapped within a Conceptual Linkage defined by the Gngara Sustainability Strategy (2009).</p> <p>As discussed above, the application area includes vegetation within two isolated patches of remnant native vegetation on the eastern side of Mitchell Freeway. Given this, the application area is also expected to contribute to vegetation connectivity and linkage values along the eastern side of Mitchell Freeway, in an area where vegetation has been extensively cleared.</p>
Conservation areas	The closest conservation area is Woodvale Nature Reserve (Bush Forever Site 407), which runs directly adjacent to the northern portion of the application area. The application area is also within 100 metres of Bush Forever Site 303, which occurs west of the application area on the opposite side of the Mitchell Freeway.
Vegetation description	<p>A flora and vegetation survey undertaken by Astron Environmental Services Pty Ltd (2020) indicates that the vegetation within the proposed clearing area consists of two vegetation units:</p> <ul style="list-style-type: none"> • Tuart Forest 2: <i>Eucalyptus gomphocephala</i> mid open to closed forest over <i>Eucalyptus marginata</i> (+/- <i>Banksia attenuata</i>, <i>Allocasuarina fraseriana</i>, <i>Corymbia calophylla</i>) mid to low woodland to open woodland over <i>Xanthorrhoea preissii</i> (+/- <i>Acacia rostellifera</i>, <i>Jacksonia sternbergiana</i>, <i>Allocasuarina humilis</i>) mid shrubland to isolated shrubs over <i>Mesomelaena pseudostygia</i> and <i>Lepidosperma calcicola</i> sparse sedgeland over an introduced tussock grassland, and • Jarrah Woodland 2: <i>Eucalyptus gomphocephala</i> isolated trees to isolated clumps of trees over <i>Eucalyptus marginata</i> (+/- <i>Banksia attenuata</i> and/or <i>Allocasuarina fraseriana</i>) woodland to open woodland over +/- <i>Acacia rostellifera</i> +/- <i>Calothamnus quadrifidus</i>, +/- <i>Melaleuca nesophila</i> tall shrubland to tall open shrubland over <i>Xanthorrhoea preissii</i> mid sparse to open shrubland over closed tussock grassland of introduced grasses (Astron, 2020). <p>Approximately 21 per cent of the application area is mapped within the Jarrah Woodland 2 vegetation unit, with the remaining 79 per cent mapped within the Tuart Forest 2 vegetation unit (Astron, 2020). The full survey descriptions and maps are available in Appendix G.</p>

Characteristic	Details
	<p>This is consistent with the mapped Swan Coastal Plain vegetation type, Karrakatta Complex – Central and South, described as predominantly open forest of <i>Eucalyptus gomphocephala</i> (Tuart), <i>Eucalyptus marginata</i> (Jarrah) and/or <i>Corymbia calophylla</i> (Marri) and woodland of <i>Eucalyptus marginata</i> (Jarrah) and/or Banksia species (Hedde et al., 1980). The mapped vegetation type retains approximately 23.49 per cent of the original extent (Government of Western Australia, 2019a).</p>
Vegetation condition	<p>A flora and vegetation survey undertaken by Astron Environmental Services Pty Ltd (2020) indicates that the vegetation within the proposed clearing area ranges from Good to Completely Degraded (Keighery, 1994) condition (Astron, 2020), described as:</p> <ul style="list-style-type: none"> • Good: Vegetation structure significantly altered by very obvious signs of multiple disturbances but retains basic vegetation structure or ability to regenerate it, • Degraded: Basic vegetation structure severely impacted by disturbance with scope for regeneration but not to a state approaching good condition without intensive management, and • Completely Degraded: The structure of the vegetation is no longer intact and the area is completely or almost completely without native species (Keighery, 1994). <p>Approximately 56 per cent of the application area is in Completely Degraded (Keighery, 1994) condition, 37 per cent is in Degraded to Completely Degraded (Keighery, 1994) condition, six per cent is in Degraded (Keighery, 1994) condition, and two per cent is in Good (Keighery, 1994) condition (Astron, 2020).</p> <p>The full Keighery (1994) condition rating scale is provided in Appendix E. The full survey mapping is available in Appendix G.</p>
Climate and landform	<p>The application area occurs on gently undulating to flat topography and has a mean annual maximum temperature of 24.8°C and a mean annual minimum temperature of 12.9°C. The mean annual rainfall is 800 millimetres and the annual evapotranspiration rate is 700 millimetres.</p>
Soil description and land degradation risk	<p>The soil is mapped as within the Karrakatta Sand Yellow Phase (211Sp__Ky), described as low hilly to gently undulating terrain with yellow sand over limestone at 1-2 metres, including Banksia spp. woodland with scattered emergent <i>Eucalyptus gomphocephala</i> and <i>Eucalyptus marginata</i> and a dense shrub layer (DPIRD, 2019).</p> <p>The Karrakatta Sand Yellow Phase (211Sp__Ky) is mapped at a low risk of land degradation resulting from water erosion, salinity, flooding, waterlogging and phosphorus export, but is mapped at a high risk of land degradation resulting from wind erosion and subsurface acidification (Schoknecht et al., 2004).</p>
Waterbodies	<p>The desktop assessment and aerial imagery indicated that the application area does not transect any watercourses or wetlands. The closest watercourses are several perennial lakes within the Pinnaroo Valley Memorial Park, which occur approximately 300 metres west of the application area, separated by road infrastructure. The closest wetlands are Joondalup Lake and Beenyup Swamp, occurring approximately 1.2 kilometres and 1.4 kilometres east of the application area, respectively, separated by road and residential infrastructure. Biological survey information also did not identify any remnants representative of riparian vegetation or any wetland indicator species within the survey area (Astron, 2020).</p>
Hydrogeography	<p>The application area is mapped within the Perth Groundwater Area, proclaimed under the Rights in Water and Irrigation Act 1914 (the RIWI Act), and the Perth Coastal and Gwelup Underground Water Pollution Control Area, a Priority 3 Public Drinking Water</p>

