16.5 Commonwealth Land

A 4.05 km section of the proposal alignment crosses Commonwealth land to the south of Neaves Road (Figure 16.1). This land is controlled and operated by the DOD and comprises 1,094 ha, with approximately 46.4 ha being impacted by the proposal.

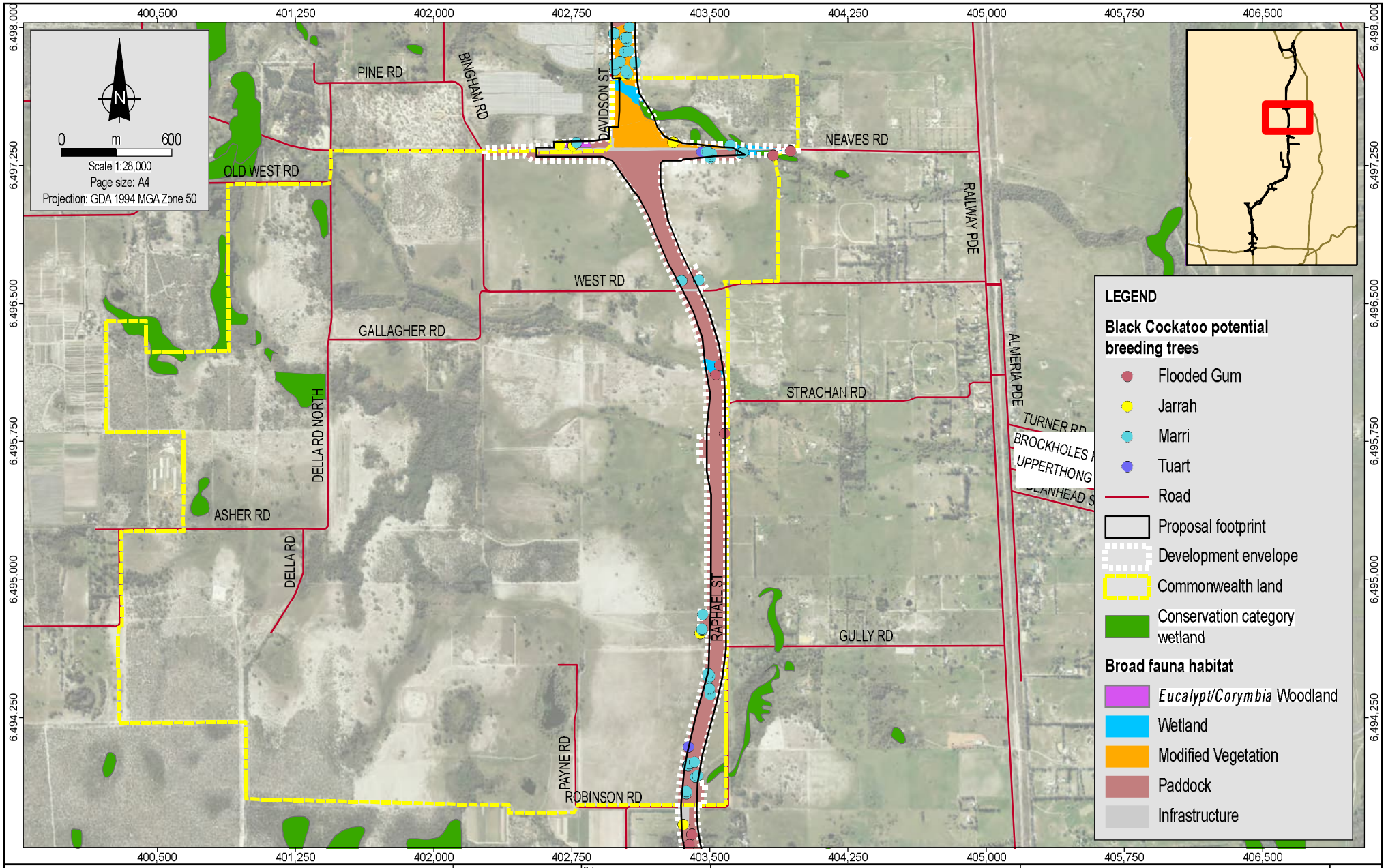
During 2004 and as part of a route selection study, an initial alignment was developed based on known constraints at that time. During the consultation phase in October 2004 a number of alignment issues were raised by the community and other stakeholders that required further investigation. At the time, the DOD requested that an alignment further to the east be considered in order to reduce severance to their estate (WAPC, 2012).

The resulting alignment is along the eastern boundary of the DOD land, to the west of Raphael Road, and is now gazetted in the Perth MRS. In the southeastern corner of the property the proposal turns slightly to the west in the vicinity of Robinson Road to avoid a CCW located in this area. In the northeastern corner of the DOD land, the alignment turns slightly westward to reduce impact on water bores and another CCW (MRWA, 2009).

At the planning stage, the DOD did not agree with the proposed alignment deviations at the southeastern and northeastern corners of their estate as described above. DOD's current position is that it does not agree with the alignment in the vicinity of Neaves Road and suggests that the alignment be straightened to reduce severance of DOD land. However, the proposal has not been amended to incorporate this request as it would result in a greater impact to CCWs in the vicinity of Neaves Road. In addition, the proposed alignment was subject to public consultation as part of the MRS amendment process and was subsequently gazetted in the MRS. Acquisition of adjacent private properties is progressing on the basis of the alignment in the MRS.

The key factors impacted by the proposal on Commonwealth land include:

- Conservation Category Wetlands.
- Fauna habitat.



Source & Notes
Black cockatoo trees and broad fauna habitat from Coffey (October 2014).
Conservation category wetlands from DPAW (January 2015).
Cadastre from MRWA (August 2014).
Aerial imagery from Landgate (August 2014).

NorthLinkWA

coffey

Date: 18.06.2015
MXD: 4483AA_03_GIS032_2
File Name: 4483AA_03_F16.1_GIS

Main Roads WA
Public Environmental Review
Perth–Darwin National Highway

Commonwealth land and associated ecological values

Figure No: **16.1**

16.5.1 Flora and Vegetation Values

The Commonwealth land between Neaves Road and Raphael Road consists of largely cleared paddocks with remnant paddock trees of Flooded Gum (*Eucalyptus rudis* subsp. *rudis*) and Marri (*Corymbia calophylla*) and highly disturbed drainage lines dominated by native trees and Kikuyu grass (**Cenchrus clandestinus*). In addition, significant environmental weeds, including Blackberry (**Rubus laudatus*) and Arum Lily (**Zantedeschia aethiopica*) were recorded within the minor drainage lines. The paddocks were considered completely degraded (Coffey, 2015a).

The extent of the mapped vegetation associations within the Commonwealth land is provided in Table 16.8. The values for the extent within the proposal footprint are detailed in Section 8.4.1.1.

Table 16.8 Vegetation association extent within Commonwealth land

Vegetation association	Description	Extent within Commonwealth land		Vegetation condition
		(ha)	(%)	
CcEr[3]	Open paddocks with remnant *Corymbia calophylla* and *Eucalyptus rudis* subsp. *Rudis* over pasture species (introduced) dominated by **Cenchrus clandestinus.*	36.5	78.6	Completely degraded
Cl	Cleared areas, consisting of paddocks, infrastructure corridors (i.e. Roads and Highways), building envelopes (i.e. residential housing, industry etc.) and the former Ellenbrook settlement (within Rocla mine tenement).	3.8	8.2	Completely degraded
Er[8]	*Eucalyptus rudis* subsp. *Rudis*, *Corymbia calophylla* sparse mid woodland over *Melaleuca preissiana* and *Melaleuca rhaphiophylla* isolated clumps of low trees over **Holcus lanatus* and **Cenchrus clandestinus* closed mid grassland.	0.7	1.5	Degraded to completely degraded
Mp[7]	*Melaleuca preissiana* sparse to open low woodland over **Zantedeschia aethiopica* sparse tall herbland over **Cenchrus clandestinus* and **Holcus lanatus* sparse mid grassland.	0.1	0.2	Good to degraded
MpMr	*Melaleuca preissiana* and *Melaleuca rhaphiophylla* low (open) woodland over **Zantedeschia aethiopica* and **Typha orientalis* open mid herbland.	1.1	2.4	Good to degraded
R	*Corymbia calophylla, Eucalyptus camaldulensis* and *Eucalyptus todtiana* low woodland over *Calothamnus quadrifidus* and *Banksia nivea* sparse mid shrubland over **Bromus diandrus* and **Ehrharta calycina* sparse mid grassland over **Ursinia anthemoides* and **Hypochaeris glabra* sparse low herbland (Revegetation-site).	4.2	9.1	Completely degraded to degraded
Total	**–**	**46.4**	**100**	**–**

The vegetation south of Neaves Road does not constitute native vegetation and, as a result, the proposal through this section of the Commonwealth land will not require the clearing of native vegetation (see Section 8.4.1.1).

The Commonwealth land located in the proposal footprint on the northern side of Neaves Road consists of rehabilitated land and highly modified vegetation along Bingham Creek. Bingham Creek is dominated by

planted exotics (deciduous trees) and weeds, including Bulrush (**Typha orientalis*) and Arum Lily. The vegetation was considered to be in a good to completely degraded condition (Coffey, 2015a).

The rehabilitated portion of the property included Marri, River Red Gum (*Eucalyptus camaldulensis*) and Prickly Bark (*Eucalyptus todtiana*) (Coffey, 2015a). Although Marri and Prickly Bark occur naturally within the region, the specimens within the property are considered to be planted. The River Red Gum was planted.

The vegetation within the Commonwealth land is not considered to be significant and does not represent any Commonwealth or State listed ecological communities. In addition, no Commonwealth or State listed Threatened flora occur within the proposal footprint on Commonwealth land (Coffey, 2015a). A summary of the appropriate management measures and residual impacts to flora is provided in Table 16.9 (at the end of this chapter). All mitigation measures listed were considered through the application of the management hierarchy (Government of Western Australia, 2014) and based on current best practice methods.

16.5.2 Conservation Category Wetlands

A total of 0.4 ha of CCW 8773 and 0.02 ha of CCW 8909 occur within the proposal footprint and will be directly impacted by the proposal (Section 10.2.2 and Table 16.10). This impact is considered to be minor given the scale of the impact (only 12.3% and 5% respectively of the CCW mapped extent) and the degraded condition of these wetlands. A summary of the management measures and residual impacts to CCWs is provided in Table 16.9. All mitigation measures listed were considered through the application of the management hierarchy (EPA, 2014b) and based on current best practice methods.

Table 16.10 Commonwealth land wetland impacts

Wetland Unique Feature Identifier (UFI)	Category	Extent of wetland (ha)	Extent of proposal footprint on Commonwealth land	
			(ha)	(%)
8773	CCW	3.2	0.40	12.5
15732	MUW	13,744.4	30.22	0.2
8909	CCW	0.4	0.02	5.0

16.5.2.1 Wetlands at Southern End of Commonwealth Land

The geomorphic wetland located at the southern end of the Commonwealth land was classified as a CCW. It is located on both the eastern and western side of Raphael Road, having previously been split as a result of the construction of this road, and is connected via a culvert under Raphael Road (GHD, 2008b). The wetland consists of three sections with separate unique feature identifiers (UFIs), 8914, 8915 and 8916. The northern portion (UFI 8915 and UFI 8916) has been classified as resource enhancement palusplain, with the southern section as CCW.

The area is typical palusplain with a shallow depth to groundwater that is prevalent in the area. On the western side, the ground surface has intersected the natural groundwater level and has become a point of groundwater discharge. The wetland is, therefore, an expression of local groundwater levels and intersects the upper most part of the superficial aquifer. It was noted that there are other discharge points in the area in the form of various small creeks running in an easterly direction. The source of this groundwater discharge is likely to be from the Gnangara Mound located to the west of the site (GHD, 2008b).

The site has previously been cleared and was highly degraded with few native species, including Marri and shrubs located in the paddocks adjacent to the wetland. Some native species remained within the wetland, but the majority of it was dominated by introduced grasses and herbs, including Narrowleaf Lupin (*Lupinus angustifolium*) and Yellow Serradella (*Ornithopus compressus)*. The wetland condition ranged from Degraded to Completely Degraded (GHD, 2008b).

Although the wetland is degraded and has low conservation value, it was considered an important source of groundwater discharge that feeds the higher conservation value wetland to the east of Raphael Road. At the time, the DEC did not support an alignment that crosses the wetland and the alignment at this point was shifted slightly west to avoid the CCW (MRWA, 2009).

The DOD has acknowledged the outcomes of the 2008 survey and the decision regarding the alignment, but did not support the position due to the degraded nature of the CCW (MRWA, 2009).

16.5.2.2 Wetlands at Northern End of Commonwealth Land

The wetlands at the northern end of Commonwealth land at Neaves Road were surveyed during September 2014 (Coffey, 2014) and included a survey of plant communities, flora taxa and wetland values. The wetland vegetation is currently mapped as a combination of MUW and CCW. Five relevés and one mapping point were sampled within the wetlands and vegetation located within Lot 800 Neaves Road.

The current alignment of the proposal, in the Neaves Road region, will have a lower environmental impact on the wetlands within Lot 800 than the alignment further to the east preferred by DOD, which will impact significantly on the Conservation Category Wetland. In addition, the wetland is located within Bush Forever Site 100 (Neaves Road Creek, Bullsbrook). The construction of the proposal will divide the Bush Forever Site, however, the current alignment traverses a section of the Bush Forever Site that is completely degraded and would require lower levels of native vegetation clearing. If the proposal footprint was to move to the east, significantly more native vegetation clearing would be required, in addition to the impacts on the CCW.

The vegetation located in association with the MUW mapping is considered to be in a completely degraded condition, while the native vegetation in association with the CCW is considered to be in degraded condition.

Although there is scope for regeneration of vegetation in degraded condition, intensive management would be required over an extended period to rehabilitate the wetlands to a state approaching good condition. The upper stratum of the vegetation structure is present, thus reducing the scope for the rehabilitation of the upper stratum. An intensive weed eradication program and the revegetation of the middle and lower stratum would be required to manage the degraded understorey of the wetland.

The wetlands within Lot 800 are located within the Keysbrook Suite of wetlands. Several other wetlands within the Keysbrook Suite are located within and adjacent to the proposal footprint. The wetlands within Lot 800 may represent good examples of the Keysbrook Suite.

According to mapping and information obtained from DPAW (2013), approximately 1.5% of the original extent of wetlands in the Keysbrook consanguineous suite still supports a high level of values, attributes and functions and is, therefore, mapped as CCW.

The current alignment has a lower impact on the CCW and allows for the retention and revegetation of the CCW in Lot 800.

16.5.3 Fauna Habitat

The majority of Commonwealth land within the proposal footprint occurs on secondary fauna habitat classified as Paddock (36.7 ha) (Lots 1677, 1478, 5, 1, 2, 3, 4, 1729 and 1690). This habitat is characterised by sporadic Eucalypts/Corymbias such as *Eucalyptus rudis*, *Eucalyptus m16-29arginata* and *Corymbia*

calophylla, over pastures. As the original vegetation structure of this habitat has been disrupted, it does not support the full fauna assemblage although it does provide limited habitat for some species. The Paddock habitat is of low habitat value and is classified as being in a completely degraded condition (Coffey, 2015b).

Lot 800 contains secondary fauna habitat classified as Modified Vegetation (6.4 ha). The original vegetation structure of this habitat has been disrupted and it does not support the full fauna assemblage, although it does provide limited habitat for some species. The vegetation on this Lot is rehabilitated vegetation and consists of *Corymbia calophylla, Eucalyptus camaldulensis* and *Eucalyptus todtiana* low woodland over *Calothamnus quadrifidus* and *Banksia nivea* shrubland over sparse grassland and low herbland. This habitat is of low value and is classified as being in degraded condition (Coffey, 2015b).

Lots 800, 1478 and 5 contain approximately 1.9 ha of Wetland habitat. The vegetation of this habitat is characterised by *Eucalyptus rudis* and *Melaleuca preissiana* woodland over mixed shrubs over sedges and rushes with surface water expression. The Wetland habitat in Lots 800 and 1478 corresponds to a small lake and the Wetland habitat in Lot 5 is an ephemeral creek. These water bodies provide habitat to some aquatic species, but not for fauna that require deep lakes or large wetland habitats such as rivers, swamps and large lakes. This habitat does not contain the shallow margins that migratory wading birds prefer as foraging habitat. This habitat does, however, contain stands of suitable sized trees which are classified as breeding habitat for Black cockatoos. The Wetland habitat provides moderate habitat value and is classified as being in completely degraded to degraded condition on Lot 5 and good to degraded condition on Lots 800 and 1478 (Coffey, 2015b).

The remaining 1.5 ha of Commonwealth land is classified as cleared/infrastructure and does not provide any fauna value.

A total of 26 trees with a DBH of over 500 mm were recorded on Commonwealth land. Trees with a DBH of 500 mm or above are classified as providing breeding habitat for Black Cockatoos. The Wetland habitat contains stands of suitably sized trees and is classified as potential breeding habitat for Black Cockatoos (1.9 ha). As the Paddock and Modified Vegetation habitats contain sporadic Eucalypt/Corymbia trees rather than stands, the individual suitably sized trees were recorded in the total number of suitable breeding trees rather than the total area of breeding habitat.

None of the fauna habitats present on Commonwealth land are considered more significant than similar habitats in the local vicinity of the proposal footprint. Due to the vast majority of Commonwealth land occurring on the secondary habitat of Paddocks, impacts to the fauna values from the proposal are limited to habitat loss (Wetland habitat and potential Black Cockatoo habitat). No critical habitat exists on the Commonwealth land for conservation significant fauna other than the Black Cockatoos. A summary of impacts and mitigation measures for each Lot on Commonwealth land is provided in Table 16.11 and Figure 16.1 and residual impacts are provided in Table 16.9. All mitigation measures listed were considered through the application of the management hierarchy (Government of Western Australia, 2014) and based on current best practice methods.

Table 16.11 Fauna impacts on Commonwealth lands

Lot No.	Habitat	Management measures	Potential impacts
800	Wetland Modified Vegetation	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks. Installation of two drainage culverts to maintain hydrological flow. Reduction of design footprint.	• 1.1 ha of Wetland cleared. • One potential breeding tree.
1677	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	No expected impact due to the lack of fauna habitat.
1478	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	• 0.02 ha of Wetland cleared. • Eight potential breeding trees.
5	Wetland Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks. Installation of a drainage culvert to maintain hydrological flow.	• 0.7 ha of Wetland cleared. • Two potential breeding trees.
1	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	One potential breeding tree.
2	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	No expected impact due to the lack of fauna habitat.
3	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	No expected impact due to the lack of fauna habitat.
4	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	No expected impact due to the lack of fauna habitat.
1729	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	Six potential breeding trees.
1690	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	Eight potential breeding trees.

Table 16.9 Summary of residual impacts to ecological values on Commonwealth land following implementation of management and mitigation measures

Aspect	Existing environment	Management measures	Residual impacts
Vegetation associations (CcEr[3], Cl, Er[8] Mp[7], MpMr and R)	1.2 ha of native vegetation (Mp[7] and MpMr) in extent in the proposal footprint on Commonwealth land. 45.2 ha of degraded to completely degraded of vegetation and infrastructure in the proposal footprint on Commonwealth land.	• An EMP will be prepared and implemented, including management and monitoring of intact native vegetation. • Disturbance will be restricted to the proposal footprint.	• Loss of 1.2 ha of native vegetation in degraded or better condition.
CCW and MUW	0.4 ha of CCW 8773, 0.02 ha of CCW 8909 and 30.22 of MUW 15732 in the proposal footprint on Commonwealth land.	• Disturbance will be restricted to the proposal footprint. • Finalisation of design will endeavour to avoid and minimise impacts to CCW and REWs within the proposal footprint. Where any areas of CCW and REW can be retained these will be identified within a detailed infrastructure plan prior to construction. • A wetland management and monitoring plan will be prepared and implemented.	• Loss of 0.42 ha of CCW wetlands. • Loss of 30.22 of MUW wetlands.
Black Cockatoo habitat and fauna habitat	26 potential breeding trees for Black Cockatoos. Approximately 1.9 ha of Wetland habitat.	• An EMP will be implemented. • During construction use boundary fencing or flagging will be used. • Black Cockatoo habitat will be offset.	• Loss of 26 potential breeding trees for Black Cockatoos. • Loss of approximately 1.9 ha of Wetland habitat.

16.6 Other Information Required by the Environment Protection and Biodiversity Conservation Regulations 2000

The Environment Protection and Biodiversity Conservation Regulations 2000 require a Public Environment Report prepared under the EPBC Act to provide certain information that has not otherwise been discussed elsewhere in this PER. This information is tabulated in Table 16.12.

Table 16.12 Other information required by Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000

Regulation[1]	Requirement[1]	Proponent response
4.01(e)	The name of the agency responsible for endorsing or approving each mitigation measure or monitoring program.	The DPAW are responsible for the endorsing or approving of all mitigation measures and monitoring programs relating to protected fauna and flora. The EPA is responsible for compliance with conditions that prescribe monitoring and mitigation measures as part of an approval under the EP Act. The DOW is responsible for the water licencing and monitoring of compliance with conditions.
4.01 (f)	A consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including mitigation measures proposed to be taken by State governments, local governments or the proponent.	A consolidated list of mitigation measures has been included in the Executive Summary of the PER. It is not anticipated that any mitigation measures will be undertaken by state or local governments (other than MRWA), but they will instead be the responsibility of the proponent (MRWA) or their appointed contractor.
5.01(a)(ii)	How the scheme provides for the prevention, minimisation and management of any relevant impacts.	The schemes referred to in Table 5.2 do not provide for direct management of impacts and therefore the EMP is the primary reference document for the management of environmental impacts. All efforts have been made to include all applicable management measures that will be implemented by the relevant construction contactor.
6.01(a)	Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against the person proposing to take the action.	MRWA is not aware of any proceedings under Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against the Department.
6.01(b)	Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against, for an action for which a person has applied for a permit, the person making the application.	MRWA is not aware of any proceedings under Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources in relation to any permits.

Regulation[1]	Requirement[1]	Proponent response
6.01(c)	If the person proposing to take the action is a corporation — details of the corporation's environmental policy and planning framework.	Regulation 6.01(c) is not applicable as the person taking the action, the Commissioner of Main Roads Western Australia, is not a corporation.

1. Cross-reference to the Environment Protection and Biodiversity Conservation Regulations 2000.

17 OFFSETS

The assessment of impacts presented in Chapters 8, 9, 10 and 16 describe the proposal's residual impacts following avoidance, impact minimisation and rehabilitation/restoration.

This chapter documents the proposal's offset strategy to address residual impacts on environmental values relevant to both the State, as assessed by the EPA, and for MNES, as determined by the DOTE.

17.1 Definition of Offsets

Under the Commonwealth Environmental Offsets Policy (Government of Australia, 2012) the term 'environmental offsets' refers to measures that compensate for the residual adverse impacts of an action on the environment. Offsets provide environmental benefits to counterbalance the impacts that remain after avoidance and mitigation.

Under the WA Environmental Offsets Policy (Government of Western Australia, 2011) an environmental offset is an off-site action or actions that addresses significant residual environmental impacts of a development or activity.

Both State and Commonwealth policies specify that environmental offsets are not intended to make proposals with unacceptable impacts acceptable and are not a substitute for undertaking all reasonable avoidance and environmental mitigation measures.

Under both the State and Commonwealth offset policies, environmental offsets can be classified as direct or indirect. Definitions for direct and indirect offsets under these policies are discussed in Table 17.1.

Table 17.1 Definition of direct and indirect offsets

Offset category	Definition	
	State	Commonwealth
Direct	Actions designed to provide for on-ground improvement, rehabilitation and conservation of habitat outside the proposal footprint. Direct offsets vary, depending on the specific circumstances of environmental impacts, and include acquisition, restoration, revegetation and rehabilitation of natural areas.	Actions that provide a measurable conservation gain for an impacted protected matter. A conservation gain may be achieved by improving or creating new habitat, reducing threats, or averting the loss of a protected matter or its habitat that is under threat.
Indirect	Actions aimed at improving scientific or community understanding and awareness of environmental values that are affected by a development or activity. These actions are designed to result in positive conservation outcomes and may include research to improve the management and protection of existing conservation estate or contributions to State Government initiatives, policies or strategic funds.	Actions that do not directly offset the impacts on the protected matter, but are anticipated to lead to benefits for the impacted protected matter, for example funding for research or educational programs. Requirements for other compensatory measures.

Sources: Government of Western Australia (2011) and Government of Australia (2012).

17.2 Application of Offsets

Environmental offsets aim to counterbalance the significant residual environmental impacts or risks of a particular activity or project. Both the State and Commonwealth Governments provide advice on the application of offsets and principles for their use. The Western Australian Government endeavours to work cooperatively with the Commonwealth Government to avoid duplication of offsets, however, this is not always possible where a proposal or action is not jointly assessed under a bilateral agreement or a strategic assessment.

The State and Commonwealth Governments have formally agreed to conduct a strategic assessment in accordance with section 146 of the EPBC Act, focussing on the Perth and Peel regions of the SCP. While this proposal lies within the boundary of this strategic assessment, none of the proposed offsets are to be secured through the Strategic Assessment of the Perth Peel Region (SAPPR) process.

17.3 Offset Policies

17.3.1 State Offset Policy

The State's Environmental Offset Guidelines (Government of Western Australia, 2014) assist the EPA in the determination and application of environmental offsets on a project by project basis and ensure that decisions made on environmental offsets are consistent and accountable.

In general, significant residual impacts include those that affect rare and endangered plants and animals, areas within the formal conservation reserve system, important environmental systems and species that are protected under international agreement (e.g. Ramsar wetlands) (Government of Western Australia, 2014). A residual impact significance model has been developed to assist proponents in consistently determining the significance of residual impacts and when an offset is likely to, or may, require an offset (Government of Western Australia, 2014).

Following the determination of the level of significance for residual impacts, the type of offset should be determined in line with the EPA principles for the development of an offset package (Government of Western Australia, 2011). These are:

1. Environmental offsets will only be considered after avoidance and mitigation options have been pursued.
2. Environmental offsets are not appropriate for all projects.
3. Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted.
4. Environmental offsets will be based on sound environmental information and knowledge.
5. Environmental offsets will be applied within a framework of adaptive management.
6. Environmental offsets will be focussed on longer term strategic outcomes.

17.3.2 Commonwealth Offset Policy

The Commonwealth's Offset Assessment Guide (DSEWPAC, 2012a) provides a framework to determine the suitability (i.e. appropriateness and adequacy) of proposed offsets for protected matters, including an impact and offset calculator. The Commonwealth outlines that (Government of Australia, 2012):

- Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter.
- Suitable offsets must be built around direct offsets, but may include other compensatory measures.

- Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter.
- Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter.
- Suitable offsets must effectively account for and manage the risks of the offset not succeeding.
- Suitable offsets must be additional to what is already required, determined by law or planning regulations or agreed to under other schemes and programs.
- Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reliable.
- Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

17.4 Rationale

The offset strategy for this proposal has been developed in consideration of various field assessments and supporting studies and consultations with the EPA, DOTE, DPAW and the Department of the Premier and Cabinet. The objective for this offset strategy is to achieve a net environmental benefit once the proposal has been implemented. To achieve this objective, a suite of offsets are proposed to address the various residual impacts and formulate the offset package for this proposal.

The following specific principles have been adopted when assessing the suitability of the proposed offsets:

- The offset represents a lasting environmental benefit.
- Preference is given to offsets that are relevant to the values being impacted by the proposal, including the conservation of:
  - Existing Black Cockatoo foraging, breeding and roosting habitat.
  - State listed TECs.
  - CCWs.
  - Conservation areas.

17.5 Summary of Significant Residual Impacts

A summary of significant residual impacts that are likely to require offsetting, as identified in Chapters 8, 9, 10, 15 and 16 and the relevant offset proposal under which they are addressed, is provided in Table 17.2.

Table 17.2 Summary of significant residual impacts requiring offset

Significant environmental value	Residual impact	Extent of residual impact[1]	Total extent of residual impact outside SAPPR boundary	Relevant offset proposal[2]
Black Cockatoo habitat[1]	Removal of Carnaby's Cockatoo foraging habitat, inclusive of breeding habitat, potential breeding trees and roosting habitat[3].	201.8 ha foraging habitat, including: • 120.1 ha breeding habitat • 763 potential breeding trees; and • 58.6 ha roosting habitat[3].	5.15 ha of foraging, roosting and breeding habitat and 107 potential breeding trees.	1
Forest Red-tailed Black Cockatoo habitat	Removal of Forest Red-tailed Black Cockatoo foraging habitat, inclusive of breeding habitat and potential breeding trees and roosting habitat[3].	120.1 ha foraging habitat, including: • 120.1 ha breeding habitat • 763 potential breeding trees; and • 58.6 ha roosting habitat[3].	5.15 ha of foraging, roosting and breeding habitat and 107 potential breeding trees.	1 and 4
Conservation areas	Excision of Class A Nature Reserve.	8 ha	Not applicable.	1
	Excision of 106 ha of State Forest.	Removal of 106 ha of State Forest	Not applicable.	1
	Removal of intact native vegetation across nine Bush Forever sites (partial and complete removal).	171.5 ha[4]	Not applicable.	1
TECs	Removal of SCP02 (Southern wet shrublands).	0.4 ha	Not applicable.	3
	Removal of SCP20a (*Banksia attenuata* woodlands over species rich dense shrublands).	4.0 ha	Not applicable.	1
CCWs	Partial or complete filling of five CCWs and other indirect impacts.	16.0 ha	Not applicable.	2
Threatened Flora	Removal of critical habitat for *Caladenia huegelii*.	39.2 ha	Not applicable.	1

1. Total extent of residual impact, both inside and outside the SAPPR boundary. None of the proposed offsets are to be secured through the SAPPR process.
2. For details relating to each of the offset proposals, see Sections 17.6, 17.7, 17.8 and 17.9.
3. These figures represent the area to be impacted on both State and Commonwealth lands.
4. Inclusive of 31.5 ha of State Forest and Class A Nature Reserve.

17.6 Offset Proposal 1 – Ioppolo Rd, Chittering

17.6.1 Commitment

MRWA will vest 673.5 ha of land with the Conservation Commission, and subsequent management by the DPAW for conservation purposes.

