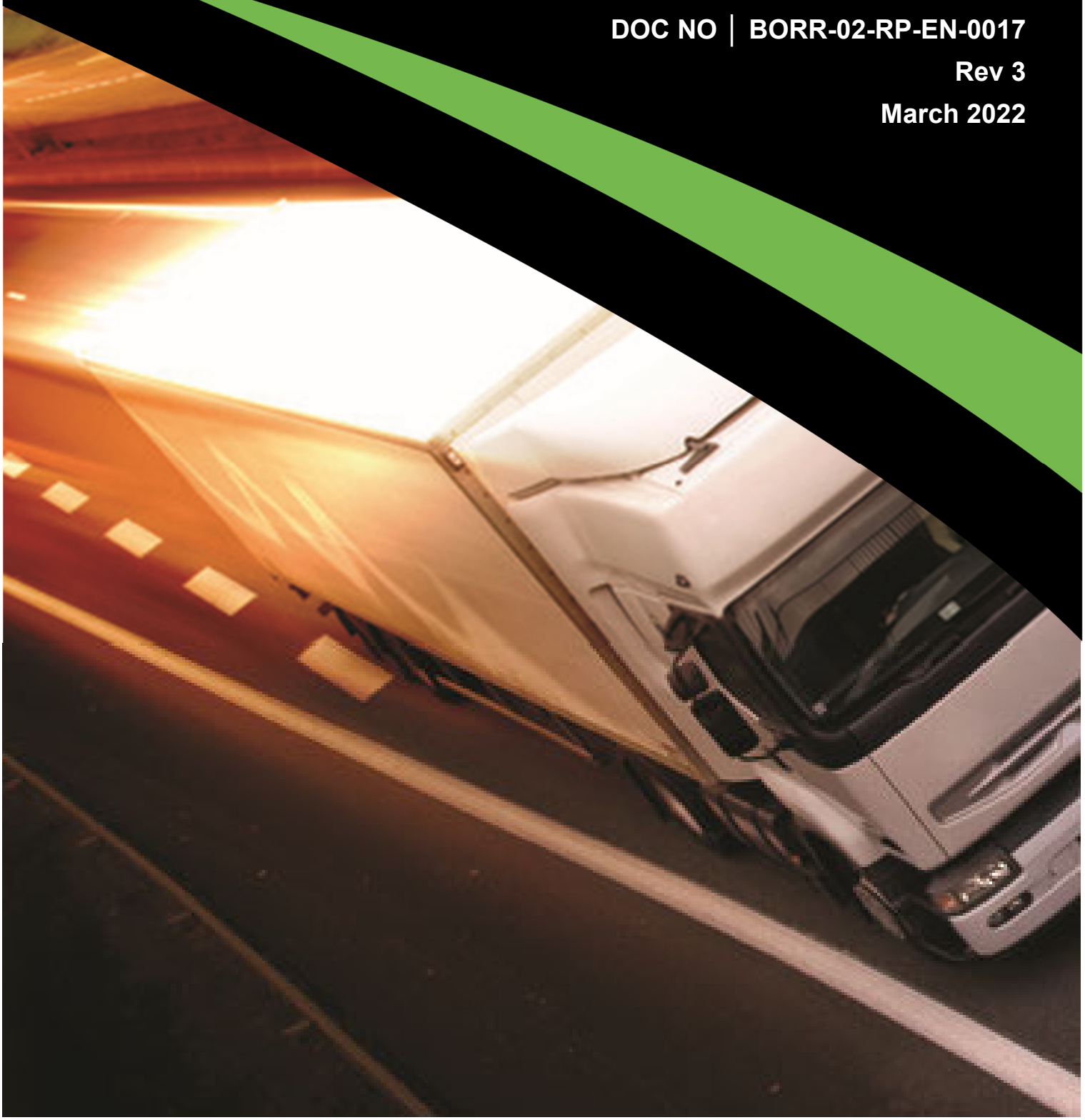
BORR Team

Southern Section Additional Information for Preliminary Documentation – EPBC Ref: 2019/8543

DOC NO | BORR-02-RP-EN-0017

Rev 3

March 2022



EXECUTIVE SUMMARY

The Commissioner of Main Roads Western Australia (Main Roads) is proposing to construct and operate the Southern Section of the Bunbury Outer Ring Road (BORR) project. BORR is a planned Controlled Access Highway linking the Forrest Highway and Bussell Highway. The completed project will provide a high standard route for access to the Bunbury Port, improve road user safety and facilitate proposed development to the east of the City of Bunbury. BORR provides an effective bypass of Bunbury for inter-regional traffic. The proposed BORR comprises three sections:

- 'BORR Northern Section' – Forrest Highway to Boyanup-Picton Road
- 'BORR Central Section' – Boyanup-Picton Road to South Western Highway (an existing four km section which was completed in May 2013, along with a three km extension of Willinge Drive southwards to South Western Highway)
- 'BORR Southern Section' – South Western Highway (near Bunbury Airport) to Bussell Highway.

This document refers to BORR Southern Section only (the Proposal). The BORR Northern and Central Sections have been referred under a separate proposal (EPBC 2019/8471). The Proposal includes the construction and operation of 10.5 km of new freeway standard dual carriageway, associated bridges, interchanges and other road infrastructure including, but not limited to, culverts, lighting, noise barriers, fencing, landscaping, road safety barriers and signs. The Proposal is located approximately 200 km south of Perth and, at its closest point, approximately six km south-east of Bunbury. The 200 ha Proposal Area is within the City of Bunbury and Shire of Capel. Approximately 62 % of land within the Proposal Area is cleared for agriculture. The Proposal Area comprises 76 ha of native vegetation and 124 ha of cleared agricultural land.

In September 2019, Main Roads referred the Proposal to the Environmental Protection Authority (EPA) of Western Australia (WA) for assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act). The referral included an Environmental Referral Supporting Document (BORR IPT, 2019d) which describes the receiving environments, potential impacts and mitigation strategies to address the identified impacts. The Proposal was advertised for a seven day public comment period during September 2019. In October 2019, the EPA determined that the Proposal would be subject to an environmental assessment at the level of Referral Information, with additional information required under Section 40(2)(a) of the EP Act.

The Proposal was formally referred to the then Commonwealth Department of the Environment and Energy (DoEE) in September 2019 (EPBC Act referral 2019/8543) as a potential Controlled Action under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) due to impacts on Matters of National Environmental Significance (MNES).

Under Commonwealth government reforms announced in December 2019, DoEE was consolidated with the Department of Agriculture to form the new Department of Agriculture, Water and Environment (DAWE), effective 1 February 2020. DAWE is the Commonwealth Department with primary EPBC Act regulatory authority. DAWE provided advice in February 2020 that the Proposal is considered a Controlled Action and that it would be assessed by preliminary documentation (DAWE, 2020a). This Additional Information Request for Preliminary Documentation will be submitted to DAWE for assessment.

Purpose of this document

This document has been prepared to address DAWE's 11 February 2020 request for further information to support assessment of a controlled action by preliminary documentation (DAWE, 2020a).

Description of protected matters within the proposed action area

Section 2 of this document includes a description of the existing environment, including discussion of protected matters. MNES listed under the EPBC Act that are or have the potential to be in the Proposal Area and surrounds include the following:

- Banksia Woodlands of the Swan Coastal Plain ecological community (Endangered)
- Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (Critically Endangered)
- Clay pans of the Swan Coastal Plain ecological community (Critically Endangered)
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (Vulnerable)
- Baudin's Cockatoo (*Calyptorhynchus baudinii*) (Endangered)
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Endangered)
- Black-stripe Minnow (*Galaxiella nigrostriata*) (Endangered)
- Western Ringtail Possum (*Pseudocheirus occidentalis*) (Critically endangered)
- King Spider-orchid (*Caladenia huegelii*) (Endangered)
- Tall Donkey Orchid (*Diuris drummondii*) (Vulnerable)
- Dwarf Bee-orchid (*Diuris micrantha*) (Vulnerable)
- Glossy-leafed Hammer Orchid (*Drakaea elastica*) (Endangered)
- Dwarf Hammer-orchid (*Drakaea micrantha*) (Vulnerable)
- Keighery's Eleocharis (*Eleocharis keigheryi*) (Vulnerable).

The following protected matters could also be impacted by the proposed action:

- Selena's Synaphea (*Synaphea* sp. Fairbridge Farm) (Critically Endangered)
- *Austrostipa jacobsiana* (Critically Endangered)
- *Austrostipa bronwenae* (Endangered)

Subsequent to the referral of the Proposal to the WA EPA and DAWE, additional flora and vegetation surveys were undertaken. A targeted *Drakaea* survey of selected sites was completed in August 2019. In response to additional information requested by the DAWE and WA EPA, a targeted survey for Banksia Woodland Threatened and Priority Ecological Communities and confirmation of vegetation types in previously unsurveyed gaps in the Proposal Area was completed in October 2019 (BORR IPT, 2020i). Ecoedge (2019a) also undertook a Claypan TEC assessment in July-August 2019 (Table 2-4) specific to the EPA request for additional information.

Additional targeted aquatic fauna surveys were undertaken in 2019 to further survey habitat and presence for Black Striped Minnow (*Galaxiella nigrostriata*). Further discussion and description of potential impacts of the Proposal on threatened fauna species including Western Ringtail Possum (*Pseudocheirus occidentalis*) and Black Cockatoos is also provided.

All previous and additional studies conducted for the Proposal are summarised in Table 2-5.

Assessment of Impacts

Section 3 includes an assessment of potential direct and indirect impacts on protected matters determined to be present in the direct footprint of the proposal or proximate to potential indirect impacts. Assessments are included for:

- Threatened Communities
  - Banksia Woodlands of the Swan Coastal Plain Ecological Community (Banksia Woodlands TEC) (Section 2.4.1)
  - Clay Pans of the Swan Coastal Plain (Section 2.4.3)
  - Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (Tuart Woodlands TEC) (Section 2.4.2)
- Fauna
  - Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (Section 2.5.1)
  - Baudin's Cockatoo (*Calyptorhynchus baudinii*) (Section 2.5.1)
  - Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Section 2.5.1)
  - Western Ringtail Possum (*Pseudocheirus occidentalis*) (Section 3.2.2)
  - Black-stripe Minnow (*Galaxiella nigrostriata*) (Section 3.2.3)
- Flora
  - King Spider-orchid (*Caladenia huegelii*) (Section 3.3.1)
  - Tall Donkey Orchid (*Diuris drummondii*) (Section 3.3.2)
  - Dwarf Bee-orchid (*Diuris micrantha*) (Section 3.3.3)
  - Glossy-leafed Hammer Orchid (*Drakaea elastica*) (Section 3.3.4)
  - Dwarf Hammer-orchid (*Drakaea micrantha*) (Section 3.3.5)
  - Keighery's Eleocharis (*Eleocharis keigheryi*) (Section 3.3.6)
  - Selena's Synaphea (*Synaphea* sp. Fairbridge Farm) (Section 3.3.7)
  - *Austrostipa jacobsiana* (Critically endangered) and *Austrostipa bronwenae* (Section 3.3.8)

Where appropriate and consistent with guidance, protected matters have been assessed against the MNES Significant Impact Guidelines (DoE, 2013).

Avoidance and Mitigation Measures

Section 4 outlines avoidance through design changes that have been implemented since referral of the Proposal and management measures proposed. Substantial changes to the Proposal design have been made since referral in June 2019 to reduce impacts on threatened ecological communities, conservation significant fauna, and conservation significant flora, as appropriate and necessary to avoid and minimise effects on the environment.

Offsets

Section 4.3.1 provides a summary of the offset package to counterbalance the significant residual impacts to Banksia Woodlands TEC, Tuart Woodlands TEC, Western Ringtail Possum and Black Cockatoo species. The offsets proposed are based on preliminary offset calculations using the EPBC Act Offset Assessment Guide, as presented in Appendix N.

Economic and Social Matters

Section 6 describes the Proponent's funding commitments towards the Proposal, including identification of Commonwealth funding contributions for the Proposal. Discussion of the economic and social costs and benefits of the proposal subject to State assessment are also reviewed in detail, including the Stakeholder

Consultation process undertaken by the Proponent to engage affected stakeholders and decision making authorities during the development of the Proposal.

Ecologically sustainable development

Section 7 assesses consideration of EPBC Act principles of ecologically sustainable development undertaken in the development of the Proposal.

Environmental record of the person proposing to take the action

Section 8 documents Main Roads' record of environmental management and certification of Main Roads environmental management system. This includes compliance with Main Roads' environment and heritage compliance obligations under prior Commonwealth approvals.

Other approvals and conditions

Section 9 reviews requirements for approval or conditions that apply, or that are likely to apply, to the Proposal from Western Australia state agencies that exist outside of approval under the EPBC Act.

Relevant Policies and Publications

Section 10 assesses the relevant recovery plans and threat abatement plans that have been considered during the preparation of the Proposal.

Information Sources

Section 11 assesses the reliability and potential for uncertainties in the technical studies undertaken in preparation of the Proposal.

ACRONYMS

AHD	Australian Height Datum
AH Act	*Aboriginal Heritage Act 1972*
AMP	*Action Management Plan*
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Assessment on Referral Information
ASS	Acid Sulfate Soils
BC Act	*Biodiversity Conservation Act 2016*
BORR	Bunbury Outer Ring Road
CCW	Conservation Category Wetlands
CEMP	Construction Environmental Management Plan
CRG	Community Reference Group
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter Breast Height
DoEE	Department of Environment and Energy
DoW	Department of Water
DPaW	Department of Parks and Wildlife
DPLH	Department of Planning, Lands and Heritage
DPIRD	Department of Primary Industries and Regional Development
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DWER	Department of Water and Environmental Regulation
EMP	Environmental Management Plan
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GBRS	Greater Bunbury Region Scheme
GKB	Gnaala Karla Booja People
GKB NTC	Gnaala Karla Booja Native Title Claim group
GoWA	Government of Western Australia
IBRA	Interim Biogeographic Regionalisation of Australia
ILM	Investment Logic Mapping
IPT	Integrated Project Team

KSIA	Kemerton Strategic Industrial Area
MCA	Multi-Criteria Assessment
MNES	Matters of National Environmental Significance
MSE	Mechanically Stabilised Earth
PEC	Priority Ecological Community
PSP	Principal Shared Path
RDASW	Regional Development Australia South West
RIWI Act	*Rights in Water and Irrigation Act 1914*
SCP	Swan Coastal Plain
SPP 5.4	*State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning*
SWDC	South West Development Commission
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Committee
WA	Western Australia
WAHERB	Western Australian Herbarium
WAPC	Western Australian Planning Commission
WoNS	Weeds of National Significance

DEFINED TERMS

TERM	DEFINITIONS
BORR Sections	BORR includes three sections (North, Central and South), which are referred to as: The 'BORR Northern Section' – section between Forrest Highway (north) and Boyanup-Picton Road (south). The 'BORR Central Section' – section that has already been constructed, between Boyanup-Picton Road (north) and South Western Highway (south). The 'BORR Southern Section' – section between South Western Highway (north) and Bussell Highway (south).
Conservation Wetland	Wetlands which support a high level of attributes and functions.
Main Roads	Main Roads Western Australia
Multiple Use Wetland	Wetland with few important ecological attributes and functions remaining.
Proposal	Main Roads proposes to construct the Bunbury Outer Ring Road (BORR) Southern Section from southwest of South Western Highway near Bunbury Airport (north) to Bussell Highway adjacent Capel Golf Course (south), in the South West Region of Western Australia (WA) (referred to as the Proposal).
Proposal Area	The Proposal Area is located within the City of Bunbury and Shire of Capel, at its closest point approximately six km south of the Bunbury townsite and 200 km south of Perth. The Proposal Area extends 19 km between Forrest Highway and South Western Highway. The Proposal Area covers approximately 200 hectares (ha) and includes existing road reserves, agricultural land and native vegetation.
Resource Enhancement Wetland	Wetlands which may have been partially modified but still support substantial ecological attributes and functions.
Site	As per the Proposal Area.
Surveyed Area	The Surveyed Area includes all sites of significance that occur both within the Proposal Area and wherever relevant, outside the Proposal Area, in order to determine both direct and indirect impacts.
Swan Coastal Plain	Low-lying coastal plain in the south west of Australia mainly covered with woodlands, with rare landscape features such as Holocene dunes and wetlands.

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FIGURES INDEX

APPENDICES

Document *Control*

Revision	Date	Description	Prepared	Reviewed	Approved
A	30/07/2020	Draft for Main Roads review	BORR IPT	FH	FH
0	01/10/2021	Final for issue	BORR IPT	FH	FH
1	25/03/2021	Final for issue	BORR IPT	Main Roads	FH
2	01/11/2021	Final for issue	BORR IPT	Main Roads	FH
3	16/03/2022	Final for issue	BORR IPT	Main Roads	FH

1 INTRODUCTION

1.1 Background

The Commissioner of Main Roads Western Australia (Main Roads) is proposing to construct and operate the Southern Section of the Bunbury Outer Ring Road (BORR) project (Figure 1, Appendix A). BORR is a planned Controlled Access Highway linking the Forrest Highway and Bussell Highway. The completed project will provide a high standard route for access to the Bunbury Port, improve road user safety and facilitate proposed development to the east of the City of Bunbury. BORR will also provide an effective bypass of Bunbury for inter-regional traffic. BORR forms a major component of the planned regional road network for the Greater Bunbury area. The land requirement for BORR was identified in the draft Greater Bunbury Region Scheme (GBRS), with the route advertised to the broader community as part of the GBRS assessment.

In late 2016, Main Roads commenced a planning review for a future South West Freeway (Forrest Highway, BORR and Bussell Highway between Mandurah to Busselton) spanning the Forrest and Bussell Highways. This network forms the primary connection of Perth with Bunbury, Busselton and the broader South West Region including the Ports of Fremantle, Bunbury and the proposed Outer Harbour at Kwinana. This planning review resulted in a revised alignment for the northern section of BORR that joins Forrest Highway near Australind, which is now located further east than previously proposed. This northern section revised alignment is therefore not identified in the GBRS.

The proposed BORR comprises three sections:

- 'BORR Northern Section' – Forrest Highway to Boyanup-Picton Road
- 'BORR Central Section' – Boyanup-Picton Road to South Western Highway, an existing four km section which was completed in May 2013, along with a 3 km extension of Willinge Drive southwards to South Western Highway
- 'BORR Southern Section' – South Western Highway (near Bunbury Airport) to Bussell Highway.

The proposed BORR occurs within the City of Bunbury and Shire of Capel. This document refers to BORR Southern Section (the Proposal) only. The BORR Northern and Central Sections have been referred under a separate proposal (EPBC 2019/8471).

In September 2019, Main Roads referred the Proposal to the Environmental Protection Authority (EPA) of Western Australia (WA) for assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act). The referral included an Environmental Referral Supporting Document (BORR IPT, 2019d) which describes the receiving environments, potential impacts and mitigation strategies to address the identified impacts. The Proposal was advertised for a seven day public comment period during September 2019. In October 2019, the EPA determined that the Proposal would be subject to an environmental assessment at the level of Referral Information, with additional information required under Section 40(2)(a) of the EP Act.

The Proposal was formally referred to the then Commonwealth Department of the Environment and Energy (DoEE) in September 2019 (EPBC Act referral 2019/8543) as a potential Controlled Action under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) due to impacts on Matters of National Environmental Significance (MNES).

Subsequent to the referral of the Proposal in September 2019, the Department of Environment and Energy (DoEE) was consolidated with the Department of Agriculture. Effective 1 February 2020, the Department of Agriculture, Water and the Environment (DAWE) is the Commonwealth Department with primary EPBC Act regulatory authority. Reference documents published prior to 1 February 2020 will be appropriately

attributed to DoEE or the relevant predecessor agency. All discussion and context relative to EPBC responsibilities and compliance will refer to DAWE.

Further refinement of the BORR Southern Section has been undertaken subsequent to the commitments presented in the Southern Section Information Document submitted in October 2020. The additional refinement was undertaken to further improve both social connectivity for Gelorup residents and improve fauna connectivity between established fauna habitat patches along the BORR corridor. Further offsets have also been proposed in addition to those presented in the October 2020 response (**Error! Reference source not found.**).

1.2 Purpose of this document

This document has been prepared to address DAWE's 11 February 2020 request for further information to support assessment of a controlled action by preliminary documentation (DAWE, 2020a). The general location of the further information requested is outlined in Table 1-1, while the section that addresses the specific content to be included is shown in Table 1-1. Details of DAWE's Additional Information request are annotated in **Error! Reference source not found.**.

Table 1-1 Additional information requirements reference table

SPECIFIC CONTENT TO BE INCLUDED	ADDITIONAL INFORMATION PROVIDED Y/N/NA	SECTION NUMBER
1. Description of the action	Y	Section 1.3
2. Description of the environment and MNES	Y	Section 2
3. Assessment of impacts	Y	Section 3
4. Avoidance and mitigation measures	Y	Section 4
5. Offsets	Y	Section 4.3.1
6. Economic and social matters	Y	Section 6
7. Ecologically sustainable development	Y	Section 7
8. Environmental record of the person proposing to take the action	Y	Section 8
9. Other approvals and conditions	Y	Section 9
10. Relevant Policies and Publications	Y	Section 10
11. Information Sources	y	Section 11

1.3 Description of the action

The Proposal is located approximately 160 km south of Perth, mainly within the Shire of Capel including the localities of Gelorup, North Boyanup and Statham with some overlap into neighbouring localities (College Grove, Usher and Dalyellup). A small part of the Proposal occurs in the City of Bunbury.

The Proposal includes the construction and operation of approximately 10.5 km of new freeway standard, dual carriageway southwest of South Western Highway to Bussell Highway and a 3 km regional distributor from Bussell Highway at Centenary Road southeast to a grade separated interchange at the western end of Lilydale Road. The Proposal includes associated bridges, interchanges, local road modifications and other infrastructure including, but not limited to, drainage basins, drains, culverts, lighting, noise barriers, fencing, landscaping, road safety barriers and signs. The area being referred by Main Roads covers approximately 200 hectares (ha) and is referred to as the Proposal Area. The Proposal Area connects the Northern and Central Sections of BORR (from Forrest Highway) to Bussell Highway.

The existing north-south route of Forrest Highway, Robertson Drive and Bussell Highway runs through a highly populated area of the Greater Bunbury Region resulting in increased congestion, inefficient freight operations, significant road safety issues, reduced social amenity and community separation. The future planning for the Greater Bunbury Region projects a population growth from approximately 86,400 persons in 2011 to approximately 122,400 persons by 2026 (WAPC, 2018). This, in conjunction with increased freight and tourist movements to the South West, will lead to unsustainable traffic growth within the existing north-south route resulting in further congestion and reduced amenity.

The northeast end of the Proposal is located approximately 8 km southeast of Bunbury Central Business District. The northwest end of the Proposal (regional distributor) at Bussell Highway is approximately 7 km south of Bunbury and the southernmost point of the Proposal Area (on Bussell Highway adjacent Capel Golf Course), is approximately 15 km south of Bunbury CBD.

Approximately 62 % of the land within the Proposal Area is cleared and highly modified, including previously constructed roads. Approximately 38 % of the land within the Proposal Area is native vegetation, including revegetation and scattered vegetation in road reserves or as isolated patches on agricultural land.

1.3.1 Layout plan

A layout plan for the Proposal, including the locality, has been included in Figure 1, Appendix A.

Land use type within and surrounding the Proposal Area is illustrated in Figure 2, Appendix A.

1.3.2 Pre-construction, construction and operation of the proposed action

1.3.2.1 Pre-construction

The Concept Design has been developed on the basis of linking the BORR Southern Section to the BORR Central and Northern sections to complete the BORR, i.e. freeway standard, dual carriageway between Forrest Highway (north) and Bussell Highway (south). In addition, the Concept Design provides for a regional distributor from Bussell Highway at Centenary Road southeast to a grade separated interchange at the western end of Lilydale Road.

A key constraint on the design for the Proposal is consideration of land uses, public infrastructure and other interests that include:

- Quarry resources to the east and west of Allenville Road
- Large farm lots with dairy and stock operations
- Special rural and special residential areas
- Agricultural activities
- Mining interests
- Privately-owned land within the Primary Regional Road corridor
- Engineering, environmental and economic aspects.

The Concept Design has been developed to minimise the potential impacts on these constraints as far as practicable.

The locations of the proposed structures in the Concept Design are included in Table 1-2 and illustrated in Figure 3, Appendix A.

Table 1-2 Locations of proposed BORR structures in the Concept Design

PROPOSED BRIDGE STRUCTURE	VERTICAL CLEARANCE (m)	SPAN LENGTH (m)	NO OF SPANS
BORR over Centenary Road / Lilydale Road	7.0	25	1
Yalinda Drive over BORR	5.9	46	1
Bussell Highway southbound over BORR	5.9	26	2
BORR over Five Mile Brook	TBC based on flood modelling	Centre span 20 Outside spans 10	3

Due to the topography of the Proposal Area (palusplain wetlands, established overland flow patterns and some established flood irrigated agricultural land), road construction area will involve infilling using cut-to-fill materials sourced within the Proposal Area and imported fill where necessary. As much as practical, vertical alignments have been designed to be as low as possible to minimise impacts on the landscape and reduce requirements for imported fill.

Key areas of earthworks are:

- Raised earthworks will be necessary at interchange locations to facilitate grade separation between the highway and connecting roads
- North of Five Mile Brook, where the Proposal Area traverses seasonally inundated, low lying land, clearance of 1.5 m from groundwater level to the design reference line will be achieved
- Significant cutting will be required in the Centenary Road area of the Proposal Area in order to achieve gradients for safe link up with Bussell Highway.

The adopted cross sections and geometry for road construction are consistent with Austroads, Main Roads and local government standards. The vertical alignment has been designed as low as possible to minimise impacts on the landscape and quantities of imported fill. Detailed design will address key constraints such as groundwater level, bridge and culvert clearances, sight distance, vertical curve lengths and surfacing which may result in changes to the Concept Design.

Bushfire management was taken into account during the design phase and will be progressed during detailed design. In consultation with the Department of Fire and Emergency Services (DFES) the following key aspects were incorporated into the design

- Widening the corridor at the Jilley Road connection to Ducane Road allowing access to the severed lot on the northern side of the alignment.
- The inclusion of access to the northern side of the alignment to reduce the impact on the local community and provide bushfire egress. The alignment cannot be moved any further south at this location as the alignment needs to tie into the existing road reserve through Gelorup.

1.3.2.2 Construction

Construction is planned to commence in quarter four 2021 for a period of two to three years. The construction methodology for structures will depend on final design forms.

Construction will be undertaken using traditional earth-moving equipment and construction techniques. As previously described in this document, road formation will be built using both fill materials sourced within the Proposal Area and, where necessary, imported fill. Geohydrology investigations and modelling (currently underway) will inform site excavations levels and final design.

Bridges are likely to consist of pre-cast concrete or steel supported on piled foundations or spread footings with mechanically stabilised earth (MSE) walls at abutments. Piers (upright columns that support the structure) will be concrete columns. High-level construction methodology for bridges typically comprises:

- Piling works for foundation construction
- Construction of concrete pier columns
- Construction and installation of MSE walls at abutments
- Construction of concrete topping slabs
- Completion of ancillary works such as landscaping.

Underpasses will be installed and comprise either pre-cast concrete arch or trapezoid structures supported on concrete strip footings.

Materials for construction of the road and associated structures will be sourced according to the Materials Sourcing Strategy (MSS) (currently under preparation) (BORR IPT, 2020a). The MSS considers projects, nearby developments, potential areas of acquisition and commercial quarries as well as alternative recyclable material sources. The key basic raw materials required for construction of the road include sand, limestone, clay, lateritic gravel and crushed rock aggregate. The impacts associated with sourcing materials are not considered part of the Proposal.

Lay down areas for material will be established by the contractor in consultation with Main Roads and Local Government Authorities; laydown areas are expected to be within the Proposal Area.

Construction water will be sourced from temporary boreholes and other water suppliers.

1.3.2.3 Operation

The BORR Southern Section will operate as a component of the BORR providing a freeway standard, dual carriageway link between Forrest Highway (north) and Bussell Highway (south). In addition, the BORR Southern Section will provide a 3 km regional distributor from Bussell Highway at Centenary Road southeast to a grade separated interchange at the western end of Lilydale Road.

The BORR (including the BORR Southern Section) will be subject to normal routine, recurrent and periodic maintenance during operation of the highway. Maintenance operations will be confined to the road corridors and the roads themselves, typically including vegetation, drainage, lighting, road markings, signs and road surfaces.

1.3.3 Description of the activities associated with the proposed action

Key Proposal activities that quantify the limits or context of the physical and operation elements are presented in Table 1-3.

Table 1-3 Key Proposal activities

ELEMENT	PROPOSED EXTENT
Physical elements	
Overall Proposal footprint (including all physical elements below)	Clearing or disturbance of up to 200 ha comprising approximately: • 71.5 ha of native vegetation (from an initial 76 ha, refer section 1.3.6 below) • 124 ha of cleared and highly modified area (agricultural land and existing built infrastructure).
Road construction and associated infrastructure	The road construction and associated infrastructure for the Proposal includes the following components: • Approximately 10.5 km of new rural freeway standard, dual carriageway • Grade separation of Yalinda Drive across the highway • A grade separated interchange at Bussell Highway • Approximately 3 km of regional distributor (Centenary Road at Bussell Highway to Lilydale Road) • A grade separated interchange at the western end of Lilydale Road • Local road modifications • Utility modifications • A Principal Shared Path for the full length of the Proposal including grade separated crossings of local roads and Bussell Highway • Other road infrastructure and furniture including, but not limited to culverts, lighting, noise barriers, fencing, landscaping, road safety barriers, underpasses and signs.
Bridges and drainage infrastructure	Bridge construction and associated infrastructure for the Proposal includes the following components: • New bridge, BORR over Centenary Road / Lilydale Road • New bridge, Yalinda Drive over BORR • New bridge, Bussell Highway southbound over BORR • New bridge, BORR over Five Mile Brook • Drainage basins, drains and other associated infrastructure
Operational elements	
Constructed BORR	Main Roads will operate the Proposal including standard management and maintenance practices.

1.3.4 Rehabilitation activities

Revegetation along the development envelope would comply with *MRWA Vegetation Placement within the Road Reserve* Doc. No. 6707/022 (MRWA, 2013). This guide defines the recommended setbacks and

clearance requirements that apply to all revegetation or landscaping associated with new road construction.

Revegetation would utilise locally native species that will be resilient within three years after the rehabilitation works are completed. Revegetation would not include species of foraging habitat for black cockatoos, including but not limited to, *Banksia* spp., *Hakea* spp., *Grevillea* spp. and *Eucalyptus* spp. within 10 m of the constructed road carriageway.

Placement of vegetation near road infrastructure is restricted to maintain road safety. These requirements minimise ongoing maintenance and maintain a standard amenity level for road users. Revegetation will incorporate these restrictions when undertaking planting, in particular, the need for roadside maintenance and clear zones. Rehabilitation would not include areas required for ongoing operations such as drainage basins, road embankments and median strips. Specific rehabilitation activities are also included in the environmental offset strategy (refer to Section 4.3.1).

1.3.5 Anticipated timing

Construction is expected to start in quarter four, 2021 and continue until April 2024.

Once the BORR Southern Section is constructed and open for public use, operation of the BORR will be ongoing.

1.3.6 Changes to the Proposal

Following referral of the Proposal to the Commonwealth, Main Roads undertook a comprehensive review of the design and revised the infrastructure components and the Proposal Area with the objective to reduce the potential impacts to key environmental values, including:

- Conservation significant fauna taxa, specifically WRP, BSM and BTP.
- TECs and PECs, specifically Banksia Woodlands TEC / PEC, Tuart Woodlands TEC / PEC and Tuart-Peppermint Woodland PEC.

From Centenary Road to Lilydale Road these refinements included:

- Main alignment amended to further avoid areas of vegetation and fauna habitat
- Reduced median width to minimise impacts on vegetation
- Batter slopes steepened to minimise width of clearing
- Access track off Centenary Road designed in a cleared area
- Jules Road connection redesigned to reduce clearing impacts.

Since the Preliminary Documentation was released for public comment, Main Roads has further reduced the amount to be cleared for the project from 76 ha to 71.5 ha. This reduction in the native vegetation clearing limit will also see the impacts on other significant values reduce. The proposed change will result in the Proposal impacting up to:

- 60.9 ha of WRP habitat (down from 65.4 ha)
- 49 to 72 WRP individual home ranges (down from 53 to 79 WRP individual home ranges)
- 60.9 ha of Black Cockatoo habitat (down from 65.4 ha)
- 1,088 Suitable DBH Trees (down from 1,098)

- 11 trees containing a suitable nest hollow for breeding of Black Cockatoos (down from 13 trees). It should be noted that there is no change to the number (two) of trees to be impacted that have some evidence of use.
- 39.2 ha of BTP foraging / breeding habitat (down from 43.7 ha)
- 23.4 ha Banksia Woodlands TEC / PEC (down from 26.6 ha).

Several changes have been made since the publication of the Preliminary Documentation to reduce the Proposal's overall impact, including:

- Design modifications and establishing Clearing Exclusion Areas to reduce clearing impacts
- Additional fauna movement structures to improve habitat connectivity for the WRP, Brush-tail Phascogale and other fauna
- Additional environmental offset measures to address the EPA's concerns regarding the Proposal's residual impact on the local and regional WRP population.

These changes represent the full extent of possible design alterations at the time of completion of the revised Additional Information Document. Additional avoidance is not possible. Main Roads has assumed the full extent of impacts based on the concept design as it currently stands.

The proposed variations will reduce the maximum clearing limit associated with MNES. These modifications have been developed in close consultation with the EPA and the proposed amendment will ensure consistency between Commonwealth and State impact assessments processes.

The proposed variation will result in most MNES impacts being reduced, as shown in Table 1-4:

Table 1-4. How the proposed variation impacts on MNES compared with impacts of the original proposal.

MNES	ORIGINAL PROPOSAL	VARIED PROPOSAL	COMMENT
Western Ringtail Possum habitat	• 65.4 ha	• 60.9 ha	• 4.5 ha reduction
Fauna movement structures	• Fauna land bridge at Yalinda Drive bridge • 8 fauna rope bridges • 14 fauna underpasses/culverts	• Two fauna land bridges (Yalinda Drive bridge and a new land bridge east of Yalinda Drive) • 10 fauna rope bridges • 14 fauna underpasses	• Additional fauna land bridge east of Yalinda Drive • Two additional fauna rope bridge overpass structures
Brush-tail Phascogale habitat	• 26.6 ha	• 23.4 ha	• 3.2 ha reduction
Black Cockatoo foraging habitat	• 65.4 ha	• 60.9 ha	• 4.5 ha reduction
Potential Black Cockatoo breeding habitat (trees	• 13	• 11	• No change to the number (two) of trees to be impacted

MNES	ORIGINAL PROPOSAL	VARIED PROPOSAL	COMMENT
containing a suitable nest hollow for breeding)			that have some evidence of use.
Banksia Woodland TEC	• 26.6 ha	• 23.4 ha	• 3.2 ha reduction

1.3.7 Feasible alternatives considered

1.3.7.1 Planning history

The BORR concept was originally developed by Main Roads WA in the early 1970s in consultation with other State Government departments and local authorities and formed part of the Bunbury Region Plan (State Planning Commission, 1987). The Bunbury-Wellington Region Plan (State Planning Commission, 1987), released for public comment in 1993 and published in 1995, further supported the need for the road including the Gelorup southern alignment. The GBRS replaced the Bunbury Wellington Region Plan was issued for public comment in 2000, and confirmed the southern alignment of the BORR. The Scheme came into effect in 2007 and remains the current planning document for the Greater Bunbury region (WAPC, 2017b).

The BORR GBRS corridor alignment was refined in 1995, based on work undertaken by Halpern, Glick and Maunsell (HGM) to prepare a BORR Concept Report (HGM, 1995). The purpose of that work was to develop an environmentally and socially acceptable concept alignment suitable for inclusion in the town planning scheme. The HGM assessment considered a number of alignment options, including the current GBRS alignment, and concluded that the current GBRS alignment was the most suitable alignment option of those considered.

In 1997, Main Roads commissioned ERM Mitchell McCotter (ERM Mitchell Mc Cotter, 1997), to undertake a further review of alternative alignments for the BORR Southern section through Gelorup as a result of the Gelorup community's appeals to the local Members of Parliament and direction from the Minister for Transport. The review investigated similar routes to the HGM report and one route proposed by the Gelorup community. A broad multi-criteria analysis (MCA) highlighted the advantage of the route currently identified in the GBRS over the other alternatives considered.

Further planning and development work followed over many years resulting in construction of the BORR Central Section in 2013 as part of the Bunbury Port Access Road (PAR), Stage 2.

In November 2012, Main Roads referred a proposal to the EPA for the BORR Southern Section, from South Western Highway to Bussell Highway (GHD, 2012c), see Figure 4 (**Error! Reference source not found.**). In February 2013, the EPA determined that the referred proposal did not require formal environmental assessment. Main Roads subsequently applied to the Department of the Environmental Regulation (now Department of Water and Environmental Regulation) for a clearing permit through the Environmental Protection (Clearing of Native Vegetation) Regulations (1995).

The 2012 BORR Southern Section Project was also referred to the Commonwealth Minister for the Environment through the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC, now DAWE) for a decision on the requirement for formal assessment under the EPBC Act. In March 2013, DSEWPaC advised Main Roads that the proposal was considered a Controlled Action and would be assessed through preliminary documentation.

In mid-2017, Main Roads withdrew both the clearing permit application and the EPBC referral as a result of more detailed development of the concept design for the BORR Southern Section being proposed.

In May 2018, the Commonwealth elevated the conservation status of the WRP from 'Vulnerable' to 'Critically Endangered'. This change raised concerns about the 2012 BORR Southern Section and a review was subsequently undertaken to ascertain the most appropriate alignment.

1.3.7.2 **2019 alignment r**eview

The BORR Southern Section alignment was based on the alignment and design as outlined within *Environmental Impact Assessment Bunbury Outer Ring Road - Southern Section (South Western Highway to Bussell Highway)* (GHD, 2012c), herein referred to as the 'GBRS Alignment' (being the alignment identified in the GBRS).

In response to changes to the EPBC Act's protection status of the WRP in May 2018, Main Roads WA commissioned an Environmental Options Assessment for the BORR Southern Section (BORR IPT, 2018).

The alignment review (BORR IPT, 2019b) (https://www.mainroads.wa.gov.au/globalassets/projects-initiatives/projects/regional/bunbury-outer-ring-road/borr-south-alignment-selection-report-sep-19.pdf) was initiated principally to assess the potential impacts to environmental values (in particular the clearing of native vegetation comprising fauna habitat) and social values, while also assessing land use planning, heritage values, engineering and economic constraints, and potential impacts on agricultural businesses, raw materials and mining tenements.

South Western Highway to Hasties Road

A high level review was undertaken on the section between South Western Highway and Hasties Road. The review identified that there was no significant benefit in deviating from the GBRS Alignment. It was concluded that for this section of BORR, the GBRS Alignment was considered appropriate. The engineering and economic constraints for the alternate options were considered manageable. However, the environmental impact of the additional clearing and the social impact resulting from the proximity to an increased number rural residences and lot severance, along with associated access issues, limited the practicality of the alternate alignments considered.

Hasties Road to Bussell Highway

As outlined above, this section of the BORR alignment has undergone a number of reviews by HGM (1995) and ERM Mitchell McCotter (1997).

The following section outlines the results of the *Bunbury Outer Ring Road Alignment Selection Report* (BORR IPT, 2019b) which can viewed at https://www.mainroads.wa.gov.au/globalassets/projects-initiatives/projects/regional/bunbury-outer-ring-road/borr-south-alignment-selection-report-sep-19.pdf.

In 2018, the BORR IPT identified a corridor for the investigation of alternative alignments to the GBRS alignment. The corridor was notionally 750 m wide, in order to allow for flexibility in defining a nominal 100 m wide alignment. Environmental surveys and landowner consultation was carried out within this investigation corridor to allow for the definition of potential alternative alignments.

An MCA assessment was conducted to select a preferred alternative alignment within the 750 m corridor, and is provided as Appendix E in the alignment selection report (see link above). The preferred alternative alignment was identified for comparison against the GBRS alignment as shown at Figure 4 (**Error! Reference source not found.**).

After completing additional environmental surveys for both the GBRS Alignment and Alternative Alignment, an Environmental Impact Assessment (EIA) was undertaken for each to inform the alignment selection process. These assessments are addressed in the following documents:

- *Bunbury Outer Ring Road Southern Section Alignment Selection Report* (BORR IPT, 2019b) (https://www.mainroads.wa.gov.au/globalassets/projects-initiatives/projects/regional/bunbury-outer-ring-road/borr-south-alignment-selection-report-sep-19.pdf)

- *Bunbury Outer Ring Road Southern Section Alternative Alignment Environmental Impact*
- *Assessment* (BORR IPT, 2019c) https://www.mainroads.wa.gov.au/globalassets/projects-initiatives/projects/regional/bunbury-outer-ring-road/borr-southern-section-gbrs-alignment-eia-rev-1-final-june-20192.pdf
- *Bunbury Outer Ring Road Southern Section GBRS Alignment Environmental Impact Assessment* (BORR IPT, 2019e) https://www.mainroads.wa.gov.au/globalassets/projects-initiatives/projects/regional/bunbury-outer-ring-road/borr-southern-section-alternative-alignment-eia-rev-0-final-june-2019.pdf

The EIA process for the GBRS Alignment and the Alternative Alignment compared both alignments with equal consideration of EPA factors and guidance for Flora and Vegetation, Terrestrial Fauna, Inland Waters and Social Surroundings. Each of the two EIAs addressed the Principles and Factors of Section 4A of the EP Act and was structured around the EPA's *Instructions on how to prepare an Environmental Review Document* (EPA, 2018d).

The alignment selection process included a MCA, which is included at Appendix F of the Alignment Selection Report, to evaluate the Alternative Alignment against the GBRS alignment (i.e. within the GBRS corridor). The MCA considered environmental, social, engineering, environmental and economic constraints including regional planning context, traffic and safety assessment, community stakeholder views.

The EIA and MCA process determined that both the GBRS Alignment and Alternative Alignment would result in impacts to environmental values, although each being of a different scale and nature. Principally, the GBRS Alignment would have a greater impact to native vegetation including the habitat and individuals of Threatened terrestrial fauna, whereas the Alternative Alignment would have a greater impact to wetlands including the habitat and individuals of Threatened aquatic fauna.

Based on the outcomes of the MCA, the GBRS Alignment was determined to be consistent with the current long-term land use planning for the area, and therefore selected as the preferred alignment. Consequently, Main Roads recommended to proceed with the GBRS Alignment for the Proposal and this decision was endorsed by the WA Minister for Transport as the preferred alignment for the BORR Southern section (the Proposal).

Further refinement of BORR Southern Section (GBRS Option)

The Proposal design has been informed by the results of environmental, aboriginal heritage and other surveys and constraints assessments. It has undergone further refinement by the BORR IPT during development of the current concept design to minimise environmental impacts where possible, including alteration of the alignment to avoid the vintage tuart tree in Gelorup.

Since referral of the Proposal to DoEE in September 2019 (BORR IPT, 2019e), Main Roads undertook a comprehensive review of the design and revised infrastructure components and the Proposal Area with the objective to reduce the potential impacts to key environmental values, including:

- Western Ringtail Possum (WRP), Black Cockatoos (BC) and Black-stripe Minnow (BSM)
- Banksia Woodlands of the Swan Coastal Plain TEC (Banksia Woodlands TEC) and Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain TEC (Tuart Woodlands TEC).

The extents to which design changes result in impact reductions for conservation significant species and communities is summarised in Table 1-5.

The Proposal is currently at Concept Design phase. Further refinement of the alignment within the Proposal Area to minimise impacts to Matters of National Environmental Significance (MNES) and other environmental values will occur during the detailed design process.

Table 1-5 Detailed design changes to avoid impacts to threatened fauna, ecological communities and flora

ASPECT	ORIGINAL PROPOSAL (SEPTEMBER 2019) [1]	REVISED PROPOSAL (OCTOBER 2021)	CHANGE IN IMPACT
Banksia Woodlands of the SCP TEC	Clearing of 26.6 ha	Clearing of up to 23.4 ha	3.4 ha
Tuart Woodlands TEC[2]	Not quantified	Clearing of up to 4.4 ha	N/A
Western ringtail possum Habitat extent (ha)	Clearing of 80.0 ha Disturbance of a minimum of 73 WRP individual home ranges	Clearing of up to 60.9 ha Disturbance of 49 to 72 WRP individual home ranges	14.6 ha 1 to 24 individual home ranges
Black Cockatoo Habitat extent (Ha)	Clearing of 80 ha	Clearing of up to 60.9 ha	19.1 ha
Black Cockatoo Suitable DBH trees without a Suitable Nest Hollow	Minimum of 538	1,088[3]	Increase due to further survey and greater knowledge of the Proposal area
Black Cockatoo Trees with a Suitable Nest Hollow	Minimum of 18 large trees (DBH > 500 mm) containing a suitable nest hollow for breeding of Black Cockatoos	Up to 11 trees (DBH > 500 mm) containing a suitable nest hollow for breeding of Black Cockatoos	7 large trees (DBH > 500 mm) containing a suitable nest hollow for breeding of Black Cockatoos
Black Cockatoo known nesting trees	Minimum of 8	0	8
Black-stripe Minnow Habitat extent (Ha)	Clearing of up to 9.6 ha	Clearing of up to 5.5 ha	4.1 ha

Changes to the design of the Proposal (detailed in Table 1-6) made to minimise impacts include:

- Reduction in median widths where the alignment is on high fill embankments
- Changes to the form of interchanges to reduce impacts including fragmentation
- Increased batter slope (gradients) and use of retaining walls to reduce the area of clearing required
- Bridge designs to avoid the need for piers or abutments within watercourses

[1] Additional MNES were potentially present in unsurveyed areas, therefore in some cases, the original proposal quantum is stated as a minimum.
[2] The extent of Tuart Woodlands TEC within the original referral boundary was confirmed in a supplementary flora and vegetation survey conducted after the submission of the referral. The Proposal Area boundary was then modified to reduce impacts to this community.
[3] Surveys conducted in response to the EPA's request for additional information confirmed and quantified the extent of Black Cockatoo habitat within the Proposal Area, including in areas previously unsurveyed. The number of suitable DBH trees has increased since the September referral because all areas have now been surveyed.

- Amendment of the alignment to reduce the area of native vegetation cleared
- Staging of construction to allow for the reduced clearing footprint
- Moving the principal shared path (PSP) closer to the highway to reduce the project footprint
- Inclusion of fauna crossings
- Design of drainage to maintain hydrological regimes.

Table 1-6 Summary of design changes and environmental effects

DESIGN CHANGE	SPECIES AND COMMUNITIES BENEFITTING			
	BC	WRP	BSM	TEC
Whole of alignment				
A combination of permanent and temporary fauna fences will be installed adjacent to known habitat areas to limit WRP access to the Proposal Area. The fence will be 1.5 m high and constructed to prevent WRP being able to climb it or dig under it.	X	X		X
The median widths have been reduced where the BORR alignment is on high fill embankments to mitigate the environmental impacts	X	X		X
All bridge designs have been modified to avoid the need for piers or abutments within the watercourse, mitigating environmental and heritage impacts				
Install 22 fauna crossings to maintain and enhance existing movement pathways consisting of: • **Eight rope bridges** • **Seven fauna underpasses** • **Seven fauna culverts**		X	X	
Centenary Road to Lilydale Road				
BORR main alignment amended to further minimise impacts on vegetation	X	X	X	X
Reduced median width on BORR to minimise impacts on vegetation	X	X		X
Batter slopes steepened to minimise width of clearing	X	X		X
Access track off Centenary Road designed in a cleared area.	X	X		X
Jules Road connection redesigned to reduce clearing impacts.	X	X		X
Centenary Road / Lilydale Road Interchange				
BORR main alignment amended to further minimise impacts on vegetation	X	X		X

DESIGN CHANGE	SPECIES AND COMMUNITIES BENEFITTING			
	BC	WRP	BSM	TEC
Reduced median width on BORR to minimise impacts on vegetation	X	X		X
Batter slopes steepened to minimise width of clearing	X	X		X
Hasties Road to Jilley Road				
BORR main alignment amended to further minimise impacts on vegetation	X	X		X
Reduced median width on BORR to minimise impacts on vegetation	X	X		X
Batter slopes steepened to minimise width of clearing	X	X		X
Jilley Road (Gelorup corridor)				
Design amended to reduce amount of clearing required for project by shifting footprint further into cleared areas	X	X	X	X
Noise wall alignment designed to mitigate environmental impacts by building the noise wall along an existing cleared tracks through the constrained Gelorup area.	X	X		X
Jilley Road was redesigned closer to the main line in order to reduce the clearing footprint.	X	X		X
Bussell Highway				
Design amended to reduce amount of clearing required for project by modifying connections to existing carriageways.	X	X		X
Bussell Highway profile raised to accommodate fauna structures.	X	X		X
Retaining walls designed at the interchange to minimise the design footprint and hence clearing impacts.	X	X		X
At the southern tie in (Capel Golf Course), further design work on the mainline and local access roads has resulted in a decrease in the extent of works and hence a reduction in clearing area.	X	X		X
Bridge designs revised to long-span to avoid the need for piers and abutments within watercourses	X	X		

BC: Black Cockatoo, WRP: Western Ringtail Possum, BSM: Black-stripe Minnow, TEC: Threatened Ecological Community.

2 DESCRIPTION OF THE ENVIRONMENT AND MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

2.1 Description of protected matters within the proposed action area

MNES listed under the EPBC Act that are, or have the potential to be, in the Proposal Area and surrounds include the following:

- Banksia woodlands of the Swan Coastal Plain ecological community (Endangered) (Banksia Woodlands TEC)
- Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (Critically Endangered) (Tuart Woodlands TEC)
- Clay Pans of the Swan Coastal Plain (Critically Endangered) (Clay Pans TEC)
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (Vulnerable)
- Baudin's Cockatoo (*Calyptorhynchus baudinii*) (Endangered)
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Endangered)
- Western Ringtail Possum (*Pseudocheirus occidentalis*) (Critically endangered)
- Black-stripe Minnow (*Galaxiella nigrostriata*) (Endangered)
- King Spider-orchid (*Caladenia huegelii*) (Endangered)
- Tall Donkey Orchid (*Diuris drummondii*) (Vulnerable)
- Dwarf Bee-orchid (*Diuris micrantha*) (Vulnerable)
- Glossy-leafed Hammer Orchid (*Drakaea elastica*) (Endangered)
- Dwarf Hammer-orchid (*Drakaea micrantha*) (Vulnerable)
- Keighery's Eleocharis (*Eleocharis keigheryi*) (Vulnerable).

The following protected matters could also be impacted by the Proposal:

- Selena's Synaphea (*Synaphea* sp. Fairbridge Farm) (Critically Endangered)
- *Austrostipa jacobsiana* (Critically Endangered)
- Austrostipa bronwenae (Endangered).

2.2 Existing environment

2.2.1 Current land use

The Proposal Area intersects 134 cadastral units comprising Crown, reserves, freehold, easements, roads and other lot types (e.g. closed road and vacant Crown land) (Figure 2, Appendix A).

The GBRS, legislated under the *Planning and Development Act 2005*, applies to land use in the Greater Bunbury area. This Scheme comprises the City of Bunbury and Shires of Harvey, Dardanup and Capel.

The majority (54 %) of land within the Proposal Area that is within the GBRS is zoned as either Primary regional roads (the current BORR alignment as identified in the GBRS) or Rural (41 %). The Proposal Area also intersects land zoned as urban and regional open space.

2.2.2 Topography

Topography ranges from 5 – 39 m Australian Height Datum (AHD) with the more elevated areas associated with the Spearwood sands and the least elevated areas associated with drainage lines.

2.2.3 Geology

The Proposal Area lies within the Spearwood and Bassendean Dunes and Pinjarra Plain geomorphological elements as described by (Churchward & McArthur, 1980; McArthur & Bettenay, 1960). The units are broadly described as:

- Bassendean dune and sandplain system: Pleistocene sand dunes with very low relief, leached grey siliceous sand intervening sandy and clayey swamps and gently undulating plains. These occur immediately west of, and partly overlie, the Pinjarra Plain
- Spearwood dune system: Pleistocene and aeolian sands overlying Tamala limestone. Low dunes and swales of shallow pale grey sands over yellow sands are characteristic of the Spearwood system. Wetlands are associated with peats and carbonate sands, occasionally with clay overlaying sands
- Pinjarra Plain: Broad low relief plain west of the foothills, comprising predominantly Pleistocene fluvial sediments and some Holocene alluvium associated with major current drainage systems. Major soils are naturally poorly drained with many swamps.

Desktop assessment of broad geological formations indicates that the Proposal Area occurs within three broad formations, in addition to rivers and wetland areas (GSWA, 2009), which are outlined in Table 2-1.

Table 2-1 Geology, landform and soils information for the Proposal Area

FORMATION	GEOLOGICAL TYPE	GEOLOGICAL DESCRIPTION/ LANDFORM
Tamala Limestone	Qts	Sand associated with Tamala Limestone, high dunes
Guildford Formation	Qpa	Mainly alluvial sandy clay
Bassendean Sand	Qpb	Low rounded dunes

2.2.4 Soils

The Proposal Area occurs within the Swan Province and lies within the Spearwood and Bassendean Dunes and Pinjarra Plain geomorphological elements as described by (Churchward & McArthur, 1980; McArthur & Bettenay, 1960). The Bassendean dune and sandplain system is described as Pleistocene sand dunes with very low relief, leached grey siliceous sand, intervening sandy and clayey swamps and gently undulating plains. These occur immediately west of, and partly overlie, the Pinjarra Plain (Barnesby, B.A., King P.D. and Proulx-Nixon, M.E., 1995).

The Spearwood dune system is described as Pleistocene and aeolian sands overlying Tamala limestone featuring low dunes and swales of shallow pale grey sands over yellow sands are characteristic of the Spearwood system. Wetlands are associated with peats and carbonate sands, occasionally with clay overlaying sands. The Pinjarra Plain is described as a broad low relief plain west of the foothills, comprising predominantly Pleistocene fluvial sediments and some Holocene alluvium associated with major current drainage systems. Major soils are naturally poorly drained with many swamps.

The Proposal Area comprises mostly cleared land, primarily for agricultural land, with some remnant vegetation on Crown land, private property, road reserves and creek lines. Agricultural land use has impacted the terrestrial environment of the Proposal Area.

Twenty-one (21) soil phases occur within the Proposal Area. The two most represented soil phases are the Bassendean B2 and Pinjarra P1b phases, which each represent 18 % of the Proposal Area (GoWA, 2020).

2.2.5 Acid sulfate soils

A review of the ASS risk mapping for the Proposal Area indicates 72 % of the Proposal Area is rated as low to moderate risk of ASS with 7 % comprising minor areas of high risk associated with wetlands and watercourses and the Capel Golf Course. 21 % of the Proposal Area (upland areas) was not assessed (GoWA, 2020).

A preliminary ASS investigation was undertaken by BORR IPT throughout the Proposal Area (BORR IPT, 2020h) (**Error! Reference source not found.**). Soil profiles and soil samples were collected at each of the 27 test locations, with groundwater samples collected at ten of these locations. Soil samples were collected at 0.5 m intervals or where significant changes within the soil profile were encountered. The water and soil samples were sent to a National Association of Testing Authorities (NATA) accredited laboratory and screened for analytes that are indicative of ASS, including pH, chromium reducible sulphur and net acidity values.

The field screening results indicate that most of the soils sampled were trending mildly acidic to basic. Eleven (out of 56) primary samples analysed were found to have a net acidity above the assessment criteria for coarse sands and gravels, with a further five found to have a net acidity above the more conservative criteria for Bassendean Sand. The greatest potential for acid generation was generally recorded within the sandy units and Bassendean Dune Sand.

The results within the test pits in particular indicate that the soil profile has previously been exposed to variations within the groundwater table and that acidity is represented as actual (sulfidic) acidity indicating that acidity is likely to be easily mobilised and leached during excavation and dewatering operations.

The groundwater samples from each of the ten test locations further confirmed the presence of ASS where laboratory results exceeded the ASS criteria (DER, 2015). The analytes which exceeded the criteria were:

- Total acidity concentrations, which were below the ASS criteria (40 mg/L) at three out of ten test locations
- Total alkalinity concentrations, which were below the ASS criteria (30 mg/L) at five out of ten test locations.
- Field pH was above the ASS criteria (5.0) at all test locations. pH values ranged between 5.30 and 7.21, and are indicative of acidic to neutral conditions.

2.2.6 Contaminated sites

A search of the DWER Contaminated Sites Database indicates there are no listed contaminated sites within the Proposal Area (GoWA, 2020).

The DWER Contaminated Sites Database does not provide details of Sites that are listed as ‘Possibly contaminated – investigation required’.

A further limitation to the DWER Contaminated Sites Database is unreported contaminated sites.

Contaminated sites constraints mapping was conducted for the Proposal (BORR IPT, 2020f). This assessment identified a number of land parcels within the Proposal Area that are considered to represent a potential contamination risk to human health or the environment associated with the construction of BORR Southern Section. It was recommended that further investigation of these sites be undertaken prior to

construction and that the requirement for further investigation or management will ultimately depend on the final design of the road alignment.

2.2.7 Groundwater

The Project is within the Bunbury Groundwater Area and Busselton-Capel Groundwater Area, as proclaimed under the *Rights in Water Irrigation Act 1914* (RIWI Act) (GoWA, 2020).

The majority of wetlands and associated vegetation within the Proposal Area have been identified as having a moderate to high potential to be groundwater dependent ecosystems (GDEs) in the Bureau of Meteorology (BoM) GDE Atlas (BoM, 2018). While not all GDEs are solely reliant on groundwater, the Proposal Area is also mapped as likely to be an Inflow Dependence Ecosystem (IDE) and therefore reliant on ground water in addition to rainfall (BoM, 2018).

Annual rainfall in the Bunbury area has been generally declining since record keeping began in 1877 (BoM, 2019). Declining rainfall in the area has affected groundwater recharge and surface water runoff which in turn affects GDEs. GDEs are also susceptible to impacts associated with land clearing, water abstraction, fragmentation of native vegetation, weed invasion and spread of dieback disease.

2.2.8 Surface water and Waterways

No rivers proclaimed under the RIWI Act will be impacted by the Proposal, although a number of minor drainage lines (not proclaimed under the RIWI Act) will be impacted, including Five Mile Brook.

There are no Proclaimed Surface Water Areas (PSWAs) within the Proposal Area.

Most of the western boundary of the Proposal Area abuts and in several areas overlaps the boundary of the Bunbury Reserve Priority 3 (P3) PDWSA. P3 areas are defined where it is necessary to manage the risk of contamination to a water source and where water supply sources need to co-exist with other land uses such as residential, commercial and light industrial developments (DoW, 2009).

Mitigation measures to address contamination risks to the Bunbury Reserve PDWSA posed by the Proposal will be included in the CEMP and will be consistent with the Bunbury Water Reserve drinking water source protection plan (DWSPP) (DoW, 2008).

The Proposal Area is not within a proclaimed Waterways Conservation Area.

There are no Ramsar wetlands located within 10 km of the Proposal Area; the nearest (Vasse-Wonnerup System) is located approximately 19 km southwest of the Proposal Area (GoWA, 2020).

The Proposal Area overlaps or intersects 16 Geomorphic Wetlands (GoWA, 2020). The number of wetlands in each category and the total areas of overlap for each category (approximate) are as follow:

- One Conservation Category – 0.2 ha (0.08 % of the Proposal Area)
- Two Resource Enhancement –1.4 ha (0.7 % of the Proposal Area)
- 13 Multiple Use – 41.8 ha (21 % of the Proposal Area).