Characteristic	Details
	<p>Source Area (PDWSA) proclaimed under the <i>Metropolitan Water Supply Sewerage and Drainage Act 1909</i>.</p> <p>Groundwater salinity within the application area is mapped at <500 to 1000 milligrams per litre total dissolved solids.</p>
Flora	<p>The desktop assessment identified that a total of 24 rare flora species have been recorded within the local area, comprising five Priority 1 (P1) flora, five Priority 2 (P2) flora, 10 Priority 3 (P3) flora, one Priority 4 (P4) flora, and three threatened flora (Western Australian Herbarium, 1998-). None of these existing records occur within the application area, with the closest record being an occurrence of <i>Jacksonia sericea</i> (P4) approximately 0.2 kilometres from the application area.</p> <p>With consideration for the site characteristics set out above, relevant datasets (see Appendix H.1), the habitat preferences of the aforementioned species, and biological survey information (Astron, 2020), the application area may provide suitable habitat for 14 threatened or priority flora species and impacts to these species required further consideration (see Appendix C.3).</p>
Ecological communities	<p>The desktop assessment identified that the closest state-listed threatened ecological community (TEC) is an occurrence of the SCP30a; <i>Callitris preissii</i> (or <i>Melaleuca lanceolata</i>) forests and woodlands, Swan Coastal Plain (floristic community type 30a as originally described in Gibson et al. (1994)) TEC, located approximately 0.75 kilometres west of the application area, separated by road infrastructure.</p> <p>The desktop assessment identified that the application area intersects two mapped priority ecological communities (PECs); the Tuart (<i>Eucalyptus gomphocephala</i>) woodlands and forests of the Swan Coastal Plain PEC and the Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region PEC. Both communities are federally listed threatened ecological communities under the EPBC Act. With consideration for the site characteristics set out above, relevant datasets (see Appendix H.1), and biological survey information (Astron, 2020), impacts to these ecological communities required further consideration (see Appendix C.3).</p>
Fauna	<p>The desktop assessment identified that a total of 52 threatened or priority fauna species have been recorded within the local area, including 21 threatened fauna species, 12 priority fauna species, 16 fauna species protected under international agreement, and three other specially protected fauna species (DBCA, 2007-). One record of a quenda (<i>Isoodon fusciventer</i>) occurs within the application area, with the next closest record being an occurrence of a Swan Coastal Plain shield-backed trapdoor spider (<i>Idiosoma sigillatum</i>), approximately 800 metres from the application area.</p> <p>With consideration for the site characteristics set out above, relevant datasets (see Appendix H.1), the habitat preferences of the aforementioned species, and biological survey information (Astron, 2020), the application area may provide suitable habitat for eight conservation significant fauna species and impacts to these species required further consideration (see Appendix C.3).</p>

C.2. Vegetation extent

	Pre-European extent (ha)	Current extent (ha)	Extent remaining (%)	Current extent in all DBCA managed land (ha)	Current proportion (%) of pre-European extent in all DBCA managed land
IBRA bioregion**					
Swan Coastal Plain	1,501,221.93	579,813.47	38.62	222,916.97	14.85
Swan Coastal Plain vegetation complex					
Karrakatta Complex-Central and South*	53,080.99	12,467.20	23.49	4282.73	8.07
Local area					
10-kilometre radius	30,233.89	6,166.48	20.40	-	-

*Government of Western Australia (2019a)

**Government of Western Australia (2019b)

C.3. Flora analysis table

With consideration for the site characteristics set out above, relevant datasets (see Appendix H.1), and biological survey information (Astron, 2020), impacts to the following conservation significant flora required further consideration.

Species name	Conservation status	Suitable habitat features ? [Y/N]	Suitable vegetation type? [Y/N]	Suitable soil type? [Y/N]	Distance of closest record to application area (km)	Number of known records (total)	Are surveys adequate to identify? [Y, N, N/A]
<i>Acacia benthamii</i>	P2	Y	Y	Y	1.0	7	Y
<i>Amanita preissii</i>	P3	Y	Y	Y	2.3	3	Y
<i>Austrostipa mundula</i>	P3	N	Y	Y	2.7	1	Y
<i>Baeckea</i> sp. Limestone (N. Gibson & M.N. Lyons 1425)	P1	Y	Y	Y	1.6	13	Y
<i>Caladenia huegelii</i>	T	Y	N	Y	8.3	1	Y
<i>Conostylis bracteata</i>	P3	Y	Y	Y	2.7	9	Y
<i>Eucalyptus argutifolia</i>	T	Y	Y	Y	9.1	1	Y
<i>Hibbertia leptotheca</i>	P3	Y	Y	Y	7.7	3	Y
<i>Jacksonia sericea</i>	P4	Y	Y	Y	0.2	35	Y
<i>Pimelea calcicola</i>	P3	Y	Y	Y	3.4	7	Y
<i>Sarcozona bicarinata</i>	P3	Y	N	Y	6.4	4	Y
<i>Stylidium paludicola</i>	P3	N	Y	Y	3.1	1	Y
<i>Styphelia filifolia</i>	P3	Y	Y	Y	4.8	2	Y
<i>Thelymitra variegata</i>	P2	Y	Y	Y	3.4	1	Y

T: threatened, CR: critically endangered, EN: endangered, VU: vulnerable, P: priority

C.4. Fauna analysis table

With consideration for the site characteristics set out above, relevant datasets (see Appendix H.1), and biological survey information (Astron, 2020), impacts to the following conservation significant fauna required further consideration.

Species name	Conservation status	Suitable habitat features? [Y/N]	Suitable vegetation type? [Y/N]	Distance of closest record to application area (km)	Number of known records (total)	Are surveys adequate to identify? [Y, N, N/A]
<i>Calyptorhynchus banksii naso</i> (Forest red-tailed black cockatoo)	VU	Y	Y	1.7	20	Y
<i>Calyptorhynchus baudinii</i> (Baudin's cockatoo)	EN	Y	Y	3.9	4	Y
<i>Calyptorhynchus latirostris</i> (Carnaby's cockatoo)	EN	Y	Y	0.1	1079	Y
<i>Falco peregrinus</i> (Peregrine falcon)	OS	Y	Y	0.4	15	Y
<i>Hylaeus globuliferus</i> (Woolybush bee)	P3	Y	Y	8.9	1	N
<i>Idiosoma sigillatum</i> (Swan Coastal Plain shield-backed trapdoor spider)	P3	Y	Y	0.1	44	N
<i>Isoodon fusciventer</i> (Quenda)	P4	Y	Y	0.0	187	Y
<i>Neelaps calonotos</i> (Black-striped burrowing snake)	P3	Y	Y	1.7	32	Y

T: threatened, CR: critically endangered, EN: endangered, VU: vulnerable, P: priority, OS: Other specially protected fauna

C.5. Ecological community analysis table

With consideration for the site characteristics set out above, relevant datasets (see Appendix H.1), and biological survey information (Astron, 2020), impacts to the following conservation significant ecological communities required further consideration.