17.6.2 Description of Offset

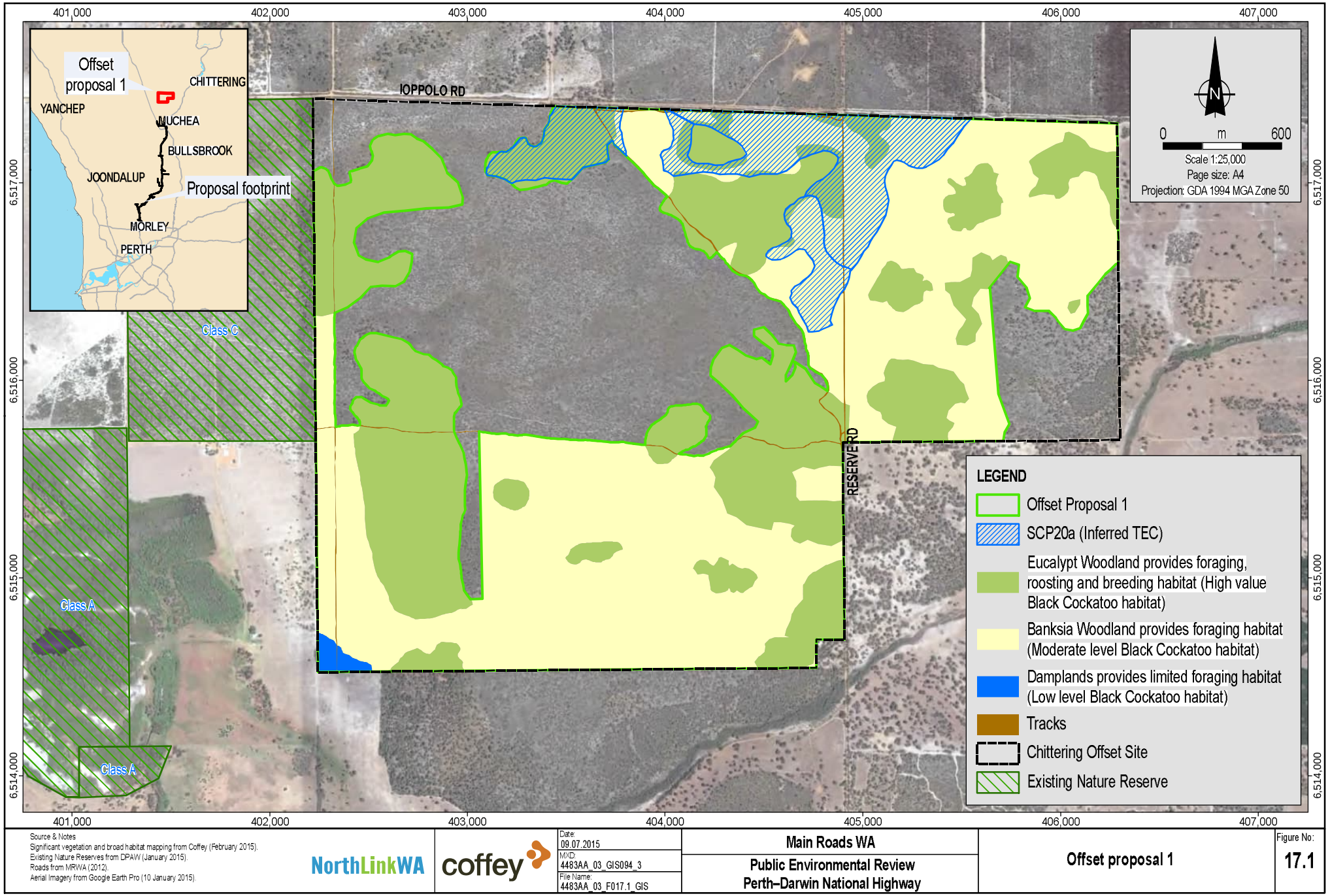
The proposed 673.5 ha offset area occurs within a larger 983 ha block of land located on Ioppolo Road, Chittering (herein referred to as Ioppolo Road). Ioppolo Road is surrounded by private land, with the exception of an existing C Class Nature Reserve managed by the DPAW to the west (Figure 17.1). It is currently zoned 'Agriculture Resource' under the Shire of Chittering Town Planning Scheme No. 6. MRWA has purchased Ioppolo Road for the purpose of offsetting impacts of the wider NorthLink WA Project (including this proposal and the Tonkin Grade Separations project).

A field survey was undertaken to determine the existing environmental values within Ioppolo Road (Coffey, 2015f) (Appendix V). The environmental assessment included a Level 1 flora and vegetation survey and a Level 1 fauna survey and Black Cockatoo habitat assessment. The assessment identified the following key values:

- The majority (84%) of the vegetation was in excellent condition due to the intact vegetation structure, minimal anthropogenic disturbances and minimal signs of disturbance as a result of pathogens, diseases and overgrazing from native and non-native fauna.
- Approximately 981 ha of Carnaby's Cockatoo foraging habitat, 315 ha of Forest Red-tailed Black Cockatoo foraging habitat, both of which include 315 ha of Black Cockatoo breeding and roosting habitat.
- Two inferred Threatened Ecological Communities (SCP20a and SCP20b), one known TEC (SCP20c), and three inferred PECs (Banksia yellow-orange sands, SCP23b and SCP21c)
- One Threatened and one Priority flora species were recorded, another five Priority listed plant taxa (including one P4 taxa known to occur in the proposal footprint) are known to occur and a further 25 conservation significant plant taxa have the potential to occur.
- The Western Brush Wallaby (*Macropus irma*), listed as Priority 4 under DPAW's Priority listing, was recorded and a further 10 conservation significant fauna species are considered to have the potential to occur within this study area.

The Carnaby's Cockatoo foraging habitat is associated with Eucalypt Woodland and Banksia Woodland and contains 17 species of foraging resources, including the following dominant species: *Eucalyptus marginata*, *E. todtiana*, *Corymbia calophylla*, *Allocasuarina humilis*, *Banksia menziesii* and *B. attenuata*. The 315 ha of Forest Red-tailed Black Cockatoo habitat is associated with Eucalypt Woodland that contains *Eucalyptus marginata* and *Corymbia calophylla,* both of which are the main constituents of this species' diet.

Within the Ioppolo Road site, 315 ha of Eucalypt Woodland habitat (specifically the stands of tall *Eucalyptus marginata*, *E. todtiana* and *Corymbia calophylla)* also represents Black Cockatoo breeding and roosting habitat. An estimated 6,300 potential breeding trees are present within the Eucalypt Woodland habitat, based on an average tree density of 20 trees per hectare. Given that tree age is sufficient to produce large hollows and as the region is known to have breeding records (Johnstone and Kirkby, 2011b), Ioppolo Road is classified as having current breeding potential for Carnaby's Cockatoos.



Source & Notes
Significant vegetation and broad habitat mapping from Coffey (February 2015).
Existing Nature Reserves from DPAW (January 2015).
Roads from MRWA (2012).
Aerial Imagery from Google Earth Pro (10 January 2015).

NorthLinkWA

coffey

Date: 09.07.2015
MXD: 4483AA_03_GIS094_3
File Name: 4483AA_03_F017.1_GIS

Main Roads WA

Public Environmental Review
Perth–Darwin National Highway

Offset proposal 1

Figure No: 17.1

The threatened taxa *Chamelaucium* sp. Gingin (N.G. Marchant 6) occurs in the northwest of Ioppolo Road. *Chamelaucium* sp. Gingin (N.G. Marchant 6) is considered to be a Threatened taxon under the WC Act with a classification of Vulnerable under the Act. In addition to the listing under the WC Act, it is listed as Endangered under the EPBC Act. *Chamelaucium* sp. Gingin (N.G. Marchant 6) is endemic to WA and is apparently confined to the Gingin/Chittering area, where it is known from a range of only 3 km and six populations (Stack and English, 2003). The six priority flora known to occur include *Acacia cummingiana* (P3), *Caustis* sp. Gigas (A.S. George 9318) (P2), *Hypolaena robusta* (P4), *Schoenus griffinianus* (P3), *Verticordia rutilastra* (P3) and *Verticordia serrata* var. *linearis* (P3). MRWA will conduct further surveys in spring 2015 to confirm the extent of the inferred occurrence of TEC SCP20a.

The Ioppolo Road site is currently outside (approximately 10 km north) the known distribution for the Forest Red-tailed Black Cockatoo. Given recent expansion of this species' distribution west from the edge of the Darling Scarp and onto the SCP (Johnstone et al., 2013), a review of current and historic information and a field survey is to be conducted to verify the suitability of this site as an offset for Forest Red-tailed Black Cockatoos. If the Ioppolo Road site is found unsuitable, MRWA commits to providing an appropriate offset for this species.

Based upon vegetation mapping a total of 39.2 ha of critical habitat for *Caladenia huegelii* will be removed as part of the proposal. Surveys for suitable habitat at the Ioppolo Road offset site will be conducted during spring 2015. If surveys show that the Ioppolo Road site does not comprise suitable habitat, then MRWA commits to offsetting the amount of critical habitat impacted by the proposal through a package that may comprise protection of habitat through acquisition or covenant, and contributions to the recovery plan such as a cultivation and translocation program.

17.6.3 Purpose of Offset

The purpose of Offset Proposal 1 is to offset the proposal's significant residual impacts on Black Cockatoo habitat, conservation areas of Nature Reserve, State Forest and Bush Forever, TEC SCP20a and threatened flora. A summary of Offset Proposal 1 is provided in Table 17.3 and is depicted in Figures 17.1 and 17.2.

Offset 1 provides the following values and net conservation benefits:

- Vesting with the Conservation Commission for long-term conservation management as a conservation reserve.
- Vegetation in better condition (Excellent) than the majority of the vegetation to be cleared.
- Additional numbers of rare and priority listed flora and conservation significant fauna to be protected.
- Is adjacent to a Class C conservation reserve and forms part of the catchment protecting Chandala wetlands a significant conservation area.
- Provides conservation management of an important ecological linkage for Black Cockatoos and is part of an ecological linkage between conservation areas.
- Management of Ioppolo Road as part of the conservation estate will include management of threatening processes such as dieback.

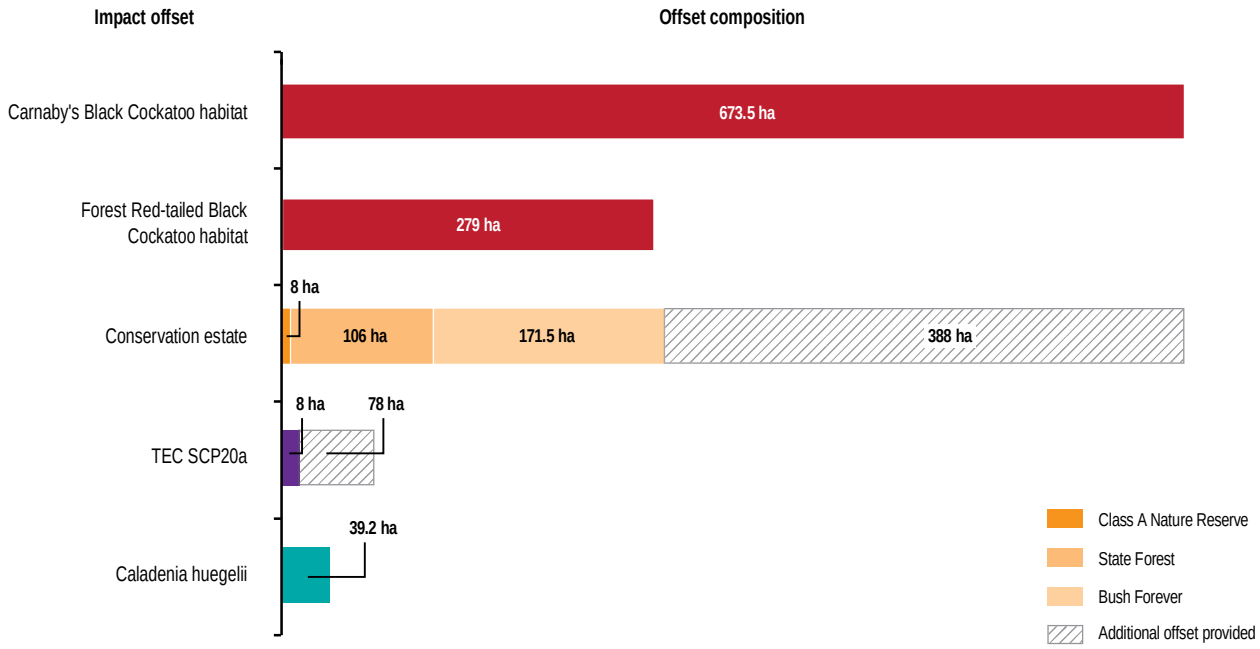
Management of the Ioppolo Road site will be undertaken by DPAW and will include control of third party access and reducing the risk of the introduction and/or spread of dieback and weeds and existing weeds and dieback.

Table 17.3 Summary of Offset Proposal 1

Significant environmental value	Extent of residual impact	Regulatory agency requiring offset	Offset area required	Indicative values provided in Offset Proposal 1[1]
Carnaby's Cockatoo habitat	Removal of 201.8 ha foraging habitat, inclusive of 120.1 ha breeding habitat (and 763 potential breeding trees) and 58.6 ha roosting habitat[2].	EPA/DOTE	673.5 ha[3]	Formal protection of 673.5 ha of foraging habitat, including 279 ha of potential breeding habitat and approximately 5,580 trees.
Forest Red-tailed Black Cockatoo habitat	Removal of 120.1 ha foraging habitat, inclusive of 120.1 ha breeding habitat (and 763 potential breeding trees) and 58.6 ha roosting habitat[2].	EPA/DOTE	339 ha[3]	Formal protection of 279 ha of foraging and potential breeding habitat including approximately 5,580 trees.
Caladenia huegelii critical habitat	Removal of 39.2 ha of critical habitat for *Caladenia huegelii*.	DOTE	39.2 ha	Formal protection of suitable habitat to equivalent area of impacts.
Conservation areas	Excision of 8 ha of Class A Nature Reserve, 106 ha of State Forest and 171.5 ha of intact native vegetation within Bush Forever sites[4].	EPA	253 ha[5]	673.5 ha vested in Conservation Commission to be managed as a Nature Reserve.
SCP20a TEC	Removal of 4.0 ha of SCP20a (*Banksia attenuata* woodlands over species rich dense shrublands).	EPA	8 ha	Formal protection of 78 ha of inferred SCP20a.

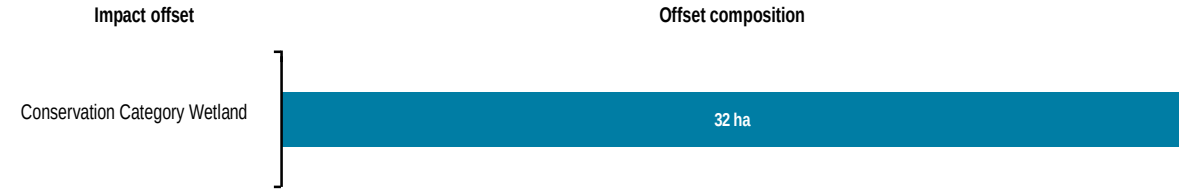
1. As illustrated in Figures 17.1 and 17.2.
2. These figures represent the area to be impacted on both State and Commonwealth lands.
3. Based on the Commonwealth offset assessment guide (see Appendix V). Includes 673.5 ha of foraging habitat and 279 ha of potential breeding habitat (including 5,580 potential breeding trees).
4. Includes the 31.5 ha of Bush Forever site that is also recognised as State Forest/Class A Nature Reserve.
5. Total impact on conservation areas based on 8 ha of Class A Nature Reserve, 106 ha of State Forest and 139 ha of Bush Forever (excluding the 31.5 ha of Bush Forever also recognised as State Forest/Class A Nature Reserve).

OFFSET PROPOSAL ONE



* Excluding the 31.5ha of Bush Forever recognised as State Forest/Class A Nature Reserve.

OFFSET PROPOSAL TWO



OFFSET PROPOSAL THREE*

* Only required where TEC SCP02 is confirmed to be present within the proposal footprint.

OFFSET PROPOSAL FOUR

coffey	Date: 01.09.2015 File Name: 4483AA_03_F17.02_GIS_GL_10	Main Roads WA Public Environmental Review Perth–Darwin National Highway	NorthLinkWA	Composition of indicative offset proposals	Figure No: 17.2

17.7 Offset Proposal 2 – Conservation of Land Comprising CCWs

17.7.1 Commitment

MRWA will fund the acquisition or covenanting of a property or properties to be managed for conservation, or for improved management or rehabilitation to offset the loss of CCW. The properties will contain at least 32 ha of CCW (Figure 17.2).

17.7.2 Purpose of Offset

The purpose of the Offset Proposal 2 is to offset the loss of 16 ha of CCW comprised of direct impacts to 14.8 ha from 6 CCWs and the indirect impacts to CCW 15260 of 1.2 ha. The acquisition of 32 ha of CCW, when implemented, will provide a ratio of 2:1 for the area of protected wetland for each hectare of impacted CCW. This will achieve a net gain of more than 16 ha of CCW to be protected and managed and improved (if necessary), for conservation.

17.8 Offset Proposal 3 – Conservation of TEC

17.8.1 Commitment

MRWA will undertake further surveys of the site that potentially represents TEC SCP02 Southern Wet Shrublands. These surveys will be conducted in spring 2015. If the TEC is confirmed, MRWA will commit to acquire or covenant the location of one ha of land representative of this TEC or a TEC of similar of greater threat (see Figure 17.2).

17.8.2 Purpose of Offset

As an Endangered TEC at the State level, effective management of remaining sites contributes to the long term conservation of this community that is readily invaded by weeds and affected by hydrological changes. The purpose of this offset proposal, if the community is confirmed, is to increase the conservation management of the known locations of the TEC by providing funding for the acquisition or covenanting and protection of at least one ha of SCP02, based on an offset ratio of 2:1. This will achieve an additional hectare of an endangered TEC to be protected and managed for conservation.

17.9 Offset Proposal 4 – Conservation of Forest Red-tailed Black Cockatoo Habitat

17.9.1 Commitment

MRWA will fund the acquisition or covenanting of a property or properties to be managed for conservation or for improved management or rehabilitation to offset the loss of Forest Red-tailed Black Cockatoo habitat in addition to the offset area proposed in Offset Proposal 1. Offset Proposal 1 does not contain sufficient Forest Red-tailed Black Cockatoo habitat to offset the impacts of the proposal and an additional 60 ha of habitat in similar condition to Offset Proposal 1 is required (see Figure 17.2).

17.9.2 Purpose of Offset

As the Ioppolo Road site in Offset Proposal 1 does not contain sufficient habitat to completely offset impacts to Forest Red-tailed Black Cockatoo, a supplementary offset is required. The purpose of Offset Proposal 4 is to offset the loss of Forest Red-tailed Black Cockatoo habitat through the protection of at least 60 ha of suitable habitat to meet the total of 339 ha.

17.10 Offset Summary

To offset effectively the significant residual impacts of the proposal (see Figure 17.2) MRWA will provide:

- Offset Proposal 1: Purchase and transfer of 673.5 ha of freehold land to conservation estate, which includes intact native vegetation, Threatened flora, Threatened Ecological Communities and Black Cockatoo habitat.
- Offset Proposal 2: Provision of funding to acquire or covenant wetlands comprising at least 32 ha of CCW.
- Offset Proposal 3: Provision of funding to acquire or covenant 1 ha of TEC SCP02, subject to the confirmation of the presence of TEC SCP02 within the proposal footprint following further surveys.
- Offset Proposal 4: Provision of funding to acquire or covenant 60 ha of Forest Red-tailed Black Cockatoo habitat.

The majority of the significant residual impacts are offset by Offset Proposal 1. Additional offsets are required to address the CCW areas, the potential TEC SCP02 and further Forest Red-tailed Black Cockatoo habitat. The degree to which each of these offsets addresses significant residual impacts of the proposal is represented in Figure 17.2.

A summary of all four offset proposals using the Western Australian offsets template is provided in Table 17.4.

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Table 17.4 Quantification of offset proposals

Existing environment and impact	Mitigation			Significant residual impact	Offset calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehab. success		Type	Risk	Likely offset success	Time lag	Offset quantification
Carnaby's Cockatoo habitat Removal of 201.8 ha foraging habitat, inclusive of 120.1 ha breeding habitat (and 763 potential breeding trees) and 58.6 ha roosting habitat.	The proposal alignment predominantly (approximately 77.5%) follows existing infrastructure, cleared areas or secondary habitats, which reduces impacts to existing fauna habitats. Through design efficiencies the proposal footprint has been reduced from 1,028.4 ha to about 746 ha in size and reduced impacts to fauna habitats by a total of 49.6 ha across the alignment (Table 9.5). To avoid an area containing a high concentration of Black Cockatoo breeding trees, the width of the proposal footprint was reduced between Baal Street and Gnangara Road (see Figure 4.3), reducing the number of breeding trees cleared from 410 to 342.	Onsite rehabilitation opportunities will be limited to temporary construction areas. Furthermore the use of Banksia and other Black Cockatoo foraging resources will be limited as part of revegetation activities within 10 m of the road, as this increases the risk of bird strike. As MRWA will work to minimise its footprint, temporary areas of disturbance greater than 10 m from the road are anticipated to be limited.	N/A	**Extent:** Significant residual impact remains as 201.8 ha foraging habitat, inclusive of 120.1 ha breeding habitat (and 763 potential breeding trees) and 58.6 ha roosting habitat as potential area of suitable rehabilitation unknown at this stage. **Quality:** In accordance with the How to Use the DOTE's Offset Assessment Guide (DSEWPAC, 2012a), the assessment of a threatened species' habitat must consider the site's condition, the site's context and the species' stocking rate. A Quality Score of 6 has been applied to this species habitat within the proposal footprint (see Appendix V). **Conservation significance:** Endangered species. **Land tenure:** The following habitat features are located in conservation reserve: • State Forest: 2.5 ha of breeding and roosting habitat and 30.5 ha foraging habitat. • Nature Reserve: 0.4 ha of foraging habitat. • Bush Forever Site: 95.9 ha of breeding habitat, 32.6 ha of roosting habitat and 155.2 ha of foraging habitat. **Timescale:** Permanent.	Offset Proposal 1	Low – land to be acquired and transferred conservation estate.	This is not applicable for land acquisition – see risk comments.	No time lag. The proposed offset site has already been acquired and is in the process of being ceded to the Conservation Commission.	In accordance with the DOTE's Offset Assessment Guide (see Appendix V): 673.5 ha of foraging habitat, inclusive of 279 ha of Eucalyptus Woodland (which contains approximately 6,300 breeding/roosting trees).

Existing environment and impact	Mitigation			Significant residual impact	Offset calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehab. success		Type	Risk	Likely offset success	Time lag	Offset quantification
Forest Red-tailed Black Cockatoo habitat Removal of 120.1 ha foraging habitat, inclusive of 120.1 ha of breeding habitat (and 763 potential breeding trees) and 58.6 ha roosting habitat.	The proposal alignment predominantly (approximately 77.5%) follows existing infrastructure, cleared areas or secondary habitats, which reduces impacts to existing fauna habitats. Through design efficiencies the proposal footprint has been reduced from 1,028.4 ha to about 741 ha in size and reduced impacts to fauna habitats by a total of 49.6 ha across the alignment (Table 9.5). To avoid an area containing a high concentration of Black Cockatoo breeding trees, the width of the proposal footprint was reduced between Baal Street and Gnangara Road (see Figure 4.3), reducing the number of breeding trees cleared from 410 to 342.	Onsite rehabilitation opportunities will be limited to temporary construction areas. Furthermore the use of Black Cockatoo foraging resources will be limited as part of revegetation activities within 10 m of the road, as this increases the risk of bird strike. As MRWA will work to minimise its footprint, temporary areas of disturbance greater than 10 m from the road are anticipated to be limited.	N/A	**Extent:** Significant residual impact remains as 120.1 ha foraging habitat, inclusive of 120.1 ha breeding habitat (and 763 potential breeding trees) and 58.6 ha roosting habitat as potential area of suitable rehabilitation unknown at this stage. **Quality:** In accordance with the How to Use the DOTE's Offset Assessment Guide (DSEWPAC, 2012a), the assessment of a threatened species' habitat must consider the site's condition, the site's context and the species' stocking rate. A Quality Score of 6 has been applied to this species habitat within the proposal footprint (see Appendix V). **Conservation significance:** Vulnerable species. **Land tenure:** The following habitat features are located in conservation reserve: • State Forest: 2.5 ha of breeding, roosting and foraging habitat. • Bush Forever Site: 95.9 ha breeding and foraging habitat and 32.6 ha of roosting habitat. **Timescale:** Permanent.	Offset Proposals 1 and 4	Low – land to be acquired and transferred to conservation estate.	This is not applicable for land acquisition – see risk comments.	No time lag for Offset proposal 1. The proposed offset site has already been acquired and is in the process of being ceded to the Conservation Commission. Time lag anticipated for Offset Proposal 4.	In accordance with the DOTE's Offset Assessment Guide (see Appendix V): 279 ha of foraging habitat (Eucalyptus Woodland, which contains approximately 5,580 breeding/roosting trees).

Existing environment and impact	Mitigation			Significant residual impact	Offset calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehab. success		Type	Risk	Likely offset success	Time lag	Offset quantification
Conservation areas • Excision of 8 ha of Class A Nature Reserve. • Excision of 106 ha of State Forest. • Removal of 171.5 ha of intact native vegetation across nine Bush Forever sites (Inclusive of 31.5 ha of State Forest and Class A Nature Reserve).	Through design efficiencies the proposal footprint has been refined to reduce the impact to 14 ha of State Forest, 2 ha of Nature Reserve and 58 ha of Bush Forever.	Onsite rehabilitation opportunities will be limited to temporary construction areas. Total area to be rehabilitated unknown at this stage- will be dependent on final design. Revegetation will focus on using native provenance vegetation that is suited to the surrounding landscape characteristics and land use. However, the use of Banksia and other Black Cockatoo foraging resources will be limited as part of revegetation activities within 10 m of the road, as this increases the risk of bird strike.	N/A	**Extent:** Significant residual impact remains as: • Excision of 8 ha of Class A Nature Reserve. • Excision of 106 ha of State Forest. • Removal of 171.5 ha of intact native vegetation across nine Bush Forever sites (Inclusive of 31.5 ha of State Forest and Class A Nature Reserve). **Quality:** All native vegetation with condition rated degraded or above. **Conservation significance:** • 3 individuals *Millotia tenuifolia* var. *laevis* (P2). • 1 individual *Hypolaena robusta* (P4). • 1 individual *Anigozanthos humilis* subsp. *chrysanthus* (P4). • 1 individual *Meeboldina decipiens* subsp. *decipiens* ms (P3). • 98.6 ha of high value Black Cockatoo habitat and 28 ha of moderate value. • 3.8 ha of TEC SCP20a. **Land tenure:** Class A Nature Reserve/ State Forest. 31.5 ha impacted Bush Forever Sites overlap/within the abovementioned State Forest and Nature Reserve. **Timescale:** Permanent.	Offset Proposal 1	Low – land to be acquired and transferred to conservation estate.	This is not applicable for land acquisition – see risk comments.	No time lag. The proposed offset site has already been acquired and is in the process of being ceded to the Conservation Commission.	Acquisition and ceding of 673.5 ha to Conservation Commissions with the intention that the land will become a conservation reserve and be managed by the DPAW in the long term.
TECs Removal of 0.4 ha of inferred SCP02 (Southern wet shrublands). The existence of this TEC will be confirmed during spring 2015 surveys and the information will be provided to OEPA during the response to submissions period.	Through design efficiencies the proposal footprint has also been refined to reduce the impact to inferred SCP02 from 1.1 ha to 0.4 ha.	No rehabilitation possible. MRWA will work to minimise its footprint, and will locate any temporary construction areas (i.e. laydown areas) outside of this TEC.	N/A	**Extent:** 0.4 ha of inferred SCP02. **Quality:** Very Good condition. **Conservation significance:** State listed TEC. **Land Tenure:** N/A. **Timescale:** Permanent.	Offset Proposal 3	Low – land to be acquired and transferred to conservation estate or covenanted and managed in perpetuity	This is not applicable for land acquisition – see risk comments.	–	MRWA will fund the acquisition or covenanting of 1 ha of TEC SCP02, subject to the confirmation of the presence of TEC SCP02 within the proposal footprint following further surveys.

Existing environment and impact	Mitigation			Significant residual impact	Offset calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehab. success		Type	Risk	Likely offset success	Time lag	Offset quantification
TECs Removal of 4.0 ha of inferred SCP20a (*Banksia attenuata* woodlands over species rich dense shrublands). The extent of this TEC will be confirmed during spring 2015 surveys and the information will be provided to OEPA during the response to submissions period.	A location of inferred SCP20a along Reid Highway, east of the Reid Tonkin interchange, has been avoided. Through design efficiencies the proposal footprint has been refined to reduce the impact to inferred SCP20a from 4.3 ha to 4.0 ha.	No rehabilitation possible. MRWA will work to minimise its footprint, and will locate any temporary construction areas (i.e. laydown areas) outside of any known locations of this TEC.	N/A	**Extent:** 4.0 ha of inferred SCP20a. **Quality:** Mostly in Excellent condition. **Conservation significance:** State listed TEC. **Land tenure:** N/A. **Timescale:** Permanent.	Offset Proposal 1	Low – land to be acquired and transferred to conservation estate.	This is not applicable for land acquisition – see risk comments.	No time lag. The proposed offset site has already been acquired and is in the process of being vested with the Conservation Commission.	Acquisition and ceding of 673.5 ha to Conservation Commission with the intention that the land will become a conservation reserve and be managed by the DPAW in the long term. This site provides 78 ha of inferred TEC SCP20a.
CCWs Partial or complete filling of seven CCWs totalling 14.8 ha. Loss of ecosystem function in a portion of one CCW isolated by the proposal (1.2 ha).	Design changes have been employed to avoid impacts to one CCW (UFI 8914) and an additional 17.8 ha of CCW within the development envelope.	No rehabilitation possible. MRWA will work to minimise its footprint, and will locate any temporary construction areas (i.e. laydown areas) outside of any known CCW locations.	N/A	**Extent:** Complete loss of one CCW (0.9 ha) and partial loss of an additional six CCWs (13.9 ha). Indirect loss of 1.2 ha of CCW. **Quality:** Varying condition. **Conservation significance:** Conservation Category wetland. **Land tenure:** N/A. **Timescale:** Permanent.	Land acquisition and/or covenant.	Low – land is expected to be either vested with the Conservation Commission, or covenanted with the intention that the land will be managed for conservation in the long term.	This is not applicable for land acquisition – see risk comments.	–	MRWA will fund the acquisition or covenanting of a property or properties to be managed for conservation or for improved management or rehabilitation to offset the loss of CCWs. The properties acquired/ covenanted will collectively contain at least 32 ha of CCWs.

18 CONCLUSION

MRWA is proposing to construct a new 38 km section of the PDNH between Malaga and Muchea, Western Australia. The proposal has been driven by traffic congestion, increased travel times and reduced amenity on the existing PDNH along the Great Northern Highway. Construction is scheduled to commence in 2016 or 2017 and will proceed in stages.

This PER has presented the EPA's preliminary key environmental factors for the proposal as well as other environmental and integrating factors requiring consideration. MRWA believes that the proposal can meet the EPA's objective for each of the environmental and integrating factors addressed, as well as requirements under the EPBC Act.

The proposal will result in the loss of 205 ha of native vegetation, impacts to two state-listed TECs and five state-listed PECs. Five Priority flora species are located in the proposal footprint, though no threatened flora will be cleared. Approximately 128 ha of native vegetation within Bush Forever Sites will be cleared. With the appropriate mitigation measures and offsets for Threatened and Priority flora, TECs and native vegetation, the proposal is likely to meet the EPA's objectives.

Clearing will result in the loss of 159 ha of natural fauna habitats. Fauna habitat will become more fragmented and susceptible to edge effects; however, the provision of fauna underpasses in key locations will help to maintain ecological connectivity.

Black Cockatoo habitat expected to be cleared includes foraging habitat (201.8 ha for Carnaby's Cockatoo and 120.1 ha for Red-tailed Black Cockatoo), 58.6 ha of roosting habitat, 120.1 ha of potential breeding habitat and 737 suitable breeding trees. Acceptable mitigation measures and offset strategies to manage the potential impacts on Black Cockatoo species to meet the EPA objectives, will be implemented.

Conservation significant species for which habitat is expected to be lost include Great Egret (15.5 ha), Cattle Egret (271.2 ha), Rainbow Bee-eater (367.5 ha), Jewelled Sandplain Ctenotus (81.7 ha), Black Striped-snake (124.8 ha), Western Carpet Python (124.8 ha), Western Brush Wallaby (124.8 ha) and Southern Brown Bandicoot (19.0 ha).