A Drainage Strategy has been developed for the Proposal Area in consultation with the Project Drainage Reference Group (DRG) (BORR IPT, 2019g). The DRG is comprised of relevant stakeholders and was formed to investigate the opportunities, issues and options related to drainage and water management across the Proposal Area.

The objectives of the Drainage Strategy include:

- Minimisation of road user risk, including risk of injury or loss of life, by effective removal and disposal of surface runoff water from the pavement
- Protection of the existing and future built environment from flooding and water logging conditions. Prevention of adverse impacts where the existing built environment is already impacted by flooding. In

areas where the existing ground is already water logged (i.e. in areas of palusplain), ponding adjacent the road formation should be minimised

Maintenance of existing water cycle balance within the Proposal Area whilst also improving the surface and groundwater quality.

To inform the selection of appropriate treatments for the runoff off the highway, the main constituents in highway runoff were identified and are presented below:

- Sediment
- Oil and Grease/hydrocarbons
- Heavy metals
- Inorganics
- Nutrients.

Heavy metals present in highway runoff are largely insoluble and adhere to sediments. Therefore, the removal of sediment from the highway runoff is also effective at removing heavy metals from the runoff.

Nutrients (TN and TP) in highway runoff are largely from atmospheric deposition. There is also some loading resulting from spillage from stock haulage, spillage of fertiliser from trucks and fertiliser application along the highway, however, the contribution of nutrients to the catchment from the highway is minor compared to adjacent land uses.

Construction Environmental Management Plans (CEMP) will be prepared by the contractor prior to ground disturbing works. The CEMP will include details on the handling and storage of hydrocarbons, chemicals and hazardous materials during construction activities. Any incidences will require that a report for the regulator is prepared.

Main Roads has completed a 12 month groundwater (GW) and surface water (SW) monitoring programme. This dataset provides the baseline data from which potential contamination may be monitored. Main Roads will continue to monitor GW and SW levels and analytes on a quarterly basis at sensitive locations.

The dates of the 12 month monitoring program are provided in Table 2-2. The analytical suites are provided in Table 2-3.

Table 2-2 Surface water and groundwater monitoring dates for BORR

Monitoring Event	Survey dates
1	19 to 22 August 2019
2	16 to 19 September 2019
3	21 to 28 October 2019
4	18 to 21 November 2019
5	16 to 19 December 2019
6	20 to 23 January 2020
7	17 to 20 February 2020

8	16 to 19 March 2020
9	20 to 23 April 2020
10	18 to 21 May 2020
11	15 to 18 June 2020
12	20 to 27 July 2020
13	19 to 21 October 2020
14	18 to 20 January 2020

Table 2-3 Suite of analytes tested throughout the 12 month GW and SW monitoring program

LABORATORY ANALYTICAL SUITES	
Groundwater analytical suites	
Field parameters	pH, EC, DO (mg/L, % sat), redox, temperature (°C), TDS*[4]
Inorganics	pH, EC (laboratory by titration), TDS (laboratory by gravimetric)**[5]
Acidity and alkalinity	Alkalinity (carbonate as $CaCO_3$), alkalinity (bicarbonate as $CaCO_3$), alkalinity (hydroxide as $CaCO_3$), alkalinity (total as $CaCO_3$), acidity (as $CaCO_3$)
Major ions	Calcium, magnesium, potassium, sodium, chloride, sulfate, cations total, anions total, ionic balance, sulfide
Nutrients	Ammonium (as N), ammonia (as N), nitrogen (total oxidised) (as N), nitrogen (total), reactive phosphorus (as P), Kjeldahl nitrogen total, phosphorus (total).
Metals	Aluminium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, zinc
BTEXN	Benzene, toluene, ethylbenzene, xylene, naphthalene (sum of total)
TRH	Total recoverable hydrocarbons
Surface water analytical suites	
Field parameters	pH, EC, DO (mg/L, % sat), redox, temperature (°C), TDS*, turbidity (NTU)
Inorganics	pH, EC (laboratory by titration), TDS (laboratory by gravimetric)**
Acidity and alkalinity	Alkalinity (carbonate as $CaCO_3$), alkalinity (bicarbonate as $CaCO_3$), alkalinity (hydroxide as $CaCO_3$), alkalinity (total as $CaCO_3$), acidity (as $CaCO_3$)
Major ions	Calcium, magnesium, potassium, sodium, chloride, sulfate, cations total, anions total, ionic balance, sulfide
Nutrients	Ammonium (as N), ammonia (as N), nitrogen (total oxidised) (as N), nitrogen (total), reactive phosphorus (as P), Kjeldahl nitrogen total, phosphorus (total)

[4] *Field TDS recorded from YSI ProDSS water quality meter - calculated from conductivity and temperature
[5] ** Where available laboratory results for pH, EC and TDS have been reported. If laboratory results are missing or otherwise not available, field results are reported.

LABORATORY ANALYTICAL SUITES	
Metals	Aluminium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, zinc
BTEXN	Benzene, toluene, ethylbenzene, xylene, naphthalene (sum of total)
TRH	Total recoverable hydrocarbons
Pesticides and herbicides	OP pesticides, glyphosate

2.2.9 Vegetation and flora

2.2.9.1 Broad vegetation

The Proposal Area is located in the Swan Coastal Plain (SCP) Bioregion (abbreviated as SWA) and the Perth Subregion (SWA02) as described by the Interim Biogeographic Regionalisation for Australia (IBRA) (DoE, 2012). The Perth Subregion is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The outwash plains, once dominated by *C. obesa* - Marri woodlands and Melaleuca shrublands, are extensive only in the south (Mitchell, D., Williams, K. and Desmond, A., 2002).

Broad scale (1:250,000) pre-European vegetation mapping of the area has been completed by Beard (1979) at an association level. This indicates that the Proposal Area intersects three vegetation associations:

- Medium woodland; Tuart and Jarrah (Vegetation Association 6) – occurs in the northern, central and southern extents of the Proposal Area
- Medium woodland; Tuart (Vegetation Association 998) – occurs in the northern extent of the Proposal Area
- Mosaic: Medium forest; Jarrah-Marri / Low woodland; Banksia / Low forest; Teatree (*Melaleuca spp.*) (Vegetation Association 1000) – occurs in the northeast of the Proposal Area.

Regional vegetation complex mapping based on major geomorphic units of the SCP (Heddle, Loneragan, & Havel, 1980; Mattiske & Havel, 1998), as updated by Webb *et al.* (2016), identifies four vegetation complexes within the Proposal Area:

- Bassendean Complex – Central and South: Vegetation ranges from woodland of *Eucalyptus marginata* (Jarrah) - *Allocasuarina fraseriana* (Sheoak) - *Banksia* species to low woodland of *Melaleuca* species, and sedgelands on the moister sites. This area includes the transition of *Eucalyptus marginata* (Jarrah) to *Eucalyptus todtiana* (Pricklybark) in the vicinity of Perth
- Karrakatta Complex – Central and South: Predominantly open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) and woodland of *Eucalyptus marginata* (Jarrah) - *Banksia* species. *Agonis flexuosa* (Peppermint) is co-dominant south of the Capel River
- Southern River Complex – Open woodland of *Corymbia calophylla* (Marri) - *Eucalyptus marginata* (Jarrah) - *Banksia* species with fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark) along creek beds
- Yoongarillup Complex – Woodland to tall woodland of *Eucalyptus gomphocephala* (Tuart) with *Agonis flexuosa* in the second storey. Less consistently an open forest of *Eucalyptus gomphocephala* (Tuart) -

Eucalyptus marginata (Jarrah) - *Corymbia calophylla* (Marri). South of Bunbury is characterised by *Eucalyptus rudis* (Flooded Gum)-*Melaleuca* species open forests.

2.2.9.2 Flora

All of the approximately 200 ha Proposal Area was included in the flora and vegetation survey conducted by the BORR IPT (BORR IPT, 2020i). This study has been included in Appendix C. 71.5 ha (38 %) of the Proposal Area comprises native vegetation that will be cleared to enable Proposal implementation. Of this 71.5 ha, 70.5 ha is remnant native vegetation and 1 ha is revegetation (planted native vegetation). The remaining 124 ha (62 %) of the Proposal Area comprises cleared / disturbed agricultural land.

The flora and vegetation values have primarily been derived from the flora and vegetation report, which covered a survey area of 297 ha, referred to herein as the 'Surveyed Area'[6] (BORR IPT, 2020i). This assessment included a desktop study and review of previous flora and vegetation assessments undertaken within the Surveyed Area or in close proximity. Field assessments were undertaken in August (reconnaissance), and October and November (detailed and targeted) 2018. A targeted survey was also completed for *Diuris drummondii* (a late-flowering threatened orchid species) in December 2018 and a review of potential conservation listed claypan occurrences was also undertaken. In addition a targeted survey for TECs and confirmation of vegetation types in previously unsurveyed gaps in the Surveyed Area was also undertaken in September 2019.

A *Phytophthora* dieback survey for the Proposal Area was completed in September 2019 to inform the assessment of the condition of vegetation units identified (Great Southern Bio Logic Pty Ltd, 2020) (Appendix D).

BORR IPT (2020i) recorded 289 plant taxa (including subspecies and varieties) representing 71 plant families and 227 genera within their wider Surveyed Area. This comprised 198 native species and 91 introduced (exotic) and planted species.

Dominant families recorded from the study area included:

- Fabaceae (35 taxa including 20 introduced taxa)
- Cyperaceae (21 taxa including five introduced)
- Asteraceae (21 taxa including ten introduced species)
- Orchidaceae (22 taxa including one introduces species)
- Poaceae (18 taxa including 17 introduced species)
- Myrtaceae (16 taxa including four planted species).

Desktop searches of the EPBC Act Protected Matters Search Tool (PMST), NatureMap, DBCA Threatened and Priority Flora List (TPFL) and Western Australian Herbarium (WAHERB) databases identified the presence / potential presence of 54 conservation significant flora taxa within a 5 km buffer around the BORR IPT (2020i) field survey area (the Surveyed Area). This included 21 taxa listed under the EPBC Act and / or as Threatened under the BC Act and 33 listed as Priority species by the DBCA. The likelihood of occurrence assessment, post-field survey, concluded that three taxa are known or likely to occur and eleven taxa possibly occur within the Proposal Area.

The field survey did not record any EPBC Act or BC Act listed flora. Three DBCA Priority-listed flora species were recorded within the Proposal Area:

- *Lasiopetalum membranaceum* (P3)

[6] The Surveyed Area includes all sites of significance that occur both within the Proposal Area and wherever relevant, outside the Proposal Area, that were surveyed for the Proposal in order to determine both direct and indirect impacts.

- *Acacia semitrullata* (P4)
- *Caladenia speciosa* (P4).

2.2.9.3 Introduced and invasive species

Ninety-one (91) introduced flora species were recorded during the BORR IPT (2020i) survey. Of these, five are listed as Declared Pests under the *Biosecurity and Management Act 2007* and / or as a WoNS known to be present within the Proposal Area, namely:

- **Asparagus asparagoides* (Bridal Creeper) – Declared Pest and WONS
- **Lantana camara* – Declared Pest and WONS
- **Moraea flaccida* (One-leaf Cape Tulip) – Declared Pest
- **Opuntia stricta* (Common Prickly Pear) – Declared Pest and WONS
- **Zantedeschia aethiopica* (Arum lily) – Declared Pest.

The remaining introduced species are considered environmental weeds and all have previously been recorded on the SCP. Locations of the Declared Pests are shown in Appendix C.

2.2.9.4 Vegetation types

The flora and vegetation study undertaken for the BORR Southern Section describes the Proposal Area as being extensively cleared for agriculture with native vegetation occurring within road reserves, along rivers and creeklines, in patches on private land and as scattered trees (BORR IPT, 2020i). Some larger patches of native vegetation within the agricultural area are present, particularly in the southern portion. Isolated larger patches are also present in the north and centre of the Proposal Area.

Within the Proposal Area, BORR IPT (2020i) recorded 75 ha of native vegetation (including scattered trees in paddocks), 1 ha of revegetation / regrowth and 124 ha of highly modified area (cleared paddock, existing infrastructure and non-native vegetation).

BORR IPT (2020i) mapped ten vegetation types within the Proposal Area that are considered to be remnant native vegetation, as well as three units comprising highly disturbed areas, non-native vegetation and revegetation / regrowth. Vegetation types are presented in Table 2-4 and Figure 5 (Appendix A).

The condition of vegetation within the Proposal Area ranges from Excellent (2) to Completely Degraded (7) (BORR IPT, 2020i). Remnant vegetation was assigned a condition rating of Degraded where the tree (upper) layer was retained but no native mid or ground layers were present. When these patches also had native species in the mid / ground layers, they were assigned condition ratings of Good or better. According to the scale of the EPA (EPA, 2016e), almost half (49 %, 37.1 ha) of surveyed vegetation is in Degraded or worse condition, 23% (17 ha) is in Good–Degraded condition, and the remaining vegetation (28 %, approximately 21.4 ha) is in Good or better condition.

In the south of the Proposal Area, vegetation condition predominantly was rated between Very Good and Degraded. Native vegetation within this section has been severely impacted by partial clearing and weed invasion. Vegetation in the north of the Proposal Area was largely rated between Degraded and Completely Degraded. These areas were highly disturbed for agricultural purposes and comprised scattered native trees over weedy herbs and grasses.

TEC observations within and adjacent to (within 20 m of) the Proposal Area are discussed in section 2.4.

Table 2-4 Vegetation types and extent within the Proposal Area

ID	VEGETATION TYPE	VEGETATION TYPE DESCRIPTION	EXTENT WITHIN THE PROPOSAL AREA (HA)	CONDITION
VT1	Open forest of *Eucalyptus marginata, Corymbia calophylla* and *Banksia attenuata* on Karrakatta deep sands	Open forest of *Eucalyptus marginata* and *Corymbia calophylla* +/- *Agonis flexuosa* over low open forest of *Banksia attenuata* over shrubland of *Hibbertia hypericoides*, *Macrozamia riedlei* and *Xanthorrhoea brunonis* over grassland over **Ehrharta* spp., *Briza maxima over herbland of *Dasypogon bromeliifolius*, *Lomandra* species and *Phlebocarya ciliata* over open sedgeland of *Lepidosperma pubisquameum*	20.9 ha	4.0 ha (2-3) Excellent-Very Good 2.0 ha (3) Very Good 0.5 ha (3-4) Good / Very Good 1.6 ha in (4) Good 11.6 ha (4-6) Good-Degraded 0.7 ha (6) Degraded 0.5 ha (6-7) Degraded-Completely Degraded
VT1b	Open forest of *Eucalyptus gomphocephala* with occasional *Eucalyptus marginata* over *Agonis flexuosa* and *Banksia attenuata* on yellow sand over limestone	Open forest of *Eucalyptus gomphocephala* with occasional *Eucalyptus marginata* over *Agonis flexuosa* and *Banksia attenuata* scattered trees over **Ehrharta* spp. and **Briza maxima* grassland and mixed introduced herbs on yellow sand over limestone with some limestone outcropping at the surface. Some areas contain revegetation in the understorey	4.5 ha	0.8 ha (3) Very Good 2.9 ha (4-6) Good-Degraded 0.1 ha (6) Degraded-Completely Degraded 0.7 ha (7) Completely Degraded
VT2	Open forest of *Eucalyptus marginata, Corymbia calophylla, Banksia attenuata* and *Agonis flexuosa* on Bassendean dunes	Open forest of *Eucalyptus marginata*, *Corymbia calophylla* and *Agonis flexuosa* over low forest of *Banksia attenuata* and *B. ilicifolia* over tall shrubland of *Kunzea glabrescens*, *Jacksonia furcellata* and *Xylomelum occidentale* over shrubland of *Hibbertia hypericoides*, *Acacia* spp. and	7.8 ha	0.5 ha (2) Excellent 2.2 ha (4-6) Good-Degraded 4.7 ha (6) Degraded 0.2 ha (6-7) Degraded-Completely Degraded

ID	VEGETATION TYPE	VEGETATION TYPE DESCRIPTION	EXTENT WITHIN THE PROPOSAL AREA (HA)	CONDITION
		Xanthorrhoea brunonis over grassland / Sedgeland of *Tetraria octandra*, *Desmocladus fascicularis* and introduced grasses		0.2 ha (7) Completely Degraded
VT3	*Corymbia calophylla* and *Eucalyptus marginata* +/- Banksia spp.	Scattered *Eucalyptus marginata*, *Corymbia calophylla* and +/- *Agonis flexuosa* over a tall very open shrubland of *Banksia attenuata*, *B. ilicifolia*, *Xylomelum occidentale* and *Kunzea glabrescens* over a grassland of introduced species. Occurs in paddocks and road reserves. In the road reserve along South West Highway the shrubland is largely devoid and *Agonis flexuosa* is present in the tree layer.	2.4 ha	2.3 ha (6) Degraded 0.05 ha (6-7) Degraded-Completely Degraded 0.05 ha (7) Completely Degraded
VT4	Open forest of *Banksia attenuata* and *Agonis flexuosa*	Open forest of *Banksia attenuata* and *Agonis flexuosa* over shrubland of *Hibbertia hypericoides*, *Macrozamia riedlei* and *Leucopogon propinquus* over open grassland of **Ehrharta* spp. and **Briza maxima* over herbland of *Dichopogon capillipes*, *Phlebocarya ciliata* and *Conostylis aculeata*. Scattered *Eucalyptus marginata* as an emergent. Occurs in one location on grey sands on a rounded hill slope.	3.5 ha	0.75 ha in (3) Very Good 2.75 ha in (3-4) Very Good to Good
VT5	Tall shrubland K*unzea micrantha* subsp. *micrantha* and *Melaleuca viminea* over weeds	Tall open shrubland of *Kunzea micrantha* subsp. *micrantha* and *Melaleuca viminea* over open sedgeland of *Lepidosperma longitudinale* and *Juncus subsecundus* over grassland of **Briza maxima*, **Briza minor* and **Ehrharta calycina*	0.05 ha	All Completely Degraded

ID	VEGETATION TYPE	VEGETATION TYPE DESCRIPTION	EXTENT WITHIN THE PROPOSAL AREA (HA)	CONDITION
VT6	Closed tall scrub of *Melaleuca preissiana, Astartea scoparia* and *Kunzea glabrescens* over sedgeland	Closed tall scrub of *Melaleuca preissiana*, *Kunzea glabrescens* and *Astartea scoparia* and over a sedgeland of *Baumea juncea*, *Lyginia imberbis* and **Cyperus tenellus* with introduced grasses species over open herbland of **Hypochaeris* sp., **Ornithopus compressus* and **Ursinia anthemoides*	3.4 ha	2.5 ha (3-4) Good / Very Good 0.3 ha in (4) Good 0.2 ha (4-6) Good-Degraded 0.4 ha (7) Completely Degraded
VT7	Low open forest of *Melaleuca preissiana* and *Melaleuca rhaphiophylla* over sedgeland	Low open forest of *Melaleuca preissiana*, *M. rhaphiophylla* and *M. viminea* over sedgeland of *Lepidosperma longitudinale*, *Juncus pallidus* and **Carex divisa* with introduced grasses and herbs including **Cynodon dactylon*, **Lotus subbiflorus* and **Cotula species*. Attached and floating aquatic species were present including: *Lemna disperma*, *Cycnogeton lineare* and **Callitriche stagnalis*.	9 ha	5.7 ha in (4) Good 0.1 ha (4-6) Good-Degraded 0.1 ha (6) Degraded 1.6 ha (6-7) Degraded-Completely Degraded 1.5 ha (7) Completely Degraded
VT8	Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland	Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over grassland of **Ehrharta longiflora* and **Avena* spp. over sedgeland of *Lepidosperma longitudinale* over herbland of *Rumex spp. In Lot 1 Ducane Road an open tall shrubland of *Kunzea glabrescens* and *Melaleuca teretifolia* over open heath of *Astartea scoparia* over a sedgeland of *Hypolaena exsulca* and *Lepidosperma longitudinale* was present. This was the only occurrence of the vegetation in Very Good condition. Occurs along drainage lines and seasonally inundated areas.	0.6 ha	0.5 ha (6) Degraded 0.1 ha (6-7) Degraded-Completely Degraded

ID	VEGETATION TYPE	VEGETATION TYPE DESCRIPTION	EXTENT WITHIN THE PROPOSAL AREA (HA)	CONDITION
VT09a	Scattered remnant vegetation present in agricultural areas and along road reserves	*Corymbia calophylla* and *Eucalyptus marginata* +/- *Agonis flexuosa* with very occasional *E. gomphocephala*	9.1 ha	1.0 ha (6) Degraded 5.4 ha (6-7) Degraded-Completely Degraded 2.7 ha (7) Completely Degraded
VT09b		*Melaleuca rhaphiophylla*	1.5 ha	0.15 ha (6-7) Degraded-Completely Degraded 1.35 ha (7) Completely Degraded
VT09c		*Corymbia calophylla* and *Eucalyptus marginata* with Agonis flexuosa over introduced grasses	4.6 ha	4.1 ha (6) Degraded 0.5 ha (6-7) Degraded-Completely Degraded 0.005 ha (7) Completely Degraded
VT09d		*Eucalyptus rudis* and *Corymbia calophylla* +/- *M. rhaphiophylla*, *M. preissiana*.	1.4 ha	0.6 ha (4-6) Good-Degraded 0.2 ha (6-7) Degraded-Completely Degraded 0.6 ha (7) Completely Degraded
VT10	Parkland cleared with scattered native / planted species	Parkland cleared with occasional *Corymbia calophylla, Eucalyptus gomphocephala, E. marginata* and *Agonis flexuosa* trees with planted tree species over an understorey of weedy herbs and grasses.	6.2 ha	0.5 ha (6) Degraded 5.7 ha (7) Completely Degraded
VT10b	Revegetation / Regrowth in road reserves	This includes revegetation as well as areas planted with a mixture of native and non-native vegetation. There are scattered remnant trees occasionally present (including *Corymbia calophylla, Eucalyptus marginata, E. rudis*, *Agonis flexuosa* and *Casuarina obesa).* Common shrubs include	0.7 ha	0.03 ha (6) Degraded 0.18 ha (6-7) Degraded-Completely Degraded 0.52 ha (7) Completely Degraded

ID	VEGETATION TYPE	VEGETATION TYPE DESCRIPTION	EXTENT WITHIN THE PROPOSAL AREA (HA)	CONDITION
		Melaleuca nesophila, M. lanceolata, *Kunzea glabrescens* and *Acacia saligna*. The understorey was mostly dominated by introduced grasses and herbs. This vegetation unit occurred within the median strip of Bussell Highway.		
	Cleared / Highly Modified	Areas where clearing or other activities have fundamentally altered the composition of native vegetation and are not self-sustaining. These areas are completely or almost completely without native species.	124 ha	
Total Surveyed			349.9 ha	Native Vegetation (163.8 ha) Cleared (186.1 ha)

* Denotes introduced species

2.2.10 Fauna

For the purposes of the Proposal, the targeted fauna survey report by Biota (Biota, 2020a) (Appendix E) has been used as the primary reference for fauna species occurring or likely to occur within the Proposal Area and fauna habitats occurring within the Proposal Area.

Three broad habitat types were identified by Biota (2020a) within the Proposal Area, covering a total area of 75.4 ha:

- Marri / *Eucalyptus* woodland (43.7 ha);
- Marri / *Eucalyptus* in paddocks and road reserves (21.7 ha)
- *Melaleuca* shrubland and / or woodland (10.0 ha).

Biota (2020a) completed a desktop NatureMap database search of the Surveyed Area. The results of the search were used as an indicator of potential faunal diversity within the Proposal Area. The database search listed a species inventory of 223 vertebrate fauna species comprising 25 mammals (14 native non-volant, one bat and ten non-native), 159 birds (63 of which are largely reliant on freshwater or marine habitats), 29 reptiles and ten amphibians.

Searches of the EPBC Act Protected Matters database, DBCA NatureMap database and previous studies identified the presence/ potential presence of conservation significant fauna species within 10 km of the Surveyed Area (Biota, 2020a). The desktop searches undertaken by Biota (2020a) recorded:

- 14 species listed under the EPBC Act and / or the BC Act
- 28 migratory birds protected under international agreement (Schedule 5)
- Seven DBCA Priority listed species.

An additional targeted survey for aquatic fauna was undertaken by WRM (2020b) (Appendix F). This study surveyed seasonal wetlands and creeks within and surrounding the Proposal Area.

Five Threatened fauna species listed as MNES under the EPBC Act were directly and indirectly observed within the Surveyed Area (Biota, 2020a) and / or areas sampled by WRM (2020b) including:

- Western Ringtail Possum (Critically Endangered)
- Carnaby's Cockatoo (Endangered)
- Baudin's Cockatoo (Endangered)
- Forest Red-tailed Black Cockatoo (Vulnerable)
- Black-striped Minnow (Endangered).

Threatened fauna observations within the Proposal Area and contextual sites are discussed in section 2.5.

2.3 Technical reports

Following referral of the Proposal in September 2019, additional surveys targeting threatened flora, fauna and ecological communities were undertaken to address additional information needed to conduct a comprehensive impact assessment. The previous and additional studies are summarised in Table 2-5.

Table 2-5 Studies and surveys relevant to the Proposal

SURVEY / REPORT NAME	LOCATION / EXTENT IN SURVEY AREA	METHODOLOGY
Surveys undertaken for the Proposal prior to referral		
Vegetation and Flora		
Bennett Environmental Consulting Pty Ltd (2003)	Vegetation and flora assessment of selected areas along the Bunbury Outer Ring Road and Port Access Road	Vegetation and flora assessment
Bennett Environmental Consulting Pty Ltd (2008)	Assessment of significant flora along the proposed Bunbury Ring Road	Targeted significant flora assessment
Report for Bunbury Outer Ring Road (Stage 1) and Port Access Road (Stage 2) – Flora and Vegetation Spring Survey (GHD, 2009)	Flora and vegetation survey within the Bunbury Outer Ring Road (Stage 1) and Port Access Road (Stage 2) survey areas	Vegetation and flora assessment
Lot 1 Ducane Road Environmental Values Assessment (GHD, 2014)	Flora and vegetation assessment of Lot 1 Ducane Road conducted on 13 June 2013. The area assessed vegetation types and floristic diversity for Lot 1 Ducane Road, which is partly located within the Proposal Area.	The assessment described the vegetation types present and their conditions and also searched for conservation significant flora
BORR South Flora Survey (GHD, 2015b)	Survey for BORR South Proposal Area. This occurs immediately south of the current Surveyed Area and is used to provide context. Two quadrats are within the current Surveyed Area.	Survey completed on 21 – 23 September 2011 and 16 – 18 June 2014. Level 2 flora and vegetation survey including quadrat sampling, targeted searches and vegetation type / condition mapping.
Waterloo Urban and Industrial Expansion Flora and Fauna Survey (GHD, 2015c)	Approximately 2,700 ha between Collie River and approximately Boyanup Picton Road. The study boundaries overlap the current Surveyed Area	Two season flora survey in accordance with EPA guidelines at the time of survey (EPA, 2004b). Late winter (13 – 14 August 2014) and mid-spring (30 – 31 October 2014). Vegetation type and condition mapping based on quadrats and opportunistic records. Searches for conservation significant flora.
Reassessment of Floristic Communities (Biota, 2016)	Targeted areas within BORR South alignment. Two quadrats are within the current Surveyed Area.	Additional quadrats and re-analysis of the FCTs presented in GHD (2015b). Surveys carried out in September 2016.

SURVEY / REPORT NAME	LOCATION / EXTENT IN SURVEY AREA	METHODOLOGY
Report of a Targeted Rare Flora Survey for *Diuris drummondii* along four sections of the Bunbury Outer Ring Road proposed alignment (Ecoedge, 2017)	Targeted assessment on 19 and 30 November 2016 of portions of the BORR South proposed alignment that provide suitable habitat for *Diuris drummondii*. A total of 18.6 ha was searched, however no *D. drummondii* plants were found.	The survey was completed in accordance with the Commonwealth's Draft Survey Guidelines for Australia's Threatened Orchids (Commonwealth of Australia, 2013). A known population of the species nearby was used as a reference to determine when flowering had commenced and optimal timing for the survey.
Banksia TEC Assessment for BORR South (Biota, 2018c) – included in (BORR IPT, 2020i) (Appendix C)	24 target areas within BORR South area and surrounds. This report also provides context for the Banksia TEC assessment. Three target sites are located south-west of the current Surveyed Area. The closest target site is approximately 3 km south-west of the current Surveyed Area.	Walking transects and quadrats within the target sites conducted in November 2017
A Flora and Vegetation survey on Lot 104 Willinge Drive Davenport (Ecoedge, 2018)	Survey of the 83.3 ha within Lot 104 (North east of the Preston River). The study boundary intersects the Proposal Area.	Survey carried out on 30 October and 2 and 3 November 2017. Vegetation type and condition mapping and species lists presented.
Assessment for the presence of *Phytophthora cinnamomi* - Bunbury Outer Ring Road, Stage 2 (Glevan Consulting, 2011)	BORR Southern Section alignment	Visual diagnosis of disease within areas of assessable remnant vegetation
BORR Northern and Central Sections Vegetation and Flora Study (BORR IPT, 2020c)	Detailed flora and vegetation assessment of 1,128 ha, including the Proposal Area. This occurs immediately north of the Proposal Area and is used to provide context.	Detailed vegetation and flora survey was undertaken from 20 August 2018 to 19 December 2018. Targeted surveys were undertaken from 19 to 30 August 2019. The survey included late winter, early spring, mid-spring, late spring and summer survey periods.
Bunbury Outer Ring Road South Alternate Section Vegetation and Flora Study (BORR IPT, 2019a)	Detailed flora and vegetation assessment	Detailed flora and vegetation survey and targeted survey. The surveys were undertaken from 22-25 October 2018 and on 18 November 2018. Surveys included quadrat sampling to determine vegetation types and presence of Threatened and Priority Ecological Communities, as well as targeted

SURVEY / REPORT NAME	LOCATION / EXTENT IN SURVEY AREA	METHODOLOGY
		surveys for conservation listed flora and weeds.
Fauna		
Bunbury Outer Ring Road Southern Section, South Western to Bussell Highways Fauna Assessment (GHD, 2012a)	Bunbury Outer Ring Road Southern Section, between South Western Highway and Bussell Highway	Trees within the study area were assessed for their significance to Black Cockatoo species
Bunbury Outer Ring Road Western Ringtail Possum Assessment (GHD, 2013)	Survey area contained within the current BORR Southern Section alignment	Assessment of 27 ha of native vegetation within the wider 95 ha survey area, plus approx. 14 ha of WRP habitat within nearby Reserve 23000. The survey provided a WRP population density estimate using distance sampling.
Lot 1 Ducane Road Environmental Values Assessment (GHD, 2014)	A portion of the survey area is contained within the current BORR Southern Section alignment	Within the wider scope of works, in relation to fauna the assessment included: • literature review of previous investigations and reports of the offset site and the surrounding areas • desktop assessment of environmental attributes • Level 1 fauna survey (EPA, 2004a).
Bunbury Outer Ring Road Southern Section Fauna Study (GHD, 2015a)	Survey area largely contained within the current BORR Southern Section alignment	Level 1 fauna survey in accordance with EPA Guidance Statement No. 56 (EPA, 2004a) was conducted within the BORR southern section Project Area for fauna conservation significance and any likely fauna constraints and potential impacts that may arise from the Proposal's then design
Bunbury Outer Ring Road (Southern Section) Black Cockatoo Tree Survey. Biota Environmental Sciences (Biota) (2018a)	Bunbury Outer Ring Road (BORR) southern section extending from South Western Highway to Bussell Highway	Updated assessment of Black cockatoo habitat values assessed by GHD in 2011 (GHD, 2012a), and comparison of new data with the 2011 data. Including: • reassessment of the Black Cockatoo breeding habitat trees previously identified in 2011 by GHD (2012) and confirming whether they remain standing and intact • reassessment of trees previously identified as containing hollows • reassessment of previously identified breeding habitat trees

SURVEY / REPORT NAME	LOCATION / EXTENT IN SURVEY AREA	METHODOLOGY
		• marking trees with paint, based on presence of suitable nesting hollows and Black Cockatoo use.
Bunbury Outer Ring Road Southern Section Western Ringtail Possum Assessment (Biota, 2018b)	Bunbury Outer Ring Road Southern Section alignment	Survey for WRP. Sampling undertaken over four nights between 10/07/2018 – 13/07/2018 and comprised walking 38 transects, totalling 7.87 km in the BORR (southern section). No transects were repeat sampled.
Bunbury Outer Ring Road South Alternate Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2019)	Bunbury Outer Ring Road Southern Section Alternate alignment	Survey for targeted conservation significant aquatic fauna such as Black-stripe Minnow
Further surveys undertaken for Proposal following referral to provide supplementary information		
Vegetation and Flora		
Bunbury Outer Ring Road Southern Section Vegetation and Flora Study (BORR IPT, 2020i) (Appendix C)	Detailed flora and vegetation assessment	Detailed flora and vegetation survey and targeted survey. The surveys included August (late winter/ early spring) and September 2018 (spring). A targeted orchid survey of selected sites was completed in August and September 2019. A targeted *D. drummondii* (Tall Donkey Orchid) survey was also completed in 19 November and 30 November 2016 and 30 November 2019. In addition a targeted survey for TECs/PECs, including Tuart TEC, and confirmation of vegetation types in previously unsurveyed gaps in the survey area was also undertaken in September 2019.
A Review of the Regional Conservation Status of a Clay-based Wetland Community (Claypans) (Ecoedge, 2019a) (Appendix G)	Region defined as on the SCP within Harvey, Bunbury, Capel, Dardanup and Busselton local government areas	Desktop review and targeted field assessments for Claypan TECs conducted in 26 July – 1 August 2019 to provide additional information requested in Section 40(2)(a) Notice.
Memorandum of a Targeted Rare Flora Survey for *Diuris drummondii* within and adjacent to the Bunbury Outer Ring Road South	Targeted Rare Flora Survey for *D. drummondii* within and adjacent to the Bunbury Outer Ring Road South referral area	Survey conducted in accordance with the Commonwealth's Draft Survey Guidelines for Australia's Threatened Orchids (Commonwealth of Australia, 2013)

SURVEY / REPORT NAME	LOCATION / EXTENT IN SURVEY AREA	METHODOLOGY
referral area (Ecoedge, 2019b) (Appendix H)		
Review of Potential Claypan Occurrences in the BORR Southern Section – included in (BORR IPT, 2020i)	Within the locality of the BORR Southern Section alignment	Survey carried out on 1 August 2019. Condition, hydrology and species diversity were assessed to confirm whether the vegetation met the floristic and condition thresholds of the Claypan TEC. Results are documented in an updated revision of the Flora and Vegetation Study for the Proposal to informed the avoidance, management, mitigation and monitoring actions to provide additional information requested in Section 40(2)(a) Notice.
***Phytophthora* Dieback Survey Bunbury Outer Ring Road South (Great Southern Bio Logic Pty Ltd, 2020) (Appendix D)**	*Phytophthora* dieback survey of the Bunbury Outer Ring Road southern section alignment	Survey undertaken in accordance with DBCA guidelines
Fauna		
Bunbury Outer Ring Road South Section Targeted Fauna Assessment (Biota, 2020a) (Appendix E)	Targeted habitat survey encompassing the 200 ha Proposal Area and approximately 97 ha buffering context area	Targeted field surveys conducted in five phases over the course of spring and summer 2018, and winter 2019 for conservation significant Black Cockatoo species, WRP and BSM survey
Western Ringtail Possum: *Pseudocheirus occidentalis* Regional Surveys (Biota, 2020b)	Local vicinity of Northern, Central, and Southern Section alignments and buffering context area	Focussed Regional surveys from December of 2019 through December 2020. Surveys including radio tagging for home range assessments, trapping and survey of potential offset areas and other local context sites to better define local movement of populations.
Bunbury Outer Ring Road Southern Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2020b) (Appendix F)	Targeted aquatic fauna survey within seasonal wetlands and creeks within the Proposal Area	Winter (19 - 23 August 2019) targeted conservation significant aquatic fauna survey

2.4 Threatened ecological communities

Implementation of the Proposal will result in clearing of up to 71.5 ha of native vegetation, of which 70.5 ha is remnant native vegetation and 1 ha is revegetation (planted native vegetation). An estimated 29.3 ha of the Proposal Area comprises vegetation representative of threatened ecological communities (TECs).

Occurrences of three TECs were identified by DAWE as having a potential to occur within the Proposal Area, as per the DAWE request for additional information dated 11 February 2020:

- Banksia Woodlands TEC
- Tuart Woodlands TEC
- Clay Pans TEC.

Flora and vegetation assessments conducted for the Proposal confirmed the presence of both Banksia and Tuart Woodlands TECs within and adjacent to the Proposal Area. No Clay Pans TEC was recorded within the Proposal Area. The closest known occurrence is located 650 m from the Proposal Area boundary at its nearest point (Figure 8, Appendix A).

Potential impacts of the Proposal to the TECs have been assessed below, and where these represent a Floristic Community Type (FCT) as identified by Gibson *et al.* (1994), the corresponding FCT is noted.

2.4.1 Banksia Woodlands TEC - Endangered

A description of this ecological community, direct and potential indirect impacts from the Proposal is outlined in Table 2-6.

Table 2-6 Banksia Woodlands TEC – Endangered

ASPECT	DESCRIPTION
Ecology, abundance, distribution and habitat preferences	Ecology Banksia Woodlands TEC was listed as an Endangered TEC under the EPBC Act in September 2016. The TSSC (2016) describes the key structural features of the community as: • A prominent tree layer of *Banksia*, with scattered eucalypts and other tree species often present among, or emerging above, the canopy • The understorey is a species rich mix of sclerophyllous shrubs, graminoides and forbs • High endemism and considerable localised variation in species composition across its range. • The community is a low woodland to forest, but may also include shrubland, open woodland or forest under some classification systems. The percentage canopy cover is more than 2% and typically less than 50%. The structure and appearance may also vary due to disturbance history (TSSC, 2016). The canopy is commonly dominated by *Banksia attenuata* and or *B. menziesii*. Other *Banksia* species that dominate include *B. prionotes* or *B. ilicifolia*. The patch must include at least one of these diagnostic species (TSSC, 2016). Abundance

ASPECT	DESCRIPTION
	The current extent of Banksia Woodlands TEC as of 2015 is estimated to be > 335,000 ha covering within the subregions of Dandaragan, Perth and Jarrah Forests (TSSC, 2016). Distribution The Banksia Woodlands TEC occurs within the SCP IBRA Bioregion and typically occurs on well drained, low nutrient soils on sandplains landforms, particularly in deep Bassendean and Spearwood sands and occasionally on Quindalup sands (TSSC, 2016). Critical Habitat The areas considered critical to the survival of the Banksia Woodlands TEC cover all patches that meet the key diagnostic characteristics and condition thresholds for the ecological community, plus the buffer zones, particularly where this comprises surrounding native vegetation. This is because this ecological community occurs in a landscape that has often been very heavily cleared and modified, and now exists as mostly very small and highly fragmented patches (TSSC, 2016). Threats Key threats to the TEC identified in the Approved Conservation Advice (TSSC, 2016) include clearing and fragmentation, dieback, invasive species, changes to fire regime, hydrological degradation, climate change, grazing, decline in pollination and seed dispersing fauna and loss of keystone Banksia species. Description of this TEC vegetation within the Proposal Area Vegetation types 1 (Open forest of *Eucalyptus marginata, Corymbia calophylla* and *Banksia attenuata* on Karrakatta deep sands), 2 (Open forest of *Eucalyptus marginata, Corymbia calophylla, Banksia attenuata* and *Agonis flexuosa* on Bassendean dunes) and 4 (Open forest of *Banksia attenuata* and *Agonis flexuosa*) mapped by BORR IPT (2020i) were considered to be potentially representative of the Banksia Woodland TEC, however, not all occurrences of these vegetation types are considered to be TEC due to not meeting the patch size / condition thresholds for the Banksia Woodlands TEC. These vegetation types were inferred to be FCT21a. Extent within and adjacent to the Proposal Area The flora and vegetation surveys mapped a total of 33.9 ha of Banksia Woodlands TEC within the 350 ha Surveyed Area (BORR IPT, 2020i). Up to 24.9 ha of vegetation representing Banksia Woodlands TEC was identified within the Proposal Area. This vegetation was inferred to be FCT21a. A further 4.9 ha is located within 20 m of the Proposal Area boundary, as detailed below (indirect impact). Occurrences within the Proposal Area are listed below and shown in Figure 6 (Appendix A), and those directly adjacent to the Proposal Area are shown in Figure 7 (Appendix A).

ASPECT	DESCRIPTION
Direct impact (ha)	Up to 23.4 ha of Banksia Woodlands TEC vegetation within the Proposal Area will be cleared as a result of implementing the Proposal (Figure 6, Appendix A). The Banksia Woodlands TEC vegetation within the Proposal Area is split across three sites: • **Site BW-S-D-1** Bussell Highway road reserve from Calinup Road and Lakes Road 20 ha - VT1 - Open forest of *Eucalyptus marginata, Corymbia calophylla* and *Banksia attenuata* on Karrakatta deep sands and VT4 - Open forest of *B. attenuata* and *Agonis flexuosa* - Condition: 2-3 to 7 (Excellent-Very Good to Completely Degraded) • **Site BW-S-D-2** North of Jilley Road - 2.9 ha - VT1 - Open forest of *E. marginata, C. calophylla* and *B. attenuata* on Karrakatta deep sands - Condition: 2-3 (Excellent-Very Good) • **Site BW-S-D-3** Marchetti Road - 0.5 ha - VT2 - Open forest of *E. marginata, C. calophylla, B. attenuata* and *A. flexuosa* on Bassendean dunes - Condition: 2 (Excellent)
Indirect impact (ha)	Potential indirect impacts resulting from Proposal implementation that may occur in Banksia Woodlands TEC vegetation directly adjacent to the Proposal Area include: • Possible introduction and / or spread of *Phytophthora* dieback and weeds • Damage through accidental generation of a bushfire during construction. Of these, the risk of fire and *Phytophthora* dieback are potentially the most far-reaching, extending up to 100 m or more beyond the Proposal Area boundary. Main Roads' standard construction practices combined with the management actions detailed in Section 4.1 will specifically and effectively manage the potential for these indirect impacts to occur. As such, the potential for fire and *Phytophthora* dieback impacts up to 100 m from the Proposal are not anticipated to result from Proposal implementation. Main Roads has defined a potential indirect impact management zone extending 20 m into adjacent Tuart Woodland TEC occurrences. The introduction and spread of weeds is a more localised potential impact within 20 m of the Proposal with a greater risk of occurrence that will be managed through implementation of the proposed active management in accordance with Main Roads standards, as detailed in Section 4.1.4.

ASPECT	DESCRIPTION
	• The extent of Banksia Woodlands TEC within 20 m of the Proposal Area has been calculated and is presented below to identify areas of higher risk and greater potential for indirect impacts proximate to the Proposal Area (Figure 7, Appendix A). Considering the nature of the project (road construction) and that construction will be limited to the Proposal Area, the likelihood of indirect impacts from the introduction or spread of weeds on Banksia Woodlands TEC vegetation further than 20 m from the Proposal Area boundary resulting from the Proposal is negligible. • **Site BTW-S-I-3** Road reserve along Centenary Road east of Bussell Hwy - 0.5 ha within 20 m of the Proposal Area - Approximate patch size: > 100 ha - Percentage of patch within 20 m of Proposal Area: < 0.5 % - Vegetation type: *Corymbia calophylla* and *Eucalyptus marginata* Open Woodland over *Banksia attenuata, Agonis flexuosa, Xylomelum occidentale, Banksia grandis* Low Open Woodland over *Kunzea glabrescens* Tall Open Shrubland over *Jacksonia sternbergiana, Acacia extensa, Stirlingia latifolia brunonis* Open Shrubland over *Xanthorrhoea brunonis, Hibbertia hypericoides* and *Macrozamia riedlei* Low Open Shrubland over Lomandra micrantha, *Phlebocarya ciliata* Very Open Herbland and **Ehrharta calycina*, **Briza maxima* Very Open Grassland and *Lepidosperma squamatum* and *Hypolaena exsulca* Very Open Sedgeland. - Condition: Excellent to Good • **Site BTW-S-I-4** West of Bussell Hwy (two land parcels) (Reserve 23000 (land_id_nu: 3415480)) - 3.4 ha within 20 m of the Proposal Area - Approximate patch size: > 100 ha - Percentage of patch within 20 m of Proposal Area: < 3.4 % - Vegetation type: *Eucalyptus marginata* and *Corymbia calophylla* Open Woodland over *Banksia attenuata, Xylomelum occidentale, Banksia grandis* Low Open Forest over *Hibbertia hypericoides, Xanthorrhoea brunonis* and *Macrozamia riedlei* Low shrubland over *Phlebocarya ciliata*, *Conostylis aculeata*, *Burchardia congesta*, *Orthrosanthus laxus* Very Open Herbland **Ehrharta calycina*, **Briza maxima* Very Open Grassland and *Lepidosperma squamatum*, *Lepidosperma pubisquameum* and *Hypolaena exsulca* Very Open Sedgeland - Condition: Excellent to Good • **Site BW-S-I-6** Jilley Road north of Woods Road - 0.6 ha within 20 m of the Proposal Area - Approximate patch size: 3 ha - Percentage of patch within 20 m of Proposal Area: ~ 20 %

ASPECT	DESCRIPTION
	- Vegetation type: *Corymbia calophylla* Low Open Forest over *Banksia attenuata, Banksia grandis, Xylomelum occidentale* Low Open Woodland over *Hibbertia hypericoides* Low Shrubland over *Phlebocarya ciliata* and *Lomandra micrantha* Open Herbland - Condition: Excellent and Very Good • **Site BW-S-I-7** East of Yalinda Drive, west of Marchetti Road (P232768 / 156) - 0.4 ha within 20 m of the Proposal Area - Approximate patch size: 7 ha - Percentage of patch within 20 m of Proposal Area: ~ 5.7 % - Vegetation type: *Eucalyptus marginata* Open Woodland over *Banksia attenuata, Banksia ilicifolia, Xylomelum occidentale* Low Open Woodland over *Kunzea glabrescens* Tall Open Shrubland over *Macrozamia riedlei, Stirlingia latifolia* Open Shrubland over *Hibbertia hypericoides, Melaleuca thymoides, Acacia pulchella* Low Shrubland over *Phlebocarya ciliata, Dasypogon bromeliifolius* Very Open Herbland over *Lepidosperma pubisquameum* Very Open Sedgeland and **Ehrharta calycina* Very Open Grassland - Condition: Very Good to Excellent
Areas of larger contiguous patches that will be fragmented	Based on the findings of the BORR IPT (2020i) vegetation and flora study (and as detailed in Section 3.1.1), no occurrences of Banksia Woodlands TEC will be fragmented by the Proposal to the extent that they no longer represent occurrences of the TEC under the criteria specified by the TSSC (2016). Further, no occurrences of Banksia Woodlands TEC vegetation are expected to be indirectly impacted to the extent that these no longer represent this TEC.
Quality and importance of known or potential habitat within the proposed action area and surrounds	Areas considered critical to the survival of the Banksia Woodlands TEC cover all patches that meet the key diagnostic characteristics and condition thresholds for the ecological community, plus the buffer zones, particularly where this comprises surrounding native vegetation. This is because this ecological community occurs in a landscape that has often been very heavily cleared and modified, and now exists as mostly very small and highly fragmented patches (TSSC, 2016). The condition of the Banksia Woodlands TEC within the Proposal Area is as follows: • **Site BW-S-D-1** - 20.0 ha located in the Bussell Highway road reserve from Calinup Road and Lakes Road intersection extending north of Woods Road - Condition: ▪ 1.1 ha Excellent-Very Good ▪ 2.8 ha Very Good ▪ 3.3 ha - Good-Very Good ▪ 1.5 ha - Good

ASPECT	DESCRIPTION
	▪ 11.6 ha - Good-Degraded ▪ 0.7 ha - Degraded ▪ 0.4 ha - Degraded-Completely Degraded ▪ 0.1 ha - Completely Degraded • **Site BW-S-D-2** - 2.9 ha located North of Jilley Road - Condition: 2.9 ha - Excellent-Very Good • **Site BW-S-D-3** - 0.5 ha located near Marchetti Road - Condition: 0.5 ha - Excellent
Known extent within at least a 2 km buffer	An assessment of DBCA database extracts (DBCA, 2020) indicates the predicted occurrence of > 4,600 ha of Banksia Woodlands TEC within a 5 km radius of the Proposal Area (Figure 8, Appendix A). Occurrences of Banksia Woodlands TEC communities directly adjacent to the Proposal Area have been identified as part of the proposed monitoring program. These are detailed above and shown in Figure 7, Appendix A.
Adequacy of any surveys undertaken	Areas of potential TEC were identified through the desktop review (including soils mapping), previous surveys in the area (Biota, 2018c; Ecoedge, 2018; GHD, 2014), initial site reconnaissance visit, detailed vegetation assessment and aerial photography. Potential TEC areas were assessed (using quadrats and traverses) during the BORR IPT survey (BORR IPT, 2020i) (Appendix C). Field surveys were undertaken in accordance with the EPA's Technical Guidance (EPA, 2004b). The BORR IPT vegetation and flora survey (BORR IPT, 2020i) was undertaken over a 2-year period, from August to November 2018 and from August to November 2019, with the survey effort totalling approximately 560 person-hours. Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation.
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of Banksia Woodlands TEC occurrences within and adjacent to the Proposal Area was assessed based on data collected during field surveys and analysed using multivariate analysis, NatureMap and Protected Matters Search results, and consideration of the Approved Conservation Advice (TSSC, 2016).

2.4.2 Tuart Woodlands TEC – Critically Endangered

A description of this ecological community, direct and potential indirect impacts from the Proposal has been outlined in Table 2-7.

Table 2-7 Tuart Woodlands TEC – Critically Endangered

ASPECT	DESCRIPTION
Ecology, abundance, distribution and habitat preferences	Ecology The Tuart Woodlands TEC was listed as a TEC under the EPBC Act in 2019 at the level of Critically Endangered as assessed using the criteria of the IUCN (2015) and guidance of (TSSC, 2019). The TSSC (2019) describes the key structural features of the Tuart Woodlands TEC as comprising: • Woodlands or forests or other structural forms where the primary defining feature is the presence of (Tuart) trees in the uppermost canopy layer (comprising at least two living established individuals and > 0.5 ha in area) • Co-occurring with other tree species such as *Banksia attenuata* (Candlestick Banksia), *Agonis flexuosa* (Peppermint), *Eucalyptus marginata* (Jarrah) or *Corymbia calophylla* (Marri) • An understorey of native plants is typically present, which may include grasses, herbs and shrubs, although this is often modified by disturbance. The TSSC (2019) provides guidance for determining the presence of the Tuart Woodlands TEC including criteria used to define the requirements for the community structure and composition, vegetation condition and minimum patch size. These criteria were used to assess vegetation communities representative of the Tuart Woodlands TEC during the environmental surveys for the Proposal. Abundance The current extent of Tuart Woodlands TEC as of 2015 is estimated to be > 17,000 ha, with the majority (approximately 75%) occurring within the southern part of its distribution, in which the Proposal Area is also located. The three largest patches of the Tuart Woodlands TEC are also found in the southern part of the range, and are all substantially in conservation tenure (TSSC, 2019). Distribution The Tuart TEC occurs on the SCP in the SCP IBRA Bioregion, from Jurien, approximately 200 km north of Perth, to the Sabina River, near Busselton, 225 km south of Perth (TSSC, 2019). Critical Habitat In relation to critical habitat, the TSSC (2019) states that, given the high rates and loss of the TEC across its range, all remnants contribute to the survival of the ecological community, but not all are protected as MNES. Areas that are

ASPECT	DESCRIPTION
	included within secure conservation reserves are very important to the survival of the ecological community. Areas that meet the key diagnostic characteristics but not the minimum size and condition thresholds are also recognised as contributing to recovering the integrity of the ecological community, as are areas of nearby native vegetation be they Tuart woodlands and forests or not. <u>Threats</u> Key potential threats to the Tuart Woodlands TEC identified in the (TSSC, 2019) conservation advice include vegetation clearing and fragmentation, invasive introduced flora and fauna taxa, *Phytophthora* dieback, altered fire regimes, climate change, and hydrological change including groundwater abstraction. <u>Description of this TEC vegetation within the Proposal Area</u> Vegetation type VT1b (Open forest of *Eucalyptus gomphocephala* with occasional *Eucalyptus marginata* over *Agonis flexuosa* and *Banksia attenuata* on yellow sand over limestone) mapped by BORR IPT (2020i) was considered to be potentially representative of the Tuart Woodlands TEC however, not all occurrences of these vegetation types are considered to be TEC due to not meeting the patch size / condition / structure thresholds for the TEC. These vegetation types were inferred to be FCT25. <u>Extent within and adjacent to the Proposal Area</u> The flora and vegetation surveys mapped a total of 7.3 ha of the Tuart Woodlands TEC within the Surveyed Area, all in a single occurrence BORR IPT (2020i). This occurrence extends beyond the Surveyed Area (and Proposal Area) to a total extent of > 25 ha. Up to 4.4 ha of the TEC, inferred to be FCT25, was identified within the Proposal Area. A further 2.55 ha is located within 30 m of the Proposal Area boundary, as detailed below (indirect impact). Occurrences within the Proposal Area are listed below and shown in Figure 6. (Appendix A), and those directly adjacent to the Proposal Area are shown in Figure 7 (Appendix A).
Direct impact (ha)	The Proposal Area contains 4.4 ha of Tuart Woodlands TEC, all of which will potentially be cleared to enable Proposal implementation (Figure 6, Appendix A). The Proposal Area contains one occurrence of Tuart Woodlands TEC: • **Site TW-S-D-2** located near the eastern side of Bussell Highway at the intersection of Bussell Highway and Centenary Road: - 4.4 ha - VT1b Open forest of *Eucalyptus gomphocephala* with occasional *E. marginata* over *Agonis flexuosa* and *Banksia attenuata* on yellow sand over limestone - Condition ranging from Very Good to Completely Degraded.

ASPECT	DESCRIPTION
Indirect impact (ha)	Potential indirect impacts to Tuart Woodlands TEC directly adjacent to the Proposal include: - Introduced flora taxa - introduction and / or spread of introduced flora taxa (weeds) during construction works - *Phytophthora* dieback - introduction and / or spread of *Phytophthora* dieback during construction works - Fire – potential for fire caused by construction works (in particular, for 'hot works' such as grinding/welding of steel). Of these, the risk of fire and *Phytophthora* dieback are potentially the most far-reaching, extending up to 100 m or more beyond the Proposal Area boundary. Main Roads' standard construction practices combined with the management actions detailed in Section 4.1 will specifically and effectively manage the potential for these indirect impacts to occur. As such, the potential for fire and *Phytophthora* dieback impacts up to 100 m from the Proposal are not anticipated to result from Proposal implementation. Main Roads has defined a potential indirect impact management zone extending 20 m into adjacent Tuart Woodland TEC occurrences. The introduction and spread of weeds is a more localised potential impact within 20 m of the Proposal with a greater risk of occurrence that will be managed through implementation of the proposed active management in accordance with Main Roads standards, as detailed in Section 4.1. To quantify potential indirect impacts, the extent of Tuart Woodlands TEC within 30 m of the Proposal Area has been calculated and is presented below to identify areas of higher risk and greater potential for indirect impacts proximate to the Proposal Area (Figure 7, Appendix A). Considering the nature of the project (road construction) and that construction will be limited to the Proposal Area, the likelihood of indirect impacts from the introduction or spread of weeds on Tuart Woodlands TEC vegetation further than 20 m from the Proposal Area boundary resulting from the Proposal is negligible. All three potential indirect impact sites listed below are associated with the same Tuart Woodlands TEC occurrence. After clearing for the Proposal has been completed, this TEC occurrence will be more than 25 ha in size. Up to 14.6 % of the occurrence is within 30 m of the Proposal Area boundary. • **Site BTW-S-I-2** North side of Centenary Rd east of Bussell Hwy, north westernmost part of Proposal Area (P183835 / 632) - 1.13 ha within 30 m of the Proposal Area - Approximate patch size: > 25 ha - Percentage of patch within 30 m of Proposal Area: ~ 4.5 % - Vegetation type: *Eucalyptus gomphocephala* Open Woodland over *Banksia attenuata, Agonis flexuosa, Xylomelum occidentale* Low Woodland over *Spyridium globulosum* Tall Open Shrubland over *Hibbertia hypericoides, Xanthorrhoea brunonis* and *Macrozamia riedlei* Low Shrubland over *Orthrosanthus laxus, Dichopogon capillipes, *Ursinia anthemoides* Very Open Herbland

ASPECT	DESCRIPTION
	and **Briza maxima, *Avena barbata, *Ehrharta calycina* Open Grassland and L*epidosperma squamatum* Very Open Sedgeland. - Condition: Excellent to Good • **Site TW-S-I-3** East of Bussell Highway (P023258 / 100) - 1.05 ha within 30 m of the Proposal Area - Approximate patch size: > 25 ha - Percentage of patch within 30 m of Proposal Area: ~ 4 % - Vegetation type: Open forest of *Eucalyptus gomphocephala* with occasional *Eucalyptus marginata* over *Agonis flexuosa* and *Banksia attenuata* - Condition: Degraded – Completely Degraded • **Site TW-S-I-4** East of Jules Road (P023258 / 101) - 0.37 ha within 30 m of the Proposal Area - Approximate patch size: > 25 ha - Percentage of patch within 30 m of Proposal Area: ~ 1.5 % - Vegetation type: *Eucalyptus gomphocephala* Open Woodland - Condition: Degraded – Completely Degraded.
Areas of larger contiguous patches that will be fragmented	Indirect impacts to Tuart Woodlands TEC from fragmentation is not expected, and accordingly, has not been listed above. The Proposal will not remove areas of Tuart Woodlands TEC to an extent that the remaining area is no longer representative of the TEC under the (TSSC, 2019) criteria. A portion of a single large (> 30 ha) occurrence will be cleared. More than 25 ha of the occurrence will remain after clearing.
Quality and importance of known or potential habitat within the proposed action area and surrounds	The Proposal Area contains one occurrence of Tuart Woodlands TEC: • **Site TW-S-D-2** - 4.4 ha located on the eastern side of Bussell Highway at the intersection of Bussell Highway and Centenary Road - Condition: ▪ 0.8 ha - Very Good ▪ 2.9 ha - Good-Degraded ▪ 0.7 ha - Completely Degraded
Known extent within at least a 2 km buffer	At a local scale, regional mapping indicates the predicted occurrence of > 1,700 ha of the Tuart Woodlands TEC within a 5 km radius of the Proposal[7] (DBCA, 2020) (Figure 8, Appendix A).
Adequacy of any surveys undertaken	Areas of potential Tuart Woodlands TEC were identified through the desktop review (including soils mapping), previous surveys in the area (Biota, 2018c; Ecoedge, 2018; GHD, 2014), initial site reconnaissance visit, detailed vegetation assessment and aerial photography. Potential TEC areas were

[7] Note: The regional extent of the Tuart Woodlands TEC from DBCA (2020a) has been cropped to DPIRD (2019) *Current Extent of Native Vegetation – Western Australia* layer to remove any mapped TEC areas which may extend into cleared land areas (i.e. TEC mapping 'buffers' or recently cleared native vegetation).