Community name	Conservation status	Suitable habitat features? [Y/N]	Suitable vegetation type? [Y/N]	Suitable soil type? [Y/N]	Distance of closest record to application area (km)	Number of known records (total)	Are surveys adequate to identify? [Y, N, N/A]
Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region	P	Y	N	Y	0.0		Y
Tuart (<i>Eucalyptus gomphocephala</i>) woodlands and forests of the Swan Coastal Plain	P	Y	Y	Y	0.0		Y

T: threatened, CR: critically endangered, EN: endangered, VU: vulnerable, P: priority

Appendix D. Assessment against the clearing principles

Assessment against the clearing principles	Variance level	Is further consideration required?
Environmental value: biological values		
<p><u>Principle (a):</u> <i>“Native vegetation should not be cleared if it comprises a high level of biodiversity.”</i></p> <p><u>Assessment:</u> The area proposed to be cleared contains regionally significant ecological communities and habitats, including significant habitat for Carnaby’s black cockatoo and mapped occurrences of the Tuart (<i>Eucalyptus gomphocephala</i>) woodlands and forests of the Swan Coastal Plain (Priority 3) and Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region (Priority 3) priority ecological communities (PECs).</p>	At variance	Yes <i>Refer to Sections 3.2.1, 3.2.2, and 3.2.3 above.</i>
<p><u>Principle (b):</u> <i>“Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna.”</i></p> <p><u>Assessment:</u> The area proposed to be cleared contains significant foraging and breeding habitat for conservation significant fauna species.</p>	At variance	Yes <i>Refer to Section 3.2.3, above.</i>
<p><u>Principle (c):</u> <i>“Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, threatened flora.”</i></p> <p><u>Assessment:</u> The area proposed to be cleared may contain suitable habitat for flora species listed under the BC Act, however not likely to contain significant habitat for these species.</p>	Not likely to be at variance	Yes <i>Refer to Section 3.2.2, above.</i>
<p><u>Principle (d):</u> <i>“Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.”</i></p> <p><u>Assessment:</u> The area proposed to be cleared does not contain species that can indicate a threatened ecological community (TEC) listed under the BC Act. Given the distance and separation from the nearest TEC by infrastructure, the proposed clearing is not likely to impact or be necessary for the maintenance of any state-listed TEC.</p>	Not likely to be at variance	No
Environmental value: significant remnant vegetation and conservation areas		
<p><u>Principle (e):</u> <i>“Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.”</i></p> <p><u>Assessment:</u> The extent of the mapped vegetation type and native vegetation in the local area is inconsistent with the national objectives and targets for biodiversity conservation in Australia, however is consistent with the 10 per cent threshold for constrained areas. The vegetation proposed to be cleared constitute significant ecological communities and habitat and contributes to vegetation connectivity and ecological linkages in the local area.</p>	May be at variance	Yes <i>Refer to Section 3.2.4, above.</i>
<p><u>Principle (h):</u> <i>“Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.”</i></p> <p><u>Assessment:</u> Given the application area is adjacent to a conservation area and within 100 metres of a Bush Forever Site, the proposed clearing may have an impact on the environmental values of nearby conservation areas.</p>	May be at variance	Yes <i>Refer to Section 3.2.4, above.</i>

Environmental value: land and water resources		
<p><u>Principle (f):</u> <i>“Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.”</i></p> <p><u>Assessment:</u> Given no wetlands are recorded within one kilometre of the application area, that the nearest watercourse is separated from the application area by existing infrastructure, and that biological surveys identified no characteristic riparian vegetation, the proposed clearing is unlikely to impact on- or off-site hydrology and water quality or the environmental values of any riparian communities.</p>	Not likely to be at variance	No
<p><u>Principle (g):</u> <i>“Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.”</i></p> <p><u>Assessment:</u> The mapped soils are susceptible to wind erosion and subsurface acidification. However, it is noted that the proposal includes the clearing of 3.02 hectares across a 6-kilometre long, linear footprint, and that cleared areas will be developed into a principal shared path and associated infrastructure and will not be left exposed to weathering for long periods. Noting the above, the condition of the vegetation, and that the applicant will implement a Construction Environmental Management Plan with measures to mitigate erosion, the proposed clearing is not likely to have an appreciable impact on land degradation.</p>	Not likely to be at variance	No
<p><u>Principle (i):</u> <i>“Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.”</i></p> <p><u>Assessment:</u> The application area is mapped within a proclaimed groundwater area and a Priority 3 PDWSA but does not transect any mapped watercourses or wetlands. Given no groundwater will be taken under the proposal, the separation from the nearest source of surface water, the extent of clearing across a long, linear clearing footprint, and the condition of the vegetation, the proposed clearing is unlikely to impact surface or ground water quality.</p>	Not likely to be at variance	No
<p><u>Principle (j):</u> <i>“Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.”</i></p> <p><u>Assessment:</u> The mapped soils and topographic contours in the surrounding area do not indicate that the application area is susceptible to flooding or waterlogging. Noting this, the extent of the proposed clearing across a long, linear footprint, and the condition of the vegetation, the proposed clearing is unlikely to contribute to increased incidence or intensity of flooding.</p>	Not likely to be at variance	No

Appendix E. Vegetation condition rating scale

Vegetation condition is a rating given to a defined area of vegetation to categorise and rank disturbance related to human activities. The rating refers to the degree of change in the vegetation structure, density and species present in relation to undisturbed vegetation of the same type. The degree of disturbance impacts upon the vegetation's ability to regenerate. Disturbance at a site can be a cumulative effect from a number of interacting disturbance types.

Considering its location, the scale below was used to measure the condition of the vegetation proposed to be cleared. This scale has been extracted from Keighery, B.J. (1994) *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*. Wildflower Society of WA (Inc). Nedlands, Western Australia.

Measuring vegetation condition for the South West and Interzone Botanical Province (Keighery, 1994)

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, with disturbance affecting individual species; weeds are non-aggressive species.
Very good	Vegetation structure altered, with obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and/or grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and/or grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and/or grazing.
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Appendix F. Offset calculator value justification

Table 3. Offset calculator value justification for residual impacts to the Tuart Woodlands TEC.