The proposal will result in the loss of one conservation category wetland (0.9 ha), direct impacts to another six conservation category wetlands (13.9 ha) and indirect impacts to one further wetland (1.2 ha). Four resource enhancement wetlands will also be partially lost (14.0 ha). Hydrological and hydrogeological impacts are otherwise expected to be limited to minor localised alterations to surface water flows and groundwater levels. The existing surface water flow regime will be maintained as much as possible by the incorporation of retention basins and drainage culverts into the design. The proposal will result in benefits to the Lexia wetlands as public access will be restricted and associated rubbish dumping activities being curtailed by the presence of the highway. The proposal will be managed to ensure that surrounding hydrological regimes and ecosystem function is maintained and so it is considered that the proposal is likely to meet the EPA's objectives for hydrological processes and inland waters environmental quality.

Revegetation of areas disturbed only during construction will ensure stability of roadside soils. In the long term, revegetation will enhance the ecological function of adjacent native vegetation, assisting in the conservation of local biodiversity values and contributing towards amenity and aesthetics. Implementation of the revegetation strategy and associated management measures will meet the EPA's objective to ensure that the proposal footprint is rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without unacceptable liability to the State.

The proposal will impact four registered Aboriginal heritage places. The temporary disturbance of Ellen Brook and other watercourses is not considered to have a significant effect on Aboriginal heritage values. The registered Aboriginal Site DAA Place ID 20058 is not extant, having been destroyed in the 1990s, and construction will have no additional impact. Lightning Swamp (DAA Place ID 21393), adjacent to Reid Highway, will be impacted through construction of the proposal. However, the impact was not described by Aboriginal representatives as significant.

Four European heritage sites will also be impacted during construction. The European heritage in the proposal footprint is of limited archaeological or cultural value and is not included on any Commonwealth or State statutory heritage lists. The demolition/clearing of these places is not likely to adversely affect any historical or cultural associations. As such, the proposal is considered likely to meet the EPA's objectives for heritage. An application under Section 18 of the AH Act will be submitted to the DAA to obtain approval to disturb these sites within the proposal footprint.

Traffic noise from the operation of the proposal will be managed in accordance with the provisions of SPP5.4. For areas between Reid Highway and Hepburn Avenue the noise limit of 60 dB L_{Aeq} can be achieved through the construction of noise walls. For areas between Hepburn Avenue and Ellenbrook, the noise target of 55 dB L_{Aeq} will be achievable. Noise wall heights will be capped at a maximum height of 5m to reduce visual and amenity impacts. The noise limit of 60 dB L_{Aeq} will not be exceeded at any noise sensitive receptors along this section of the proposal. It is expected that the daytime noise target of 55 dB L_{Aeq} will not be achieved at eight rural residential properties north of Ellenbrook due to limitations on noise wall locations. All reasonably practical management measures will be implemented to meet the EPA's objectives in respect of noise north of Ellenbrook.

The proposal will result in the loss of land on which recreational infrastructure had been planned in Dick Perry Reserve. Construction of the proposal will result in a reduction in the size of the proposed reserve and the potential for its use as community open space. Amenity to users of Whiteman Park is expected to be largely unaffected, as none of the facilities used by the community will be disturbed by the proposal. Vegetation clearance, habitat fragmentation and fauna mortalities from vehicle interactions are the principal impacts to Whiteman Park and have been addressed under the relevant environmental factors.

The proposal will impact a number of conservation areas, including requiring the excision of 8 ha of Class A Nature Reserve (46919 and 46920), 106 ha of Gnangara–Moore River State Forest (No. 65) and the clearing 128 ha of intact native vegetation across nine Bush Forever sites (including sites 97, 100, 192, 198, 300, 304, 307, 399 and 480). The area to be excised through the State excision process has been minimised as far as practicable, whilst ensuring a suitably sized development envelope to accommodate a safe and efficient highway in these areas and so is likely to meet the EPA's objective, even before consideration of the proposed offsets.

Matters of National Environmental Significance under the EPBC Act will be directly affected by the proposal. The proposal will not impact on any known TECs or any Threatened flora species. Five fauna species listed under the EPBC Act will be impacted by the proposal, including the Carnaby's Black Cockatoo, Forest Red-tailed Black Cockatoo, Great Egret, Cattle Egret and Rainbow Bee-eater. Impacts to these species comprise the habitat loss and degradation described above.

A 4.05 km section of Commonwealth land, managed by the DOD, will be impacted by the proposal. Impacts to this land include the loss of conservation category wetlands (0.4 ha of CCW 8773 and 40 m^2 of CCW 8909), 26 suitable breeding trees for Black Cockatoos, water bores, remnant portions of land and local road access.

As the residual impacts to flora and vegetation, conservation significant fauna and wetlands are likely to be significant, the proposal will include measures to offset the remaining impacts for these environmental factors. To offset the loss of Black Cockatoo habitat under both Western Australian and Commonwealth

legislation, removal of conservation areas, the TEC SCP20a and native vegetation, the proposal will provide for the vesting of a 674 ha portion of land in Chittering as a Class A Nature Reserve. Offsets for remaining impacts to wetlands are in development and will be subject to the approval of the EPA. Once implemented, MRWA expects that the offsets will enable the proposal to meet the EPA's objectives for flora and vegetation, terrestrial fauna, hydrological processes and inland waters environmental quality.

When the offsets described in Chapter 17 are implemented, MRWA believes that all of the EPA's objectives for environmental and integrating factors will be met.

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19 GLOSSARY

19.1 Abbreviations

Term	Definition
AAQ NEPM	National Environment Protection (Ambient Air Quality) Measure
ACMA	Australian Communications and Media Authority
AH Act	*Aboriginal Heritage Act 1972*
AHD	Australian Height Datum
AHIS	Aboriginal Heritage Inquiry System
ASA	Airservices Australia
ASS	acid sulfate soils
BAM Act	*Biosecurity and Agricultural Management Act 2007*
BOM	Bureau of Meteorology
Bonn Convention	Convention on migratory species that aims to conserve terrestrial, aquatic and avian migratory species throughout their range
CALM Act	*Conservation and Land Management Act 1984*
CAMBA	China-Australia Migratory Bird Agreement
CAR	comprehensive, adequate and representative
CCTV	closed-circuit television
CCW	Conservation Category Wetland
CO	carbon monoxide
CR	Critically Endangered
CS Act	*Contaminated Sites Act 2003*
DAA	Department of Aboriginal Affairs
DBH	diameter at breast height
DEC	Department of Environment and Conservation
DER	Department of Environment Regulation
DFES	Department of Fire and Emergency Services
DMP	Department of Mines and Petroleum
DOD	Department of Defence
DOP	Department of Planning
DOTE	Department of the Environment

Term	Definition
DOW	Department of Water
DPAW	Department of Parks and Wildlife
EAG	Environmental Assessment Guideline
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
EN	Endangered
EP Act	*Environmental Protection Act 1986*
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPP Lakes	*Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*
ESD	Environmental Scoping Document
EWNSR	East Wanneroo North-South Route
EWR	ecological water requirements
FCT	floristic community type
FPC	Forest Products Commission
GDEs	groundwater dependent ecosystems
GHPDP	Government Heritage Property Disposal Process
GNH	Great Northern Highway
GSS	Gnangara Sustainability Strategy
IBRA	Interim Biogeographic Regionalisation of Australia
ISCA	Infrastructure Sustainability Council of Australia
ISO 14001	AS/NZS ISO 14001:2004 Environmental management systems—Requirements with guidance for use
IUCN	International Union for the Conservation of Nature
IWSS	Integrated Water Supply Scheme
JAMBA	Japan-Australia Migratory Bird Agreement
LA Act	*Land Administration Act 1997*
M	Migratory
MNES	Matters of National Environmental Significance
MRS	Metropolitan Region Scheme
MRWA	Main Roads Western Australia

Term	Definition
MUW	Multiple Use Wetland
OEPA	Office of Environmental Protection Authority
P1	Priority 1
P2	Priority 2
P3	Priority 3
P4	Priority 4
P5	Priority 5
PASS	pyrite acid sulfate soils
PBP	Perth Biodiversity Project
PDNH	Perth–Darwin National Highway
PEC	Priority Ecological Community
PER	Public Environmental Review
PMST	Protected Matters Search Tool
PMR	Perth Metropolitan Region
PSP	Principal Shared Path
REW	Resource Enhancement Wetland
RIWI Act	*Rights in Water and Irrigation Act 1914*
RMP	Rehabilitation Management Plan
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
RTAA	road train assembly area
S1	Schedule 1
S2	Schedule 2
S3	Schedule 3
S4	Schedule 4
SAPPR	Strategic Assessment of Perth-Peel Region
SCP	Swan Coastal Plain
SCOTI	Standing Council on Transport and Infrastructure
SKM	Sinclair Knight Merz
SPP 2	Statement of Planning Policy No. 2: Environment and Natural Resources Policy
SPP 2.8	State Planning Policy No. 2.8: Bushland Policy for the Perth Metropolitan Region
SRE	short-range endemic
SWALSC	South-West Aboriginal Land and Sea Council

Term	Definition
SWA02	Perth subregion 2
TEC	Threatened Ecological Community
TGS	Tonkin Grade Separations
TSS	total suspended solids
UFI	unique feature identifier
UPDC	Ultimate Planning Design Concept
UWPCA	Underground Water Pollution Control Area
VU	Vulnerable
WA	Western Australia
WAH	Western Australian Herbarium
WALGA	Western Australian Local Government Association
WAPC	Western Australia Planning Commission
WC Act	*Wildlife Conservation Act 1950*
WHPZ	Wellhead Protection Zone
WONS	weeds of national significance
WPP	weed prioritisation process

19.2 Units and Symbols

°	degrees
%	percentage
°C	degrees Celsius
dB	decibel
ha	hectare
km	kilometre
kg	kilogram
L_{Aeq}	average noise energy
$L_{A10,18\ hour}$	the average of the hourly L_{a10} (noise level exceeded for 10% of the measuring period) levels between 6.00 a.m. and midnight
$L_{Aeq\ (Day)}$	the average of the hourly L_{aeq} levels between 6.00 a.m. and 10.00 p.m.
$L_{Aeq\ (Night)}$	the average of the hourly L_{aeq} levels between 10.00 p.m. and 6.00 a.m.
m	metre
m^2	square metre
mm	millimetre

NO_2	nitrogen dioxide
O_3	Ozone
Pb	Lead
SO_2	sulfur dioxide
µm	micron *or* micrometre

19.3 Definitions

A

Amenity *n.* features, facilities, or services of a house, estate, district, etc., which make for a comfortable and pleasant life.

B

Bilateral agreement *adj*. a bilateral agreement is an agreement between the Commonwealth and a state or self-governing territory, which either accredits certain environmental impact assessment processes of that state or territory (an assessment bilateral) or delegates to a state or self-governing territory the authority to decide whether to approve an action. Under an assessment bilateral agreement, the Australian Government Minister for the Environment remains responsible for deciding whether an action requires assessment and whether to approve an action.

Bonn Convention *n.* a convention on migratory species that aims to conserve terrestrial, aquatic and avian migratory species throughout their range.

Bush Forever sites *n.* a plan designed to identify, protect and manage regionally significant bushland in metropolitan Perth.

C

Carriageway *n.* each of the two sides of a dual carriageway or motorway, each of which usually have two or more lanes.

Controlled action *adj.* a proposed action that is likely to have a significant impact on: a matter of national environmental significance; the environment of Commonwealth land (even if taken outside Commonwealth land); or the environment anywhere in the world (if the action is undertaken by the Commonwealth).

Congestion *adj.* condition on road networks that occurs as use increases, and is characterized by slower speeds, longer trip times, and increased vehicular queueing. The most common example is the physical use of roads by vehicles.

Constrained area *n*. an area where there is an expectation that development will be able to proceed, this may include urban, urban deferred or industrial zoned land or land with existing development approvals.

Cosmopolitan distribution *n*. a wide ranging species found across all or most of the world in appropriate habitats.

D

Dampland *n.* a type of vegetation characterised by occasional *Eucalyptus rudis* trees over *Melaleuca preissiana* and/or *Melaleuca rhaphiophylla* low woodland over occasional heath scrub dominated by *Pericalymma spp., Astartea spp*. and *Melaleuca spp*. over sedges and rushes. This habitat type is an area where moisture collects and during the winter months becomes seasonally waterlogged.

Dieback *n.* a condition of plants observed to start at the outer leaf tips causing gradual yellowing, loss of leaves and progressive lifelessness; may be caused by a variety of agents including salinity, drought, insect damage or plant pathogens such as the fungus *Phytophthora cinnamomi*.

Development envelope *n.* the area for which Main Roads WA is seeking approval to implement the proposal within.

E

Edge effect *n.* refers to the changes in population or community structures that occur at the boundary of two habitats.

Ephemeral creek *adj*. a creek or portion of a creek which flows briefly in direct response to precipitation in the immediate vicinity and whose channel is at all times above the ground water reservoir.

Environmental offset *n.* is an offsite action or actions to address significant residual environmental impacts of a development or activity.

Eutrophication *n.* a form of water pollution involving an excess of mineral nutrients such as nitrates and phosphorus leaching from soils; often the result of pollution from sewage effluent, soil fertilisers.

F

Facultative *v.* the capacity to live under more than one specific set of environmental conditions, does not rely on groundwater in order to survive (opposed to obligate).

Flyovers *n.* a high-level overpass, built above main overpass lanes, or a bridge built over what had been an at-grade separation.

Foraging *n.* the seeking or obtaining of food.

G

Grade separation *n.* is the method of aligning a junction of two or more surface transport axes at different heights (grades) so that they will not disrupt the traffic flow on other transit routes when they cross each other.

H

Habitat fragmentation *n.* is the process by which habitat loss results in the division of large, continuous habitats into smaller, more isolated remnants.

I

Intergenerational equity *n.* the concept of fairness or justice owed by each generation or age group to the others; especially significant in considerations of what environment future generations will inherit.

L

LIDAR *n.* a detection system which works on the principle of radar, but uses light from a laser.

O

Obligate *v.* require access to groundwater to meet all or some water requirements in order to survive (opposed to facultative).

P

Pinch point *n.* a point where two areas meet creating a bottleneck for native flora and fauna.

Precautionary principle *n*. an ethical and political principle, applying particularly in the environmental context, which states that if there is the risk of serious or irreversible harm occurring to people or to the

environment, lack of full scientific certainty about the existence of the risk should not be used as a reason for failing to take or for postponing measures to prevent it.

Predation *n.* the killing of an individual of another species as a habitual source of food.

Proposal footprint *n.* the area required to be disturbed based on the proposal's current design.

R

Rehabilitation *adj.* is the repair of ecosystem processes and includes the management of weeds, disease or feral animals.

S

Salinisation *n.* the gradual increase in salinity of soil such as the introduction of brackish water.

Short-range endemic *n.* species of animal (predominantly Invertebrates) that have a restricted distribution, less than 10,000 km^2.

Study area *n.* is the survey area identified in the initial design footprint and will differ depending on the specialist study.

T

Topographical *adj*. relating to the arrangement or accurate representation of the physical features of an area.

V

Vadose zone *adj.* of, relating to, or resulting from water found above the watertable.

Vegetation association *n.* a concept that covers two or more plant communities with similar structure and dominant species. May vary significantly in associated species but all stands referred to it will have some visual similarity.

Vegetation complex *n.* a concept that covers a range of structural types that occur in a related pattern with borders defined by major geomorphological units with some subdivision on floristics between southern and northern parts of the geomorphological units.

W

Wetland *n.* an area in which the soil is frequently or permanently saturated with or under water, as a swamp, marsh.

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NorthLinkWA

Rutland Road Ecological Surveys

Rutland Road Ecological Surveys

Client: Department of Planning, Lands and Heritage

ABN: 68565723484

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Table of Contents

List of Figures

List of Tables

Executive Summary

The Department of Planning, Lands and Heritage (DPLH) commissioned AECOM Australia Pty Ltd (AECOM) to conduct biological surveys to inform planning of future works to Rutland Rd. Future works including an upgrade and realignment of Neaves Road and Rutland Road within the suburb of Bullsbrook. A linear corridor was identified for future works, hereafter referred to as the survey area.

Biological investigations were undertaken to assess the flora, vegetation and fauna values of the survey area. Investigations included a detailed flora and vegetation assessment, level 1 fauna assessment, and target flora and black cockatoo surveys.

The desktop assessment identified several conservation significant species and communities that potentially occur in the Survey Area, including:

- three fauna species that are 'likely to occur' and 13 fauna species that 'may occur'. This included three mammal, ten bird, one reptile and one invertebrate (freshwater mussel) fauna species protected under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), the *Biodiversity Conservation Act 2016* (BC Act) and the Department of Biodiversoty, Conservation and Attractions (DBCA) Priority fauna list
- two threatened flora species listed under the EPBC Act are known to occur and two are likely to occur, along with eight Priority species
- the buffer area of three Threatened Ecological Communities (TECs) listed under the EPBC Act were identified to intersect with the survey area.

A field survey was undertaken in October 2019 with follow up surveys undertaken in January 2020 at which time threatened fauna habitat, two threatened flora species, and one TEC was identified, as explained below.

Thirty vertebrate fauna species were recorded during the field survey. This comprised 23 bird, five mammal, one reptile and one amphibian species. Eight species of conservation significance were recorded including the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* (listed as Vulnerable under the EPBC Act and the BC Act), Carnaby's Cockatoo *Calyptorhynchus latirostris* (listed as Endangered under both the EPBC Act and the BC Act) and six bird species listed as Marine under the EPBC Act. Seven fauna habitats were defined and mapped.

A total of 14 black cockatoo breeding habitat trees were recorded. None of these had hollows considered suitable for utilisation by breeding black cockatoos. Approximately 11.27 ha of Carnaby's Cockatoo foraging habitat for was mapped, including 4.91 ha of High and Very High Quality foraging habitat. Approximately 5.70 ha of Forest Red-tailed Black Cockatoo foraging habitat was mapped in the Survey Area. This included no High and Very High Quality foraging habitat.

Two EPBC Act listed flora species, *Grevillea curviloba* subsp. *curviloba* and *Grevillea curviloba* subsp. *incurva* were recorded during the field survey. One population, comprising two sub-populations, of *Grevillea curviloba* subsp. *curviloba* was recorded, comprising 1,458 individuals (estimated due to difficulty in differentiating individuals). The population represents a known DBCA population, extending beyond the survey area. The target field survey effort was extended to ensure DPLH had adequate information to inform their road design.

One individual of *Grevillea curviloba* subsp. *incurva* was recorded. This individual was not identified as Threatened during the field survey as it was recorded approximately 1.15 km from the nearest known location. This individual is within a rehabilitated area currently owned by Main Roads Western Australia as part of the Northlink Project. It is not known whether it represents a planted species or a naturally recruited species.

One community listed as threatened under the EPBC Act and the *Biodiversity Conservation Act 2016* BC Act was recorded in the survey area. The Tumulus (Organic Mound) Springs of the Swan Coastal Plain TEC is represented by one vegetation community in the survey area, extending for 0.28 ha. Despite this vegetation being considered Degraded, the vegetation is considered critical habitat for the TEC as defined in the Interim Recovery Plan.

The biological assessments were successfully undertaken within the survey area. One limitation associated with the survey is the lack of population information for *Grevillea curviloba* subsp. *incurva* recorded in the rehabilitated area currently managed by Main Roads. It is recommended that this population is investigated further to determine its origins (i.e. planted or naturally recruited) and mapped to avoid impacts from any future development.

1.0 Introduction

1.1 Background

The Department of Planning, Lands and Heritage (DPLH) are undertaking a planning study to select and define a proposed road alignment between Great Northern Highway and Tonkin (Northlink) Highway. The road link will involve the upgrade and realignment of Neaves Road and Rutland Road (the Project).

An Environmental Impact Assessment (EIA) is being conducted on behalf of DPLH which will form part of the referral documentation submitted to the Environmental Protection Authority (EPA) and the Department of Agriculture, Water and the Environment (DAWE) to determine the level of environmental assessment. A biological assessment was required to inform the EIA.

1.2 Location

The Project is located in south-west of Western Australia, north of the City of Perth. The linear corridor comprises 32 ha and generally follows the alignment of Rutland Road then curves south to Neaves Road (the survey area). The survey area traverses mostly cleared vegetation and intersects with Great Northern Highway and Railway Parade as well as a rail corridor.

The survey area is shown in Figure 1.

1.3 Objective

To support the EIA, a detailed flora and vegetation, Level 1 fauna and targeted black cockatoo survey were required to determine the ecological values of the survey area. Specifically, the objectives of the assessment were to:

- Conduct desktop assessment to define the existing environment and identify significant flora, vegetation and fauna that potentially occur in the area
- Undertake field surveys including:
    - detailed flora and vegetation assessment including target threatened flora and community surveys
    - a Level 1 fauna assessment
    - a targeted black cockatoo assessment.
- relevant data analysis and mapping of environmental values with results presented in a technical report.

This technical report presents the methods and results of the biological assessments undertaken for the Project.

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CREATED BY	WYATTK2	
APPROVED BY	FDW	
LAST MODIFIED	14 FEB 2020	

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DATUM GDA 1994 MGA Zone 50

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Data sources:

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LEGEND
Survey Area

Survey Area

DEPARTMENT OF PLANNING, LANDS AND HERITAGE

RUTLAND ROAD MRS AMENDMENT – ECOLOGICAL SURVEYS

Figure
1

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2.0 Legislative Framework

2.1 Overview

Table 1 summarises the key legislation and guidance governing the protection and management of Western Australia's conservation significant flora, fauna and communities.

Table 1 Relevant legislation, regulations and guidance

Legislation	Purpose
Commonwealth of Australia	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Provides for the protection of the environment and the conservation of biodiversity.
EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species (Australian Government, 2012)	These guidelines are intended to assist proponents in determining whether an action needs to be referred to the Australian Government. Definitions of habitat are provided as are criteria used to judge significant impact for these black Cockatoo species.
EPBC Act Draft Referral Guidelines, 2017	These draft guidelines are intended to assist proponents in determining whether an action needs to be referred to the Australian Government. Definitions of habitat are provided as are criteria used to judge significant impact for these black cockatoo species.
Western Australia	
Biodiversity Conservation Act 2016 (BC Act)	Provides for the conservation and protection of Western Australia's biodiversity and biodiversity components.
Environmental Protection Act 1986 (EP Act)	Preventing, controlling and abating environmental harm and conserving, preserving, protecting, enhancing and managing the environment.
Biosecurity and Agriculture Management Act 2007 (BAM Act)	Provides for the management, control and prevention of certain plants and animals, and for the protection of agriculture and related resources generally.
EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment, 2016	Provides guidance to ensure adequate flora and vegetation data of an appropriate standard are obtained and used in EIA.
EPA Technical Guidance – Terrestrial Fauna Surveys, 2016	Provides guidance on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia's terrestrial fauna.

2.2 Federal Legislation - EPBC Act

2.2.1 Matters of National Environmental Significance

The EPBC Act is the main piece of Federal legislation protecting biodiversity in Australia. All Matters of National Environmental Significance (MNES) are listed under the EPBC Act. These include:

- listed threatened species and ecological communities
- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- world Heritage properties
- national Heritage places
- Great Barrier Reef Marine Park
- a water resource, in relation to coal seam gas development and large coal mining development
- nuclear actions.

If an action is likely to have a significant impact on a MNES this action must be referred to the Minister for the Environment for a decision on whether assessment and approval is required under the EPBC Act.

2.2.2 Flora and Fauna

The EPBC Act is the main piece of Federal legislation protecting biodiversity in Australia. Species at risk of extinction are recognised at a Commonwealth level and are categorised in one of six categories as outlined in Table 2, with an additional category for other specially protected fauna.

Table 2 Categories of species listed under Schedule 179 of the EPBC Act

Conservation	Code Category
Ex	**Extinct Taxa** which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered** Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa which is not critically endangered, and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Conservation	Code Category
CD	**Conservation Dependent** Taxa which at a particular time if, at that time: the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered the following subparagraphs are satisfied: - the species is a species of fish - the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised the plan of management is in force under a law of the Commonwealth or of a State or Territory cessation of the plan of management would adversely affect the conservation status of the species.
OS	**Other specially protected fauna** Taxa which are otherwise specifically protected. This includes species listed as Marine and Migratory, among others.

2.2.3 Vegetation Communities

Communities can be classified as Threatened Ecological Communities (TECs) under the EPBC Act. The EPBC Act protects Australia's ecological communities by providing for:

- identification and listing of ecological communities as threatened
- development of conservation advice and recovery plans for listed ecological communities
- recognition of key threatening processes
- reduction of the impact of these processes through threat abatement plans.

Categories of federally listed TECs are described in Table 3.

Table 3 Categories of TECs that are listed under the EPBC Act

Code	Category
CE	**Critically Endangered** If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
E	**Endangered** If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
V	**Vulnerable** If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

2.3 Western Australian Legislation

2.3.1 Flora and Fauna

Threatened flora are plants which have been assessed as being at risk of extinction (DPaW, 2019). Under the BC Act, the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection (WAH, 1998).

Plants and animals that are considered Threatened and need to be specially protected because they are under identifiable threat of extinction are listed under the BC Act. These categories are defined in Table 4.

Table 4 Conservation codes for WA flora and fauna listed under the Biodiversity Conservation Act 2016

Code	Category
CR	**Critically Endangered Species** Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	**Endangered Species** Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora
VU	**Vulnerable Species** Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	**Presumed Extinct Species** Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
MI	**Migratory birds protected under an international agreement** Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
CD	Special conservation
OS	Special protection for reasons other than those already mentioned

Species that have not yet been adequately surveyed to warrant being listed under the BC Act, or are otherwise data deficient, are added to a Priority Lists under Priorities 1, 2 or 3 by the State Minister for Environment. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. Categories and definitions of Priority Flora and Fauna species are provided in Table 5.

Table 5 Conservation codes for WA flora and fauna as listed by DBCA and endorsed by the Minister for Environment

Code	Category
P1	**Priority One – Poorly Known Species** Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2	**Priority Two – Poorly Known Species** Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	**Priority Three – Poorly Known Species** Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4	**Priority Four – Rare, Near Threatened and other species in need of monitoring** a. Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. b. Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

2.3.2 Vegetation Communities

Threatened Ecological Communities (TECs) are naturally occurring biological assemblages that occur in a particular type of habitat and that may be subject to processes that threaten to destroy or significantly modify the assemblage across its range. TECs are listed by both state and commonwealth legislation.

Vegetation communities in Western Australia are described as TECs if they have been endorsed by the Western Australian Minister for Environment following recommendations made by the Threatened Species Scientific Committee. Categories of TECs are defined in Table 6.

Department of Biodiversity, Conservation and Attractions (DBCA) maintains a database of state listed TECs which is available for online searches via their website. Possible TECs that do not meet survey criteria or are not adequately defined are listed as Priority Ecological Communities (PECs) under Priorities 1, 2 and 3. Ecological communities that are adequately known and are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. Conservation dependent communities are classified as Priority 5. PECs are endorsed by the Minister for Environment and are described in Table 7.

DBCA requires that all Priority and Threatened ecological communities are considered during environmental impact assessments and clearing permit applications.

Table 6 Conservation codes for State listed ecological communities

Code	Category
PD	Presumed Totally Destroyed
CR	Critically Endangered
EN	Endangered
VU	Vulnerable

Table 7 Categories for Priority ecological communities

Code	Category
P1	**Priority One**: poorly-known ecological communities
P2	**Priority Two**: poorly-known ecological communities
P3	**Priority Three**: poorly-known ecological communities
P4	**Priority Four**: ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list.

2.3.3 Biosecurity

Biosecurity is the management of the risk of animal and plant pests and diseases entering, emerging, establishing or spreading in WA to protect the economy, environment and community. Biosecurity is managed under the BAM Act which came into effect 1 May 2013. Exotic animals and plants can become an invasive species if they can establish in new areas where local conditions are favourable for their growth. Each organism listed under the BAM Act comes with certain legal / import requirements:

- Declared Pest, Prohibited - s12. Prohibited organisms are declared pests by virtue of section 22(1) and may only be imported and kept subject to permits.
- Permitted - s11. Permitted organisms may be subject to an import permit if they are potential carriers of high-risk organisms.
- Declared Pest - s22(2). Declared pests may be subject to an import permit if they are potential carriers of high-risk organisms and may also be subject to control and keeping requirements once within Western Australia.
- Permitted, Requires Permit - r73. Regulation 73 permitted organisms may only be imported subject to an import permit.

Declared pests can be assigned to a C1, C2 or C3 control category under the Biosecurity and Agriculture Management Regulations 2013:

- C1 Exclusion - Organisms which should be excluded from part or all of Western Australia.
- C2 Eradication - Organisms which should be eradicated from part or all of Western Australia.
- C3 Management - Organisms that should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism.
- Unassigned - Declared pests that are recognised as having a harmful impact under certain circumstances, where their subsequent control requirements are determined by a Plan or other legislative arrangements under the BAM Act.

3.0 Existing Environment

3.1 Climate

The survey area is located within the Perth Metropolitan Region, which is described as Warm Mediterranean (Mitchell *et al*., 2002). A Mediterranean climate is characterised by warm to hot dry summers and mild to cool wet winters. The Mediterranean climate in Australia is a result of the Indian Ocean High, a high-pressure cell that shifts towards the poles in summer and the equator in winter, playing a major role in the formation of the deserts of Western Australia, and the Mediterranean climate of southwest and south-central Australia. Precipitation occurs during winter months, with the possibility of some summer storms.

The closest meteorological station to the survey area with comprehensive data is Pearce RAAF (009053). Pearce RAAF weather station has recorded an average annual rainfall of 652.1 mm since 1940, with the majority of rainfall occurring between June – August (Figure 2). Average maximum temperatures peak between December and February (30.5^{o}C – 33.3^{o}C) (BoM, 2019).

Rainfall in the 12 months preceding the survey has varied significantly from average rainfall records. Below average rainfall was experienced for eight out of nine months preceding the survey; rainfall in May, July and September was considerably lower than average. Rainfall was higher than average in June, with all other months recording less than average rain.

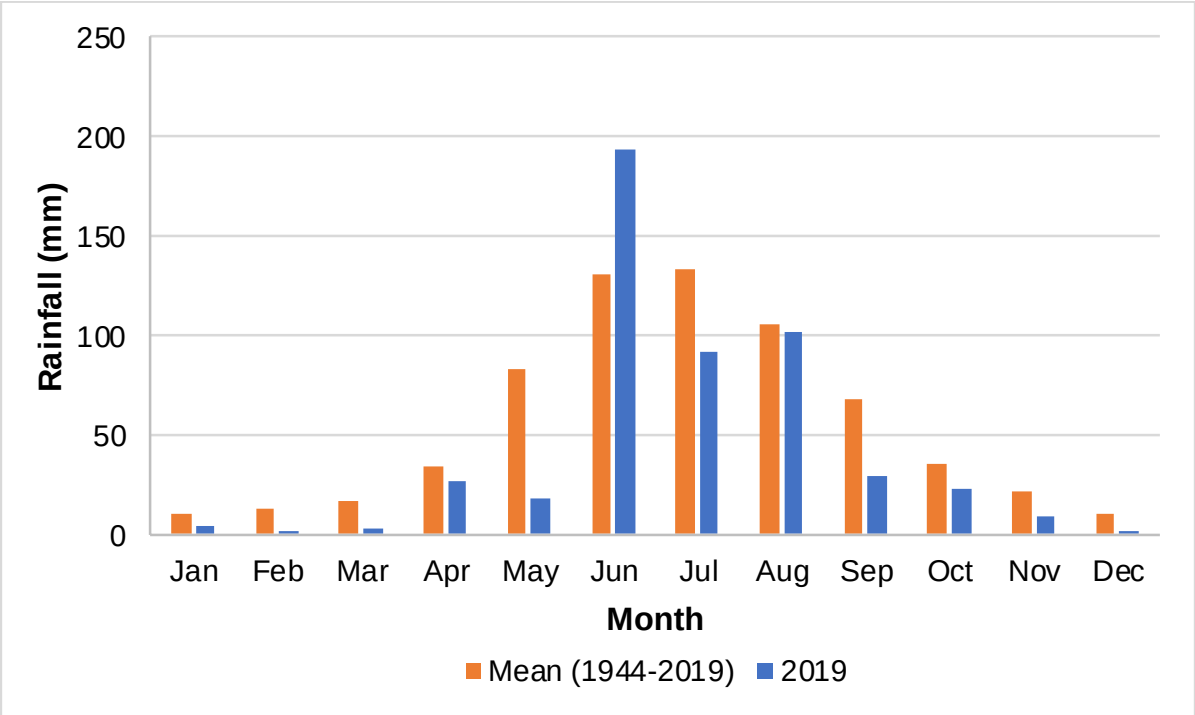


Figure 2 Rainfall data from Pearce RAAF weather station (009053) (BoM, 2020)

3.2 IBRA Regions

IBRA is the National Reserve System's planning framework which assists in identifying reservation targets and setting priorities to meet these targets (Australian Government, 2013). The survey area lies within the Swan Coastal Plain IBRA region. The IBRA regions have been defined based on climate, geology, landforms and characteristic vegetation and fauna.