ASPECT	DESCRIPTION
	assessed (using quadrats and traverses) during the BORR IPT survey (BORR IPT, 2020i) (Appendix C). Field surveys were undertaken in accordance with the EPA's Technical Guidance (EPA, 2004b). The BORR IPT vegetation and flora survey (BORR IPT, 2020i) was undertaken over a two year period, from August to November 2018 and from August to November 2019, with the survey effort totalling approximately 560 person-hours. Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation.

2.4.3 Clay Pans TEC – Critically Endangered

A description of this ecological community is outlined in Table 2-8.

Environmental surveys for the Proposal did not identify the Clay Pans TEC within or adjacent to the Proposal Area. Accordingly, the Proposal will not result in any direct impact, and is not expected to have potential for an indirect impact, to the Clay Pans TEC.

Table 2-8 Clay Pans TEC – Critically Endangered

ASPECT	DESCRIPTION
Ecology, abundance, distribution and habitat preferences	<u>Ecology</u> The Clay Pans TEC and other clay pan communities occur where clay substrate is low in the landscape and forms an impermeable layer close to the surface. These wetlands rely on rainfall and local surface drainage to fill and are unlikely to be connected to groundwater. The clay pans dry out to form a relatively impervious substrate in summer. A suite of perennial plants that propagate by underground bulbs, tubers or corms (geophytes), and annual herbs flower sequentially as the clay pans dry out. The clay pans are the most diverse of the SCP wetlands and contain a number of local endemic flora (DBCA, 2019). Clay Pans TEC vegetation is dominated by one or more of the shrubs: V*iminaria juncea, Melaleuca viminea, M. lateritia, Kunzea micrantha* or *K. recurva* with occasional emergent of *Eucalyptus wandoo*. Species such as *Hypocalymma angustifolium, Acacia lasiocarpa* var. bracteolata long peduncle variant (G. J. Keighery 5026) (P1) and *Verticordia huegelii* occur at moderate frequencies (TSSC, 2012). <u>Abundance</u> The Clay Pans TEC Approved Conservation Advice noted that in 2010, the ecological community occupied approximately 600 ha in total area, however it was highly fragmented with most remnants being less than 10 ha in size (TSSC, 2012). <u>Distribution</u> The Clay Pans TEC occurs within the SCP and Jarrah Forest Interim Biogeographic Regionalisation for Australia (IBRA) bioregions (DoE, 2012) and the South West Botanical Province (SWBP) of Western Australia (TSSC, 2012). The Clay Pans TEC

ASPECT	DESCRIPTION
	extends from Jurien in the north to Dunsborough in the south and over most of the length of the plain it is less than 30 km wide, bounded on the east by the faulted Yilgarn block and on the west by the Indian Ocean. Critical Habitat The recovery plan (DBCA, 2019) describes habitat critical to survival of the Clay Pans TEC as including the area of occupancy of known occurrences; similar habitat adjacent to important occurrences (i.e. within approximately 200 m), i.e. poorly drained flats, depressions or winter wet flats with shallow sands and loams; remnant vegetation that surrounds or links several occurrences (this is to provide habitat for pollinators or to allow them to move between occurrences); and the local catchment for the surface, and potentially groundwater, that maintains the winter-wet habitat of the community. The plant assemblages are dependent on maintenance of the local hydrological conditions (DBCA, 2019). Threats Key threats to the Clay Pans TEC include land use (historical clearing), altered hydrology, rising groundwater, weeds and pathogens, inappropriate fire regimes, inappropriate land use and recreation, the viability of the small sized remnants that remain and climate change (DBCA, 2019). Description of Clay Pans TEC vegetation within the Proposal Area Environmental surveys conducted for the Proposal did not identify the Clay Pans TEC within or adjacent to the Proposal Area (BORR IPT, 2020i). Extent within and adjacent to the Proposal Area The environmental surveys for the Proposal did not identify the Clay Pans TEC within or adjacent to the Proposal Area (BORR IPT, 2020i).
Direct impact (ha)	Environmental surveys conducted for the Proposal did not identify the Clay Pans TEC within or adjacent to the Proposal Area (BORR IPT, 2020i). The nearest record for the Clay Pans TEC is located approximately 650 m north-east of the Proposal (Figure 8, Appendix A). Accordingly, the Proposal will not result in any direct impact to Clay Pans TEC vegetation.
Indirect impact (ha)	Environmental surveys conducted for the Proposal did not identify the Clay Pans TEC within or adjacent to the Proposal Area (BORR IPT, 2020i). The nearest record for the Clay Pans TEC is located approximately 650 m north-east of the Proposal (Figure 8, Appendix A). Due to the notable separation distance, the Proposal is not expected to result in indirect impacts to the Clay Pans TEC from changes in hydrology or any other indirect impacts.
Areas of larger contiguous patches that will be fragmented	Environmental surveys conducted for the Proposal did not identify the Clay Pans TEC within or adjacent to the Proposal Area (BORR IPT, 2020i). Accordingly, the Proposal will not result in fragmentation of Clay Pans TEC occurrences.
Quality and importance of known or potential habitat within the	Environmental surveys conducted for the Proposal did not identify the Clay Pans TEC within or adjacent to the Proposal Area (BORR IPT, 2020i). Accordingly, the Proposal will not result in any direct impact to the Clay Pans TEC.

ASPECT	DESCRIPTION
proposed action area and surrounds	
Known extent within at least a 2 km buffer	Eight occurrences of Clay Pans TEC (comprising four different floristic community types) have been mapped within a 5 km radius of the Proposal (DBCA, 2020) (Figure 8, Appendix A).
Adequacy of any surveys undertaken	Areas of potential TEC were identified through the desktop review (including soils mapping), previous surveys in the area (Biota, 2018c; Ecoedge, 2018; GHD, 2014), initial site reconnaissance visit, detailed vegetation assessment and aerial photography. Potential TEC areas were assessed (using quadrats and traverses) during the BORR IPT survey (BORR IPT, 2020i). Field surveys were undertaken in accordance with the EPA's Technical Guidance and the Commonwealth Government's Survey Guidelines for Australia's Threatened Orchids (Commonwealth of Australia, 2013). The BORR IPT vegetation and flora survey (BORR IPT, 2020i) was undertaken over a 2-year period, from August to November 2018 and from August to November 2019, with the survey effort totalling approximately 560 person-hours. Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation.
Methods, data analysis and scientific literature used to identify and assess the environmental values	Environmental surveys conducted for the Proposal did not identify the Clay Pans TEC within or adjacent to the Proposal Area (BORR IPT, 2020i).

2.5 Threatened fauna

2.5.1 Black Cockatoos (Forest Red-tailed Black Cockatoo - Vulnerable; Baudin's Cockatoo - Endangered; Carnaby's Cockatoo– Endangered)

The following three species of Black Cockatoo were identified as occurring (foraging evidence) within the Proposal Area during detailed fauna assessments (Biota, 2020a):

- Baudin's Cockatoo (*Calyptorhynchus baudinii*)
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*)
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*).

The distribution and habitat requirements for each of the above taxa are similar, and accordingly, the impact of the Proposal to these three taxa has been considered together. In the assessment, the species have been grouped as 'Black Cockatoos'. For Black Cockatoos, the significance of environmental impact is considered in terms of the effect on habitat and individuals, rather than a resident population, given the mobility of the taxa.

A description of these species, as well as direct and potential indirect impacts from the Proposal is outlined in Table 2-9.

Table 2-9 Forest Red-tailed Black Cockatoo, Baudin's Cockatoo and Carnaby's Cockatoo

ASPECT	DESCRIPTION
Ecology, abundance, distribution and habitat preferences	Ecology 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 beak and bright red, orange and yellow barring in the tail. The male is distinguished by broad red tail panels that are only visible when alighting. The female is distinguished by yellow or whitish spots on the feathers of the head and upper wing (DEWHA, 2009a). The Baudin's Cockatoo is 50-57 cm in length and is mostly dull black in colour, with pale whitish margins on the feathers, ear coverts and tail. The male has a large black bill whilst females are whitish-grey with a black tip (TSSC, 2018d). The Carnaby's Cockatoo is 53-58 cm in length and is mostly black, with white cheek patches, large white panels on the tail and a curved beak (DPaW, 2013). Abundance The Forest Red-tailed Black Cockatoo occurs in one population of approximately 15,000 individuals (DEWHA, 2009a). The total population of the Baudin's Cockatoo is estimated at 12,500 individuals. The species occurs mainly in flocks (up to 300 individuals), and occasionally larger aggregations (up to 1,200 individuals) at roosts (TSSC, 2018d). The Carnaby's Cockatoo total population was estimated in the 1980s to be between 11,000 and 60,000 individuals, and in 2010 to be 40,000 individuals, and is considered to exist as one large interconnected population (DPaW, 2013). Distribution The distribution for each of the three species differs slightly. Baudin's Cockatoo occur predominantly within the Jarrah Forest and SCP zones, approximately from Northam and Muchea near Perth and south to Albany. Carnaby's Cockatoo distribution extends into the Wheatbelt north to Kalbarri and east to Esperance. Forest Red-tailed Black Cockatoo occurs within forested areas from Perth south east to Albany. Habitat preferences Black Cockatoos are known to utilise a range of habitats and plant species for foraging (including introduced species such as pines, **Pinus* spp.), although Marri and Jarrah woodlands are particularly important to Baudin's Black-Cockatoo and the Forest Red-tailed Black-Cockatoo. Proteaceous heaths (i.e. shrublands dominated by *Banksia, Hakea* and *Grevillea* species) are also utilised by Carnaby's Black-Cockatoo (DSEWPC, 2012b). Black Cockatoo breeding habitat, as defined in the Commonwealth referral guidelines (DoEE, 2017), includes: • Relevant tree species with a suitable Diameter at Breast Height (DBH) to develop a nest hollow, where DBH is greater than or equal to 500 mm (herein referred to as 'Suitable DBH Trees') • Trees with a hollow that meets the DoEE (2017) depth, width and angle criteria for nesting by Black Cockatoos, herein referred to as 'Trees with a Suitable Nest Hollow'

ASPECT	DESCRIPTION
	• Known Nesting Trees are those trees that have secondary evidence of nesting i.e. feathers, eggs / shells etc. <u>Breeding parameters</u> Studies of the breeding behaviours of the three threatened Black Cockatoo species have identified variation between the three species and characteristics of hollows chosen for nesting. Baudin's Black-Cockatoo nest in hollows in live or dead trees of Karri, Marri, Wandoo and Tuart, with hollow depth ranging from 0.1 to 2.5 m (Johnstone, 2011). Carnaby's Black-Cockatoo nest in hollows in live or dead trees of Salmon Gum, Wandoo, Tuart, Jarrah, Flooded Gum, York Gum, Powderbark, Karri and Marri with a hollow depth ranging from 0.5 to over 2.0 m, with an average of just over 1 m (Saunders, 2014). Forest Red-Tailed Black-Cockatoos nest in hollows in live or dead trees of Karri, Marri, Bullich, Swan River Blackbutt, Tuart and Jarrah with a hollow depth ranging from 1- 5 m (Johnstone, 2011). The breeding timing of the three species is as follows (DSEWPC, 2012b): • Baudin's Black-Cockatoo breeds from August / September through to February / March • Carnaby's Black-Cockatoo breeds from July / August through to January / February • Forest Red-tailed Black-Cockatoo breeds in October / November, however, in years with good autumn rainfall, may breed in March / April <u>Species and habitat extent within the Proposal Area</u> The Proposal Area is located in what is generally considered to be the typical breeding distribution of the Forest Red-tailed Black Cockatoo, however, all three cockatoo species have breeding areas overlapping the Proposal Area (Biota, 2020a). All trees and areas of potential Black Cockatoo habitat within the Proposal Area were included in field surveys (Figure 9, Appendix A). Evidence of foraging by all three species was recorded within and adjacent to the Proposal Area, and either Baudin's or Carnaby's cockatoo were observed flying overhead during field surveys (Biota, 2020a). All three species were identified as occurring within the Proposal Area with 65.4 ha of suitable habitat for foraging and potentially breeding identified in targeted surveys (Biota, 2020a). Within the Proposal Area, Black Cockatoo foraging habitat was comprised of two mapped habitat types: 'Marri / *Eucalyptus* woodland' and 'Marri / *Eucalyptus* in paddocks and road reserves', as shown in Figure 9, Appendix A. <u>Threats</u> Primary threats to Black Cockatoos as listed in (DSEWPC, 2012b) are: • Habitat Loss and habitat degradation (loss of foraging habitat, breeding hollows, habitat connectivity habitat quality) • Interactions with humans (vehicle strikes, agriculture protection measures, disturbance from noise / light, unauthorised taking (poaching))

ASPECT	DESCRIPTION
	• Invasive Species (competition for nest hollows with European honey bees and bird invading taxa, injury / death from European honey bees). Habitat loss has affected each of the species, perhaps most significantly for Carnaby's Cockatoo, which used to only visit the SCP for foraging. Over the past 10-30 years, Carnaby's Cockatoo has shifted in breeding distribution to areas south and west, now breeding in Jarrah Forest and on the SCP (DPaW, 2013).
Direct impact	<u>Foraging and roosting habitat</u> The modelled extent of foraging habitat for Black Cockatoo within a 12 km radius of the Proposal was calculated (Biota, 2020a) to provide context to the potential loss of foraging habitat associated with the Proposal. This modelling identified > 8,000 ha of foraging habitat within this radius. According to DBCA data (GoWA, 2020), there is no confirmed roosting habitat within 12 km of the Proposal Area. 5.9 ha of known roosting habitat is located just outside the 12 km buffer area in Gwindinup, in the Shire of Capel (Figure 9, Appendix A) (GoWA, 2020). The Proposal will require the clearing of up to 60.9 ha of Black Cockatoo foraging habitat, representing approximately 0.8 % of the modelled > 8,000 ha of locally available foraging habitat (suitable remnant vegetation within a 12 km radius). <u>Potential nesting habitat</u> According to DBCA data (GoWA, 2020), there is no confirmed breeding habitat within 12 km of the Proposal Area and no nesting sites are present within 12 km of the Proposal Area (Figure 9, Appendix A) (GoWA, 2020). Black Cockatoos require hollows with specific attributes for breeding (i.e. a particular size, depth and orientation), with such hollows only typically occurring in large mature trees of > 200 year age (DSEWPC, 2012b) cited in (Biota, 2020a). In response to the DAWE additional information request, additional field surveys to confirm the presence and condition of potentially suitable nesting hollows were conducted by Biota. These surveys were conducted in November which is during the breeding season of all three species of Black Cockatoo (DSEWPC, 2012b), and included the use of a remotely-piloted aircraft (drone) (RPA; DJI Mavic Pro). The field surveys recorded a total of 2,392 suitable diameter at breast height (DBH) trees (i.e. those with DBH ≥ 500 mm) within the Surveyed Area, of which 38 contain a potentially suitable nest hollow(s). Of these trees, 1,109 are within the Proposal Area, and of these 1,109, thirteen contain a potentially suitable nest hollow(s)). Five of the thirteen trees within the Proposal Area containing a potentially suitable nest hollow(s) were able to be assessed with the drone and eight were not. Photographs of the five assessed trees are included in Biota (Biota, 2020a). Two of the trees containing a potentially suitable nest hollow(s) showed previous signs of nesting, with one containing four eggs (Black Cockatoos normally lay two) but no chew marks around the hollow. The second appeared to have chew marks around the hollow (Biota, 2020a). Biota did not observe direct signs of Black Cockatoo breeding during their field survey, that is, cockatoos were not observed returning to hollows to nest or tend to chicks. However, a likely Forest Red-tailed Black Cockatoo

ASPECT	DESCRIPTION
	egg was found on the ground in the vicinity of breeding habitat trees during the 2017 survey (Biota, 2020a). No known nesting hollows were observed or will be impacted by the Proposal. The objective of recording suitable DBH trees which do not contain hollows is to identify a potential for 'future' nesting hollows which may form as these trees mature and senesce, in order to compensate for the future loss of the current nesting hollows through natural attrition.
Indirect impact	The Proposal may potentially result in the following indirect impacts to Black Cockatoo species: • Incremental loss of Black Cockatoo habitat from edge effects • Displacement of Black Cockatoos due to traffic noise and exposure • Potential vehicle strike during construction activities • Potential vehicle strike during operation. The Proposal Area sits within a landscape that has been subject to historical clearing for agricultural, urban and industrial developments. These developments have resulted in reduction in patch sizes and increasing edge effects including the introduction of weeds and *Phytophthora* dieback. This has potential to impact the composition and structure of vegetation communities, and the suitability of habitat for Black Cockatoos. Biota (2020a) recorded three trees with potentially suitable nesting hollows within 50 m of the Proposal Area. None of these showed evidence of previous nesting use and no nesting activity was observed during field surveys. If severe enough, exposure to traffic noise may result in Black Cockatoos relocating to other habitat areas in order to move away from the noise sources. Vehicle strike during construction and operation of the Proposal has the potential to impact Black Cockatoos.
Quality and importance of known or potential habitat within the proposed action area and surrounds	Biota (2020a) assessed the quality of Black Cockatoo foraging habitat within the Proposal Area. Their classification was calculated consistent with current Commonwealth guidance (DSEWPC, 2012b) (Figure 9, Appendix A): • Areas of Marri / *Eucalyptus* woodland are classified as 'high quality foraging habitat'. These areas supported a high density of foraging trees (primarily Marri and Jarrah) in the upper strata but also often also included *Banksia* in the mid-storey • Areas of Marri / *Eucalyptus* in paddocks and road reserves are classified as 'moderate quality foraging habitat'. While not high quality foraging habitat, these areas contained scattered foraging plants and have potential to represent a linkage to larger habitat remnants. • Vegetation units that don't contain any foraging plants or are cleared constitute 'not foraging habitat'. 43.7 ha of vegetation within the Proposal Area is classed as high quality foraging habitat, with a further 21.7 ha as moderate quality. The remainder of the Proposal

ASPECT	DESCRIPTION
	Area is cleared, highly disturbed, consisting of non-native vegetation or consisting of native vegetation that does not contain foraging plants, and is therefore devoid of Black Cockatoo foraging habitat (Biota, 2020a).
Quantification of impact	The Proposal will require clearing of up to 60.9 ha of Black Cockatoo foraging habitat, representing approximately < 0.1% of the recorded > 8,000 ha of locally available foraging habitat (suitable remnant vegetation within a 12 km radius). Of the 60.9 ha of foraging habitat impacted, 43.7 ha of the impacted habitat is classified as high quality foraging habitat.
Known populations within at least a 2 km buffer	Biota (2020a) reviewed the potential Black Cockatoo foraging habitat within a 12 km radius of the Surveyed Area to provide a wider context to the potential habitat loss associated with the Proposal, as is detailed in Table 2-9. This review used as its basis the vegetation complexes of Webb, *et al.* (2016). Eighteen vegetation complexes were represented in remnant vegetation within a 12 km radius of the Proposal Area. The Biota review considered in detail the four contained within the Proposal Area. Three of the four complexes comprise high quality foraging habitat, due to the presence of preferred foraging plants, with the remaining Yoongarillup Complex, which is generally devoid of preferred foraging plants (e.g. Marri, Jarrah and *Banksia*), representing lower quality habitat. The review found both the Bassendean Complex Central and South complex (1,162 ha within 12 km) and the Karrakatta Complex-Central and South (2,840 ha within 12 km) within the Proposal Area are continuous with much larger extents within the wider area. The same is true for the Southern River Complex (2,397 ha), with significant large areas of this complex occurring directly to the north of the Proposal Area (e.g. in Manea Park).
Adequacy of any surveys undertaken	Areas of potential Black Cockatoo habitat were identified through desktop review, aerial imagery and surveys in the area (Biota, 2020a), and confirmed through field survey (Figure 9, Appendix A). The surveys were completed in accordance with relevant State and Commonwealth policy, and to a standard that would provide adequate information to assess the Proposal against principles and environmental aims relating to Black Cockatoos. This included the *EPBC Act referral guidelines for three threatened Black Cockatoo species: Carnaby's Cockatoo (Calyptorhynchus latirostris), Baudin's Cockatoo (Calyptorhynchus baudinii) and the Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso)* (DSEWPC, 2012b). Field surveys were conducted in several phases. In 2018, Biota conducted an assessment of suitable DBH trees in the alignment between South Western Highway and Bussell Highway (Biota, 2018a). This work was undertaken to confirm and update data collected in a previous survey by GHD in 2011 (GHD, 2012a). In 2018 and 2019, Biota completed a targeted fauna assessment over the Proposal Area and surrounds, in five phases over the course of spring and summer 2018, and winter 2019 (Biota, 2020a). The aim of the surveys was to assess, as far as practicable, all potential breeding trees within the Proposal Area. Two approaches were taken:

ASPECT	DESCRIPTION
	1. Larger areas of continuous vegetation were identified from aerial imagery and overlain with 25 m spaced transects in GIS. Using a GPS, a biologist walked up the middle of each 25 m wide transect, assessing all trees within it. 2. In smaller treed areas (e.g. roadside verges and paddocks containing singular trees), a biologist maintained a GPS track file while using aerial imagery to visit as many trees as possible. All individual trees of species with the potential to form hollows (primarily Jarrah, Marri and Tuart) and with sufficient diameter to be considered breeding habitat trees (DBH > 500 mm) were recorded using a standard GPS (accurate to within 3 m). Furthermore, the positions of trees observed to contain hollows that were potentially suitable for black-cockatoo nesting were recorded using a differential GPS (accurate to within 1.5 m). For trees with hollows that appeared potentially suitably for breeding during the ground assessment, a follow-up survey was conducted using a using a remotely-piloted aircraft (RPA; DJI Mavic Pro) to more fully assess the suitability of the hollows for Black Cockatoo breeding. All hollows within the Proposal Area were assessed at least once with the large majority having been surveyed twice. Those hollows in areas of overlap between the indicative survey boundary of 2018 and the current Proposal Area have been surveyed twice; in November 2018 and if categorised as potentially suitable then, they were reassessed in November 2019 for any evidence of nesting that may potentially have occurred in the intervening period. Those trees added to the Proposal Area after November 2018 received their first RPA assessment in November 2019. While conducting assessments of breeding habitat, notes on foraging habitat and foraging evidence were also opportunistically recorded. Not all locations of foraging evidence were recorded, as these were too numerous for this to be practicable. However, generally any first encounter with foraging evidence within a vegetation fragment was recorded, and subsequent encounters were also recorded if they were indicative of an additional species utilising the area.
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of foraging / breeding habitat and suitable trees with hollows for breeding was assessed based on data collected from within and surrounding the Proposal Area during field surveys conducted in both 2018 and 2019, consideration of EPBC referral guidelines (DSEWPC, 2012b) and the Carnaby's Cockatoo Recovery Plan (WAPC, 2016), analysis of NatureMap and Protected Matters Search results (Biota, 2020a).

Table 2-10 Vegetation complexes within the Proposal Area and surrounds (up to 12 km) (GoWA, 2020) in (Biota, 2020a)

SCP ID	COMPLEX NAME	COMPLEX DESCRIPTION	PROPOSAL AREA (HA)	EXTENT WITHIN 12 KM (HA)
44	Bassendean Complex – Central and South	A mixture of open forest to tall open forest of *Corymbia calophylla* (Marri) – *Eucalyptus wandoo* (Wandoo) – *Eucalyptus marginata* (Jarrah), and woodland of *E. wandoo* (with rare occurrences of *Eucalyptus lane-poolei* (Salmon White Gum)). Minor components include *Eucalyptus rudis* (Flooded Gum) – *Melaleuca rhaphiophylla* (Swamp Paperbark).	14.8	1,162.2
49	Karrakatta Complex – Central and South	Predominantly open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) and woodland of *Eucalyptus marginata* (Jarrah) - *Banksia* species. *Agonis flexuosa* (Peppermint) is co-dominant south of the Capel River.	34.6	2,840.4
42	Southern River Complex	Open woodland of *Corymbia calophylla* (Marri) - *Eucalyptus marginata* (Jarrah) - *Banksia* species with fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark) along creek beds.	3.9	2,379.4
56	Yoongarillup Complex	Woodland to tall woodland of *Eucalyptus gomphocephala* (Tuart) with *Agonis flexuosa* in the second storey. Less consistently an open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri). South of Bunbury is characterised by *Eucalyptus rudis* (Flooded Gum)-*Melaleuca* species open forests.	1.2	336.6

2.5.2 Western Ringtail Possum (*Pseudocheirus occidentalis*) – Critically Endangered

The Western Ringtail Possum (WRP) was first listed as threatened under the Western Australian *Wildlife Conservation Act 1950* in 1983, and under the Commonwealth EPBC Act in 2000. Its listing was reassessed to Critically Endangered under the BC Act in 2016 and EPBC Act in 2018.

A description of this species, as well as direct and potential indirect impacts from the Proposal is outlined in Table 2-11.

Table 2-11 Western Ringtail Possum

ASPECT	DESCRIPTION
Ecology, abundance, distribution and habitat preferences	Ecology The Western ringtail possum (WRP) is a medium sized arboreal marsupial, endemic to the south-west of Western Australia. The WRP population size and density can vary significantly with seasonal conditions. Unless they are isolated or constrained, populations usually consist of a combination of resident and transient individuals. It is not possible during discrete surveys to distinguish resident from transient animals however variations in populations as a result of repeated seasonal observations provide an indication of the distinction. The proportion of transient individuals increases during the breeding season as males move through patches in search of a mate, and again when young are dispersing. Abundance In order to provide an updated estimate of the size and distribution of WRP populations within the south of WA, Biota conducted a regional survey across known strongholds for the species: the SCP, Southern Forest and South Coast (Biota, 2020b). The survey area covered five areas in the south west and south coast regions, including the South Swan coastal plain and Cape to Cape region. Regional Surveys were based on the survey of 114,243 ha using 1,249 transects equating to a total effort of 1,287.2 km of transect. Across these transects 2,939 detections of 3,677 individual WRP were made. Survey effort was divided amongst the three WRP key management zones: SCP, Southern Forest and South Coast. The field survey results recorded a population of 5,704 WRP in the South Swan Coastal Plain and 2,262 WRP in the Cape to Capes region. Of the three management zones, the surveyed footprint of the SCP management zone (in which the Proposal Area is located) yielded the greatest estimated abundance of WRP at 9,270 individuals, with the majority (around 6,500) occurring in the SCP IBRA region. The estimated abundance within the Southern Forests management zone was 7,500 and within the South Coast management zone was 3,340, taking the total estimated abundance to more than 20,000 individuals. The survey extent was limited to public land and did not include the occurrence of WRP individuals on private property and peri-urban areas. Distribution WRP were once widely distributed across the south and south-west of the state (from north of Perth to east of Albany) but are now restricted to three key management zones: the SCP, the Southern Forests and the South Coast. Local Distribution In the Bunbury area, high quality habitat with higher WRP densities is associated with the substantial north-south woodland habitat strip to the west of Bussell Highway. This coastal strip vegetation, which extends for some 13 km south of Dalyellup without a substantial break before it terminates at the Capel River flats, includes areas of high quality tuart and peppermint woodlands, with some areas of

ASPECT	DESCRIPTION
	tall peppermint. Part of this habitat strip carried 4 WRP/ha when surveyed in 2019 (Biota in prep.). The northern end of this coastal strip (almost) connects, via Dalyellup's internal habitat corridors, across another 7 km of lower density (<2 WRP/ha) habitat remnants that extend via the Kalgulup Regional Park (through Manea Park) to more or less links to the riparian habitat along the Preston River (Ms. Barb Jones, Pers. Comm.) (Conservation Significant Fauna AMP, **Error! Reference source not found.**). By linking the Preston riparian corridor back to the higher quality coastal habitat strip, these remnants provide unique and regionally critical population connectivity values (such as genetic exchange and population recovery potential) that extend for about 20 km of connected remnant woodlands between Minninup (at the northern end of the Tuart Forest National Park) and the Preston River corridor. Habitat preferences WRP feed on leaves of myrtaceous species, predominantly Peppermint (*Agonis flexuosa*), but also Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*). Home range sizes and possum density vary with the quality and productivity of the habitat. Home ranges are generally less than 5.0 ha, and those within peppermint dominated habitat are generally less than 2.0 ha and average 0.4 ha and 0.3 ha for females and males respectively (DPaW, 2017). Densities of up to 20 individuals per hectare have been recorded in Peppermint woodland in Busselton on the southern SCP (DPaW, 2017). WRP are known to be susceptible to heat stress and can overheat at ambient temperatures of 35^{o}C and above (Yin, 2006) in (DPaW, 2017)). Habitat critical for the survival of the species is understood to vary between population areas (or management zones) but is generally associated with areas that provide high nutrient foliage for food, suitable structures for protection / nesting (including suitable hollows), and canopy continuity. Linkages between areas of suitable habitat area also considered critical to the survival of the species. On the SCP, critical habitat includes areas of mature unburnt peppermint woodlands with high canopy continuity, high nutrient foliage and connectivity with other patches (DPaW, 2017). Movement pathways are often established between areas of quality habitat and water sources, and along continuous corridors such as vegetated riparian zones. WRP will move to new areas in search of high quality foraging habitat, in search of a mate or if competition for resources is high. Breeding parameters Most young are born during winter (April–June) with a second peak in spring (October–November) but some populations breed all year around. Young possums spend about three months in the pouch. Detection rates for WRP during surveys are greatest during spring (October–April) with peaks coinciding with weaning and maturation of young (April–June) (Shedley & Williams, 2014). WRP populations fluctuate locally on a seasonal basis, peaking with the maturation of young in spring and early summer and falling with the dispersal of young males and death of older individuals through natural attrition. These fluctuations can often be considerable and strongly related to climatic variations (Shedley & Williams, 2014).

ASPECT	DESCRIPTION
	The breeding periods noted in the literature (e.g. Shedley and Williams (2014)) are generalised breeding periods (from mating to young becoming independent) and are also 10 years old. Studies by Biota (2020a) and advice from Ms Barbara Jones, an independent fauna consultant, (pers comm) indicate that the peak season for WRP births in western coastal areas (Bunbury, Busselton) is usually June-September. Congruent with the Busselton WRP populations, it is unlikely that there is any substantial autumn breeding peak in Bunbury. Based on June-September birthing, most young are mature enough to leave the pouch during spring when climate and food resources are at their optimum. The overall population is expected to decline over summer into autumn due to increased temperatures, lower forage quality and less moisture availability. <u>Species and habitat extent within the Proposal Area</u> The Proposal Area provides 65.4 ha of suitable breeding and foraging habitat for WRP comprising 43.7 ha of the 'Marri/ *Eucalyptus* Woodland' and 21.7 ha of the 'Marri / *Eucalyptus* in paddocks and road reserves' habitat types of Biota (2020a). WRP was almost completely absent from the *Melaleuca* shrubland and / or woodland habitat type. Within the Surveyed Area, WRP individuals were observed utilising habitats ranging from relatively isolated trees, linear remnants along road reserves and riparian belts surrounded by cleared land, and larger remnants either isolated from, or broadly contiguous with, much larger remnants. In the northern half of the Proposal Area, WRP occur predominately in sparse native vegetation (isolated trees) within agricultural lands, and by contrast, in the southern half, they occur in areas of retained remnant native vegetation. Within the Surveyed Area, WRP were concentrated within five main areas, one of which was within the Proposal Area, being the road corridor between Gelorup North and Gelorup South Special Rural Zones. WRP habitat within the Proposal Area is contiguous with or adjacent to other areas of WRP habitat beyond the Proposal Area. No WRP habitat patches will be cleared in their entirety. The abundance of WRP recorded in the Proposal Area during the seven phases of bi-monthly strip-sampling conducted to date (August, October and December 2019 and February, April, June and August 2020) ranged from 53 to 79 with an average of 68.75. This yields an average density of 0.35 individuals per hectare within the Proposal Area (Biota, 2020a). <u>Threats</u> The key threats to WRP are habitat loss and habitat fragmentation (DPaW, 2017). Other threats include predation by introduced fauna taxa (notably the European red fox and cats), climate change, logging (habitat loss), fire (habitat quality), competition for nest hollows, and habitat tree decline from pathogens such as *Phytophthora* dieback. In addition, the Commonwealth (TSSC, 2018c) identifies potential threats as including groundwater depletion and altered hydrology (which may result in a

ASPECT	DESCRIPTION
	reduction of habitat quality), increasing temperature, tree decline and insect outbreaks, domestic dogs, ravens, and (potentially in the future) the fungus Myrtle rust. <u>WRP movement</u> WRP sighting locations recorded during each bi-monthly survey period can be used to infer movement. The results of repeated counts, in which some 'patches' were used in some monitoring periods, but not in others, indicates that WRP may move between habitats within the local area. The intensity of the observations combined with the inferred movement highlight locations suitable for installing overpasses / underpasses to maintain habitat connectivity after construction. This data has been utilised by Main Roads to refine the locations of proposed overpasses / underpasses for the Proposal (Figure 12, Appendix A). Movement pathways for WRP are often established between areas of quality habitat and water sources, and along continuous corridors such as vegetated riparian zones. WRP are known to move to new areas in search of high quality foraging habitat, in search of a mate, or if competition for resources is high. Although primarily arboreal, WRP are known to move on-ground (as observed within urban environments). Barbara Jones has been studying the WRP population for > 30 years and is recognised by the TSSC (2018c) as one of the pre-eminent experts regarding the WRP population and WRP ecology. The observations of Ms Jones on the movements of WRP on the southern SCP[8] (which includes the Proposal Area), including movement through the use of structures, have been summarised as follows: WRP display a range of behavioural adaptations to using man made features. Examples of this include using reticulation, drippers, bird-baths and pet bowls during extreme summer conditions. In areas with high densities of WRP, sheds and roof spaces (near suitable trees) often provide ideal possum shelter nooks, while appropriate fence tops, old phone cabling, and even live power-lines help individual WRP to get around in their patch more efficiently, safely or directly. WRP movement within their known habitat patches is predominantly achieved by using preferred well-known runways. In the manmade environment, these runways often accumulate a WRP residue of urine and scent. WRP have been observed using construction site scaffolding to move between trees within a week of the scaffolding being erected. Most WRP will explore and investigate infrastructure designed to enable fauna movement, but show caution exploring new structures constructed in proximity to preferred habitat.

[8] Most behavioural observations have been made in higher density areas of WRP of the southern SCP, particularly from the Busselton area, where densities of 5 – 15 individuals per hectare have been common.

ASPECT	DESCRIPTION
	The amount of time WRP spend on the ground is primarily dependent on the habitat and density of feeding trees i.e. sparser vegetation means more time on the ground. Male WRP typically travel more widely and spend more time on the ground. Where dense cover is available below good foraging trees, WRP will often shelter in thick vegetation at ground level. WRP have been observed seeking shelter in known rabbit warrens. In habitat where good foraging canopy connects numerous trees, dominant females may be almost exclusively arboreal. However, if conditions get too hot or too dry, WRP often leave the trees seeking a damp cool shelter site at ground level. The BORR WRP habitat surveyed by Biota during 2019-20 had an overall average density of approximately 0.35 individuals per hectare (Biota, 2020a). Repeated counts within the BORR footprint during August 2019 - August 2020 indicated that most patches were used by WRPs during each count period. The bi-monthly count sequence will run through 2020. This sequence will provide clarity around seasonal (or other) trends in WRP abundance in the BORR habitat remnants. <u>WRP use of structures</u> Within WRP populations of the southern SCP, attempts to mitigate habitat disjunctions associated with linear structures have relied primarily on rope bridges or cables over existing roads. Main Roads has conducted studies of the success of previously installed rope bridges for the existing BORR Central segment and a smaller crossing on Caves Road near Vasse. On Caves Road (Vasse area) a 26.5 m long bridge constructed in 2013 was used by WRP within 36 days of construction and recorded 1,300 crossings in nine months of monitoring (Yokochi & Bencini, 2015). As noted previously, the BORR Central Section included an 88 m long bridge, constructed in 2014, which resulted in only two confirmed crossings in 13 months of monitoring (Chambers & Bencini, 2016). As suggested by Chambers and Bencini (2016), the less frequent use of the BORR Central Section bridge may result from a combination of factors including a lower WRP density, the discontinuous vegetation canopy cover, longer bridge length, and greater street lighting (which may expose WRP to predators for night-time crossing). Barbara Jones' professional observations regarding WRPs and use of fauna movement structures is summarised as follows: In addition to rope bridges, there have also been attempts to encourage WRP to use kangaroo underpasses (e.g. Busselton Bypass), however, none that were monitored have shown repeated use by WRP (monitoring periods for underpasses have been relatively short). In all south west WRP crossover examples to date, there has been no field evidence to test whether the frequency of WRP road-crossing events at ground level near used rope bridges or underpasses had truly been reduced by the provision of either treatment. It is considered that WRP will continue to cross at ground level if it is the easier option for the animal. In studies undertaken to date, monitoring of WRP use typically involves a single crossover structure.

ASPECT	DESCRIPTION
	The BORR project will provide the first opportunity to monitor WRP use of multiple underpasses and allow assessment of the performance of different crossing treatments. The inclusion of road protection fencing in the BORR design has been designed to prevent WRP accessing the road at ground level. In BORR's main WRP areas, possum exclusion fencing will also function to turn native mammals away from the road, and to help funnel ground-moving WRP into an underpass forecourt area. Where feasible, these forecourt areas can be generously landscaped with features to make the underpass forecourt areas increasingly useful, desirable or comfortable for WRP, especially for WRP moving at ground level. Rope cabling has been recently used under Treendale Bridge (Eaton Drive) on the Collie River. The new bridge required a narrow riparian strip on one bank to be severed from a pre-existing connection used by resident WRP. In autumn 2018, the resultant gap was treated with simple cabling that extended out to suitable nearby trees on either side of the bridge, and was continuous just below the underside of the bridge. When inspected in August 2019, WRP scat (differing ages) was found directly below the rope bridge. It was most common where the rope bridge was sheltered by the road bridge, suggesting that on the sheltered part of the cable, WRP were comfortable enough to pause and rest, but on the exposed cabling adjacent to the bridge, they did not linger in a comparable way. Fauna bridges in the south west to date have not featured WRP perching and lay-by areas. These allow for the structure to provide a more user-friendly environment, especially suited for WRP doing staged explorations of a new set of cabling.
Direct impact	The Proposal will require the clearing of up to 60.9 ha of WRP habitat within the 200 ha Proposal Area (approximately 33 % of the 200 ha Proposal Area). WRP habitat within the Proposal Area is contiguous with or adjacent to other areas of WRP habitat beyond the Proposal Area. Using the data obtained from the environmental surveys (Biota, 2020a) and from Shedley and Williams (2014), key WRP habitat areas have been identified. Noting the WRP population peak in spring and early summer, where a significant number of WRP are recorded during the pre-clearing targeted fauna survey, the clearing of such areas will be scheduled not to occur within the WRP breeding season and pouch young season (spring and summer, as outlined in Ecology (above)). No WRP mortalities are considered likely to result directly from the Proposal. To reflect the seasonal and transient fluctuations in population size, the potential impact of the Proposal on individual WRP home ranges is presented as a range rather than a discrete number. Based on these data, it is estimated that between 49 and 72 WRPs within the Proposal Area will potentially have their home ranges disturbed by the Proposal. This indicates that up to 0.53 % to 0.78 % of the 2019 estimated WRP population within the Southern SCP Management Zone as identified by Biota (2020b) (of up to 9,270 individuals) could potentially be impacted.
Indirect impact	The Proposal may result in the following indirect impacts to WRP:

ASPECT	DESCRIPTION
	• Incremental loss of WRP habitat resulting from reduced connectivity, barrier effects and edge effects • Displacement of individuals due to traffic and other noise and / or light. Historical clearing combined with incremental reduction in habitat has restricted the distribution of WRP within the Proposal Area, particularly in the north. As habitat is cleared, patch sizes decrease and the impact of 'edge effect' increases with likely introduction of weeds and dieback, ultimately changing the species composition of the vegetation community and reducing suitability of habitat for local fauna species, including WRP. WRP have been observed utilising habitats ranging from relatively isolated trees through to remnant strips (along road reserves and riparian belts) and larger remnants either isolated from or broadly contiguous with much larger remnants. WRP do not appear to need a complicated vegetation structure or diet and can meet their requirements within either the natural or urban environment (Shedley & Williams, 2014). This indicates that the connectivity of WRP habitats, as an aspect of habitat quality, may be less important to the survival of WRP than other factors given the wide variety of habitats they may occupy. Vegetation adjacent to the existing Bussell Highway and Forrest Highway has been classified by Shedley and Williams (2014) as either High or Medium quality WRP habitat, which is generally consistent with the quality of the majority of the WRP habitat in the local area. The maintenance of the High and Medium quality habitat assessment ranking for vegetation adjacent to the existing Bussell Highway and Forrest Highway roads may indicate that the quality of WRP habitat adjacent to the Proposal is unlikely to be detrimentally affected to an extent that the habitat quality is reduced. Connectivity of habitat areas is important to enable dispersal of WRP to find habitat and mates, and maintain the exchange of genetic material between populations. Good connectivity is also important to enable WRPs resident in small patches to access additional food resources and water as required. Individual WRP were recorded in habitat adjacent to the existing dual carriageway Bussell Highway, as well as adjacent to local roads (Biota, 2020a). These results indicate that neither vehicular traffic noise exposure nor light from vehicles or street lighting may be an impediment to WRP utilising habitats adjacent to road infrastructure. This is, in part, further supported by the findings of Shedley and Williams (2014) in which high densities of WRP were observed in urban areas. Although WRP may relocate to other habitat areas in order to move away from very noisy or brightly lit areas (Barbara Jones, pers. comm., 2020), WRP have adapted to urban and semi-urban areas as outlined by Shedley and Williams (2014). This suggests that WRP are able to adjust to, and perhaps even thrive in, developed areas where light and noise levels are higher than would be found in natural habitats. The absence of a correlation between the density of WRP individuals with proximity to noise or light sources may indicate that WRP are readily capable to adapt to increased noise and light environments, and accordingly, the impact of

ASPECT	DESCRIPTION
	noise and / or light from the Proposal would not be expected to result in WRP abandoning the adjacent habitat.
Areas of larger contiguous patches that will be fragmented	The Proposal is situated in a landscape of multiple land uses including agriculture, mining, residential development, and conservation reserves. The Proposal Area represents a discontinuous 'patchwork' of WRP habitats of varying sizes and degrees of connectivity. Existing obstacles to habitat connectivity include the Bussell Highway (dual carriageway) and local roads (single carriageway). Connectivity between some habitat areas will be temporarily disrupted during Proposal construction. The maintenance of existing movement pathways and connectivity along either side of the alignment has been a priority during Proposal planning. In order to maintain connectivity between habitat areas and across the local landscape, the Proposal design incorporates a series of underpasses / rope bridges (engineered movement structures) to maintain connection between the habitat areas. A number of different structure types will be installed, including rope bridges and underpasses. Connectivity and suitability of cleared areas remaining within the Proposal Area will be further enhanced with targeted revegetation post construction and design features to ensure access to water is maintained. As is also shown on Figure 12 (Appendix A), the detailed design ensures this connectivity will remain after Proposal implementation.
Quality and importance of known or potential habitat within the proposed action area and surrounds	Shedley and Williams (2014) calculated that the Bunbury WRP 'management zone' (which encompasses an area from the Preston River in the north to the Capel River in the south) includes 6,264 ha of WRP habitat[9], most of which was rated as having a 'C' (medium) suitability score (which was the lowest score in this zone). The 60.9 ha of habitat that would be lost under the Proposal equates to approximately 1.0 % of the estimated habitat in the Bunbury management zone. Habitat mapped within the Proposal Area comprises Shedley and Williams (2014) habitat classes as follows: • 0 % of Habitat Quality Class A (Very High) (0 ha) • 11 % of Habitat Quality Class B (High) (7.0 ha) • 56 % of Habitat Quality Class C (Medium) (33.9 ha) • < 1 % of Habitat Quality Class D (Low) (0.3 ha) • 33 % not rated (21.5 ha) Due to the regional scale at which the Shedley and Williams (2014) mapping was conducted there are differences between this study and the field survey of the Proposal Area. Surveys for the Proposal identified an additional 21.6 ha of smaller suitable habitat patches than were identified by Shedley and Williams (2014), which focussed on larger patches of habitat. However, Shedley and Williams (2014) provides a valuable rigorous approximation of general quality of WRP habitat within the Proposal Area and the context of habitat quality in the greater region.

[9] Shedley and Williams (2014) noted that 'the potential area of class C is likely to be overestimated, especially in the Bunbury and Binningup zones, as there have been very few surveys in these soil landforms'.

ASPECT	DESCRIPTION
Known populations within at least a 2 km buffer	Biota (2020b) completed additional surveys (using distance sampling) to provide a regional context for potential impacts from the Proposal on the WRP. Within the SCP management zone, the survey included sites on the southern section of the SCP, between Binningup and Dunsborough, and extending into the northern section of the Whicher Scarp near Dardanup. The distance sampling of BORR context sites and regional context sites surveyed a combined distance of 256.0 km and recorded a combined total of 1,521 individual WRP. The surveyed footprint of the SCP management zone yielded the greatest estimated abundance of WRP at 9,270 individuals, with the majority (around 6,500) occurring in the SCP IBRA region. The estimate does not include suitable habitats in the semi-urban and urban environment that are known to be inhabited by WRP, and is therefore considered to be a conservative estimate.
Translocation proposal	No translocation of WRP is proposed. Clearing procedures, defined in Section 4.2.2.2, are summarised below: • Habitat clearing to be staged, commencing from existing edge lines / roads and progressing towards habitat that will be retained to direct WRP towards retained habitat. • Potential habitat trees will be cleared appropriately, by either directional felling onto vegetation within the clearing area that is yet to be cleared or by ensuring trees don't fall on hollows whenever possible (trees with multiple hollows will be assessed on a case by case basis). The 'soft felling' of habitat trees will provide a 'cushion' for the vegetation being felled, allowing any WRP in a hollow more opportunity to safely vacate the hollow. • If WRP are detected during clearing operations, the tree containing the animal shall be left for up to 48 hours to allow for the animal to vacate the tree, while clearing continues adjacent to the inhabited tree. If the tree continues to be occupied after 48 hours, the animal will be coerced / moved to a safe area outside of the clearing footprint by the appointed zoologist / environmental scientist / fauna spotter. • A post-clearing survey shall be undertaken to ensure no injured individuals are present. • Felled trees with hollows will be left on the ground overnight to allow time for any undetected fauna to vacate. All hollows will be checked immediately after felling and prior to further processing of the tree. The proposed measures are anticipated to preclude the need for active translocation by the construction contractor.
Adequacy of any surveys undertaken	Areas of potential WRP habitat were identified through desktop review, aerial imagery and surveys in the area during Biota (2020a) survey. The surveys were completed as far as practicable in accordance with relevant State and Commonwealth policy, and to a standard that would provide adequate information to assess the proposal against principles and environmental aims relating to the WRP. This included the *Significant impact guidelines for the*

ASPECT	DESCRIPTION
	vulnerable western ringtail possum (Pseudocheirus occidentalis) in the southern Swan Coastal Plain, Western Australia (DEWHA, 2009c). Field surveys comprised bi-monthly strip-sampling. The strip-sampling exercise has been undertaken on seven occasions (August, October and December 2019, and February, April, June and August 2020) to examine temporal variation in abundance throughout the Proposal Area (Biota, 2020a). The bi-monthly sampling will continue until December 2020. The aim of the surveys was to assess, as far as practicable, evidence of WRP and suitable habitat. The strip-sampling approach was applied to the entirety of the Proposal Area except for some areas not able to be accessed[10]. This near comprehensive sampling technique affords a high level of confidence in abundance estimates, although it likely represents a slight underestimate of the total number of individuals due to both a small number of possibly undetected individuals and the effect of access restrictions. A total strip-sampling transect length of 49.04 km was applied to the 75.39 ha of predominantly native vegetation within the Proposal Area (excluding areas unable to be accessed). In some areas transects extended beyond the Proposal Area. In addition to the WRP, observations of the Common Brushtail Possum and Brush-tailed Phascogale were also recorded during field surveys.
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of potential impacts to WRP habitat and individuals was assessed based on data collected from within and surrounding the Proposal Area during field surveys conducted in spring / summer of 2019, consideration of survey guidelines (DSEWPC, 2011), impact significance guidance (DEWHA, 2009c), Recovery Plan (DPaW, 2017), and analysis of NatureMap and Protected Matters Search results (Biota, 2020a).

2.5.3 Black-stripe Minnow (*Galaxiella nigrostriata*) - Endangered

The Black-stripe Minnow (*Galaxiella nigrostriata*) (BSM) is listed as Endangered under the EPBC Act and the BC Act. A description of this species, as well as direct and potential indirect impacts from the Proposal is outlined in Table 2-12.

Table 2-12 Black-stripe Minnow

ASPECT	DESCRIPTION
Ecology, abundance, distribution and habitat preferences	Ecology The Black-stripe Minnow (*Galaxiella nigrostriata*) (BSM) is a small (maximum 48 mm TL) freshwater fish species endemic to south-western Australia. It most commonly occurs in shallow ephemeral waterbodies of peat flats (WRM, 2020b). It is short lived (one year) and able to survive dry summer conditions by aestivating (burrowing) into moist soils. Dispersal is understood to be linked to climatic

[10] Of the total 75.39 ha targeted for sampling, 8.19 ha was unavailable in August 2019 while in later phases access restrictions affected between 2.48 ha and 4.18 ha (Biota, 2020a).

ASPECT	DESCRIPTION
	conditions with the species emerging from aestivation following rainfall (WRM, 2020b). Abundance Surveys for the Proposal (WRM, 2020b) recorded the species at four locations. More than 160 individuals were recorded in habitats at the southern end of the Surveyed Area, both within and adjacent to the Proposal Area. Distribution The majority of *G. nigrostriata* populations are confined to peat flat wetlands of the Warren sub-region between Augusta and Albany in the extreme south-west corner of Western Australia (TSSC, 2018e), although three isolated populations exist between Bunbury and Gingin on the SCP (Lake Chandala ca. 55 km north-east of Perth, Melaleuca Park ca. 30 km north-east of Perth, and Kemerton Nature Reserve ca. 130 km south of Perth), intimating its historically-wider distribution. Habitat preferences BSM occurs predominantly in shallow, low pH, tannin stained ephemeral wetlands with peat rich soils including isolated populations on the Swan Coastal Plain and on the south coast between Augusta and Albany. The populations on the Swan Coastal Plain are thought to be remnants of a much wider distribution which has been impacted by widespread urban and rural development. Species and habitat extent within the Proposal Area Surveys completed for the Proposal by WRM (2019; 2020b) identified BSM at multiple locations. During the August 2019 surveys, BSM were present at two of the five search sites[11]. A total of five BSM individuals were recorded during this survey; one individual was recorded from site South 8 within the Proposal Area, and four individuals were recorded from site South 11, south of the Proposal Area (WRM, 2020b) (Figure 13 Yalinda Drive Crossing Structures **Figure 14 Fauna Land Bridge** Figure 15, Appendix A). This single individual represents the only presence of BSM recorded within the Proposal Area during field surveys. Sites where BSM were recorded were relatively unaltered wetlands, with intact fringing vegetation. The single BSM individual recorded within the Proposal Area was located in a small watercourse which appears hydrologically linked in periods of high rainfall / flooding to a chain of wetlands located beyond the Proposal Area (WRM, 2020b). There was little or no suitable habitat for the species identified within the remainder of the Proposal Area, as wetlands in these areas have been largely cleared for agriculture or otherwise highly modified (WRM, 2020b). The Proposal Area contains 5.5 ha of BSM potential habitat (Figure 13 Yalinda Drive Crossing Structures

[11] Ten sites were scheduled for survey however five were dry at the time of sampling. A further three sites considered to be potential BSM habitat were surveyed in 2018. No BSM were recorded at these sites.

ASPECT	DESCRIPTION
	Figure 14 Fauna Land Bridge Figure 15, Appendix A). The results of surveys conducted for the Proposal extend the previously known distribution of BSM identified by DBCA (WRM, 2020b) within the greater Bunbury area. Due to the high mobility of the species and connectivity between wetlands in wetter years, it is possible that BSM migrate between wetlands within the local area. The chain of wetlands extending to the south along the Five Mile Brook complex would not be classified as riparian, but are important areas of habitat for BSM when flooded.
Direct impact	A single BSM individual was recorded within the Proposal Area (WRM, 2020b) (Figure 13 Yalinda Drive Crossing Structures **Figure 14 Fauna Land Bridge** Figure 15, Appendix A). The Proposal Area contains 5.5 ha of BSM potential habitat, all of which is required to be cleared to enable Proposal implementation (Figure 13 Yalinda Drive Crossing Structures **Figure 14 Fauna Land Bridge** Figure 15, Appendix A).This habitat is part of a small watercourse which appears hydrologically linked in periods of high rainfall / flooding to a chain of wetlands located beyond the Proposal Area (WRM, 2020b). Some direct loss of aestivating BSM is possible during construction through disturbance of sediments. Previous attempts to find and record aestivating BSM in sediments have not been successful (Galeotti, 2013) and the length of time the species can remain aestivating is unknown. Translocation is not considered a viable mitigation strategy for this species (WRM, 2020b).
Indirect impact	During the August 2019 surveys, a total of five BSM were recorded; one individual was recorded from site South 8 within the Proposal Area, and four individuals were recorded from site South 11, south of the Proposal Area (WRM, 2020b) (Figure 13 Yalinda Drive Crossing Structures **Figure 14 Fauna Land Bridge** Figure 15, Appendix A). Site South 11 is situated approximately 850 m from the Proposal Area boundary. Due to this substantial separation distance, indirect impacts to BMS habitat within this site is not expected to result from Proposal implementation. Additional survey sites outside of the Proposal Area included relatively undisturbed or intact wetlands within or adjacent to Manea Park bushland reserve. The area of habitat outside of the Proposal Area associated with the Manea Park sites surveyed by WRM is approximately 8.9 ha (WRM, 2020a).

ASPECT	DESCRIPTION
	The species has recently been recorded to occur in nearby wetlands (> 2 km away) in Gelorup, surveyed as part of investigations for the BORR South Alternate alignment. BSM are considered to be a transient and mobile species and abundance and distribution is likely to vary from year to year in response to seasonal rainfall (WRM, 2020b). Potential indirect impacts to BSM associated with construction and operation of the Proposal include: • Erosion and sedimentation resulting from earthworks adjacent to watercourses during construction • Contamination and / or water quality impacts during construction or operation • Alteration of hydrological regimes resulting from bridge and / or road construction • Restriction of fish movement • Fragmentation of suitable habitat.
Quality and importance of known or potential habitat within the proposed action area and surrounds	The identification of BSM during 2019 and 2020 surveys of the BORR Southern Section investigation area (WRM, 2019; WRM, 2020b), as well as nearby wetlands in Gelorup, and within the BORR Northern and Central Sections investigation area (WRM, 2020a), extends the distribution of the species on the SCP approximately 30 km further south of the known distribution (WRM, 2020b). Habitat identified for both the Northern and Central Sections and Southern Section proposals identifies habitat and species abundance outside of the proposals greater than identified within the Proposal Area.
Known populations within at least a 2 km buffer	Known populations within at least a 2 km buffer include one location in a wetland within Manea Park north of the Proposal Area and six locations in wetlands to the south of the Proposal Area (Figure 13 Yalinda Drive Crossing Structures **Figure 14 Fauna Land Bridge** Figure 15, Appendix A). An additional three wetland locations within Manea Park are also known to contain BSM (WRM, 2020a). During the various field surveys conducted in these areas for the Proposal and / or for the Northern and Central Sections proposal (WRM, 2020a), a total of 251 BSM individuals[12] were recorded from these locations (WRM, 2019; WRM, 2020b).
Adequacy of any surveys undertaken	Targeted aquatic fauna sampling for BSM was first undertaken in November 2018 at eight sites across four wetland habitats. An additional four sites considered potential habitat based on a desktop assessment were subsequently deemed unsuitable for BSM based on field assessments of site condition and habitat quality.

[12] 113 individuals recorded in wetlands in the Gelorup area in 2018 (WRM, 2019), 134 individuals recorded in wetlands in Manea Park in 2019 (WRM, 2020a) and 4 individuals recorded in a wetland south of the Proposal Area in 2019 (WRM, 2020b).

ASPECT	DESCRIPTION
	Additional targeted surveys were undertaken in August 2019 where BSM were considered likely to occur, based on desktop assessment of previous records and habitat preferences. Due to site restrictions around private property access, only four of the six identified BSM sites were sampled during this survey (WRM, 2020b). Aquatic fauna surveys were conducted by WRM under Department of Primary Industries and Regional Development (DPIRD) Fisheries Licence EXEM 2483 (Instruments of Exemption to the *Fish Resources Management Act 1994* for Scientific Research Purposes). As a condition of this licence, taxa lists and reports are required to be submitted to DPIRD. The study was also conducted under DBCA Fauna Taking (Biological Assessment) Licence BA27000105. As a condition of this licence, a fauna return including taxa lists and locations, is required upon project completion. Aquatic fauna sampling by WRM is consistent with methodology used by others in similar surveys across Australia (i.e. (Cheal, F., Davis, J., Growns, J., Bradley, J. S., & Whittles, F. H., 1993; Storey AW, Halse SA, Shiel RJ, 1993), including the sampling of wetlands of the SCP by Murdoch University (Davis, J. A., Rosich, R. S., Bradley, J. S., Growns, J. E., Schmidt, L. G., & Cheal, F., 1993) and the National Monitoring River Health Initiative (Department of Environment Sport and Territories., 1994).
Methods, data analysis and scientific literature used to identify and assess the environmental values	The potential significance of habitat for BSM was assessed based on data collected from ponds and wetlands within and adjacent to the Proposal Area during field surveys, consideration of the Approved Conservation Advice (TSSC, 2018e), and analysis of NatureMap and Protected Matters Search results (WRM, 2020b).

2.6 Threatened flora

Six Threatened flora taxa were identified by DAWE as having a potential to occur within the Proposal Area, as per the DAWE request for additional information dated 11 February 2020:

- King Spider-orchid (*Caladenia huegelii*) (Endangered)
- Tall Donkey Orchid (*Diuris drummondii*) (Vulnerable)
- Dwarf Bee-orchid (*Diuris micrantha*) (Vulnerable)
- Glossy-leafed Hammer Orchid (*Drakaea elastica*) (Endangered)
- Dwarf Hammer-orchid (*Drakaea micrantha*) (Vulnerable)
- Keighery's Eleocharis (*Eleocharis keigheryi*) (Vulnerable).

The following protected matters were also considered as potentially being impacted by the Proposal:

- Selena's Synaphea (*Synaphea sp*. Fairbridge Farm) (Critically Endangered)
- *Austrostipa jacobsiana* (Critically Endangered)
- *Austrostipa bronwenae* (Endangered)

No individuals of any of the flora taxa listed above were observed during flora and vegetation assessments conducted for the Proposal. Accordingly, the Proposal is not expected to result in any direct impact or indirect impact to these flora taxa.

The impact assessment conducted for each of the above listed flora taxa is presented below and in Section 3.3.

2.6.1 King Spider Orchid - Endangered

A description of this species, as well as direct and potential indirect impacts from the Proposal, is outlined in Table 2-13.

