GOVERNMENT OF WESTERN AUSTRALIA

Environmental Protection Authority

EPA Referral Form

Form for the referral of a proposal to the Environmental Protection Authority under Section 38 of the *Environmental Protection Act 1986*

Referrer information

Who is referring this proposal?	✓ Proponent Main Roads WA ☐ Decision-making authority ☐ Community member/third party		
Name Martine Scheltema			
Position	Manager Environment	Organisation	Main Roads Western Australia
Email	martine.scheltema@mainroads.wa.gov.au		
Address	PO Box 6202		
	East Perth	WA	6002
Date	13 September 2019		

Does the referrer request that the EPA treat any part of the proposal information in the referral as confidential? *Provide confidential information in a separate attachment.*	☐ Yes ✓ No

Referral declaration for organisations, proponents and decision-making authorities:

I, Martine Scheltema, declare that I am authorised to refer this proposal on behalf of Main Roads WA and further declare that the information contained in this form is true and not misleading.

Part A: Proponent and proposal description

Proponent information

Name of the proponent/s (including Trading Name if relevant)	Main Roads WA
Australian Company Number(s) ☐ **OR** Australian Business Number(s) ☐	50 860 676 021
Contact for the proposal (if different from the referrer) *Please include: name, physical address, phone, and email.*	☐ Yes ✓ No
Does the proponent have the legal access required for the implementation of all aspects of the proposal?	☐ Yes ✓ No

***If yes**, provide details of legal access authorisations / agreements / tenure.* ***If no**, what authorisations / agreements / tenure is required and from whom?*	Land required for the Proposal will be acquired by Main Roads pursuant to section 28 (1) of the *Land Administration Act 1997* prior to implementation.
Proposal type	
What type of proposal is being referred? For a change to an approved proposal please state the Ministerial Statement number/s (MS No./s) of the approved proposal For a derived proposal please state the Ministerial Statement number (MS No.) of the associated strategic proposal	✓ significant – new proposal ☐ significant – change to approved proposal (MS No./s: _____) ☐ proposal under an assessed planning scheme ☐ strategic ☐ derived (Strategic MS No.: _____)
For a significant proposal: • Why do you consider the proposal may have a significant effect on the environment and warrant referral to the EPA?	The Bunbury Outer Ring Road (BORR) Southern Section is a regionally significant infrastructure project. The Proposal has considerable public interest. The Proposal has the potential to impact terrestrial ecology and social amenity. Main Roads considers the impacts manageable. Given the public interest and the scale and nature of the project, Main Roads considers it appropriate to refer the Proposal to the EPA.
For a proposal under an assessed planning scheme, provide the following details: • Scheme name and number For the Responsible Authority: • What new environmental issues are raised by the proposal that were not assessed during the assessment of the planning scheme? • How does the proposal not comply with the assessed scheme and/or the environmental conditions in the assessed planning scheme?	N/A
Proposal description	
Title of the proposal	Bunbury Outer Ring Road Southern Section
Name of the Local Government Authority in which the proposal is located.	• Shire of Capel • City of Bunbury
Location: a) street address, lot number, suburb, and nearest road intersection; or b) if remote the nearest town and distance and direction from that town to the proposal site.	The Proposal is approximately 7 km south of Bunbury at its closest point. The Proposal will connect with the southwest end of the BORR Northern and Central Sections and covers an area of approximately 300 ha. Further details of the location are provided in the EPA Referral Supporting Document attached, specifically Figure 1 (Appendix A).

Proposal description – including the key characteristics of the proposal *Provide as an attachment to the form*	The Proposal includes the following: • 10.5 km of new rural freeway standard, dual carriageway, including three grade separated interchanges • 3 km of regional distributor (Centenary Road at Bussell Highway to Lilydale Road) • New bridges crossing Centenary Road/ Lilydale Road, Bussell Highway, Yalinda Drive and Five Mile Brook • Local road modifications • Associated infrastructure, including drainage structures, principal shared paths, lighting, road safety barriers, walls and service relocations. The Proposal Area covers up to 300 ha, almost 70 % of which is cleared and highly modified land, including previously constructed roads. The remaining 33 % of land within the Proposal Area is native vegetation, including revegetation and scattered vegetation in road reserves or as isolated patches on agricultural land. The Proposal Area has been developed to provide an upper limit to disturbance. This extent includes the carriageway, regional distributor, earthworks, drainage and fencing. Further details, including key characteristics of the Proposal, are provided in Section 2.2 of the EPA Referral Supporting Document.
Have you provided electronic spatial data, maps and figure in the appropriate format? *Refer to instructions at the front of the form*	✓ Yes ☐ No A shapefile of the Proposal Area is submitted with this Referral Form. Figures providing relevant information to support consideration of the referral are provided in the attached EPA Referral Supporting Document.
What is the current land use on the property, and the extent (area in hectares) of the property?	The Proposal Area covers up to 300 ha and intersects land reserved as primary regional roads, regional open space, rural and urban. All impacted lots will be acquired as road reserve prior to construction.
Have you had pre-referral discussions with the EPA at DWER Services? If so, quote the reference number and/or the DWER contact.	Yes. Main Roads met with Mr Hans Jacob of the Department of Water and Environmental Regulation in March and September 2018, and in February 2019 to discuss the Proposal.