The Swan Coastal Plain consists of the Dandaragan Plateau and the Perth Coastal Plain and is comprised of a narrow belt less than 30 km wide of Aeolian, alluvial and colluvial deposits of Holocene or Pleistocene age incorporating a complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several offshore islands. Younger sandy areas and limestone are dominated by heath and/or Tuart woodlands, while *Banksia* and *Jarrah-Banksia* woodlands are found on the older dune systems.

The Perth subregion is found on colluvial and Aeolian sands, alluvial river flats and coastal limestone and includes a complex series of seasonal wetlands (Mitchell *et al*, 2002). The climate is Warm Mediterranean with rainfall between 600 and 1000mm annually. The Perth subregion is 1,333,901 ha.

3.3 Soils

There are nine soil types mapped in the survey area (Table 8).

Table 8 Soil types that occur within the survey area (DPIRD, 2019)

Soil Type	Description
213Ya_6x	Flat plain with occasional low dunes. Yellowish brown duplex and poorly structured clay soils often with pans underlying. Low woodland with occasional tall *Eucalyptus rudis*, *Melaleuca* spp., Teatree and *Eucalyptus camaldulensis* and *Casuarina* spp.
213Ya_7x	Flat plain with occasional low dunes. Marl maybe at the surface or deeply buried, overlying alluvium, often with siliceous hardpans. Low woodland with occasional tall *E. rudis*, *Melaleuca* spp., Teatree and *E. camaldulensis*.
213Ya_8x	Flat plain with occasional low dunes. Subject to seasonal inundation. Deep white and pale-yellow sands interspersed with swamp and generally underlain by siliceous/humic pans at depth.
213Ya12n	Drainage depressions in very gently sloping plain. Saline yellow duplex and gradational soils which may have a gravelly matrix. *Casuarina obesa* and salt tolerant grasses with some *E. rudis* in less salty areas.
213Ya12x	Drainage depressions in very gently sloping plain. Yellowish brown and grey sandy duplex soils which may have a gravelly matrix. Woodland of *E. rudis*, *E. camaldulensis* and *Melaleuca* spp.
213Ya13	Drainage depressions in very gently sloping plain. Deep white humic sands overlying siliceous and humic pans. Woodland of *E. rudis*, *E. camaldulensis* and *Melaleuca* spp.
222Re_5	Level to very gently inclined swampy drainage lines with poorly drained grey siliceous and pale yellow-brown sands. Low woodland of *Eucalyptus calophylla* wandoo, some *E. marginata*, *Melaleuca* spp., *E. rudis* and reeds in wet areas.
222Re_7	Level to very gently inclined outwash fans with deep, well drained grey siliceous sands or bleached sands overlying clay at depths greater than 1 m.
222Re11	Drainage depressions on the Dandaragan Plateau. Light soils of sandy to sandy loam texture often with underlying humic pans. Low woodland of *E. calophylla*, *Melaleuca* spp. and reeds.

3.4 Vegetation

The Swan Coastal Plain is a low-lying coastal plain dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas (Mitchell *et al*., 2002).

Beard completed the vegetation mapping of the Swan Coastal Plain in 1981 and classified the area as vegetation associations Bassendean, 1018: woodland / low woodland / low forest or woodland; and Pinjarra, 4: woodland southwest, Jarrah, Marri & Wandoo. The pre-European extent of the Beard vegetation association is provided in Table 9 as informed by the Statewide Vegetation Statistics (Government of WA, 2018).

Table 9 Pre-European and current extent of vegetation associations (Government of WA, 2018)

Vegetation Association	Pre-European Extent (ha)	Current Extent (ha)	Percentage Remaining (%)		Current Extent in DPaW Managed Lands (%, as proportion of Current Extent)
			State-wide	Local Government Area	
1018	14,059	2444	17	16	4
4	1,054,279	284,102	26	54	23

Heddle *et al* (1980) vegetation mapping of the Darling System identifies the area as predominantly the Yanga Complex, with the eastern tip extending into the Beermullah Complex.

The Bassendean Complex North is also located close by to the west. Of these, the Beermullah Complex is currently below the 10% threshold. These three are described in Table 10.

Table 10 Vegetation complexes of the survey area (Heddle et al. 1980) and percent remaining in the Perth-Peel region (EPA, 2015)

Complex	Description	Percent Remaining
Yanga Complex	The Yanga Complex is a closed scrub of *Melaleuca* spp. and low open forest of *Casuarina obesa* on the flats subject to inundation. On drier sites the vegetation reflects the adjacent vegetation complexes of Bassendean.	13.4
Beermullah Complex	The Beermullah Complex is a mixture of low open forest of *C. obesa* and open woodland of *Eucalyptus calophylla – Eucalyptus wandoo – Eucalyptus marginata*. Minor components include closed scrub of M*elaleuca* spp. and occurrence of *Actinostrobus pyramidalis.*	6.6
Bassendean Complex North	Vegetation ranges from a low open forest and low woodland of *Banksia* spp. – *Eucalyptus todtiana* to low woodland of *Melaleuca* spp. and sedgelands which occupy the moister sites.	67.4

4.0 Methodology

4.1 Desktop Assessment

A detailed desktop assessment was undertaken to define the existing environment and identify potential matters of conservation significance to target during the field survey. The desktop assessment was informed by:

- DBCA threatened flora and communities database
- DBCA threatened fauna database including black cockatoo observational data (with 12 km buffer)
- Western Australian Herbarium (WAH) records
- NatureMap
- BirdLife Australia black cockatoo roosting database (BirdLife, 2018)
- Atlas of Living Australia (AoLA)
- EPBC Act Protected Matters Search Tool (PMST) database (10 km buffer)
- Neaves Road Biological Assessment (AECOM, 2014).

The existing environment was described to inform the desktop assessment including the likelihood assessment of habitat presence. Existing environment included publicly available information from Beard (1981) pre-European vegetation mapping, Heddle *et al.* (1980) vegetation complex mapping, and soil mapping (Geology Survey of Western Australia, 1979). All species of conservation significance were reviewed, and their likelihood of occurrence determined using the three categories defined in Table 11.

Table 11 Categories of likelihood of occurrence for species and communities

Likelihood	Flora	Fauna	Communities
Likely to occur	Habitat is present in the survey area and the species has been recorded in close proximity to the survey area	Survey area is within the known distribution of the species, habitat is present in the survey area and the species has been recorded in close proximity to the survey area	Known occurrences of the community in close proximity to the survey area. Vegetation looks the same within the known occurrence and survey area based on aerial imagery. Geographic location is similar to the survey area
May occur	Habitat may be present and/or the species has been recorded in close proximity to the survey area	Survey area is within the known distribution of the species, marginal habitat may be present and/or the species has been recorded in close proximity to the survey area	Known occurrence of the community in the local area, and/or vegetation looks the same within known occurrence and survey area based on aerial imagery. Geographic location is similar to the survey area
Unlikely to occur	No suitable habitat is present, and the species has not been recorded in close proximity to the survey area	Survey area is outside the known distribution for the species, or no suitable habitat is present, and the species has not been recorded in close proximity to the survey area	Known occurrence of the community in close proximity to the survey area however geographic location does not occur in survey area

4.2 Field Surveys

4.2.1 Flora and Vegetation Survey

A detailed flora and vegetation assessment was undertaken by Floora de Wit (collection permit FB62000137). Floora de Wit has 13 years' experience undertaking flora and vegetation assessments on the Swan Coastal Plain. Floora completed a Bachelor of Science in Environmental Biology (Environmental Restoration) and completed a Postgraduate Diploma in Environmental Management and Impact Assessment.

The field flora and vegetation survey was undertaken on 23 October 2019 and 21 January 2020. The survey area was represented by two quadrats and three relevés.

Quadrats were 10x10 metres (m) defined by a measuring tape. Data collected from quadrats included the presence of plant species, their cover abundance, structural composition of vegetation, physical environment, and presence/absence of disturbance. Each Site was given a unique site number, and the following parameters recorded:

- date
- location using hand-held GPS (accuracy of 5 m)
- sample site type (quadrat/relevé and size)
- photograph (northwest corner)
- soil details (type, colour, moisture)
- landform
- vegetation condition using the Keighery (1994) scale and description of disturbance
- fire history
- comprehensive species list
    - estimated height
    - estimated percentage cover (for trees both percentage within quadrat and within community was recorded to enable better description of vegetation community).

Relevés were unbounded sites used to define areas significantly modified/degraded. Floristic and contextual data similar to quadrat data was recorded including species height, foliage cover, disturbance, landform, and any additional relevant information.

Vegetation mapping was completed following the field survey. Vegetation communities were described and mapped based on changes in dominant species composition and landform. The Neaves Road (AECOM, 2014) vegetation mapping was refined to reflect the current conditions within the survey area. Vegetation community descriptions were based on the National Vegetation Information System (NVIS) framework (ESCAVI, 2003) at association level.

Vegetation condition was mapped using the Keighery (1994) vegetation condition scale.

4.2.2 Targeted Flora Searches

Targeted flora searches were completed for species considered likely to occur, in particular, *Grevillea curviloba* subsp. *curviloba*. A field booklet of all species considered likely to occur was developed prior to commencing the field survey. The booklet included all available information and photographs relevant for the tentative identification of Threatened and Priority flora in the field.

The survey area was traversed on foot by Floora de Wit and Laura Fisher, walking linear traverses 10 m apart. All species that were considered to potentially resemble a Threatened or Priority species were photographed and their location captured using a hand-held GPS.

4.2.3 Fauna Survey

A Level 1 fauna survey was conducted on 30 October 2019 and 21 January 2020 in accordance with Technical Guidance – Terrestrial Fauna Surveys (EPA, 2016b) and Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna (EPA, 2016c). The fauna survey was conducted by Ecologist Jared Leigh, in conjunction with the detailed flora and vegetation survey. Conducting the two surveys concurrently enabled consistent and clear mapping of the fauna habitats and vegetation communities.

The Level 1 fauna survey primarily focused on mapping of fauna habitat and assessing for the potential presence of conservation significant fauna, but also recorded observations of all fauna within the survey area.

Fauna habitats were assessed for specific habitat components, including consideration of structural diversity and refuge opportunities for fauna, in order to determine the potential for these habitats to support conservation significant species. The fauna habitat assessments included:

- location
- general habitat description
- habitat condition and disturbance types
- dominant / characteristic flora species and vegetation layers
- presence and abundance of key habitat features such as large mature trees, small and large hollows, fallen logs, course and fine litter, decorticating bark, bare ground, grass, stones and boulders, rock crevices, soil cracks, vines, dense shrubs, water bodies etc.
- presence of fauna and secondary signs (e.g. scats, digging, tracks, burrows, egg shell, bones, feathers etc.)
- connectivity of habitat.

In addition to recording all observed fauna and birds identified from distinctive calls, details of indirect evidence such as scats, tracks and diggings were documented. All observations were made between daylight hours of 0700 and 1700. In particular, attention was given to searching for conservation significant species identified in the desktop assessment as having the potential to occur in the area.

The taxonomy and nomenclature of vertebrate species for mammals, reptiles and amphibians is consistent with the Western Australian Museum's Checklist of the Vertebrates of Western Australia (2019) and for bird species the Bird's Australia Checklist of Australian Birds by Christidis and Boles (2008).

4.2.4 Black Cockatoo Survey

A targeted black cockatoo survey was conducted in conjunction with the Level 1 fauna survey by Ecologist Jared Leigh and Botanist Floora de Wit. The targeted black cockatoo survey focussed on Carnaby's Cockatoo *Calyptorhynchus latirostris* and the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii* subsp. *naso,* as these are the only black cockatoo species likely to utilise the survey area based on the results of the detailed desktop assessment. The survey was conducted to identify potential breeding, roosting and foraging habitat, in accordance with DSEWPaC (2012a). The draft DotEE (2017) Referral Guidelines were also used.

4.2.4.1 Breeding Habitat

The black cockatoo breeding habitat assessment focussed on quantifying breeding habitat within the survey area. All native, hollow-forming eucalypts within the survey area were assessed and either classified as "potential breeding trees", those with a Diameter at Breast Height (DBH) >500 mm (*Eucalyptus wandoo* >300 mm), with "breeding trees" containing hollows that are potentially suitable for breeding black cockatoos.

Details collected for each tree included:

- location
- tree species
- DBH
- number of potentially suitable hollows.
- hollow details – including dimensions, height from ground, direction, type of hollow, evidence of use etc.
- photos were taken of each tree and hollows if possible.

Note that tree hollow presence and suitability is assessed from ground level with the use of binoculars. Suitability and utilisation by black cockatoos cannot always be assessed adequately at ground level, and hence the Precautionary Principle is used where appropriate.

4.2.4.2 Roosting Habitat

Carnaby's Cockatoo typically roosts in or near riparian environments or near other permanent water sources. Any tall trees may provide suitable roosting, but Flat-topped Yate, Salmon Gum, Wandoo, Marri, Karri, Blackbutt, Tuart, introduced eucalypts and introduced pines are preferred. The Forest Red-tailed Black Cockatoo prefers the edges of forests for roosting, within any tall trees, but particularly tall Jarrah, Marri, Blackbutt, Tuart and introduced eucalypt trees (DotEE, 2017). Potential roosting trees were searched for and assessed during the field survey.

4.2.4.3 Foraging Habitat

The quality of foraging habitat not only reflects the availability of food sources, but also the proximity to reliable water sources, connectivity to other suitable habitat, presence of breeding and potential breeding trees, and proximity to confirmed roost and breeding sites (amongst others). These parameters were utilised by the DotEE (2017) to produce a draft quality of foraging habitat scoring system, which has been slightly amended by AECOM (Table 13). This scoring system was utilised to assess potential foraging habitat for Carnaby's Cockatoo and the Forest Red-tailed Black Cockatoo throughout the survey area.

The scoring tool is used by initially defining the quality of the overall habitat present (i.e. Very High Quality, High Quality, Quality and Low Quality) and then adding or subtracting points from this depending on the ecological values of the habitat (i.e. proximity to water, proximity to a known roost site, evidence of foraging material etc.). This determines an overall quantitative rating. These scores were then used as representative scores for that unit. Table 12 defines the levels of foraging habitat quality used during the assessment.

Table 12 Black cockatoo foraging assessment scoring

Score	Foraging Quality
1 – 3	Low Quality
4 – 6	Quality
7 – 8	High Quality
>8	Very High Quality

Table 13 Quality of foraging habitat assessment tool

	Carnaby's Cockatoo	Forest Red-tailed Black Cockatoo
10	Foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation and/or has some level of protection from clearing.	Foraging habitat that is being managed for black cockatoos, including successful rehabilitation and/or has some level of protection from clearing.
7	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as *Banksia* species (including *Dryandra* species) *Hakea* species and *Grevillea* species as well as eucalypt woodland and forest that contains foraging species. Does not include orchards, canola, or areas under RFA	Jarrah and Marri woodlands and forest, and edges of Karri forests, including Wandoo and Blackbutt, within the range of the subspecies. Does not include areas under RFA.
5	Pine plantation, mallee eucalypts, introduced eucalypts and /or native vegetation with foraging species that are not dominate	Introduced eucalypts, Cape lilac (*Melia acedarach*) and / or native vegetation with foraging species that are not dominate
1	Individual foraging plants or small stand of foraging plants (≤2 ha)	Individual foraging plants or small stand of foraging plants (≤2 ha)
Additions: Context adjustor – attributes improving habitat quality		
+3	Is within the Swan Coastal Plain	Jarrah and/or Marri shows good recruitment
+3	Contains trees with suitable nest hollows	
+2	Primarily comprises Marri	Primarily contains Marri and/or Jarrah
+2	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo)	
+1	Is used for roosting	
Subtractions: Context adjustor – attributes reducing habitat quality		
-2	No clear evidence of foraging debris	
-2	No other foraging habitat within 6 km	
-1	Is >12 km from known breeding location	
-1	Is >12 km from known roosting location	
-1	Is >2 km from watering point	
-1	Disease present (e.g. *Phytophthora cinnamomi* or Marri canker)	

Source: DotEE (2017) - amended by AECOM.

5.0 Survey Limitations

A number of limitations relating to the ecological assessment of the site have been considered and these are described below.

It is uncertain what impacts a drying climate has on ecological surveys in general. For this Project, the Threatened flora species were still able to be identified from material available. The TEC which occurs in the survey area has a hydrological component. Its identification and floristic composition may change over time in response to less rain.

Table 14 Seven limitations considered for the biological assessment

Limitation	Flora and Vegetation Assessment	Level 1 Fauna Survey	Targeted Black Cockatoo Survey
Availability of contextual information on the region	**Not a limitation** There is ample contextual information available to assess Swan Coastal Plain vegetation and determine their local and regional significance.	**Not a limitation** The DBCA database, NatureMap, EPBC Act PMST, AoLA, DotEE (2017), DSEWPAC (2012) and various field guides were utilised to inform the Level 1 fauna survey. There was sufficient ecological information on conservation significant species potentially present.	**Minor** The DBCA database, NatureMap, EPBC Act PMST, DotEE (2017), DSEWPAC (2012) and Birdlife (2018) were utilised to inform the targeted black cockatoo survey. Not all layers within these resources are updated regularly.
Competency/experience of consultant conducting survey	**Not a limitation** The flora and vegetation assessment was led by Floora de Wit who has more than 13 years' experience conducting surveys of similar scope.	**Not a limitation** Jared is an ecologist with over 16 years' experience in the environmental industry and has conducted Level 1 fauna surveys in a range of bioregions within Western Australia.	**Not a limitation** Jared is an ecologist with over 16 years' experience in the environmental industry and has conducted black cockatoo surveys in a range of bioregions within Western Australia. Floora has more than 10 years' experience conducting ecological surveys with more than three years' experience conducting black cockatoo surveys.

Limitation	Flora and Vegetation Assessment	Level 1 Fauna Survey	Targeted Black Cockatoo Survey
Proportion of flora/fauna identified, recorded and/or collected (based on sampling, timing and intensity)	**Not a limitation** The survey was conducted on 23 October 2019 which is considered the ideal survey period for the Swan Coastal Plain. The survey focussed on assessing vegetation and species of conservation significance. As such a weed species inventory was not developed and more weed species are likely to have been recorded if all paddocks were sampled to a higher level of detail. This is not considered a limitation for this Project.	**Minor limitation** The survey was conducted primarily during a Spring period of fine weather. Fauna were observed (through direct or indirect evidence) during daylight hours (0700 and 1700hrs). Nocturnal species were therefore assessed based on habitat present or observed through indirect evidence.	**Minor limitation** The survey was conducted during a Spring period of fine weather. Sufficient time was allowed to assess each habitat for foraging quality, assess breeding and potential breeding trees, and search for foraging evidence. Black cockatoo foraging evidence can be searched for at any time of year, and cones can remain on the ground for up to two years (DotEE, 2017). Tree hollow presence and suitability for utilisation by black cockatoos cannot always be assessed adequately at ground level, and hence the Precautionary Principle is utilised where appropriate.
Completeness (was relevant area fully surveyed)	**Not a limitation** All areas of native vegetation were included in the survey.	**Not a limitation** Majority of fauna habitats within the survey area were assessed. The objectives of the level 1 fauna survey were met. The survey area was traversed on-ground and most of the area was adequately assessed. Department of Defence lands, which comprise part of the survey area, were not accessed for this survey. Data from the previous AECOM survey within this area was utilised for the report. The information gained for a Level 1 fauna survey was sufficient. For those fauna habitats which occur within the Department of Defence land, which was not accessed during the survey, the Precautionary Principle was used.	**Minor limitation** Majority of fauna habitats within the survey area were assessed. The objectives of the targeted black cockatoo survey were met. The survey area was traversed on-ground and most of the area was adequately assessed. Department of Defence lands, which comprise part of the survey area, were not accessed for this survey. Data from the previous AECOM survey within this area was utilised for the report. The information gained for a targeted black cockatoo survey was sufficient. For those fauna habitats which occur within the Department of Defence land, which was not accessed during the survey, the Precautionary Principle was used for foraging evidence.

Limitation	Flora and Vegetation Assessment	Level 1 Fauna Survey	Targeted Black Cockatoo Survey
Remoteness and/or access problems	**Minor** Department of Defence lands, which comprise part of the survey area, were not accessed for this survey. However, all areas of remnant native vegetation were able to be accessed.	**Minor** Department of Defence lands, which comprise part of the survey area, were not accessed for this survey. Data from the previous AECOM survey within this area was utilised for the report. The objectives of the level 1 fauna assessment were met for areas that were accessed.	**Minor** Department of Defence lands, which comprise part of the survey area, were not accessed for this survey. The objectives of the targeted black cockatoo survey were met for areas that were accessed, with previous report data utilised for additional relevant information.
Timing, weather, season, cycle	**Nil** Rainfall was below average in the months preceding the survey. No significant limitations were identified relating to timing, weather, season or cycle.	**Minor** The survey was conducted during a period of reasonable weather in Spring and in Summer. Although it was limited to two one-off seasonal survey periods over two years, and predominantly during daylight hours, this does not significantly impact a Level 1 fauna survey.	**Nil** No limitations were identified relating to timing, weather, season or cycle. Foraging evidence can be searched for at any time of year and can remain on the ground for up to two years (DotEE, 2017).
Disturbances (e.g. fire flood, accidental human intervention) which affected results of the survey	**Nil** The survey area represents a fragmented near-rural landscape that includes maintained gardens, grazed paddocks, hardscape, and native vegetation. Best effort was made to access all patches of native vegetation all of which were subject to degrading processes (edge effects, weeds, drying climate).	**Nil** The Level 1 fauna survey was not disrupted or impacted.	**Nil** The targeted black cockatoo survey was not disrupted or impacted.

6.0 Desktop Assessment Results

6.1 Threatened and Priority Ecological Communities

The desktop assessment identified 12 threatened and priority communities that may occur in the survey area. Two of the federally listed communities encompass two or more state listed communities. their relationships, known occurrences and likelihoods are presented in Table 15.

Three TECs intersect with the survey area. That is, their buffer overlaps with the survey area. Buffers extend for up to 1km from the known occurrence, therefore this overlap does not necessarily imply the occurrence of the community.

The TEC *Communities of Tumulus Springs (Organic Mound Springs) of the Swan Coastal Plain* overlaps with the western edge of the survey area and is considered likely to occur. This community is associated with specific hydrological characteristics which are likely to be linked, or expressed in the drainage channel that intersects with the survey area.

The buffers of two other TECs overlap. Both these communities, and the other nine TECs and PECs, are considered unlikely to occur. This reflects the degraded vegetation present in the survey area and extensive clearing that has occurred.

The desktop results are mapped in Figure 3.

Table 15 Threatened and Priority Ecological Communities identified during the desktop assessment

Description	Cons. Status		Location	Likelihood
	Federal	State		
Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)	E	CR	Know to occur / buffer overlaps with survey area. Associated with springs in peaty soils at the edge of Kirby Road Bushland.	Likely
Corymbia calophylla - Kingia australis woodlands on heavy soils, Swan Coastal Plain (FCT3a)	E	CR	One occurrence at base of scarp 3 km east of survey area.	Unlikely
Corymbia calophylla – Xanthorrhoea preissii woodland and shrublands, Swan Coastal Plain (SCP3c)	E	CR	Eight occurrences in the vicinity with a buffer that overlaps with survey area. Associated with remnant native vegetation in RAAF Pearce Base. This vegetation has been cleared within the survey area.	Unlikely
Muchea Limestone: Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain	E	EN	Buffer overlaps with survey area, known from remnant vegetation within RAAF Pearce Base. No suitable habitat/vegetation in survey area.	Unlikely
Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region	E	P3	There are 212 occurrences, all are associated with Kirby Road Bushland (Bush Forever Site 97).	Unlikely
• Swan Coastal Plain *Banksia attenuata – Banksia menziesii* woodlands (FCT23b)		P3	Two known occurrences within in Muchea Defence Range west of survey area.	Unlikely
• Low lying *Banksia attenuata* woodlands or shrublands (FCT21c)		P3	Two known occurrences more than 5km i in Muchea Defence Range west of survey area.	Unlikely
• *Banksia ilicifolia* woodlands (FCT22)		P3	One known occurrence in close proximity to FCT21c in Muchea Defence Range west of survey area.	Unlikely
Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain (FCT15)	-	VU	One known occurrence at the RAAF Pearce base infrastructure, Bush Forever Site 294.	Unlikely
Clay Pans of the Swan Coastal Plain	CE			
• Herb rich saline shrublands in clay pans (FCT7)		VU	FCT7 is associated with wetland in Bullsbrook Nature Reserve, Bush Forever Site 292.	Unlikely
• Herb rich shrublands in claypans (FCT8)		VU	FCT8 is associated with wetlands near the RAAF Pearce base infrastructure, Bush Forever Site 294.	Unlikely

6.2 Conservation Significant Flora

The PMST results identified 26 Threatened flora listed under the EPBC Act that may potentially occur in the survey area. The PMST report provided an assessment of the likelihood of the species or species habitat occurrence in the survey area. The Threatened species were reviewed using Florabase (WAH, 1998-) and an independent assessment was conducted to determine the likelihood of occurrence.

DBCA and NatureMap searches were conducted which identified:

- 26 EPBC Act protected species:
  - two Critically Endangered
  - 19 Endangered
  - five Vulnerable.
- 18 Priority species as listed by DBCA and endorsed by the Minister of the Environment (WA)
  - one Priority 1
  - four Priority 2
  - nine Priority 3
  - four Priority 4.

Of these, one Critically Endangered species and two Endangered species under the EPBC Act are likely to occur. These are *Darwinia foetida*, *Grevillea curviloba* subsp. *curviloba* and *Grevillea curviloba* subsp. *incurva*. Furthermore, two EPBC Act listed species may occur, and nine Priority flora species are likely to occur in the survey area. Species considered known or likely to occur are presented in Table 16. The comprehensive desktop assessment results are presented in Appendix A, with spatial distribution shown in Figure 3.

Table 16 Desktop flora species considered likely or known to occur

Taxon	Cons. Stat		Habitat	Likelihood of Occurrence
	Federal	WA		
Centrolepis caespitosa	E	P4	White sand, clay. Salt flats, wet areas.	May
Cyathochaeta teretifolia	-	P3	Grey sand, sandy clay. Swamps, creek edges.	May
Darwinia foetida	CE	EN	Known from three populations in swampy, seasonally wet habitat in the Muchea area, approximately 70km north of Perth.	Likely
Drosera occidentalis subsp. *occidentalis*	-	P4	Sandy and clayey soils. Swamps and wet depressions.	May
Eleocharis keigheryi	V	V	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	May
Grevillea curviloba subsp. *curviloba*	E	CR	Grey sand, winter-wet heath	Likely
Grevillea curviloba subsp. *incurva*	E	EN	Sand, sandy loam. Winter-wet heath.	Likely
Platysace ramosissima	-	P3	Sandy soils.	May
Schoenus sp. *Bullsbrook* (J.J. Alford 915)	-	P2	Grey peaty sand. Low-lying flats.	May
Stylidium aceratum	-	P2	Sandy soils. Swamp heathland	May
Stylidium longitubum	-	P3	Sandy clay, clay. Seasonal wetlands.	May

Taxon	Cons. Stat		Habitat	Likelihood of Occurrence
	Federal	WA		
Stylidium paludicola	-	P3	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.	May
Stylidium squamellosum	-	P2	Brown to red-brown clay loam. Winter-wet habitats and depressions, open woodland, shrubland.	May
Verticordia serrata var. *linearis*	-	P3	White sand, gravel. Open woodland.	May

6.3 Fauna

The NatureMap search identified a total of 199 vertebrate fauna species that have been recorded in the area. This included 13 amphibian, 109 bird, four fish, 18 mammal and 55 reptile species. The desktop fauna assessment identified 47 conservation significant fauna species that could potentially occur within the survey area. The likelihood assessment determined that:

- three species are ‘likely to occur’
- 13 species ‘may occur’
- 31 species are ‘unlikely to occur’.

The 15 species considered as ‘likely to occur’ or ‘may occur’ in the survey area include three mammal, ten bird, one reptile and one invertebrate (freshwater mussel) species (Table 17). The comprehensive fauna desktop assessment is presented in Appendix A and mapped in Figure 3.

The desktop assessment also identified the potential occurrence of 15 feral fauna species, including the Common Myna *Acridotheres tristis,* Mallard *Ana platyrhynchos,* European Goldfinch *Carduelis,* Rock Pigeon *Columba livia*, House Sparrow *Passer domesitcus*, Eurasian Tree Sparrow *Passer montanus*, Laughing Turtle-dove *Streptopelia senegalensis*, Spotted Turtle-dove *Streptopelia chinensis,* Sulphur-crested Cockatoo *Cacatua galerita* subsp. *Galerita*, Eastern Long-billed Corella *Cacatua tenuirostris*, Domestic Cat *Felis catus*, House Mouse *Mus musculus*, European Rabbit *Oryctolagus cuniculus*, Black Rat *Rattus* and Red Fox *Vulpes vulpes*.