Table 2-13 King Spider-orchid – Endangered

ASPECT	DESCRIPTION
Ecology, habitat preferences, abundance, distribution and disturbance history	Ecology King Spider-orchid *Caladenia huegelii* is a tuberous, perennial, herb, growing 0.25-0.6 m high. The flowering period is from September to October and grows in grey or brown sand and clay loam (Western Australian Herbarium, 1998-). Habitat preferences Habitat preference for this species generally includes areas of mixed woodland of Jarrah, Banksia with scattered Sheoak and Marri, usually in deep grey-white sand within 20 km of the coast (DEC, 2009b). Abundance and historical records The King Spider-orchid Recovery Plan indicates that 1,614 mature plants were known from 33 extant populations, these occurrences were recorded during surveys in the decade prior to its release (DEC, 2009b). There are 41 records (approximately 635 plants) of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-). More current abundance and distribution data for this species is not available. Distribution This species has been recorded from the Jarrah Forest and SCP IBRA regions in Jarrah-Banksia woodland, within 20 km of the coast from north of Perth to the Busselton area (DEC, 2009b). Disturbance history Clearing of native vegetation for agriculture, housing and industry has resulted in clearing of much of the historical areas of habitat of *C. huegelii* (Brown, Dundas, Dixon, & Hopper, 2008).
Surveys undertaken	The BORR IPT vegetation and flora survey (BORR IPT, 2020i) was undertaken over a 2-year period, from August to November 2018 and from August to November 2019. Approximately 560 person-hours were spent on the BORR IPT vegetation and flora survey (BORR IPT, 2020i). Targeted surveys for conservation listed *Caladenia* species were undertaken by BORR IPT during the targeted searches for *Drakaea* species. The targeted surveys were undertaken in Banksia woodland habitat, including vegetation types VT1, VT2, VT3 and VT4 (Jarrah / Banksia), and VT6, VT7 and VT8 (wetland habitat)

ASPECT	DESCRIPTION
	(BORR IPT, 2020i). Mapping showing the location of the search sites is shown in Figure 16 (Appendix A). In total, 100 person hours were spent surveying for *C. huegelii* (BORR IPT, 2020i). Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation.
Extent of habitat and number of individuals directly impacted by the Proposal	Despite significant survey effort during the optimum flowering period, no individuals of *C. huegelii* were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that the species occurs within the Proposal Area or immediately adjacent to the Proposal. Accordingly, the Proposal is not expected to impact any individuals of *C. huegelii*. Approximately 12.1 ha of potentially suitable *C. huegelii* habitat was identified within the Proposal Area. This area has been determined based on the area of VT1, VT2, VT3 and VT4 present within the Proposal Area, excluding vegetation that classed as Degraded and Completely Degraded condition (BORR IPT, 2020i). Vegetation of Degraded and Completely Degraded condition was excluded as *C. huegelii* is considered to be very susceptible to disturbances such as high weed cover, grazing, overly frequent fire and reduced native species diversity, with these factors causing the decline of populations (DEC, 2009b). This vegetation will be cleared to enable the implementation of the Proposal.
Extent of habitat and number of individuals indirectly impacted by the Proposal	Despite significant survey effort during the optimum flowering period, no individuals of *C. huegelii* were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that the species occurs within the Proposal Area or immediately adjacent to the Proposal. Accordingly, the Proposal is not expected to impact any individuals of *C. huegelii*. During field surveys, approximately 1.3 ha of potentially suitable habitat (comprising VT1, VT2, VT3 and VT 4 in Good or better condition) was identified within approximately 20 m of the Proposal Area, which may have a potential to be indirectly impacted by the Proposal. Areas of potentially suitable *C. huegelii* habitat is also present adjacent to and within approximately 20 m of the Proposal Area east and west of Surveyed Area adjoining Bussell Highway and west of the southern extent of Marchetti Road.
Quality and importance of known or potential habitat within the Proposal Area	Approximately 12.1 ha of potentially suitable habitat for *C. huegelii* was identified within the Proposal Area, determined based on the quality of the following vegetation types (BORR IPT, 2020i): • VT1 (8.1 ha) - 4.0 ha of condition category 2-3 (Excellent to Very Good) - ha of condition category 3 (Very Good) - 0.5 ha of condition category 3-4 (Very Good to Good) - 1.6 ha of condition category 4 (Good) • VT2 (0.5 ha) - 0.5 ha of condition category 2 (Excellent) • VT4 (3.5 ha) - 0.7 ha of condition category 3 (Very Good)

ASPECT	DESCRIPTION
	- 2.8 ha of condition category 3-4 (Very Good to Good)
Known populations within at least a 2 km buffer	Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), one known population of *C. huegelii* has been previously recorded within 2 km of the Proposal Area. This record is located approximately 600 m to the east of the Proposal Area within Lot 677 Lakes Road, Stratham (Figure 16, Appendix A).
Adequacy of survey	The field survey was undertaken in accordance with the Commonwealth of Australia's *Draft Orchid Survey Guidelines* (2013). The methodology employed involved (BORR IPT, 2020i): • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys • Areas that had been completely cleared and heavily grazed paddocks that did not contain remnant vegetation were excluded from the survey • Surveys involved two senior botanists and a field ecologist. Sites were traversed on foot. Higher quality habitat (sites that retained structure (had an upper / mid or ground layer that comprised native species) were traversed on a parallel grid (at a 5-10 m intervals). Lower quality sites (sites that were almost completed cleared / or contained scattered native sedged (such as *Juncus pallidus*) but were grazed and had high visibility through the ground layer were traversed via meander surveys.
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of *C. huegelii* habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of the species' Recovery Plan (DEC, 2009b) and analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the vegetation and flora study (BORR IPT, 2020i).

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.2 Tall Donkey Orchid – Vulnerable

A description of this species, as well as direct and potential indirect impacts from the Proposal, is outlined in Table 2-14.

Table 2-14 Tall Donkey Orchid – Vulnerable

ASPECT	DESCRIPTION
Ecology, habitat preferences, abundance, distribution and disturbance history	<u>Ecology</u> Tall Donkey Orchid *Diuris drummondii* is a tuberous, perennial, herb, growing 0.5- 1.05 m high. It is found in low-lying depressions in peaty and sandy clay swamps. The flowering period is November to December or January. The species' conservation advice (DEWHA, 2008a) notes that certain fire regimes, in particular fire between July and early January, will damage the above ground parts of this plant. As the species is often found with its base in water, significant changes to water tables over time could also have a detrimental impact (DEWHA, 2008a).

ASPECT	DESCRIPTION
	Habitat preferences The species' preferred habitat comprises low lying depressions and swamps that are inundated well into the summer months (Brown, Dundas, Dixon, & Hopper, 2008; Western Australian Herbarium, 1998-). Abundance and historical records Approximately 7080 plants have been recorded from 51 records of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-). Distribution This species has been located within the Avon Wheatbelt, Jarrah Forest, SCP and Warren IBRA regions, in scattered populations between Northampton to Albany (Brown, Dundas, Dixon, & Hopper, 2008; Western Australian Herbarium, 1998-). Disturbance history / Fire regimes No evidence of recent occurrences of fires was observed or recorded within the targeted search areas. Fires occurring between July and January may result in damage to the plant whilst significant changes to water table levels may impact the species over time (DEWHA, 2008a).
Surveys undertaken	The BORR IPT vegetation and flora survey (BORR IPT, 2020i) was undertaken over a 2-year period, from August to November 2018 and from August to November 2019. Approximately 560 person-hours were spent on the BORR IPT vegetation and flora survey (BORR IPT, 2020i). Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation. As identified in BORR IPT (2020i), a targeted survey for *Diuris drummondii* was conducted by Ecoedge (2017) at four locations for a total of 32 person-hours. A subsequent targeted survey for the species was undertaken at three locations in 2019, also by Ecoedge (2019b) for a total of 16 person-hours. The targeted surveys were undertaken in wetland habitats (VT6, VT7 and VT8). The *D. drummondii* conservation advice (DEWHA, 2008a) notes that inappropriate fire regimes, in particular fire between July and early January, will damage the above ground parts of this plant. It is considered that fire history did not have an impact on the likely detectability of the species as no evidence of recent occurrences of fires was observed or recorded within the targeted search areas. In addition to the above, a targeted survey for the species was also undertaken in conjunction with a targeted survey for *Diuris micrantha* and *Eleocharis keigheryi.* This survey was carried out by BORR IPT in December 2018 over twenty sites within the Proposal Area (BORR IPT, 2020i), also in wetland habitats (VT6, VT7 and VT8). Grid and meander searches of the twenty sites were carried out over three days by two senior botanists and a support ecologist (BORR IPT, 2020i). Search site locations are shown in Figure 16, Appendix A. A description of each search site is provided in Appendix D of the vegetation and flora study (BORR IPT, 2020i) (Appendix C).

ASPECT	DESCRIPTION
	A Claypan TEC assessment, undertaken over three days between 26 July to 1 August 2019, also undertook targeted searches for conservation listed species in and near wetlands, including *D. drummondii*, however, did not identify this species (Ecoedge, 2019a).
Extent of habitat and number of individuals directly impacted by the Proposal	Despite significant survey effort during the optimum flowering period, no *D. drummondii* were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that *D. drummondii* occurs in the Proposal Area or wider Surveyed Area. While it is acknowledged that the species may not flower each year, the targeted survey was undertaken during the optimum flowering period and the species was not detected from either flowering or vegetative growth (long stem and leaf (BORR IPT, 2020i). Accordingly, the Proposal is not expected to impact any individuals of *D. drummondii*. Approximately 8.5 ha of potentially suitable habitat for *D. drummondii* was identified within the Proposal Area. This area was determined based on the area of VT6, VT7 and VT8 present within the Proposal Area, excluding vegetation that was of Degraded and Completely Degraded condition (BORR IPT, 2020i). Vegetation of Degraded and Completely Degraded condition was excluded as the species is considered to be very susceptible to disturbances such as high weed cover, grazing, inappropriate fire regimes and reduced native species diversity, with these factors causing the decline of populations (DEWHA, 2008a).
Extent of habitat and number of individuals indirectly impacted by the Proposal	Despite significant survey effort during the optimum flowering period, no individuals of *D. drummondii* were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that the species occurs within or immediately adjacent to the Proposal Area. Accordingly, the Proposal is not expected to impact any individuals of the species. During field surveys, approximately 1.2 ha of potentially suitable habitat (comprising VT6, VT7 and VT8 in Good or better condition) was identified within approximately 20 m of the Proposal Area, which may have a potential to be indirectly impacted by the Proposal.
Quality and importance of known or potential habitat within the Proposal Area	Approximately 8.5 ha of potentially suitable *D. drummondii* habitat was identified within the Proposal Area. This area has been determined based on the quality of the following vegetation types (BORR IPT, 2020i): • VT6 (2.8 ha) 2.5 ha of condition category 3-4 (Very Good to Good) 0.3 ha of condition category 4 (Good) • VT7 (5.7 ha) 5.7 ha of condition category 4 (Good) While VT8 comprises potential habitat for the species, this vegetation within the Proposal Area was not of sufficient condition to be classed as potential habitat (i.e. it was in Degraded or worse condition). Many of the sites surveyed during the targeted survey were found to be highly disturbed with limited native species remaining, high weed invasion and evidence of grazing by cattle (BORR IPT, 2020i).

ASPECT	DESCRIPTION
Known populations within at least a 2 km buffer	Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), one known population of *D. drummondii* has been previously recorded within 2 km of the Proposal Area. This record is located approximately 730 m southeast of the southern end of the Proposal Area (Figure 16, Appendix A).
Adequacy of survey	The field survey was undertaken by Ecoedge (2019b) in accordance with the Commonwealth of Australia's *Draft Orchid Survey Guidelines* (2013) and the methodology was discussed with Mr Andrew Webb (DBCA Parks and Wildlife Service, South West Region Flora Officer) prior to field work commencing. The methodology employed involved (BORR IPT, 2020i): • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys. • Selecting sites that were within swamps / dampland areas within the Proposal Area • Areas that had been completely cleared, heavily grazed paddocks that did not contain remnant vegetation, were excluded from the survey • Prior to the field survey, Mr Andrew Webb confirmed that *D. drummondii* was flowering in the Bunbury region and one of the known sites (outside of the Surveyed Area) was visited to confirm that the species was in flower Surveys involved two senior botanists. Three sites were traversed on foot with: • Higher quality habitat (sites that retained structure (had a upper / mid or ground layer that comprised native species) traversed on a parallel grid (at a 5-10 m intervals) • Lower quality sites (sites that were almost completed cleared / or contained scattered native sedged (such as *Juncus pallidus*) but were grazed and had high visibility through the ground layer were traversed via meander surveys
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of *D. drummondii* habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of the Approved Conservation Advice for *D. drummondii* (DEWHA, 2008a), analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the vegetation and flora survey (BORR IPT, 2020i) and, where required, consultation with DBCA staff.

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.3 Dwarf Bee-orchid – Vulnerable

A description of this species, as well as direct and potential indirect impacts from the Proposal, is outlined in Table 2-15.

Table 2-15 Dwarf Bee-orchid – Vulnerable

ASPECT	DESCRIPTION
Ecology, habitat preferences, abundance, distribution and disturbance history	Ecology Dwarf Bee-orchid *Diuris micrantha* is a tuberous, perennial, herb, growing 0.3-0.6 m high. The flowering period is from September to October (Western Australian Herbarium, 1998-). Habitat preferences Habitat preference includes winter-wet swamps in shallow water (Western Australian Herbarium, 1998-). Abundance and historical records Approximately 62 plants have been recorded from seven records of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-). Distribution This species has been recorded from the Jarrah Forest and Swan Coastal Plain IBRA regions, with seven scattered populations from east of Kwinana and south to Boyup Brook (Brown, Dundas, Dixon, & Hopper, 2008; Western Australian Herbarium, 1998-). Disturbance history The primary disturbance to the species has resulted from fire and weed invasion, with potential threats including grazing, clearing, feral animals and changes in hydrology (DEWHA, 2008b).
Surveys undertaken	The BORR IPT vegetation and flora survey (BORR IPT, 2020i) was undertaken over a 2-year period, from August to November 2018 and from August to November 2019. Approximately 560 person-hours were spent on the BORR IPT vegetation and flora survey (BORR IPT, 2020i). Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation. Targeted surveys for *Diuris micrantha* were undertaken by BORR IPT during the targeted searches for *Drakaea* species, in VT6, VT7 and VT8 (wetland habitat) (BORR IPT, 2020i). Search areas are shown in Figure 16 (Appendix A). In total, 100 person hours were spent surveying for the species during field surveys.
Extent of habitat and number of individuals directly impacted by the Proposal	Despite significant survey effort during the optimum flowering period, no *D. micrantha* were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that the species occurs in the Proposal Area or wider Surveyed Area. Accordingly, the Proposal is not expected to impact any individuals of the species. Approximately 8.5 ha of potentially suitable habitat for *D. micrantha* was identified within the Proposal Area. This area has been determined based on the area of VT6, VT7 and VT8 present within the Proposal Area, excluding vegetation that was of Degraded and Completely Degraded condition (BORR IPT, 2020i). Vegetation of Degraded and Completely Degraded condition has been excluded as suitable habitat for *D. micrantha*. This species is considered to be very susceptible to disturbances such as high weed cover, grazing, inappropriate fire regimes, changes

ASPECT	DESCRIPTION
	in hydrology and reduced native species diversity, with these factors causing the decline of populations (DEWHA, 2008b).
Extent of habitat and number of individuals indirectly impacted by the Proposal	Despite significant survey effort during the optimum flowering period, no *D. micrantha* were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that the species occurs in the Proposal Area or wider Surveyed Area. Accordingly, the Proposal is not expected to impact any individuals of the species. During field surveys, approximately 1.2 ha of potentially suitable habitat (comprising VT6, VT7 and VT8 in Good or better condition) was identified within approximately 20 m of the Proposal Area, which may have a potential to be indirectly impacted by the Proposal.
Quality and importance of known or potential habitat within the Proposal Area	Approximately 8.5 ha of potentially suitable *D. micrantha* habitat was identified within the Proposal Area. This area has been determined based on the quality of the following vegetation types (BORR IPT, 2020i): • VT6 (2.8 ha) 2.5 ha of condition category 3-4 (Very Good to Good) 0.3 ha of condition category 4 (Good) • VT7 (5.7 ha) 5.7 ha of condition category 4 (Good) While VT8 comprises potential habitat for the species, this vegetation within the Proposal Area was not of sufficient condition to be classed as potential habitat (i.e. it was in Degraded or worse condition). Many of the sites surveyed during the targeted survey were found to be highly disturbed with limited native species remaining, high weed invasion and evidence of grazing by cattle (BORR IPT, 2020i).
Known populations within at least a 2 km buffer	Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), no locations of *D. micrantha* have been previously recorded within 2 km of the Proposal Area.
Adequacy of survey	The field survey was undertaken in accordance with the Commonwealth of Australia's *Draft Orchid Survey Guidelines* (2013). Suitable survey effort covering all wetland habitats was extended during the preferred survey timing for species detection. The methodology employed involved (BORR IPT, 2020i): • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys • Areas that had been completely cleared, heavily grazed paddocks that did not contain remnant vegetation, were excluded from the survey Surveys involved two senior botanists and a field ecologist. Sites were traversed on foot with: • Higher quality habitat (sites that retained structure (had a upper / mid or ground layer that comprised native species) traversed on a parallel grid (at a 5-10 m intervals)

ASPECT	DESCRIPTION
	• Lower quality sites (sites that were almost completed cleared / or contained scattered native sedged (such as *Juncus pallidus*) but were grazed and had high visibility through the ground layer were traversed via meander surveys
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of *D. micrantha* habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of the species' Approved Conservation Advice (DEWHA, 2008b) and analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the vegetation and flora survey (BORR IPT, 2020i).

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.4 Glossy-leafed Hammer Orchid - Endangered

A description of this species, as well as direct and potential indirect impacts from the Proposal is outlined in Table 2-16.

Table 2-16 Glossy-leafed Hammer Orchid – Endangered

ASPECT	DESCRIPTION
Ecology, habitat preferences, abundance, distribution and disturbance history	Ecology Glossy-leafed Hammer Orchid *Drakaea elastica* is a tuberous, perennial, herb, growing 12-30 cm high. The flowering period is from October to November. The plant dies back to an underground tuber over summer. Habitat preferences Habitat preference includes white or grey sand in low-lying areas adjoining winter-wet swamps (Western Australian Herbarium, 1998-).The species typically occurs in banksia woodland or Spearwood thicket vegetation and often with other orchid species such as *Drakaea glyptodon* (King-in-his-Carriage), *D. livida* (Warty Hammer Orchid) and *Paracaleana nigrita* (Flying Duck Orchid) (DEC, 2009a). Abundance and historical records Approximately 1228 plants have been recorded from 19 records of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-). Distribution This species has been recorded from the SCP IBRA region, with populations identified between Cataby in the north to Busselton in the south (Brown, Dundas, Dixon, & Hopper, 2008; DEC, 2009a). Disturbance history The main threats to the species include land clearing, degradation and fragmentation of habitat, edge effects, density of ground level vegetation, grazing, construction and maintenance work, rubbish dumping, weed invasion, disease, inappropriate fire regimes, poor recruitment and salinity (DEC, 2009a).

ASPECT	DESCRIPTION
Surveys undertaken	The BORR IPT vegetation and flora survey (BORR IPT, 2020i) was undertaken over a 2-year period, from August to November 2018 and from August to November 2019. Approximately 560 person-hours were spent on the BORR IPT vegetation and flora survey (BORR IPT, 2020i). Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation. Targeted surveys for *D. elastica* were undertaken in vegetation types VT1, VT2, VT3 and VT4 (Jarrah / Banksia). The location of the search sites is shown in Figure 16 (Appendix A). In total, 100 person hours were spent surveying for the species.
Extent of habitat and number of individuals directly impacted by the Proposal	Despite significant survey effort, during the optimum flowering period, no *D. elastica* were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that the species occurs in the Proposal Area or wider Surveyed Area. Accordingly, the Proposal is not expected to impact any individuals of the species. Approximately 12.1 ha of potentially suitable habitat for *D. elastica* was identified within the Proposal Area. This area has been determined based on the area of VT1, VT2, VT3 and VT4 present within the Proposal Area, excluding vegetation that classed as Degraded and Completely Degraded condition (BORR IPT, 2020i). Vegetation of Degraded and Completely Degraded condition was excluded as *D. elastica* is considered to be very susceptible to disturbances such as high weed cover, grazing, overly frequent fire and reduced native species diversity, with these factors causing the decline of populations (DEC, 2009b). This vegetation will be cleared to enable the implementation of the Proposal. Approximately 12.1 ha of suitable habitat for *D. elastica* was identified within the Proposal Area. This has been determined based on the area of VT1, VT2, VT3 and VT4 present within the Proposal Area, excluding vegetation that was of Degraded and Completely Degraded condition (BORR IPT, 2020i). Vegetation of Degraded and Completely Degraded condition has been excluded as suitable habitat as this species is considered to be very susceptible to disturbances such as high weed cover, grazing, inappropriate fire regimes and reduced native species diversity, with these factors causing the decline of populations (DEC, 2009a).
Extent of habitat and number of individuals indirectly impacted by the Proposal	Despite significant survey effort during the optimum flowering period, no *D. elastica* individuals were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that the species occurs in the Proposal Area or wider Surveyed Area. Accordingly, the Proposal is not expected to impact any individuals of the species. During field surveys, approximately 1.3 ha of potentially suitable habitat (comprising VT1, VT2, VT3 and VT 4 in Good or better condition) was identified within approximately 20 m of the Proposal Area, which may have a potential to be indirectly impacted by the Proposal. Areas of potentially suitable habitat is also present adjacent to and within approximately 20 m of the Proposal Area east and west of Surveyed Area adjoining Bussell Highway and west of the southern extent of Marchetti Road.

ASPECT	DESCRIPTION
Quality and importance of known or potential habitat within the Proposal Area	Approximately 12.1 ha of potentially suitable habitat for *D. elastica* was identified within the Proposal Area. This area has been determined based on the condition of the following vegetation types (BORR IPT, 2020i): • VT1 (8.1 ha) - 4.0 ha of condition category 2-3 (Excellent to Very Good) - ha of condition category 3 (Very Good) - 0.5 ha of condition category 3-4 (Very Good to Good) - 1.6 ha of condition category 4 (Good) • VT2 (0.5 ha) - 0.5 ha of condition category 2 (Excellent) • VT4 (3.5 ha) - 0.7 ha of condition category 3 (Very Good) - 2.8 ha of condition category 3-4 (Very Good to Good)
Known populations within at least a 2 km buffer	Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), no locations of *D. elastica* have been previously recorded within 2 km of the Proposal.
Adequacy of survey	The field survey was undertaken in accordance with the Commonwealth of Australia's *Draft Orchid Survey Guidelines* (2013) and the methodology was discussed with Mr Andrew Webb (DBCA Flora Officer) prior to commencing the field work. The methodology employed involved (BORR IPT, 2020i): • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys. Sites selected were nearby swamps / dampland areas and contained *Kunzea* thickets with *Banksia* woodlands within the Proposal Area (Figure 16, Appendix A). Areas that had been completely cleared, heavily grazed paddocks that did not contain remnant vegetation, were excluded from the survey • Surveys were undertaken in mid to late August to coincide with the presence of *Drakaea elastica* leaf being conspicuous and detectable in the field • Surveys involved one senior botanist and botanist. Sites were traversed on foot with: - Higher quality habitat (sites that retained structure (had a upper / mid or ground layer that comprised native species) traversed on a parallel grid (at 10 m intervals) - Lower quality sites (sites that were almost completed cleared / or contained scattered native species but were grazed and had high visibility through the ground layer were traversed via meander surveys
Methods, data analysis and scientific literature used to identify and assess the	The significance of *D. elastica* habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of the *Drakaea elastica* Recovery Plan (DEC, 2009a), analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the vegetation and flora study (BORR IPT, 2020i) and, where required, consultation with DBCA staff.

ASPECT	DESCRIPTION
environmental values	

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.5 Dwarf Hammer Orchid – Vulnerable

A description of this species, as well as direct and potential indirect impacts from the Proposal is outlined in Table 2-17.

Table 2-17 Dwarf Hammer orchid – Vulnerable

ASPECT	DESCRIPTION
Ecology, habitat preferences, abundance, distribution and disturbance history	Ecology Dwarf Hammer Orchid *Drakaea micrantha* is a tuberous, perennial, herb, growing 15-30 cm high. The flowering period is from September to October. The main threat to the species is fires between June and October, when the species above ground parts and replacement tubers are actively growing (DEWHA, 2008c). Habitat preferences The preferred habitat for the species consists of thickets of *Kunzea glabrescens* with open patches of white sand, often shaded, near damplands (BORR IPT, 2020i). Known locations of *D. micrantha* outside of the wider Surveyed Area are typically in situated larger continuous patches containing suitable habitat that is in Very Good to Excellent condition (BORR IPT, 2020i). Abundance and historical records Approximately 687 plants have been recorded from 49 records of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-). Distribution This species has been recorded from the Jarrah Forest, SCP and Warren IBRA regions, with populations identified between Perth and Albany (Brown, Dundas, Dixon, & Hopper, 2008; Western Australian Herbarium, 1998-). Disturbance history Information about the species' general disturbance history is not available, however, plants usually occur on old firebreaks and open disturbed areas where competition has been removed (CALM, 2006). This indicates that the species is positively responsive to some forms of disturbance.
Surveys undertaken	The BORR IPT vegetation and flora survey (BORR IPT, 2020i) was undertaken over a 2-year period, from August to November 2018 and from August to November 2019. Approximately 560 person-hours were spent on the BORR IPT vegetation and flora survey (BORR IPT, 2020i). Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation.

ASPECT	DESCRIPTION
	Targeted surveys for *D. micrantha* were undertaken in vegetation types VT1, VT2, VT3 and VT4 (Jarrah / Banksia) (Figure 5, **Error! Reference source not found.**). The location of the search sites is shown in Figure 16 (**Error! Reference source not found.**). In total, 100 person hours were spent surveying for the species.
Extent of habitat and number of individuals directly impacted by the Proposal	Despite significant survey effort during the optimum flowering period, no *D. micrantha* were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that the species occurs in the Proposal Area or wider Surveyed Area. Accordingly, the Proposal is not expected to impact any individuals of the species. Approximately 12.1 ha of potentially suitable habitat for *D. micrantha* was identified within the Proposal Area. This area has been determined based on the area of VT1, VT2, VT3 and VT4 present within the Proposal Area, excluding vegetation that was of Degraded and Completely Degraded condition (BORR IPT, 2020i). Vegetation of Degraded and Completely Degraded condition has been excluded as suitable habitat as this species is considered to be very susceptible to disturbances such as high weed cover, grazing, inappropriate fire regimes and reduced native species diversity, with these factors causing the decline of populations (DAWE, 2020b).
Extent of habitat and number of individuals indirectly impacted by the Proposal	Despite significant survey effort during the optimum flowering period, no *D. micrantha* were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that the species occurs in the Proposal Area or wider Surveyed Area. Accordingly, the Proposal is not expected to impact any individuals of the species. During field surveys, approximately 1.3 ha of potentially suitable habitat (comprising VT1, VT2, VT3 and VT 4 in Good or better condition) was identified within approximately 20 m of the Proposal Area, which may have a potential to be indirectly impacted by the Proposal. Areas of potentially suitable *D. micrantha* habitat is also present adjacent to and within approximately 20 m of the Proposal Area east and west of Surveyed Area adjoining Bussell Highway and west of the southern extent of Marchetti Road.
Quality and importance of known or potential habitat within the Proposal Area	Approximately 12.1 ha of potentially suitable habitat for *D. micrantha* was identified within the Proposal Area. This area has been determined based on the condition of the following vegetation types (BORR IPT, 2020i): • VT1 (8.1 ha) - 4.0 ha of condition category 2-3 (Excellent to Very Good) - ha of condition category 3 (Very Good) - 0.5 ha of condition category 3-4 (Very Good to Good) - 1.6 ha of condition category 4 (Good) • VT2 (0.5 ha) - 0.5 ha of condition category 2 (Excellent) • VT4 (3.5 ha) - 0.7 ha of condition category 3 (Very Good) - 2.8 ha of condition category 3-4 (Very Good to Good)

ASPECT	DESCRIPTION
Known populations within at least a 2 km buffer	Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), no locations of *D. micrantha* have been previously recorded within 2 km of the Proposal Area.
Adequacy of survey	The field survey was undertaken in accordance with the Commonwealth of Australia's *Draft Orchid Survey Guidelines* (2013) and the methodology was discussed with Mr Andrew Webb (DBCA Flora Officer) prior to commencing the field work. The methodology employed involved (BORR IPT, 2020i): • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys. Sites selected were nearby swamps / dampland areas and contained *Kunzea* thickets with *Banksia* woodlands within the Proposal Area (Figure 5, Figure 16, **Error! Reference source not found.**). Areas that had been completely cleared, heavily grazed paddocks that did not contain remnant vegetation, were excluded from the survey • Surveys were undertaken in mid to late August to coincide with the presence of and *D. micrantha* leaf being conspicuous and detectable in the field • While the species may not flower each year, targeted surveys for the presence of the Drakaea leaf were undertaken early in the season to ensure that if Drakaea species were present it would have been detected through adequate survey effort. • Surveys involved one senior botanist and a one botanist, sites were traversed on foot with: - Higher quality habitat (sites that retained structure (had a upper / mid or ground layer that comprised native species) traversed on a parallel grid (at 10 m intervals) - Lower quality sites (sites that were almost completed cleared / or contained scattered native species but were grazed and had high visibility through the ground layer were traversed via meander surveys
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of *Drakaea micrantha* habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of the species' Approved Conservation Advice (DEWHA, 2008c), analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the vegetation and flora survey (BORR IPT, 2020i) and, where required, consultation with DBCA staff.

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.6 Keighery's Eleocharis - Vulnerable

A description of this species, as well as direct and potential indirect impacts from the Proposal is outlined in Table 2-18.

Table 2-18 Keighery's Eleocharis – Vulnerable

ASPECT	DESCRIPTION
Ecology, habitat preferences, abundance, distribution and disturbance history	Ecology Keighery's Eleocharis *Eleocharis keigheryi* is a rhizomatous, clumped perennial, grass-like or herb (sedge) to 0.4 m high. The flowering period is from August to November. Main threats include invasive weed species, firebreak, road and rail maintenance, livestock damage and grazing (DEWHA, 2008d). Habitat preferences Habitat preference includes clay, sandy loam and this is an emergent species in freshwater creeks and claypan vegetation (Western Australian Herbarium, 1998-). Abundance and historical records Approximately 10,707 plants have been recorded from 56 records of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-). Distribution This species has been recorded from the Avon Wheatbelt, Geraldton Sandplains, Jarrah Forest and SCP IBRA regions, with populations identified between Perth and Albany (Western Australian Herbarium, 1998-). Disturbance history Known populations are fragmented with considerable distances between them. Invasive weed species have impacted most populations through competition for space, water and nutrients (DEWHA, 2008d).
Surveys undertaken	The BORR IPT vegetation and flora survey (BORR IPT, 2020i) was undertaken over a 2-year period, from August to November 2018 and from August to November 2019. Approximately 560 person-hours were spent on the BORR IPT vegetation and flora survey (BORR IPT, 2020i). Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation. Searches were conducted from August-December 2018. A targeted survey for the species was also undertaken in conjunction with a targeted survey for *Diuris drummondii and D. micrantha.* This survey was carried out by BORR IPT in December 2018 over twenty sites within the Proposal Area (BORR IPT, 2020i), also in wetland habitats (VT6, VT7 and VT8) (Figure 5, **Error! Reference source not found.**). Grid and meander searches of the twenty sites were carried out over three days by two senior botanists and a support ecologist (BORR IPT, 2020i). In total, 100 person hours were spent surveying for the species. Search site locations are shown in Figure 16 (**Error! Reference source not found.**). A description of each search site is provided in Appendix D of the vegetation and flora study (BORR IPT, 2020i) (Appendix C).
Extent of habitat and number of individuals directly	Despite significant survey effort, during the optimum flowering period, no *E. keigheryi* were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that the species occurs in the Proposal

ASPECT	DESCRIPTION
impacted by the Proposal	Area or wider Surveyed Area. Accordingly, the Proposal is not expected to impact any individuals of the species. Approximately 8.5 ha of potentially suitable habitat for *E. keigheryi* was identified within the Proposal Area. This area was determined based on the area of VT6, VT7 and VT8 present within the Proposal Area, excluding vegetation that was of Degraded and Completely Degraded condition (BORR IPT, 2020i). Vegetation of Degraded and Completely Degraded condition has been excluded as suitable habitat for *E. keigheryi*. This species is considered to be very susceptible to disturbances such as high weed cover, grazing, altered hydrology and reduced native species diversity, with these factors causing the decline of populations (DEWHA, 2008d).
Extent of habitat and number of individuals indirectly impacted by the Proposal	Despite significant survey effort during the optimum flowering period, no *E. keigheryi* individuals were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that the species occurs in the Proposal Area or wider Surveyed Area. Accordingly, the Proposal is not expected to impact any individuals of the species. During field surveys, approximately 1.2 ha of potentially suitable habitat (comprising VT6, VT7 and VT8 in Good or better condition) was identified within approximately 20 m of the Proposal Area, which may have a potential to be indirectly impacted by the Proposal.
Quality and importance of known or potential habitat within the Proposal Area	Approximately 8.5 ha of potentially suitable habitat for *E. keigheryi* was identified within the Proposal Area. This area has been determined based on the quality of the following vegetation types (BORR IPT, 2020i): • VT6 (2.8 ha) - 2.5 ha of condition category 3-4 (Very Good to Good) - 0.3 ha of condition category 4 (Good) • VT7 (5.7 ha) - 5.7 ha of condition category 4 (Good) While VT8 comprises potential habitat for the species, this vegetation within the Proposal Area was not of sufficient condition to be classed as potential habitat (i.e. it was in Degraded or worse condition). Many of the sites surveyed during the targeted survey were found to be highly disturbed with limited native species remaining, high weed invasion and evidence of grazing by cattle (BORR IPT, 2020i).
Known populations within at least a 2 km buffer	Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), no locations of *E. keigheryi* have been previously recorded within 2 km of the Proposal Area.
Adequacy of survey including extent to which surveys were relevant to the species in question and undertaken in	In addition to the detailed flora and vegetation survey undertaken during 2018 and 2019 spring seasons, a targeted survey for the species was undertaken by BORR IPT in December 2018 over twenty in wetland habitat sites (VT6, VT7 and VT8) within the Proposal Area (BORR IPT, 2020i).

ASPECT	DESCRIPTION
accordance with the relevant guidelines	The survey was conducted in accordance with the Commonwealth of Australia's *Draft Orchid Survey Guidelines* (2013). The survey included early spring, mid-spring, late spring and summer survey periods. The methodology employed involved (BORR IPT, 2020i): • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys • Areas that had been completely cleared, heavily grazed paddocks that did not contain remnant vegetation, were excluded from the survey Surveys involved two senior botanists. Vegetation types VT6, VT7 and VT8 (wetland habitat) were traversed on foot with: • Higher quality habitat (sites that retained structure (had a upper / mid or ground layer that comprised native species) traversed on a parallel grid (at a 5-10 m intervals) • Lower quality sites (sites that were almost completed cleared / or contained scattered native sedged (such as *Juncus pallidus*) but were grazed and had high visibility through the ground layer were traversed via meander surveys
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of *E. keigheryi* habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of the species' Approved Conservation Advice (DEWHA, 2008d) and analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the vegetation and flora study (BORR IPT, 2020i).

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.7 Selena's Synaphea – Critically Endangered

A description of this species, as well as direct and potential indirect impacts from the Proposal is outlined in Table 2-19.

Table 2-19 Selena's Synaphea – Critically Endangered

ASPECT	DESCRIPTION
Ecology, habitat preferences, abundance, distribution and disturbance history	Ecology *Synaphea* sp. Fairbridge Farm is a dense and clumped shrub that grows to 0.3 m high and 0.4 m wide. The flowering period is in October (Western Australian Herbarium, 1998-). Habitat Preferences The preferred habitat is sand with lateritic gravel soils near winter-wet flats in low woodland areas (Western Australian Herbarium, 1998-). Abundance

ASPECT	DESCRIPTION
	Approximately 362 plants have been recorded from 27 records of this species in the WA Herbarium database. Many of these records have not recorded the number of plants observed however it has often been described as frequent or locally common (Western Australian Herbarium, 1998-). Distribution The species has been recorded from the jarrah forests and swan coastal plain IBRA regions, with populations identified between Canning & Dardanup (Western Australian Herbarium, 1998-). Disturbance history The main threats to this species include rail, road and fence maintenance works, competition from weeds, grazing and digging by rabbits, pests and recreational activities.
Surveys undertaken	The BORR IPT vegetation and flora survey (BORR IPT, 2020i) was undertaken over a 2-year period, from August to November 2018 and from August to November 2019. Approximately 560 person-hours were spent on the BORR IPT vegetation and flora survey (BORR IPT, 2020i). The location of the search sites is shown in Figure 16 (Appendix A). Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation.
Extent of habitat and number of individuals directly or indirectly by the Proposal	Despite significant survey effort during the optimum flowering period, no individuals of *Synaphea* sp. Fairbridge Farm were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that *Synaphea* sp. Fairbridge Farm occurs in the Proposal Area or wider Surveyed Area. Accordingly, the Proposal is not expected to impact any individuals of the species. As identified by (BORR IPT, 2020i), *Synaphea* sp. Fairbridge Farm is endemic to the Pinjarra Plains and grows on grey clayey sand with lateritic pebbles soils, near winter-wet flats in low woodlands of *Corymbia calophylla* with *Viminaria juncea, Xanthorrhoea preissii, Adenanthos meisneri, Hypocalymma angustifolia* and *Allocasuarina humilis* shrubs. The Surveyed Area does not contain suitable habitat on the Pinjarra Plain landform. Accordingly, the Proposal is not expected to impact any habitat potentially suitable for the species. No suitable habitat for the species was identified within 20 m of the Proposal Area boundary, therefore no indirect impacts to the species or its habitat are expected to result from Proposal implementation.
Quality and importance of known or potential habitat within the Proposal Area	As identified by (BORR IPT, 2020i), *Synaphea* sp. Fairbridge Farm is endemic to the Pinjarra Plains and grows on grey clayey sand with lateritic pebbles soils, near winter-wet flats in low woodlands of *Corymbia calophylla* with *Viminaria juncea, Xanthorrhoea preissii, Adenanthos meisneri, Hypocalymma angustifolia* and *Allocasuarina humilis* shrubs. The Surveyed Area does not contain suitable habitat on the Pinjarra Plain landform. Accordingly, the Proposal is not expected to impact any habitat potentially suitable for *Synaphea* sp. Fairbridge Farm.

ASPECT	DESCRIPTION
Known populations within at least a 2 km buffer	Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), no locations of *Synaphea* sp. Fairbridge Farm have been previously recorded within 2 km of the Proposal Area.
Adequacy of survey including extent to which surveys were relevant to the species in question and undertaken in accordance with the relevant guidelines	A detailed vegetation and flora survey was undertaken by BORR IPT, from 20 August 2018 to December 2018. The Threatened flora search component of the survey was conducted in accordance with the Commonwealth of Australia's *Draft Orchid Survey Guidelines* (2013). The survey included early spring, mid-spring, late spring and summer survey periods (BORR IPT, 2020i). The methodology employed involved: • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys • Areas that had been completely cleared, heavily grazed paddocks that did not contain remnant vegetation, were excluded from the survey Surveys involved two senior botanists, vegetation types VT6, VT7, VT8 (wetland habitat) were traversed on foot with: • Higher quality habitat (sites that retained structure (had a upper / mid or ground layer that comprised native species) traversed on a parallel grid (at a 5-10 m intervals) • Lower quality sites (sites that were almost completed cleared / or contained scattered native sedged (such as *Juncus pallidus*) but were grazed and had high visibility through the ground layer were traversed via meander surveys
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of *Synaphea* sp. Fairbridge Farm habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of *Synaphea* sp. Fairbridge Farm Approved Conservation Advice (DEWHA, 2009b) and analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the vegetation and flora survey (BORR IPT, 2020i).

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.8 *Austrostipa jacobsiana* – Critically Endangered and *Austrostipa bronwenae* - Endangered

A description of this species, as well as direct and potential indirect impacts from the Proposal is outlined in Table 2-20.

Table 2-20 *Austrostipa jacobsiana* - Critically Endangered and *Austrostipa bronwenae* - Endangered

ASPECT	DESCRIPTION
Ecology, habitat preferences, abundance, distribution and disturbance history	Ecology *A. bronwenae* is a perennial grass growing to 0.6 m high x 0.3 m wide. The green flower spikes appear from September to October (TSSC, 2018a).

ASPECT	DESCRIPTION
	A. jacobsiana is a tufted rhizomatous herb growing to 1.2 m (including flower spikes). Flower spikes appear from October to November (DPAW, 2016; TSSC, 2018b). Habitat Preferences Both *A. jacobsiana* and *A. bronwenae* occur in a flat low-lying area within the SCP. More specifically, *A. jacobsiana's* habitat is on a seasonally wet depression on calcareous clay to fine sandy clay, while *A. bronwenae's* habitat is on calcareous winter wet grey-brown sandy loam or dark brown loam over clay (TSSC, 2018a; TSSC, 2018b). *A. jacobsiana* that is populated in the Bunbury region grows on sandy loam over a lime-marl like rock in a flat, low-lying dampland. Abundance In 2018, *A. bronwenae* was known from four subpopulations from three locations approximately 175 km apart, comprising a total of 333 plants (TSSC, 2018a). In 2014, *A. jacobsiana* was known from two populations, comprising around 389 plants (DPAW, 2016; TSSC, 2018b). Distribution Both species have been recorded from the SWA02 IBRA region, with populations of *A. jacobsiana* identified in Bunbury and Gosnells, and populations of *A. bronwenae* identified between Gosnells & Busselton (Western Australian Herbarium, 1998-). Populations of both species are severely fragmented. Disturbance history The main current threats to *A. bronwenae* are mineral sand mining, grazing, feral pigs, recreational activities / vehicles, weed invasion, drought, fire / firebreak prevention and maintenance, and inappropriate fire intervals. The Bunbury population is mainly threatened by recreational activities, drought, weed invasion and fire prevention management. The main current threats to *A. jacobsiana* are road, firebreak and utilities maintenance, weed invasion / competition, grazing and trampling, lack of recruitment due to grazing / mowing of plants, farming activities, rubbish dumping, vegetation clearing and altered fire regimes. The City of Bunbury reserve population is mainly threatened by weed invasion, fire management and prevention activities and hydrological change.
Surveys undertaken	The BORR IPT vegetation and flora survey (BORR IPT, 2020i) was undertaken over a 2-year period, from August to November 2018 and from August to November 2019. Approximately 560 person-hours were spent on the BORR IPT vegetation and flora survey (BORR IPT, 2020i). Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation. Targeted surveys for *A. jacobsiana* and *A. bronwenae* were undertaken in vegetation types VT6, VT7 and VT8 (wetland habitats) (Figure 5 **Error! Reference source not found.**). The location of the search sites is shown in Figure 16

ASPECT	DESCRIPTION
	(Appendix A). In total, 100 person hours were spent surveying for *A. jacobsiana* and *A. bronwenae* (BORR IPT, 2020i).
Extent of habitat and number of individuals directly or indirectly by the Proposal	Despite significant survey effort during the optimum flowering period, no individuals of *A. jacobsiana* or *A. bronwenae* were observed within the Proposal Area or surrounds (BORR IPT, 2020i). It is therefore considered unlikely that *A. jacobsiana* or *A. bronwenae* occurs in the Proposal Area or wider Surveyed Area. Accordingly, the Proposal is not expected to impact any individuals of *A. jacobsiana* or *A. bronwenae*. Suitable survey effort covering all wetland habitats was extended during the preferred survey timing for species detection. The species were also targeted during the surveys for *Diuris drummondii* as both share similar habitat. Wetland habitat is present within the Surveyed Area, however disturbances such as weed invasion, edge effects, tracks, clearing and rubbish dumping have led to the habitat being disturbed causing a reduction the habitat condition. Areas in better condition were adequately surveyed. The closest recorded occurrence is approximately 1.06 km for *A. jacobsiana* and 2.73 km for *A. bronwenae* from the Surveyed Area in protected habitat that is in Excellent-Very Good condition. Suitable search effort did not record the species in the Surveyed Area. During field surveys, approximately 1.2 ha of potentially suitable habitat (comprising VT6, VT7 and VT8 in Good or better condition) was identified within approximately 20 m of the Proposal Area, which may have a potential to be indirectly impacted by the Proposal.
Quality and importance of known or potential habitat within the Proposal Area	Approximately 8.5 ha of potentially suitable habitat for *A. jacobsiana* and *A. bronwenae* was identified within the Proposal Area. This area has been determined based on the quality of the following vegetation types (BORR IPT, 2020i): • VT6 (2.8 ha) - 2.5 ha of condition category 3-4 (Very Good to Good) - 0.3 ha of condition category 4 (Good) • VT7 (5.7 ha) - 5.7 ha of condition category 4 (Good) While VT8 comprises potential habitat for the species, this vegetation within the Proposal Area was not of sufficient condition to be classed as potential habitat (i.e. it was in Degraded or worse condition). Many of the sites surveyed during the targeted survey were found to be highly disturbed with limited native species remaining, high weed invasion and evidence of grazing by cattle (BORR IPT, 2020i).
Known populations within at least a 2 km buffer	The closest recorded occurrence is approximately 1.06 km for *A. jacobsiana* and 2.73 km for *A. bronwenae* from the Surveyed Area in protected habitat that is in Excellent-Very Good condition (DBCA, 2020) (Figure 17, Appendix A).
Adequacy of survey including extent to which surveys were	A detailed vegetation and flora survey was undertaken by BORR IPT from 20 August 2018 to December 2018 (BORR IPT, 2020i). The Threatened flora search component of the survey was conducted in accordance with the Commonwealth of

ASPECT	DESCRIPTION
relevant to the species in question and undertaken in accordance with the relevant guidelines	Australia's *Draft Orchid Survey Guidelines* (2013). The survey included early spring, mid-spring, late spring and summer survey periods. The methodology employed involved (BORR IPT, 2020i): • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys • Areas that had been completely cleared, heavily grazed paddocks that did not contain remnant vegetation, were excluded from the survey Surveys involved two senior botanists. Vegetation types VT6, VT7 and VT8 (wetland habitat) were traversed on foot with: • Higher quality habitat (sites that retained structure (had a upper / mid or ground layer that comprised native species) traversed on a parallel grid (at a 5-10 m intervals) • Lower quality sites (sites that were almost completed cleared / or contained scattered native sedged (such as *Juncus pallidus*) but were grazed and had high visibility through the ground layer were traversed via meander surveys.
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of *A. bronwenae* and *A. jacobsiana* habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of *A. bronwenae* and *A. jacobsiana* Approved Conservation Advices (TSSC, 2018a; TSSC, 2018b) and analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the vegetation and flora study (BORR IPT, 2020i).

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

3 ASSESSMENT OF IMPACTS

This section addresses the Proposal's potential direct and indirect impacts on protected matters that are likely to be present within the proposed action area and surrounds, examining each protected matter in a separate subsection. Each protected matter is assessed consistent with the Department of Environment (DoE) *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* which identifies 'significant impact criteria' to assist in determining whether the environmental impacts of a Proposal are likely to be significant (DoE, 2013). Conservation advice, recovery plans, and other relevant guidance have been applied where applicable to specific protected matters. These are listed in Section 10.

The assessment of impacts for the BORR Southern Section has been considered at both local and regional levels, and with regard to the potential impacts of the BORR Northern and Central Section (EPBC 2019/8471). An assessment of direct and potential indirect impacts, as well as cumulative impacts for both proposals, is presented in the following section.

Respective to the ongoing development of land within the Bunbury region, approval and assessment is encompassed under the Greater Bunbury Regional Scheme (GBRS) and subsequent amendments which considered the cumulative context of BORR within the landscape. The GBRS provides the legal basis for land use planning within the Greater Bunbury area. The GBRS defines the future use of land and requires local government to provide detailed plans consistent with the GBRS local planning schemes. The GBRS has been in operation since November 2007 (WAPC, 2017b) and encompasses the planning approval for the BORR alignment.

The WA EPA conducted an assessment of the proposed GBRS in 2003 (EPA, 2003). The EPA's assessment included a *Strategy for the EPA to identify regionally significant natural areas in its consideration of the Greater Bunbury Region Scheme portion of the Swan Coastal Plain* (the Natural Areas Strategy). In order to determine the potential impact of proposed new zones in the GBRS and resulting potential new development and infrastructure, the Natural Areas Strategy evaluated the regional significance of remnant vegetation against set criteria, along with the context and adequacy of Regional Open Space reserves. The primary objective in regard to the conservation of ecological communities was to achieve a standard retention level of at least 30 % of the pre-clearing extent, with this target reduced to 10 % for the Greater Bunbury Region 'Constrained Area', in which a portion of the Proposal Area is located.

The regional context of the EPA's GBRS assessment, while preceding a number of TEC and fauna listings considered in this assessment, informed a cumulative approach to development and retention of native vegetation across the GBRS envelope that will remain in effect through the proposed implementation period for the Proposal.

Risk assessments conducted in relation to potential impacts from the Proposal to conservation significant fauna and TEC vegetation are included in **Error! Reference source not found.**.

3.1 Threatened ecological communities

Construction and construction related clearing is the primary driver for both direct and indirect impacts on TECs and is a permanent impact on the landscape. As noted in Section 1, construction of the Proposal is intended to commence from quarter four, 2021, with vegetation clearing expected to commence within that timeframe.

3.1.1 Banksia Woodlands TEC – Endangered

A risk assessment for Banksia Woodlands TEC relating to the Proposal is included in **Error! Reference source not found.**.

Direct impacts

Up to 23.4 ha of vegetation representing Banksia Woodlands TEC will be cleared as a result of Proposal implementation, as detailed in Table 2-6. This loss will be permanent. Across the three direct impact sites of the TEC, the condition of vegetation in the largest site (20.0 ha) ranges Excellent-Very Good to Completely Degraded, with the two smaller sites ranging from Excellent to Very Good condition.

An assessment of the proposed clearing of Banksia Woodlands TEC at local, subregional and total extent scales was made by comparing the extent within the Proposal Area to that published for the community (total and subregional) as well as the extent within a 5 km radius of the Proposal Area and the extent within the broader BORR IPT (2020i) Surveyed Area (Table 3-1).

As at 2015[13], the total known extent of the Banksia Woodlands TEC was 336,489 ha, of which > 253,000 ha is in the Perth subregion of the SCP bioregion (in which the Proposal Area is located), and 81, 832 ha (~25 %) is protected within conservation reserves (TSSC, 2016). At a local scale, regional mapping indicates the predicted occurrence of > 4,600 ha of Banksia Woodlands TEC within a 5 km radius of the Proposal (DBCA, 2020). BORR IPT (2020i) recorded 34 ha of Banksia Woodlands TEC within their wider Surveyed Area.

Based on these assessments, the clearing of up to 23.4 ha associated with the Proposal would result in a reduction of up to 0.007 % in the reported extent of the Banksia Woodlands TEC. At the Perth (SWA02) subregion scale, this would represent a reduction of less than 0.01 % (Table 3-1). This represents the maximum possible direct impact associated with the Proposal.

Table 3-1 Extent of Banksia Woodlands TEC within Proposal and Surveyed Areas and regional / total extents

TEC	EXTENT IN PROPOSAL AREA (HA)	EXTENT IN BORR IPT (2020i) SURVEY AREA	% LOSS OF PERTH SWA02 SUBREGION EXTENT (> 253,000 HA)	% LOSS OF TOTAL KNOWN EXTENT (> 336,000 HA)
Banksia Woodlands TEC	23.4	34 ha	< 0.01 %	0.007 %

Indirect impacts

Weeds, fire and *Phytophthora* dieback

Indirect impacts to Banksia Woodlands TEC potentially resulting from Proposal implementation are expected to be restricted to the introduction and / or spread of weeds and *Phytophthora* dieback, and

[13] This is the most current estimate available.

damage through the accidental generation of a bushfire during construction. Some indirect impacts can be permanent in nature, while others may be temporary if managed appropriately.

Indirect impact to Banksia Woodlands TEC / PEC from changes in hydrology is not expected, and accordingly, has not been listed above. Altering existing flow paths has the potential to negatively impact the hydrological regime (most notably drying) of TEC / PEC occurrences. Through implementation of the Drainage Strategy developed for the Proposal (BORR IPT, 2019g), and the management actions listed in Table 4-3, existing drainage patterns to adjacent TEC / PEC vegetation will be maintained. Impacts from changes to flow paths are therefore not expected to result from the Proposal.

The risk of fire and *Phytophthora* dieback are potentially the most far-reaching of the potential indirect impacts, extending up to 20 m or more beyond the Proposal Area boundary. Main Roads' standard construction practices combined with the management actions detailed in section 4.1.4 will specifically and effectively manage the potential for these indirect impacts to occur. As such, the potential for fire and *Phytophthora* dieback impacts up to 20 m from the Proposal are not anticipated to result from Proposal implementation.

The introduction and spread of weeds is a more localised potential impact within 20 m of the Proposal with a greater risk of occurrence that will be managed through implementation of the proposed active management in accordance with Main Roads standards, as detailed in section 4.1.4.

To identify areas of higher risk and greater potential for indirect impacts proximate to the Proposal Area, Main Roads has defined a potential indirect impact management zone extending 20 m into adjacent Banksia Woodland TEC occurrences. The extent of Banksia Woodlands TEC within 20 m of the Proposal Area has been calculated and is presented in Table 2-6. Considering the nature of the project (road construction) and that construction will be limited to the Proposal Area, the likelihood of indirect impacts from the introduction or spread of weeds on Banksia Woodlands TEC vegetation further than 20 m from the Proposal Area boundary resulting from the Proposal is negligible.

This zone is in accordance with the Banksia Woodlands TEC conservation advice, which suggests buffers of between 20 m and 50 m in width[14]. The Proposal comprises linear road infrastructure that is not erosion causing or sedimentation forming, and for which all stormwater will be contained within the footprint and access beyond the footprint will be controlled (through fencing).

The Proposal is being implemented by Main Roads, an organisation with many decades of experience in the effective monitoring and management of roadside vegetation. Through the development and implementation of industry-leading standards and practices, impacts to vegetation adjacent to construction and maintenance activities, rarely occur and if they do occur, rarely extend more than 5-10 m beyond the construction zone. The fact that much of the State's high-value remnant vegetation is contained within road reserves is testament to this.

For these reasons and based on the nature and scale of the Proposal, Main Roads considers a Banksia Woodland TEC buffer width of 20 m to be sufficient for the Proposal, and considers this to be in accordance with the conservation advice. As detailed in Table 2-6, four occurrences of Banksia Woodlands TEC are present within 20 m of the Proposal Area. The size of these occurrences after clearing for the Proposal has been completed, and the extent of each occurrence within 20 m of the Proposal Area boundary, is described below:

[14] It was not possible to incorporate buffers into the proposal footprint/design given that the Proposal Area is constrained within the road reserve gazetted under the Greater Bunbury Region Scheme.

- The occurrence associated with indirect impact Site BTW-S-I-3[15] is more than 100 ha, of which less than 0.5 % is within 20 m
- The occurrence associated with indirect impact Site BTW-S-I-4 is more than 100 ha, of which less than 3.4 % is within 20 m
- The occurrence associated with indirect impact Site BW-S-I-6 is approximately 3 ha, of which 20 % is within 20 m
- The occurrence associated with indirect impact Site BW-S-I-7 is approximately 7 ha, of which 5.7 % is within 20 m

Fragmentation

Banksia Woodlands TEC occurrences must meet minimum patch size and vegetation condition criteria in order to qualify as occurrences of the TEC (TSSC, 2016). The size and condition thresholds are:

- Pristine condition – no minimum
- Excellent condition – 0.5 ha
- Very Good condition – 1 ha
- Good condition – 2 ha.

As is detailed in

Table 3-2, all the occurrences of Banksia Woodlands TEC remaining after Proposal implementation will still meet the criteria for the TEC as defined in TSSC (2016). While the Banksia Woodland TEC occurrence in Gelorup will be divided into a northern and southern occurrence as a result of the Proposal, the viability of these occurrences is considered unlikely to change as a result of the Proposal.

The vegetation monitoring program will enable the detection of any indirect impacts to adjacent TEC occurrences, such as edge effects. The proposed management actions detailed in Table 4-3 will effectively manage these impacts should they occur.

Banksia Woodlands TEC adjacent to the Proposal Area is in varying condition. Along the Gelorup Corridor, the TEC occurs across privately owned small (approximately 2 ha) land holdings in a rural residential setting. Each landholder individually manages their property, and may or may not be aware of the presence of the TEC, and may or may not manage the vegetation for the conservation of the TEC. Each Lot has a firebreak, and the area is traversed by many local roads. As such, edge effects are already present throughout and the TEC condition is variable throughout.

Similarly, the TEC occurrences at Marchetti Road, Jilley Road and adjacent to Centenary Road adjoin cleared agricultural land, and are therefore already subjected to edge effects, noting that the Marchetti and Jilley Road occurrences are in Excellent and Very Good-Excellent condition, respectively.

Considering the above, as well as the nature and scale of the Proposal and Main Roads experience and standard of works as detailed above, the construction and operation of BORR is unlikely to further increase the existing edge effects in the adjacent TEC vegetation.

[15] Sites BTW-S-I-3, BTW-S-I-4, BW-S-I-6 and BW-S-I-7 are monitoring sites and not necessarily separate patches.

Main Roads will implement the Vegetation Monitoring Program, vegetation management actions as detailed in Table 4-3 (which include control of Declared weeds and WONS), and in the CEMP to detect and mitigate any impacts that may occur within the 20 m indirect impact zone.

Table 3-2 Banksia Woodlands TEC occurrences status before and after Proposal implementation

OCCURRENCE	ORIGINAL AREA (HA) AND CONDITION	HA (%) TO BE CLEARED AND CONDITION	HA (%) TO BE RETAINED AND CONDITION	MET CRITERIA PRIOR TO CLEARING (Yes/No)	MEETS CRITERIA AFTER CLEARING (Yes/No)
BW-S-D-1	23.9 ha Excellent-Very Good to Completely Degraded Note: forms part of a large expanse (> 100 ha) of Banksia Woodlands in a rural residential setting	20 ha (90 %) Excellent-Very Good to Completely Degraded Note: forms part of a large expanse (> 100 ha) of Banksia Woodlands in a rural residential setting	2.4 ha (10 %) Excellent-Very Good to Completely Degraded Note: forms part of a large expanse (> 100 ha) of Banksia Woodlands in a rural residential setting	Yes	Yes
BW-S-D-2	4.6 ha Excellent-Very Good	2.9 ha (63 %) Excellent-Very Good	1.7 ha (37 %) Excellent-Very Good	Yes	Yes
BW-S-D-3	> 8.5 ha Excellent to Very Good[16]	0.5 ha (< 6 %) Excellent	> 8 ha (> 94 %) Excellent to Very Good	Yes	Yes

Cumulative impacts

The assessment of impacts for the BORR Southern Section has been considered at both local and regional levels. Additional regard to the cumulative context of the project with the BORR Northern and Central Sections has also been considered. A summary of the potential cumulative direct impacts of both proposals on Banksia Woodlands TEC is included in Table 3-3.

[16] Assessed from the property boundary.

Table 3-3 Potential cumulative impacts of BORR Proposals

TEC TYPE	BORR SOUTHERN SECTION	BORR NORTHERN AND CENTRAL SECTIONS	CUMULATIVE IMPACT
Banksia Woodlands TEC	Clearing of up to 23.4 ha (0.007 % of regional extent)	Clearing of up to 3.7 ha (0.001 % of regional extent)	Clearing of up to 27.1 ha (0.01 % of regional extent)

The cumulative BORR Proposals would result in the permanent loss of up to 27.1 ha of Banksia Woodlands TEC across the cumulative 825 ha area of both Proposals (including 148 ha of cumulative native vegetation). The cumulative amount of Banksia Woodlands TEC impacted by both Proposals would constitute approximately 0.01 % of the regional extent (> 253,000 ha) and approximately 0.008% of the total extent of the TEC (> 335,000 ha).