Field Name	Description	Field Name
<i>IUCN Criteria</i>	The IUCN criteria for the value being impacted	6.8% - offset mitigates the loss of vegetation that is representative of the Tuart Woodlands TEC (Critically Endangered under EPBC Act), which has annual probability of extinction 6.8%
<i>Area of impact (habitat/community) or Quantum of impact (features/individuals)</i>	The area of habitat/community impacted or number of features/individuals impacted	2.93 - application area in hectares considered to be representative of the Tuart Woodlands TEC, identified through a biological survey (Astron, 2020).
<i>Quality of impacted area (habitat/community)</i>	The quality score for area of habitat/community being impacted - a measure of how well a particular site supports a particular threatened species or ecological community and contributes to its ongoing viability	3 - Native vegetation condition predominantly in a Completely Degraded to Degraded (Keighery, 1994) condition (patches of Good), however the site contains vegetation representative of a TEC/PEC and includes significant habitat for threatened fauna.
<i>Time over which loss is averted (habitat/community)</i>	This describes the timeframe over which changes in the level of risk to the proposed offset site can be considered and quantified	20 year - The proposed offset site has been placed in secure conservation tenure and is currently managed in perpetuity by the State (DBCA), therefore the maximum of 20 years is applied.
<i>Time until ecological benefit (habitat/community) or Time horizon (features/individuals)</i>	This describes the estimated time (in years) that it will take for the main benefit of the quality (habitat/community) or value (features/individuals) improvement of the proposed offset to be realised	1 year - Shortest time frame has been applied, given the proposed offset site has already been placed in secure conservation tenure and is managed in perpetuity by DBCA.
<i>Start area (habitat/community) or Start value (features/individuals)</i>	The area of habitat/community or number of features/individuals proposed to offset the impacts	11.6 hectares - offset area proposed by the applicant (MRWA, 2021).
<i>Start quality (habitat/community)</i>	The quality score for the area of habitat/community proposed as an offset - a measure of how well a particular site supports a particular threatened species or ecological community and contributes to its ongoing viability	8 - Native vegetation in the offset site is in Excellent (Keighery, 1994) condition and includes High quality Tuart woodlands, identified through a biological survey (AECOM, 2016) and targeted TEC survey (AECOM, 2020).
<i>Future quality without offset (habitat/community) or Future value without offset (features/individuals)</i>	The predicted future quality score (habitat/community) or value (features/individuals) of the proposed offset site without the offset	7 - Without ongoing management from DBCA through the offset, the vegetation at the offset site may experience some degradation from weed incursion, fire and dieback.
<i>Future quality with offset (habitat/community) or Future value with offset (features/individuals)</i>	The predicted future quality score (habitat/community) or value (features/individuals) of the proposed offset site with the offset	8 - As the offset site already exists within DBCA managed estate and ongoing management will occur through the offset, the quality of the vegetation is unlikely to change.
<i>Risk of loss (%) without offset (habitat/community)</i>	This describes the chance that the habitat/community on the proposed offset site will be completely lost (i.e. no longer hold any value for the protected matter of concern) over the foreseeable future without an offset	10% - It is considered that the risk of loss will be low, as the revegetation offset site is currently within DBCA managed estate (conservation estate), but impacts from weed invasion, fire and dieback still remain.
<i>Risk of loss (%) with offset (habitat/community)</i>	This describes the chance that the habitat/community on the proposed offset site will be completely lost (i.e. no longer hold any value for the protected matter of concern) over the foreseeable future with an offset	10% - It is considered that the risk of loss remains the same, as the revegetation offset site will continue to persist within DBCA managed estate (conservation estate), but impacts from weed invasion, fire and dieback still remain.
<i>Confidence in result (%) – risk of loss (habitat/community)</i>	The capacity of measures to mitigate risk of loss of the proposed offset site	90% - It is considered that there is a high level of confidence that the risk of future development is low, given the offset site has been placed in secure tenure and will be managed in perpetuity by DBCA.
<i>Confidence in result (%) – Change in quality (habitat/community) or Change in value (features/individuals)</i>	The level of certainty about the successful achievement of the proposed change in quality (habitat/community) or value (features/individuals)	90% - Given ongoing management by DBCA, it is considered that there is a high level of confidence that vegetation quality will be maintained.
<i>% of impact offset</i>	% of the significant residual impact that would be offset by the proposed offset (note: the offset calculations combined should equate to 100% for each residual impact)	100% - reverse-calculated using the 'what if' function to achieve at least 100% offset based on assumptions.
<i>Other comments</i>	Include here any relevant additional comments (e.g. the size of offset required to offset 100% of the residual impacts)	100% of the residual impacts resulting from the clearing of 2.93 hectares of vegetation representative of the Tuart Woodlands TEC would be offset through the acquisition of 11.6 hectares of native vegetation within secure conservation estate, managed in perpetuity by DBCA.

Table 4. Offset calculator value justification for residual impacts to significant foraging habitat for Carnaby's cockatoo.