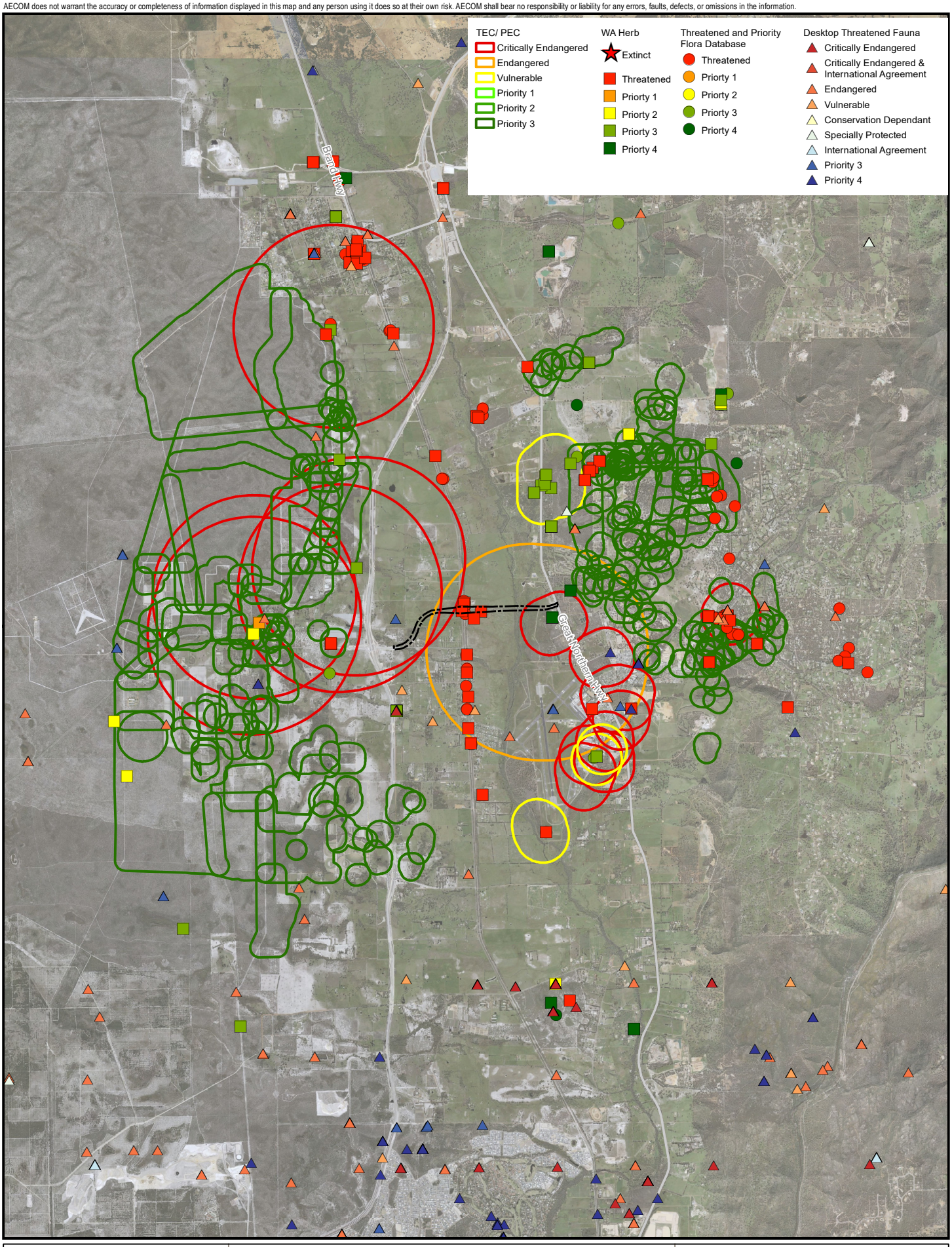
Table 17 Conservation significant fauna species that are 'likely to' occur or 'may occur' in the survey area

Species	Source	EPBC Act	State	DBCA Records (Latest Year and Total No.)	Ecology
Birds					
Ardea modesta Great Egret	DAWE	Marine	-	-	The Great Egret occupies a wide variety of wet habitats including freshwater wetlands, dams, flooded pastures, estuarine mudflats, mangroves and reefs (Morcombe, 2003). The species is also known to visit shallows of rivers, sewage ponds and irrigation areas (Pizzey & Knight, 2007).
Ardea ibis Cattle Egret	DAWE	Marine	-	-	The Cattle Egret is a small egret weighing only 390g and standing 70cm tall. The heaviest distribution of this species in WA is in the north east, and into the Northern Territory. In the non-breeding season, it can be found throughout most of Australia (Marchant & Higgins, 1990).
Calidris acuminata Sharp-tailed Sandpiper	DAWE	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	MI	-	The Sharp-tailed Sandpiper is a small to medium sized wader with a length of 17 to 22 cm and weighing 65g. They spend the non-breeding season in Australia. In Western Australia (WA), scattered records occur along the Nullarbor Plain and the southern areas of the Great Victoria Desert. They are widespread across Australia. In Australasia they prefers muddy edges of shallow coastal or inland wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. They also occur in saltworks, sewage farms, flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves (DAWE, 2020).
Calidris ferruginea Curlew Sandpiper	DAWE	Critically Endangered Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	CE	-	The Curlew Sandpiper is a small, slim wader weighing 57 g. In Australia, Curlew Sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. In Western Australia, they are widespread around coastal and sub coastal plains from Cape Arid to the south-west Kimberley. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand (Higgins & Davies, 1996).

Species	Source	EPBC Act	State	DBCA Records (Latest Year and Total No.)	Ecology
Calidris melanotos Pectoral Sandpiper	DAWE	Migratory & Marine (Bonn, JAMBA, ROKAMBA)	MI	-	The Pectoral Sandpiper occupies shallow, fresh waters often containing low grass or other small herbs. It is also observed in swamp margins, flooded pastures and saltmarshes. This species breeds in the northern hemisphere and is a regular though uncommon summer visitor to Australia (Pizzey & Knight, 2007). Rarely recorded in Western Australia (DAWE, 2020).
Calyptorhynchus banksii subsp. *naso* Forest Red-tailed Black Cockatoo	DBCA / DAWE	Vulnerable	VU	2018 - 169	The Forest Red-tailed Black Cockatoo is 55-60 cm in length and are mostly glossy black with a pair of black central tail feathers, a crest, robust bill and bright red, orange or yellow barring in the tail (Higgins, 1999). Requires tree hollows to nest and breed, occurs in forests of Karri *Eucalyptus diversicolor*, Jarrah *E. marginata* and Marri *Corymbia calophylla*), with flocks moving out onto the Swan Coastal Plain in search of food from exotic trees such as White Cedar (Johnstone *et al*., 2010). Foraging habitat for the species consists of Jarrah and Marri woodlands and forest throughout its range.
Calyptorhynchus latirostris Carnaby's Cockatoo	DBCA / DAWE	Endangered	EN	2018 - 5,880	Carnaby's Cockatoo is a white-tailed black cockatoo endemic to the south-west of Western Australia. Breeding occurs mainly from early July to mid-December. The species nests in hollows in eucalypts, particularly Salmon Gum *Eucalyptus salmonophloia* and Wandoo *E. Wandoo*, but nests have been found in other eucalypts including York Gum *E. loxophleba*, Flooded Gum *E. rudis*, Tuart *E. gomphocephala* and Marri *Corymbia calophylla* (Johnstone *et al*., 2010). Diet consists of an array of Proteaceous and *Eucalyptus* species.
Falco peregrinus Peregrine Falcon	DBCA	-	OS	2010 - 5	The Peregrine Falcon is a medium-sized raptor (length 35-55cm; wingspan 80-105cm) with slate-grey back, a striking charcoal black head and face which contrast with a pale cream bib on the neck and breast (Birdlife Australia, 2018). A well-known falcon, the Peregrine inhabits a vast array of environs in Australia. Usually uncommon and migratory (Pizzey & Knight, 2007). This species lays its eggs in recesses of cliff faces, tree hollows or large abandoned nests (Bamford, 2009)

Species	Source	EPBC Act	State	DBCA Records (Latest Year and Total No.)	Ecology
Merops ornatus Rainbow Bee-eater	DAWE	Marine	-	-	The Rainbow Bee-eater is a common species which occupies numerous habitats including open woodlands with sandy loamy soil, sand ridges, sandpits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves and rainforests. It is possible that this species will occupy open woodland areas within the survey area. The Rainbow Bee-eater avoids heavy forest that would hinder the pursuit of its insect prey (Morcombe, 2003).
Plegadis falcinellus Glossy Ibis	DBCA	Migratory (Bonn) & Marine	MI	2001 - 4	The Glossy Ibis occupies well vegetated wetlands, wet pastures, floodwaters, brackish wetlands and mudflats. This species is a non-breeding visitor to south-west Western Australia (Pizzey & Knight, 2007).
Tringa glareola Wood Sandpiper	DBCA	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	MI	1981 - 2	The Wood Sandpiper is a summer migrant to Australia where it is more common in the north although a casual visitor to southern parts. It occupies wetland margins, saltmarshes and sewage ponds (Pizzey & Knight, 2007).
Tringa nebularia Common Greenshank	DBCA DAWE	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	MI	1981 - 2	The Common Greenshank is a largely built wader, weighing up to 190 g for both sexes. The species is found in a large variety of inland wetlands and sheltered coastal habitats (DAWE, 2020).
Mammals					
Dasyurus geoffroii Chuditch	DBCA	Vulnerable	VU	2016 - 7	At maturity the Chuditch is the size of a small domestic cat with white spotted brown pelage, large rounded ears, pointed muzzle, large dark eyes and non-hopping gait. Following European settlement, the range of this species contracted dramatically, from much of the continent to a small area in the south west. It currently only occurs in areas dominated by sclerophyll forest or drier woodland, heath and mallee shrubland (Van Dyck & Strahan, 2008). The Chuditch requires adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) and sufficient prey biomass (large invertebrates, reptiles and small mammals) to survive.

Species	Source	EPBC Act	State	DBCA Records (Latest Year and Total No.)	Ecology
Hydromys chrysogaster Water Rat	DBCA	-	P4	2011 - 2	The rakali, or water-rat, is the only amphibious land-based Australian mammal aside from the platypus. It is most active around sunset and has been seen foraging during the day. They are slightly clumsy on land and can climb hollow trees in search of prey. However, they prefer to catch their prey in the water. The species lives in burrows on the banks of rivers, lakes and estuaries and feeds on aquatic insects, fish, crustaceans, mussels, snails, frogs, birds' eggs and water birds.
Isoodon fusciventer Quenda	DBCA	-	P4	2017 - 373	The Quenda or Southern Brown Bandicoot exists only in a fragmented distribution to its former range in southern south western and eastern Australia. It is found in forest, woodland, heath and shrub communities in these regions. Preferred habitat usually consists of a combination of sandy soils and dense heathy vegetation (Van Dyck & Strahan, 2008).
Reptiles					
Neelaps calonotos Black-striped Snake	DBCA	-	P3	2006 - 22	The Black-striped Snake is mostly confined to the Swan Coastal Plain between Mandurah and Lancelin. It takes shelter in upper layers of loose soil beneath leaf litter in *Eucalyptus/Banksia* woodlands, typically at the base of trees and shrubs (Bush *et al.,* 2010).
Invertebrates					
Westralunio carteri Carter's Freshwater Mussel	DBCA	Vulnerable	VU	2010 - 16	The only reasonably large bivalve in freshwaters of south-west Western Australia. Occurs in greatest abundance in slower flowing waters with stable sediments that are soft enough for burrowing. Salinity tolerance is quite low (>3 g /L is lethal) (Klunzinger, 2012).



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0 0.5 1 1.5 2
Kilometres

Data sources:

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LEGEND
Survey Area

Desktop Results for Flora, Fauna and Communities

DEPARTMENT OF PLANNING, LANDS AND HERITAGE

RUTLAND ROAD MRS AMENDMENT – ECOLOGICAL SURVEYS

Figure 3

Map Document: \\AUPER1FP001.AU.AECOMNET.COM\Projects\606X\60613901\900_CAD_GIS\920_GIS\02_MXDs\20200214_EcologyReportFigures\G60613901_Fig3_DesktopFloraFauna_A4P_v1.mxd (WyattK2)

A4 size

7.0 Field Survey Results and Discussion

7.1 Vegetation

7.1.1 Conservation Significant Communities

The field survey intersects with the buffer of three TECs listed under the EPBC Act and BC Act. Each of these are discussed separately below.

The **Tumulus (Organic Mound) Springs of the Swan Coastal Plain TEC (EPBC Endangered BC Critically Endangered)** is described in the interim recovery plan (DEC, 2006), presented below:

> The habitat of this community is characterised by continuous discharge of groundwater in raised areas of peat. The peat and surrounds provide a stable, permanently moist series of microhabitats. Intact vegetated tumulus springs are only found at four locations. There is a high level of heterogeneity of invertebrate fauna assemblages between these sites, but all are associated with a rich, healthy fauna. Groups commonly represented include Ostracoda, Nematoda, Cladocera, Copepoda, Oligochaeta, Tardigrada, Turbellaria and Insecta.
>
> Typical and common native vascular plant species associated with the tumulus springs are the trees *Banksia littoralis*, *Melaleuca preissiana* and *Eucalyptus rudis*, and the shrubs *Agonis linearifolia*, *Pteridium esculentum*, *Astartea fascicularis* and *Cyclosorus interruptus*. The following non-vascular plants have also been located on peat mounds associated with the community: *Lycopodium serpentium* (bog clubmoss), *Riccardia aequicellularis*, *Jungermannia inundata*, *Goebelobryum unguiculatum* and *Hyalolepidozia longiscypha*.

Habitat critical to the survival of the TEC is defined as “area of occupancy of known occurrences; areas of similar habitat within 200 metres of known occurrences; remnant vegetation that surrounds or links occurrences; and the local catchment for the surface and groundwater that maintain the habitat of the community”.

There is no definitive way of assessing the TEC presence, i.e. by using key diagnostic characteristics common for other listed communities. For this Project we have applied the precautionary principle to determine that critical habitat for the Organic Mounds TEC occurs in the survey area, represented by vegetation community MrTlBj. This community has organic peaty loam soils, riparian vegetation, and is likely to be hydrologically connected to the know occurrence northwest of the survey area.

The community is very degraded, with understorey comprising of weeds including Declared Pest **Zantedeschia aethiopica* (Arum Lily).

This TEC is mapped for 0.28 ha and directly corresponds with MrTlBj, mapped in Figure 4.

The TEC **SCP3c: *Corymbia calophylla – Xanthorrhoea preissii* woodland and shrublands** was not recorded during the field survey. None of the vegetation communities supported both *C. calophylla* and *X. preissii*. It is likely that the survey area intersects with the buffer of this TEC only.

The TEC **Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain** was not recorded. No limestone landforms were recorded. It is likely that the survey area intersects with the buffer of this TEC only.

7.1.2 Vegetation Communities

The survey area comprised highly modified vegetation where the majority of land had been cleared for agriculture. Native vegetation is restricted to infrastructure corridors including the Midland Railway line, Rutland Road reserve, and riparian vegetation associated with Ellen Brook and an unnamed creek.

Three native vegetation communities and six highly modified communities were defined and mapped. This includes two significant vegetation communities, MrTlBj which represents the Organic (Mound Springs) TEC discussed in Section 7.1.1, and community GrEcJc which is dominated by the Threatened *Grevillea curviloba* subsp. *curviloba* discussed in Section 7.2.1.

Ellen Brook dissects the survey area along Rutland Road. The vegetation along Ellen Brook is highly modified from grazing and only the tree stratum remains.

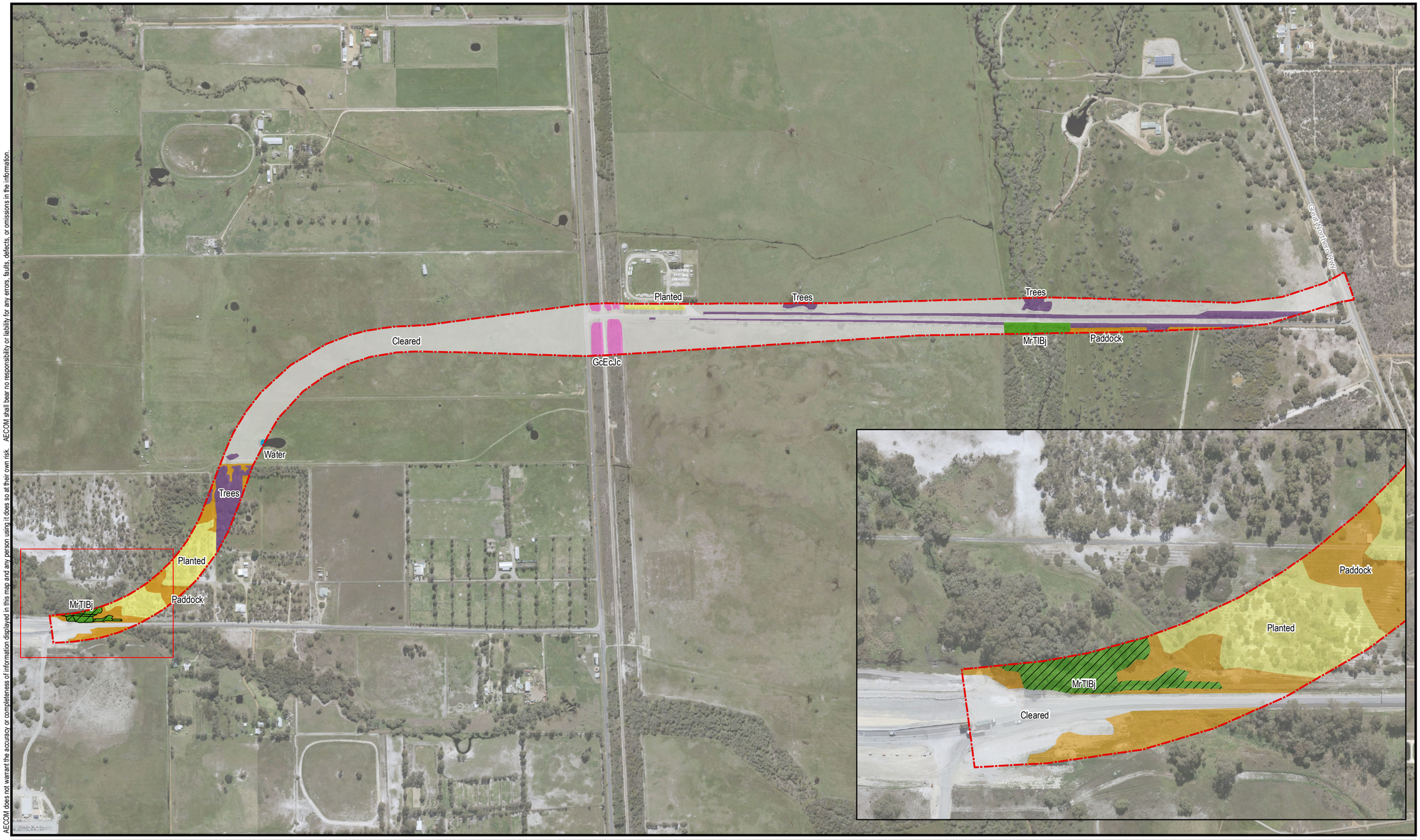
The community descriptions and details are presented in Table 18 and mapped in Figure 4.

Table 18 Vegetation community descriptions including mapping code and photographs

Description	Additional Detail	Photograph
GcEcJc Shrubland *Grevillea curviloba* subsp. *curviloba* (T)*, Acacia saligna* subsp. *lindleyi* and *Regelia inops* mid to tall shrubland over **Eragrostis curvula, *Briza maxima* and **Ehrharta calycina* low to tall grassland with *Juncus capitatus, Lepidosperma tenue* and *Hypolaena pubescens* mid open sedgeland. Includes thickets of *G. curviloba* subsp. *curviloba* and *Regelia inops*. Locally and regionally significant as habitat refuge for Threatened flora species and includes wetland functions and values.	Survey effort: 01, 02 Extent: 0.69 ha Species richness: 22 native species	
MrTlBj Riparian Woodland *Melaleuca rhaphiophylla, Eucalyptus rudis* and some *Melaleuca preissiana* Medium Woodland to Open Forest over *Taxandria linearifolia* Tall Open Shrubland over *Baumea juncea, Cycnogeton lineare* and **Zantedeschia aethiopica* Tall Mixed Sedges and Herbs This community represents Tumulus (Organic Mound) Springs of the Swan Coastal Plain TEC (EPBC Endangered WA Critically Endangered).	Survey effort: 03 Extent: 0.23 ha Species richness: 5 native species	

Description	Additional Detail	Photograph
EtRiAm *Eucalyptus todtiana* isolated trees over *Regelia inops, Calothamnus quadrifidus* and *Kunzea glabrescens* tall open shrubland over **Avellinia michelii*, **Cynodon dactylon* and **Bromus* sp. grassland. This area represents rehabilitation undertaken approximately 10 years ago (private landowner). It includes an individual of *Grevillea curviloba* subsp. *incurva* (T).	Survey effort: 04 and 05 Extent: 0.71 ha	
ErCo *Eucalyptus rudis* and *Casuarina obesa* over common pasture weeds. Riparian degraded vegetation along Ellen Brook.	Survey effort: observation (no access) Extent: 0.70 ha	

Description	Additional Detail	Photograph
Significantly Altered - Paddock – 20.73 ha - Trees – 4.80 ha - Planted (introduced trees) – 0.18 ha - Water – 0.01 ha - Cleared – 3.65 ha Condition considered to range from Degraded to Completely Degraded.	Extent: 29.37 ha	 



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DATUM GDA 1994 MGA Zone 50

0 100 200 300 400

metres

Data

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LEGEND

Survey Area

Critical habitat for EPBC & WA TEC Tumulus (Organic Mound) Springs of the Swan Coastal Plain

Vegetation Community

- GcEcJc
- MrTlBj
- Paddock
- Planted
- Trees
- Water
- Cleared

Vegetation Communities

DEPARTMENT OF PLANNING LANDS AND HERITAGE

RUTLAND ROAD MRS AMENDMENT – ECOLOGICAL SURVEYS

Figure

4

Map Document: \\AUPER1FP001.AU.AECOMNET.COM\Projects\606X\60613901\900_CAD_GIS\920_GIS\02_MXDs\20200214_EcologyReportFigures\G60613901_Fig4_VegComm_A3L_v1.mxd (WyattK2)

A3 size

7.2 Flora

7.2.1 Threatened and Priority Flora

Two Threatened flora species listed under the EPBC Act were recorded in the survey area; *Grevillea curviloba* subsp. *curviloba* and *Grevillea curviloba* subsp. *incurva.*

One population of ***G. curviloba* subsp. *curviloba*** was recorded as part of the targeted surveys for this Project. A total of 1,458 individuals were recorded, with 292 within the original survey area, and another 1,166 individuals recorded between Rutland Road and Neaves Road in the rail corridor (Table 19). The survey was extended to ensure that DPLH have adequate information for informing their design and results are mapped in Figure 5. Individual counts should be considered estimates as it was difficult to differentiate between individuals.

Within the survey area this species has two distinct habits including erect shrub and prostrate spreading shrub (Plate 1). The species was recorded in one vegetation community (GcEcJc) comprising shrubland over weed grassland with sedges. The sedges and terrain indicate the area is a winter-wet/low-lying area.

This population corresponds with DBCA population 4, demarcated by yellow markers (Plate 2) along Railway Parade and the railway access track. The survey population information will be presented to DBCA in a threatened flora form.

Table 19 Population information of Grevillea curviloba subsp. curviloba

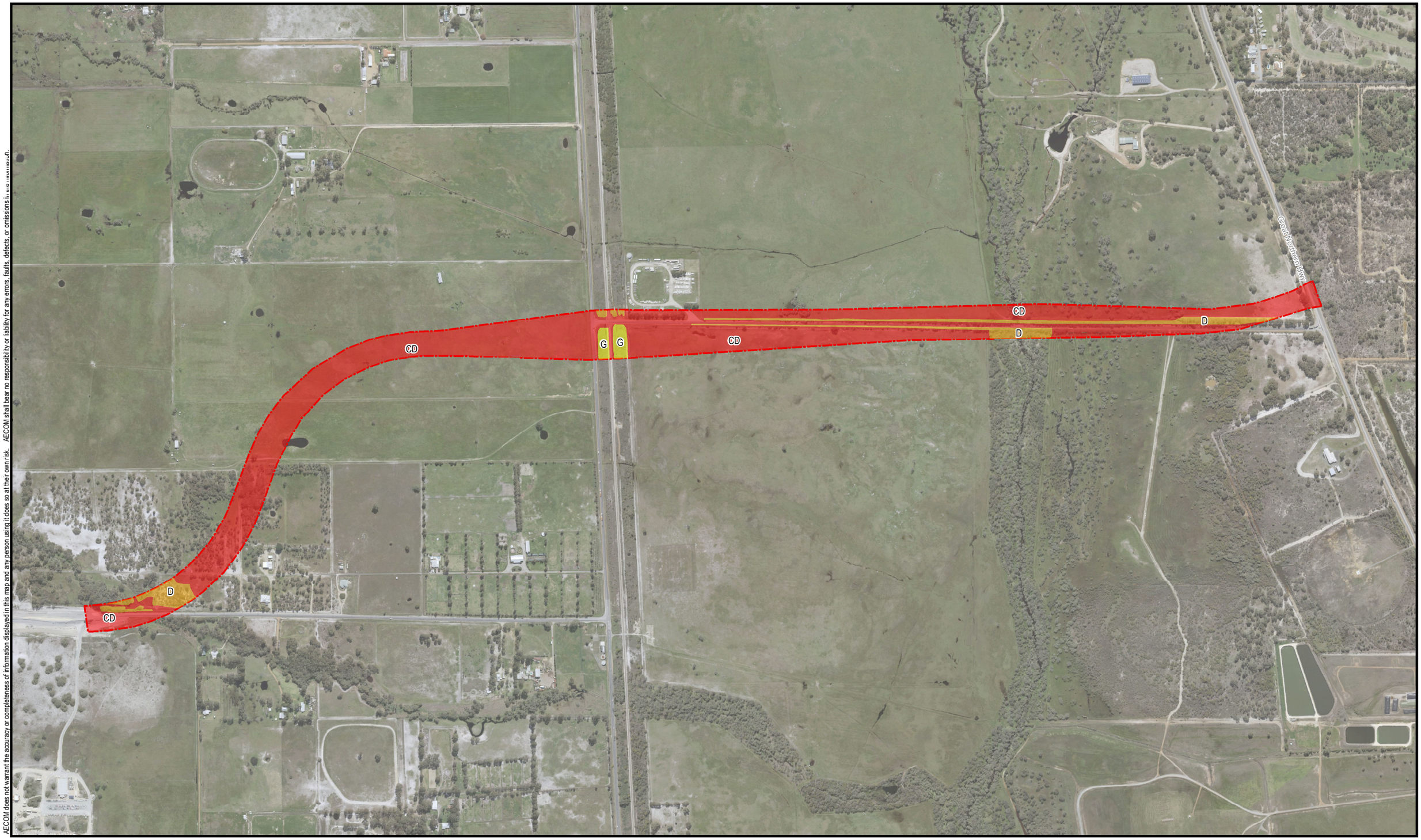
Source	Inside Survey area	Outside Survey Area – Within Rail Corridor	Total
AECOM	292	1,166	1,458
DBCA	2	5	7
WA Herbarium	2	3	5

Plate 1 *Grevillea curviloba* subsp. *curviloba* in its erect (left) and prostrate (right) habit

Plate 2 ***Grevillea curviloba*** **subsp.** ***curviloba*** **typical leaf form (left) and DBCA identifying marker (right)**

One individual of ***G. curviloba*** **subsp.** ***incurva*** was recorded during the survey. *G. curviloba* subsp. *incurva*, the Narrow Curved-leaf Grevillea, is a prostrate to erect shrub which grows up to 2.5 m high. Flowers are white to cream in colour (flowering in August to September) and is known from sand or sandy loam and winter-wet heath habitat. It differs from *Grevillea curviloba* subsp. *curviloba*, in that subsp. *incurva* has prominently incurved, narrowly linear leaf lobes, 0.8 to 1.2 millimetres wide (DAWE, 2020)

There are four known occurrences of this species identified in the desktop assessments. All of these are restricted to the railway corridor. The record within the survey area represents a new population where the closest DBCA record occurs 1.27 east of this record, along an unnamed creek. It was recorded in a rehabilitated area that was until recently privately owned. It is currently managed by Main Roads Western Australia. It is unknown whether the individual represents a planted species, or a naturally recruited species. In either case, the individual is significant as a new population and will be reported to DBCA in a threatened flora form.



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DATUM GDA 1994 MGA Zone 50

0 100 200 300 400

metres

LEGEND

- Survey Area

Vegetation Condition

- Good
- Degraded
- Completely Degraded

Vegetation Condition

DEPARTMENT OF PLANNING LANDS AND HERITAGE

RUTLAND ROAD MRS AMENDMENT – ECOLOGICAL SURVEYS

Figure 5

Map Document: \\AUPER1FP001.AU.AECOMNET.COM\Projects\606X\60613901\900_CAD_GIS\920_GIS\02_MXDs\20200214_EcologyReportFigures\G60613901_Fig5_VegCon_A3L_v1.mxd (WyattK2)

A3 size

7.2.2 Inventory of Flora Species

A total of 32 native flora species from 27 genera and 14 families were recorded within the survey area during the field assessment. Families with the highest representation are Myrtaceae (18 taxa), Proteaceae (6 taxa) and Cyperaceae (4 taxa). The complete list of flora species that were recorded is presented in Appendix B.

Weed species represented the majority of the flora species list where 39 introduced weed species were recorded. Of these, the Arum Lily *Zantedeschia aethiopica*, Bridal Creeper *Asparagus asparagoides* and the Elmleaf Blackberry *Rubus ulmifolius* are considered Declared Pest species under s22 of the BAM Act.

Both the Arum Lily and the Elmleaf Blackberry are listed in the C3 category. Pests will be assigned this category if they are established in Western Australia, but it is feasible or desirable to manage them in order to limit their damage. Under the BAM Act, control measures are required to prevent this pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of this pest.

7.3 Vegetation Condition

The condition of the vegetation ranges from good to completely degraded. Over 90% of the survey area is degraded or completely degraded. This reflects the extent of agricultural use and development that has occurred.

Only two patches of remnant vegetation remain, including the rail reserve, and the considerably modified drainage channel that intersects with Neaves Road. Weed invasion, Declared Pest populations, and a changing climate, are affecting both these patches.

The total area of each condition rating is provided in Table 20 and mapped in Figure 6.

Table 20 Vegetation condition extent

Condition Rating	Area (ha)	Percentage of survey area (%)
Completely degraded	26.73	84
Degraded	4.43	14
Good	0.59	2
Very Good	0	0
Excellent	0	0

Grevillea curviloba subsp. curviloba

Grevillea curviloba subsp. incurva

Great Northern Hwy

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LAST MODIFIED	14 FEB 2020

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DATUM GDA 1994 MGA Zone 50

0 100 200 300 400

Metres

Data

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LEGEND

- Survey Area
- *Grevillea curviloba subsp. curviloba*
- *Grevillea curviloba subsp. incurva*

WA Herb / Threatened and Priority Flora Database

- *Grevillea curviloba* subsp. *curviloba*
- *Grevillea curviloba* subsp. *incurva*

Locations of *Grevillea curviloba* subsp. *curviloba* and *Grevillea curviloba* subsp. *incurva*

DEPARTMENT OF PLANNING LANDS AND HERITAGE

RUTLAND ROAD MRS AMENDMENT – ECOLOGICAL SURVEYS

Figure 6

Map Document: \\AUPER1FP001.AU.AECOMNET.COM\Projects\606X\60613901\900_CAD_GIS\920_GIS\02_MXDs\20200214_EcologyReportFigures\G60613901_Fig6_LocationsGrevillea _A3L_v1.mxd (WyattK2)

A3 size

7.4 Level 1 Fauna Survey

7.4.1 Inventory of Fauna Species

Thirty vertebrate fauna species were recorded during the field survey. This comprised 23 bird, five mammal, one reptile and one amphibian species. A complete inventory of fauna species recorded within the Survey Area is provided in Table 21.