Assessment against MNES Significant Impact Guidelines

The DoE document *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* identifies 'significant impact criteria' for TECs to assist in determining whether the environmental impacts of a Proposal are likely to be significant (DoE, 2013). The criteria are in addition to the general test for significance as to whether an impact is 'important, notable or of consequence, having regard to its context or intensity'.

Table 3-4 provides an assessment of the potential impact of the Proposal to the Banksia Woodlands TEC using the 'Critically Endangered' and 'Endangered' ecological communities significant impact criteria (DoE, 2013).

Table 3-4 Assessment of the potential impact of the Proposal to the Banksia Woodlands TEC

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BANKSIA WOODLAND TEC
'reduce the extent of an ecological community'	Not Significant The Banksia Woodlands TEC conservation advice (TSSC, 2016) estimates that > 335,000 ha of Banksia Woodlands TEC remains, with more than 253,000 ha remaining on the SCP. Based on this, the clearing of up to 23.4 ha (direct impact), would result in a reduction of up to 0.007 % in the reported extent of the Banksia Woodlands TEC.
'fragment or increase fragmentation of an ecological community, for example by clearing for roads or transmission lines'	Not Significant No occurrences of Banksia Woodlands TEC will be fragmented by the Proposal to the extent that they no longer represent occurrences of the TEC under the criteria specified by the TSSC (2016). Further, no occurrences of Banksia Woodlands TEC vegetation are expected to be indirectly impacted to the extent that these no longer represent their respective Floristic Community Type.
'adversely affect habitat critical to the survival of an ecological community'	Not Significant The Banksia Woodlands TEC conservation advice (TSSC, 2016) estimates that > 335,000 ha of Banksia Woodlands TEC remains, with

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BANKSIA WOODLAND TEC
	more than 253,000 ha remaining on the SCP. Based on this, the clearing of up to 23.4 ha (direct impact), would result in a reduction of up to 0.007 % in the reported extent of the Banksia Woodlands TEC. While Proposal implementation will result in the direct loss of a comparatively small area of Banksia Woodlands TEC, it is not likely to adversely affect habitat critical to the survival of the community.
'modify or destroy abiotic (non living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns'	Not Significant The Proposal may cause minor temporary (dewatering activities) change to groundwater levels associated with the Banksia Woodlands TEC in the short term. Changes to surface water hydrology as a consequence of construction of the Proposal are considered unlikely. A Drainage Strategy has been developed for the project with in-principle support from DWER (BORR IPT, 2019g). One of the main objectives of the strategy is "maintenance of existing water cycle balance within the project area whilst also improving the surface and groundwater quality". Drainage design will be undertaken at the detailed design stage to allow for pre-development flows to be maintained within the Proposal Area.
'cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting'	Not Significant The Proposal will be carried out in accordance with the management actions detailed in Section 4.1.4. These include management of aspects that have the potential to cause further degradation of the retained Banksia Woodlands TEC patches. This includes *Phytophthora* dieback, weeds, topsoil and drainage management. Monitoring will be conducted according to the Vegetation Monitoring Plan, which is included in **Error! Reference source not found.**. Triggers and thresholds against which impacts will be measured are also detailed therein, along with proposed contingency measures. As a result of the implementation of these management actions, substantial changes in the species composition of Banksia Woodlands TEC occurrences adjacent to the Proposal Area are not expected to result from the Proposal. Similarly, no decline or loss of functionally important species is expected to occur.
'cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: • assisting invasive species, that are harmful to the listed ecological	Not Significant The Proposal will be carried out in accordance with the management actions detailed in Section 4.1.4. These include management of aspects that have the potential to cause further degradation of the retained Banksia Woodlands TEC patches. This includes *Phytophthora* Dieback, weeds, topsoil and drainage management. Monitoring will be conducted according to the Vegetation Monitoring Plan, which is included in **Error! Reference source not found.**. Triggers and

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BANKSIA WOODLAND TEC
community, to become established, or • causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community'	thresholds against which impacts will be measured are also detailed therein, along with proposed contingency measures. As a result of the implementation of these management actions, no reduction in the quality or integrity of an occurrence of an ecological community is expected to result from the Proposal.
'interfere with the recovery of an ecological community'	Not Significant The Proposal will be carried out in accordance with the management actions detailed in Section 4.1.4. These include management of aspects that have the potential to cause further degradation of the retained Banksia Woodlands TEC patches. This includes *Phytophthora* Dieback, weeds, topsoil and drainage management. Monitoring will be conducted according to the Vegetation Monitoring Plan, which is included in **Error! Reference source not found.**. Triggers and thresholds against which impacts will be measured are also detailed therein, along with proposed contingency measures. There is no recovery plan for the Banksia Woodlands TEC.

3.1.2 Tuart Woodlands TEC – Critically Endangered

A risk assessment for Tuart Woodlands TEC relating to the Proposal is included in **Error! Reference source not found.**.

Direct impacts

Up to 4.4 ha of vegetation representing Tuart Woodlands TEC will be cleared as a result of Proposal implementation, as is detailed in Table 2-7. This loss will be permanent. Tuart Woodlands TEC is contained within one occurrence in the Proposal Area, comprising vegetation ranging in condition from Excellent-Very Good to Completely Degraded.

An assessment of the loss of Tuart Woodlands TEC within local and total extent scales was made by comparing the extent within the Proposal Area to that published for the community (total extent), as well as the extent within a 5 km radius of the Proposal Area and the extent within the broader BORR IPT (2020i) Surveyed Area (Table 3-5).

As at 2015[17], the TSSC (2019) identified the total extent of the Tuart Woodlands TEC as being > 17,000 ha. An estimated extent has not been provided for the Perth (SWA02) subregion, however it is stated in TSSC (2019) that the majority (approximately 75%) of the total extent occurs within the southern part of the

[17] This is the most current estimate available.

TEC's distribution, in which the Proposal is also located. The three largest patches of the TEC are also found in the southern part of the range, and are all substantially in conservation tenure.

At a local scale, regional mapping indicates the predicted occurrence of > 1,700 ha of the Tuart Woodlands TEC within a 5 km radius of the Proposal (DBCA, 2020). BORR IPT (2020i) recorded 7.3 ha of Tuart Woodlands TEC within their wider Surveyed Area.

Based on these assessments, the clearing of up to 4.4 ha associated with the Proposal would result in a reduction of up to 0.03 % of the reported extent of the Tuart Woodlands TEC. At a local scale, this would represent a reduction of 0.26 % of the Tuart Woodlands TEC. This represents the maximum possible direct impact associated with the Proposal.

A small (0.09 ha) portion of Tuart Woodlands TEC directly impacted patch TW-S-D-2 occurs within both the Kalgulup Regional Park and the Proposal Area. This would be cleared as part of the proposal.

Table 3-5 Extent of Tuart Woodlands TEC within Proposal and Surveyed Areas and total extents

TEC TYPE	EXTENT IN PROPOSAL AREA (HA)	EXTENT IN BORR IPT (2020i) SURVEY AREA	% LOSS OF TOTAL KNOWN EXTENT (17,000 ha)
Tuart Woodlands TEC	4.4	7.3 ha	Up to 0.03 %

Indirect impacts

Weeds, fire and *Phytophthora* dieback

Indirect impacts to Tuart Woodlands TEC potentially resulting from Proposal implementation are expected to be restricted to the introduction and / or spread of weeds and *Phytophthora* dieback and damage through the accidental generation of a bushfire during construction. Some indirect impacts can be permanent in nature, while others would be temporary if managed appropriately.

Indirect impact to Tuart Woodlands TEC / PEC from changes in hydrology is not expected, and accordingly, has not been listed above. Altering existing flow paths has the potential to negatively impact the hydrological regime (most notably drying) of TEC / PEC occurrences. Through implementation of the Drainage Strategy developed for the Proposal (BORR IPT, 2019g), and the management actions listed in Table 4-3, existing drainage patterns to adjacent TEC / PEC vegetation will be maintained. Impacts from changes to flow paths are therefore not expected to result from the Proposal.

The risk of fire and *Phytophthora* dieback are potentially the most far-reaching of the potential indirect impacts, which may extend up to 100 m or more beyond the Proposal Area boundary. Main Roads standard construction practices combined with the management actions detailed in section 4.1.4 will specifically and effectively manage the potential for these indirect impacts to occur. As such, the potential for fire and *Phytophthora* dieback impacts up to 100 m from the proposal are not anticipated to result from Proposal implementation.

The introduction and spread of weeds is a more localised potential impact within 20 m of the Proposal with a greater risk of occurrence. This will be managed through implementation of the proposed active management in accordance with Main Roads standards, as detailed in Section 4.1.4.

To identify areas of higher risk and greater potential for indirect impacts proximate to the Proposal Area, Main Roads has defined a potential indirect impact management zone extending 20 m into adjacent Tuart Woodland TEC occurrences. The extent of Tuart Woodlands TEC within 20 m of the Proposal Area has been calculated and is presented in Table 2-7.

Considering the nature of the project (road construction) and that construction will be limited to the Proposal Area, the likelihood of indirect impacts from the introduction or spread of weeds on Tuart Woodlands TEC vegetation further than 20 m from the Proposal Area boundary resulting from the Proposal is negligible.

The Proposal comprises linear road infrastructure that is not erosion causing or sedimentation forming, and for which all stormwater will be contained within the footprint and access beyond the footprint will be controlled (through fencing).

The Proposal is being implemented by Main Roads, an organisation with many decades of experience in the effective monitoring and management of roadside vegetation. Through the development and implementation of industry-leading standards and practices, impacts to vegetation adjacent to construction and maintenance activities, rarely occur and if they do occur, rarely extend more than 5-10 m beyond the construction zone. The fact that much of the State's high-value remnant vegetation is contained within road reserves is testament to this.

For these reasons and based on the nature and scale of the Proposal, Main Roads considers a Tuart Woodland TEC buffer and indirect impact management zone width of 20 m to be sufficient for the Proposal.

As detailed in Table 2-7, all three Tuart Woodlands TEC potential indirect impact sites are associated with the same Tuart Woodlands TEC occurrence. In accordance with the conservation advice, to calculate the potential indirect impact area, a 30 m buffer was applied. After clearing for the Proposal has been completed, this TEC occurrence will be more than 25 ha in size. The extent of the occurrence within 30 m of the Proposal Area boundary is described below. Up to 14.6 % of the occurrence is within 30 m of the Proposal Area boundary.

- The occurrence associated with indirect impact Site BTW-S-I-2 is more than 25 ha, of which approximately 4.5 % is within 30 m
- The occurrence associated with indirect impact Site TW-S-I-3 is more than 25 ha, of which less than 4 % is within 30 m
- The occurrence associated with indirect impact Site TW-S-I-4 is more than 25 ha, of which 1.5 % is within 30 m

Fragmentation

Tuart Woodlands TEC occurrences must meet minimum patch size and vegetation condition (including vegetation structure) criteria in order to qualify as occurrences of the TEC (TSSC, 2019). The size and condition thresholds are:

- If the patch is < 0.5 ha, it is not part of the TEC
- For patches 0.5 ha to 2 ha in area or 2 ha to 5 ha, specific criteria need to be met to be considered the TEC
- All patches > 5 ha that meet the key diagnostic characteristics and patch definition are part of the TEC with no condition thresholds required

As is detailed in Table 3-6, the occurrence of Tuart Woodlands TEC remaining after Proposal implementation will still meet the criteria for the TEC as defined by the TSSC (2019). At Centenary Road, the Proposal will divide the existing single Tuart Woodlands TEC occurrence into two occurrences, one to the north of Centenary Road and one to the south. The viability of this occurrence is considered unlikely to change as a result of the Proposal.

The vegetation monitoring program will enable the detection of any indirect impacts to adjacent TEC occurrences, such as edge effects. The proposed management actions detailed in Table 4-3 will effectively manage these impacts should they occur.

Considering the nature and scale of the Proposal and Main Roads experience and standard of works as detailed above, the construction and operation of BORR is unlikely to further increase the existing edge effects in the adjacent TEC vegetation.

Main Roads will implement the Vegetation Monitoring Program, vegetation management actions as detailed in Table 4-3 (which include control of Declared weeds and WONS), and in the CEMP to detect and mitigate any impacts that may occur within the 20 m indirect impact management zone.

Table 3-6 Tuart Woodlands TEC occurrences status before and after Proposal implementation

OCCURRENCE	ORIGINAL AREA (HA) AND CONDITION	HA TO BE CLEARED AND CONDITION	HA TO BE RETAINED AND CONDITION	MET CRITERIA PRIOR TO CLEARING (Yes/No)	MEETS CRITERIA AFTER CLEARING (Yes/No)
TW-S-D-2	> 30 ha Majority in Good to Degraded with parts Very Good and Completely Degraded condition Note, patch extends north and south beyond the Surveyed Area (total extent > 25 ha)	4.4 ha (< 14.7 %) Majority in Good to Degraded with parts Very Good and Completely Degraded condition Note, patch extends north and south beyond the Surveyed Area (total extent > 25 ha)	> 25 ha (> 83.3 %) Majority in Good to Degraded with parts Very Good and Completely Degraded condition Note, patch extends north and south beyond the Surveyed Area (total extent > 25 ha)	Yes	Yes

Assessment against MNES Significant Impact Guidelines

The DoE document *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* identifies 'significant impact criteria' for TECs to assist in determining whether the environmental impacts of a Proposal are likely to be significant (DoE, 2013). The criteria are in addition to the general test for significance as to whether an impact is 'important, notable or of consequence, having regard to its context or intensity' (DoE, 2013).

Table 3-7 provides an assessment of the potential impact of the Proposal to the Tuart Woodlands TEC using the 'Critically Endangered' and 'Endangered' ecological communities significant impact criteria (DoE, 2013).

Table 3-7 Assessment of the potential impact of the Proposal to the Tuart Woodlands TEC

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR TUART WOODLAND TEC
'reduce the extent of an ecological community'	Not Significant The DoEE (2019) identifies the regional extent of the Tuart Woodlands TEC being > 17,000 ha, with the majority (approximately 75 %) occurring within the southern part of its distribution, which is where the Proposal Area is located. The three largest patches of the Tuart Woodlands TEC are also found in the southern part of the range, and are all substantially in conservation tenure. The clearing of up to 4.4 ha (direct impacts), would result in a reduction of < 0.03 % in the reported extent of the Tuart Woodlands TEC.
'fragment or increase fragmentation of an ecological community, for example by clearing for roads or transmission lines'	Not Significant The occurrence of Tuart Woodlands TEC impacted by the Proposal will not be fragmented to the extent that it no longer represents an occurrence of the Tuart Woodlands TEC under the criteria specified by the DoEE (2019). The occurrence of Tuart Woodlands TEC extends beyond the Surveyed Area (> 25 ha).
'adversely affect habitat critical to the survival of an ecological community'	Not Significant The DoEE (2019) identifies the regional extent of the Tuart Woodlands TEC being > 17,000 ha, with the majority (approximately 75%) occurring within the southern part of its distribution, which is where the Proposal Area is located. The three largest patches of the Tuart Woodlands TEC are also found in the southern part of the range, and are all substantially in conservation tenure. The clearing of up to 4.4 ha (direct impacts), would result in a reduction of < 0.03 % in the reported extent of the Tuart Woodlands TEC.
'modify or destroy abiotic (non living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns'	Not Significant The Proposal may cause minor temporary (dewatering activities) change to groundwater levels associated with the Tuart Woodlands TEC in the short term. Changes to surface water hydrology as a consequence of construction of the Proposal are considered unlikely. A Drainage Strategy has been developed for the project with in-principle support from DWER. One of the main objectives of the strategy is "maintenance of existing water cycle balance within the project area whilst also improving the surface and groundwater quality" (BORR IPT, 2019g). Drainage design will be undertaken at the detailed design stage to allow for pre-development flows to be maintained within the Proposal Area.
'cause a substantial change in the species composition of an	Not Significant

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR TUART WOODLAND TEC
occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting'	The Proposal will be carried out in accordance with the management actions detailed in section 4.1.4. These include management of aspects that have the potential to cause further degradation of the retained Tuart Woodlands TEC occurrence. This includes *Phytophthora* dieback, weeds, topsoil and drainage management. Monitoring will be conducted according to the Vegetation Monitoring Plan, which is included in **Error! Reference source not found.**. Triggers and thresholds against which impacts will be measured are also detailed therein, along with proposed contingency measures. There is no recovery plan for the Tuart Woodlands TEC.
'cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: • assisting invasive species, that are harmful to the listed ecological community, to become established, or • causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community'	Not Significant The Proposal will be carried out in accordance with the management actions detailed in section 4.1.4. These include management of aspects that have the potential to cause further degradation of the retained Tuart Woodlands TEC occurrence. This includes *Phytophthora* dieback, weeds, topsoil and drainage management. Monitoring will be conducted according to the Vegetation Monitoring Plan, which is included in **Error! Reference source not found.** Triggers and thresholds against which impacts will be measured are also detailed therein, along with proposed contingency measures. There is no recovery plan for the Tuart Woodlands TEC.
'interfere with the recovery of an ecological community'	Not Significant The Proposal will be carried out in accordance with the management actions detailed in section 4.1.4. These include management of aspects that have the potential to cause further degradation of the retained Tuart Woodlands TEC occurrence. This includes *Phytophthora* dieback, weeds, topsoil and drainage management. Monitoring will be conducted according to the Vegetation Monitoring Plan, which is included in **Error! Reference source not found.** Triggers and thresholds against which impacts will be measured are also detailed therein, along with proposed contingency measures. There is no recovery plan for the Tuart Woodlands TEC

3.1.3 Clay Pans TEC – Critically Endangered

The vegetation and flora surveys undertaken for the Proposal did not identify the Clay Pans TEC within or adjacent to the Proposal Area (BORR IPT, 2020i). No impact on the Clay Pans TEC is therefore expected as a result of the Proposal, either from direct loss or indirectly from changes to hydrological regimes. The Proposal is not expected to result in indirect impacts to the Clay Pans TEC from changes in hydrology or any other indirect impacts and would have no direct impact on the community. An indirect impact is not expected as:

- The Proposal is located 650 m away from nearest the Clay Pan TEC occurrence.
- The Proposal will not impact on rainfall levels or alter surface water hydrology in the vicinity of the Claypan TEC occurrence.
- Transverse drainage design will be developed at the detailed design stage to achieve the objective of maintaining the existing water cycle balance of the Proposal Area. Appropriate management of surface water hydrology will also be included in the CEMP.
- Further, DBCA has advised that it is unlikely that the hydrology of the Clay Pan TEC occurrence will be impacted by this proposal.

Accordingly, an assessment of the potential impacts of the Proposal to the Clay Pans TEC is not necessary.

3.2 Threatened fauna

3.2.1 Black Cockatoos (Forest Red-tailed Black Cockatoo – Vulnerable; Baudin's Cockatoo – Endangered; Carnaby's Cockatoo– Endangered)

A risk assessment for Black Cockatoos relating to the Proposal is included in **Error! Reference source not found.**.

Direct impacts

Clearing of habitat

Biota (2020a) reviewed the potential Black Cockatoo foraging habitat within a 12 km radius of the Surveyed Area to provide a wider context to the potential habitat loss associated with the Proposal, as is detailed in Table 2-9. This review used as its basis the vegetation complexes of Webb, *et al.* (2016). Eighteen vegetation complexes were represented in remnant vegetation within a 12 km radius of the Proposal Area. The Biota review considered in detail the four contained within the Proposal Area.

The review found that the Bassendean Complex Central and South complex (1,162 ha) occurs in fragments throughout the northern half of the Proposal Area. Lot 1 Ducane Road, located directly east and adjacent to the Proposal Area, represents this habitat type. The Karrakatta Complex-Central and South (2,840 ha) occurs in the Jilley Road to Bussell Highway section of the Proposal Area and is contiguous with this same complex adjacent to the corridor, although it is intersected by roads and housing.

The Southern River Complex (2,397 ha) generally comprises Marri, Jarrah and *Banksia* so represents favourable foraging habitat. This complex occurs as small isolated fragments within the Proposal Area, while significant large areas of the complex occur directly to the north of the Proposal Area (e.g. in Manea Park).

Little (337 ha) of the Yoongarillup Complex remains in the local area. Of the four vegetation complexes within the Proposal Area, this complex represents lower quality foraging habitat for Black Cockatoos, being generally devoid of preferred foraging plants (e.g. Marri, Jarrah and *Banksia*).

The clearing of 60.9 ha of potential habitat represents a reduction of up to 0.8 % in the extent of potential foraging and breeding habitat within the local area.

A total of 115 trees were subject to a hollow-suitability assessment. Of these:

- 76 were determined to be not suitable
- 26 were determined to be Unlikely suitable[18]
- Three (3) were determined to be potentially suitable
- Two (2) were determined to be potentially suitable and had potential BC nesting evidence
- Eight (8) were ground assessed only and conservatively assumed to be potentially suitable

In total 11 trees were determined to be potentially suitable within the Proposal Area, including 8 which could not be accessed by drone for assessment.

Eleven trees with a potentially suitable nest hollow(s) will be cleared under the Proposal. Two of these trees showed previous signs of nesting, with one containing four eggs (Black Cockatoos normally lay two) but no chew marks around the hollow. The second appeared to have chew marks around the hollow (Biota, 2020a). No direct signs of Black Cockatoo breeding were observed during field surveys, however, a likely Forest Red-tailed Black Cockatoo egg was found on the ground in the vicinity of breeding habitat trees during the 2017 survey (Biota, 2020a).

No known breeding trees will be impacted by the Proposal. There are 11 trees in the Proposal Area containing hollows that are potentially large enough for Black Cockatoo breeding but that are not known to have been used for breeding by Black Cockatoos.

No confirmed evidence of Black Cockatoo breeding was observed in relation to any of the hollows during field surveys. While evidence of past hollow use was observed in two hollows in the Gelorup corridor, including a broken eggshell, this was not confirmed to be Black Cockatoo use, with many bird species using hollows including ducks, owls and parrots. If Black Cockatoos did breed in habitat within this area, any such breeding activity would be likely to be observed and recorded given the close proximity to a local community that is very engaged in the observation and management of the natural environment, and given that eggshells are expected to be associated with recent breeding activity.

Taking into account the lack of evidence of confirmed use of any Proposal Area hollows by Black Cockatoos, the accessibility of the area for community observations, the number of surveys undertaken over several breeding seasons, and the fact that the species is iconic and easily identified, Main Roads considers that Black Cockatoo breeding is not occurring within the Proposal Area.

Based on discussions to date with DBCA on the Proposal, nesting hollows on the Swan Coastal Plain are not believed to be a constraint for Black Cockatoo breeding. Main Roads will continue to consult with DBCA and is open to the use of artificial hollows should it be determined that the loss of breeding habitat is likely to have a significant residual impact on the breeding of Black Cockatoos in the area.

[18] Consistent with Draft Commonwealth Guidance, “Unlikely Suitable” trees have hollows with an entrance greater than 12cm, but other required criteria of “Potentially suitable” (i.e. width and depth to support nesting chamber, suitable angle of entrance/egress) were absent (DoEE, 2017).

In the Surveyed Area adjacent to the Proposal Area, Biota (2020a) located 25 trees with a potentially suitable hollow(s) for Black Cockatoo nesting, none of which showed evidence of previous nesting use. Three of these trees are within 50 m of the Proposal Area boundary.

Loss of individuals (mortality)

No direct loss of Black Cockatoo individuals is expected as an impact of the Proposal.

Due to the high mobility of Black Cockatoos, clearing operations conducted for the Proposal are not expected to directly affect any live individuals.

The potential for mortality of Black Cockatoo chicks in nest hollows during the clearing of native vegetation will also be avoided. As outlined within the *Black Cockatoo Action Management Plan (AMP)* (**Error! Reference source not found.**) (BORR IPT, 2020e), prior to the breeding season, potential nesting hollows within the Proposal Area will be blocked to prevent breeding within those hollows to avoid the risk of individuals being present during construction. Where blocking of the nest hollows prior to the breeding season is not possible e.g. due to timing or access restrictions, a pre-clearing fauna survey of potential nesting hollows will be undertaken to determine if they are being used by Black Cockatoos. If a hollow is occupied by nesting Black Cockatoos, clearing within a 10 m radius of the occupied hollow will not occur until a subsequent fauna survey has confirmed the chicks have fledged and left the nest.

In relation to vehicle use of the Proposal Area following construction, the risk of mortality of Black Cockatoos from vehicle strike has been minimised as far as practicable. Mortality or injury by vehicle strike has been recognised as a general threat from interaction with humans, and vehicle strike is a specific threat to Carnaby's Cockatoo (DSEWPC, 2012b). Vehicle strike has been recorded as accounting for up to 10 % of mortality or injury to Black Cockatoos (Saunders *et al.* 2011b cited in DBCA (2013), however this is considered to be conservative as there are likely to be a large proportion of vehicle strikes not reported (DBCA, 2013), and in addition, the number of vehicle strikes is expected to increase as the number of vehicles on roads increase (DBCA, 2013).

Revegetation works within the Proposal Area will ensure that vegetation suitable for Black Cockatoo foraging is not established within 10 m of the road formation; such that Black Cockatoos are less likely to be present near the road formation when compared to other existing roads (for example, Bussell Highway where the foraging vegetation occurs adjacent to the road formation).

Further, the risk of pooled water on the road surface which may attract Black Cockatoos for drinking has been minimised through the Proposal design which incorporates road drainage to direct water run-off away from the road formation. Commonwealth guidance recommends road designs which limit the concentration of Black Cockatoos on roadsides (DSEWPC, 2012b). While management will minimise impacts, the risk of vehicle strike cannot be eliminated completely as foraging habitat and water sources for Black Cockatoos occur adjacent to the Proposal Area.

Indirect impacts

Indirect impacts to Black Cockatoos from noise during construction may be the greatest risk of impact and will be temporary.

Operation of BORR will result in an increase in traffic / vehicle movements and therefore result in a greater risk of fauna strike from vehicle movements. Impacts or disturbance of Black Cockatoos from operational (traffic) noise from the Proposal is likely to be minor and, based on observations of Black Cockatoo foraging recorded in habitat adjacent to the existing Bussell Highway, not likely to cause an impediment to habitat utilisation.

No impact to any of the three trees adjacent to the Proposal Area that contain a potentially suitable nesting hollow(s) is expected to result from Proposal construction activities or operation. None of these trees

showed evidence of previous nesting use, therefore no indirect impact resulting in the disruption of nesting in these hollows is likely to result from the Proposal.

Cumulative impacts

The assessment of impacts for the BORR Southern Section has been considered at both local and regional levels. Additional regard to the cumulative context of the project with the BORR Northern and Central Sections has also been considered. A summary of the potential cumulative direct impacts of both proposals on Black Cockatoos is included in Table 3-8.

Table 3-8 Potential cumulative impacts of BORR Proposals on Black cockatoos

BLACK COCKATOOS	BORR SOUTHERN SECTION	BORR NORTHERN AND CENTRAL SECTIONS	CUMULATIVE IMPACT
Foraging habitat extent (ha)	Clearing of up to 60.9 ha	Clearing of up to 37.8 ha	Clearing of up to 102.3 ha
% of foraging / breeding habitat within 12 km of the Proposal(s)	0.8 %	0.5 %	0.7 %
Trees with potentially suitable hollows	13	3	16

Cumulatively, up to 102.3 ha of Black Cockatoo foraging habitat will be cleared, approximately 0.7 % of the foraging habitat within 12 km of the Proposals (approximately 14,628.5 ha) and consistent with the individually assessed potential impacts of each proposal. Neither Proposal will impact any known nesting hollows. The removal of 16 trees containing potentially suitable hollow(s) for Black Cockatoo nesting across the cumulative 825 ha comprising both Proposals (including 148 ha of native vegetation) is not anticipated to be significant.

Assessment against MNES Significant Impact Guidelines

Table 3-9 provides an assessment of the potential impact of the Proposal to Black Cockatoos using the Critically Endangered and Endangered species significant impact criteria (DoE, 2013).

Table 3-9 Assessment of the potential impact of the Proposal to Black Cockatoos

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BLACK COCKATOO SPECIES
'lead to a long-term decrease in the size of a population'	Not Significant Assessment of the potential impacts on Black Cockatoo habitat using vegetation complexes within a 12 km radius indicated that the vegetation complexes which provided the highest quality foraging habitat (e.g. Bassendean Central and South, Karrakatta Central and South and the Southern River vegetation complexes) are in general well represented outside of the Proposal Area (Biota, 2020a). Within 12 km of the Proposal Area, a total of 8,000 ha of foraging habitat remains, of which the Bassendean Complex Central and South complex has 1,162 ha, the Karrakatta Complex-Central and South has 2,840 ha, the

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BLACK COCKATOO SPECIES
	Southern River Complex has 2,397 ha, and the lower quality Yoongarillup Complex has 337 ha (Biota, 2020a). The clearing of 60.9 ha of potential habitat represents a reduction of up to 0.8 % reduction in Black Cockatoo foraging and potential breeding habitat within the local area. The reduction in foraging and breeding habitat is unlikely to contribute to a long-term decrease in the population.
'reduce the area of occupancy of the species'	Not Significant The Proposal is located within the mapped distribution of these species (DoEE, 2017; DSEWPC, 2012b), with their presence confirmed in the field (Biota, 2020a). The species are known to occur throughout the greater South-West region and Southern Jarrah Forest bioregion. Given the habitat within the broader area, the proposed clearing of 60.9 ha is unlikely to significantly reduce the area of occupancy of the species.
'fragment an existing population into two or more populations'	Not Significant The revised draft referral guideline for the three Black Cockatoo species (DoEE, 2017) identifies the species as mobile and highly dispersed and indicates that definition of distinct and / or important populations is not considered appropriate for these species. The proposed action is within an area where habitat is highly fragmented. The gap created by the proposed action will be approximately 200 m wide on average and is unlikely to fragment an existing population into two or more populations.
'adversely affect habitat critical to the survival of a species'	Not Significant The species were observed within the Proposal Area with foraging and potential nesting habitat present (Figure 10, Appendix A). Approximately 8,000 ha of Black Cockatoo foraging and potential breeding habitat (suitable remnant vegetation based on mapped vegetation complexes) is present within a 12 km radius of the Proposal Area. The clearing of 60.9 ha of potential habitat represents a reduction of up to 0.8 % in this extent. The *Black Cockatoo AMP* (BORR IPT, 2020e) (**Error! Reference source not found.**) provides mitigation measures to reduce indirect impacts that may reduce the quality of adjacent / retained habitat. The proposed clearing of 60.9 ha is considered unlikely to affect habitat critical to the survival of the species.
'disrupt the breeding cycle of a population'	Not Significant No known Black Cockatoo nesting hollows were recorded within the Proposal Area. Implementing the Proposal will result in the clearing of up to thirteen trees with a potentially suitable nest hollow(s) for Black Cockatoos, and a further 1,088 Suitable DBH Trees.

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BLACK COCKATOO SPECIES
	Bunbury represents a known breeding area for Baudin's Cockatoo and is within the breeding range for Carnaby's Cockatoo (Biota, 2020a). No evidence of breeding was observed within the Proposal Area during the field survey (Biota, 2020a). The removal of potential breeding trees and foraging habitat may result in some disruption to the species breeding cycle during construction. As a result management measures for this Proposal are proposed accordingly in the Black Cockatoo AMP (**Error! Reference source not found.**). However, when considered in the context of habitat availability within the local area (based on suitable remnant vegetation within a 12 km radius), the potential loss of 60.9 ha, which represents a reduction of up to 0.8 % in the extent of Black Cockatoo foraging and potential breeding habitat within the local area, this impact is not considered significant.
'modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline'	Not Significant The Proposal will result in the clearing of up to 60.9 ha of suitable Black Cockatoo habitat and thirteen trees containing a potentially suitable nest hollow(s) (Figure 10, Appendix A). The clearing of 60.9 ha of potential habitat represents a reduction of up to 0.8 % in the extent of potential Black Cockatoo foraging and breeding habitat within the local area (suitable remnant vegetation within a 12 km radius). The reduction in foraging and potential breeding habitat for Black Cockatoo species may result in a minor residual impact associated with the Proposal.
'result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat'	Not Significant The proposed action is unlikely to result in the introduction of new species to the area. However, competition currently exists for nest hollows with European honeybees and other bird species. The loss of up to thirteen potential hollows has the potential to marginally increase the competition for remaining hollows by a variety of species.
'introduce disease that may cause the species to decline'	Not Significant The Proposal is unlikely to introduce a disease (e.g. beak and feather disease virus) that may cause the species to decline. There are no known diseases that may be introduced to the area that may cause the Black Cockatoo population to decline and it is unlikely that any disease already exists in the Proposal Area that may be spread by the activities of the Proposal (as there has been no indication of any such disease).
'interfere with the recovery of the species'	Not Significant The Recovery Plans (DPaW, 2013; DEC, 2008) provide measures for the species' recovery. These include identifying, protecting and managing important habitat. The proposed action is likely to result in minor residual

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BLACK COCKATOO SPECIES
	impacts to Black Cockatoo habitat including foraging and potential breeding habitat, however this loss is unlikely to interfere with the recovery of the species in the local area.

3.2.2 Western Ringtail Possum (*Pseudocheirus occidentalis*) – Critically Endangered

A risk assessment for WRP relating to the Proposal is included in **Error! Reference source not found.**.

Direct impacts

The Proposal Area contains 60.9 ha of WRP habitat, as identified in Table 2-11 (section 2.5.2), all of which will be cleared to enable Proposal implementation (Biota, 2020a).

Based on the habitat assessment by Shedley and Williams (2014) the majority (56 %) of mapped habitat coinciding with the Proposal is 'Medium' quality. 11 % of the Proposal Area habitat was mapped as 'High' quality, and less than 1.0 % as 'Low' quality. No areas were mapped as 'Very High' or 'Very Low' quality. One third (33 %) of the habitat mapped within the Proposal Area by Biota (2020a) was not included in Shedley and Williams's (2014) habitat assessment and therefore was not assigned a habitat quality rating.

Shedley and Williams (2014) calculated that the Bunbury WRP 'management zone' (which encompasses an area from the Preston River in the north to the Capel River in the south) includes 6,264 ha of WRP habitat[19], most of which was rated as having a 'C' (Medium) suitability score (which was the lowest score in this zone).

Based on observed densities within different habitat types, the 60.9 ha of mapped WRP habitat to be cleared under the Proposal covers the home ranges of an estimated 49 to 72 WRP individuals (Table 2-11, Table 3-10). To note, in order to reflect the seasonal and transient fluctuation in the WRP individuals recorded, the impact of the Proposal to the home ranges of WRP individuals is presented as a range rather than a definitive number.

Table 3-10 WRP habitat and individuals contained within the Proposal Area

PROPOSAL ACTIVITIES	DIRECT IMPACT
Clearing of native vegetation	Clearing of native vegetation comprising: • 60.9 ha of WRP habitat, comprising 49 to 72 WRP individuals' home ranges

Loss of individuals (mortality)

No direct loss of WRP individuals (mortality) is expected as an impact of the Proposal.

As outlined in Section 4.2.2, a pre-clearing targeted fauna survey will be undertaken to identify the presence and the locations of WRP individuals to assist with the planning of the clearing activities. WRP are mobile fauna taxa and will be encouraged and enabled (shepherded) to move of their own accord into adjacent areas of retained habitat during the clearing activities.

[19] Shedley and Williams (2014) noted that 'the potential area of class C is likely to be overestimated, especially in the Bunbury and Binningup zones, as there have been very few surveys in these soil landforms'.

The approach of allowing WRP to self-relocate to adjacent habitat has been chosen over translocation of WRP to other areas because, for this Proposal, it is considered to provide the best outcome in terms of animal welfare. The success rates of documented translocation projects is poor, and as yet no successful methodology has been developed or implemented (Clarke, 2011), (de Tores, 2005). Allowing WRP to relocate to adjacent habitat of their own accord eliminates the requirement for handling, substantially reducing the likelihood of WRP being put under further stress.

The linear clearing corridor for the Proposal provides for good dispersal options for WRP into adjacent habitat, and it is likely that dispersing individuals are already familiar with these adjacent habitat areas (as part of their home range). It is anticipated that WRP individuals will readily relocate into other areas of their home ranges (see below - Viability of habitat areas and Carrying capacity of habitat areas).

Using the data obtained from Biota (2020b; Biota, 2020a) and Shedley and Williams (2014), key WRP habitat areas have been identified. These are detailed in the *Conservation Significant Fauna AMP* (BORR IPT, 2020j) (**Error! Reference source not found.**). Where pre-clearing fauna surveys (described in Section 4.2.2) identify a significant abundance of individuals in these areas, clearing of these areas will be restricted to the period of February to August (late summer to late winter) in order to avoid the peak population and when breeding WRP females have unweaned young.

In relation to vehicle use of the Proposal following construction, mortality of WRP from vehicle strike is not expected due to the Proposal design incorporating a combination of walls and fencing on either side for the length of the Proposal that will prevent WRP access to the road. Where walls are required to reduce noise levels on nearby dwellings, the walls are expected to be of sufficient height (minimum 2.4 m height) and of vertical construction that would exclude access to the road by WRP. The remainder of the Proposal length will have a chain-link fence to 1.8 m high with a fine mesh skirt added to the lower margins (to prevent climbing through / under), and an additional 'smooth top' (to prevent climbing over) within key WRP habitat areas (key habitat areas as identified by Shedley and Williams (2014) and Biota (2020a)).

Where possible, the walls and fencing have been positioned on the tops of batters and as close to the road as possible to ensure the maximum retention of WRP habitat outside of the walls / fencing (to encourage WRP to stay within the habitat), with conversely a minimum area of habitat then remaining within the internal road side (so as not to be attractive to WRP movement). The Proposal design incorporating a combination of walls and fencing on either side for the length of the Proposal is expected to prevent mortality of WRP by vehicle strike by preventing access to the road as far as practicable.

Loss of habitat

At a regional scale, the Proposal is located within the SCP management zone for WRP, for which (DPaW, 2017) identifies > 11,000 ha of suitable WRP habitat and of which > 2,600 ha (approximately 24 %) is protected within conservation areas.

Locally, based upon the mapping of Shedley and Williams (2014), the Bunbury WRP 'management zone' (which is located within the SCP management zone) includes 6,264 ha of WRP habitat[20], most of which was rated as having a 'C' (Medium) suitability score (which was the lowest score in this zone). Consistent with this, the majority (58 %) of the WRP habitat defined by Shedley and Williams (2014) to be cleared under the Proposal has also been classified as 'Medium' quality. Importantly, variances do exist between the higher scale mapping of Shedley and Williams (2014) in comparison to the site specific habitat characterisation completed for the Proposal as shown in Figure 11, Appendix A (Biota, 2020a). Shedley and Williams (2014) provides a valuable approximation of the quality of WRP habitat in the Proposal Area, but does not represent a site specific assessment of habitat quality.

[20] Shedley and Williams (2014) noted that 'the potential area of class C is likely to be overestimated, especially in the Bunbury and Binningup zones, as there have been very few surveys in these soil landforms'.

The Proposal will require the clearing of up to 60.9 ha of WRP habitat, representing approximately 0.6 % of the recorded WRP habitat across the SCP management zone (> 11,000 ha) and 1.0 % of the local distribution of WRP habitat (6,264 ha). This loss will be permanent. Having regard to the extent of WRP habitat at these scales, and the area of WRP habitat clearing required for the Proposal, the impact of the Proposal to WRP habitat is not considered to be significant.

In the Bunbury area, high quality habitat with higher WRP densities is associated with the substantial north-south woodland habitat strip to the west of Bussell Highway. This coastal strip vegetation, which extends for some 13 km south of Dalyellup without a substantial break before it terminates at the Capel River flats, includes areas of high quality tuart and peppermint woodlands, with some areas of tall peppermint. Part of this habitat strip carried 4 WRP/ha when surveyed in 2019 (Biota in prep.). The northern end of this coastal strip (almost) connects, via Dalyellup's internal habitat corridors, across another 7 km of lower density (<2 WRP/ha) habitat remnants that extend via the Kalgulup Regional Park (through Manea Park) to more or less links to the riparian habitat along the Preston River (Ms. Barb Jones, Pers. Comm.) (Conservation Significant Fauna AMP, **Error! Reference source not found.**). By linking the Preston riparian corridor back to the higher quality coastal habitat strip, these remnants provide unique and regionally critical population connectivity values (such as genetic exchange and population recovery potential) that extend for about 20 km of connected remnant woodlands between Minninup (at the northern end of the Tuart Forest National Park) and the Preston River corridor.

Together, these important north-south and east-west Bunbury woodland habitat strips provide high quality conservation values of significance to the species, and to the regional population of the Southern Swan Coastal Plain. They also support the existing local populations that make up the Bunbury subpopulation. Their collective conservation values are so substantial that they match key indicators common to most definitions of critical habitat, noting that there is no single or formal definition.

The above-mentioned north-south and east-west habitat strips are supported by extensive modified (subdivided and settled) habitat with retained mixed woodland canopy in the Gelorup subdivision. Compared to the higher quality tuart and/or peppermint woodland habitat further west, WRP density in the mixed Gelorup woodland is much lower at around 1 WRP/ha . This description is reflected in mapping by the Department of the Environment, Water, Heritage and the Arts (2009) which identifies the WRP habitat traversed by the BORR Southern Section as Supporting Habitat, and the north- south corridor west of Bussell Highway as Core Habitat for the species.

BORR Southern Section impacts are concentrated in <61 ha of this low density, modified mixed woodland habitat of which, according to the field data, only 45 ha was regularly used by one or more WRP on most nights (Clearing Category 1, as defined in the Conservation Significant Fauna AMP (**Error! Reference source not found.**)). The habitat fragments that make up the remaining 16 ha of the Proposal Area habitat (Clearing Categories 2 and 3) had more nights without WRP detections than nights with one or more detections (Biota, in prep). Patches of habitat that are often without WRP on repeat count sequences represent marginal WRP habitat that is infrequently used by the local WRP. Habitat without a pattern of consistent and regular detections is probably unsuited to use by settled resident animals but adequate for wandering or dispersing WRP to feed and rest in for a few nights or weeks before moving to other areas. Therefore clearing the habitat fragments in this 16 ha would present only minor population disturbance. For the remaining 45 ha with settled resident animals, the bimonthly count sequence suggest an upper limit of 40 settled WRP home ranges would have lost a few, many or most trees if low season clearing had been conducted in 2020.

The removal of 45 ha of suitable and occupied (0.91 WRP/ha, as was recorded for the Proposal Area) habitat that would result from construction of the Proposal represents a minor and insubstantial impact for the extensive local WRP population using the Gelorup subdivision habitat.

The radio collaring study (Biota, in prep) prepared for Main Roads (Ethics AEC No. 19-6-26, DBCA Licence No. TFA 2019-0188) determined that, of 10 WRP collared in the Gelorup corridor during 2020, five would

have retained 29-35% of their home range outside of the Proposal corridor, and three would retain 58-74% outside the corridor. Only two of the ten home ranges would not retain more than 12% outside of the clearing area, and only one of the ten studied home ranges was entirely within the clearing footprint.

Overall, 30% of the 2020 settled home ranges would be reduced by less than half. Such reduced home ranges may not be viable in subsequent seasons but are likely to provide ideal post-clearing refuge conditions that can support residents and transients immediately after clearing, and potentially for weeks or months. To provide additional resources for WRP with a reduced home range, artificial shelters, with water, will be added to the nearby receiving habitat at least six weeks prior to clearing. These will be removed after the winter rain has started in the following year.

These field results imply that for a probable upper limit of 40 settled WRP home ranges, up to 10 WRP would be likely to have retained no part of their former home range. For these displaced animals, clearing means they must immediately move on to nearby trees and would join the transient part of the population. Most of these animals would have been transients before they became residents. Around 30% of the displaced animals are likely to be living out their last year, as is described above. The animals in the 30 settled home ranges that retain 29-74 % of their former habitat will be able to relocate to familiar trees within their retained home ranges and remain there or join the transient population if they decide that the reduced home range is too small.

Home ranges

WRP home ranges are generally less than 5.0 ha, and those within peppermint dominated habitat are generally less than 2.0 ha and average 0.4 ha and 0.3 ha for females and males respectively (DPaW, 2017). The Proposal Area is a relatively long and narrow road corridor, generally between approximately 70 m to 180 m in width and 10.5 km in length. As such, although a number of WRP home ranges may be reduced, it is unlikely that entire WRP home ranges are contained within the Proposal Area.

It is expected that between 49 and 72 home ranges may be disturbed to some degree by the Proposal. Based on preliminary analysis of a regional survey undertaken to provide context to the potential impacts of the Proposal, the population of WRPs for the Southern SCP Management Zone was estimated at 9,270 individuals (Biota, 2020b). The potential displacement of up to 49 to 72 individuals therefore represents 0.53 % to 0.78 % of the regional population.

As these home ranges are considered likely to extend beyond the Proposal Area, the impact of the Proposal on WRP home ranges is expected to be minor.

Territoriality

Natural WRP populations are not all highly territorial. As is the case for the low density Gelorup population, strong WRP territoriality is not a characteristic feature. Field data for the subject WRP population, in low density habitat, contradicts this assumption, as is shown by the following data recorded during the 2020 radio collaring study (Biota, in prep):

- One field example confirmed three overlapping home ranges
- One field example displayed adjacent home ranges separated by a narrow corridor rarely used by either
- Isolated records indicated that adjacent females may rarely visit, or transit through, an adjacent home range used by a mature female ‘next door’.

The bimonthly monitoring count sequence revealed that the population had both a settled resident component (mature and dominant), and a substantial presence of transient animals that were sometimes moving in and out of the survey areas that had settled home ranges. These transient counts indicated that there was no shortage of suitable WRP habitat outside of the alignment. The survey data also imply that

temporary transient animals were often tolerated moving around settled resident WRP. Transients would include sub-adults or young adults of both sexes as well as wandering males, and would include animals displaced by low season clearing. It is reasonable to conclude that most WRP have gone through an earlier life stage when they were a part of the local transient population.

The behaviour of this species (*P. occidentalis*) must include a wide range of flexibilities (depending on variable environmental conditions) that have kept the species functioning in diverse and changing habitats during the last few decades. An extensive recent survey (Biota in prep.) confirmed that broad scale habitat values at sampled sites across the species' distribution ranged from 0.25 hectares per possum in the best of the surveyed habitat to as low as 10-100 hectares for just one WRP. Resilient populations seem to need habitat values that can support WRP on about one suitable hectare per resident breeder. The species' highest observed densities (see Shedley and Williams 2014) indicate the south west's best forage supply could support 10 WRP on one hectare of prime Peppermint forage.

Competition for resources

The bimonthly count sequence (August 2019-August 2021) confirmed that WRP numbers were seasonal, increasing from an August low to seasonal peak around October-December (which reflects the year's main recruiting effort). From January on, WRP numbers declined, which means that the low impact seasonal clearing window for the Proposal habitat extended from March to August. It is during this period that clearing is proposed to be undertaken for the Proposal.

The large areas of undisturbed natural woodland habitat near the Proposal Area at Lot 2 Boyanup Picton Road and Reserve 23000, which together total 234 ha, were distance sampled in August 2018 and have been sampled on a bimonthly schedule (along with the Proposal Area habitat) since October 2019. In both monitored seasons the April counts were 33% lower than they had been on the most recent peak (in December 2019 or October 2020). By the August counts, numbers were 41-42% lower than they had been on the peak. This means that between 30-40% of the population has died or vacated the habitat each year, and also that, during the seasonal low, the habitat values that represent a critical limit during the seasonal recruiting peak are becoming available for transient animals, potentially including individuals displaced by a small enough clearing event.

The lifespan of mature WRP is determined and ultimately limited by how their grinding teeth wear down with each year of use. Few individuals would still have another year of viable grinding capacity at the end of their third year of wear (Volck, 20157). This suggests that, in wild populations with a natural diet, most individuals would be unlikely to be able to live past their fourth year. Therefore, on average, the oldest portion of the population would account for approximately 25% of the previous season's adults, implying a 1 in 4 adult vacancy rate that the population needs to resettle before the next recruiting season.

The extent of the receiving habitat determines whether a proposed low season clearing event is small enough to result in impacts that do not significantly exceed normal tolerance levels for a natural pre-existing population (i.e. the seasonal peaks). For the Proposal, most displaced WRP will be associated with the Gelorup corridor. Field evidence suggests that overall, about 26% of the Gelorup habitat mosaic was suited for use by transient WRPS and 74% was best suited to use by settled residents (Biota, in prep.). This ratio suggests that in low (1 WRP/ha) density Bunbury mixed woodland habitat, some 20-30% of WRP habitat remains available for transients, including WRP displaced by a small enough low season clearing event.

The Gelorup corridor receiving (i.e. retained adjacent) habitat is extensive, and has an abundance of connected WRP habitat that is immediately outside of the clearing area. Its suitability for transients and settled residents was confirmed in data collected during both the count sequence and tracking study. In most cases, shepherded or displaced WRP would be initially relocating to trees that are part of the retained

connected Gelorup habitat that are less than 50 m from the edge of the clearing area, and generally less than 100-150 m from the closest part of their former home range.

Overall, 80% of the settled residents that would have been impacted by clearing in a 2020 low season clearing event would have been retaining >29% of their former home range immediately after clearing. Field evidence (Biota in prep.) suggests that Gelorup WRP individuals that have untenable home range retention as a result of Proposal clearing would transition from this population's residential component to its transient component. Most displaced animals would have been part of the transient group before they became settled residents.

WRP/Brushtail possum (*Trichosurus vulpecula*) interaction/competition

With regard to competition from Brushtail possums (*Trichosurus vulpecula*) in the Bunbury mixed woodlands, Brushtail possum density was also low (Biota in prep) when compared to reported densities for other south-western sites (Molloy and Davis, 2016). Brushtail possums have home ranges that are larger, or much larger, than WRP home ranges which means that the Proposal's linear clearing area is too narrow to entirely include even a single Brushtail possum home range. Thus although some Brushtail possums will be deprived of access to the cleared area within the Proposal Area, the density of Brushtails in the receiving habitat on either side of the proposed alignment will not increase as a result of clearing conducted for the Proposal. Therefore, for the Proposal, Brushtail possum-WRP interactions will also remain within this population's 'normal operating range'.

The results of a 2018-19 distance sampling survey recorded the densities of WRP and Brushtail possums in seven larger woodland blocks within 6 km of the Proposal Area (Biota, 2020b). At the time of this survey, the ratio of WRP to Brushtail possums in these remnants was 3:1.

Table 3-11 Possum number estimates for seven woodland remnants near the BORR Southern Section Proposal Area (Biota, 2020b).

Site	Area of habitat	Estimated WRP population	Estimated Brushtail population	Density WRP/ ha	Density Brushtail/ha
DSB1	88	141	45	1.6	0.52
DSB2	155	191	95	1.23	0.61
DSB3	40	14	21	0.34	0.51
DSB4	146	151	56	1.03	1.38
DSB5	194	126	16	0.65	0.08
DSB6	188	80	146	0.42	0.77
DSB7	265	1053	193	3.98	0.72
Totals	1076	1755	571		
Averages				1.63	0.53

Timing of clearing

WRP numbers are known to fluctuate seasonally based on habitat quality and in response to climatic conditions, and this is also the case with populations in the Proposal Area (Biota, 2020a). The proposed

timing of habitat clearing was determined based on species' breeding cycles and site survey information. In consideration of timing, WRP was the priority species, in particular the timing of birthing, with additional consideration of the breeding cycles for Black Cockatoo, and consideration for *Phytophthora* dieback management. Using data obtained from site surveys undertaken to date, Main Roads has identified key WRP habitat areas within the Proposal Area (refer to **Error! Reference source not found.**). This information has informed the timing of, and process for, clearing habitat to minimise potential impacts during the breeding season on WRP.

Connectivity

The Proposal is situated in a landscape of multiple land uses including agriculture, mining, residential development, and conservation reserves. As such, the Proposal Area and its surrounds is a discontinuous 'patchwork' of WRP habitat patches of varying sizes and with varying levels of connectivity between them. Existing obstacles to habitat connectivity in the Proposal Area include both the Bussell Highway (dual carriageway) and local roads (single carriageway). The Bussell Highway presents a wider obstacle to habitat connectivity, while local roads present a narrower obstacle, but are significantly more numerous.

Fragmentation of habitat may lead to the isolation of populations, reduced population size and / or genetic decline. Maintenance of an effective meta-population size through the retention of adequate habitat area and connectivity may be important for maintaining WRP genetic diversity and population viability (Shedley & Williams, 2014).

The maintenance of existing movement pathways and connectivity along either side of the alignment has been a priority during Proposal planning. In order to maintain connectivity between habitat areas and across the local landscape, the Proposal design incorporates a series of underpasses / rope bridges (engineered movement structures) to maintain connection between the habitat areas. A number of different structure types will be installed, including rope bridges which have been demonstrated as successful for maintaining WRP connectivity between Peppermint woodland on either side of the Bussell Highway in Vasse (Yokochi & Bencini, 2015), and underpasses, which have been demonstrated as successful for maintaining WRP connectivity along the riparian zone along the Collie River in Australind (Treendale) (Barbara Jones, pers. comm., 2020). The conceptual locations and design specifications for the underpasses and rope bridges are identified in Figure 12 (Appendix A). Connectivity between the habitat areas will be maintained as far as practicable through installation of the proposed underpasses and rope bridges

The designs for the underpasses also apply potential improvements upon earlier designs including the installation of ledges in the tops of underpasses so that WRP do not have to go to ground, and ropes linking these ledges into the adjacent canopy, both of which may assist WRP to avoid predators[21]. The designs for the rope bridges have also had regard to the existing rope bridge in BORR Central Section which has not been as successful as was planned, likely as a result of contributing factors such as the long span length, potential exposure to predators and sub-optimal entry / exit points.

Connectivity and suitability of cleared areas remaining within the Proposal Area will be further enhanced with targeted revegetation post construction.

The Proposal will introduce a new obstacle to habitat connectivity, however, the impact of the Proposal to habitat connectivity can be expected to be consistent with the impact from the existing Bussell Highway dual carriageway.

Viability of habitat areas

[21] Although primarily arboreal, WRP commonly move on-ground as observed within urban environments. Use of underpasses by WRP is therefore not expected to be limited by requiring access through overhead connections, but rather, may provide an additional access pathway.

WRP habitat within the Proposal Area is contiguous with or adjacent to other areas of WRP habitat beyond the Proposal Area. As such, no WRP habitat patches will be cleared in their entirety.

Habitat patch size is not a reliable indicator of either WRP presence or density. In fact, small habitat remnants have been shown to be well utilised by WRP, especially when Peppermint is present (Shedley & Williams, 2014), as is the case with the Proposal Area and adjacent habitat. In the vicinity of the Proposal Area, WRP have been recorded in very small areas of habitat and even in isolated paddock trees as well as in larger patches of remnant native vegetation (Biota, 2020a). In their assessment of WRP habitat, Shedley and Williams (2014) concluded that all small patches of high quality habitat are important as they contribute significantly to the overall WRP carrying capacity of the region.

A number of WRP habitat patches will be reduced in area as a result of Proposal implementation. The retained WRP habitat patches are generally well-connected or in close proximity to other WRP habitat patches. As such, it is not anticipated that any WRP habitat patch will become unviable.

Carrying capacity of habitat areas

WRP density within different habitat patches is not predictable and does not follow a set pattern (Shedley & Williams, 2014). As such, the carrying capacity of a given habitat patch is difficult to determine. Some factors which intuitively would be considered important, such as canopy cover and vegetation condition, have been found not to influence WRP densities. Shedley and Williams (2014) further noted that nearly half of the patches assessed in their study with high and very high WRP densities were degraded to completely degraded *"where the basic vegetation structure had been severely impacted by disturbance, and where intensive management was required for regeneration".* Despite stated limitations of their assessment, Shedley and Williams (2014) identified the presence and dominance of Peppermint as an important factor in predicting the carrying capacity of a habitat patch. Within the Proposal Area and adjacent vegetation, Peppermint occurs as a mid-storey species in mixed woodland habitats, which form the majority of the Proposal Area and adjacent WRP habitat (Biota, 2020a).

WRP populations within a given area of habitat fluctuate seasonally. The maximum seasonal WRP population provides an indication of the year round WRP population an area of habitat is capable of sustaining (Barbara Jones, pers. comm., 2020). Based on this advice and all information obtained through studies and consultation conducted for the Proposal, shepherding WRP into adjacent habitat areas during clearing is considered the optimal approach in regard to WRP welfare i.e. favoured over translocation. In addition, management provisions including timing of clearing operations to occur outside of the population peak wherever possible, will ensure that adjacent habitat is capable of sustaining any existing resident individuals as well as dispersing individuals.

Indirect Impacts

Decline in habitat quality

WRP have been observed utilising habitats ranging from relatively isolated trees through to remnant strips (along road reserves and riparian belts) and larger remnants either isolated from or broadly contiguous with much larger remnants. WRP do not appear to need a complicated vegetation structure or diet and can meet their requirements within either the natural or urban environment (Shedley & Williams, 2014). This indicates that the connectivity of WRP habitats, as an aspect of habitat quality, may be less important to the survival of WRP than other factors given the wide variety of habitats they may occupy.

Vegetation adjacent to the existing Bussell Highway and Forrest Highway has been classified by Shedley and Williams (2014) as either High or Medium quality WRP habitat, which is generally consistent with the quality of the majority of the WRP habitat in the local area. The maintenance of the High and Medium quality habitat assessment ranking for vegetation adjacent to the existing Bussell Highway and Forrest Highway roads may indicate that the quality of WRP habitat adjacent to the Proposal is unlikely to be detrimentally affected to an extent that the habitat quality is reduced.

Displacement of individuals due to noise and / or light

Individual WRP were recorded in habitat adjacent to the existing dual carriageway Bussell Highway, as well as adjacent to local roads (Biota, 2020a). These results indicate that neither vehicular traffic noise exposure nor light from vehicles or street lighting may be an impediment to WRP utilising habitats adjacent to road infrastructure. This is, in part, further supported by the findings of Shedley and Williams (2014) in which high densities of WRP were observed in urban areas.

Although WRP may relocate to other habitat areas in order to move away from very noisy or brightly lit areas (Barbara Jones, pers. comm., 2020), WRP have adapted to urban and semi-urban areas as outlined by Shedley and Williams (2014). This suggests that WRP are able to adjust to, and perhaps even thrive in, developed areas where light and noise levels are higher than would be found in natural habitats.

The absence of a correlation between the density of WRP individuals with proximity to noise or light sources may indicate that WRP are readily capable to adapt to increased noise and light environments, and accordingly, the impact of noise and / or light from the Proposal would not be expected to result in WRP abandoning the adjacent habitat.

Cumulative impacts

The assessment of impacts for the BORR Southern Section has been considered at both local and regional levels. Additional regard to the cumulative context of the project with the BORR Northern and Central Sections has also been considered. A summary of the potential cumulative direct impacts of both proposals on WRP is included in Table 3-12.

Table 3-12 Potential cumulative impacts of BORR Proposals on WRP

WRP	BORR SOUTHERN SECTION	BORR NORTHERN AND CENTRAL SECTIONS	CUMULATIVE IMPACT
Habitat extent (ha)	Clearing of up to 60.9 ha	Clearing of up to 43.9 ha	Clearing of up to 104.8 ha
% of WRP habitat within Bunbury Management Zone	1.0 %	0.7 %	1.7 %
Home ranges	49 to 72 WRP individual home ranges	15 to 25 WRP individual home ranges	64 to 97 WRP individual home ranges
% of WRP population within Southern SCP Management Zone	0.53-0.78 %	0.11-0.26 %	0.64-1.04 %
Individuals within 5 km of the Proposal(s) [22]	1,909	1,188	1,977

Cumulatively, up to 104.8 ha of WRP habitat will be cleared, approximately 1.7 % of the WRP habitat within the Shedley and Williams (2014) local Bunbury Management Zone. The home range of an estimated 64 to 97 individuals would be potentially disturbed by both proposals, constituting less than 1 % of the conservatively estimated abundance of 9,270 individuals within the SCP management zone and approximately 0.4 % of the estimated statewide population of 20,000 individuals.