Part B: Environmental impacts

Environmental factors

What are the likely significant environmental factors for this proposal?	☐ Benthic Communities and Habitat ☐ Coastal Processes ☐ Marine Environmental Quality ☐ Marine Fauna ✓ Flora and Vegetation ☐ Landforms ☐ Subterranean Fauna ✓ Terrestrial Environmental Quality ✓ Terrestrial Fauna ✓ Inland Waters ✓ Air Quality ✓ Social Surroundings ☐ Human Health

*For **each** of the environmental factors identified above, complete the following table, or provide the information in a supplementary report*

Potential environmental impacts

1	***EPA Factor***	All EPA Factors selected above
2	***EPA policy and guidance*** - What have you considered and how have you applied them in relation to this factor?	See Section 4 in the attached EPA Referral Supporting Document for details of relevant EPA guidelines potential environmental impacts against relevant environmental factors.
3	***Consultation*** – Outline the outcomes of consultation in relation to the potential environmental impacts	See Section 3 in the attached EPA Referral Supporting Document for details of stakeholder consultation for the Proposal.
4	***Receiving environment*** – Describe the current condition of the receiving environment in relation to this factor.	See Section 4 and Appendix A, B and C in the attached EPA Referral Supporting Document for details of the receiving environment for the Proposal.
5	***Proposal activities*** – Describe the proposal activities that have the potential to impact the environment	See Section 2 and Figure 1 (Appendix A) of the attached EPA Referral Supporting Document for details of the Proposal activities.
6	***Mitigation*** – Describe the measures proposed to manage and mitigate the potential environmental impacts.	See Section 4 of the attached EPA Referral Supporting Document for details of mitigation measures for the relevant environmental factors.

7	***Impacts*** – Assess the impacts of the proposal and review the residual impacts against the EPA objective.	See Section 4 of the attached EPA Referral Supporting Document for details of potential environmental impacts on relevant environmental factors.
8	***Assumptions*** - Describe any assumptions critical to your assessment e.g. particular mitigation measures or regulatory conditions.	The following assumptions have been made in the preparation of the EPA Referral Supporting Document: • Comprehensive and adequate site surveys have been undertaken to identify all key environmental values within the Proposal Area. All surveys undertaken comply with the relevant EPA guidance statements • All key environmental values and potential impacts that may result from the Proposal are well understood.

Part C: Other approvals and regulation

State and Local Government approvals

Is rezoning of any land required before the proposal can be implemented? If yes, please provide details.	☐ Yes ✓ No Land required for the Proposal will be acquired by Main Roads under the provisions of the *Land Administration Act 1997*, prior to implementation.
If this proposal has been referred by a decision-making authority, what approval(s) are required from you?	N/A

Please identify other approvals required for the proposal:

Proposal activities e.g. clearing, dewatering, mining, processing, dredging	**Land tenure/access** e.g. Crown land, Mining lease, specify legislation for access if relevant	**Type of approval** e.g. Native Vegetation Clearing Permit, licence, mining proposal,	**Legislation regulating the activity** e.g. *EP Act 1986* – Part V, *RiWI Act 1914*, *Mining Act 1979*
Impact to Matters of National Environmental Significance		Referral of a Proposal – Approval type to be determined if the Proposal is deemed a Controlled Action	*Environment Protection and Biodiversity Conservation Act 1999*
Sourcing of water for construction		Licence to take	*Rights in Water and Irrigation Act 1914* (RIWI Act)
Disturbance of a registered Aboriginal Heritage site		Section 18 consent	*Aboriginal Heritage Act 1972*
Land acquisition process		Administration of State Land Transfer of private land	*Land Administration Act 1997*