Field Name	Description	Field Name
<i>IUCN Criteria</i>	The IUCN criteria for the value being impacted	1.2% - offset mitigates the loss of vegetation that comprises significant foraging habitat for Carnaby's cockatoo (Endangered under EPBC Act), which has annual probability of extinction 1.2%
<i>Area of impact (habitat/community) or Quantum of impact (features/individuals)</i>	The area of habitat/community impacted or number of features/individuals impacted	3.02 - application area in hectares considered to comprise significant foraging habitat, identified through black cockatoo habitat assessment (Astron, 2020).
<i>Quality of impacted area (habitat/community)</i>	The quality score for area of habitat/community being impacted - a measure of how well a particular site supports a particular threatened species or ecological community and contributes to its ongoing viability	3 - Native vegetation condition predominantly in a Completely Degraded to Degraded (Keighery, 1994) condition (with patches of Good), however the vegetation value is considered higher as the black cockatoo habitat assessment identified the vegetation to include 3.02 hectares of quality foraging habitat, evidence of foraging has been observed within the development envelope and foraging habitat is restricted in the local area.
<i>Time over which loss is averted (habitat/community)</i>	This describes the timeframe over which changes in the level of risk to the proposed offset site can be considered and quantified	20 year - The proposed offset site has been placed in secure conservation tenure and is currently managed in perpetuity by the State (DBCA), therefore the maximum of 20 years is applied.
<i>Time until ecological benefit (habitat/community) or Time horizon (features/individuals)</i>	This describes the estimated time (in years) that it will take for the main benefit of the quality (habitat/community) or value (features/individuals) improvement of the proposed offset to be realised	10 - The benefit of the revegetation is considered to be available after 10 years.
<i>Start area (habitat/community) or Start value (features/individuals)</i>	The area of habitat/community or number of features/individuals proposed to offset the impacts	7.1 hectares - revegetation offset area proposed by the applicant (MRWA, 2021).
<i>Start quality (habitat/community)</i>	The quality score for the area of habitat/community proposed as an offset - a measure of how well a particular site supports a particular threatened species or ecological community and contributes to its ongoing viability	2 - Assuming that vegetation within the offset site to be revegetated/rehabilitated will be in Degraded (Keighery, 1994) condition.
<i>Future quality without offset (habitat/community) or Future value without offset (features/individuals)</i>	The predicted future quality score (habitat/community) or value (features/individuals) of the proposed offset site without the offset	2 - As the revegetation/rehabilitation areas already exist within DBCA managed estate, it is expected that they would remain the same quality without active revegetation/rehabilitation.
<i>Future quality with offset (habitat/community) or Future value with offset (features/individuals)</i>	The predicted future quality score (habitat/community) or value (features/individuals) of the proposed offset site with the offset	4 - It is assumed that with appropriate revegetation/rehabilitation measures the sites will improve in condition, with the potential to increase from a Degraded to a Good (Keighery, 1994) condition.
<i>Risk of loss (%) without offset (habitat/community)</i>	This describes the chance that the habitat/community on the proposed offset site will be completely lost (i.e. no longer hold any value for the protected matter of concern) over the foreseeable future without an offset	10% - It is considered that the risk of loss will be low, as the revegetation offset site is currently within DBCA managed estate (conservation estate), but impacts from weed invasion, fire and dieback still remain.
<i>Risk of loss (%) with offset (habitat/community)</i>	This describes the chance that the habitat/community on the proposed offset site will be completely lost (i.e. no longer hold any value for the protected matter of concern) over the foreseeable future with an offset	10% - It is considered that the risk of loss remains the same, as the revegetation offset site will continue to persist within DBCA managed estate (conservation estate), but impacts from weed invasion, fire and dieback still remain.
<i>Confidence in result (%) – risk of loss (habitat/community)</i>	The capacity of measures to mitigate risk of loss of the proposed offset site	90% - Given ongoing management by DBCA, it is considered that there is a high level of confidence that vegetation quality will be maintained.
<i>Confidence in result (%) – Change in quality (habitat/community) or Change in value (features/individuals)</i>	The level of certainty about the successful achievement of the proposed change in quality (habitat/community) or value (features/individuals)	80% - If MRWA provides a comprehensive revegetation/rehabilitation plan, there is reasonable level of confidence that revegetation will provide the values outlined in the calculation.
<i>% of impact offset</i>	% of the significant residual impact that would be offset by the proposed offset (note: the offset calculations combined should equate to 100% for each residual impact)	100% - reverse-calculated using the 'what if' function to achieve at least 100% offset based on assumptions.
<i>Other comments</i>	Include here any relevant additional comments (e.g. the size of offset required to offset 100% of the residual impacts)	100% of the residual impacts resulting from the clearing of 3.02 hectares of significant foraging habitat for Carnaby's cockatoo would be offset through the revegetation/rehabilitation of 7.1 hectares of native vegetation from Degraded to Good (Keighery, 1004) condition within secure conservation estate, managed in perpetuity by DBCA.

Appendix G. Biological survey information excerpts

Table 5. Vegetation types described for the application area (Astron, 2020).

Vegetation units and description	Site(s)	Range of vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
<p>Jarrah Woodland 2</p> <p><i>Eucalyptus gomphocephala</i> isolated trees to isolated clumps of trees over <i>Eucalyptus marginata</i> (+/- <i>Banksia attenuata</i> and/or <i>Allocasuarina fraseriana</i>) woodland to open woodland over +/- <i>Acacia rostellifera</i> +/- <i>Calothamnus quadrifidus</i>, +/- <i>Melaleuca nesophila</i> tall shrubland to tall open shrubland over <i>Xanthorrhoea preissii</i> mid sparse to open shrubland over closed tussock grassland of introduced grasses.</p>	<p>MFR-06 MFR-08 MFR-10</p>	<p>Degraded to Completely Degraded</p>	<p>0.63 (1%)</p>	 <p>Plate 3: Jarrah Woodland 2</p>
<p>Tuart Forest 2</p> <p><i>Eucalyptus gomphocephala</i> mid open to closed forest over <i>Eucalyptus marginata</i> (+/- <i>Banksia attenuata</i>, <i>Allocasuarina fraseriana</i>, <i>Corymbia calophylla</i>) mid to low woodland to open woodland over <i>Xanthorrhoea preissii</i> (+/- <i>Acacia rostellifera</i>, <i>Jacksonia sternbergiana</i>, <i>Allocasuarina humilis</i>) mid shrubland to isolated shrubs over <i>Mesomelaena pseudostygia</i> and <i>Lepidosperma calcicola</i> sparse sedgeland over an introduced tussock grassland.</p>	<p>MFQ-03 MFQ-04 MFQ-05 MFR-16 MFR-18 MFR-20 MFR-22 MFR-24 MFR-26 MFR-28 MFR-36 MF5Q-01 MF5Q-02 MF5Q-03 MF5R-02 MF5R-03 MF5R-04 MF5R-05 MF5R-06 MF5R-08 MF5R-09 MF5R-10 MF5R-11 MF5R-13 MF5R-14</p>	<p>Good to Completely Degraded</p>	<p>8.43 (17%)</p>	 <p>Plate 5: Tuart Forest 2</p>

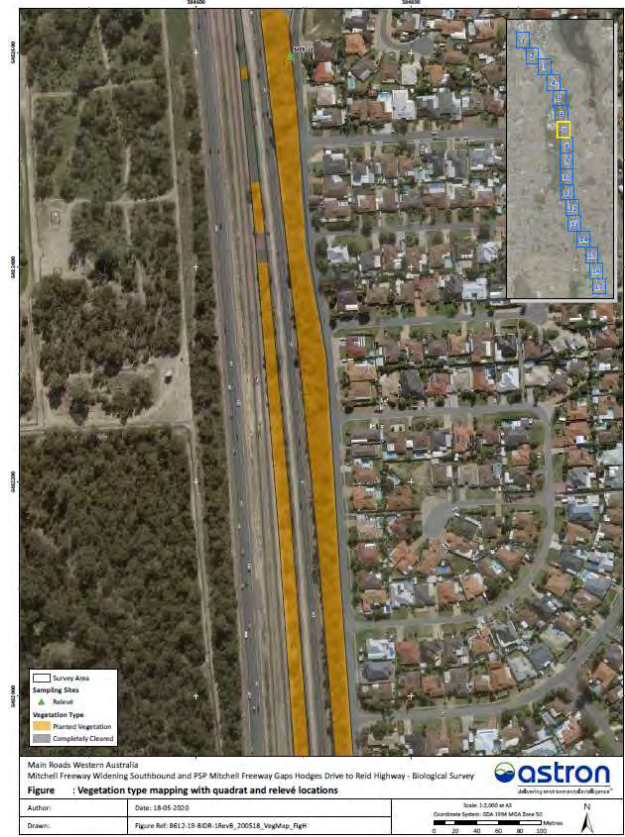
a)



b)



c)



d)