[22] These figures represents the sum total of WRP individuals recorded during field surveys conducted for the Proposal between August 2019 and August 2020.

No areas of WRP habitat will be cleared in their entirety and the cumulative proposals do not additively reduce connectivity in any given location. Connectivity of WRP habitat along and across each Proposal Area will be maintained through retaining key habitat areas and installing fauna underpasses and / or rope bridges.

Assessment against MNES Significant Impact Guidelines

Table 3-13 provides an assessment of the potential impact of the Proposal to WRP using the Critically Endangered and Endangered species significant impact criteria (DoE, 2013).

Table 3-13 Assessment of the potential impact of the Proposal to Western Ringtail Possum

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR WESTERN RINGTAIL POSSUM
'lead to a long-term decrease in the size of a population'	Not Significant The proposed action involves clearing of up to 60.9 ha habitat and potential displacement of 49 to 72 individual WRPs (Figure 11, Appendix A). Based on data from a regional survey undertaken to provide context to the potential impacts of the Proposal, the population of WRPs for the southern SCP was estimated at 9,270 individuals (Biota, 2020b). The potential displacement of up to 49 to 72 individuals therefore represents 0.57 % to 0.85 % of the regional population. Effort will be made to retain WRP in habitat abutting the clearing area. Based on the results of the regional population survey and the estimated maximum number of possums displaced as a result of the Proposal, it is considered unlikely that the Proposal will result in a long-term decrease in the size of the WRP population.
'reduce the area of occupancy of the species'	Not Significant The proposed action involves clearing of up to 60.9 ha habitat. Biota (2020a) conducted surveys for WRP in additional habitat areas (referred to as context sites) near to the Proposal Area. Based on their survey results and the area of contiguous habitat not surveyed, the local population within these sites was estimated to be in excess of 1,000 individuals. The five context sites included Manea Park, Reserve 23000, Lots 1 and 266 -268 Ducane Road and the Southern Lots survey areas. These areas combined contain approximately 746 ha of remnant native vegetation and support an estimated 706 individual WRPs (Biota, 2020a). The loss of up to 60.9 ha of habitat may result in a minor residual impact to the area of occupancy for the species when considered in broader local context.
'fragment an existing population into two or more populations'	Potentially Significant The Proposal will result in the fragmentation of existing habitat but is not expected to fragment the local WRP population.

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR WESTERN RINGTAIL POSSUM
	Construction of BORR will create a barrier to movement of WRPs. In the north of the Proposal Area, this will result in the separation of two areas of habitat (both > 100 ha either side of the Proposal Area) currently connected by vegetation with breaks (generally < 30 m) (Figure 11, Appendix A). In the south of the Proposal Area, this will result in the division of one currently very large continuous area of habitat into two areas. The new areas will be located either side of the Proposal Area, and will be > 100 ha. While the Proposal will present a new obstacle to habitat connectivity, the Proposal design incorporates a series of underpasses / rope bridges (engineered movement structures) to maintain connection between the habitat areas. The potential impact to habitat connectivity for WRP will therefore be minimised as far as practicable.
'adversely affect habitat critical to the survival of a species'	Potentially Significant The Proposal will potentially result in the clearing of up to 60.9 ha of habitat for the WRP and disturbance of up to 49 to 72 individual's home ranges. Based on the results of regional surveys, this is estimated to represent 0.53 % to 0.78 % of the regional population. Up to 746 ha of remnant vegetation in surveyed local contextual sites was estimated to provide habitat for up to 706 individual WRPs. The loss of up to 60.9 ha of habitat may result in a minor residual impact to the species when considered in the local and regional context.
'disrupt the breeding cycle of a population'	Potentially Significant The proposed action involves clearing of up to 60.9 ha of habitat for the WRP and disturbance of up to 49 to 72 individual's home ranges, representing 0.53 % to 0.78 % of the regional population. The proposal may result in minor disruption of the breeding cycle of the population through loss of foraging and breeding habitat and loss of individual possums.
'modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline'	Not Significant The proposed action involves clearing of up to 60.9 ha of habitat for the WRP and disturbance of up to 49 to 72 individual's home ranges, representing 0.53 % to 0.78 % of the regional population. Given the extent of the regional population it is considered that the impacts are unlikely to result in decline of the species.
'result in invasive species that are harmful to a critically endangered or endangered species becoming established in	Not Significant The Proposal is unlikely to result in the introduction of new invasive aquatic species to wetlands and waterways in the Proposal Area and surrounding vicinity.

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR WESTERN RINGTAIL POSSUM
the endangered or critically endangered species' habitat'	
'introduce disease that may cause the species to decline'	Not Significant The Proposal is unlikely to result in the introduction of a disease. Main Roads standard management measures to prevent the spread of dieback and weeds to adjacent vegetation dieback will be incorporated into a Hygiene Management Plan as part of the Construction Environmental Management Plan (CEMP).
'interfere with the recovery of the species'	Potentially Significant The WRP Recovery Plan (DPaW, 2017) outlines the key items for the recovery of this species. Of these, the Proposal will result in habitat loss (60.9 ha) and fragmentation and potentially increase competition for tree hollows (by reducing their availability). These have the potential to inhibit the recovery of the species at a local scale.

3.2.3 Black-stripe Minnow (*Galaxiella nigrostriata*) – Endangered

A risk assessment for BSM relating to the Proposal is included in .

Direct Impacts

Clearing of habitat

The Proposal will result in the clearing of up to 5.5 ha of surveyed BSM potential habitat. This loss will be permanent.

During field surveys conducted by WRM in areas surrounding the Proposal Area, BSM were recorded in four wetlands within Manea Park north of the Proposal Area (WRM, 2020a) and in a wetland located approximately 850 m south of the Proposal Area (WRM, 2020b) (Figure 13, Appendix A). The species has also recently been recorded in nearby wetlands (> 2 km away) in Gelorup, surveyed as part of investigations for the BORR South Alternate alignment (WRM, 2019).

During these surveys, a total of 251 BSM individuals[23] were recorded from these locations.

In consideration of the broader distribution of BSM potential habitat at a local scale, and the area of clearing of BSM potential habitat required for the Proposal, the impact of the Proposal to BSM habitat is not expected to be significant.

Loss of individuals (mortality)

Whilst the number of BSM individuals likely to be affected by the Proposal is not able to be estimated, it is expected that there will be a loss of individuals resulting from the construction works for the Proposal. This loss may include aestivating individuals in sediments. Previous attempts to find and record aestivating BSM

[23] 113 individuals recorded in wetlands in the Gelorup area in 2018 (WRM, 2019), 134 individuals recorded in wetlands in Manea Park in 2019 (WRM, 2020a) and 4 individuals recorded in a wetland south of the Proposal Area in 2019 (WRM, 2020b).

in sediments have not been successful (Galeotti, 2013) and the length of time the species can remain aestivating is unknown. Translocation is not considered to be a viable mitigation strategy for this species.

The impact of the Proposal to BSM potential habitat is not considered to be significant given the extent of BSM potential habitat at a local scale and the potential area of clearing of BSM habitat required for the Proposal. The impact of the Proposal to BSM individuals is also not expected to be significant given the loss of associated habitat proposed.

Potential loss of connectivity will be minimised and mitigated (refer to section 4.2.3.2).

Indirect Impacts

Alteration of water quality

Implementation of the Proposal will involve works including the clearing of native vegetation, construction earthworks and drainage construction. Each of these may have the potential to result in an increase in water turbidity (suspended sediments) and / or sedimentation within BSM habitat both within the Proposal Area and its immediate surrounds. Whilst an increase in turbidity and sedimentation of aquatic habitats cannot be avoided entirely due to the nature of the works, potential impacts can be effectively managed and minimised through standard mitigation measures including the installation of silt curtains / fences in areas of BSM habitat to minimise water quality impacts beyond the Proposal Area.

Construction works will also require the storage and use of common hazardous materials (e.g. vehicle fuels and oils, bitumen). If not appropriately managed, hazardous materials could enter the surrounding environment through surface water runoff during rainfall events and enter areas of BSM habitat, resulting in a potential for changes in water quality and contamination. In accordance with Main Roads' standard operational controls, hazardous materials will be stored and used in accordance with the relevant Materials Safety Data Sheet, such that a significant indirect impact to BSM habitat or individuals from the storage and use of hazardous substances is not expected.

The exposure of acid sulfate soils (ASS) during excavation associated with construction may have the potential to result in impacts to BSM habitat. In the *Overarching Acid Sulfate Soil and Dewatering Management Plan* (ASSDMP) (BORR IPT, 2020h), the Proposal Area has been predominantly mapped as having a low to moderate risk of ASS, with small areas associated with watercourses and wetlands mapped as high risk. If not appropriately managed, the disturbance of ASS may result in a range of water quality impacts which may include acidification and metal bioaccumulation, or habitat quality impacts including vegetation condition decline (BORR IPT, 2020h).

In accordance with Main Roads' standard operational controls, the risk of ASS will be managed via the both the ASSDMP and CEMP, addressing spoil treatment, groundwater dewatering and water monitoring / management, such that the risk of disturbance of ASS by the Proposal is not expected to result in a significant impact to BSM habitat.

As outlined within the *Environmental Referral Supporting Document* (BORR IPT, 2019d), a CEMP will be prepared for the Proposal that outlines Main Roads' standard operational controls.

Alteration of hydrological regimes

Drainage design for the Proposal has sought to maintain the existing surface water hydrology, both within the Proposal Area and surrounds (BORR IPT, 2019g). The sizing and design of surface water drainage structures for the Proposal will be sufficient to maintain the existing hydrological flows through the mapped watercourse / wetland areas. Accordingly, a significant indirect impact to BSM habitat or individuals through altered hydrological regimes is not expected. The drainage design specifies that the elevation of the base of culverts is consistent with or below the base of the current drainage line to allow

for water movement, and the use of suitably sized and shaped (flat-based[24]) culverts to minimise the velocity of water movement. Accordingly, a significant indirect impact to BSM habitat or individuals through altered habitat is not expected.

Habitat fragmentation

Maintaining connectivity between wetlands that provide suitable BSM habitat is a consideration in drainage design for the Proposal. If not appropriately designed, the Proposal may have the potential to fragment areas of BSM habitat, thereby restricting the movement of BSM individuals between habitat areas. The Proposal design has incorporated drainage designs which will maintain the connectivity between watercourse / wetland areas, such that BSM individuals will be able to move between habitat areas. Specifically, the drainage design has set the elevation of the base of culverts consistent with or below the base of the current drainage line (to allow for water movement) and specified the use of suitably sized and shaped (flat-based) culverts (to minimise the velocity of water movement). Accordingly, a significant indirect impact to BSM habitat or individuals through altered habitat fragmentation is not expected.

Cumulative impacts

The assessment of impacts for the BORR Southern Section has been considered at both local and regional levels. Additional regard to the cumulative context of the project with the BORR Northern and Central Sections has also been considered. A summary of the potential cumulative direct impacts of both proposals on BSM is included in Table 3-14.

Table 3-14 Potential cumulative impacts of BORR Proposals on BSM

BSM	BORR SOUTHERN SECTION	BORR NORTHERN AND CENTRAL SECTIONS	CUMULATIVE IMPACT
Habitat extent (ha)	Clearing of up to 5.5 ha	Clearing of up to 0.55 ha	Clearing of up to 6.05 ha

Given the distribution of the species in wetlands adjacent to both Proposal Areas and to the south, loss of 6.05 ha as a result of construction of the Proposal is unlikely to have a significant impact on the species.

Assessment against MNES Significant Impact Guidelines

Table 3-15 provides an assessment of the potential impact of the Proposal to BSM using the Critically Endangered and Endangered species significant impact criteria (DoE, 2013).

Table 3-15 Assessment of the potential impact of the Proposal to Black-stripe Minnow

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BLACK-STRIPE MINNOW
'lead to a long-term decrease in the size of a population'	Not Significant

[24] Water flow through round culverts is more likely to have higher velocity than flows through flat-bottomed culverts as the flat bottom allows water to spread out and flow slower. Flat-bottomed culverts are the standard to allow for movement of aquatic species. Current design for culverts is two concrete box culverts (1200 mm wide x 900 mm tall) built on a concrete base. Culverts will be set at or slightly below the existing channel invert to ensure the existing drainage is maintained either side of the culvert.

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BLACK-STRIPE MINNOW
	The Proposal Area contains 5.5 ha of BSM potential habitat (Figure 13 Yalinda Drive Crossing Structures **Figure 14 Fauna Land Bridge** Figure 15, Appendix A). A single BSM individual was recorded within the Proposal Area, located in a small watercourse which appears hydrologically linked in periods of high rainfall / flooding to a chain of wetlands located beyond the Proposal Area (WRM, 2020b). It was not recorded from additional areas (six sites surveyed) of wetland habitat in the Proposal Area. BSM presence could not be determined at three additional sites as these sites were dry during the time of sampling. During field surveys conducted by WRM in areas surrounding the Proposal Area, BSM were recorded in four wetlands within Manea Park north of the Proposal Area (WRM, 2020a) and in a wetland located approximately 850 m south of the Proposal Area (WRM, 2020b) (Figure 13 Yalinda Drive Crossing Structures **Figure 14 Fauna Land Bridge** Figure 15, Appendix A). The species has also recently been recorded in nearby wetlands (> 2 km away) in Gelorup, surveyed as part of investigations for the BORR South Alternate alignment (WRM, 2019). The results of surveys conducted for the Proposal extend the previously known distribution of BSM identified by DBCA within the greater Bunbury area (WRM, 2020b). BSM are considered to be a transient and mobile species and abundance and distribution is likely to vary from year to year in response to seasonal rainfall (WRM, 2020b). Given the distribution of the species in wetlands surrounding the Proposal Area location, the clearing of 5.5 ha of potential habitat for Proposal construction is unlikely to have a significant impact on the population. Translocation is not considered to be a viable mitigation strategy for this species (WRM, 2020b). Impacts to the hydrologic function of wetlands undisturbed within and adjacent to the Proposal Area will be managed through the implementation of the Drainage Strategy (BORR IPT, 2019g), and actions outlined in the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**).

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BLACK-STRIPE MINNOW
'reduce the area of occupancy of the species'	Not Significant Within the Proposal Area, BSM were restricted to a small watercourse which appears hydrologically linked in periods of high rainfall / flooding to a chain of wetlands located beyond the Proposal Area (WRM, 2020b). It was not recorded from additional areas (four sites surveyed) of wetland habitat within the Proposal Area but was present at one site south of the Proposal Area. The species has also recently been recorded from nearby wetlands in Manea Park and Gelorup, surveyed as part of investigations for the BORR Northern and Central Section (WRM, 2020a) and BORR South Alternate Alignment (WRM, 2019). BSM are considered to be a transient and mobile species and abundance and distribution is likely to vary from year to year in response to seasonal rainfall (WRM, 2020b). Given the distribution of the species in wetlands adjacent to the Proposal Area and to the south, loss of 5.5 ha of potential habitat as a result of Proposal construction is unlikely to have a significant impact on the species habitat.
'fragment an existing population into two or more populations'	Not Significant Maintaining connectivity between wetlands that provide suitable BSM habitat will be achieved by incorporating drainage design that is conducive to movement of aquatic species. In the BSM habitat area drainage design will: • Set the elevation of the base of the culvert consistent with or below the base of the current drainage line to allow for water movement • Use suitably sized and shaped (flat based) culverts to minimise the velocity of water movement. Accordingly, a significant indirect impact to BSM habitat or populations through fragmentation is not expected.
'adversely affect habitat critical to the survival of a species'	Not Significant Within the Proposal Area, BSM were restricted to a small watercourse which appears hydrologically linked in periods of high rainfall / flooding to a chain of wetlands located beyond the Proposal Area (WRM, 2020b). It was not recorded from additional areas (four sites surveyed) of wetland habitat within the Proposal Area but was present at one site south of the Proposal Area. The species has also recently been recorded from nearby wetlands in Manea Park and Gelorup, surveyed as part of investigations for the

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BLACK-STRIPE MINNOW
	BORR Northern and Central Section (WRM, 2020a) and BORR South Alternate Alignment (WRM, 2019). BSM are considered to be a transient and mobile species and abundance and distribution is likely to vary from year to year in response to seasonal rainfall (WRM, 2020b). Given the distribution of the species in wetlands adjacent to the Proposal Area and to the south, loss of 5.5 ha of potential habitat as a result of Proposal construction is unlikely to have a significant impact on the species habitat.
'disrupt the breeding cycle of a population'	Not Significant Some direct loss of aestivating BSM is possible during construction through disturbance of sediments. Previous attempts to find and record aestivating BSM in sediments have not been successful (Galeotti, 2013) and the length of time the species can remain aestivating is unknown. Minor loss of cleared and degraded wetlands within the Proposal Area will occur however, hydrological regimes of wetlands adjacent to the Proposal Area will be maintained through the implementation of the Proposal Drainage Strategy (BORR IPT, 2019g). Where appropriate, drainage design will incorporate designs to facilitate the movement of aquatic fauna.
'modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline'	Not Significant Minor loss of cleared and degraded wetlands within the Proposal Area will occur however, hydrological regimes of wetlands adjacent to the Proposal Area will be maintained through the implementation a Drainage Strategy (BORR IPT, 2019g).
'result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat'	Not Significant The Proposal is unlikely to result in invasive species that are harmful to BSM being introduced. The Proposal will be carried out in accordance with the management actions detailed in Section 4.2.3 and the *Conservation Significant Fauna AMP* (**Error! Reference source not found.**).
'introduce disease that may cause the species to decline'	Not Significant The Proposal is unlikely to result in the introduction of disease that may cause BSM population to decline. The Proposal will be carried out in accordance with the management actions detailed in Section 4.2.3, and the *Conservation Significant Fauna AMP* (**Error! Reference source not found.**).

SIGNIFICANT IMPACT CRITERIA (DoE, 2013)	ASSESSMENT FOR BLACK-STRIPE MINNOW
'interfere with the recovery of the species'	Not Significant As no other criteria have been determined to be significant in nature, it is unlikely the Proposal would interfere with the recovery of the species.

3.3 Threatened flora

3.3.1 King Spider-orchid – Endangered

Environmental surveys were undertaken within areas of potentially suitable habitat at appropriate times in order to identify the potential for *Caladenia huegelii* to occur within the Proposal Area and surrounds. No individuals of *C. huegelii* were recorded in habitats either within or adjacent to the Proposal Area. Accordingly, no impact to *C. huegelii* individuals is anticipated as a consequence of the construction or operation of the Proposal. No *C. huegelii* exclusion zones are required, and no translocations are proposed.

3.3.2 Tall Donkey Orchid – Vulnerable

Environmental surveys were undertaken within areas of potentially suitable habitat at appropriate times in order to identify the potential for *Diuris drummondii* to occur within the Proposal Area and surrounds. No individuals of the species were recorded in habitats either within or adjacent to the Proposal Area. Accordingly, no impact to *D. drummondii* individuals is anticipated as a consequence of the construction or operation of the Proposal. No *D. drummondii* exclusion zones are required, and no translocations are proposed.

3.3.3 Dwarf Bee-orchid – Vulnerable

Environmental surveys were undertaken within areas of potentially suitable habitat at appropriate times in order to identify the potential for *Diuris micrantha* to occur within the Proposal Area and surrounds. No individuals of the species were recorded in habitats either within or adjacent to the Proposal Area. Accordingly, no impact to *D. micrantha* individuals is anticipated as a consequence of the construction or operation of the Proposal. No *D. drummondii* exclusion zones are required, and no translocations are proposed.

3.3.4 Glossy-leafed Hammer Orchid – Endangered

Environmental surveys were undertaken within areas of potentially suitable habitat at appropriate times in order to identify the potential for *Drakaea elastica* to occur within the Proposal Area and surrounds. No individuals of the species were recorded in habitats either within or adjacent to the Proposal Area. Accordingly, no impact to *D. elastica* individuals is anticipated as a consequence of the construction or operation of the Proposal. No *D. elastica* exclusion zones are required, and no translocations are proposed.

3.3.5 Dwarf Hammer Orchid – Vulnerable

Environmental surveys were undertaken within areas of potentially suitable habitat at appropriate times in order to identify the potential for *Drakaea micrantha* to occur within the Proposal Area and surrounds. No individuals of the species were recorded in habitats either within or adjacent to the Proposal Area. Accordingly, no impact to *D. micrantha* individuals is anticipated as a consequence of the construction or operation of the Proposal. No *D. micrantha* exclusion zones are required, and no translocations are proposed.

3.3.6 Keighery's Eleocharis - Vulnerable

Environmental surveys were undertaken within areas of potentially suitable habitat at appropriate times in order to identify the potential for *Eleocharis keigheryi* to occur within the Proposal Area and surrounds. No individuals of *E. keigheryi* were recorded in habitats either within or adjacent to the Proposal Area. Accordingly, no impact to *E. keigheryi* individuals is anticipated as a consequence of the construction or operation of the Proposal. No *E. keigheryi* exclusion zones are required, and no translocations are proposed.

3.3.7 Selena's Synaphea - Critically Endangered

Environmental surveys were undertaken within areas of potentially suitable habitat at appropriate times in order to identify the potential for *Synaphea* sp. Fairbridge Farm to occur within the Proposal Area and surrounds. No individuals of the species were recorded in habitats either within or adjacent to the Proposal Area. Accordingly, no impact to *Synaphea* sp. Fairbridge Farm individuals is anticipated as a consequence of the construction or operation of the Proposal. No *Synaphea* sp. Fairbridge Farm exclusion zones are required, and no translocations are proposed.

3.3.8 *Austrostipa jacobsiana* Critically Endangered and *Austrostipa bronwenae* Endangered

Environmental surveys were undertaken within areas of potentially suitable habitat at appropriate times in order to identify the potential for *Austrostipa jacobsiana* and *Austrostipa bronwenae* to occur within the Proposal Area and surrounds. No individuals of either species were recorded in habitats either within or adjacent to the Proposal Area. Accordingly, no impact to *A. jacobsiana* or *A. bronwenae* individuals is anticipated as a consequence of the construction or operation of the Proposal. No *A. jacobsiana* or *A. bronwenae* exclusion zones are required, and no translocations are proposed.

4 AVOIDANCE AND MITIGATION MEASURES

DAWE offsets policy (DSEWPC, 2012a) identifies that mitigation and management actions should prioritise the avoidance of environmental effects over reduction measures. Substantial changes to the Proposal design have been made since referral in September 2019 to reduce impacts on threatened ecological communities, conservation significant fauna, and conservation significant flora, as appropriate and necessary to avoid and minimise effects on the environment.

Given the extent and timing of the survey effort, measures provided in Section 4 are proposed only for species known to occur within the Proposal footprint or where presence of suitable habitat and / or past presence of species indicates measures are warranted under the precautionary principle.

A consolidated list of the impact avoidance and mitigation measures presented in Section 4 that will be implemented to reduce impacts on protected matters is included in **Error! Reference source not found.** for reference.

4.1 Threatened ecological communities

4.1.1 Banksia Woodlands TEC – Endangered

4.1.1.1 Avoidance

Changes to the Proposal design have been made since referral in September 2019 to reduce impacts to Banksia Woodlands TEC vegetation. As discussed in section 1.3.6, changes to the design have included a range of refinements to minimise the impacts to the environment such as reducing median widths and changing the design of interchanges to reduce clearing requirements. The resulting Proposal reflects the minimum land area required for the road corridor. Impacts to MNES and other environmental values have been reduced to the maximum extent possible and the remaining impact cannot be avoided if the Proposal is to proceed.

A summary of the original impact, and resulting impact post design changes and the net reduction in clearing area of Banksia Woodlands TEC is presented in Table 4-1.

Table 4-1 Detailed design changes to avoid impacts to Banksia Woodlands TEC vegetation

TEC TYPE	ORIGINAL PROPOSAL (SEPTEMBER 2019 REFERRAL)	REVISED PROPOSAL (OCTOBER 2021)	REDUCTION IN TEC CLEARING AREA
Banksia Woodlands TEC	Clearing of up to 26.6 ha	Clearing of up to 23.4 ha	Reduction in clearing area of 3.2 ha

4.1.1.2 Mitigation

Actions to be implemented to manage indirect impacts to remaining Banksia Woodlands TEC vegetation directly adjacent to the Proposal Area are detailed in section 4.1.4 and **Error! Reference source not found.**. The majority of these actions are included in the Main Roads Standard Scope of Work and Technical Criteria and have been formulated in consideration of the specific TEC occurrences that will remain after Proposal implementation. It is expected that they will sufficiently manage any indirect impacts. As is detailed in Section 3.1.1, Proposal implementation is not expected to reduce the viability of any remaining Banksia Woodlands TEC occurrences.

Main Roads intends to further counterbalance the residual impacts of the Proposal through implementation of an environmental offset strategy (Appendix N).

4.1.2 Tuart Woodlands TEC – Critically Endangered

4.1.2.1 Avoidance

Changes to the Proposal design have been made since referral in September 2019 to reduce impacts to Tuart Woodlands TEC vegetation. As discussed in section 1.3.7, changes to the design have included a range of refinements to minimise the impacts to the environment such as reducing median widths and changing the design of interchanges to reduce clearing requirements. The resulting Proposal reflects the minimum land area required for the road corridor. Impacts to MNES and other environmental values have been reduced to the maximum extent possible and the remaining impact cannot be avoided if the Proposal is to proceed.

A summary of the original impact, and resulting impact post design changes and the net reduction in clearing area of Tuart Woodlands TEC is presented in Table 4-2.

Table 4-2 Design changes to avoid Tuart Woodlands TEC

TEC TYPE	ORIGINAL PROPOSAL (SEPTEMBER 2019 REFERRAL)	REVISED PROPOSAL (OCTOBER 2021)	REDUCTION IN TEC CLEARING AREA
Tuart Woodlands TEC[25]	Not quantified	Clearing of up to 4.4 ha	N/A

4.1.2.2 Mitigation

Actions to be implemented to manage indirect impacts to remaining Tuart Woodlands TEC vegetation directly adjacent to the Proposal Area are detailed in section 4.1.4 and **Error! Reference source not found.**. The majority of these actions are included in the Main Roads Standard Scope of Work and Technical Criteria and have been formulated in consideration of the specific TEC occurrences that will remain after Proposal implementation. It is expected that they will sufficiently manage any indirect impacts. As is detailed in Section 3.1.2, Proposal implementation is not expected to reduce the viability of any remaining Tuart Woodlands TEC occurrences.

Main Roads intends to further counterbalance the residual impacts of the Proposal through implementation of an environmental offset strategy (see Section 4.3.1 and Appendix N).

4.1.3 Clay Pans TEC – Critically Endangered

The vegetation and flora surveys undertaken for the Proposal did not identify the Clay Pans TEC within or adjacent to the Proposal Area (BORR IPT, 2020i). No impact on the Clay Pans TEC is therefore expected as a result of the Proposal. Accordingly, avoidance and mitigation measures for the Proposal are not considered to be necessary for Clay Pans TEC.

Although no impact to Clay Pans TEC is expected to result from Proposal implementation, the Clay Pans TEC site has been included in the vegetation monitoring program as part of the conservative approach adopted for the Proposal. The site is anticipated to also inform Vegetation Monitoring of Clay Pans TEC already in progress for the BORR North and Central Sections Project. Monitoring of vegetation within Claypan TEC occurrences in the BORR Northern and Central section commenced in spring 2019 and is conducted bi-

[25] The extent of Tuart Woodlands TEC within the original referral boundary was confirmed in a supplementary flora and vegetation survey conducted after the submission of the referral. The Proposal Area boundary was then modified to reduce impacts to this community.

annually, in August and October. To date, vegetation monitoring has occurred in spring 2019, August 2020 and spring 2020. Monitoring comprises of transects and photopoints. The following parameters are assessed:

- Species diversity and cover
- Plant deaths
- Level of plant stress
- Ground characteristics (% bare ground, leaf litter, etc)
- Site conditions
- Evidence of erosion
- Vegetation community structure.

In addition to vegetation monitoring, drainage monitoring is also conducted quarterly at Claypan TEC occurrences to assess for changes in hydrology. Evidence of the following impacts are assessed:

- Flooding and / or inundation
- Erosion
- Drying of Claypan TEC vegetation.

Monitoring of groundwater and surface water is required and managed under the Vegetation Monitoring Program and will be included in the CEMP.

4.1.4 Management actions and completion criteria

Actions that will be implemented to manage indirect impacts to remaining all TEC vegetation immediately adjacent to the Proposal Area, and associated completion criteria, are detailed in Table 4-3 and **Error! Reference source not found.**. These actions are all included in the Main Roads Standard Scope of Work and Technical Criteria and are expected to sufficiently manage any indirect impacts.

As is detailed in Sections 3.1.1, 3.1.2 and 3.1.3, Proposal implementation is not expected to reduce the viability of any remaining TEC occurrences.

Indirect impacts to TEC vegetation within a 20 m buffer of the Proposal Area will be actively managed, as detailed in Table 4-3. No TEC vegetation will be retained within the Proposal Area, therefore no exclusion zones of TEC vegetation are required.

No rehabilitation of TEC vegetation is included as part of the Proposal.

Table 4-3 TEC vegetation management actions and targets

MANAGEMENT ACTION	MEASURABLE PERFORMANCE CRITERIA	COMPLETION CRITERIA	ROLES AND RESPONSIBILITIES	MONITORING / REPORTING
Prior to construction				
• **Design refinement to minimise area of TEC vegetation needed to be cleared for the Proposal** • **As part of the contractor's CEMP, development of a Hygiene Management Plan to prevent the spread of dieback and weeds to adjacent vegetation. The CEMP will include procedures such as machinery / vehicle clean down, weed treatments and restrictions on vehicle / machinery movements** • **As part of the contractor's CEMP, development of a Fire Management Plan** • **Declared Plants and WoNS within the Proposal Area and in adjacent Banksia Woodlands TEC and Tuart Woodlands TEC vegetation (in reserve or on land owned by Main Roads) will be removed or treated with herbicide.**	TEC vegetation clearing area is minimised CEMP and associated plans prepared Declared Plants and WoNS within the Proposal Area and in adjacent Tuart Woodlands TEC and Banksia Woodlands TEC vegetation (in reserve or on land owned by Main Roads) are removed or treated with herbicide	Design refined to minimise TEC clearing area Baseline condition of TEC vegetation adjacent to the Proposal Area is maintained[26]	Construction contractor to refine Proposal design, and develop and implement required plans, and implement all other listed actions Environmental Officer to conduct monitoring and compliance assessment Manager Environment to assess and respond to any incident reports or trigger exceedances	Monitoring in accordance with the *Vegetation Monitoring Program* (VMP) included in **Error! Reference source not found.** Annual Compliance Report
During construction				
• **The final road design will be assessed against the proposed clearing area to ensure the required clearing area is no more than the approved area** • **Contractor induction will include familiarisation with and discussion of TEC vegetation, *Phytophthora* dieback management and hygiene management** • **The Proposal Area boundary will be fenced to restrict access. The fence will be installed inside the approved Proposal Area.** • **Low impact temporary fencing will be installed on the active construction front of TEC vegetation areas prior to clearing and maintained during construction phase** • **No stockpiling or laydown of equipment will occur within 20 m of retained adjacent TEC vegetation (that is not subject to clearing)** • **Movement of machines and other vehicles to be restricted to the limits of the areas cleared within the Proposal Area or on designated tracks outside the area** • **Infestations of Declared Plants and WoNS in retained TEC vegetation and in revegetation and landscaping within the Proposal Area will be removed or treated with herbicide** • **No re-fuelling of equipment will be conducted within 100 m of TEC vegetation** • **As far as practical, clearing activities will occur during the dry months to reduce the risk of spreading *Phytophthora* dieback** • **All Department of Fire and Emergency Services (DFES) and Local Government Authority (LGA) restrictions on fire and machinery movement will be strictly adhered to** • **The Proposal Drainage Strategy (BORR IPT, 2019g) and ground and surface water management measures will be implemented to avoid impact to monitored TEC vegetation.**	No clearing outside the approved footprint No decline in condition of TEC vegetation adjacent to the Proposal Area attributable to Proposal implementation No disturbance of TEC vegetation during construction as a result of unrestricted access No new Dieback infestations identified in TEC vegetation as a result of Proposal implementation No new WoNS or Declared Plants identified in TEC vegetation as a result of Proposal implementation	Not more than 23.4 ha of Banksia Woodlands TEC and 4.4 ha of Tuart Woodlands TEC cleared Baseline condition of TEC vegetation adjacent to the Proposal Area is maintained. Refer to **Error! Reference source not found.** for more information	Construction contractor to develop all plans prior to construction and implement required plans, and implement all other listed actions Environmental Officer to conduct monitoring and compliance assessment Manager Environment to assess and respond to any incident reports or trigger exceedances	Monitoring in accordance with the *Vegetation Monitoring Program* included in **Error! Reference source not found.** Annual Compliance Report
Post construction				
• **For three years post construction, undertake control of Declared Plants and WoNS in monitored TEC vegetation in reserve or under Main Roads jurisdiction, as well as in revegetation and landscaping within the Proposal Area.**	No new WoNS or Declared Plants identified in monitored TEC vegetation in reserve or under Main Roads	Baseline condition of TEC vegetation adjacent to the Proposal Area is maintained.	Main Roads to implement listed actions	Monitoring in accordance with the *Vegetation Monitoring Program* included

[26] Baseline conditions have been assessed through pre-disturbance monitoring undertaken since spring 2020 in accordance with the Vegetation Monitoring Program (**Error! Reference source not found.**).

MANAGEMENT ACTION	MEASURABLE PERFORMANCE CRITERIA	COMPLETION CRITERIA	ROLES AND RESPONSIBILITIES	MONITORING / REPORTING
	jurisdiction as a result of Proposal implementation	Refer to **Error! Reference source not found.** for more information	Environmental Officer to conduct monitoring and compliance assessment Manager Environment to assess and respond to any incident reports or trigger exceedances	in **Error! Reference source not found.** Annual Compliance Report

4.1.5 Monitoring

A Vegetation Monitoring Program (VMP) has been designed to assess the effectiveness of management actions on potentially indirectly impacted occurrences of TEC vegetation adjacent to the Proposal Area (as detailed in Table 2-6 and shown in Figure 7, Appendix A), and enable the detection of a decline in vegetation condition. This includes a combination of transects (incorporating 2 x 2 m plots) and photopoints and uses species composition and vegetation health attributes as measurement parameters. Consultation with DBCA (Mr. Andrew Webb) regarding the monitoring program design was undertaken, with advice incorporated into the design. The proposed monitoring program is detailed in **Error! Reference source not found.**.

The program includes both 'potential impact sites' in retained TEC vegetation adjacent to the Proposal Area and 'reference sites' located away from the Proposal Area, outside the potential area of indirect impact. Three reference sites known to support Banksia Woodlands TEC vegetation and two known to support Tuart Woodlands TEC vegetation have been identified. All reference sites are located on Crown land or road reserve in close proximity to the potential impact monitoring sites. Their locations are shown in **Error! Reference source not found.**. The purpose of these sites is to enable comparison of potential impact site data with data from sites located away from the Proposal Area to assist in determining whether any indirect impacts have resulted from Proposal implementation.

It is proposed that the vegetation monitoring program will be implemented for two years post construction, with the option to extend for a third year if required. The monitoring program consists of activities undertaken in two different frequencies – photo point monitoring will be conducted biannually and transect monitoring annually in spring.

Opportunistic visual inspection for inundation of TEC vegetation from the Proposal will be conducted during construction. A drainage monitoring plan is included in the VMP (**Error! Reference source not found.**).

Triggers, thresholds and contingency actions that will be implemented should monitoring indicate a decline in monitored parameters are detailed in the VMP (**Error! Reference source not found.**).

Table 4-4 outlines the proposed monitoring type and monitoring frequency for the retained TEC vegetation.

Table 4-4 TEC vegetation monitoring frequency

TIMING	MONITORING TYPE	MONITORING FREQUENCY
Prior to construction	Photopoints	Bi-annually
	Transects	Annually (spring)
During construction	Visual inspection	Weekly and opportunistically (of clearing area)
	Photopoints	Bi-annually
	Transects	Annually (spring)
Post construction (for 2-3 years)	Photopoints	Bi-annually
	Transects	Annually (spring)

4.1.6 Reporting

Results of monitoring and compliance with proposed management actions will be reported to DAWE as part of the Proposal's annual report. The format of this report will be consistent with requirements stipulated by DAWE. The report will document compliance with conditions of approval.

Triggers, thresholds and contingency actions are based on the environmental monitoring and are included in **Error! Reference source not found.**. If environmental monitoring identifies a non-conformance with environmental conditions / targets / relevant legislation or guidelines, the incident will be reviewed and corrective actions implemented. The corrective actions, which are aimed at preventing recurrences of the incident taking place, are also detailed in the VMP (**Error! Reference source not found.**).

The corrective actions will include changes to equipment / processes / management measures if required. Any changes to processes / management will be updated in the management actions. These changes will be communicated through site inductions / toolbox meetings.

Environmental incidents are defined as events that cause or potentially cause harm to the environment. Environmental incidents are to be reported to the Manager Environment by the person responsible for the incident or the first person to observe the incident. The Manager Environment will assess the type and severity of the incident in accordance with Main Roads' standard incident procedures. Relevant personnel will be notified, including reporting to regulatory authorities.

The number and type of corrective actions to be implemented in the case of trigger exceedance will depend upon various factors, including the state of the natural surrounding environment, the location of the trigger and the works undertaken at the time of the exceedance.

4.2 Threatened fauna

4.2.1 Black Cockatoos (Forest Red-tailed Black Cockatoo - Vulnerable; Baudin's Cockatoo - Endangered; Carnaby's Cockatoo – Endangered)

A high level of mitigation and management has been applied to the Proposal, with Main Roads making substantial changes to the Proposal design in order to mitigate potential impacts on terrestrial fauna including Black Cockatoos. The changes made have resulted in the reduction of 14.6 ha in the area of Black Cockatoo habitat impacted, and five trees with potentially suitable nest hollows no longer being impacted. Connectivity of habitat will be maintained and enhanced through revegetation of additional areas within the Proposal Area.

4.2.1.1 Avoidance

As discussed above and in section 1.3.7, changes to the Proposal design have been made since referral in September 2019 to reduce impacts to Black Cockatoos. Changes to the design have included a range of refinements to minimise the impacts to the environment such as reducing median widths and changing the design of interchanges to reduce clearing requirements. The resulting Proposal reflects the minimum land area required for the road corridor. Impacts to MNES and other environmental values have been reduced to the maximum extent possible and the remaining impact cannot be avoided if the Proposal is to proceed.

Changes relating to the extent of Black Cockatoo habitat to be impacted are detailed in Table 4-5.

Table 4-5 Design changes to avoid Black Cockatoo foraging habitat and suitable nest hollows

ASPECT	ORIGINAL PROPOSAL (SEPTEMBER 2019 REFERRAL)	REVISED PROPOSAL (OCTOBER 2021)	REDUCTION IN IMPACT
Black Cockatoo Habitat area (Ha)	Clearing of up to 80 ha	Clearing of up to 60.9 ha	19.1 ha
Black Cockatoo Suitable DBH trees without a suitable nest hollow	Minimum of 538	Up to 1,088[27]	Increase due to further survey and more knowledge of the Proposal area
Black Cockatoo trees with a suitable nest hollow	Minimum of 18 large trees (DBH > 500 mm) containing a suitable hollow for breeding of Black Cockatoos	Up to 11 large trees (DBH > 500 mm) containing a suitable nest hollow for breeding of Black Cockatoos	7 large trees (DBH > 500 mm) containing a suitable nest hollow for breeding of Black Cockatoos
Black Cockatoo known nesting trees		Two of the 11 trees within the Proposal Area indicated some evidence of previous nesting use however no direct signs of Black Cockatoo breeding were observed	Not applicable

4.2.1.2 Mitigation / management

The key management actions that Main Roads will implement to manage the potential impacts of the Proposal to Black Cockatoo individuals and habitat are identified in Table 4-6. A complete list of management actions is outlined within the *Black Cockatoo Action Management Plan (AMP)* (BORR IPT, 2020e) (**Error! Reference source not found.**) and in the management matrices presented in **Error! Reference source not found.**.

As a result of refinement of the Proposal Area boundary, no Black Cockatoo habitat will be retained within the Proposal Area, therefore no Black Cockatoo habitat exclusion zones are required.

Translocation

No translocation of Black Cockatoos is proposed. The proposed mitigation and management measures detailed below and in the *Black Cockatoo AMP* (BORR IPT, 2020e) (**Error! Reference source not found.**) are anticipated to preclude the need for active translocation by the construction contractor.

[27] Surveys conducted in response to DAWE's request for additional information confirmed and quantified the extent of Black Cockatoo habitat within the Proposal Area, including in areas previously unsurveyed. The number of suitable DBH trees has increased since the September referral because all areas have now been surveyed.

Table 4-6 Black Cockatoo management actions

TIMING	MANAGEMENT ACTIONS
Prior to construction	• Refine Proposal design to minimise area of Black Cockatoo habitat needed to be cleared for the Proposal • Habitat to be cleared within the area of the Proposal Area will be demarcated in the field to ensure clearing only occurs within the approved clearing area • The final design will avoid trees with suitable nest hollows where possible • Where any of the three trees with suitable nest hollows for Black Cockatoo will require clearing for the Proposal, the hollow will be visually inspected where safe and practicable. Where not in use the hollow will be 'blocked' to prevent breeding • Where blocking of the nest hollows cannot be undertaken (e.g. timing, access), a pre-clearing fauna assessment will be undertaken by a suitably experienced person to determine if the hollows are being used by Black Cockatoos
During construction	• A suitably experienced zoologist / environmental scientist will be on-site at all times during clearing of breeding habitat for Black Cockatoos and must maintain radio communication with machinery operators • Where a suitable nest hollow has been blocked prior to the Black Cockatoo breeding season, the tree may be felled as part of the standard vegetation clearing process. • Where a suitable nest hollow has not been blocked and the pre-clearing fauna assessment has not identified any Black Cockatoo occupation of the nest hollow, prior to clearing the tree will be 'bumped gently'[28] with a machine with the machine operator and zoologist to wait and observe the tree for a short time after. If no Black Cockatoo appears to be present following being bumped gently then the tree shall be pushed over slowly to minimise risk of injury to any undetected animal (if present). • Where a suitable nest hollow has not been blocked and the pre-clearing fauna assessment identifies any Black Cockatoo occupation of the nest hollow (which may include chicks (young)), the tree with the nest hollow will not be cleared until after the completion of the breeding season. No vegetation within 50 m of the tree would be cleared until after the completion of the breeding season. • Any Black Cockatoos showing signs of injury or illness will be promptly referred to an experienced wildlife veterinarian or approved wildlife rehabilitation facility. • A post-clearing survey shall be undertaken to ensure no injured Black Cockatoo individuals are present.
Post construction	• Where space and access allows, revegetation and landscaping of cleared areas within the Proposal Area with suitable endemic native species will be undertaken to provide foraging habitat for Black Cockatoos (excluding 10 m buffer from nearest traffic lane).

[28] The combination of the preclusion of refuge site use prior to clearing (where possible), pre-clearance surveys, staged clearing and implementation of sensitive clearing protocols will substantially reduce the likelihood of any Black Cockatoos remaining within trees to be felled. To ensure the best outcome in regard to animal welfare, Main Roads intends to avoid handling any fauna during Proposal construction. The proposal to gently bump any trees still housing Black Cockatoos after 48 hrs is considered adequate and the best option to allow animals to self-relocate.

Main Roads intends to further counterbalance the residual impacts of the Proposal through implementation of an environmental offset strategy (see Section 4.3.1 and Appendix N).

4.2.1.3 Monitoring

Table 4-7 identifies the key monitoring actions that Main Roads will implement to monitor the potential impacts of the Proposal to Black Cockatoo individuals and habitat. A complete list of monitoring and reporting requirements is outlined within the *Black Cockatoo AMP* (BORR IPT, 2020e) (**Error! Reference source not found.**).

Table 4-7 Black Cockatoo monitoring and reporting

KEY IMPACT / RISK	MONITORING	REPORTING
Direct impacts to Black Cockatoos	Injury or death of Black Cockatoos Visual inspection: Pre-clearing Visual inspection during construction: Post each clearing event and opportunistically Post construction: Not applicable	Injury or death of Black Cockatoos recorded by construction contractor and reported to Manager Environment within 24 hours of incident occurring Report annually to DAWE as part of annual compliance reporting
Clearing of Black Cockatoo habitat to the extent practicable in final design **Avoid clearing outside the approved footprint**	Clearing area (ha) of Black Cockatoo foraging habitat During construction: Quarterly field survey of cleared areas with comparison to approved clearing area and mapped Black Cockatoo habitat areas Post construction: Not applicable	Area of Black Cockatoo habitat cleared recorded by construction contractor and reported to Manager Environment quarterly Report annually to DAWE as part of annual compliance reporting
	Number of suitable DBH trees (DBH ≥ 500 mm) containing a potentially suitable nesting hollow(s) cleared During construction: Quarterly field survey of cleared areas with comparison to approved clearing area and known Black Cockatoo nest hollow locations Post construction: Not applicable	Number of suitable DBH trees cleared recorded by construction contractor and reported to Manager Environment quarterly Report annually to DAWE as part of annual compliance reporting
Preclude potential breeding within Proposal Area prior to construction	Black Cockatoo access to potentially suitable nesting hollow(s) Visual inspection: Pre-clearing Visual inspection: Prior to Black Cockatoo breeding season(s)	Number of potentially suitable nesting hollow(s) blocked prior to construction recorded by construction contractor and reported to Manager Environment monthly
Rehabilitation does not provide suitable foraging habitat within 10	Presence / absence and quality of foraging habitat available in rehabilitated areas	Presence / absence and quality of Black Cockatoo foraging habitat in rehabilitated

KEY IMPACT / RISK	MONITORING	REPORTING
years of completion	Post construction: Bi-annual field survey by suitably experienced personnel	areas recorded by construction contractor and reported to Manager Environment: Post construction: bi-annually once rehabilitation works are completed

4.2.2 Western Ringtail Possum (*Pseudocheirus occidentalis*) – Critically Endangered

4.2.2.1 Avoidance

Changes to the Proposal design have been made since referral in September 2019 to reduce impacts to WRP habitat and home ranges, including consultation with technical experts Ms. Barbara Jones (Independent Consultant) and Mr Roy Teale (of Biota Environmental Sciences Pty Ltd). As discussed in section 1.3.7, changes to the design have included a range of refinements to minimise the impacts to the environment such as reducing median widths and changing the design of interchanges to reduce clearing requirements. The resulting Proposal reflects the minimum land area required for the road corridor. Impacts to MNES and other environmental values have been reduced to the maximum extent possible and the remaining impact cannot be avoided if the Proposal is to proceed.

A summary of the original impact, and resulting impact post design changes and the net reduction in clearing area is presented in Table 4-8. Through the design changes, the area of WRP habitat that will be cleared as a result of Proposal implementation has been reduced by 14.6 ha (18 %), with a corresponding reduction in the number of WRP home ranges disturbed.

Table 4-8 Design changes to avoid Western Ringtail Possum habitat

ASPECT	ORIGINAL PROPOSAL (SEPTEMBER 2019 REFERRAL)	REVISED PROPOSAL APRIL 2020	REVISED PROPOSAL (OCTOBER 2021)	REDUCTION IN IMPACT
Habitat extent (ha)	Clearing of up to 80.0 ha of WRP habitat	Clearing of up to 65.4 ha of WRP habitat	Clearing of up to 60.9 ha of WRP habitat	Minimum of 19.1 ha of WRP habitat or approximately 24 % of expected habitat loss saved through detailed design
Home ranges	Disturbance of a minimum of 73 WRP individual home ranges	Disturbance of up to 53 to 79 WRP individual home ranges	Disturbance of up to 49 to 72 WRP individual home ranges	Avoidance of disturbance to a minimum of 1 to 24 WRP individual home ranges

4.2.2.2 Mitigation / management

As a result of refinement of the Proposal Area boundary, no WRP habitat will be retained within the Proposal Area, therefore no WRP habitat exclusion zones are required.

Translocation

No translocation of WRP is proposed. The proposed mitigation and management measures detailed below, in the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**) and also

in the management matrix presented in **Error! Reference source not found.**, are anticipated to preclude the need for active translocation by the construction contractor.

Tagging and tracking

Tagging and tracking of WRP is not proposed. It is considered that the capturing and handling of individuals for attachment of collars / tracking devices would put animals under unnecessary stress. It is also unlikely to be sufficiently beneficial given the narrow linear clearing area and the presence of adjacent habitat that is likely to already be within the home ranges of any displaced individual WRPs. The proposed bi-annual presence and abundance surveys in adjacent retained habitat and comparison of this data with reference site data will provide sufficient indication of the success of the approach.

Rehabilitation

No rehabilitation of WRP habitat within the Proposal Area is proposed. Rehabilitation of WRP habitat adjacent to the Proposal Area may be undertaken around engineered movement structure locations in order to make these more attractive to and effective for WRP.

Timing of clearing

WRP numbers are known to fluctuate seasonally based on habitat quality and in response to climatic conditions, and this is also the case with populations in the Proposal Area (Biota, 2020a). The proposed timing of clearing was determined based on species' breeding cycles and site survey information. In consideration of timing, WRP was the priority species, in particular the timing of birthing, with additional consideration of the breeding cycles for Black Cockatoo, and consideration for *Phytophthora* dieback management. Using data obtained from site surveys undertaken to date, Main Roads has identified key WRP habitat areas within the Proposal Area (refer to **Error! Reference source not found.**). This information has informed the timing of, and process for, clearing to minimise potential impact on WRP.

Shepherding

Through the implementation of sensitive clearing protocols as detailed in the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**), WRP will be encouraged and enabled to move of their own accord into adjacent areas of retained habitat. As is shown in Figure 3 of the AMP, the proposed clearing methodology will direct any displaced WRP into trees in the retained adjacent habitat, not into cleared agricultural land. Surveys conducted by Biota indicate that habitat areas adjacent to the Proposal Area support populations of WRP, indicating that these areas provide the necessary habitat requirements. Any given area of habitat is capable of sustaining a year-round WRP population equivalent to but not exceeding the maximum seasonal WRP population recorded for that habitat area (Barbara Jones, pers. comm., 2020) i.e. the maximum seasonal population provides an indication of the maximum carrying capacity of a given area of habitat. Clearing will be timed (to avoid seasonal population peaks) and staged to encourage WRP to move into adjacent areas of habitat and where possible, to the largest and best-connected habitat.

The approach of allowing WRP to self-relocate to adjacent habitat has been chosen over translocation of WRP to other areas because it provides the best outcome in terms of animal welfare. The success rates of documented translocation projects is poor, and as yet no successful methodology has been developed or implemented (Clarke, 2011; de Tores, 2005). Allowing WRP to relocate to adjacent habitat of their own accord eliminates the requirement for handling, substantially reducing the likelihood of WRP being put under undue stress. The linear clearing corridor provides good dispersal options for WRPs, and it is highly probable that dispersing WRP are already familiar with adjacent habitat areas as these likely form part of their home range. It is anticipated that WRPs will readily relocate into other areas of their home ranges during construction.

Connectivity

Fragmentation of habitat can lead to isolation of populations, reduced population size and genetic decline. Maintenance of effective meta-population size through retention of adequate habitat area and connectivity is important for maintaining WRP genetic diversity and population viability (Shedley & Williams, 2014).

Recognising the critical importance of maintaining connectivity between habitat areas and across the local landscape, Main Roads has prioritised this aspect of impact mitigation. Known movement pathways have been retained through the detailed design process where possible, and suitably designed underpasses / rope bridges (engineered movement structures) will be installed to reconnect disrupted movement pathways between habitat areas.

In October 2021, Main Roads made additional modifications to the proposal within the Gelorup section to address concerns raised by the WA EPA and DBCA. These modifications include:

- Additional Protected Areas. Three properties acquired at Yalinda Drive will be retained with disturbed areas revegetated to provide retained WRP habitat adjacent to crossing structures.
- Additional Fauna Connectivity:
  - Vegetated Strip on Yalinda Drive Bridge protected from bridge traffic
  - Fauna Land Bridge east of Yalinda Drive
  - Two additional rope bridges west of Yalinda Drive

In total, twenty two (22) connections are now proposed, as follows and as shown in Figure 12 (Appendix A):

- Eight rope bridges
- Seven fauna underpasses
- Seven dual use fauna culverts.

Further information on the design and implementation on fauna crossings is included in Appendix L.

Due to the high number of locations where engineered movement structures can be installed along the Proposal Area, Main Roads has taken the initiative to trial a number of different structures in order to build knowledge around WRP requirements and preferences. Designs for fauna over and underpasses and rope bridges used locally and nationwide have been researched and considered. Main Roads has also considered expert advice to ensure best practice in the designs proposed for the Proposal, as well as investigate how existing structures can be improved, such as installing ledges in the tops of underpasses so that WRP do not have to go to ground, and, via ropes, linking these ledges straight up into the adjacent canopy, assisting WRP to avoid predators. The Proposal includes several design options based on these improved designs and on successful designs used at Treendale (where an underpass connects the riparian zone along the Collie River in Australind) (Barbara Jones, pers. comm., 2020) and Vasse (where substantial areas of Peppermint woodland habitat on either side of Bussell Highway are connected via rope bridges) (Yokochi & Bencini, 2015).

Main Roads acknowledges that an existing rope bridge in BORR Central has not been effectively used by WRP. The lack of usage of this overpass appears to be due to a number of contributing factors such as span length, exposure to predators and less-than-ideal entry and exit points. These learnings have informed the designs proposed for BORR Southern Section, such that rope bridge spans in the proposed structures are shorter where possible, and other structures are used in places where long exposed rope bridges would otherwise be required. The proposed monitoring detailed in the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**) will assess the effectiveness / use of the different designs by WRP.

Although primarily arboreal, WRPs do move on ground, as evidenced in urban populations. Usage of underpasses by WRP is not expected to be limited by requiring access to the underpass through overhead connections.

It is noted that the success of the Vasse rope bridges has been due to the presence of historic telegraph pole and line infrastructure, the resident WRP population was already familiar with using these kinds of structures to move between areas. Further, the density of WRP in these areas was very high, increasing the requirement to move between habitat areas in search of food, other resources and mates. None of the Proposal Area populations are as high density as those at Busselton and also it is not known whether these WRP are familiar with using rope bridge type structures. As such, should the structures installed by Main Roads not initially be successful, this may not be because of design failure or incorrect structure placement but because the level of motivation for the WRP to use these structures is not great (low density = low competition) and / or because the resident populations are not yet familiar with that kind of structure. Main Roads will conduct ongoing monitoring to determine the efficacy of the various structures installed, to inform general knowledge about the species and determine any adaptive management actions that may need to be implemented.

Fragmentation of the regional WRP population

Based on our field data, in the vicinity of the Proposal, WRP have been moving between the low density habitats of the Gelorup mixed woodland and that in Reserve 23000 (immediately west of and adjacent to Bussell Highway) via the Bussell Highway median strip, much of which retains woodland habitat. This median strip has been used by wandering WRP, some observed during the period 2018-2021 (Biota field observations), but roadkills have remained relatively uncommon on this section of road over the last 20 years or so (Barb Jones, pers. observation). This indicates that an important east-west migration or dispersal option has remained available for animals moving between the two habitat areas. Bussell Highway's retained median woodland also provides north-south transit options for wandering WRPs. The Proposal will have only a minor impact on WRP values associated with the median woodland habitat.

In regard to concerns around the Proposal creating a potential genetic barrier to the regional population, Mills and Allendorf (1996) suggest that one migrant animal per generation into a sub-population is the minimum necessary to maintain genetic diversity. To put the Proposal habitat clearing in context, the Gelorup corridor is 2,500 m in length and transects a large native canopy patch that is part of the larger Gelorup WRP habitat. As shown at Figures 1 and 2 WRP have been recorded as occurring widely surrounding the Proposal Area providing a potential pathway for genetic flow into the areas. Further, as stated above, to the west of this habitat, WRP have been using the Bussell Highway median as a road crossing refuge, indicating that the majority of this area's main dispersal or genetic flow options (east-west and north-south) remain largely undisturbed by the Proposal.

In addition to the above, within the Gelorup corridor, Main Roads has committed to installing thirteen fauna crossing structures of five different designs. Of these, one design for a rope connection which hangs below the shelter provided by an overhead carriageway was used across the Collie River at Treendale, and has a local track record of repeated WRP crossings within 2-3 years of installation. This crossing structure, which is located in a low WRP density area, is the same design as is proposed for the four-way Yalinda

bridge crossing structure. Another of the proposed crossing structures (culverts) has also been shown to be used by the eastern species, *Pseudocheirus peregrinus*[29,30,31].

Based on the above, any genetic Gelorup disjunction effects resulting from construction of the Proposal would be minor but not locally or regionally significant, and not perpetual or severe. Only a small part of the larger Gelorup population would be 'effectively' prevented from using either a northern or southern dispersal option, and then probably for less than 5-10 years (1-2 WRP generations, while plantings around the fauna crossing structures acquire their first 4-8 growth seasons).

Predation

The Gelorup WRP population is low density (1 WRP/ha), and the majority of WRP likely to be impacted by Proposal clearing will have portions of their home range retained to which they can relocate after clearing. In addition to this, there is a substantial extent of habitat available for transient/displaced WRPs. In light of this, predation by foxes or domestic dogs is less likely to be problematic for animals displaced by the Proposal clearing than for animals displaced by a clearing event proposed for a footprint that would displace higher densities (>3-4 WRP/ha).

The bimonthly count sequence confirmed that the Gelorup WRP population has a high proportion (almost 26%) of transient WRPs. This indicates that these individuals have a history of persisting in the wider Gelorup habitat in spite of predation threats from domestic dogs, cats or foxes. The range of management options that Main Roads has committed to will aim to keep dispersing WRPs off the ground and in trees with which they are familiar.

Watering

WRPs can suffer serious dehydration, principally during record dry or hot conditions. Such WRP-adverse weather periods have become a common feature of the south west's last two decades of climate drift (Barbara Jones, pers. comm., 2020). If hot or dehydrated, WRPs tend to go to ground, and in urban circumstances they often find water in pet bowls, shade-houses, bird-baths or reticulation systems. They do not sweat, but like kangaroos, they lick body water onto their forearms where it can evaporate to cool the blood.

As part of the WRP self-relocation process, Main Roads will install artificial dreys (2/ha) into adjacent habitat areas while the rural residential development abutting the Gelorup section also provides substantial alternative options to hollows and dreys.

In the forecourt areas associated with the BORR Proposal's main WRP underpasses, supplementary WRP watering points will be made available for the first dry season after the forecourt landscaping is completed. Making these areas very attractive for dehydrated WRPs offers the best way for local animals to learn about the new (dark, cool and useful) cavities left in their habitat by the Proposal.

Fencing and noise wall design

A combination of permanent and temporary fauna fences will be installed adjacent to known habitat areas to limit WRP access to the Proposal Area and reduce the chance of vehicle strike of WRP and other fauna, and to protect WRP habitat from unauthorised access. The fences will be 1.5 - 1.8 m high and constructed to prevent possums being able to climb it or dig under them (Figure 12, Appendix A).