Table 21 Fauna species recorded within the survey area

Species	Vernacular	Status	Observations
Birds			
Anassuperciliosa	Pacific Black-duck	Native	Several observed in modified wetland towards the middle of the Survey Area.
Anthochaera carunculata	Red Wattlebird	Native	Observed in scattered *Eucalyptus* and *Melaleuca* trees in cleared paddocks towards the western end of the Survey Area.
Platycercus zonarius	Australian Ringneck	Native	Three birds seen and heard towards western end of Survey Area.
Cacomantis flabelliformis	Fan-tailed Cuckoo	Native	One bird heard calling adjacent wetland to the west of the Survey Area.
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	Native	Observed in multiple locations, both foraging and over-flying the Survey Area.
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	Native	Observed in multiple locations, both foraging and over-flying the Survey Area.
Colluricincla harmonica	Grey Shrikethrush	Native	Bird heard calling adjacent wetland to the west of the Survey Area.
Coracina novae-hollandiae	Black-faced Cuckoo Shrike	Native	Observed flying over eastern end of Survey Area.
Corvus coronoides	Australian Raven	Native	Observed in trees within a paddock towards the western end of the Survey Area.
Cracticus tibicen	Australian Magpie	Native	Observed commonly throughout Survey Area.
Dacelo novaeguineae	Laughing Kookaburra	Naturalised exotic	Observed in trees within a paddock towards the western end of the Survey Area.
Elanus axillaris	Black-shouldered Kite	Native	Two observed flying over paddocks in the centre of the Survey Area.
Grallina cyanoleuca	Magpie Lark	Native	Two birds observed towards east of Survey Area.
Gavicalis virescens	Singing Honeyeater	Native	Two birds observed in mature trees in western end of Survey Area.
Gerygone fusca	Western Gerygone	Native	Two birds heard calling to the west of the Survey Area.
Hirundo neoxena	Welcome Swallow	Native	Three birds observed flying adjacent modified wetland towards the middle of the Survey Area.
Malurus sp.	Fairy-wren	Native	Family group heard in shrubs to western end of Survey Area.
Merops ornatus	Rainbow Bee Eater	Native	Heard within the western end of the Survey Area.
Pardalotus striatus	Striated Pardalote	Native	Observed in trees in a paddock towards the western end of the Survey Area and along a drainage line in the eastern portion of the Survey Area.
Petrochelidon nigricans	Tree Martin	Native	Numerous birds observed flying over Survey Area adjacent mature trees and modified water sources.
Rhipidura leucophrys	Willie Wagtail	Native	One bird observed in paddock and one observed towards the east of the Survey Area.
Tadorna tadornoides	Australian Shelduck	Native	Two observed in modified wetland towards the middle of the Survey Area.
Zosterops lateralis	Silvereye	Native	Three observed in *Eucalyptus rudis* to the west of the Survey Area.

Species	Vernacular	Status	Observations
Mammals			
Canis familiaris	Dog/Feral Dog	Introduced	Dogs and dog scat commonly observed throughout the survey area.
Equus caballus	Horse	Naturalised Exotic	Several observed in paddock.
Macropus fuliginosus	Western Grey Kangaroo	Native	Multiple groups observed adjacent wetland at western end of Survey Area, and a carcass recorded on Neaves Road at eastern end of survey area.
Oryctolagus cuniculus	European Rabbit	Introduced	Scat, diggings and burrows observed commonly throughout Survey Area.
Vulpes vulpes	Red Fox	Introduced	Scat recorded around wetland survey area.
Reptiles			
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink	Native	Four individuals observed on large fallen log, along with a single individual in a cleared area to the west of the survey area,
Amphibians			
Crinia glauerti	Clicking Froglet	Native	Multiple frogs calling in modified wetland in the west of the survey area.

7.4.2 Conservation Significant Fauna

Of the 30 fauna species observed, eight of conservation significance were recorded:

- Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* (listed as Vulnerable under the EPBC Act and the BC Act). Refer to 7.4.4 for further details
- Carnaby's Cockatoo *Calyptorhynchus latirostris* (listed as Endangered under both the EPBC Act and the BC Act). Refer to 7.4.4 for further details
- Six species listed as Marine under the EPBC Act, comprising the Magpie Lark *Grallina cyanoleuca,* Rainbow Bee Eater *Merops ornatus*, Tree Martin *Petrochelidon nigricans*, Silvereye *Zosterops lateralis*, Welcome Swallow *Hirundo neoxena* and the Black-faced Cuckoo-shrike *Coracina novaehollandiae*. Species listed as Marine are only considered of conservation significance in Commonwealth land (e.g. the DoD land).

Based on the desktop assessment and the field survey, the following additional conservation significant fauna species are considered to have the potential to utilise habitats within the survey area:

- Quenda *Isoodon fusciventer* (listed as Priority 4 by DBCA)
- Peregrine Falcon *Falco peregrinus* (listed as OS by DBCA)
- Rainbow Bee-eater *Merops ornatus* (listed as Marine under the EPBC Act).

Marginal habitat also exists for:

- Carter's Freshwater Mussel *Westralunio carteri* (listed as Vulnerable under the BC Act and the EPBC Act)
- Rakali / Water Rat *Hydromys chrysogaster* (listed as Priority 4 by DBCA)
- Marine and / or Migratory listed wetland bird species including the Wood Sandpiper *Tringa glareola*, Common Greenshank *Tringa nebularia,* Glossy Ibis *Plegadis falcinellus,* Great Egret *Ardea modesta*, Cattle Egret *Ardea ibis*, Sharp-tailed Sandpiper *Calidris acuminata*, Pectoral Sandpiper *Calidris melanotos*
- Black-striped Snake *Neelaps calonotos* (listed as Priority 3 by DBCA).

The habitats within the survey area that these species may utilise are discussed in further detail in Section 7.4.4.

The Chuditch *Dasyurus geoffroii* was assessed as may occur in the survey area based on the desktop assessment, however the field survey has determined that the habitats and habitat features that this species require are not located within the survey area. The Chuditch prefers habitat dominated by sclerophyll forest or dry woodland/heathland/shrubland, with adequate numbers of suitable den sites such as horizontal hollow logs (Van Dyck & Strahan, 2008).

7.4.3 Introduced Species

Two introduced species were recorded within the survey area during the field survey. The species and their legal status under the BAM Act are listed below:

- European Wild Rabbit *Oryctolagus cuniculus* (Feral) – Declared Pest – s22(2)
- Red Fox *Vulpes vulpes* - Declared Pest - s22(2) (C3 Exempt).

The European Wild Rabbit and Red Fox are listed as Declared Pests under the BAM Act. Generally, these species were recorded sporadically throughout the survey area, and were identified by tracks, scats, dens and burrows.

Dog tracks and cats were also recorded throughout the survey area, however as the area does contain residences, it is difficult to discern if these animals are pets or feral. These animals have therefore been excluded from the introduced species section.

7.4.4 Fauna Habitats

Seven fauna habitats (including completely Cleared) were defined and mapped (Figure 10) within the survey area. Apart from the “Cleared Paddock with Scattered Trees” fauna habitat, which covers 20.55 ha (65%), the “Mixed Shrubland” fauna habitat occupies the next largest area, covering 2.08 ha (6.55%) of the survey area. Both of these habitats are likely to be utilised by common fauna species of the local area, as well as providing habitat for the conservation significant Quenda *Isoodon fusciventer* and Peregrine Falcon *Falco peregrinus*. These habitat types also potentially provide marginal foraging habitat for Carnaby's Cockatoo *Calyptorhynchus latirostris,* Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*, Rainbow bee-eater *Merops ornatus*, Wood Sandpiper *Tringa glareola* and the Common Greenshank *Tringa nebularia*. The “Cleared Paddock with Scattered Trees” habitat also provides marginal hunting habitat for the Peregrine Falcon, along with the “Mixed Shrubland”.

Table 22 describes these fauna habitats and includes the area and percentage these cover within the survey area, as well as the conservation significant fauna species likely to utilise these habitats.

Table 22 Fauna habitats of the survey area

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Area (ha)	Percentage (%)	Photos
Mixed Shrubland	This often-degraded habitat is highly variable and contains an open to closed shrubland over grasses and bare sandy loamy soils. These areas are often found along roadside and rail corridors. An area of rehabilitation to the west of the survey area has also been mapped as Mixed Shrubland. It does have occasional small emergent Marri trees. Habitat quality is variable and largely depends on the level of disturbance and edge effects, ranging from moderate to low given the lack of complexity.	• Marginal foraging habitat for: - Carnaby's Cockatoo - Forest Red-tailed Black Cockatoo • Habitat for Quenda • Habitat for Peregrine Falcon • Marginal habitat for Black-striped Snake	2.08	6.55	 

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Area (ha)	Percentage (%)	Photos
Scattered Trees	These are generally areas with scattered mature introduced and native trees over minimal understorey, over cleared sandy soils. Often these areas are planted. Habitat quality is moderate based on the lack of complexity (minimal understorey) and the on the level of disturbance.	• Foraging and potential breeding and roosting habitat for: - Forest Red-tailed Black Cockatoo - Carnaby's Cockatoo • Marginal habitat for Quenda • Habitat for Peregrine Falcon	0.45	1.42	
Eucalypts over Mixed Shrubland	This generally degraded habitat predominantly contains *Eucalyptus rudis,* and Sheoak and / or the occasional Marri, over a mixed open shrubland. This habitat is located along the roadside to the east of the survey area. Habitat quality is considered moderate to high given the levels of complexity and various habitat characteristics it provides, though with impacts from clearing and edge effects.	• Foraging, breeding and potential roosting habitat for: - Forest Red-tailed Black Cockatoo - Carnaby's Cockatoo • Habitat for Quenda • Habitat for Peregrine Falcon • Marginal habitat for Black-striped Snake	1.59	5.01	No photo

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Area (ha)	Percentage (%)	Photos
Wetland, Drainage and Riparian Vegetation	This habitat Includes wetlands, drainage areas and associated riparian vegetation. Areas are often highly modified and disturbed, and may include an overstorey of *Eucalyptus rudis*, Paperbark and / or Sheoak over a generally degraded understorey high in weed abundance, on loamy sandy soils. The habitat varies in quality depending on the degree of modification and disturbance. The drainage lines to the east and west of the survey area are considered moderate to high quality due to the wetland and riparian nature but reduced in quality due to high disturbance levels and lack of a native understorey.	• Foraging, breeding and roosting habitat for: - Forest Red-tailed Black Cockatoo - Carnaby's Cockatoo • Habitat for Quenda • Potential habitat for Rakali. • Potential marginal habitat for Carter's Freshwater Mussel • Potential marginal habitat for wetland birds: - Wood Sandpiper - Common Greenshank - Common Greenshank - Glossy Ibis - Great Egret - Cattle Egret - Sharp-tailed Sandpiper - Pectoral Sandpiper.	0.97	3.06	 

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Area (ha)	Percentage (%)	Photos
					
Eucalypts over Cleared	This highly modified habitat generally contains either *Eucalyptus rudis,* Marri or introduced eucalypts over cleared bare sandy soils. This habitat contains no understorey. Much of this habitat appears to have been rehabilitated or selectively cleared. Habitat quality is moderate based on the lack of complexity (no native understorey) and the level of disturbance.	• Foraging, breeding and potential roosting habitat for: - Forest Red-tailed Black Cockatoo - Carnaby's Cockatoo • May provide marginal hunting and roosting habitat for the Peregrine Falcon • May provide marginal habitat for the Rainbow Bee-eater	2.42	7.62	

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Area (ha)	Percentage (%)	Photos
Cleared Paddock with Scattered Trees	This habitat generally comprises areas which have been cleared (e.g. paddocks) and now comprise a high cover of grasses and weeds. This habitat may contain the occasional shrub or tree Areas of the paddocks may flood after significant rains and may provide marginal habitat for some waterbird species. Habitat is considered low quality.	• Marginal foraging habitat for: - Forest Red-tailed Black Cockatoo - Carnaby's Cockatoo • Marginal hunting habitat for the Peregrine Falcon • Potential marginal habitat for the following species if / when flooded: - Wood Sandpiper - Common Greenshank - Rainbow Bee-eater - Glossy Ibis - Great Egret - Cattle Egret - Sharp-tailed Sandpiper - Pectoral Sandpiper.	20.55	64.72	

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Area (ha)	Percentage (%)	Photos
Cleared	This habitat generally comprises areas which have been cleared of native vegetation (e.g. paddocks) and may now contain bare ground, weeds and grasses. Areas of the paddocks may flood after significant rains and may provide marginal habitat for some waterbird species. Habitat is considered low quality.	• Marginal hunting habitat for the Peregrine Falcon • Potential marginal habitat for the following species if / when flooded: - Wood Sandpiper - Common Greenshank - Rainbow Bee-eater - Glossy Ibis - Great Egret - Cattle Egret - Sharp-tailed Sandpiper - Pectoral Sandpiper.	0.81	2.55	

Notes: 2.88 ha of hardstand areas have also been mapped. These contain minimal fauna habitat and as such were excluded from the table above.

7.4.5 Habitat Linkages

Habitat linkages are typically corridors of vegetation that link larger areas of potential fauna habitat. Linkages are important as they enable organisms to move freely between remnant bushland patches, therefore increasing gene-flow between populations.

The survey area predominately consists of cleared and modified land, along with the broader surroundings. Potential habitat linkages in the survey area are primarily the strips of riparian vegetation associated with watercourses, which are located both to the east and west of the survey area. Shrubland, including rehabilitation areas, also provide minimal habitat linkages along roadsides, however this vegetation is not considered to be significant in habitat linkage value.

It is considered likely that avian fauna species are the primary fauna species which are likely to use these habitats; in particular as an intermediary habitat whilst moving between larger areas of suitable habitat.

7.5 Targeted Black Cockatoo Survey

7.5.1 Ecology

7.5.1.1 Carnaby's Cockatoo

Carnaby's Cockatoo is endemic to the southwest of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin. This Black Cockatoo has a white patch on its cheek, white bands on its tail, and a strong curved bill.

Carnaby's Cockatoo feeds on seeds, nuts and flowers of a variety of native and exotic plants. Feed plants include the various proteaceous species (e.g. *Banksia, Grevillea* and *Hakea*), Marri *Corymbia calophylla*, eucalypts e.g. Jarrah *Eucalyptus marginata*, and seeds from the cones of Pine trees (*Pinus sp*.) (Cale, 2003).

Carnaby's Cockatoo displays strong pair bonds and nest in the hollows of live or dead mature eucalypts including Salmon Gum *Eucalyptus salmonophloia*, York Gum *E. loxophleba* subsp. *loxophleba*, Flooded Gum *E. rudis*, Karri *E. diversicolor*, Marri *Corymbia calophylla*, Wandoo *E.wandoo* and Tuart *E. gomphocephala* (DSEWPAC, 2012). Nest hollows generally range from 2.5-12 m above ground, size of entrance from 23-30 cm and depth of hollows from 1-2.5 m (Johnstone and Storr, 1998). The species appears to be expanding its current breeding range westward and south into the Jarrah-Marri forests of the Darling Range and into the Tuart forests of the SCP (Johnstone *et al.,* 2010). After breeding, Carnaby's Cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July. Breeding has been recorded from early July to mid-December.

Carnaby's Cockatoo has undergone a dramatic decline of approximately 50 percent in the past 45 years, with the main contributing factors the clearing of core breeding habitat in the Wheatbelt, the deterioration of nesting hollows, and clearing of foraging habitat.

One flock of six Carnaby's Cockatoo were observed (seen and heard) flying east over the survey area during the field survey (7.4.1).

7.5.1.1 Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo is endemic to the south-west humid and semi-humid zones of Western Australia, where it inhabits dense Jarrah, Karri and Marri forests which receive more than 600 mm average annual rainfall (DSEWPaC, 2012). It has a pair of black central tail feathers and a bright red, orange or yellow barring on the tail.

This species predominantly feeds in eucalypt forests, preferring Marri (*Corymbia calophylla*) and Jarrah *Eucalyptus marginata* seeds, but also feeding on Blackbutt *E. patens*, Albany Blackbutt *Eucalyptus staer*), Karri *E. diversicolor*, Sheoak *Allocasuarina sp.* and Snottygobble *Persoonia longifolia* (Johnstone, 2016 pers. comm.).

Forest Red-tailed Black Cockatoo are monogamous and pairs nest in tree hollows from 6.5 to 33 m above ground. Most nests are in very large and very old, mature Marri (Johnstone, Kirkby & Sarti, 2013), though they will nest in other eucalypts such as Tuart (Johnstone, 2016 pers. comm.). Breeding habitat for this species occurs in the eastern margins of the Jarrah forests of the Wheatbelt, and within the Jarrah Forest regions, and the Forest Red-tailed Black Cockatoo is expanding its current breeding range with small patches of breeding habitat now being utilised across the SCP.

A male and female Forest Red-tailed Black Cockatoo were observed foraging on Tuart seed pods at the eastern extent of the survey rea (See section 7.4.1).

7.5.2 Breeding

The Survey Area contains a total of 14 hollow-bearing native eucalypt trees with a DBH >500 mm (*Eucalyptus wandoo* >300 mm). Eight (57%) of these were Flooded Gum *Eucalyptus rudis*, two (14%) were Marri *Corymbia calophylla* and four (29%) were Tuart *Eucalyptus gomphocephala*. Hollow formation in eucalypt trees is a result of a number of processes including fungal attack, termites and fire and the propensity for hollow formation varies between the eucalypt species (Whitford, 2002). None of the 14 trees, or any other native eucalypts within the survey area, had potentially suitable hollows for utilisation by breeding black cockatoos.

The SCP is used by black cockatoos primarily for foraging resources, however their breeding ranges are expanding due to heavy historic clearing. Small patches of breeding habitat are now being utilised across the SCP. On the SCP most black cockatoo breeding records (nests), particularly for Carnaby's Cockatoo, are in Tuart (Johnstone & Kirkby, 2010).

Refer to Table 23 and for the details of all 14 potential breeding trees.

Table 23 Black cockatoo breeding habitat trees within the survey area

ID	Species	Tree Height (m)	DBH (cm)	Comments	No. of Potentially Suitable Hollows	Easting	Northing
1	Marri *Corymbia calophylla*	15	60	Forks just above DBH	0	406542.9	6498119
2	Marri *Corymbia calophylla*	15	60	-	0	403605.4	6497363
3	Flooded Gum *Eucalyptus rudis*	10	55	Tree forks just above DBH	0	404062.9	6497731
4	Flooded Gum *Eucalyptus rudis*	10	65	Tree forks just above DBH	0	404002.3	6497742
5	Flooded Gum *Eucalyptus rudis*	10	53	Tree forks just above DBH	0	404004.5	6497717
6	Flooded Gum *Eucalyptus rudis*	10	65	-	0	404003.8	6497687
7	Flooded Gum *Eucalyptus rudis*	12	65	Tree forks just above DBH	0	403993.7	6497672
8	Tuart *Eucalyptus gomphocephala*	16	70		0	406826.1	6498218
9	Tuart *Eucalyptus gomphocephala*	15	55	Tree forks just above DBH	0	406723.5	6498131
10	Tuart *Eucalyptus gomphocephala*	20	100	Three main trunks fused together	0	406836.6	6498198
11	Flooded Gum *Eucalyptus rudis*	12	52	-	0	406847.1	6498177
12	Tuart *Eucalyptus gomphocephala*	18	100	-	0	406849.3	6498169

ID	Species	Tree Height (m)	DBH (cm)	Comments	No. of Potentially Suitable Hollows	Easting	Northing
13	Flooded Gum *Eucalyptus rudis*	15	55	Several hollows but all too small	0	406411.9	6498138
233	Flooded Gum *Eucalyptus rudis*	12	170	-	0	406463.9	6498102

Note: Tree ID 233 was sourced form AECOM (2014) as access to this property was limited.

Male and female Forest Red-tailed Black Cockatoo foraging within Tuart tree

Great Northern Hwy

Six Carnaby's Cockatoo observed flying east over Survey Area

PROJECT ID	60613901
CREATED BY	WYATTK2
APPROVED BY	FDW
LAST MODIFIED	14 FEB 2020

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DATUM GDA 1994 MGA Zone 50

0 100 200 300 400

metres

LEGEND

- Survey Area
- Fauna: Observation

Fauna Habitats

- Cleared Paddock with Scattered Trees
- Eucalypts over Cleared
- Eucalypts over Mixed Shrubland
- Hardstand
- Mixed Shrubland
- Scattered Trees
- Wetland, Drainage and Riparian Vegetation
- Cleared

Fauna Habitats

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Figure

7

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A3 size

7.5.3 Roosting

Carnaby's Cockatoo typically roost in the tallest trees in the landscape in or near riparian environments or near other permanent water sources (DSEWPAC, 2012). The Forest Red-tailed Black Cockatoo prefers the edges of forests for roosting (DSEWPaC, 2012). Evidence of roosting usually involves large amounts of bird scat beneath a large, mature tree, with a significant amount of broken branches, twigs etc. on the ground. Roosting sites were searched for throughout the survey area and none were identified.

The Birdlife (2018) black cockatoo roosting database has the closest confirmed black cockatoo roost site (SWABULR002) approximately four kilometres east of the survey area. This roost site is defined as a white-tailed black cockatoo and Forest Red-tailed Black Cockatoo roost.

7.5.4 Foraging

7.5.4.1 Carnaby's Cockatoo

The survey area contains a total of 11.27 ha of foraging habitat for Carnaby's Cockatoo. This includes 4.91 ha of Very High and High Quality foraging habitat for Carnaby's Cockatoo. This consisted of areas with mature eucalypts, including the Scattered Trees; Eucalypts over Mixed Shrubland; Eucalypts over Cleared; and some of the Wetland, Drainage and Riparian Vegetation Fauna Habitats. These Very High and High Quality foraging habitat areas generally contained potential breeding trees, were within 12 km of roosting and breeding sites, and were less than two kilometres from a watering point.

Foraging habitat is presented spatially in Figure 8, and the total areas for each foraging quality are presented in Table 24. The foraging quality assessments are presented in Appendix D.

No Carnaby's Cockatoo foraging evidence was recorded within the survey area.

Table 24 Carnaby's Cockatoo foraging habitat areas

Foraging Quality	Areas (ha)
Low Quality (1-3)	1.37
Quality (4-6)	4.99
High Quality (7-8)	3.87
Very High Quality (>8)	1.04
Total	**11.27**

7.5.4.2 Forest Red-tailed Black Cockatoo

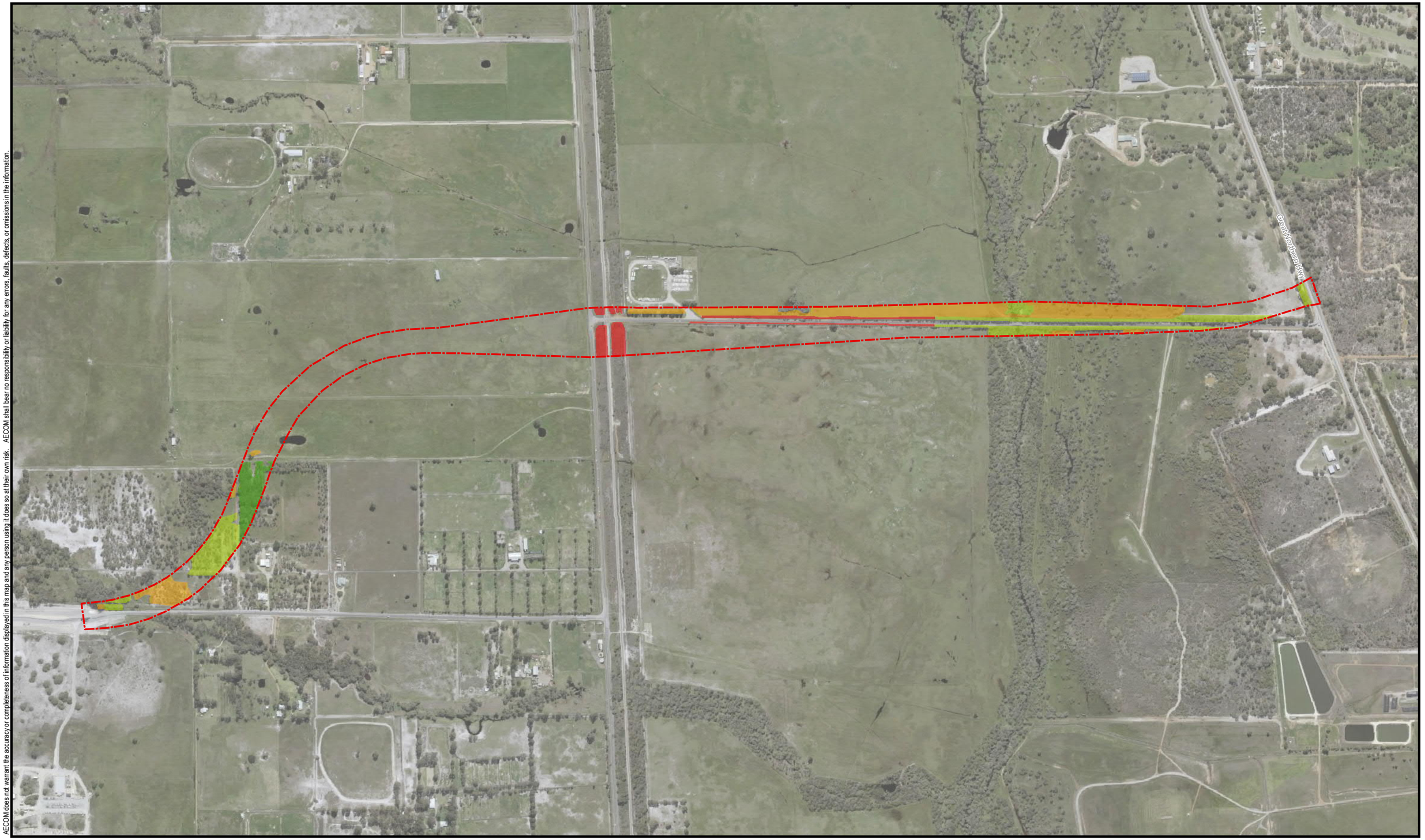
The survey area contains a total of 5.70 ha of foraging habitat for the Forest Red-tailed Black Cockatoo. This did not include any Very High and High Quality foraging habitat due to the general lack of Marri and Jarrah trees within the survey area. Foraging habitat is presented spatially in Figure 9, and the total areas for each foraging quality are presented in Table 25.

Table 25 Forest Red-tailed Black Cockatoo foraging habitat areas

Foraging Quality	Areas (ha)
Low Quality (1-3)	4.27
Quality (4-6)	1.43
High Quality (7-8)	0
Very High Quality (>8)	0
Total	**5.70**

Potential foraging evidence from the Forest Red-tailed Black Cockatoo was recorded at two locations within the survey area (refer to Plate 3 and Figure 9). As discussed in Section 7.4.1, a male and female Forest Red-tailed Black Cockatoos were also observed foraging on Tuart seed pods at the eastern extent of the survey area.

Plate 3 Probable Forest Red-tailed Black Cockatoo foraging evidence



PROJECT ID	60613901
CREATED BY	KAI.DU
APPROVED BY	FDW
LAST MODIFIED	13 FEB 2020

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DATUM GDA 1994 MGA Zone 50

0 100 200 300 400

metres

Data Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information

LEGEND

- Survey Area
- Low Quality
- Quality
- High Quality
- Very High Quality

Carnaby's Cockatoo Foraging Habitat

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Figure 8

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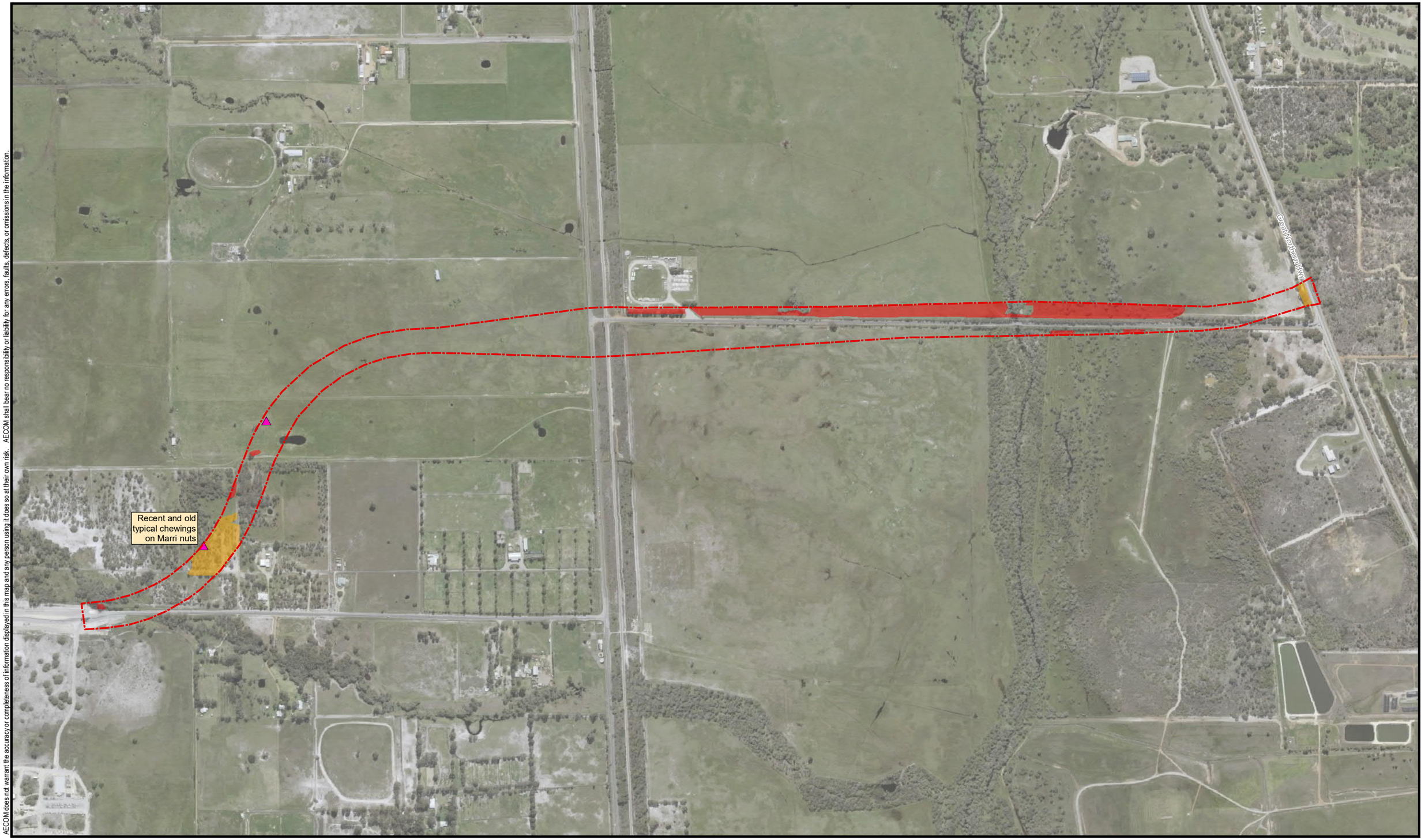
A3 size



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DATUM GDA 1994 MGA Zone 50

0 100 200 300 400

metres

LEGEND

- Survey Area
- Fauna: Observation
- Low Quality
- Quality
- High Quality
- Very High Quality