Figure 17(a-g). Vegetation type mapping for the application area (Astron, 2020).

a)



b)



c)



d)



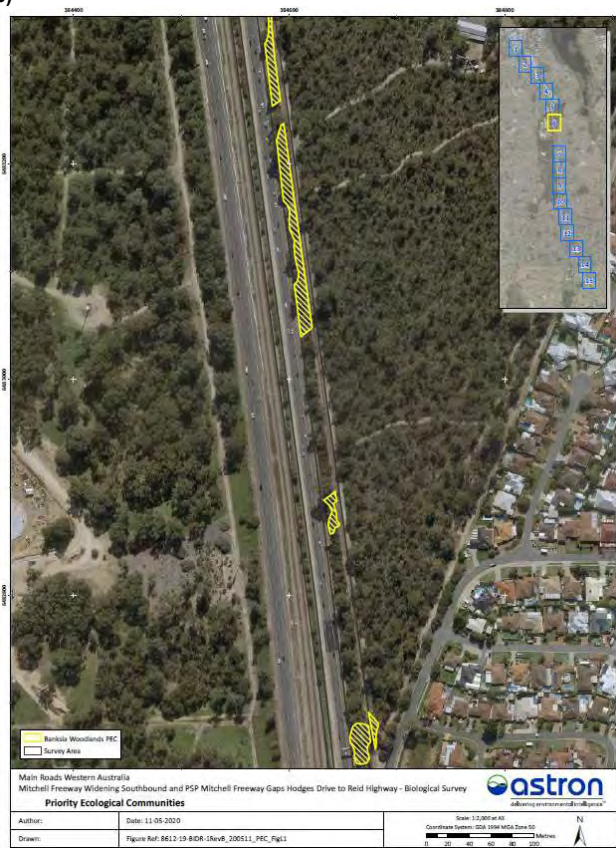


Figure 18(a-g). Vegetation condition mapping for the application area (Astron, 2020).

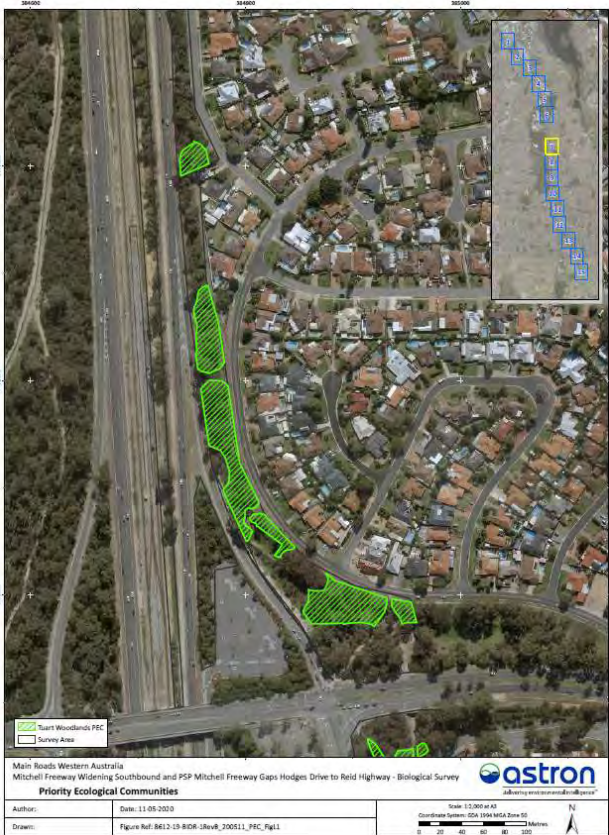
a)



b)



c)



d)



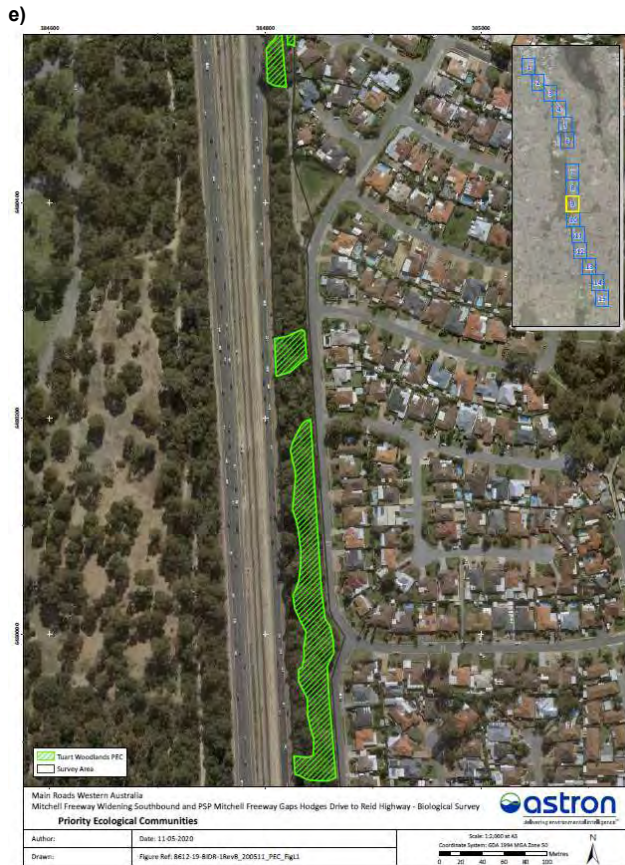


Figure 19(a-f). Priority ecological community (PEC) mapping within the application area (Astron, 2020)



c)



d)



e)



f)



g)



Figure 20(a-g). Location of conservation significant fauna species and black cockatoo habitat within the application area (Astron, 2020).

Table 6. Black cockatoo habitat trees with suitably sized hollows for breeding within the application area (Astron, 2020).