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[29] Taylor, B. D. and Goldingay, R. L. (2003) Cutting the carnage: wildlife usage of road culverts in north-eastern New South Wales. *Wildlife Research* **30**, 529-537.

[30] Bond Amy R., Jones Darryl N. (2008) Temporal trends in use of fauna-friendly underpasses and overpasses. *Wildlife Research* **35**, 103-112.

[31] van der Ree, R., Clarkson, D.T., Holland, K., Gulle, N., Budden M., 2008. *Review of Mitigation Measures used to deal with the Issue of Habitat Fragmentation by Major Linear Infrastructure*, Report for Department of Environment, Water, Heritage and the Arts (DEWHA), Contract No. 025/2006, Published by DEWHA.

A 1.8 m high chain mesh fence will be used to define the road reserve (cadastral) boundary through the rural sections of the project. These fences are not designed to exclude WRP.

Noise and screen walls through the Gelorup section will be located between the road reserve boundary and the road driving surface. These walls will be solid flat structures to exclude climbing by WRP (and other arboreal animals) on or over the wall and gaining access to the Proposal Area (inside the fence / wall), and vary in height from 2.5 – up to 5.0 m in height. The height of these walls will be dictated by the ultimate noise management plan which is yet to be finalised. WRP exclusion fencing will be used at specific locations where high density WRP populations have been identified and in the vicinity of movement structures. The 1.5 m fence design as shown in the Conservation Significant Fauna AMP (**Error! Reference source not found.**) will be adopted to exclude WRP moving on to or crossing the nearby road. This fence is designed with a smooth 600 mm high section directly above the ground and a 300 mm buried mesh skirt surface to avoid climbing / digging under by WRP.

Table 4-9 identifies the key management actions that Main Roads will implement to manage the potential impacts of the Proposal to WRP individuals and habitat. A complete list of management actions is outlined in the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**) and in the management matrix presented in **Error! Reference source not found.**.

Table 4-9 WRP management actions

TIMING	MANAGEMENT ACTIONS
Prior to construction	• Refine Proposal design to minimise area of WRP habitat required to be cleared • Prior to clearing, the final road design will be assessed against the proposed clearing area to ensure the required clearing area is no more than the approved area • Pre-clearing fauna assessment and spotlighting will be undertaken by a suitably qualified person for two nights within the five nights prior to clearing • Assessments are to include hollows, dreys, ground debris, dense ground-level vegetation, timber and logs • Habitat that is to be retained within the development envelope will be marked accordingly or delineated with temporary fencing to ensure it is avoided.
During construction	• A qualified zoologist / environmental scientist / fauna-spotter will be on-site at all times during clearing of habitat for WRP and must maintain radio communication with machinery operators • Clearing will be conducted congruent with the habitat clearing categories as detailed in the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**) • Vacant dreys will be removed prior to clearing where they are accessible • Vacant tree hollows suitable for possums will be removed or blocked prior to clearing where they are accessible • If WRP are observed during clearing operations, the tree containing the animal shall be left for up to 48 hours to allow for the animal to vacate, while clearing continues in adjacent vegetation. If the tree continues to be occupied after 48 hours, the animal will be coerced / moved to a safe area outside of the clearing footprint by the appointed zoologist / environmental scientist / fauna spotter.

TIMING	MANAGEMENT ACTIONS
	• Trees, as noted above, that are observed to support WRP after 48 hours will be 'bumped gently'[32] with a machine prior to felling. The operator and spotter will wait and observe the tree for a short time. If the animal remains in the tree, the tree shall be pushed over slowly onto vegetation within the clearing area that is yet to be cleared. The 'soft felling' of habitat trees will provide a 'cushion' for the vegetation being felled, minimising the risk of injury to the animal and allowing any WRP present with the opportunity to safely vacate. • Felled trees with hollows will be checked immediately for fauna after felling and prior to further processing. If it is not possible to fully inspect the hollow the tree will be left on the ground overnight to allow time for any undetected fauna to vacate. • Habitat clearing is to be staged, commencing from existing edge lines / roads and progressing towards habitat that will be retained to direct WRP towards these areas as per the proposed clearing staging in the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**). • A post-clearing survey shall be undertaken immediately following each day's clearing operations and the following morning to identify the presence of any injured animals • Possum fencing (temporary and permanent) will be installed adjacent at known habitat areas to exclude WRP moving onto the road (Figure 12, Appendix A). The fencing will be 1.5 m high and be constructed to prevent possums being able to climb it or dig under it.
Post construction	• Undertake targeted rehabilitation and install design features at engineered movement structure locations (adjacent to the Proposal Area) to ensure access to water is maintained, and to make utilisation of the structures attractive and effective for WRP.

Main Roads intends to further counterbalance the residual impacts of the Proposal through implementation of an environmental offset strategy (see Section 4.3.1 and Appendix N).

4.2.2.3 Monitoring

Table 4-10 identifies the key monitoring actions that Main Roads will implement to monitor the potential impacts of the Proposal to WRP individuals and habitat. A complete list of monitoring actions is outlined within the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**).

Tagging and tracking of WRP is not proposed. It is considered that the capturing and handling of individuals for attachment of collars / tracking devices would put animals under unnecessary stress. It is also unlikely to be sufficiently beneficial given the narrow linear clearing area and the presence of adjacent habitat that is likely to already be within the home ranges of any displaced individual WRPs. The proposed bi-annual presence and abundance surveys in adjacent retained habitat and comparison of this data with reference site data will provide sufficient indication of the success of the approach.

[32] The combination of the preclusion of refuge site use prior to clearing (where possible), pre-clearance surveys, staged clearing and implementation of sensitive clearing protocols will substantially reduce the likelihood of any WRP remaining within trees to be felled. To ensure the best outcome in regard to animal welfare, Main Roads intends to avoid handling any fauna during Proposal construction. The proposal to gently bump any trees still housing WRP after 48 hrs is considered adequate and the best option to allow animals to self-relocate.

Bi-monthly monitoring of WRP within and adjacent to the Proposal is being conducted (commenced in August 2019 and will continue for at least 12 months) to collect baseline data for the number of WRP in each area. This monitoring also includes Reference Sites located near to the Proposal Area, selected because of their large size and lack of connectivity. As these sites are generally unconnected to other habitat areas, variations in WRP density which may be the result of natural cycles (breeding and attrition) and/or climatic conditions will be more easily detected here. Through a comparison with trends in reference site data, variations in the number of individuals of WRP adjacent to the Proposal can be measured and investigated further if significant differences are detected.

Table 4-10 WRP monitoring

MONITORING PARAMETER	METHODOLOGY / FREQUENCY	LOCATION
Habitat clearing	Daily construction area assessment to visually check / review clearing boundaries and assess vegetation clearing	Within cleared areas containing native vegetation
Impacts to fauna in adjacent habitat	Nocturnal survey for WRP bi-annually during construction and for three years post construction	In potential impact sites and current reference site (Reserve 23000 Bussell Highway)
	Inspect possum fence installation and maintenance during construction and bi-annually for five years post-construction	All committed possum fence locations (once constructed)
Loss of ecological connectivity	Review of design reports and drawings to ensure WRP bridges / underpasses are designed and incorporated into the Proposal At 50 % design and IFC (issued for construction)	All committed WRP bridge / underpass locations
	Bi-annual visual inspection of WRP bridges / underpasses during construction	All committed WRP bridge / underpass locations (once constructed)
	Quarterly visual inspection for WRP scats to assess utilisation for five years post construction	Beneath rope bridges and in underpasses
	Use motion sensor IR cameras to assess utilisation (visual assessment of footage) Intermittent for five years post construction	At rope bridge and underpass locations
Rehabilitation success	Visual inspection of rehabilitation installed around engineered movement structure locations bi-annually for three years post construction	At rope bridge and underpass locations

4.2.3 Black-stripe Minnow (*Galaxiella nigrostriata*) - Endangered

4.2.3.1 Avoidance

Substantial changes to the Proposal design have been made subsequent to referral of the Proposal in September 2019 to reduce impacts to BSM habitat.

Through these design changes, the area of BSM habitat that will be removed as a result of Proposal implementation has been reduced by 4.1 ha (40 %) (Table 4-11).

Table 4-11 Design changes to avoid BSM habitat

ASPECT	ORIGINAL PROPOSAL (SEPTEMBER 2019 REFERRAL)	REVISED PROPOSAL (OCTOBER 2021)	REDUCTION IN IMPACT
Habitat extent (ha)	Clearing of up to 9.6 ha of BSM habitat	Clearing of up to 5.5 ha of BSM habitat	Reduction in clearing of 4.1 ha of BSM habitat

4.2.3.2 Mitigation / management

Table 4-12 identifies the key management actions that Main Roads will implement to manage potential impacts to BSM habitat and individuals. A complete list of management actions is outlined within the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**) and also in the management matrix presented in **Error! Reference source not found.**.

As a result of refinement of the Proposal Area boundary, no BSM habitat will be retained within the Proposal Area, therefore no BSM habitat exclusion zones are required.

No translocation of BSM is proposed. The proposed mitigation and management measures detailed below and in the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**) are anticipated to preclude the need for active translocation by the construction contractor.

No rehabilitation of BSM habitat is proposed.

Potential impacts on surface water hydrology and inland waters will be minimised during the detailed design phase, and implementation of the *Conservation Significant Fauna AMP* (BORR IPT, 2020d) (**Error! Reference source not found.**) and CEMP. Specific measures from the AMP include:

- Transverse drainage design will be developed at the detailed design stage to achieve the objective of maintaining the existing water cycle balance of the Proposal Area (i.e. minimising drainage shadow effects on surrounding wetlands, waterways, vegetation and agricultural properties) and prevention of adverse impacts to the existing built environment.
- In particular, detailed drainage design will consider requirements for fauna movement including fish passage (BSM) under the constructed road (culverts or other) where appropriate.
- No direct run-off will drain into adjacent watercourses and wetlands. Drainage for the Proposal will be largely through infiltration using table drains and sumps with the majority of the road being unkerbed. design of the road will be based on other major successful Main Roads projects that have managed the movement of water cross and along road infrastructure.
- The risk of erosion and sedimentation during construction will be managed under a CEMP, and will include (but is not limited to) the following site-specific erosion and sediment controls:
  - Ensure there is no direct run-off to the adjacent watercourses and wetlands.

  - Install temporary erosion and sediment control measures and during bridge construction.
  - Design watercourse crossings to include erosion control and scour protection measures.
  - Prepare the Landscape Management Plan so that roadsides and medians will be vegetated and capable of acting as a biological filter for run-off.

- The risk of contamination from poor hydrocarbon and chemical management during construction will be managed under a CEMP which includes management measures outlined in Table 4-12, as well as the following:
  - Ensure there is a Spill Response Procedure for hazardous material spill events to ensure any spill is contained effectively and cleaned up appropriately.
  - Hydrocarbon storage and re-fuelling will not be permitted within 200 m of a natural watercourse or Conservation / Resource Enhancement wetland.
  - Storage of hydrocarbons on site will be within suitably designed containers within a bunded area.
- Implement an ASS Management Plan throughout construction of the Proposal. Compliance with the ASS Management Plan is required in the event of dewatering. Compliance will ensure correct dewatering methods, effluent management, effluent treatment, effluent disposal and monitoring requirements. The ASS Management Plan will be prepared in accordance with the *Overarching ASS Management and Dewatering Plan* prepared by BORR IPT (2020g).
- Minimise the risk of exposing existing contamination as described in
- The risk of erosion, sedimentation and spills of hazardous chemicals during operation of the Proposal will be managed through drainage design:
  - Erosion control will be applied at drainage discharge points.
  - Detention / infiltration basins where there is potential for discharge of hazardous spills into the major waterways.

Monitoring of groundwater and surface water will be required and managed under both a CEMP, *Conservation Significant Fauna AMP* (**Error! Reference source not found.**) and Vegetation Monitoring Program (**Error! Reference source not found.**) and will include the following:

  - Baseline water monitoring event prior to commencing construction, which will be used to ascertain water quality performance criteria.
  - Evidence of erosion on embankments to be monitored opportunistically and weekly during construction.
  - Run-off from construction areas into wetlands and watercourses to be monitored opportunistically and weekly during construction.
  - Daily surface water monitoring during construction over rivers.
  - If dewatering is required:
    - Fortnightly groundwater and surface water monitoring by an Environmental Scientist.
    - Daily monitoring and reporting of dewater effluent, undertaken by the Contractor, with reference to specific trigger criteria (as outlined in the CEMP).
    - Twice per week groundwater monitoring undertaken by the Contractor.

- Monitoring as per individual ground and / or surface water abstraction and dewatering licence conditions (if required).
- Post-construction monitoring of surface and groundwater required.

Table 4-12 BSM management actions

TIMING	MANAGEMENT ACTIONS
Prior to construction	• Refine Proposal design to minimise area of BSM habitat required to be cleared
During construction	• Install silt curtains / fences as required at, up and downstream of the Five Mile Brook bridge construction area to maintain water quality (turbidity) in areas of BSM habitat • Install flat-based culverts to maintain connectivity of habitat in areas of BSM habitat • A clear span bridge with footings outside of the bed and banks of the channel will be installed where the BORR carriageway crosses Five Mile Brook to maintain habitat connectivity and hydrology for BSM.
Post construction	Not applicable (monitoring and as-needed corrective action activities only)

4.2.3.3 Monitoring

Table 4-13 identifies the key monitoring actions that Main Roads will implement to monitor potential impacts to BSM habitat and individuals. A complete list of monitoring actions is outlined within the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**).

Table 4-13 BSM monitoring

MONITORING PARAMETER	METHODOLOGY / FREQUENCY	LOCATION
Impacts to fauna in adjacent habitat	Measure surface water quality parameters critical to BSM survival (including TN, TP, temperature, pH, oxidation-reduction potential, conductivity and turbidity). Sampling using appropriate water quality meters and / or laboratory analysis. Ongoing quarterly prior to and during construction and bi-annually for three years post construction	Within suitable BSM habitat
	Visual inspection for presence of BSM Annually during construction and for three years post construction	In known habitat areas and in at least one reference area
Hydrology and drainage changes	Manual water level sampling and / or measurement of waterbody depth Quarterly (where able e.g. winter / spring only for surface water) during construction and bi-annually for three years post construction	Known BSM habitat

MONITORING PARAMETER	METHODOLOGY / FREQUENCY	LOCATION
	Visual inspection of condition and functioning of installed silt curtain / fence and for offsite discharges from the Proposal Area into BSM habitat Opportunistic and weekly during construction	BSM habitat within and adjacent to the Proposal Area
	Visual inspection for evidence of erosion or sedimentation of BSM habitat Opportunistic and weekly visual inspection during construction and biannually for three years post construction	BSM habitat within and adjacent to the Proposal Area
Loss of ecological connectivity	Visual inspection for damage to or blockage of BSM habitat and / or fish passageways Annually in winter during construction and for three years post construction	BSM habitat and / or fish passageways

4.3 Effectiveness and Cost of Proposed Measures

Mitigation measures proposed for the Proposal by Main Roads are based on results of studies and / or expert advice (where stated) and past experience with similar projects. Main Roads has a strong track record of both developing and implementing best practice in environmental management and implementation of management measures. The measures proposed herein have been successfully implemented on past projects subject to EPBC conditions and management measures, including the following projects for which Compliance Reports have been issued in the past year:

- Great Northern Highway Upgrade Stage 2 (EPBC 2016/7761)
- Bowelling Curves Realignment (EPBC 2016/7757)
- Northam Pithara Road Widening (EPBC 2015/7454)
- Mitchell Freeway Extension - Burns Beach to Hester Avenue (EPBC 2013/7091)
- Broome - Cape Leveque Road Upgrade (EPBC 2013/6984)
- Dampier Highway Duplication project (EPBC 2010/5419)
- Gateway WA – Perth Airport and Freight Access Project (EPBC 2010/5384)

Main Roads' project development process includes appropriate resource allocation to ensure compliance costs are appropriately budgeted and assessed as part of the overall business case for the project. This ensures that the costs of proposed management measures and offsets are considered in the budget approvals and ensures compliance is appropriately funded and resourced.

Of specific note, the Proposal includes the provision of twenty two (22) designed underpasses / rope bridges (engineered movement structures) to reconnect disrupted movement pathways between habitat areas, as shown in Figure 12 (Appendix A). Main Roads acknowledges that the existing rope bridge in BORR Central has not been effective. The lack of usage of this overpass appears to be due to a number of contributing factors such as span length, exposure to predators and less-than-ideal entry and exit points. These learnings have informed the designs proposed for BORR Southern Section, such that rope bridge spans in the proposed structures are shorter where possible, and other structures are used in places where long exposed rope bridges would otherwise be required.

Main Roads has taken the initiative to trial a number of different structures in order to build knowledge around WRP requirements and preferences. The Proposal includes several design options based on these improved designs and on successful designs used at Treendale (where an underpass connects the riparian zone along the Collie River in Australind) (Barbara Jones, pers. comm., 2020) and Vasse (where substantial areas of Peppermint woodland habitat on either side of Bussell Highway are connected via rope bridges) (Yokochi & Bencini, 2015).

The proposed monitoring detailed in the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**) will assess the effectiveness of engineered structures and the other management measures included as part of the Proposal.

Main Roads adopts an 'adaptive management' approach which seeks to embed a cycle of monitoring, reporting and implementing change, where required. Accordingly, it is intended that the AMP, VMP and CEMP may be updated (as required) over the life of the Proposal to reflect changes in the monitoring and management practices, subject to the results of the monitoring to identify that the environmental objectives are being achieved. The AMP, VMP and CEMP may also be revised to address learnings from the implementation of corrective actions, should this occur.

4.3.1 Audit and review

Auditing and review schedules are necessary to embed a formal process to identify and consider any need to update the AMP, VMP and CEMP in order to achieve improved environmental performance (which may not otherwise be triggered by management or monitoring outcomes).

After completion of the construction contract, the BORR will be managed in line with Main Roads' operational management procedures for the maintenance of roads.

4.3.1.1 Environmental auditing

The AMP and CEMP will be audited annually by Main Roads during construction for the Proposal to ensure the implementation of the management and monitoring measures, and to confirm the management measures specified are achieving the environmental outcomes.

The proposed auditing schedule for the AMP and CEMP is identified in Table 4-14.

Table 4-14 Environmental audit schedule

TIMING	ACTION	SCHEDULE
Pre-construction	Review of construction procedures to ensure AMP and CEMP management / monitoring actions are incorporated within works procedures	Prior to construction (single event)
Construction	Inspections by site environmental personnel to identify compliance with AMP and CEMP	Periodic (generally weekly)
	Independent 'third-party' audit for assessment of compliance with AMP and CEMP	Annually (once per calendar year)
Post construction	Independent 'third-party' audit for assessment of compliance with AMP and CEMP	Annually (once per calendar year for up to 3 years)

The results of the construction and post construction independent 'third-party' audit findings will be reported by Main Roads to DAWE as part of annual compliance reporting as outlined within Section 4.1.6.

4.3.1.2 Environmental review

Main Roads proposes to review the AMP and CEMP annually in order to:

- consider the management and monitoring actions
- consider opportunities for improvement in environmental performance (for example, changes to construction methodology or timing)
- identify a need to update the AMP, VMP and / or CEMP to capture changes to the management and / or monitoring actions
- identify any general need to update the AMP, VMP and / or CEMP (for example, to capture new information on TEC or Black Cockatoo knowledge or management).

Main Roads acknowledge that a revision to the AMP and / or CEMP may trigger a need for additional approval by DAWE a prior to implementing any changes to the specified management or monitoring actions.

The proposed CEMP review schedule for the Proposal is identified in Table 4-15.

Table 4-15 CEMP and AMP review schedule

TIMING	ACTION	SCHEDULE
Pre-construction, construction and post construction	Review of CEMP management and monitoring actions Review of opportunities for an improvement in environmental performance Revise CEMP (if appropriate) and seek approval of DAWE for revised CEMP	Annually (once per calendar year)

5 OFFSETS

5.1 Background

Environmental offsets are conservation actions that provide environmental benefits intended to counterbalance the significant residual environmental impacts associated with a proposal (GoWA, 2014b). Main Roads intend to counterbalance the residual impact of the Proposal through implementation of an environmental offset strategy. The strategy will be prepared in accordance with the WA Government's *Environmental Offset Policy* (GoWA, 2011), *WA Offset Guideline* (GoWA, 2014b), and the Australian Government's *EPBC Act Environmental Offset Policy* (DSEWPC, 2012a) and *Environmental Offset Assessment Guide* (DSEWPC, 2012c). The offset will be proportionate to the level of impact and significance of the environmental impact.

Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate and offset environmental impacts. This hierarchy is achieved primarily through changes in scope and design, development and implementation of relevant management plans (*Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**), *Black Cockatoo AMP* (BORR IPT, 2020e) (**Error! Reference source not found.**) and finally, an offset proposal. The Environmental Offset Strategy for the Proposal is included in **Error! Reference source not found.**. Application of the management hierarchy has been documented throughout this document.

Further to the Offset Strategy, as part of the offsets package, Main Roads will develop an Offset Management Plan detailing SMART targets, management measures (including methodologies for ensuring security of tenure) and monitoring required to ensure that each proposed offset site provides the required value(s) commensurate with the relevant residual impact. The Offset Management Plan will address each of the requirements specified in the *EPBC Act Environmental Offsets Policy* (DSEWPC, 2012a) and *WA Environmental Offsets Policy* (GoWA, 2011), as listed in Sections 5.2 and 5.3.

5.2 EPBC Act Environmental Offsets Policy

The *EPBC Act Environmental Offsets Policy* (DSEWPC, 2012a) requires that the Principles outlined in Table 5-1 are met by an offset. Table 5-1 includes an assessment of the proposed offsets against each Principle.

Table 5-1 Assessment of proposed offset against *EPBC Act Environmental Offsets Policy* principles

EPBC ACT ENVIRONMENTAL OFFSETS POLICY PRINCIPLE	WRP	BLACK COCKATOOS	TECs
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter	Proposed offsets provide 202 ha of potential WRP habitat that will be secured in perpetuity and managed for its habitat values	Proposed offsets provide 202 ha of potential Black Cockatoo habitat that will be secured in perpetuity and managed for its habitat values	Proposed offsets provide 202 ha of potential Banksia Woodlands TEC that will be secured in perpetuity and managed for its conservation values
Suitable offsets must be built around direct offsets but may include other compensatory measures	Proposed offsets comprise 100 % direct offsets	Proposed offsets comprise 100 % direct offsets	Proposed offsets comprise 100 % direct offsets
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	Offsets proposed for impacts to WRP are in proportion to the species conservation status and associated level of statutory protection	Offsets proposed for impacts to Black Cockatoos are in proportion to the species conservation status and associated level of statutory protection	Offsets proposed for impacts to Banksia Woodlands TEC and Tuart Woodlands TEC are in proportion to the conservation status and associated level of statutory protection afforded to each community
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	Proposed WRP habitat offsets provide benefits in proportion to residual impacts	Proposed Black Cockatoo habitat offsets provide benefits in proportion to residual impacts	Proposed Banksia Woodlands TEC and Tuart Woodlands TEC offsets provide benefits in proportion to residual impacts
Suitable offsets must effectively account for and manage the risks of the offset not succeeding	Risk of failure has been factored into the offset calculation. Management actions to be determined under the Offset Management Plan will include a risk assessment and responsive actions to pre-empt and mitigate those risks.	Risk of failure has been factored into the offset calculation. Management actions to be determined under the Offset Management Plan will include a risk assessment and responsive actions to pre-empt and mitigate those risks.	Risk of failure has been factored into the offset calculation. Management actions to be determined under the Offset Management Plan will include a risk assessment and responsive actions to pre-empt and mitigate those risks.

EPBC ACT ENVIRONMENTAL OFFSETS POLICY PRINCIPLE	WRP	BLACK COCKATOOS	TECs
Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs	The proposed WRP habitat offsets are in addition to what is required under other schemes, mechanisms or programs	The proposed Black Cockatoo habitat offsets are in addition to what is required under other schemes, mechanisms or programs	The proposed Banksia Woodlands TEC and Tuart Woodlands TEC offsets are in addition to what is required under other schemes, mechanisms or programs
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	Proposed WRP habitat offsets comprise land acquisition offsets and management offsets. Land acquisition is an efficient, effective, timely, transparent, scientifically robust and reasonable offset mechanism. The proposed management offset comprises rehabilitation of WRP habitat. The rehabilitation program will be designed to ensure that this work and resulting offset is efficient, effective, timely, transparent, scientifically robust and reasonable.	Proposed Black Cockatoo habitat offsets comprise land acquisition offsets and management offsets. Land acquisition is an efficient, effective, timely, transparent, scientifically robust and reasonable offset mechanism. The proposed management offset comprises rehabilitation of Black Cockatoo habitat. The rehabilitation program will be designed to ensure that this work and resulting offset is efficient, effective, timely, transparent, scientifically robust and reasonable.	Proposed Banksia Woodlands TEC and Tuart Woodlands TEC offsets comprise land acquisition offsets and management offsets. Land acquisition is an efficient, effective, timely, transparent, scientifically robust and reasonable offset mechanism
Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	Land acquisition offsets proposed for WRP will be readily measured, monitored, audited and enforced. The Offset Management Plan will comprise SMART goals, a monitoring program, adaptive management recommendations and completion criteria to ensure that all offset	Land acquisition offsets proposed for Black Cockatoo habitat will be readily measured, monitored, audited and enforced. The Offset Management Plan will comprise SMART goals, a monitoring program, adaptive management recommendations and completion criteria to ensure that all offset	Land acquisition offsets proposed for Banksia Woodlands TEC and Tuart Woodlands TEC will be readily measured, monitored, audited and enforced. The Offset Management Plan will comprise SMART goals, a monitoring program, adaptive management

EPBC ACT ENVIRONMENTAL OFFSETS POLICY PRINCIPLE	WRP	BLACK COCKATOOS	TECs
	values are readily measured, monitored, audited and enforced.	values are readily measured, monitored, audited and enforced.	recommendations and completion criteria to ensure that all offset values are readily measured, monitored, audited and enforced.

5.3 WA Environmental Offset Policy (GoWA, 2011)

The *WA Environmental Offsets Policy* (GoWA, 2011) requires that the following Principles are considered when developing an offset proposal:

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

5.4 Residual impact

Residual impacts associated with the Proposal have been determined through application of the residual impact significance model detailed in the *WA Environmental Offsets Guidelines* (GoWA, 2014), and included in **Error! Reference source not found.**. Residual impacts for which Main Roads proposes environmental offsets are detailed in Table 5-2.

Table 5-2 Residual environmental impacts requiring offset

ENVIRONMENTAL ATTRIBUTE	RESIDUAL IMPACT	PROPOSED OFFSET TYPE AND SUMMARY
Western Ringtail Possum habitat	60.9 ha	Land acquisition direct offset (five Lots providing a combined total of 202 ha of potential WRP habitat) On-ground management direct offset (80 ha of revegetation within State Forest No. 2)
Black Cockatoo (Carnaby's and Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo) habitat	60.9 ha	Land acquisition direct offset (five Lots providing a combined total of 202 ha of Black Cockatoo habitat) On-ground management direct offset (80 ha of revegetation within State Forest No. 2)
Banksia Woodlands TEC	23.4 ha	Land acquisition direct offset (five Lots providing a combined total of 202 ha of potential Banksia Woodlands TEC)
Tuart Woodlands TEC	4.4 ha	Land acquisition and management direct offset (One Lot providing > 20 ha of existing Tuart Woodlands TEC)

Main Roads has pursued a number of options in developing a package of offsets to counterbalance these residual impacts. The options investigated have comprised acquisition of land providing TEC vegetation and fauna habitat, and the creation of fauna habitat by on-ground rehabilitation. Four of the proposed offset

sites will address the requirement for more than one offset attribute i.e. TEC and provision of habitat for WRP and Black Cockatoos at a single site (Offsets 1-4).

The offset package solely comprises direct offsets, with no 'other compensatory measures' proposed.

The value of the proposed offsets directly relates to the Proposal impact, with fauna habitat being either secured in perpetuity or re-established to replace habitat cleared for the Proposal, and TEC vegetation being secured in perpetuity to offset TEC vegetation that will be cleared for the Proposal.

The proposed offsets are proportionate to the size and scale of the residual impacts resulting from the Proposal and will deliver conservation gains that are considered to adequately compensate for these impacts.

All proposed offset sites are located within approximately 20 km of the Proposal Area except for the Tredrea Rd Tuart Woodlands TEC offset, which is located 30 km north of the Proposal Area.

The preliminary offset calculations presented in **Error! Reference source not found.** have been based on the *EPBC Offset Assessment Guide* (DSEWPC, 2012c) and the *WA Environmental Offsets Template* (EPA, 2014). The proposed offsets exceed the one hundred percent offset of the predicted impact requirement for each protected matter.

Table 5-3 provides an overview of the offset package under consideration, with offset property locations presented in Figure 18 (Appendix A).

Table 5-3 Overview of proposed offset package

NO.	OFFSET TYPE	OFFSET SUMMARY	PROPERTY LOCATION	EXISTING TENURE
1	Land Acquisition	152 ha of existing native vegetation providing: • Banksia Woodlands TEC (to be confirmed) • WRP habitat • Black Cockatoo habitat.	Lots 153, 267 and 268 Ducane Road	Main Roads has funded the purchase of these properties by DBCA. Lots 123, 267 and 268 are currently zoned as Rural under the Greater Bunbury Region Scheme.
2	Land Acquisition	34 ha of existing native vegetation providing: • Banksia Woodlands TEC (to be confirmed) • WRP habitat • Black Cockatoo habitat.	Confidential	DBCA is negotiating the purchase of a privately owned property with Main Roads to fund the acquisition. The property is currently zoned as Rural under the Greater Bunbury Region Scheme.
3	Land Acquisition	16 ha of existing native vegetation providing: • Banksia Woodlands TEC (to be confirmed) • WRP habitat • Black Cockatoo habitat.	Confidential	Main Roads is in negotiations regarding the purchasing of a portion of this private property. The property is currently zoned as Rural under the Greater Bunbury Region Scheme.

NO.	OFFSET TYPE	OFFSET SUMMARY	PROPERTY LOCATION	EXISTING TENURE
4	On-ground Management	80 ha of revegetation to provide habitat for WRP and Black Cockatoo	Ludlow State Forest (SF No. 2)	Vested in the Conservation and Parks Commission
5	Land acquisition and management	More than 20 ha of existing Tuart Woodlands TEC	Lot 27 Tredrea Rd, Myalup	Purchased and owned by the Commissioner of Main Roads

5.5 Description of offsets

The components of the offset package are described below. Offset 1 has been subject to some detailed survey which has confirmed the presence of WRP, Black Cockatoo. Additional surveys are proposed for 2020 to confirm the extent of Banksia Woodlands TEC.

5.5.1 Offset 1 – Lots 153, 267 and 268 Ducane Road, Gelorup

Offset 1 comprises a total of 162.6 ha and includes Lots 153, 267 and 268 Ducane Road, Gelorup as shown in Figure 18 (Appendix A). These properties occur 2 km east of the BORR Southern Section alignment.

The previous landowner, a commercial construction materials supplier, set aside 22.5 ha of the property under a Conservation Covenant through Section 30B of the *Soil and Land Conservation Act 1945*. The remaining 140.1 ha is proposed as Offset 1.

Main Roads agreed the purchase of these privately owned properties with DBCA with the intention of utilising the site vegetation as an environmental offset for the BORR Southern Section project. DBCA supported the purchase of the land for addition to the conservation estate. Main Roads then funded the purchase by DBCA and the properties are now owned by the State of Western Australia.

Offset 1 is currently zoned as rural under the GBRS. DBCA has indicated that the properties will be rezoned to Regional Open Space or Conservation under the scheme in the future. Main Roads supports the rezoning of the properties and will assist with the rezoning, as required.

A targeted Fauna Survey of Lots 267, 268 and 153 Ducane Road, Gelorup (Biota, 2019a) confirmed the occurrence of WRP and BTP animals and habitat within these properties, and the occurrence of high quality Black Cockatoo foraging habitat within the Jarrah-Banksia habitat areas. With regard to fauna, Offset 1 has been shown to have the following environmental values:

and

- 126.0 ha of WRP and BTP habitat
- 124.1 ha of high quality foraging habitat for Forest Red-tailed Black Cockatoo and Carnaby's Black Cockatoo

Site assessment in spring 2020 (Biota, 2021a) confirmed 124.1 ha of the properties, outside of the covenanted area, conforms to Banksia woodlands TEC / PEC. Main Roads proposes that 95 ha of these properties address the offset requirement for Banksia Woodlands TEC / PEC for the BORR Southern Section.

These properties form a component of the 'Dalyellup/Gelorup/Crooked Brook Ecological Linkage' identified by the EPA in their assessment of the GBRS (EPA, 2003). The South West Regional Ecological Linkage

(SWREL) project further refined the ecological linkages identified by the EPA (Molloy, Wood, Wallrodt, & Whisson, 2009). Offset 1 is traversed by an axis line and buffer of a SWREL mapped ecological linkage.

Ongoing site management for long term conservation (for 20 years from the date of approval) will include fencing and access management and weed control to improve the site vegetation quality in the long term. In consultation with DBCA, Main Roads has started to implement management of the offset site by the creation of firebreaks on the boundary of the properties.

Main Roads proposes Offset 1, comprising 140.1 ha to address the offset requirements for WRP and Black Cockatoo habitat, and Banksia Woodlands TEC / PEC.

5.5.2 Offset 2 – Lot 1 Ducane Road, Gelorup

Offset 2 comprises the acquisition of the vegetated Lot 1 Ducane Road, Gelorup which is a total of 40.5 ha in area. The construction of BORR Southern Section will require the taking of 1.6 ha of the property along the western boundary. 38.9 ha of the remainder of the property is proposed as Offset 2.

Offset 2, as shown in Figure 9 (**Error! Reference source not found.**) and occurs immediately abutting the BORR Southern Section alignment. It is currently owned by the West Australian Planning Commission (WAPC) and Main Roads is in the final stages of acquiring the property.

Offset 2 is currently zoned as rural and primary regional road under the GBRS. Main Roads will request WAPC to rezone Lot 1 to Regional Open Space or Conservation under the scheme. Main Roads will discuss long term management options with DBCA and/or the Shire of Capel. Main Roads will fund and manage the property for the purposes of conservation for 20 years from the date of approval, with this documented in a maintenance funding agreement as required.

The property has been assessed by site survey(GHD, 2014; Biota, 2019b; Biota, 2021b) and has been shown to have the following environmental values:

- 38.5 ha of WRP and BTP habitat (Biota, 2021b)
- 36.6 ha of potential foraging habitat for Forest Red-tailed Black-Cockatoo and Carnaby's Black-Cockatoo (Biota, 2021b)

Offset 2 also forms a component of the 'Dalyellup/Gelorup/Crooked Brook Ecological Linkage' identified by the EPA in their assessment of the GBRS (EPA, 2003). The SWREL project further refined the ecological linkages identified by the EPA (Molloy, Wood, Wallrodt, & Whisson, 2009). Offset 2 is traversed by an axis line and buffer of a SWREL mapped ecological linkage.

Ongoing site management for long term conservation (for 20 years from the date of approval) will include fencing and access management and weed control to improve the site vegetation quality in the long term. In consultation with DBCA, Main Roads will implement management of the offset site by the creation of firebreaks on the boundary of the properties (upon purchase of the property).

Main Roads proposes Offset 2, comprising a 38.9 ha portion of an existing lot to address the offset requirements for WRP and Black Cockatoo habitat.

5.5.3 Offset 3 – Lot 156 Marchetti Road, Gelorup

Offset 3 comprises the 16 ha western vegetated portion of Lot 156 Marchetti Road, Gelorup. Offset 3 is located as shown at Figure 18 (**Error! Reference source not found.**) and occurs approximately 150 m north of the BORR Southern Section alignment.

Lot 156 is currently privately owned. Main Roads is in the process of acquiring the western portion of the property. Offset 3 is currently zoned as rural under the GBRS. erequest WAPC to rezone the acquired portioneeor Conservation under the scheme.

Main Roads will discuss long term management options with DBCA and/or the Shire of Capel. Main Roads will fund and manage the property for the purposes of conservation for 20 years from the date of approval, with this documented in a maintenance funding agreement as required.

The property has been assessed by site survey (Stream and Water Environmental, 2021; Biota, 2021b) and has been shown have the following environmental values:

- 8.5 ha of Banksia Woodlands TEC / PEC (Stream and Water Environmental, 2021)
- 14.2 ha of WRP and BTP habitat (Biota, 2021b)
- 9.7 ha of foraging habitat for Forrest Red-tailed Black Cockatoo and Carnaby's Cockatoo (Stream and Water Environmental, 2021)

Furthermore, Offset 3 is traversed by Five Mile Brook which creates a vegetated linkage to LGA managed reserves within the Gelorup area to the north west.

Main Roads proposes the following ongoing site management for long term conservation:

- The installation of firebreaks
- The repair and installation of fencing on the property boundaries to manage unauthorised property access
- On-going feral animal control – foxes and rabbits
- Selective weed control to improve the site vegetation quality in the long term.

Main Roads proposes Offset 3, comprising a 16 ha portion of the existing lot, to address the offset requirements for WRP and Black Cockatoo habitat.

5.5.4 Offset 4 – Lot 104 (North) Willinge Drive, Davenport

Offset 4 comprises the revegetation of a 35 ha portion of Lot 104 (north) Willinge Drive. Offset 4 is located as shown at Figure 18 (**Error! Reference source not found.**) and occurs immediately north of the BORR Northern and Central Sections alignment.

Lot 104 is owned freehold by the Commissioner of Main Roads and was purchased as a potential environmental offset site. Lot 104 occurs as two land parcels bisected by the existing BORR central section. Offset 4 comprises a 35 ha area of the 48.3 ha northern portion of the property.

Lot 104 is currently zoned as rural under the GBRS. Main Roads will request WAPC to rezone the entire Lot 104 to Regional Open Space or Conservation under the scheme.

Main Roads will discuss long term management options with DBCA and the Shire of Dardanup. Until an alternative management structure is in place Main Roads will manage the property for the purposes of conservation.

The proposed offset site abuts the Preston River (to the west). The riparian woodland of the Preston River provides a habitat linkage for WRP and BTP. The riverine woodland provides a corridor to a number of widely separated reserve areas occurring outside the Referral Area (e.g. Manea Park and Franklandia Nature Reserve) (Biota, 2019a).

The South West Regional Ecological Linkage (SWREL) project indicates that Offset 4 occurs within the buffer of a SWREL mapped ecological linkage.

Revegetation flora species will be selected to provide habitat and foraging vegetation suitable for these fauna species and will be based on site parameters and selected in consultation with DBCA. This reflects the approach for similar offset revegetation works by Main Roads in the region. Ongoing site management for long term conservation (for 20 years from the date of approval) will include fencing and access management, weed control, firebreaks and feral animal control to maintain/improve habitat quality.

Revegetation completion criteria will be agreed with EPA, based on advice from DBCA.

As noted above, much of Lot 104 was previously used for a commercial Blue Gum operation with the timber being harvested in 2017 and the area now cleared. Main Roads proposes to rehabilitate and revegetate a 35 ha portion of the property to provide habitat for WRP, BTP and Black Cockatoo species.

5.5.5 Offset 5 – State Forest No. 2

Offset 5 comprises the proposed revegetation of an 80 ha area of a degraded portion of State Forest No. 2 (SF No. 2) which is located approximately 10-15 km east of the Busselton town centre, and is the focus of an on-going revegetation program. The site is 12-25 km from the southern end of the Proposal Area and also within the SCP IBRA sub-region.

The proposed rehabilitation works are congruent with the objectives of the Tuart Forest National Park Management Plan (TFNPMP) (DPaW, 2014) which are to:

- Protect and enhance the eastern wetland / tall Tuart community transition zone
- Protect and increase habitat for fauna that are highly represented in zones 5 and 6 (for example, WRP and Common Brushtail Possum).
- Enhance the resilience of this zone to disturbance and threatening processes.

Proposed management actions to achieve these objectives include “Re-establishing native vegetation in cleared areas, adapting management according to results of experimental trials.” Ongoing site management for long term conservation will include fencing and access management, weed control, firebreaks and feral animal control to maintain / improve habitat quality.

The exact location of the 80 ha revegetation site/s is yet to be agreed with DBCA, although Main Roads has an ‘in principle’ agreement with DBCA to conduct additional offset revegetation works in SF No. 2. Potential offset areas are shown in Figure 18 (Appendix A).

The proposed offset is congruent with similar environmental offsets within SF No. 2 negotiated by Main Roads with DBCA, DWER and DoEE for other road projects. Plant species will be selected to provide habitat for offset target species based on site parameters. Seed and seedling species will be selected in consultation with DBCA as per similar Main Roads offsets in SF No. 2.

Completion criteria will be determined with EPA based on advice from DBCA in line with existing Main Roads revegetation environmental offset sites in SF No. 2.

Main Roads proposes to rehabilitate and revegetate an 80 ha portion of SF No. 2 to provide habitat for WRP and Black Cockatoo species for 20 years from the date of approval.

The proposed offset areas occur on Crown land which is managed by DBCA under the *Conservation and Land Management Act 1984.* Consequently, the offset areas will be protected in the long term.

5.5.6 Offset 6 – Lot 27 Tredrea Road, Myalup

Offset 6 comprises a portion of Lot 27 Tredrea Road, Myalup (Lot 27). Lot 27 was previously purchased by Main Roads for the purposes of developing a limestone and sand pit. Lot 27 is 40 ha in area and is located approximately 30 km north of the Proposal as shown in Figure 18 (Appendix A).

A reconnaissance survey conducted by Main Roads botanists in March 2021 confirmed the presence of more than 20 ha of Tuart Woodlands TEC / PEC on the property (Main Roads WA, 2021).

There are also opportunities to conduct additional revegetation works on the property to improve its environmental values as Tuart Woodlands TEC / PEC.

Offset 6 is currently zoned as rural under the GBRS. Main Roads will initiate protection of the property and provide long term security of the Tuart Woodlands TEC / PEC through a conservation covenant or rezoning to Regional Open Space under the GBRS.

The property is currently unmanaged with open access. Signs of illegal rubbish dumping and firewood collection is evident on the property. Ongoing site management for long term conservation (for 20 years from the date of approval) will include fencing and access management, and weed control to improve the site vegetation quality in the long term.

5.6 Monitoring and corrective action plan

Additional site assessment is proposed in spring 2020 to confirm the proposed offset areas meet all of the anticipated criteria for selection and consultation with DBCA. For offsets that include the proposed re-establishment of native vegetation in cleared areas, Main Roads will conduct experimental trials to inform the final plan for offset revegetation works in consultation with DBCA. If at any time corrective actions are required, corrective actions will be determined with DAWE based on advice from DBCA.

5.7 Offset completion criteria

Revegetation completion criteria will be determined with DAWE based on advice from DBCA. For the SF No. 2 offset, completion criteria are anticipated to be in line with existing Main Roads revegetation environmental offset sites of SF No. 2.

6 ECONOMIC AND SOCIAL MATTERS

6.1 Financial investment

In May 2017, $12.5 million of joint funding was announced by the Australian ($10 million) and the State ($2.5 million) Governments to complete the planning and project development for the unbuilt sections of BORR. This work is to be completed in 2020, including all necessary approvals to award a construction contract in late 2020.

A total of $852 million of funding has been committed towards construction of BORR ($681.6 million Federal and $170.4 million State), with the commencement of works anticipated in quarter four, 2021.

6.2 Costs and benefits

The existing north-south route of Forrest Highway, Robertson Drive and Bussell Highway runs through a highly populated area of the Greater Bunbury Region resulting in increased congestion, inefficient freight operations, significant road safety issues, reduced social amenity and community separation. Future planning for the Greater Bunbury Region projects a population growth from approximately 86,400 persons in 2011 to approximately 122,400 persons by 2026 (WAPC, 2018). This, in conjunction with increased freight and tourist movements to the South West, will lead to unsustainable traffic growth within the existing north-south route resulting in increased congestion and reduced amenity.

6.2.1 Costs

$852 million of funding has been committed towards construction of BORR ($681.6 million Federal and $170.4 million State), including costs for property acquisition, environmental management, and the environmental offsets package.

6.2.2 Benefits

The BORR project aims to create free flowing traffic movement for the freight industry while simultaneously reducing local congestion and improving public safety. By eliminating the need for large freight vehicles to travel through the centre of Bunbury to continue south, the efficiency of those freight vehicles is increased through the ability to bypass Bunbury and avoid 13 sets of traffic lights between Forrest Highway and Bussell Highway. The BORR project will also improve access to the Bunbury Port which will strengthen Greater Bunbury's position as a regional industrial hub for the South-West region.

The key benefits of the Proposal include:

- Providing an effective bypass of Bunbury for inter-regional traffic and heavy vehicle transport, such as trucks travelling to and from the Kemerton Strategic Industrial Area (KSIA), thereby reducing congestion, air and noise pollution in developed urban areas on the existing network
- Providing a direct connection to the Port of Bunbury via Willinge Drive, thereby promoting economic activity, improve utilisation and development of the Port of Bunbury and growth of industry in the South West Region
- Supporting local industries, heavy vehicle transport operators and commuters with improved freight efficiency and reduced travel time and costs
- Increasing direct and indirect employment opportunities for the local population during the construction phase
- Improving road user safety on Forrest Highway, Bussell Highway and Robertson Drive

- Providing an estimated 4,500 employment opportunities in the construction industry during the design and construction phases of the Proposal
- Providing opportunities for local and Aboriginal businesses in the delivery of the Proposal
- Post-construction the Proposal is expected to have broader economic benefits for the Greater Bunbury Region.

The completed BORR will provide a high standard route for access to the Bunbury Port and facilitate proposed development within Greater Bunbury. It will cater for a projected long-term doubling of the existing population to approximately 200,000 people within Greater Bunbury. The BORR forms a major component of the planned regional road network for Greater Bunbury, providing an effective route for inter-regional traffic as well as a safe and efficient road network for traffic travelling into and around Bunbury.

The existing road network within Greater Bunbury accommodates a range of vehicle movements, including freight, commercial and light vehicles, as well as regional and local traffic. This combination can at peak times impact on road safety and amenity within Bunbury. The new road will encourage separation of heavy and light vehicles, providing a safer, more efficient overall environment with improved travel times.

Land for the southern section of BORR through Gelorup has been identified for many decades (at least since the early 1980's), has been included in numerous planning documents and strategies and has been reserved within the Greater Bunbury Region Scheme for many years. Identification of the southern section of BORR pre-dates the rural-residential development of Gelorup which now surrounds this corridor.

Since 2016, planning for the BORR alignment has been coordinated with updated long-term land use planning in collaboration with the Department of Planning, Lands and Heritage. As a result, the BORR alignment is located to follow the perimeter of the long-term proposed urban footprint within Greater Bunbury. The only exceptions to this are several low density rural-residential areas on the outer fringe of the urban footprint including Gelorup.

The BORR has been planned to ultimately provide a controlled access and grade separated highway improving heavy vehicle efficiency as well as providing safety benefits by removing potential conflicts at intersections and minimising interactions with local traffic.

The BORR provides a direct link to the Bunbury Port via Willinge Drive. The ultimate planning for Willinge Drive and South Western Highway includes provision for a four lane dual carriageway. Major upgrades to these roads are not part of the current BORR project and will be implemented once traffic and safety requirements warrant this further work.

6.3 Stakeholder consultation

Stakeholder consultation has been integral in developing this Proposal. The overarching objectives of the stakeholder engagement program are:

- To inform stakeholders about the Proposal and its impacts to the environment and describe the outcomes of consultation in project design
- To establish relationships with key stakeholders that enable ongoing dialogue through implementation and regulatory phases of the Proposal.

Main Roads has been engaged in consultation with key stakeholders with interests in the BORR Project since the mid-1990s.

Consultation undertaken by Main Roads with key stakeholders has included:

- Technical Working Group: including engineering and planning representatives from Main Roads, the City of Bunbury, the Department of Planning, the DBCA (formerly Department of Department of Environment and Conservation), the Shire of Capel and the Shire of Dardanup
- BORR Stakeholder Group: State and local government agencies met as required and included: City of Bunbury (CEO, Mayor), Shire of Capel (CEO, Shire President), Shire of Dardanup (CEO, Shire President), Bunbury Port Authority, South West Development Commission (SWDC), Bunbury Chamber of Commerce and John Castrilli (former Member for Bunbury)
- Consultation with: DPLH (formerly Department of Planning), Public Transport Authority, Local Government, Service Authorities
- Consultation with environmental stakeholders including:
- Commonwealth DAWE (formerly DEE and DSEWPaC)
- DBCA (formerly Department of Environment and Conservation)
- DWER (formerly Department of Water (DoW), Department of Environment Regulation (DER) and Office of the EPA).

Stakeholder and community engagement is continuing with landowners and local residents, communities of interest, local government authorities and State Government agencies. Key stakeholders are provided in Table 6-1.

During 2018 and 2019, Main Roads consulted with key stakeholders to discuss BORR Project issues and potential impacts including environmental, heritage (Aboriginal and European), social and economic impacts. This consultation will continue until construction of the proposal is complete (Table 6-1).

Table 6-1 Key stakeholders

STAKEHOLDER TYPE	STAKEHOLDER
Commonwealth Government	Department of Agriculture, Water and the Environment (DAWE) (As of 1 Feb 2020. Formerly the Department of Environment and Energy) Regional Development Australia
State Government	Bunbury Port Authority DBCA Department of Treasury Department of Infrastructure, Regional Development and Cities DPLH DWER (Office of the EPA) DWER (Native Vegetation Regulation) Local Members SWDC
Industry	Chamber of Commerce and Industry Chamber of Minerals and Energy

STAKEHOLDER TYPE	STAKEHOLDER
Local Government	City of Bunbury Shire of Capel
Community	Gnaala Karla Booja WC1998/058 Native Title Claim group (GKB NTC) BORR South Community Reference Group (CRG) Friends of Gelorup Corridor Land owners General public and local residents
Committees and Reference Groups	Bunbury Wellington Economic Alliance Investment Logic Mapping (ILM) Workshop Project Steering Committee Project Enabling Group BORR Regional Local Government Advisory Group (RLGAG) Economic Advisory Group Drainage Reference Group (DRG) Freight and Road Users Group

A summary of stakeholder consultation completed to date is provided in Table 1A of Appendix O. Regulatory agencies consulted to date are shown in Table 1B of Appendix O. A summary of the key concerns raised during stakeholder consultation is provided in Table 1C of Appendix O, along with Main Roads' responses.

In response to information obtained through commissioned surveys and consultations with local traditional owners, the Proposal Area referred in this Additional Information Request response document has been refined since initial referral in September 2019. Through these refinements, the Proposal Area has been reduced by almost one third (97 ha), with corresponding reduction in impacts to MNES, as detailed in Section 4.

6.3.1 Aboriginal community consultation

The Proposal Area occurs within the Gnaala Karla Booja (GKB) People Indigenous Land Use Agreement (ILUA).

Extensive Aboriginal heritage surveys for the BORR have been commissioned by or on behalf of Main Roads over a twenty-five year period, including in 1995 (Hammond & O'Reilly, 1995), 2002 and 2009 (Brad Goode & Associates, 2010), 2012 (Brad Goode & Associates, 2012), 2019 (Brad Goode & Associates, 2020), November 2019 and January 2020 (Ethnosciences, 2020). The Aboriginal heritage surveys have adopted both archaeological and ethnographic methodologies, to a site identification standard, and have been undertaken in collaboration with Gnaala Karla Booja traditional owners.

In November 2017, Main Roads sought advice from the South West Aboriginal Land and Sea Council (SWALSC) on appropriate Aboriginal community representatives to be consulted regarding BORR project. After consideration by the Working Party of the Gnaala Karla Booja (GKB) Native Title Claim group, ten community representatives were identified.

Main Roads met with the identified representatives as detailed below:

- In November 2019, Main Roads and BORR IPT representatives held a consultative meeting and completed a site tour with nine Aboriginal community representatives to discuss the project in detail and visit the BORR Southern section alignment
- Further ethnographic consultation was undertaken in January 2020 to focus specifically on the proposed Five Mile Brook crossing.

The Archaeological Aboriginal Heritage Survey (Brad Goode & Associates, 2020) has been included in Appendix Q and the Ethnographic Survey (Ethnosciences, 2020) has been included in Appendix R.

6.4 Scale of economic and social impacts

6.4.1 National Impacts

6.4.1.1 World Heritage Properties and Commonwealth Heritage Places

No World Heritage Properties or Commonwealth Heritage Places occur within 10 km of the Proposal Area.

6.4.2 State and Local Impacts

6.4.2.1 Aboriginal heritage

State assessment requirements

In Western Australia, potential impacts to Aboriginal Heritage are assessed under the *Aboriginal Heritage Act 1972* in accordance with the EPA *Guidance for the Assessment of Environmental Factors, Assessment of Aboriginal Heritage No. 41* (EPA, 2004a).

Under s. 17 of the AH Act it is an offence to excavate, destroy, damage, conceal, or in any way alter an Aboriginal site. Consent under s. 18(2) of the AH Act can be sought by proponents to allow use of land in a manner which is likely to breach s. 17 with respect to Aboriginal heritage sites. Consent removes criminality from any breach of s. 17 which may occur in relation to the proposed land use.

Receiving environment description

Archaeological, ethnographic and anthropological studies have been undertaken in the BORR Southern Section corridor have been conducted since 1995, with the most recent undertaken in 2019 and 2020 (Appendix E of the Updated Referral Document). All Sites registered or identified as potential Sites of cultural significance have been recorded and assessed. The Tuart Woodlands within the corridor are not registered nor recognised as a Site of significance from a cultural heritage perspective and hence were not assessed in the Heritage Reports.

Notwithstanding the surveys undertaken, Western Australia's Aboriginal Heritage Inquiry System (AHIS) confirms that there are no registered Aboriginal sites within the Proposal, as shown in Appendix P (DPLH, 2019a).

The boundaries of five lodged places intersect the Proposal Area (**Error! Reference source not found.**):

- Site ID 18884 Bunbury Bypass Archaeological Site 1 (Stored data / not a site)
- Site ID 37869 Paper bark wet lands (Lodged)
- Site ID 37870 The Gelorup Corridor (Stored data / not a site)
- Site ID 38551 Five canoes (Stored data / not a site)
- Site ID 38552 Ancient Moojar Grove Burial Ground (Stored data / not a site)

One of these (ID 37869), is yet to be assessed as sites under the AH Act. One place (ID 38552) is associated with *Nuytsia floribunda* trees. This site was lodged in September 2020. According to the AHIS database, the

site status is 'Stored data / not a site' (AHIS database accessed 11 March 2022). One place (ID 37870) bisecting the Proposal Area has been assessed under the AH Act as not an Aboriginal site.

Place ID 18884 (artefact scatter) is located within the slopes of a dam, approximately 30 m SW of the junction of Hasties and Allenville roads. The place is described as a low density, highly disturbed artefact scatter. Seventeen artefacts were observed and recorded within a 30 m x 35 m area during the 2019 survey. These artefacts included three flakes (27 %), six flaked pieces (55 %) and two chips (18 %) all manufactured on quartz or crystal quartz. Boundaries for place ID 18884 partially extend into the Proposal Area (Brad Goode & Associates, 2020). According to the AHIS database, the site status is 'Stored data / not a site' (AHIS database accessed 11 March 2022).

As a result of the 2019 field survey, one new archaeological place, BR1, was located approximately 15 m east of the Proposal Area in a cleared paddock. BR1 is a culturally modified jarrah tree approximately 150 years old. The significance of the scarred tree is considered 'moderate' (Brad Goode & Associates, 2020).

Place ID 37869 (paper bark wet lands) is currently lodged as female-only ethnographic site. An ethnographic survey of the Proposal Area was undertaken by Dr Edward McDonald and Ms Jan Turner, with Gnaarla Karla Booja traditional owners in accordance with the Noongar Standard Heritage Agreement (NSHA), in November 2019 and January 2020 (Ethnosciences, 2020).

The ethnographic survey concluded that both Place ID 37869 and Place ID 37870 lack cultural significance underpinning them and cannot be regarded as sites under Section 5 of the AH Act. The survey with Gnaarla Karla Booja traditional owners did not provide any evidence to confirm Place ID 37869 (paper bark wetlands) as a 'women's only site' (Ethnosciences, 2020).

No additional sites of cultural significance were identified during the November 2019 and January 2020 ethnographic surveys and the report recommends that that the Proposal be permitted to proceed (Ethnosciences, 2020).

Mitigation of potential impacts to Aboriginal heritage

Ministerial consent to use land that may hold Aboriginal cultural values will be sought under Section 18 of the AH Act prior to any ground disturbance within lodged place boundaries. In regard to Place ID 18884, Main Roads propose that, subject to the granting of a Section 18 clearance, works will be monitored by two Aboriginal traditional custodians and any significant cultural material, if present, will be repatriated to local traditional owners.

Furthermore, should the Minister confirm that Place ID 37869 and / or Place ID 18884 are indeed Aboriginal sites pursuant to the AH Act, then impact on Aboriginal heritage sites can be managed through the implementation of a CEMP and / or an Aboriginal Heritage Management Plan to address recommendations made in Brad Goode and Associates (2020). Main Roads will undertake consultation with all relevant groups and will undertake work in accordance with the AH Act.

Potential impacts to Aboriginal heritage sites associated with the Proposal will be managed through consultation with all relevant groups and works will be undertaken in accordance with AH Act. Potential impacts to Aboriginal heritage will be managed through the AH Act.

Predicted outcome

Potential impacts to Aboriginal heritage resulting from the Proposal will be compliant with state requirements.

6.4.2.2 Noise

State assessment requirements

In Western Australia, potential noise impacts from Proposals are assessed in accordance with the following guidance documents:

- *Environmental Factor Guideline 'Social Surroundings'* (EPA, 2016b)
- *State Planning Policy 5.4 (SPP 5.4) Road and Rail Noise* (WAPC, 2019a)
- *Road and Rail Noise Guidelines* (WAPC, 2019b)

Receiving environment description

The existing noise environment within the vicinity of the Proposal Area is anticipated to be dominated by the following local noise sources:

- Rural activities
- Traffic noise associated with Forrest Highway and other existing roads.

In response to the request for additional information, noise modelling and assessment was undertaken by Lloyd George Acoustics (2020). The assessment has been provided in Appendix S.

The assessment included unattended noise monitoring which was undertaken at five sites within the vicinity of the Proposal. The results of the monitoring were used to quantify the existing noise levels and provide data to calibrate a noise model constructed to predict noise levels over the Proposal Area (Lloyd George Acoustics, 2020). Details of the modelling software, adjustments made to the model to reflect local conditions and assumptions incorporated into the model (e.g. existing and future vehicles speeds) are provided in Lloyd George Acoustics (2020).

To assess current road traffic noise to sensitive receptors (residences) near the BORR alignment, an existing road traffic noise assessment was undertaken using a 2018 modelled scenario. The 2018 modelled scenario incorporated current daytime and night traffic volumes and included a percentage of heavy vehicles reflective of current traffic patterns.

Based on the outcomes of the assessment, sixty five (65) lots with a noise sensitive dwelling within Rural and Residential zoned areas were identified as potentially being impacted by the Proposal.

Potential noise impact on sensitive receptors

Direct impacts include exceeding the noise targets detailed in the Western Australian State Planning Policy No. 5.4 (SPP 5.4) within adjacent residential dwellings as a result of the Proposal.

The potential direct impacts of the Proposal were assessed using predicted future (modelled 2041) noise levels for 65 lots identified as most likely to be impacted. Point calculations (predicted noise levels for specific residences) and noise contours output from the noise model were used to inform the assessment.