Forest Red-tailed Black Cockatoo Foraging Habitat

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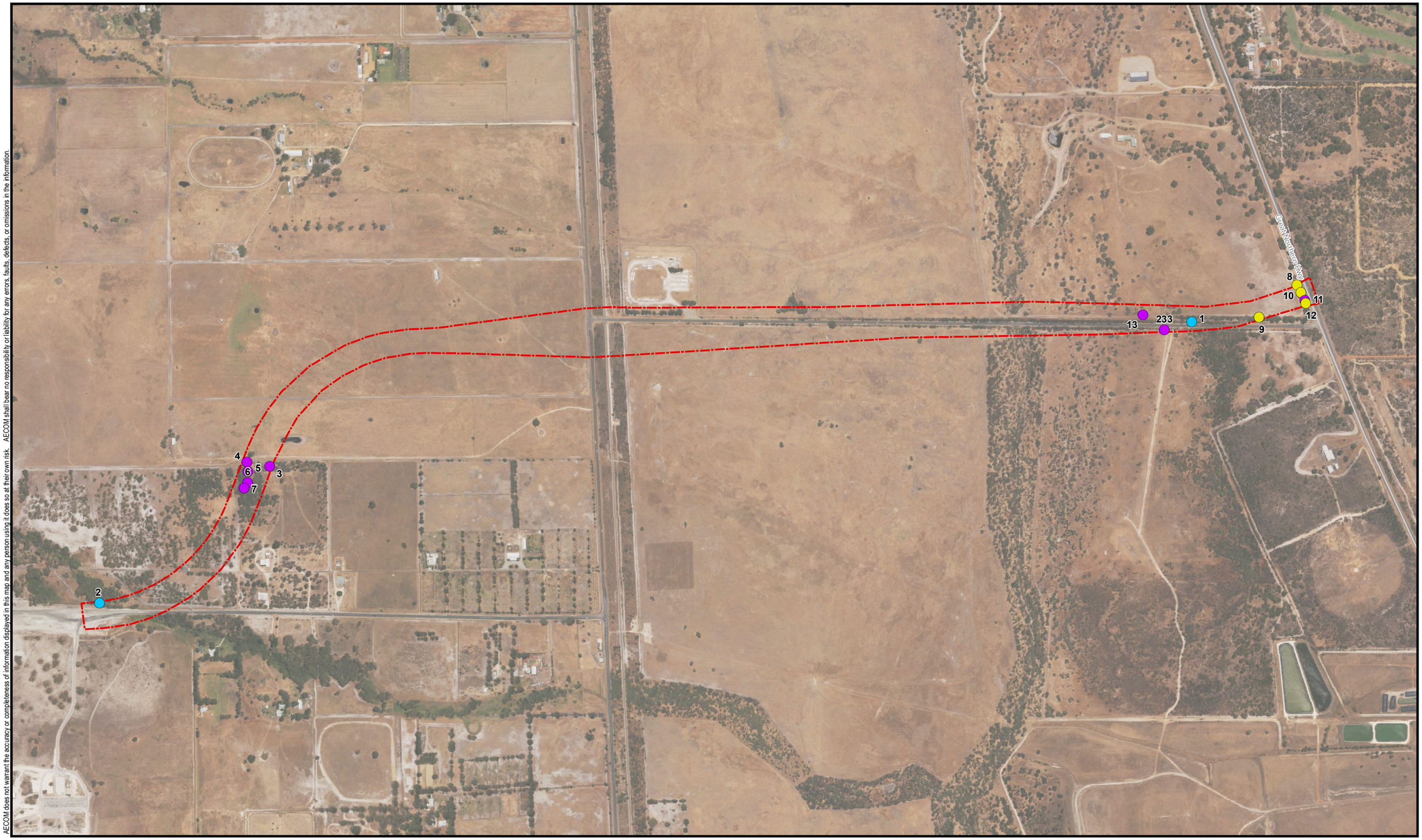
RUTLAND ROAD MRS AMENDMENT – ECOLOGICAL SURVEYS

Figure 9

Map Document: \\AUPER1FP001.AU.AECOMNET.COM\Projects\606X\60613901\900_CAD_GIS\920_GIS\02_MXDs\20200203_EcologyMXD\G60613901_Fig9_RedBCForaging_A3L_v1.mxd (kai.du)

A3 size



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CREATED BY SOPHIE.RICHARDS
APPROVED BY FDW
LAST MODIFIED 13 MAY 2020

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LEGEND

Survey Area

Black Cockatoo Breeding Habitat Trees

- Flooded Gum
- Marri
- Tuart

Black Cockatoo Breeding Habitat

DEPARTMENT OF PLANNING LANDS AND HERITAGE

RUTLAND ROAD MRS AMENDMENT – ECOLOGICAL SURVEYS

Figure 10

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8.0 Conclusion

A detailed flora and vegetation, Level 1 fauna and targeted black cockatoo survey was conducted in Spring 2019 (October) and early Summer 2020 (January) for the Project. The desktop assessment identified a number of significant environmental factors that were further investigated during the field surveys. The results of the assessment are presented below:

- The Tumulus (Organic Mound) Springs of the Swan Coastal Plain TEC, listed under the EPBC Act and BC Act, was identified in the survey area, represented by community MpTlBj. This community is associated with the drainage channel that intersects Neaves Road and is considered critical habitat for the TEC. It extends for 0.28 ha.
- Two flora species listed as threatened under the EPBC Act and BC Act were recorded including *Grevillea curviloba* subsp. *curviloba* (1,458 individuals) and *Grevillea curviloba* subsp. *incurva* (1 individual).
- Thirty vertebrate fauna species were recorded during the field survey. This comprised 23 bird, five mammal, one reptile and one amphibian species. Eight species of conservation significance were recorded including the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* (listed as Vulnerable under the EPBC Act and the BC Act), Carnaby's Cockatoo *Calyptorhynchus latirostris* (listed as Endangered under both the EPBC Act and the BC Act) and six bird species listed as Marine under the EPBC Act.
- Seven fauna habitats were defined and mapped. Apart from the “Cleared Paddock with Scattered Trees” fauna habitat, which covers 20.55 ha (65%), the “Mixed Shrubland” fauna habitat occupies the next largest area, covering 2.08 ha (6.55%) of the survey area. Both of these habitats are likely to be utilised by common fauna species of the local area, as well as providing habitat for conservation significant species.
- A total of 11.27 ha of foraging habitat for Carnaby’s Cockatoo was mapped in the survey area, including 4.91 ha of High and Very High Quality foraging habitat.
- A total of 5.70 ha of foraging habitat for the Forest Red-tailed Black Cockatoo was mapped in the survey area. This included no High and Very High Quality foraging habitat.
- The survey area contains 14 native hollow-bearing eucalypt trees, defined as black cockatoo breeding habitat. None of these contained potentially suitable hollows.

No significant limitations were identified that may influence the results of the field survey. It is recommended that the *Grevillea curviloba* subsp. *incurva* population is further investigated to determine its extent and size to ensure it is considered during the road design.

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Appendix A

Desktop Assessment Results

Appendix A Desktop Assessment Results

A1: Protected Matters Search Report

A2: Desktop Flora

A3: Desktop Fauna

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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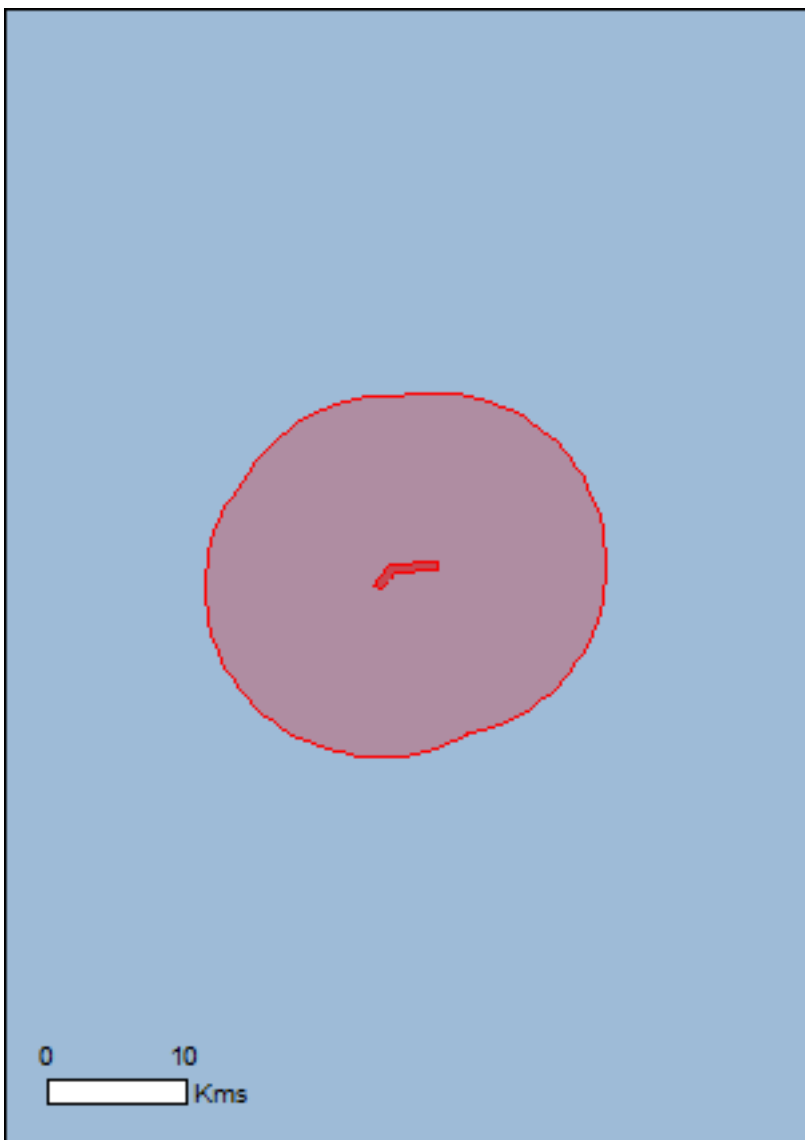

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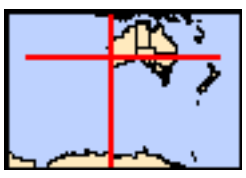

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	42
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	16
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	14
Regional Forest Agreements:	1
Invasive Species:	37
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	Endangered	Community known to occur within area
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	Endangered	Community known to occur within area
Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain	Endangered	Community known to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe	Endangered	Species or species

Name	Status	Type of Presence
[77037]		habitat known to occur within area
Fish		
Galaxiella nigrostriata		
Blackstriped Dwarf Galaxias, Black-stripe Minnow [88677]	Endangered	Species or species habitat known to occur within area
Insects		
Hesperocolletes douglasi		
Douglas' Broad-headed Bee, Rottnest Bee [66734]	Critically Endangered	Species or species habitat may occur within area
Leioproctus douglasiellus		
a short-tongued bee [66756]	Critically Endangered	Extinct within area
Mammals		
Bettongia penicillata ogilbyi		
Woylie [66844]	Endangered	Species or species habitat likely to occur within area
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Petrogale lateralis lateralis		
Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Translocated population known to occur within area
Other		
Westralunio carteri		
Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat may occur within area
Plants		
Acacia anomala		
Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat known to occur within area
Andersonia gracilis		
Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area
Anigozanthos viridis subsp. terraspectans		
Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area
Anthocercis gracilis		
Slender Tailflower [11103]	Vulnerable	Species or species habitat may occur within area
Caladenia huegelii		
King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6)		
Gingin Wax [88881]	Endangered	Species or species habitat likely to occur within area
Conospermum densiflorum subsp. unicephalatum		
One-headed Smokebush [64871]	Endangered	Species or species habitat may occur within area
Darwinia foetida		
Muchea Bell [83190]	Critically Endangered	Species or species habitat known to occur within area
Diplolaena andrewsii		
[6601]	Endangered	Species or species habitat known to occur within area
Diuris micrantha		
Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus leprophloia Scaly Butt Mallee, Scaly-butt Mallee [56712]	Endangered	Species or species habitat may occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area
Grevillea althoferorum [64906]	Endangered	Species or species habitat likely to occur within area
Grevillea christineae Christine's Grevillea [64520]	Endangered	Species or species habitat likely to occur within area
Grevillea corrugata a shrub [65445]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. curviloba Curved-leaf Grevillea [64908]	Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat known to occur within area
Hypocalymma sylvestre [86384]	Endangered	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Melaleuca sciotostyla Wongan Melaleuca [24324]	Endangered	Species or species habitat may occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat likely to occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat likely to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area
Reptiles		
Pseudemydura umbrina Western Swamp Tortoise [1760]	Critically Endangered	Translocated population known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Defence - MUCHEA ARMAMENT RANGE
Defence - PEARCE - AP11OBSTRUCTION BEACON NO.5
Defence - PEARCE - AP15 WATER TREATMENT PLANT
Defence - PEARCE - AP17 WATER SUPPLY TANKS
Defence - PEARCE - AP19 HF RECEIVER STATION BULLSBROOK
Defence - PEARCE - AP2 OBSTRUCTION BEACON NO.2
Defence - PEARCE - AP3 RADAR STATION BULLSBROOK
Defence - PEARCE - AP4 AERIAL FARM
Defence - PEARCE - AP5 OPERATIONS SITE
Defence - PEARCE - AP6 OBSTRUCTION BEACON NO.3
Defence - PEARCE - AP7 OBSTRUCTION BEACON NO.1
Defence - PEARCE - AP8 BORE SITES
Defence - PEARCE - AP9 OBSTRUCTION BEACON NO.4
Defence - PEARCE - RAAF BASE
Defence - VACANT LAND - BULLSBROOK AP102

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Bullsbrook	WA
Ellen Brook	WA
NTWA Bushland covenant (0121)	WA
Neaves Road	WA
Paruna	WA
Twin Swamps	WA
Unnamed WA02336	WA
Unnamed WA41938	WA
Unnamed WA44622	WA
Unnamed WA46564	WA
Unnamed WA46875	WA
Unnamed WA46919	WA
Unnamed WA49300	WA
Walyunga	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		

Name	Status	Type of Presence
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Ellen Brook Swamps System	WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-31.640074 116.019773,-31.640074 116.019916,-31.640074 116.019916,-31.644337 116.02006,-31.646651 115.992736,-31.655541 115.984153,-31.654323 115.978003,-31.641415 115.989016,-31.640074 116.019773

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This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
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-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Species	EPBC	State	Habitat	Flowering period	Likelihood	Justification
Acacia anomala	V	VU	Lateritic soils. Slopes	Aug, Sep	Unlikely to occur	No suitable habitat in survey area.
Acacia drummondii subsp. *affinis*	-	P3	Lateritic gravelly soils.	Jul-Aug	Unlikely to occur	No suitable habitat in survey area.
Adenanthos cygnorum subsp. *chamaephyton*	-	P3	Grey sand, lateritic gravel.	Jul, Sep-Dec	Unlikely to occur	No suitable habitat in survey area.
Andersonia gracilis	E	EN	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Sep-Nov	Unlikely to occur	Only identified in EPBC report, no known locations in the survey area.
Anigozanthos viridis subsp. *terraspectans*	V	VU	Grey sand, clay loam. Winter-wet depressions.	Aug-Sep	Unlikely to occur	Only identified in EPBC report. No known occurrences in survey area.
Caladenia huegelii	E	CR	Grey or brown sand, clay loam.	Sep-Oct	Unlikely to occur	Verified location within 1km of the western edge of survey area. Suitable habitat unlikely within survey area.
Calectasia sp. Pinjar (C. Tauss 557)	-	P1	Deep grey quartz soils. Gentle slopes, above damplands.	Jul-Oct	Unlikely to occur	Two known locations 5km east of survey area. Suitable habitat unlikely within survey area.
Centrolepis caespitosa	E	P4	White sand, clay. Salt flats, wet areas.	Oct-Dec	May occur	Listed as P4 species in WA. Known occurrence near survey area, potentially suitable habitat in survey area.
Chamelaucium sp. Gingin (N.G. Marchant 6)	E	VU	White/yellow sand supporting open low woodland	Sep-Dec	Unlikely to occur	Only identified in EPBC report. No known locations in survey area.
Conospermum densiflorum subsp. *unicephalatum*	E	EN	Clay soils. Low-lying areas.	Sep-Nov	Unlikely to occur	Only identified in EPBC report. No known locations in survey area. No clay soils in survey area.
Cyathochaeta teretifolia	-	P3	Grey sand, sandy clay. Swamps, creek edges.	-	May occur	Two populations in the survey area and suitable habitat in survey area.
Darwinia foetida	CE	EN	Known from three populations in swampy, seasonally wet habitat in the Muchea area, approximately 70km north of Perth.	Oct-Nov	Likely to occur	Verified locations in a wetland community north of Neaves Road.
Diuris micrantha	V	VU	Brown loamy clay. Winter-wet swamps, in shallow water.	Sep-Oct	Unlikely to occur	Only identified in EPBC report, suitable habitat unlikely to be present in survey area.
Diuris purdiei	E	EN	Grey-black sand, moist. Winter-wet swamps.	Sep-Oct	Unlikely to occur	Only identified in EPBC report. No known occurrences in survey area however suitable habitat may be present in survey area.
Drakaea elastica	E	CR	White or grey sand. Low-lying situations adjoining winter-wet swamps.	Oct-Nov	Unlikely to occur	Only identified in EPBC report. No known occurrences in survey area however suitable habitat may be present in survey area.
Drosera occidentalis subsp. *occidentalis*	-	P4	Sandy and clayey soils. Swamps and wet depressions.	Oct-Dec, Jan	May occur	One population in the survey area, suitable habitat in the survey area.
Eleocharis keigheryi	V	VU	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	Aug-Nov	May occur	May occur in flowline leading from known location south of the survey area.
Eryngium pinnatifidum subsp. *Palustre* (G.J. Keighery 13459) PN	-	P3	No details.	-	May occur	Occurs 3km northeast of survey area. Suitability of habitat unknown.
Eucalyptus balanites	E	CR	Sandy soils with lateritic gravel.	Oct-Feb	Unlikely to occur	Only identified in EPBC report. No known occurrences in survey area. No suitable habitat.
Eucalyptus leprophloia	E	EN	White or grey sand over laterite. Valley slopes.	Aug-Dec	Unlikely to occur	Only identified in EPBC report. Known locations are from Eneabba, Badgingarra and Jurien Bay.
Grevillea althoferorum subsp. *fragilis*	E	CR	Found at the base of the Darling Scarp, growing in greyish-yellow colluvial sand	Sep-Oct	Unlikely to occur	Occurs 3km northeast of survey area. Recorded on the plains at the base of the scarp.
Grevillea corrugata	E	VU	Amongst low trees or tall to low shrubland in gravelly soil or loam.	Aug-Sep	Unlikely to occur	Only identified in EPBC report. Recorded on the Darling Scarp in Chittering and Toodyay.
Grevillea curviloba subsp. *curviloba*	E	CR	Grey sand, winter-wet heath	Oct	Likely to occur	Verified locations along Railway Parade.
Grevillea curviloba subsp. *incurva*	E	EN	Sand, sandy loam. Winter-wet heath.	Aug, Sep	Likely to occur	Verified locations along Railway Parade north of the survey area.
Guichenotia tuberculata	-	P3	Sand clay over laterite, sand.	Aug-Oct	Unlikely to occur	No suitable habitat in survey area.
Lepidosperma rostratum	E	EN	Peaty sand, clay.	May-June	Unlikely to occur	Only identified in EPBC report. Recorded in Kenwick.
Microtis quadrata	-	P4	No details.	Dec-Jan	Unlikely to occur	Scattered records in Jandakot, Denmark, Albany and Beaufort Inlet.
Ornduffia calthifolia (formerly known as *Villarsia calthifolia*)	E	EN	No details.	-	Unlikely to occur	Only identified in EPBC report. All known records were recorded in Albany.
Oxymyrrhine coronata	-	P4	No details	Dec, Jan	Unlikely to occur	Known locations in Chittering and Toodyay.
Persoonia rudis	-	P3	White, grey or yellow sand, often over laterite.	Sep-Dec, Jan	Unlikely to occur	Population within 2km of survey area.
Platysace ramosissima	-	P3	Sandy soils.	Oct-Nov	May occur	Two populations to the north of the survey area, possible suitable habitat.
Schoenus sp. Bullsbrook (J.J. Alford 915)	-	P2	Grey peaty sand. Low-lying flats.	Oct-Nov	May occur	One population to the south of survey area, possible suitable habitat.
Stylidium aceratum	-	P2	Sandy soils. Swamp heathland	Oct-Nov	May occur	Two known locations to the north of the survey area, possible suitable habitat.
Stylidium longitubum	-	P3	Sandy clay, clay. Seasonal wetlands.	Oct-Dec	May occur	One population to the south of the survey area, possible suitable habitat.
Stylidium paludicola	-	P3	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.	Oct-Dec	May occur	One population to the north of the survey area, possible suitable habitat.
Stylidium squamellosum	-	P2	Brown to red-brown clay loam. Winter-wet habitats and depressions, open woodland, shrubland.	Oct-Nov	May occur	One known location to the north-east of the survey area. Possible suitable wetland habitat.
Synaphea grandis	-	P4	Laterite	Oct-Nov	Unlikely to occur	No suitable habitat in survey area.
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CE	CR	Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	Sep-Nov	Unlikely to occur	Occurs further south of Perth.
Thelymitra dedmaniarum (formerly known as *T. manginii*)	E	CR	Granite	Oct-Nov	Unlikely to occur	Only identified in EPBC report. No granite outcrops in survey area.
Thelymitra stellata	E	EN	Sand, gravel, lateritic loam	Oct-Nov	Unlikely to occur	Only identified in EPBC report. No verified occurrences in the survey area.
Trithuria occidentalis	E	CR	Grows partly submerged on the edge of shallow, winter-wet claypans in very open shrubland of *Melaleuca lateritica*	Oct-Nov	Unlikely to occur	Known from one location 7km south of survey area. No suitable habitat in the survey area.
Verticordia serrata var. *linearis*		P3	White sand, gravel. Open woodland.	Sep-Oct	May occur	Two populations near the survey area, potentially suitable habitat in the survey area.

Appendix A3 Desktop Fauna Assessment

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Birds						
Actitis hypoleucos Common Sandpiper	DotEE	Migratory & Marine (CAMBA, JAMBA ROKAMBA)	MI	-	The Common Sandpiper is widespread in small numbers throughout Australia, found along all coastlines and in many inland areas (DotEE, 2019). They visit Australia during the non-breeding season. The population when in Australia is concentrated in northern and western Australia (Higgins & Davies, 1996). Areas of national importance within Western Australia include Nuytsland Nature Reserve and Roebuck Bay (Watkins, 1993). The species utilises a wide range of coastal wetlands and some inland wetlands and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties (DotEE, 2019).	Unlikely to occur based on lack of any recent records and preferred habitat in the area.
Apus pacificus Fork-tailed Swift	DotEE	Migratory & Marine (CAMBA, JAMBA ROKAMBA)	MI	-	The Fork-tailed Swift is almost exclusively aerial, and a non-breeding visitor to Australia (DotEE, 2019). They are rarely seen roosting on land.	Unlikely to be seen on ground. May overfly the survey area.
Ardea alba Great Egret	DotEE	Marine	-	-	The Great Egret occupies a wide variety of wet habitats including freshwater wetlands, dams, flooded pastures, estuarine mudflats, mangroves and reefs (Morcombe, 2003). The species is also known to visit shallows of rivers, sewage ponds and irrigation areas (Pizzey & Knight, 2007).	May occur; no recent records though marginal habitat available.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Ardea ibis Cattle Egret	DotEE	Marine	-	-	The Cattle Egret is a small egret weighing only 390g and standing 70cm tall. The heaviest distribution of this species in WA is in the north east, and into the Northern Territory. In the non-breeding season, it can be found throughout most of Australia (Marchant & Higgins, 1990).	May occur; no recent records though marginal habitat available.
Botaurus poiciloptilus Australasian Bittern	DBCA DotEE	Endangered	EN	1977 - 2	The Australasian Bittern is a large thick-necked bird, growing to a length of 66 to 76 cm. Upper parts are brown and black and mottled to aid in camouflage. It grows to a length of 66–76 cm and has a wingspan of 1,050–1180 cm. The Australasian Bittern has a straw yellow bill and the legs and feet are pale green to olive (Marchant & Higgins, 1990; Pizzey & Knight, 1997). In Western Australia the species was formerly widespread in the south-west however is now thought to only occur on the western coastal plain, southern coastal region and inland to some wetlands in the Jarrah forests (DSEWPaC, 2011). The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water (Marchant & Higgins, 1990).	Unlikely to occur based on lack of any recent records in the area.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Calidris acuminata Sharp-tailed Sandpiper	DotEE	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	MI	-	The Sharp-tailed Sandpiper is a small to medium sized wader with a length of 17 to 22 cm and weighing 65g. They spend the non-breeding season in Australia. In Western Australia (WA), scattered records occur along the Nullarbor Plain and the southern areas of the Great Victoria Desert. They are widespread across Australia. In Australasia they prefer muddy edges of shallow coastal or inland wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. They also occur in saltworks, sewage farms, flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves (DotEE, 2019).	May occur; no recent records though marginal habitat available.
Calidris ferruginea Curlew Sandpiper	DotEE	Critically Endangered Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	CE	-	The Curlew Sandpiper is a small, slim wader weighing 57 g. In Australia, Curlew Sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. In Western Australia, they are widespread around coastal and sub coastal plains from Cape Arid to the south-west Kimberley. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand (Higgins & Davies, 1996).	Unlikely to occur based on lack of any recent records and preferred habitat in the area.
Calidris melanotos Pectoral Sandpiper	DotEE	Migratory & Marine (Bonn, JAMBA, ROKAMBA)	MI	-	The Pectoral Sandpiper occupies shallow, fresh waters often containing low grass or other small herbs. It is also observed in swamp margins, flooded pastures and saltmarshes. This species breeds in the northern hemisphere and is a regular though uncommon summer visitor to Australia (Pizzey & Knight, 2007). Rarely recorded in Western Australia (DotEE, 2019).	May occur; no recent records though marginal habitat available.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Calyptorhynchus banksii subsp. *naso* Forest Red-tailed Black Cockatoo	DBCA DotEE	Vulnerable	VU	2018 - 169	The Forest Red-tailed Black Cockatoo is 55-60 cm in length and are mostly glossy black with a pair of black central tail feathers, a crest, robust bill and bright red, orange or yellow barring in the tail (Higgins, 1999). Males are distinguished by broad red tail panels that are only visible when taking off or alighting (Higgins, 1999). Requires tree hollows to nest and breed, occurs in forests of Karri (*Eucalyptus diversicolor*), Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*), with flocks moving out onto the Swan Coastal Plain in search of food from exotic trees such as White Cedar (Johnstone *et al*., 2010). Foraging habitat for the species consists of Jarrah and Marri woodlands and forest throughout its range. Has become more common in the Metropolitan area in the past few years.	Likely to occur. Multiple recent records exist near the survey area and breeding and foraging habitat may occur.
Calyptorhynchus baudinii Baudin's Cockatoo	DotEE	Vulnerable	VU	-	Baudin's Cockatoo is a large cockatoo that measures 50–57 cm in length, with a wingspan of approximately 110 cm. Mostly dull black in colour, with pale whitish margins on the feathers (Higgins, 1999). Habitat critical to the survival of this species includes forests of Karri (*E. diversicolor*), Jarrah (E. *marginata*) and Marri (*C. calophylla*), in areas of 600 mm average rainfall per year. Individuals typically move north through the Perth region from March to May and south through the Perth region from August to October. This species ranges north to Gidgegannup and Hoddy Well and west to the Eastern Strip of the Swan Coastal Plain including West Midland in the north, heading south through Armadale, Byford and south and towards the coast until Lake Clifton where it continues to hug the coastline to east of Albany (Johnstone *et al.,* 2010). Breeding has been recorded to the south-west of the area bounded by Leschenault, Collie and Albany (DSEWPaC, 2012), with the most northerly record at Lowden, near Donnybrook (Johnstone & Storr, 1998). Breeding has also been recorded at Serpentine (hills area), and east to Kojonup and near Albany (Johnstone & Kirkby, 2008).	Unlikely to occur. No DBCA records of this species within 12km of the survey area.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Calyptorhynchus latirostris Carnaby's Cockatoo	DotEE DBCA	Endangered	EN	2018 - 5,880	Carnaby's Cockatoo is a white-tailed black cockatoo endemic to the south-west of Western Australia. It is a postnuptial nomad and typically moves west soon after breeding. Breeding occurs mainly from early July to mid-December. There has been an apparent shift in its breeding range further west and south since the middle of last century (Johnstone *et al*., 2010). The species nests in hollows in eucalypts, particularly Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*E. Wandoo*), but nests have been found in other eucalypts including York Gum (*E. loxophleba*), Flooded Gum (*E. rudis*), Tuart (*E. gomphocephala*) and Marri (*Corymbia calophylla*) (Johnstone *et al.*, 2010). Breeding success is largely dependent on suitable feeding habitat adjacent to the nest site to provide the necessary food for the survival of the chick (Johnstone *et al*., 2010). Diet consists of an array of Proteaceous and *Eucalyptus* species. Foraging habitat, including *Banksia* woodlands, is considered to be habitat critical to the survival of the species (Johnstone *et al*., 2010).	Likely to Occur. Breeding and foraging habitat is likely to occur within the survey area and numerous records exist within 12 km.
Falco peregrinus Peregrine Falcon	DBCA	-	OS	2010 - 5	The Peregrine Falcon is a medium-sized raptor (length 35-55cm; wingspan 80-105cm) with slate-grey back, a striking charcoal black head and face which contrast with a pale cream bib on the neck and breast (Birdlife Australia, 2018). A well-known falcon, the Peregrine inhabits a vast array of environs in Australia. Usually uncommon and migratory (Pizzey & Knight, 2007). This species lays its eggs in recesses of cliff faces, tree hollows or large abandoned nests (Bamford, 2009)	May occur. Recent records exist in close proximity to the survey area.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Glareola maldivarum Oriental Pratincole	DBCA	Migratory & Marine (CAMBA, JAMBA, ROKAMBA)	MI	1981 - 1	The Oriental Pratincole is a medium sized tern-like shorebird which is widespread in northern Australia, with sparse records in southern Australia. It usually inhabits open plains, floodplains or short grassland (including farmland), often occurring near terrestrial wetlands, and also occurring along the coast. The species does not breed in Australia (DotEE, 2019).	Unlikely to occur. Records in southern Australia are uncommon and no recent records occur in close proximity to the survey area.
Haliaeetus leucogaster White-bellied Sea-Eagle	DotEE	Marine	-	-	The White-bellied Sea-Eagle is a large raptor that is widespread throughout coastal Australia. The White Bellied Sea-Eagle occupies a wide range of habitats, usually in close proximity to a large body of water (including the ocean). Breeding usually occurs in tall open woodlands overlooking bodies of water (DotEE, 2019).	Unlikely to occur with minimal suitable habitat available.
Leipoa ocellata Malleefowl	DotEE	Vulnerable	VU	-	The Malleefowl is a large, ground-dwelling bird with strong feet and a short bill. It is found principally in the semi-arid to arid zone in shrublands and low woodlands dominated by mallee and associated habitats such as such as Broombush *Melaleuca uncinata* and Scrub Pine *Callitris verrucosa*. In WA Malleefowl distribution was associated with landscapes that had lower rainfall, greater amounts of mallee and shrubland that occur as large remnants, and lighter soil surface textures (Benshemesh, 2007). At a finer scale, malleefowl occurrence was associated with mallee/shrubland and thicket vegetation with woodland representing poor habitat for the species (Parsons, 2008).	Unlikely to occur with no DBCA records within 12 km of the survey area and minimal suitable habitat.
Limosa lapponica Bar-tailed Godwit	DBCA	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	MI	1980 - 2	The Bar-tailed Godwit is a large wader weighing up to 450 g and in Western Australia is widespread around the coast from Eyre to Derby (DotEE, 2019).	Unlikely to occur. Typically found in large lake edges or coastal habitats.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Merops ornatus Rainbow Bee-eater	DotEE	Marine	-	-	The Rainbow Bee-eater is a common species which occupies numerous habitats including open woodlands with sandy loamy soil, sand ridges, sandpits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves and rainforests. It is possible that this species will occupy open woodland areas within the survey area. The Rainbow Bee-eater avoids heavy forest that would hinder the pursuit of its insect prey (Morcombe, 2003).	May occur. Potentially suitable habitat exists.
Motacilla cinerea Grey Wagtail	DoTEE	Migratory & Marine (CAMBA, JAMBA, ROKAMBA)	MI	-	The Grey Wagtail is a scarce but regular visitor to northern Australia, typically arriving in October and leaving in March. The species is most commonly associated with water and are found across a wide variety of wetlands, watercourses and on the banks of lakes and marshes (Referral guideline for 14 birds listed as migratory species under the EPBC Act, DotE, 2015)	Unlikely; no recent records and marginal habitat available within the survey area.
Numenius madagascariensis Eastern Curlew	DotEE	Critically Endangered, Marine & Migratory	CE	-	The Eastern Curlew is Australia's largest shorebird and a long-haul flyer. It is easily recognisable, with its long, down-curved bill. The Eastern Curlew takes an annual migratory flight to Russia and north-eastern China to breed, arriving back home to Australia in August to feed on crabs and molluscs in intertidal mudflats. It is extremely shy and will take flight at the first sign of danger (DotEE, 2019). The southern most important international site in Western Australia is Eighty Mile Beach (Bamford *et al*., 2008).	Unlikely to occur, with no records or suitable habitat within close proximity to the survey area.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Oxyura australis Blue-billed Duck	DBCA	-	P4	1981 - 2	The Blue-billed Duck is a compact diving duck with males having a large scooped bright, light blue bill. The tail is dark with stiff pointed feather tips and is usually held flat on the surface of the water except when in display (Birdlife Australia, 2019). The Blue-billed Duck is endemic to south eastern and south western Australia. It prefers deep water in large permanent wetlands and swamps with aquatic vegetation. This species of duck is fully aquatic and rarely comes onto land.	Unlikely to occur. Requires deep water.
Pandion haliaetus *Osprey*	DotEE	Migratory & Marine (Bonn)	-	-	The breeding range of the Osprey includes the northern coast of Australia from Albany in WA to Lake Macquarie in NSW. This bird is moderately common in Australia, mostly in northern Australia. It is rare to uncommon in southern WA. The Osprey inhabits littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Found mostly in coastal areas but can travel inland along major rivers. Areas of open fresh, brackish or saline water for foraging is essential for their habitat, visiting various wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps and broad rivers, reservoirs and large lakes. They can also occur over atypical habitats such as heath, woodland or forest when travelling between foraging sites (DotEE, 2019).	Unlikely to occur based on habitats present.
Plegadis falcinellus Glossy Ibis	DBCA	Migratory & Marine (Bonn)	MI	2001 - 4	The Glossy Ibis occupies well vegetated wetlands, wet pastures, floodwaters, brackish wetlands and mudflats. This species is a non-breeding visitor to south-west Western Australia (Pizzey & Knight, 2007).	May occur. Records exist within 12 km of the survey area and suitable habitat is likely to be present.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Pluvialis squatarola Grey Plover	DBCA	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	MI	1978 - 1	The Grey Plover is a medium sized plover. The Australian population breeds in Siberia between May and August, with individuals reaching the south coast of Australia in October and November (DotEE, 2019). The closest site of international significance for this species is Thomsons Lake in Perth.	Unlikely to occur. Only one record from 1978 occurs within 12 km of the survey area.
Rostrulata australis Australian Painted Snipe	DBCA DotEE	Endangered	EN	2012 - 1	The Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans (DotEE, 2019). This species is a very rare summer visitor to the south-west of Western Australia. Breeding habitat in Western Australia is not quite known however a nest located near Moora was located in a tussock beside a swamp (Johnstone & Storr, 1998).	Unlikely to occur, with only one record in close proximity to the survey area.
Thalasseus bergii Crested Tern	DBCA	Migratory & Marine (JAMBA)	MI	1978 - 1	This large tern is predominantly found offshore and coastal, on beaches, bays, inlets, tidal rivers, salt swamps, lakes and larger rivers (Pizzey & Knight, 2010).The Crested Tern is usually a strictly coastal species, though there are occasional records in the arid interior of Australia, where birds were possibly blown by passing tropical cyclones (Birdlife Australia, 2018).	Unlikely to occur. No suitable habitat.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Thinornis rubricollis Hooded Plover	DotEE	Marine	-	-	The Hooded Plover is a medium-sized sandy-brown plover. It has a black head and a white nape, and the black hindneck collar extends around and forks onto the breast. West of the Nullarbor Plain, Hooded Plovers are also often recorded on ocean beaches, but they are just as likely to be seen foraging at salt lakes, sometimes hundreds of kilometres from the coast (http://birdlife.org.au/bird-profile/hooded-plover, accessed Nov 2018).	Unlikely to occur. No suitable habitat.
Tringa glareola Wood Sandpiper	DBCA	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	MI	1981 - 2	The Wood Sandpiper is a summer migrant to Australia where it is more common in the north although a casual visitor to southern parts. It occupies wetland margins, saltmarshes and sewage ponds (Pizzey & Knight, 2007).	May occur. Two records exist within 10 km of the survey area however these are from the early 1980's.
Tringa nebularia Common Greenshank	DBCA DoTEE	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	MI	1981 - 2	The Common Greenshank is a largely built wader, weighing up to 190 g for both sexes. The species is found in a large variety of inland wetlands and sheltered coastal habitats (DotEE, 2019).	May occur. Records exist within 13 km of the survey area however these are likely near the larger wetlands to the west of the survey area.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Mammals						
Bettongia penicillata ogilbyi Brush-tailed Bettong, Woylie	DotEE	Endangered	CE	-	The Woylie is a small marsupial with grey to greyish brown fur on the back and flanks, and pale greyish on the undersides. The tail is dark and has a distinctive black brush at the end (de Tores & Start, 2008). The Woylie previously occurred over large areas of western, central and eastern Australia, however naturally occurring extant populations are now restricted to three small reserves in the Western Australian wheatbelt (Van Dyck & Strahan, 2008). They inhabit woodlands and adjacent heaths with a dense understorey of shrubs, particularly *Gastrolobium spp.* (Poison Pea).	Unlikely to occur with no records within 12 km of the survey area and minimal suitable habitat likely to exist.
Dasyurus geoffroii Chuditch	DBCA	Vulnerable	VU	2016 - 7	At maturity the Chuditch is the size of a small domestic cat with white spotted brown pelage, large rounded ears, pointed muzzle, large dark eyes and non-hopping gait. Following European settlement the range of this species contracted dramatically, from much of the continent to a small area in the south west. It currently only occurs in areas dominated by sclerophyll forest or drier woodland, heath and mallee shrubland (Van Dyck & Strahan, 2008). The Chuditch requires adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) and sufficient prey biomass (large invertebrates, reptiles and small mammals) to survive.	May occur. Recent records occur within 12 km of the survey area and suitable habitat may exist.
Hydromys chrysogaster Water Rat	DBCA	-	P4	2011 - 2	The Water Rat is one of the few Australian mammals adapted to the aquatic environment. It has a streamlined body and broad, partially webbed hind feet. The species occurs in the vicinity of permanent bodies of fresh or brackish water. Dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck & Strahan, 2008).	May occur based on the habitat present and some recent records within 12 km of the survey area.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Isoodon fusciventer Quenda	DBCA	-	P4	2017 - 373	The Quenda or Southern Brown Bandicoot exists only in a fragmented distribution to its former range in southern south western and eastern Australia. It is found in forest, woodland, heath and shrub communities in these regions. Preferred habitat usually consists of a combination of sandy soils and dense heathy vegetation (Van Dyck & Strahan, 2008).	Likely to occur with many recent records in close proximity and suitable habitat within the survey area.
Macrotis lagotis Bilby	DBCA	Vulnerable	VU	1974 - 2	The Greater Bilby is the sole surviving member of the sub-family Thylacomyinae (Pavey, 2006). It is a slight, rabbit-sized marsupial with soft grey fur covering most of the body, large ears and a long, pointed snout. The Bilby occupies arid to semi-arid woodlands and hummock grasslands in the north of Australia. The Bilby formerly occupied much of the Australian mainland however has experienced a vast contraction in its range (Van Dyck & Strahan, 2008).	Unlikely to occur given species current distribution.
Notamacropus eugenii derbianus Tammar Wallaby	DBCA	-	P4	2015 - 84	*Notamacropus eugenii derbianus* is a small nocturnal Tammar Wallaby subspecies that is native to south-western Western Australia and five offshore islands. The mainland population has substantially declined since the 1890s due to habitat clearing, hunting, fire, predation by foxes and cats, and competition with rabbits. Tammar Wallabies shelter in dense low vegetation during daylight and move to open grassy areas to feed after dark. The species inhabit coastal scrub, heath, dry sclerophyll forest, and thickets in mallee and woodland.	Unlikely to occur with all records in close proximity to the survey area within Walyunga National Park.
Notamacropus Irma Western Brush Wallaby	DBCA DoTEE	-	P4	2008 - 2	The Western Brush-wallaby occurs in the south-west of Western Australia. Its preferred habitat consists of open sclerophyll forest or woodland and favours open flats over scrub thickets. However, it doesn't seem to venture into open pasture areas adjacent it's bushland refuges. It is also found in larger areas of mallee and heathland in the wheat belt and is uncommon in wet sclerophyll forest (Van Dyck & Strahan, 2008). Three most commonly consumed species are *Cynodon dactyol, Nuytsia floribunda* and *Carpobrotus edulis* (DEC, 2006).	Unlikely to occur with minimal suitable habitat present.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Petrogale lateralis subsp. *lateralis* Black-footed Rock-wallaby	DBCA DotEE	Endangered	EN	2004 - 57	The Black-footed Rock-wallaby was a widespread species which has suffered a vast contraction in its former range, thought to be due to fox predation (Van Dyck & Strahan, 2008). Extant populations occur in a few locations in the wheatbelt region, Barrow Island, Salisbury Island, Cape Range and Calvert Range, with translocated populations in the Cape Le Grand National Park, Avon Valley National park and Paruna Sanctuary. Rock wallabies can occur on a wide variety of rock types but require sufficient cave and crevice development to provide shelter from extremes of heat and predators (DPaW, 2013).	Unlikely to occur given lack of preferred habitat within the survey area.
Phascogale tapoatafa wambenger South-western Brush-tailed Phascogale	DBCA	-	CD	1992 - 1	The Brush-tailed Phascogale is one of the most arboreal dasyurids and rarely feeds on the ground. The species is distinguished by a large black tail. The species formerly occupied all the dry sclerophyll forests and woodlands of temperate and tropical Australia. The species suffered a drastic reduction in habitat due to clearing of prime habitat for agriculture and now prefers open forest with sparse groundcover. It has been observed in habitats ranging from mallee to rainforest.	Unlikely to occur due to lack of recent records and suitable habitat within survey area.
Reptiles						
Ctenotus gemmula (SCP subpop.) Jewelled Southwest Ctenotus	DBCA	-	P3	1999 - 2	The Jewelled Ctenotus is endemic to Western Australia. In the Perth region it is uncommon and restricted to the Swan Coastal Plain (Bush *et al*., 2010). The Jewelled Ctenotus inhabits low vegetation in Banksia woodlands where it shelters in leaf litter under trees and shrubs and abandoned stick-ant nests (Bush *et al*., 2010).	Unlikely to occur due to preferred habitat unlikely to be found in survey area.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Neelaps calonotos Black-striped Snake	DBCA	-	P3	2006 - 22	The Black-striped Snake is mostly confined to the Swan Coastal Plain between Mandurah and Lancelin. It takes shelter in upper layers of loose soil beneath leaf litter in *Eucalyptus/Banksia* woodlands, typically at the base of trees and shrubs (Bush *et al.,* 2010).	May occur although presence of suitable habitat to be assessed in the field.
Pseudemydura umbrina Western Swamp Tortoise	DBCA DoTEE		CR	1,161	The Western Swamp Tortoise is a brown turtle growing up to 150 mm in length with a squarish shell, flat and broad lower shell and a broad, flat head with a horny casque (helmet) (Cogger, 2000). The Western Swamp Tortoise has a very small geographic range. The species has only been recorded from scattered localities in a narrow strip (3–5 km wide) of the Swan Coastal Plain, roughly parallel with the Darling Range (Burbidge & Kuchling, 2004). Currently, the Ellen Brook Nature Reserve population is the only viable, naturally occurring population in the wild. The Twin Swamps Nature Reserve and Mogumber Nature Reserve populations are maintained with translocated individuals (TSSC, 2004).	Unlikely to occur with the known populations outside of the survey area.
Fish						