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
190	September 2019	384627.5	6482991.7	Dead Stag	1000	12	No	3	Large (>20 cm entrance) x 2, 8 m Medium (10 cm to 20 cm entrance), 9 m	
290	September 2019	384887.5	6479559.4	Tuart (<i>Eucalyptus gomphocephala</i>)	2,500	18	No	1	Medium (10 cm to 20 cm entrance), 10 m	

Appendix H. Sources of information

H.1. GIS databases

Publicly available GIS Databases used (sourced from www.data.wa.gov.au):

- 10 Metre Contours (DPIRD-073)
- Aboriginal Heritage Places (DPLH-001)
- Bush Forever Areas 2000 (DPLH-019)
- Cadastre (LGATE-218)
- Cadastre Address (LGATE-002)
- Contours (DPIRD-073)
- DBCA – Lands of Interest (DBCA-012)
- DBCA Legislated Lands and Waters (DBCA-011)
- DBCA Statewide Vegetation Statistics
- Directory of Important Wetlands in Australia – Western Australia (DBCA-045)
- Environmentally Sensitive Areas (DWER-046)
- Flood Risk (DPIRD-007)
- Groundwater Salinity Statewide (DWER-026)
- Hydrography – Inland Waters – Waterlines
- Hydrological Zones of Western Australia (DPIRD-069)
- IBRA Vegetation Statistics
- Imagery
- Local Planning Scheme – Zones and Reserves (DPLH-071)
- Native Title (ILUA) (LGATE-067)
- Offsets Register – Offsets (DWER-078)
- Pre-European Vegetation Statistics
- Public Drinking Water Source Areas (DWER-033)
- Ramsar Sites (DBCA-010)
- Regional Parks (DBCA-026)
- Remnant Vegetation, All Areas
- RIWI Act, Groundwater Areas (DWER-034)
- RIWI Act, Surface Water Areas and Irrigation Districts (DWER-037)
- Soil Landscape Land Quality – Flood Risk (DPIRD-007)
- Soil Landscape Land Quality – Phosphorus Export Risk (DPIRD-010)
- Soil Landscape Land Quality – Subsurface Acidification Risk (DPIRD-011)
- Soil Landscape Land Quality – Water Erosion Risk (DPIRD-013)
- Soil Landscape Land Quality – Water Repellence Risk (DPIRD-014)
- Soil Landscape Land Quality – Waterlogging Risk (DPIRD-015)
- Soil Landscape Land Quality – Wind Erosion Risk (DPIRD-016)
- Soil Landscape Mapping – Best Available
- Soil Landscape Mapping – Systems
- Vegetation Complexes - Swan Coastal Plain (DBCA-046)

Restricted GIS Databases used:

- ICMS (Incident Complaints Management System) – Points and Polygons
- Threatened Flora (TPFL)
- Threatened Flora (WAHerb)
- Threatened Fauna
- Threatened Ecological Communities and Priority Ecological Communities
- Threatened Ecological Communities and Priority Ecological Communities (Buffers)

H.2. References

AECOM Australia Pty Ltd (AECOM) (2016) *Biological Assessments Lot 1000, 2240, 2275, 2657 & 3045 Preston Beach Road Lake Clifton*. Prepared for Main Roads Western Australia (DWER Ref: A1992430).

AECOM Australia Pty Ltd (AECOM) (2020) *Targeted Tuart Woodlands TEC Survey Lake Clifton*. Prepared for Main Roads Western Australia (DWER Ref: A1992430).

Astron Environmental Services Pty Ltd (Astron) (2020) *Mitchell Freeway Widening Southbound and PSP Mitchell Freeway Gaps Hodges Drive to Reid Highway Biological Survey, September/October 2019 and March/April 2020*. Prepared for Main Roads Western Australia (DWER Ref: A1985628).

Atlas of Living Australia (ALA) (2021) *Neelaps calonotus* (Duméril, Bibron & Duméril, 1854), Western Black-Striped Snake. Available from: <https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:47207ba8-4d27-4535-8263-1f4ff135be31> (accessed April 2021).

City of Joondalup (2021) *Advice for clearing permit application CPS 9225/1*, received 02 June 2021 (DWER Ref: A2014051).

Commonwealth of Australia (2001) *National Objectives and Targets for Biodiversity Conservation 2001-2005*, Canberra.

Commonwealth of Australia (2012) *EPBC Act referral guidelines for three threatened black cockatoo species*. Department of Sustainability, Environment, Water, Populations and Communities, Canberra.

Department of Agriculture, Water and the Environment (DAWE) (2021) *The Peregrine Falcon (Falco peregrinus) Fact Sheet*. Department of Agriculture, Water and the Environment, Canberra.

Department of Biodiversity, Conservation and Attractions (DBCA) (2007-) NatureMap: Mapping Western Australia's Biodiversity. Department of Parks and Wildlife. Available from: <http://naturemap.dpaw.wa.gov.au/> (accessed April 2021).

Department of Biodiversity, Conservation and Attractions (DBCA) (2021) *Priority Ecological Communities for Western Australia, Version 31*, current as of 20 March 2021. Department of Biodiversity, Conservation and Attractions, Western Australia.

Department of Environment and Conservation (DEC) (2008) *Forest black cockatoo (Baudin's cockatoo, Calyptorhynchus baudinii, and forest red-tailed black cockatoo, Calyptorhynchus banksii naso) Recovery Plan*. Department of Environment and Conservation, Canberra.

Department of Environment and Conservation (DEC) (2012) *Fauna profiles: Quenda, Isoodon obesulus fusciventer*. Department of Environment and Conservation, Western Australia.

Department of the Environment and Energy (DoEE) (2019) *Approved Conservation Advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community*. Department of the Environment and Energy, Canberra.

Department of Environment Regulation (DER) (2013). *A guide to the assessment of applications to clear native vegetation*. Perth. Available from: https://www.der.wa.gov.au/images/documents/your-environment/native-vegetation/Guidelines/Guide2_assessment_native_veg.pdf.

Department of Parks and Wildlife (2013) *Carnaby's cockatoo (Calyptorhynchus latirostris) Recovery Plan*. Department of Parks and Wildlife, Perth, Western Australia.

Department of Primary Industries and Regional Development (DPIRD) (2019) *NRInfo Digital Mapping. Department of Primary Industries and Regional Development*. Government of Western Australia. Available from: <https://maps.agric.wa.gov.au/nrm-info/> (accessed April 2021).

Department of Water (DoW) (2016) *Water quality protection note no. 25: Land use compatibility tables for public drinking water source areas*. Department of Water, Perth, Western Australia.

Department of Water and Environmental Regulation (DWER) (2019) *Procedure: Native vegetation clearing permits*. Joondalup. Available from: https://dwer.wa.gov.au/sites/default/files/Procedure_Native_vegetation_clearing_permits_v1.PDF.