Modelling results were assessed against the 'Road Upgrade' or 'New Road' criteria from the SPP 5.4. Where residences were located within the trigger distance (Table 6-2) of existing major roads (e.g. Bussell Highway), the 'Road Upgrade' criteria of 60 dB $L_{Aeq(Day)}$ / 55 dB $L_{Aeq(Night)}$ has been applied. The 'New Road' criteria of 55 dB $L_{Aeq(Day)}$ / 50 dB $L_{Aeq(Night)}$ has been applied for all other residences.

Table 6-2 Road corridor classification and trigger distances (adapted from (Lloyd George Acoustics, 2020)

TRANSPORT CORRIDOR CLASSIFICATION	TRIGGER DISTANCE	DISTANCE MEASURED FROM
Strategic freight and major traffic routes **Roads as defined by Perth and Peel Planning Frameworks and / or roads with either 500 or more Class 7 to 12 Austroads vehicles per day, and / or 50,000 per day traffic volume**	300 m	Road carriageway edge
Other significant freight / traffic routes **These are generally any State administered road and/or local government road identified as being a future State administered road (red road) and other roads that meets the criteria of either > 100 Class 7 to 12 Austroads vehicles daily of > 23,000 daily traffic count (average equivalent to 25,000 vehicles passenger car units under region schemes).**	200 m	Road carriageway edge

Residences within proximity to upgraded roads

17 of the 65 properties identified as most likely to be impacted are within the trigger distance for the 'Road Upgrade' criteria. Without noise mitigation treatment, 13 of the 17 properties are predicted to experience noise levels above the SPP 5.4 noise target of 60 $L_{Aeq,day}$[33] in 2041. Without treatment, the worst affected property is forecast to receive noise levels up to 66 $L_{Aeq,day}$.

In recognising the challenges of achieving noise level reduction where existing road infrastructure is surrounded by existing noise sensitive development, such as in areas adjacent to the Bussell Highway, the Proposal aims to mitigate noise levels as low as reasonably practicable and at a minimum to meet the outdoor noise target of 60 $L_{Aeq,day}$.

Residences within proximity to new roads

The new road criteria of 55 $L_{Aeq,day}$ is applicable to 48 residences. In the absence of mitigation measures, the modelling undertaken predicts 39 of the 48 properties will experience noise levels over the SPP 5.4 noise target for new roads of 55 $L_{Aeq,day}$ in 2041. The most affected property is forecast (without mitigation) to receive noise levels up to 70 $L_{Aeq,day}$.

Mitigation of noise impacts on sensitive receptors

Mitigation of noise impacts on sensitive receptors where noise levels are expected to exceed SPP 5.4 trigger levels will include:

- Use of improved (quieter) road surfaces in targeted section of the alignment
- Construction of noise walls in (relatively) densely populated areas
- Provision of architectural treatments where potentially impacted residences are (relatively) isolated.

To mitigate the operational noise impacts from the Proposal, the road surface will be improved to stone mastic asphalt (SMA) between Jilley Road and Bussell Highway (in Gelorup). For the upgraded section of

[33] The $L_{Aeq\ day}$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the $L_{A10,18hour}$.

Centenary Road between Bussell Highway and Jules Road, dense graded asphalt will be used to reduce noise impacts.

Noise walls are proposed to be constructed to mitigate operational day and night traffic noise predicted for the more densely populated section of Gelorup between Jilley Road and Bussell Highway. The noise walls proposed for this section of the Proposal Area will be constructed of painted concrete panels and steel posts, and meet the requirements of SPP 5.4. Noise walls will be designed with visual amenity in mind and the context of the local environment. Where appropriate, generally where the height of walls is proposed to be above 2.5 – 3.8 m, high density acrylic / perspex may be used in the top section of the wall to reduce visual impacts and to assist light transfer to adjacent residences.

In areas where it is not feasible to extend the noise wall to manage noise at more remote sensitive receptors architectural treatments will be offered to impacted residences. Architectural treatment packages consisting of, for example, upgraded glazing (such as thicker or double glazing) and mechanical ventilation (to allow windows to be kept closed) will provide the most practical mitigation approach for sparsely located residences. Specific architectural treatment packages will be determined for residences following completion of an architectural treatment inspection.

Due to the isolated nature of the existing sensitive receptors in sections of the route (outside of areas where noise walls will be constructed) and cognisant of the current and future land use planning (e.g. rural farmland to future industrial park), mitigation treatment will be discussed on a one-to-one basis with impacted landowners.

Predicted outcome

All sensitive receptors will be compliant with state legislation.

Installation of noise walls will mitigate predicted (2041) traffic noise emissions adjacent to the Proposal Area (between Jilley Road and Bussell Highway), to below the SPP 5.4 noise target for new roads of 55 $LA_{eq,day}$ for all except one residence in this portion of the Proposal Area. This residence has been modelled (with mitigation noise levels) to be 56 $LA_{eq,day}$. Post construction noise monitoring will be undertaken at this residence to confirm noise levels and inform the need for treatment.

An additional 16 properties will exceed their relevant outdoor noise targets in areas where residential densities are lower (e.g. east of Jilley Road and south of the proposed Bussell Hwy interchange). Five of these properties are subject to the new road criteria of 55 $L_{Aeq,day}$. The remaining 12 properties are within the trigger distance of existing roads and the applicable criteria of 60 $L_{Aeq,day}$ is exceeded.

For residences predicted to be above their relevant outdoor noise target, consideration will be given to architectural treatments to mitigate noise impacts. Suitable mitigation measures for affected residential properties will be discussed on a one-to-one basis with impacted landowners. It is expected that through the application of architectural treatments, traffic noise emissions resulting from the operation of the Proposal can be suitably mitigated.

6.4.2.3 Air quality

In Western Australia, potential impacts to air quality from Proposals are assessed in accordance with the following guidance documents:

- *Environmental Factor Guideline 'Air Quality'* (EPA, 2020a).
- *Guidance for the Assessment of Environmental Factors 'Separation Distances between Industrial and Sensitive Land Uses No. 3'* (EPA, 2005).
- *National Environment Protection (Ambient Air Quality) Measure* (AIR NEPM) (National Environment Protection Council, 2016).

Receiving environment description

The Proposal occurs within the Bunbury Regional Airshed, which encompasses an area approximately 38,610 km^2 and includes 22 Shires including the City of Bunbury and Shire of Capel. Economic activities in the Bunbury Regional Airshed are diverse and include mining, agriculture, tourism, forestry and manufacturing. Motor vehicles dominate the emissions of carbon monoxide (CO), volatile organic carbon (VOC) and nitrous oxides (NO_x) (SKM, 2003).

Background air quality

With the exception of particulate matter (PM_{10} and $PM_{2.5}$), there is no monitoring of background air quality carried out at Bunbury. In lieu of background air quality measurements, it is generally accepted that the 75th percentile of ambient air quality measurements taken from a representative site can be used in dispersion modelling (BORR IPT, 2020e).

DWER carry out ambient air quality measurements at 13 air quality monitoring stations (AQMS) in WA. The Bunbury AQMS and can be considered representative of the Proposal Area due to its proximity, and similar topography and land use. The Bunbury AQMS records PM_{10} and $PM_{2.5}$ only.

The Rockingham AQMS records NO_2 and the South Lake AQMS records CO. Although Rockingham and South Lake are situated further north, the 75th percentile of ambient air quality concentrations were used in this assessment as no other measurements were available. Due to the surrounding built up areas of Rockingham and South Lake, it is expected that the background concentrations used will provide a conservative estimate (BORR IPT, 2020e).

Background concentrations for other averaging periods and VOC were not available and therefore not included in the assessment. For all other constituents, a background concentration of zero was assumed. Background concentrations adopted are provided in Table 6-3.

Table 6-3 Ambient background concentrations (BORR IPT, 2020e)

POLLUTANT	AVERAGING PERIOD	BACKGROUND CONCENTRATION
CO	8-hour	625 µg / m^3
NO_2	1-hour	34.9 µg / m^3
Particulate matter as PM_{10}	24-hour	20.1 µg / m^3
Particulate matter as $PM_{2.5}$	24-hour	9.8

Potential air quality impacts on sensitive receptors

Sensitive receptors are any place where people are likely to reside in a non-occupational setting. This may include dwellings, schools, hospitals or public recreational areas (NSW Department of Environment and Conservation, 2005). As the majority of the BORR alignment is situated on rural land with a minimal number of dwellings within proximity, receptors were automatically generated along the modelled road networks at intervals of 10 m, 25 m, 50 m, 100 m and 200 m setback from the road (called auto-generated receptors).

This was intended to adequately predict concentrations of pollutants within close proximity to the proposed BORR alignment, demonstrating a worst case scenario. Residential areas are located within 20 m of the Proposal Area.

Potential air quality impact on sensitive receptors

Potential direct construction impacts that may to occur to air quality as a consequence of the Proposal are:

- Increased construction vehicle emissions.

- Dust generated from construction activities.

Construction of the Proposal also has the potential to reduce air quality via increased road vehicle traffic. Modelling indicates that operation of the Proposal is predicted to increase vehicle emissions slightly over existing levels (6.7 and 10.2 kilolitres in the 2021 and 2041 modelled years respectively) (BORR IPT, 2020l).

Human health effects of the major vehicle emissions (CO, PM10, NOx and VOCs) range from mild airway irritations to major organ damage. Vehicle emissions can also react with each other and with pollutants from other sources to form secondary pollutants such as ozone (O3), which may also have photochemical effects.

Potential indirect impacts from the Proposal are expected to be limited to dust generated during construction which result in impacts to vegetation and changes to vegetation communities (smothering) directly adjacent to the Proposal Area.

Mitigation of noise impacts on sensitive receptors

It is considered unlikely that the operation of the Proposal will have a significant impact on local air quality. Therefore, mitigation measures have not be proposed.

Main Roads has a carbon reduction target of 5 % of 2010 carbon emissions by 2020, with a stretch target reduction of 15 % through improving energy efficiency that is independent of individual project proposals. The impact on air quality during construction of the Proposal will be minimised through implementation of a CEMP. The CEMP will include mitigation measures including:

- Implementation of dust suppression measures, such as surface watering and spreading of hydromulch.
- Daily monitoring of meteorological conditions to identify and prepare or modify operations which increase the risk of windblown dust.
- Restriction of earthmoving if high winds are generating unmanageable dust levels.
- Progressive clearing to minimise the extent of soil exposed.
- Restriction on vehicle speeds to minimise the generation of dust.
- Establishment of a complaints register.
- Maintenance of vehicles in accordance with manufacturer's specifications to minimise exhaust emissions.
- Low emissions producing equipment will be selected (if possible).

Predicted outcome

Dust is expected to be generated during construction. This impact will be controlled using standard mitigation measures, such as watering trucks, implemented under the Proposal CEMP. Appropriate measures will be implemented to ensure that short term construction related air quality impacts are effectively managed.

The results of the Air Quality Assessment (BORR IPT, 2020e) for future road traffic emissions indicate that the constructed Proposal is unlikely to have an adverse impact on local air quality.
Given the proposed measures outlined above, no residual impacts are expected for this aspect and the Proposal meets the requirements of the relevant policies and guidelines.

6.4.2.4 Light Spill

Light spill from street lighting has been identified as a significant concern by the community during operation. For this reason, a lighting specialist was engaged to conduct an existing lighting study and provide some recommendations for lighting design aspects to meet the minimum safety standards as well as the expectations of the community. Given the proposed use of LED street lighting at the interchanges, the potential light spill is already reduced as LED lights tend to have a more directional light and the backspill is expected to be minimal. This Project will use a white/yellow LED luminaire with a Correlated Colour Temperature (CCT) ≤3000k. A luminaire of this frequency is unlikely to impact wildlife whilst still providing energy efficiency benefits.

The opportunity to implement a set of standards for lighting more suitable for a rural grade separated highway was investigated. The standard reviewed and now planned for implementation on BORR is the VicRoads TCG 006: Guidelines to Street Lighting Design Clause 3.1. This standard removes the requirements for lighting the entry and exit to the highway and the highway between ramps. Reducing the number street lights along the highway and associated impacts from light spill for the communities living in close vicinity to one or more of the interchanges.

Screen walls are included in the Proposal at various locations for the purposes of providing visual privacy to nearby residences and protection from headlight glare. A headlight glare study was undertaken to assess potential glare issues on nearby residences. Visual mitigation recommendations were provided to the design team and headlight screen walls incorporated into the Proposal design (BORR IPT, 2020b). Proposed planting includes native screening vegetation to the Proposal Area boundary between the new road and viewer, therefore over time, this would screen views of the road from in areas without screen walls (BORR IPT, 2018).

6.4.2.5 Visual impact

State assessment requirements

In Western Australia, potential visual amenity impacts from Proposals are assessed in accordance with the following guidance documents:

- *Environmental Factor Guideline Social Surroundings* (EPA, 2016b)
- *Visual Landscape Planning in Western Australia: a manual for evaluation, assessment, siting and design* (WAPC, 2007)
- *Environmental Standard Brief: Visual Impact Assessment* (MRWA, 2003)
- *Guidelines for Landscape and Visual Impact Assessment, 3rd Edition* (Landscape Institute and Institute of Environmental Management and Assessment, 2013)

Receiving environment description

The Swan Coastal Plain is characterised as a low lying coastal plain mainly covered with woodlands, with landscape features such as Holocene dunes and wetlands. Bushland is often retained as a visual or spatial buffer between land uses (BORR IPT, 2020f). Changes to amenity are greatest in areas with a high perceived scenic amenity value which are visible from public locations, such as roads, walk trails and lookouts.

The landscape context of the Proposal is a rural and rural residential setting, including areas of partially cleared low-lying land, as well as bush blocks upon the gently undulating dunal landforms of Gelorup, with extensive remnant bushland surrounding rural residential properties. Gelorup has a visual character that is broadly enclosed in nature due to the abundance of dense vegetation, whereas the rural areas have more open views across clearings typically towards clumps of native vegetation.

An *Urban and Landscape Design Framework* (ULDF) (BORR IPT, 2018) has been developed which outlines the urban and landscape design vision, objectives and principles for the Proposal. A Landscape and Visual

Impact Assessment (LVIA) (BORR IPT, 2020k) (**Error! Reference source not found.**) has also been undertaken to assess potential impacts from the Proposal. The primary concepts of the ULDF have been incorporated into the Proposal LVIA and Landscape Concept Design. As part of the LVIA, BORR IPT focused their assessment on five of the 13 previously identified Landscape Character Units (LCU) relevant to the Proposal Area.

The units defined were:

- Forest (LCU1): Topography that is flat to very gently undulating with native bushland
- Peri-urban (LCU2): Gently undulating topography associated with dunal rises. Predominantly residential and rural residential land use with significant areas of relatively dense native vegetation
- Rural (LCU3): Low-lying and generally flat to very gently undulating. Scattered residences of rural character and rural infrastructure (e.g. sheds), surrounded by grazing pasture and scattered remnant vegetation
- Quarry (LCU4): Situated on a flat low-lying part of the study area but with altered topography, including excavation pits and stockpiles as a consequence of mining activities. Vegetation restricted to buffer areas
- Highway (LCU5): Bussell Highway corridor characterised by generally flat topography, constructed road surface and drainage features and dense native vegetation within the verges and median.

An assessment of the potential impacts to visual amenity and landscape character was completed with consideration of the sensitivity, magnitude and significance of potential impact to each of the five landscape character units. The assessment was completed in accordance with the advice provided in national and state recognised resource documents and in accordance with all relevant legislation.

The Forest, Peri-urban and Rural LCUs were identified as having high landscape character value, the Highway LCU as having moderate landscape character value and the Quarry LCU as having low landscape character value.

Potential impact on visual amenity

Potential direct impacts from the Proposal on visual amenity and landscape character include:

- Changes to landscape character and visual amenity resulting from the clearing of native vegetation
- Changes to landscape character and visual amenity from construction of cuttings and other earthworks associated with the Proposal
- Changes to the landscape character and visual amenity as a result of the construction of infrastructure included in the Proposal including the new road, bridges and abutments, road connections and interchanges, principle shared path, lighting and noise walls.

The following additional temporary impacts are restricted to the construction phase of the project and include:

- Temporary site hoardings
- Site clearance works, including the removal of vegetation
- The presence of construction traffic and workers
- Temporary parking areas
- Materials stockpiling
- Importation and storage of construction equipment and plant

- The presence of earth-moving equipment for road formation works, which would include excavation and filling works
- Road construction activities including compaction and laying of road surface materials, and installation of associated infrastructure such as signage
- Construction of bridges, walls and underpasses, including the construction of below-ground footings and above-ground concrete structures or MSE walls
- The presence of incomplete structures
- Landscape planting to disturbed areas and to the roadside and medians.

The LVIA identified the Peri-urban and Rural landscape units as the most sensitive to potential direct impacts associated with the Proposal. The high sensitivity of these units is due to the presence of remnant vegetation, lower capacity to accommodate change, and unique development characteristics. A moderate impact to these units was anticipated, associated with vegetation clearing, built form elements and topographic changes, including grade-separated interchanges.

The predicted visual impacts associated with the Proposal varied across the 16 locations assessed. The areas identified with the greatest impacts were those where existing native vegetation is required to be cleared during construction of the Proposal and / or areas where there are long uninterrupted views that will be impacted by the Proposal.

Key features of the Proposal that have potential for impact on visual amenity are:

- The Yalinda Road bridge
- Clearing of native vegetation in the Gelorup area where existing residences are in close proximity (< 50 m) to the Proposal Area.

There will be changes in the local light environment as a result of the Proposal. It is anticipated that only intersections and interchanges will be lit.

Mitigation of potential impact on visual amenity

Avoid

The disturbance to the landscape and visual amenity resulting from the construction of the Proposal has been reduced through refinement of the design to minimise the area of native vegetation to be cleared. Clearing of native vegetation resulting from the Proposal has been reduced from 98 ha in the original design as referred to DAWE in 2019 to 71.5 ha in in the current design.

Mitigate

Impacts to visual amenity will be addressed through the detailed design of the Proposal, and minimised and suitably managed through the implementation of a CEMP. The Landscape Concept Design for the proposal is included in **Error! Reference source not found.**.

Additional impacts to social and visual amenity will be mitigated through the implementation of the ULDF that sets the framework for the urban design and landscape strategy for the Proposal. The ULDF is comprehensive and incorporates a range strategies including for built form (bridges and abutments), aesthetic treatments and public art, roadside elements and accessibility and connectivity that informed the Landscape Concept Design and will be carried through to detailed design. Broadly the design has been undertaken to reduce the visual and social impact and respond to the existing site character and conditions, including topography, landform and natural systems. The design of the Proposal will allow for open views to the surrounding landscape to provide a sense of place.

The ULDF also includes a range of measures to mitigate visual and landscape impacts during detailed design such as:

- Formal multi-row tree planting and feature planting mixes to interchanges
- Screen planting of native shrubs and trees to edges interfacing residential land uses
- Corridor amenity trees to either side of the proposed shared path
- Median planting, where appropriate, of native shrubs and groundcovers to tie into the character of the wider road journey
- Riparian planting to rivers; drainage / swale planting to basins and swales.

Predicted outcome

Impacts to social amenity and visual amenity will be suitably managed with mitigation measures described above. Visual amenity impacts resulting from thse Proposal will be compliant with state requirements.

6.4.2.6 Socioeconomics

The South West has a diverse range of industries with an annual economic output of $34.762 billion (as at 2017/18) (South West Economy Profile | Gross Regional Product, Industries | REMPLAN). The Gross Regional Product (net measure of wealth generated by the region) grew 25.6% between 2009 and 2019 (Diverse & Growing Industry - South West Development Commission (swdc.wa.gov.au), and in 2020 was estimated at $16.024 billion. $8.092 billion of this was contributed by the local authorities traversed by BORR, including $4.731 billion contributed by Bunbury (South West Economy Profile | Gross Regional Product, Industries | REMPLAN).

Bunbury is the largest regional city outside the Perth/Peel regions and functions as the commercial and administrative hub of the broader South West region and some parts of the western Wheatbelt region. Continued population growth in Bunbury and the broader South West region is likely to generate opportunities for further commercial and retail development. This, however, is tempered by the increasing popularity of on-line shopping that is becoming more prevalent (State of WA, 2020).

The estimated construction cost of BORR is greater than $600 M which will be expended over several years. A spending target of $300 m has been set aside for local businesses, including over $20m with Aboriginal businesses. KPMG (Bunbury Outer Ring Road | Main Roads Western Australia) estimated that local industry sectors expected to directly benefit from the project include:

- Construction services - $50m output
- Professional, scientific and technical services - $58m output
- Wholesale and retail trade - $30m output
- Transport, machinery and equipment services - $7m output
- Other business sectors - $10m output

Bypass Effects

Main Roads conducted Traffic Origin and Destination (OD) Surveys in 2018 and 2019 on both a long weekend and a normal weekend to monitor traffic at locations north and south of Bunbury. The OD Survey provided a snapshot of traffic movements including those vehicles recorded bypassing Bunbury. The survey results indicated that:

- Around 60% of traffic did not stop in Bunbury;
- Some 30% of traffic stopped in Bunbury for less than one hour (the majority of which stop for up to 20 minutes); and

- Approximately 10% of traffic stopped in Bunbury for longer than one hour.

The results of the OD Survey indicated that Bunbury, including the CBD, is already impacted by the bypass effect (via Forrest Highway, Robertson Drive and Bussell Highway) given that some 60% of through traffic do not stop.

The 30% of vehicles that stop along the route, or in Bunbury for up to one hour may choose BORR over the current route which may impact businesses along the current route depending on location and customer base.

During the recent planning for BORR Main Roads facilitated the establishment of an Economic Advisory Group (EAG) with local business and industry stakeholders in order to prepare them for the potential economic benefits and impacts of the Proposal, and to encourage their early implementation of actions that would help to maintain customer visitation. The EAG was chaired by the SW Development Commission with membership including City of Bunbury, Bunbury Geographe Economic Alliance and Bunbury Geographe Chamber of Commerce and Industry.

The NSW Roads and Traffic Authority commissioned an evaluation of the economic impact of highway bypasses on three towns where the Hume Highway was re-aligned (Parolin, 2012) in the 1990s. The study also included a literature review of the economic impact of town bypasses in Australia and overseas. The outcomes of the study indicated the following:

To a large extent the findings of the study mirror those identified in the review of literature – that in the long-term, highway bypasses do not have adverse economic impacts on towns that are bypassed and that in most cases bypasses have resulted in economic development benefits for towns which have been bypassed;

Other factors may have more of an impact on the economy of a town than the introduction of a highway bypass (e.g. state of the national and regional economy, rural population decline, restructuring of industry and services and the number and scale of chain retail stores.); and

In consideration of the above, it is reasonable to assume that any negative economic impacts resulting from a BORR 'bypass effect' are likely to be short to medium term but not long term. It is more likely that businesses that specifically service passing trade would experience impacts but any such effect may in fact result in overall benefits to local Bunbury businesses and the community.

Furthermore, Bunbury has a diverse range of businesses, industry and commerce and serves as the regional South West hub for a number of services and facilities. With an existing urban population of around 80,000 people it is anticipated the overall bypass impacts to Bunbury and its surrounding suburbs are manageable and will result in an overall benefit to industry, business and the community.

6.4.2.7 Community connectivity and multi-modal options

The BORR Local Access Strategy was finalised during development of the Proposal and informed by consultation with the local community. This included a local access strategy workshop held in Gelorup in July 2019, to gather community feedback regarding the potential changes required to local access arrangements around the Gelorup and Stratham area as part of the Proposal.

The extension of Jules Road was included in the project to provide a safer access to Bussell Highway via Centenary Road. Jules Road would be used by local traffic only and does not provide a convenient route for through traffic. It should be noted that the Shire of Capel requested inclusion of a roundabout at Jules Road Sleaford Road intersection. The roundabout will further discourage the use of the route by through traffic and will aim to calm traffic. As a result, there is a minor land requirement on Reserve 45214, which is public open space. The playground on the reserve is not impacted by the works.

The Jaymon Road intersection will remain as a full movement intersection as part of the project, with minor improvements to right turn out of Jaymon Rd. The Jaymon Road intersection will be monitored, like all road intersections in the state, for road user safety.

Cycling has a multitude of benefits including reduced traffic congestion, improved air quality and significant health benefits. The provision of cycling infrastructure is the key to making this alternative transport mode desirable for the community. This initiative has been identified as a priority by the Department of Transport, in consultation with the four affected LGAs and other key stakeholders including community members. In response they have developed the Bunbury-Wellington 2050 Cycling Strategy and this has been a significant consideration for the planning of BORR's PSP connectivity.

Non-typical extensions of the Principal Shared Path (PSP) have been incorporated within the scope to enable greater connection. The most significant being the extension along Willinge Drive, connecting BORR with the existing South Western Highway. This particular opportunity is mentioned in the 2050 strategy.

The initiative will contribute to enhancing the connectivity for pedestrians and cyclists in the south-west region. The current network is considered unappealing due to lack of coverage, connectedness and separation from motorised traffic. Also with significant urban development proposed in the greater Bunbury area, the PSP network will provide connectivity into the future.

Social connectivity within Gelorup will be maintained through the provision of pedestrian and vehicle access across the Proposal alignment. Social connectivity within the Gelorup was originally provided by way of a dual use path at the Yalinda Bridge and a Principal Shared Path (PSP) on the northern side of BORR South.

To further improve the Gelorup community's social connectivity and amenity, Main Roads has amended the Proposal to:

- install a new pedestrian underpass at Woods Road to connect to local roads and walk trails.
- establish walking trails, primarily utilising previously cleared areas, that connect underpasses, bridges, local roads, remnant bush areas, including along firebreaks on BORR boundaries, and to the large tuart tree, where a viewing area will be established.
- establish a walking trail under the Five Mile Brook Bridge to connect the northern and southern sections of Gelorup.

These additional structures are presented in Figure 27.

Main Roads invited the general public to comment on the changes to social connectivity via a survey available the Main Roads website. The survey was open for two weeks and closed 22 October 2021.

7 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Section 3A of the EPBC Act defines the principles of ecologically sustainable development. Table 7-1 outlines how each of the five principles has been applied to the Proposal.

Table 7-1 EPBC Act Principles of Ecologically Sustainable Development

NO.	PRINCIPLE	CONSIDERATION OF PRINCIPLE IN THE PROPOSAL
a)	Decision-making processes should effectively integrate both long-term and short-term economic,	A holistic decision making process has been established for the Proposal with the aim to provide an integrated and transparent approach. A comprehensive decision making tool was used to assist in making a range of significant decisions, through consideration of the triple bottom line (environment, social, local

NO.	PRINCIPLE	CONSIDERATION OF PRINCIPLE IN THE PROPOSAL
	environmental, social and equitable considerations	economic). The tool allows some flexibility in the weightings appointed to each sustainability aspect while maintaining a holistic balance. Where the tool has been used to inform and document significant design decisions, the inputs, selection criteria and outcomes have been documented in design reports. Additionally, the decisions have been summarised within a decision making register (BORR-00-SC-SU-0002).
b)	If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation	A Natural Hazards and Climate Change Risk Assessment workshop was held to identify risks to the project from natural hazards and aspects of climate change. These risks were then rated and adaption controls were identified which will be integrated into the detailed design for the Proposal. A wide range of comprehensive desktop and field studies were undertaken to assess the impact of the Proposal. A selection of key studies included: • Brad Goode & Associates (2020) Report of an Aboriginal Heritage Survey of the BORR Southern Section, WA • Biota (2020a) BORR Southern Section Targeted Fauna Assessment • BORR IPT (2020h) Overarching Acid Sulfate Soil and Dewatering Management Plan (ASSDMP) Southern Section • BORR IPT (2020d) BORR Southern Section Air Quality Assessment • BORR IPT (2020i) BORR Southern Section Vegetation and Flora Study • BORR IPT (2019g) Drainage Strategy – Southern Section • Lloyd George Acoustics (2020) BORR Southern Section Transportation Noise Assessment • Great Southern Biologic (2020) Phytophthora Dieback Occurrence Survey Bunbury Outer Ring Road South • WRM (2020b) Bunbury Outer Ring Road Southern Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey. Information gathered during these studies was used to inform this Proposal and has reduced the uncertainty surrounding the prediction of impacts for the assessment. Main Roads has ensured that the Proposal design (where possible) avoids serious or irreversible damage to the environment. Impacts to MNES have been identified and described. Mitigation and management measures have been proposed to ensure they are environmentally acceptable.

NO.	PRINCIPLE	CONSIDERATION OF PRINCIPLE IN THE PROPOSAL
c)	The principle of intergenerational equity That the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The Proposal will ensure the health, diversity and productivity of the environment is maintained through retaining as much habitat as possible, establishing noise walls to reduce noise related impacts and maintaining access for property owners.
d)	The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making	There are areas of limited biological diversity and ecological integrity within and adjacent to the Proposal. Main Roads has sought to preserve as much of the remnant biodiversity as possible by avoiding areas of native vegetation where practicable.
e)	Improved valuation, pricing and incentive mechanisms should be promoted	Main Roads acknowledges the need for improved valuation, pricing and incentive mechanisms and endeavours to pursue these principles when appropriate. For example, environmental factors will greatly determine the location of road corridors, with the project having a strong focus on reducing its direct and indirect clearing footprint. Impacts on flora, vegetation and terrestrial fauna have been assessed and mitigation and management measures proposed. Main Roads accepts that the cost of the Proposal must include environmental impact mitigation, management and maintenance activities. These requirements will be incorporated into the overall Proposal costs. The Proposal has been assessed under the Infrastructure Sustainability Council of Australia (ISCA) Infrastructure Sustainability (IS) rating framework, which considers environmental, social and economic impacts to project outcomes. The framework supports the integration of sustainability on infrastructure projects and provides criteria beyond the business as usual approach which projects are assessed against. The BORR Proposal (Northern, Central and Southern Sections) is the first project to be verified under the V2.0 of the IS framework. The Proposal has been verified in the Planning phase for a Silver rating, achieving a total of 43.2 points.

8 ENVIRONMENTAL RECORD OF THE PERSON PROPOSING TO TAKE THE ACTION

Main Roads is a State agency with an assured record of responsible environmental management and a certified environmental management system. Main Roads is not subject to any past or present proceedings under Commonwealth or State law for protection of the environment or conservation and sustainable use of natural resources. All work undertaken by Main Roads is completed in accordance with their Environmental Policy and Environmental Management System (EMS), which is certified with the requirements of ISO 14001:2015 environmental management systems comprising 'Activities, products and services associated with delivering Road Management (planning, building and maintaining) on Western Australia's State Road Network' (Certificate #MRWQ51-CCE04). Main Roads' environmental policy can be found at https://www.mainroads.wa.gov.au/OurRoads/Environment/Pages/environmentalmanagement.aspx#policy

Main Roads' EMS is independently certified and covers the processes and activities that have the potential to impact the environment, including mitigation and management measures proposed as part of the action. The EMS ensures compliance with Main Roads' environment and heritage compliance obligations, providing the framework for driving environmental requirements through leadership, planning, support, operation, performance evaluation and improvement actions. The action, therefore, will be undertaken, monitored and measured in accordance with the Main Roads EMS.

Main Roads EMS covers processes and activities that have the potential to impact on the environment and ensures compliance with environment and heritage compliance obligations. The EMS responsibilities includes appropriate resource allocation to ensure compliance costs are appropriately budgeted and assessed as part of the overall business case for the project. This ensures that the costs of proposed management measures and offsets is considered in the budget approvals and ensures compliance is appropriately funded and resourced.

9 OTHER APPROVALS AND CONDITIONS

Other than an approval under the EPBC Act, requirements for approval or conditions that apply, or that are likely to apply, to the Proposal include various approvals from Western Australia state agencies and have been outlined below.

9.1 *Environmental Protection Act 1986,* Part IV Environmental Impact Assessment

The Proposal will be assessed by the Environmental Protection Authority, under Part IV of the *Environmental Protection Act 1986* (EP Act), which is the primary legislation governing environmental protection and impact assessment in Western Australia. Division 1 of Part IV of the EP Act provides for the referral and assessment of significant and strategic proposals.

The Proposal Area partially overlaps with the Greater Bunbury Region Scheme (GBRS) which was formally assessed under Part IV of the EP Act (referred in 1996 and Ministerial Statement 697 issued in 2005). This Proposal is not being referred to the EPA as a proposal under the GBRS. Conditions set out in Ministerial Statement 697 (Western Australian Minister for the Environment, 2005) therefore, do not formally apply to the Proposal, but have been taken into account where relevant.

9.2 Other Approvals and Regulation

In addition to environmental approval of the Proposal under Part IV of the EP Act, additional regulatory approvals will be required to develop and operate the Proposal. These have been summarised in (Table 9-1).

Table 9-1 Summary of other regulatory approvals required

PROPOSED ACTIVITIES	TYPE OF APPROVAL	REGULATORY AGENCY	LEGALISATION REGULATING THE ACTIVITY	EXPECTED CONDITIONS THAT APPLY
Interference with bed and banks of a watercourse or wetland (clearing of vegetation and construction works)	Application for a permit to authorise interference or obstruction of the bed and banks of a watercourse or wetland	Department of Water and Environmental Regulation (DWER)	*Rights in Water and Irrigation Act 1914* (RIWI Act)	None that apply
Sourcing of construction water	Licence to take	DWER	RIWI Act	None that apply
Disturbance of a registered Aboriginal heritage site	Section 18 consent	Department of Planning, Lands and Heritage (DPLH)	Aboriginal Heritage Act 1972 (AH Act)	None that apply
Land acquisition process	Administration of State Land	DPLH	Land Administration Act 1997	None that apply

PROPOSED ACTIVITIES	TYPE OF APPROVAL	REGULATORY AGENCY	LEGALISATION REGULATING THE ACTIVITY	EXPECTED CONDITIONS THAT APPLY
	Transfer of private land			
Authorisation to take (flora and fauna) and modify (TEC) for the Proposal and associated service locations	Licence to take and modify	Department of Biodiversity, Conservation and Attractions (DBCA)	Biodiversity Conservation Act 2016 (BC Act)	None that apply

9.3 Planning Approvals

Land within the proposed alignment will be acquired by Main Roads pursuant to section 28 (1) of the *Land Administration Act 1997*.

The alignment of the Proposal will not be fully located within land currently reserved under the GBRS for Primary Regional Roads or Other Regional Roads.

The Minister for Planning has granted approval to the declaration of a Planning Control Area (PCA1) for the Bunbury Outer Ring Road. The WAPC considered that the Planning Control Area is required to ensure that no development occurs on this land which may prejudice this purpose until it may be reserved for Primary Regional Roads in the GBRS.

Declaration PCAs is a standard statutory planning process commonly used to protect strategic land from inappropriate development. In accordance with Part 7 of the Planning and Development Act 2005 the WAPC is the sole determining authority for all development applications within a Planning Control Area.

10 RELEVANT POLICIES AND PUBLICATIONS

10.1 Policy and guidelines

MNES are listed and protected under the following legislation and guidelines:

- *Environment Protection and Biodiversity Conservation Act 1999*
- Environment Protection and Biodiversity Conservation Regulations 2000
- *Significant Impact Guidelines (No. 1.1): Matters of National Environmental Significance* (DEE, 2013).

Other legislation and guidance documents relevant to studies conducted for and assessment of the Proposal are listed in Table 10-1.

Table 10-1 Legislation and guidance documents relevant to the Proposal

REFERENCE SOURCE	STATE / COMMONWEALTH
Aboriginal Heritage	
Aboriginal Heritage Act 1972	State
Environmental Factor Guideline Social Surroundings (EPA, 2016b)	State
Guidance for the Assessment of Environmental Factors, Assessment of Aboriginal Heritage No. 41 (EPA, 2004a)	State
Fauna	
Environment Protection and Biodiversity Conservation Act 1999	Commonwealth
Environment Protection and Biodiversity Conservation Regulations 2000	Commonwealth
Matters of National Environmental Significance: Significant Impact Guidelines 1.1 (DoE, 2013)	Commonwealth
Biodiversity Conservation Act 2016	State
Environmental Factor Guideline 'Terrestrial Fauna' (EPA, 2016a)	State
Technical Guidance 'Sampling Methods for Terrestrial Vertebrate Fauna' (EPA, 2016b)	State
Technical Guidance 'Terrestrial Fauna Surveys' (EPA, 2016c)	State
Vegetation and flora	
Environment Protection and Biodiversity Conservation Act 1999	Commonwealth
Environment Protection and Biodiversity Conservation Regulations 2000	Commonwealth
Matters of National Environmental Significance: Significant Impact Guidelines 1.1 (DoE, 2013)	Commonwealth

REFERENCE SOURCE	STATE / COMMONWEALTH
Biodiversity Conservation Act 2016	State
Environmental Factor Guideline 'Flora and Vegetation' (EPA, 2016d)	State
Technical Guidance 'Flora and Vegetation Surveys for Environmental Impact Assessment' (EPA, 2016e)	State
Protection of Naturally Vegetated Areas Through Planning and Development, Environmental Protection Bulletin No. 20 (EPA, 2013)	State
Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations)	State
Noise	
Environmental Factor Guideline Social Surroundings (EPA, 2016b)	State
State Planning Policy 5.4 (SPP 5.4) Road and Rail Noise (WAPC, 2019a)	State
Road and Rail Noise Guidelines (WAPC, 2019b)	State
Visual Impact Assessment	
Visual Landscape Planning in Western Australia: a manual for evaluation, assessment, siting and design (WAPC, 2007)	State
Guidelines for Landscape and Visual Impact Assessment, 3rd Edition (Landscape Institute and Institute of Environmental Management and Assessment, 2013)	State

10.2 Summary of assessment of level of significance of impact on MNES

Recovery Plans, Threat Abatement Plans and Conservation Advice relevant to MNES which the Proposal may impact upon have been listed in Table 10-2 and Table 10-3. A discussion of how the Proposal conforms to the Advice or Plan requirements is included in the Tables.

Table 10-2 Relevant Recovery Plans, Threat Abatement Plans and Conservation Advice for MNES

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
Banksia Woodlands TEC	DEE (2016), 'Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community'		
	1	Land clearing and impacts associated with fragmentation	The Proposal will result in the direct loss of 23.4 ha of Banksia Woodlands TEC vegetation (equivalent to a 0.007 % reduction in extent) but is not expected to exacerbate this threat.
	2	Groundwater drawdown	The Proposal may cause temporary (dewatering activities) change to groundwater levels associated with the TEC but is not expected to exacerbate this threat.
	3	Altered fire regimes	The Proposal is not expected to exacerbate this threat. There is considered to be a low risk of accidental fire as a result of construction activities. Clearing activities are a potential risk of fire generation. To minimise the risk of fire, clearing activities will not be undertaken when the Fire Danger Rating is severe or higher. The CEMP will include an emergency management plan.
	4	Plant pathogens (dieback)	The Proposal is not expected to exacerbate this threat. A dieback occurrence assessment has been completed to identify priority areas within the Proposal Area (Great Southern Bio Logic Pty Ltd, 2020). A Hygiene Management Plan will be implemented for construction of the Proposal as per the CEMP to minimise risk of the impact of disease.
	5	Invasive flora and fauna	The Proposal is not expected exacerbate this threat. A Hygiene Management Plan will be implemented for construction of the Proposal as per the CEMP, to minimise risk of the impact of spread of invasive flora.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
	6	Other disturbances to patches (dumped rubbish, access by unauthorised vehicles, paths from trampling through the vegetation, illegal cutting of vegetation, firewood collections, bare patches of ground where vegetation cover has been destroyed, erosion, feral animals and domestic animals)	The Proposal is not expected to exacerbate this threat. Access to the Proposal Area will be managed through the construction phase and access to remnant vegetation controlled during the operational phase through appropriate fencing and vehicle management.
Tuart Woodlands TEC	**TSSC** (2019)**, 'Approved Conservation Advice (incorporating listing advice) for the Tuart (*Eucalyptus gomphocephala*) Woodlands and forests of the Swan Coastal Plain ecological community'**		
	1	Clearing and fragmentation of vegetation	The Proposal will result in the direct loss of 4.4 ha of Tuart Woodlands TEC vegetation (equivalent to a 0.03 % reduction in extent) but is not expected to exacerbate this threat.
	2	Invasive flora and fauna	The Proposal is not expected exacerbate this threat. A Hygiene Management Plan will be implemented for construction of the Proposal as per the CEMP, to minimise risk of the impact of spread of invasive flora.
	3	Tree dieback and pathogens	The Proposal is not expected to exacerbate this threat. Dieback mapping will be updated as part of project planning especially in regards to ascertaining areas that can be effectively protected from dieback infestation. A Hygiene Management Plan will be implemented for construction of the Proposal as per the CEMP to minimise risk of the impact of disease.
	4	Altered fire regimes	The Proposal is not expected to exacerbate this threat. There is considered to be a low risk of accidental fire as a result of construction activities. Clearing activities are a potential risk of fire generation. To minimise the risk of fire, clearing activities will not be undertaken when the Fire Danger Rating is severe or higher.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
			The CEMP will include an emergency management plan.
	5	Climate change	The Proposal is not expected exacerbate this threat.
	6	Water extraction and other hydrological change	The Proposal may cause temporary (dewatering activities) change to groundwater levels associated with the TEC but is not expected to exacerbate this threat.
	7	Loss of fauna supporting key ecological processes	The Proposal will result in the direct loss of suitable fauna habitat but is not expected to exacerbate this threat.
Black Cockatoos	**WA Department of Parks and Wildlife (DPaW)** (2013)**, 'Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan'**		
	1	Loss of breeding habitat	The Proposal may exacerbate this threat, however the Proposal is designed to maximise use of existing disturbed areas to minimise the loss of breeding habitat. Up to an estimated 60.9 ha of native vegetation will be removed for the Proposal which has been assessed as potential Black Cockatoo breeding habitat. A total of up to 1,088 Black Cockatoo Suitable DBH Trees will be removed for the Proposal including 11 trees with a potentially suitable nest hollow(s). No known nesting trees are present within the Proposal Area.
	2	Loss of non-breeding, foraging and night roosting habitat	The Proposal may exacerbate this threat, however the Proposal is designed to maximise the use of existing disturbed areas to minimise the loss of habitat.
	3	Tree health	The Proposal is not expected to exacerbate this threat. Dieback mapping will be updated as part of project planning especially in regards to ascertaining areas that can be effectively protected from dieback infestation. A Hygiene Management Plan will be implemented for construction of the Proposal as per the CEMP to minimise risk of the impact of disease.
	4	Illegal shooting	The Proposal will not exacerbate this threat.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
			No firearms will be permitted on site as per the CEMP.
	5	Illegal taking	The Proposal will not exacerbate this threat. Only qualified fauna handlers will relocate fauna as per the *Conservation Significant Fauna AMP* (BORR IPT, 2020g) (**Error! Reference source not found.**).
	6	Collisions with motor vehicles	The Proposal may exacerbate this threat; mitigation options will be considered as part of detailed design.
	Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009a)**, 'Approved Conservation Advice for *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo)'**		
	1	Illegal shooting	The Proposal will not exacerbate this threat. No firearms will be permitted on site as per the CEMP.
	2	Habitat loss	The Proposal may exacerbate this threat, however the Proposal is designed to maximise the use of existing disturbed areas to minimise the loss of habitat. Up to an estimated 60.9 ha of native vegetation that has been assessed as potential Black Cockatoo (breeding and foraging) habitat will be removed for the Proposal.
	3	Nest hollow shortage	The Proposal may exacerbate this threat however, the Proposal is designed to maximise use of existing disturbed areas to minimise the loss of breeding habitat. An estimated maximum of approximately 60.9 ha of native vegetation that has been assessed as potential Black Cockatoo breeding habitat will be removed for the Proposal. A total of up to 1,088 Black Cockatoo Suitable DBH Trees will be removed for the Proposal including 11 trees with a potentially suitable nest hollow(s). No known nesting trees are present within the Proposal Area.
	4	Competition from other species	The Proposal is unlikely to exacerbate this threat.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
			Various other bird species (e.g. other Black Cockatoo species, Galahs and Wood Ducks) and other fauna (WRP and South-western Brush-tailed Phascogales) that may compete for hollows with the Black Cockatoos are known to occur within the Proposal Area.
	5	Injury or death from *Apis mellifera* (European Honeybees)	The Proposal is unlikely to exacerbate this threat. The Proposal will result in the clearing of 11 Trees with a potentially Suitable Nest Hollow for Black Cockatoos. A general reduction in the amount of tree hollows may increase competition between fauna using the hollows and the European Honeybee. There are no plans to control European Honeybee populations.
	Department of Environment and Conservation (DEC) (2008)**, 'Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus Baudinii* and Forest Red-Tailed Black Cockatoo *Calyptorhynchus Banksii Naso*) Recovery Plan'**		
	1	Killing by illegal shooting	The Proposal will not exacerbate this threat. No firearms will be permitted on site as per the CEMP.
	2	Feral honeybees	The Proposal is unlikely to exacerbate this threat. The Proposal will result in clearing 11 Trees a potentially suitable nest hollow(s) for Black Cockatoos. A general reduction in the amount of tree hollows may increase competition between fauna using the hollows and feral honeybees. There are no plans to control feral honeybee populations.
	3	Habitat loss	The Proposal may exacerbate this threat, however the Proposal is designed to maximise the use of existing disturbed areas to minimise the loss of habitat. Up to an estimated 60.9 ha of native vegetation that has been assessed as potential Black Cockatoo (breeding and foraging) habitat will be removed for the Proposal.
	4	Nest hollow shortage	The Proposal may exacerbate this threat however, the Proposal is designed to maximise use of existing disturbed areas to minimise the loss of breeding habitat

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
			Up to an estimated 60.9 ha of native vegetation that has been assessed as potential Black Cockatoo (breeding and foraging) habitat will be removed for the Proposal. A total of up to 1,088 Black Cockatoo Suitable DBH Trees will be removed for the Proposal including 11 trees with a potentially suitable nest hollow(s). No known nesting trees are present within the Proposal Area.
	5	Nest hollow competition	The Proposal is unlikely to exacerbate this threat. The Proposal will result in clearing of up to 11 Trees a potentially suitable nest hollow(s) for Black Cockatoo. A general reduction in the amount of tree hollows may increase competition between fauna and other species using hollows.
	TSSC (2018d)**, 'Conservation Advice *Calyptorhynchus baudinii* Baudin's Cockatoo'**		
	1	Destruction of nesting and foraging trees from fire events	The Proposal is not expected to exacerbate this threat. The threat of bushfires will be managed as per the CEMP.
	2	Loss of hollows from European honey bees (*Apis mellifera*)	The Proposal is unlikely to exacerbate this threat. The Proposal will result in clearing of up to 11 Trees a potentially suitable nest hollow(s) for Black Cockatoo. A general reduction in the amount of tree hollows may increase competition between fauna using the hollows and the European Honeybee. There are no plans to control European Honeybee populations.
	3	Nest hollow shortage due to competition with native bird species	The Proposal may exacerbate this threat, however the Proposal is designed to maximise use of existing disturbed areas to minimise the loss of breeding habitat. Various other bird species (e.g. other Black Cockatoo species, Galahs and Wood Ducks) and other fauna (WRP and South-western Brush-tailed Phascogales) that may compete for hollows with Baudin's Cockatoo are known to occur within the Proposal Area; the general reduction in available hollows may increase competition between bird species.
	4	Illegal shooting	The Proposal will not exacerbate this threat. No firearms will be permitted on site as per the CEMP.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
	5	Phytopathogens (Dieback)	The Proposal is not expected to exacerbate this threat. Dieback mapping will be updated as part of detailed project planning especially in regards to ascertaining areas that can be effectively protected from dieback infestation. A Hygiene Management Plan will be implemented for construction of the Proposal as per the CEMP to minimise risk of the impact of disease.
Western Ringtail Possum	**DPaW** (2017)**, 'Western Ringtail Possum (*Pseudocheirus occidentalis*) Recovery Plan. Wildlife Management Program No. 58'**		
	1	Habitat loss and fragmentation	The Proposal may exacerbate this threat. Clearing of up to an estimated 60.9 ha of potential habitat and impact to the home ranges (to varying degrees) of up to 49 to 72 individuals estimated to utilise this habitat (up to 0.53 % to 0.78 % of the estimated regional population) could result in a minor residual impact associated with the Proposal.
	2	Timber harvesting	The Proposal is not expected to exacerbate this threat. Timber harvesting will not be undertaken other than to recover the timber within the clearing area.
	3	Fire	The Proposal is not expected to exacerbate this threat. There is considered to be a low risk of accidental fire as a result of construction activities. Clearing activities are a potential risk of fire generation. To minimise the risk of fire, clearing activities will not be undertaken when the Fire Danger Rating is severe or higher. The CEMP will include an emergency management plan.
	4	Competition for tree hollows	The Proposal may exacerbate this threat due to clearing of suitable WRP habitat thereby potentially increasing competition for tree hollows within habitat immediately surrounding the Proposal Area. Monitoring of WRP abundance in habitat immediately adjacent to the Proposal Area will be conducted with data compared against that of reference areas to determine any such impacts.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
	5	Habitat tree decline	The Proposal is not expected to exacerbate this threat. Dieback mapping will be updated as part of project planning especially in regards to ascertaining areas that can be effectively protected from dieback infestation. A Hygiene Management Plan will be implemented for construction of the Proposal as per the CEMP to minimise risk of the impact of disease.
	6	Unregulated relocation of orphaned, injured and rehabilitated Western Ringtail Possums	The Proposal will not exacerbate this threat. A Conservation Significant Fauna EMP has been prepared for the Proposal. An appropriately qualified fauna handler will be on site during clearing of Western Ringtail Possum habitat.
	7	Disease	The Proposal is not expected to exacerbate this threat. Dieback mapping will be updated as part of project planning especially in regards to identifying areas that can be effectively protected from dieback infestation. A Hygiene Management Plan will be implemented for construction of the Proposal as per the CEMP to minimise risk of impact of the disease.
	8	Gaps in knowledge	The Proposal will not exacerbate this threat, but rather has minimised this threat. Nnumerous studies and investigations have been conducted for the Proposal for the purpose of addressing knowledge gaps and more will be undertaken as part of detailed design.
	TSSC (2018c)**, 'Conservation Advice *Pseudocheirus occidentalis* Western Ringtail Possum'**		
	1	Groundwater depletion and altered hydrology	The Proposal is not expected to exacerbate this threat. A Drainage Strategy has been developed with the main objectives of maintaining the water cycle balance within the Proposal Area whilst also improving surface and groundwater

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
			quality. Drainage design will be undertaken during detailed design to ensure pre-development flows are maintained within the Proposal Area.
	2	Land clearing and habitat fragmentation caused by urbanisation	The Proposal may exacerbate this threat. Clearing of up to an estimated 60.9 ha potential habitat for an estimated 49 to 72 WRP individuals (up to 0.53 % to 0.78 % of the estimated regional population) could result in a minor residual impact associated with the Proposal.
	3	Fire	The Proposal is not expected to exacerbate this threat. There is considered to be a low risk of accidental fire as a result of construction activities. Clearing activities are a potential risk for fire generation. To minimise the risk of fire, clearing activities will not be undertaken when the Fire Danger Rating is severe or higher. The CEMP will include an emergency management plan.
	4	Tree decline and insect outbreaks	The Proposal is not expected to exacerbate this threat. Dieback mapping will be updated as part of project planning especially in regards to identifying areas that can be effectively protected from dieback infestation. A Hygiene Management Plan will be implemented for construction of the Proposal to minimise risk of impact of the disease.
	5	Competition for tree hollows	The Proposal may exacerbate this threat due to clearing of suitable WRP habitat thereby potentially increasing competition for tree hollows within habitat immediately surrounding the Proposal Area. Monitoring of WRP abundance in habitat immediately adjacent to the Proposal Area will be conducted with data compared against that of reference areas to determine any such impacts.
	6	Logging	The Proposal will not exacerbate this threat. Timber harvesting will not be undertaken other than to recover timber within clearing area.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
	7	Myrtle rust	The Proposal is not expected to exacerbate this threat. A Hygiene Management Plan will be implemented for construction of the Proposal to minimise risk of the impact of disease.
	8	Injury and mortality due to vehicle strike	The Proposal may exacerbate this threat; mitigation options will be considered as part of detailed design.
	9	Unregulated relocation of orphaned, injured and rehabilitated Western Ringtail Possums	The Proposal will not exacerbate this threat. Fauna relocation will be considered for conservation significant terrestrial fauna species, including trapping of WRPs. A Fauna Management Plan will be developed. An appropriately qualified fauna handler will be on site during clearing of WRP habitat.
Black-stripe Minnow	**TSSC** (2018e)**, 'Conservation Advice *Galaxiella nigrostriata* Black-stripe Minnow'**		
	1	Introduced invasive fish: • The introduction of exotic fish including the mosquitofish *Gambusia holbrooki*, could impact on *Galaxiella nigrostirata* through food competition, aggressive or predatory behaviour (i.e. fin-nipping) leading to displacement, injury and/or death, and introduction of diseases.	The Proposal is not expected to exacerbate this threat.
	2	Habitat modification leading to degradation and loss of habitat: • Filling and draining of wetlands and waterways for various land-use	The Proposal is not expected to exacerbate this threat. Minor loss of cleared and degraded wetlands within the Proposal area will occur, however hydrological regimes of wetlands adjacent the Proposal Area will be maintained through

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
		practices including agriculture, urbanisation, road construction and maintenance, forestry, dams and other related infrastructure, and mineral and quartzite sand mining • Excessive anthropogenic groundwater extraction • Altered fire regimes • Increased salinity due to agricultural practices/historical land clearing.	implementation of a Drainage Strategy. Where appropriate, drainage design will facilitate movement of aquatic fauna.

Table 10-3 Relevant Commonwealth threat abatement plan/ objectives for potential impacts on MNES within the Proposal Area

IMPACT	PLAN/ CONSERVATION ADVICE AND OBJECTIVES		RESPONSE
Dieback	**DEE** (2018) **'Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi*'**		
	1	Identify and prioritise for protection of biodiversity assets that are, or may be, impacted by *Phytophthora cinnamomi*	The Proposal is considered to be consistent with this objective. Dieback mapping will be updated as part of detailed project planning especially in regards to identifying areas that can be effectively protected from dieback infestation.
	2	Reduce the spread and mitigate the impacts of Phytophthora to protect priority biodiversity assets and susceptible landscapes	A Hygiene Management Plan will be implemented for construction of the Proposal to minimise risk of the impact of disease.
	3	Inform and engage the community by promoting information about Phytophthora, its impacts on biodiversity and actions to mitigate these impacts	The Proposal is considered to be consistent with this objective. Extensive community and stakeholder consultation has been undertaken regarding environmental investigations undertaken for the Proposal and are outlined in Section .

11 INFORMATION SOURCES

The reliability and uncertainties in the technical studies undertaken in preparation of the Proposal have been outlined in Table 11-1.

Table 11-1 Reliability and uncertainties in technical studies used in preparing the referral

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
Aboriginal Heritage		
Brad Goode & Associates (2009) ***A Desktop Aboriginal Heritage Survey of the Proposal Bunbury Outer Ring Road, Western Australia*****. Unpublished report prepared for GHD Pty Ltd on behalf of Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Brad Goode & Associates (2010) ***An Aboriginal Heritage Survey of the Proposed Bunbury Outer Ring Road (Stage 1) and the Port Access Road (Stage 2) at Picton, Western Australia*****. Unpublished report prepared for GHD Pty Ltd on behalf of Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Brad Goode & Associates (2012) ***Aboriginal Heritage Survey Report of the Proposed Bunbury Outer Ring Road (Stage 2) at Gelorup, Western Australia*****. Unpublished report prepared for GHD Pty Ltd on behalf of Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Brad Goode & Associates (2020) ***Report of an Archaeological Aboriginal Heritage Survey of Bunbury Outer Ring Road, Southern Section: Greater Bunbury Region, Western Australia.*** **Unpublished report prepared for BORR IPT on behalf of Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Ethnosciences (2020) ***Report of an Ethnographic Survey of Bunbury Outer Ring Road Southern Section, Gelorup, Western Australia*****. Unpublished report prepared for BORR IPT on behalf of Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Fauna		
Biota (2019) ***Bunbury Outer Ring Road Southern Alternative Alignment Targeted Fauna Assessment*****. Unpublished report**	Information is reliable	There are no uncertainties

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
prepared for BORR IPT on behalf of Main Roads Western Australia.		
Biota (2020a) ***Bunbury Outer Ring Road Southern Section Targeted Fauna Assessment*. Unpublished report prepared for BORR IPT on behalf of Main Roads Western Australia.**	Information is reliable	The 22 ha of the Proposal Area that was unsurveyed in the original referral was surveyed in spring of 2019. This information gap has now been filled and no uncertainties in relation to the Proposal Area remain.
Biota (2020b) ***Western Ringtail Possum Pseudocheirus occidentalis Regional Surveys*. Unpublished report prepared for Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Wetland Research and Management (WRM) (2019) ***Bunbury Outer Ring Road Alternate Alignment: Targeted Conservation Significant Aquatic Fauna Survey.* Unpublished report prepared for BORR IPT on behalf of Main Roads Western Australia.**	Information is reliable	There are no uncertainties
WRM (2020a) ***Bunbury Outer Ring Road Northern and Central Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey.* Unpublished report prepared for BORR IPT on behalf of Main Roads Western Australia.**	Information is reliable	There are no uncertainties
WRM (2020b) ***Bunbury Outer Ring Road Southern Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey.* Unpublished report prepared for BORR IPT on behalf of Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Vegetation and flora		
BORR IPT (2019a) ***Bunbury Outer Ring Road South Alternate Section Vegetation and Flora Study*. Unpublished report prepared for Main Roads Western Australia.**	Information is reliable	There are no uncertainties
BORR IPT (2020i) ***Bunbury Outer Ring Road Southern Section Vegetation and Flora Study*. Unpublished report prepared for Main Roads Western Australia.**	Information is reliable	The 22 ha of the Proposal Area that was unsurveyed in the original referral was surveyed in spring of 2019. This information gap has now been filled and no uncertainties in relation to the Proposal Area remain.
Ecoedge (2017) ***Report of a Targeted Rare Flora Survey for Diuris drummondii along four***	Information is reliable	There are no uncertainties

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
sections of the Bunbury Outer Ring Road proposed alignment. **Unpublished report prepared for Main Roads Western Australia.**		
Ecoedge (2019a) ***A Review of the Regional Conservation Status of a Clay-based Wetland Community (Claypans)*****. Unpublished report prepared for Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Ecoedge (2019b) ***Memorandum of a Targeted Rare Flora Survey for Diuris drummondii within and adjacent to the Bunbury Outer Ring Road South referral area.*** **Unpublished report prepared for Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Ecoedge (2019c) ***Review of Potential Claypan Occurrences in the BORR Southern Section*** **– included in** (BORR IPT, 2020i)**. Unpublished report prepared for Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Great Southern Biologic (2020) ***Phytophthora*** **Dieback Survey Bunbury Outer Ring Road South. Unpublished report prepared for Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Noise		
Lloyd George Acoustics (2020) ***Transportation Noise Assessment, Bunbury Outer Ring Road (Southern Section)*****. Unpublished report prepared for BORR IPT on behalf of Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Visual Impact Assessment		
BORR IPT (2020k) ***Bunbury Outer Ring Road Southern Section Landscape and Visual Impact Assessment.*** **Unpublished report prepared for Main Roads Western Australia.**	Information is reliable	There are no uncertainties
Drainage		
BORR IPT (2019g) ***Drainage Strategy – Southern Section*****. Unpublished report prepared for Main Roads Western Australia.**	Information is reliable	There are no uncertainties

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
Environmental Impact Assessment		
GHD (2012b) **Environmental Impact Assessment Bunbury Outer Ring Road - Southern Section (South Western Highway to Bussell Highway). Unpublished report prepared for Main Roads Western Australia.**	Information is reliable	There are no uncertainties

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