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Galaxiella nigrostriata Black-stripe Minnow	DBCA DoTEE	Endangered	EN	Unknown	The Black-stripe Minnow is a small (maximum 48 mm TL), scaleless freshwater fish. It is characterised by two black longitudinal bands separated with a yellow/orange to red stripe. It is found in acidic ephemeral bodies of water in peat flats located in the south west corner of Western Australia. The major populations occur from Augusta to Albany with two disjunct populations discovered in the same peat flats near Bunbury and one north of Perth near Gingin (Morgan *et al*., 1998). They generally prefer sandy soils, as it will burrow into the moist soil when ephemeral pools dry out.	Unlikely to occur, as unsuitable habitat and only one historic record in the vicinity of the survey area.
Invertebrates						
Euoplos inornatus Inornate Trapdoor Spider	DBCA	-	P3	1950 - 1	Euoplos is a spider genus in the family Idiopidae which is found in various geographical locations in Australia. The trapdoor spider species *Euoplos inornatus* occurs on the eastern edge of the SCP, although most records are from the Darling Scarp and the jarrah forest to the east (Invertebrate Solutions, 2018).	Unlikely to occur. Only one historic record (from 1950) occurs in close proximity to the survey area.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Hesperocolletes douglasi Douglas' Broad-headed Bee, Rottnest Bee	DotEE	Critically Endangered	CE	-	*Hesperocolletes douglasi* is a native bee species that is superficially like a number of other native bees and careful examination under a microscope would be required to distinguish a specimen. The bee is about the same size as a honeybee (approx. 12 mm), generally black and brown and moderately hairy (Houston, 2014). The geographic range of this species is unknown, with only one extant population known in Pinjar. The population size is also unknown, though it is likely a small population (< 250 mature individuals) as there have only been two individuals ever found, even though there has been intensive searching and targeted surveys (TSSC, 2019).	Unlikely to occur. No records within 12 km of survey area.
Hylaeus globuliferus Woolybush Bee	DBCA	-	P3	1996 - 5	This species is believed to feed on flowers from A*denanthos cygnorum* and *Banksia attenuata* (Western Wildlife, 2009).	Unlikely to occur in survey area due to lack of recent records and suitable plant species.
Leioproctus contrarius A short-tongued bee	DBCA	-	P3	1954 - 2	A short-tongued native bee found in Western Australia, associated with *Goodenia* sp. and *Lechenaultia* sp. (South Metro Connect, 2011).	Unlikely to occur given time since previous records in close proximity to the survey area and lack of suitable plant species.
Leioproctus douglasiellus A short-tongued bee	DBCA DoTEE	Critically Endangered	EN	1954 - 2	This small black native bee species is known from the SCP (Kenwick wetlands, Cannington and Forestdale Lake) and near Lithgow in the Blue Mountains of NSW (ALA, 2019) and has an association with *Goodenia filiformis* and *Anthotium junciforme* (South Metro Connect, 2011).	Unlikely to occur given the time since previous records in close proximity to the survey area and lack of suitable plant species.

Species	Source	EPBC Act	BC Act and DBCA Code	DBCA Records (Latest Year and Total No.)	Ecology	Likelihood of Occurrence in Study Area
Westralunio carteri Carter's Freshwater Mussel	DBCA	Vulnerable	VU	2010 - 16	The only reasonably large bivalve in freshwaters of south-west Western Australia. Occurs in greatest abundance in slower flowing waters with stable sediments that are soft enough for burrowing. Salinity tolerance is quite low (>3 g /L is lethal) (Klunzinger *et al.*, 2012).	May occur given the recent records in close proximity to the survey area.

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Appendix B

Flora by Family by Community Matrix

Appendix B Flora by Family by Community Matrix

Appendix B Flora Species by Family by Community Matrix

Family	Taxon	Community	
		GcEcJc	MrTlBj
Araceae			
	*DP *Zantedeschia aethiopica*		X
Asparagaceae			
	* *Asparagus asparagoides*	X	
	Thysanotus manglesianus	X	
Asphodelaceae			
	* *Asphodelus fistulosus*	X	
Asteraceae			
	* *Arctotheca calendula*	X	
	* *Dittrichia sp.*		X
	* *Hypochaeris glabra*	X	
	* *Hypochaeris radicata*	X	
	* *Leontodon rhagadioloides*	X	
	* *Sonchus oleraceus*	X	X
	* *Ursinia anthemoides*	X	
Boraginaceae			
	* *Echium plantagineum*	X	
Brassicaceae			
	* *Rorippa nasturtium-aquaticum*		X
Campanulaceae			
	* *Monopsis debilis*	X	
	* *Wahlenbergia capensis*	X	
Centrolepidaceae		X	
	Centrolepis aristata	X	
Cyperaceae			
	Isolepis cernua	X	
	Lepidosperma longitudinale		X
	Lepidosperma tenue	X	
Droseraceae			
	Drosera sp.	X	
Fabaceae			
	Acacia saligna	X	
	* *Lotus* sp.	X	
Gentianaceae			
	* *Cicendia filiformis*	X	
Geraniaceae			
	* *Pelargonium capitatum*	X	
Hemerocallidaceae			
	Tricoryne elatior	X	
Iridaceae			
	* *Moraea flaccida*	X	
	* *Romulea rosea*	X	
	* *Watsonia meriana*	X	
Juncaceae			
	* *Juncus capitatus*	X	
	Juncus pallidus		X
Myrtaceae			
	Callistemon phoeniceus		
	Calothamnus quadrifidus		
Myrtaceae (cont.)	*Corymbia calophylla*		
	Eucalyptus rudis		X
	Eucalyptus todtiana		
	Eucalyptus camaldulensis		

Appendix B Flora Species by Family by Community Matrix

Family	Taxon	Community	
		GcEcJc	MrTlBj
	Hypocallymma angustifolium		
	Kunzea glabrescens		
	Melaleuca preissiana		
	Melaleuca rhaphiophylla		X
	Melaleuca ?hamata		
	Regelia inops	X	
	Taxandria linearifolia		X
	Verticordia plumosa var. *brachyphylla*		
Orchidaceae			
	Microtis sp.	X	
Phytolaccaceae			
	* *Phytolacca octandra*		X
Poaceae			
	Avellinia michelii		
	* *Avena barbata*	X	
	* *Briza maxima*	X	X
	* *Briza minor*	X	
	* *Bromus sp.*		X
	* *Cynodom dactylon*	X	
	* *Ehrharta brevifolia*	X	
	* *Ehrharta calycina*	X	
	* *Eragrostis curvula*	X	
	* *Holcus lanatus*		X
	* *Lolium sp.*	X	
	* *Pentameris airoides*	X	
Polygonaceae			
	* *Rumex acetosella*		
Primulaceae			
	* *Lysimachia arvensis*	X	X
Proteaceae			
	Grevillea curviloba subsp. *curviloba*	X	
	Grevillea curviloba subsp. *Incurva*		
	Grevillea obtusifolia	X	
	Hakea varia	X	
	Stirlingia latifolia	X	
Ranunculaceae			
	* *Ranunculus muricatus*		X
Restionaceae			
	Hypolaena pubescens	X	
Rosaceae			
	*DP *Rubus ulmifolius*		X
Rubiaceae			
	* *Galium divaricatum*	X	
Xanthorrhoeaceae			
	Xanthorrhoea preissii	X	

Appendix C

Flora Site Data

Appendix C Flora Site Data

Appendix C – Flora Site Data

Site 1	**Location**: -31.64889, 115.998057	**Date**: 23/10/19
Type: Quadrat	**Size**:	**Community**: GcEcJc
Topography: Lowlands	**Soil**: Sand, dry	**Colour**: Grey
Bare Ground:	**Fire**: 10+	
Vegetation significance: Yes,		
Condition: Degraded; weeds, clearing		

*	Taxon	Height (cm)	Foliage (%)
	Acacia saligna	50	0.2
*	*Asparagus asparagoides*		
*	*Asphodelus fistulosus*	10	0.5
*	*Avena barbata*		
*	*Briza maxima*	15	15
*	*Briza minor*	5	1
	Centrolepis aristata	5	1

*	Taxon	Height (cm)	Foliage (%)
*	*Cynodon dactylon*		
*	*Echium plantagineum*		
*	*Ehrharta brevifolia*	10	0.1
*	*Ehrharta calycina*	100	6
*	*Eragrostis curvula*	120	4
*	*Galium divaricatum*	2	0.1
	Grevillea curviloba subsp. *curviloba*	250	3
	Grevillea obtusifolia	30	0
	Hakea varia	250	2
*	*Hypochaeris glabra*	10	10
*	*Juncus capitatus*	5	2
	Lepidosperma tenue		
*	*Lysimachia arvensis*		
	Microtis sp.	20	0.1
*	*Monopsis debilis*	5	0.1
*	*Pentameris airoides*	5	1
	Regelia inops	120	35
*	*Sonchus oleraceus*	10	0.1
	Stirlingia latifolia	30	0
	Thysanotus manglesianus		
	Tricoryne elatior		
*	*Ursinia anthemoides*	10	2
*	*Wahlenbergia capensis*	10	0.1
*	*Watsonia meriana*		
	Xanthorrhoea preissii	120	2

Note: * depicts an introduced (weed) species

Site 2	**Location**: -31.6487, 115.997477	**Date**: 23/10/19
Type: Quadrat	**Size**:	**Community**: GcEcJc
Topography: Lowland	**Soil**: Sand, dry	**Colour**:
Bare Ground: Coarse and fine litter, some open (wet) areas	**Fire**: 10+	
Vegetation significance: Yes,		
Condition: Good; weeds, clearing, rubbish, tracks		

*	Taxon	Height (cm)	Foliage (%)
	Acacia saligna	250	6
*	*Arctotheca calendula*	10	0.5
*	*Briza maxima*	10	4
*	*Briza minor*	5	8
	Centrolepis aristata	5	1
*	*Cicendia filiformis*	2	0.1
	Drosera sp.	30	0.1
*	*Ehrharta calycina*	150	2
*	*Eragrostis curvula*	150	25

*	Taxon	Height (cm)	Foliage (%)
	Grevillea curviloba subsp. *curviloba*	100	10
*	*Hypochaeris glabra*	10	10
*	*Hypochaeris radicata*	20	2
	Hypolaena pubescens	30	1
	Isolepis cernua	5	0.1
*	*Juncus capitatus*	5	6
*	*Leontodon rhagadioloides*	20	0.1
*	*Lepidosperma tenue*	20	0.2
*	*Lolium sp.*		
*	*Lotus sp.*	5	0.5
	Microtis sp.	20	0.1
*	*Monopsis debilis*	5	0.1
*	*Moraea flaccida*	20	0.1
*	*Pelargonium capitatum*		
*	*Pentameris airoides*	5	0.5
	Regelia inops	100	2
*	*Romulea rosea*	10	0.1
*	*Ursinia anthemoides*	5	1
	Xanthorrhoea preissii	150	2

Note: * depicts an introduced (weed) species

Site 3	**Location**: -31.654888, 115.983614	**Date**: 23/10/19
Type: Releve	**Size**:	**Community**: MrTlBj
Topography: Waterway	**Soil**: Sand, inundated	**Colour**:
Bare Ground:	**Fire**: 10+	
Vegetation significance: Yes,		
Condition: Degraded; weeds, arum lily, cleared, road		

*	Taxon	Height (cm)	Foliage (%)
*	*Briza maxima*	20	0.5
*	*Bromus* sp.	40	80
*	*Dittrichia* sp.	40	1
	Eucalyptus rudis	1200	4
*	*Holcus lanatus*	40	5
	Juncus pallidus		
	Lepidosperma longitudinale		
*	*Lysimachia arvensis*		
	Melaleuca rhaphiophylla	800	30
*	*Phytolacca octandra*	60	0.5

*	Taxon	Height (cm)	Foliage (%)
*	*Ranunculus muricatus*	15	0.1
*	*Rorippa nasturtium-aquaticum*	15	4
*DP	*Rubus ulmifolius*		
*	*Sonchus oleraceus*	30	0.1
	Taxandria linearifolia	200	3
*DP	*Zantedeschia aethiopica*	120	40

Note: * depicts an introduced (weed) species

Site 4	**Location**: -31.654725, 115.985268	**Date**: 23/10/19
Type: Releve	**Size**:	**Community**: Planted
Topography: Flat	**Soil**: Sand, dry	**Colour**: Grey
Bare Ground: Bare	**Fire**: 10+	
Vegetation significance: No		
Condition: Good		

*	Taxon	Height (cm)	Foliage (%)
*	*Arctotheca calendula*	5	1
	Avellinia michelii	5	20
*	*Bromus sp.*	20	5
	Callistemon phoeniceus	150	0.5
	Calothamnus quadrifidus	250	3
*	*Cynodon dactylon*	5	0.5
	Eucalyptus todtiana	400	2
	Grevillea curviloba subsp. *incurva*		
	Hypocalymma angustifolium		
*	*Hypochaeris radicata*	5	1

*	Taxon	Height (cm)	Foliage (%)
	Kunzea glabrescens	300	2
	Melaleuca ?hamata		
	Regelia inops	250	10
*	*Rumex acetosella*	10	0.1
	Verticordia plumosa var. *brachyphylla*	80	1

Note: * depicts an introduced (weed) species

Site 5	**Location**: -31.653869, 115.986498	**Date**: 23/10/2019
Type: Releve	**Size**:	**Community**: Planted
Topography: Flat	**Soil**: Sand	**Colour**: Grey
Bare Ground: Bare	**Fire**: 10+	
Vegetation significance: None		
Condition: Degraded; planted, no understory		

*	Taxon	Height (cm)	Foliage (%)
*	*Bromus sp.*	10	5
	Corymbia calophylla	400	2
*	*Cynodon dactylon*	5	10
	Eucalyptus camaldulensis	600	15
	Kunzea glabrescens	150	0.5
	Melaleuca preissiana	200	1
	Regelia inops	250	10

Note: * depicts an introduced (weed) species

Appendix D

Black Cockatoo Foraging Assessments

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Carnaby's Cockatoo

Fauna Habitat	Fauna Habitat Assess UniqueID	Initial Quality	Is within the Swan Coastal Plain (+3)	Contains trees known to be used for breeding and / or with suitable nest hollows (+3)	Primarily comprises Marri (+2)	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo (+2)	Known to be a large or key roosting site (+1)	Does not contain evidence of foraging by species (-2)	No other foraging habitat within 6 km (-2)	Is >12 km from known breeding location (-1)	Is >12km from known roosting site (-1)	Is >2 km from a watering point (-1)	Disease present (-1)	Final Score	General Comments
Scattered Trees (no breeding habitat)	5	5	3	0	0	0	0	-2	0	0	0	0	0	**6**	Scattered introduced eucalypts and occasional Sheoak over cleared on the SCP. No breeding or potential breeding trees. No foraging evidence recorded, within 12 km of roosting and breeding site and <2km from a watering point.
Scattered Trees breeding habitat)	40	5	3	0	0	2	0	-2	0	0	0	0	0	**8**	Scattered introduced and native eucalypts over cleared on the SCP. Contains potential breeding trees. No foraging evidence recorded, within 12 km of roosting and breeding site and <2km from a watering point.
Scattered Trees (no breeding habitat / foraging evidence)	50	5	3	0	0	0	0	0	0	0	0	0	0	**8**	Scattered predominantly introduced eucalypts on the SCP. No breeding or potential breeding trees. Foraging evidence recorded, within 12 km of roosting and breeding site and <2km from a watering point.
Mixed shrubland	15	1	3	0	0	0	0	-2	0	0	0	0	0	**2**	Mixed shrubland containing occasional proteaceous / foraging species, on the SCP. No breeding or potential breeding trees. No foraging evidence recorded, within 12 km of roosting and breeding site and <2km from a watering point.
Mixed Shrubland with emergent Marri	60	5	3	0	0	0	0	-2	0	0	0	0	0	**6**	Mixed shrubland with occasional foraging species. Contains potential breeding trees.
Scattered Trees	7	0												**0**	Scattered trees containing no foraging species on the SCP. No foraging evidence recorded, within 12 km of roosting and breeding site and <2km from a watering point.
E. rudis (and Sheoak and / or occ Marri in some habitats)	8	5	3	0	0	2	0	-2	0	0	0	0	0	**8**	Degraded habitats containing *E. rudis* (and Sheoak in some habitats) on the SCP. Contains potential breeding trees. No foraging evidence recorded, within 12 km of roosting and breeding site and <2km from a watering point.
Cleared Paddock with Scattered Trees	30	1	3	0	0	2	0	0	0	0	0	0	0	**6**	Cleared paddock with ocassional foraging plant. Contains potential breeding trees. Precautionary Principle used for foraging evidence as area not accessed, within 12 km of roosting and breeding site and <2km from a watering point.

Fauna Habitat	Fauna Habitat Assess UniqueID	Initial Quality	Is within the Swan Coastal Plain (+3)	Contains trees known to be used for breeding and / or with suitable nest hollows (+3)	Primarily comprises Marri (+2)	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo (+2)	Known to be a large or key roosting site (+1)	Does not contain evidence of foraging by species (-2)	No other foraging habitat within 6 km (-2)	Is >12 km from known breeding location (-1)	Is >12km from known roosting site (-1)	Is >2 km from a watering point (-1)	Disease present (-1)	Final Score	General Comments
Eucalypts (E. rudis) over Cleared	4	7	3	0	0	2	0	-2	0	0	0	0	0	**10**	Habitat dominated by eucalypts on the SCP. Contains potential breeding trees, no foraging evidence, within 12 km of roosting and breeding site and <2km from a watering point.
Small stand of Marri	70	1	3	0	2	2	0	-2	0	0	0	0	0	**6**	Small stand of Marri on the SCP. Does not contains foraging evidence, contains potential breeding trees, within 12 km of roosting and breeding site and <2km from a watering point.

Forest Red-tailed Black Cockatoo

Fauna Habitat	Fauna Habitat Assess UniqueID	Initial Quality	Jarrah and/or Marri shows good recruitment (+3)	Contains trees known to be used for breeding and / or with suitable nest hollows (+3)	Primarily contains Marri and/or Jarrah (+2)	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo (+2)	Known to be a large or key roosting site (+2)	No other foraging habitat within 6 km (-2)	Is >12km from known roosting site (-1)	Does not contain evidence of foraging by species (-2)	Is >12 km from known breeding location (-1)	Is >2 km from watering point (-1)	Disease present (-1)	Final Score	General Comments
Scattered Trees (no breeding habitat)	5	5	0	0	0	0	0	0	0	-2	-1	0	0	**2**	Scattered introduced and native eucalypts over cleared. No breeding or potential breeding trees. No foraging evidence recorded, within 12 km of roosting site and <2km from a watering point.
Scattered Trees breeding habitat)	40	5	0	0	0	2	0	0	0	0	-1	0	0	**6**	Scattered introduced eucalypts and occasional Sheoak over cleared. Contains potential breeding trees and foraging evidence recorded, within 12 km of roosting site and <2km from a watering point.
Scattered Trees (no breeding habitat/ foraging evidence)	50	5	0	0	0	0	0	0	0	0	-1	0	0	**4**	Scattered predominantly introduced eucalypts over cleared. No breeding or potential breeding trees. Foraging evidence recorded, within 12 km of roosting site and <2km from a watering point.
Mixed Shrubland	15	0												**0**	Mixed shrubland containing minimal foraging species.
Mixed Shrubland with emergent Marri	60	1	0	0	0	2	0	0	0	-2	-1	0	0	**0**	Mixed shrubland with occasional foraging species. Contains potential breeding trees. No foraging evidence recorded, within 12 km of roosting site and <2km from a watering point.
Scattered Trees	7	0												**0**	Scattered trees containing no foraging species.
Euc rudis (and Sheoak and / or occ Marri) in some habitats)	8	1	0	0	0	2	0	0	0	-2	-1	0	0	**0**	Degraded habitats containing E. rudis (and sometimes Sheoak and / or occ Marri). Contains potential breeding trees. No foraging evidence recorded, within 12 km of roosting site and <2km from a watering point.
Cleared Paddock with Scattered Trees	30	1	0	0	0	2	0	0	0	0	-1	0	0	**2**	Cleared paddock with occasional foraging plant. Contains potential breeding trees. Precautionary Principle used for foraging evidence as area not accessed, within 12 km of roosting site and <2km from a watering point.
Eucalypts (*E. rudis*) over Cleared	4	0												**0**	Habitat containing E. rudis and minimal to no foraging species.
Small stand of Marri	70	1	0	0	2	2	0	0	0	-2	-1	0	0	**2**	Small stand of Marri. Contains potential breeding trees. No foraging evidence recorded, within 12 km of roosting site and <2km from a watering point.