Department of Water and Environmental Regulation (DWER) (Water Source Protection Planning) (2021) *Public Drinking Water Source Area (PDWSA) advice for clearing permit application CPS 9225/1*, received 3 May 2021 (DWER Ref: A2002080).

- Environmental Protection Authority (EPA) (2008) *Environmental Guidance for Planning and Development Guidance Statement No 33*. Environmental Protection Authority, Western Australia.
- Environmental Protection Authority (EPA) (2016a). *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment*. Available from: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/EPA%20Technical%20Guidance%20-%20Flora%20and%20Vegetation%20survey_Dec13.pdf.
- Environmental Protection Authority (EPA) (2016b). *Technical Guidance – Terrestrial Fauna Surveys*. Available from: https://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Tech%20guidance-%20Terrestrial%20Fauna%20Surveys-Dec-2016.pdf.
- Environmental Protection Authority (EPA) (2019) *EPA Technical Report: Carnaby's Cockatoo in Environmental Impact Assessment in the Perth and Peel Region. Advice of the Environmental Protection Authority under Section 16(j) of the Environmental Protection Act 1986*. Environmental Protection Authority, Western Australia.
- Government of Western Australia (2019a) *2018 South West Vegetation Complex Statistics. Current as of March 2019*. WA Department of Biodiversity, Conservation and Attractions, Perth, <https://catalogue.data.wa.gov.au/dataset/dbca>.
- Government of Western Australia. (2019b) *2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of March 2019*. WA Department of Biodiversity, Conservation and Attractions. <https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics>.
- Groom, C., Mawson, P., Roberts, J.D. and Mitchell, N.J. (2014) *Meeting an expanding human population's need whilst conserving a threatened parrot species in an urban environment*. WIT Transactions on Ecology and the Environment, 191, pp.1199-1212.
- Groom, C. (2015) *Roost site fidelity and resource use by Carnaby's Cockatoo (Calyptorhynchus latirostris), on the Swan Coastal Plain, Western Australia*. Thesis submitted for the degree of Doctor of Philosophy, University of Western Australia, Crawley.
- Hedde, E.M., Loneragan, O.W., and Havel, J.J. (1980) *Vegetation Complexes of the Darling System, Western Australia*. In Department of Conservation and Environment, Atlas of Natural Resources, Darling System, Western Australia.
- Houston, T.F. (2018) *A guide to native bees of Australia*. CSIRO Publishing. Clayton South, Victoria.
- Johnstone, R.E. and Kirkby T. (2008) *Carnaby's Cockatoo (Calyptorhynchus latirostris) on the northern Swan Coastal Plain (Lancelin – Perth) Western Australia*. Western Australian Museum, Welshpool.
- Keighery, B.J. (1994) *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*. Wildflower Society of WA (Inc). Nedlands, Western Australia.
- Kirkby, T. (2020) *Black Cockatoo Breeding, Feeding and Roosting Habitat Assessment, Mitchell Freeway*. Prepared for Main Roads Western Australia (DWER Ref: A1985628).
- Main Roads Western Australia (MRWA) (2021a) *Clearing permit application CPS 9225/1 and supporting information*, received 2 March 2021 (DWER Ref: DWERDT422235).
- Main Roads Western Australia (MRWA) (2021b) *Offset proposal (Mitchell Freeway Principal Shared Path Gaps Proposal) for clearing permit application CPS 9225/1*, received 2 March 2021 (DWER Ref: DWERDT422235).
- Main Roads Western Australia (MRWA) (2021c) *Supporting information for clearing permit application CPS 9225/1*, received 19 May 2021 (DWER Ref: A2009591).
- Rix, M.G., Huey, J.A., Cooper, S.J.B., Austin, A.D. and Harvey, M.S. (2018) *Conservation systematics of the shield-backed trapdoor spiders of the nigrum-group (Mygalomorphae, Idiopidae, Idiosoma): integrative taxonomy reveals a diverse and threatened fauna from south-western Australia*. ZooKeys, 756, pp. 1–121.

- Rose, P.W. (1993) *Production of habitat hollows by wheatbelt eucalypts: final report, Save the bush research grant 1991/92, project R053*. Report prepared by Rose and Bending Forest and Environmental Consultants for the Department of Conservation and Land Management, Western Australia
- Saunders, D.A., Smith, G.T. and Rowley, I. (1982) *The availability and dimensions of tree hollows that provide nest sites for cockatoos (Psittaciformes) in Western Australia*. Australian Wildlife Research, 9, pp. 541-56.
- Schoknecht, N., Tille, P. and Purdie, B. (2004) *Soil-landscape mapping in South-Western Australia – Overview of Methodology and outputs* Resource Management Technical Report No. 280. Department of Agriculture.
- Shephard, J.M. and Warren, K.S. (2018) *The Potential Role of the Forest Product Commission's Midwest Pine Plantations as a Food Resource for Carnaby's Cockatoo: A Concept Study using GPS and Satellite Tag Data*. Report for The Forest Products Commission, Western Australia.
- Stock, W., Finn, H., Parker, J. and Dodds, K. (2013) *Pine as fast food: foraging ecology of an endangered cockatoo in a forestry landscape*, PlosOne 2013, 8(4), pp. 1-12.
- Submission (2021) *Public submission in relation to clearing permit application CPS 9225/1*, received 6 April 2021 (DWER Ref: DWERDT436057).
- Threatened Species Scientific Committee (TSSC) (2016) *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community*. Canberra, Department of the Environment and Energy.
- Valentine, L. and Stock, W. (2008) *Food resources of Carnaby's Black Cockatoo (Calyptorhynchus latirostris) in the Gnangara sustainability strategy area*. Department of Water, Perth, Western Australia.
- Western Australian Herbarium (1998-). *FloraBase - the Western Australian Flora*. Department of Biodiversity, Conservation and Attractions, Western Australia. <https://florabase.dpaw.wa.gov.au/> (Accessed April 2021).
- Whiteford, K.R. and Williams, M.R. (2002) *Hollows in jarrah (Eucalyptus marginata) and marri (Corymbia calophylla) trees: II. Selecting trees to retain for hollow dependent fauna*. Forest Ecology and Management, 160, pp. 215-278.
- Williams, M.R., Yates, C.J., Saunders, D., Dawson, R., and Barrett, G.W. (2017) *Combined demographic and resource models quantify the effects of potential land-use change on the endangered Carnaby's Cockatoo (Calyptorhynchus latirostris)*. Biological Conservation 2017, 210, pp. 8-15.