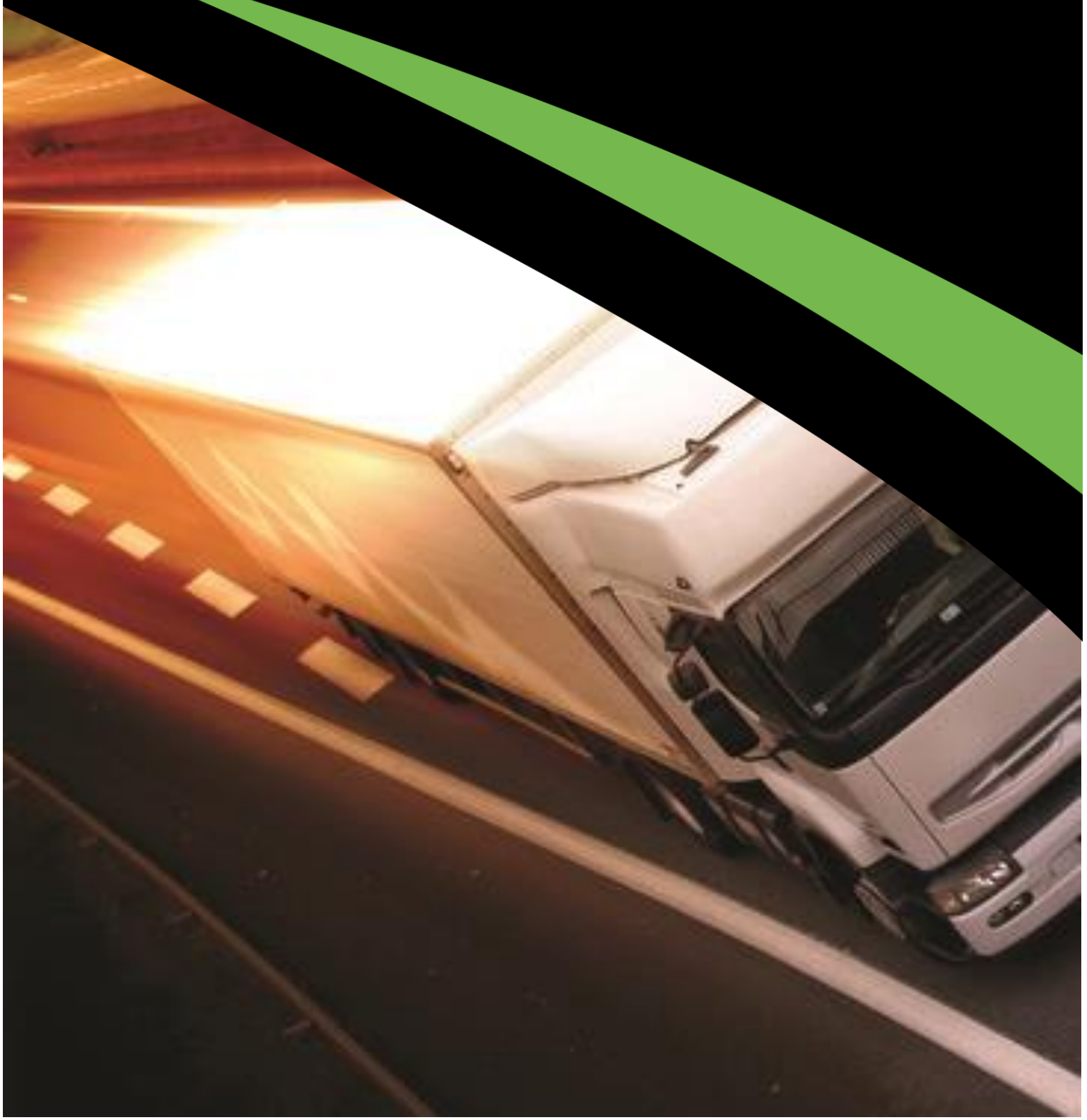
Part C: Other approvals and regulation			
State and Local Government approvals			
Authorisation to take (flora and fauna) and modify (TEC)		Licence to take and modify	*Biodiversity Conservation Act 2016*
Commonwealth Government approvals			
Does the proposal involve an action that may be or is a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)?		✓ Yes ☐ No	
Has the proposed action been referred? If yes, when was it referred and what is the reference number (EPBC No.)?		☐ Yes ✓ No Yet to be referred EPBC No.: _____	
If referred, has a decision been made on whether the proposed action is a controlled action? If 'yes', check the appropriate box and provide the decision in an attachment.		☐ Yes ✓ No ☐ Decision – controlled action ☐ Decision – not a controlled action	
If the proposal is determined to be a controlled action, do you request that this proposal be assessed under the bilateral agreement or as an accredited assessment?		☐ Yes - Bilateral ✓ No ☐ Yes - Accredited	
Is approval required from other Commonwealth Government/s for any part of the proposal? *If yes, describe.*		☐ Yes ✓ No Approval:	

BORR Team

Bunbury Outer Ring Road
Southern Section

EPA Environmental Referral Supporting Document

September 2019



EXECUTIVE SUMMARY

The Bunbury Outer Ring Road (BORR) is a planned Controlled Access Highway linking the Forrest Highway and Bussell Highway. BORR will be a high standard route for access to the Bunbury Port and facilitate proposed development to the east of the City of Bunbury. BORR provides an effective bypass of Bunbury for inter-regional traffic. The BORR Project 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 kilometre (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.

The Commissioner of Main Roads Western Australia (Main Roads) is proposing to construct and operate the southern section of the BORR Project. Main Roads is referring the BORR Southern Section (the Proposal) to the Environmental Protection Authority (EPA) for a decision on assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act). The purpose of this document is to provide information to support the decision on assessment of the Proposal.

The Proposal includes the construction and operation of 10.5 km of freeway standard, dual carriageway southwest of South Western Highway (south of Bunbury Airport) 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 300 hectares (ha) and is referred to as the **Proposal Area**. The Proposal Area connects the northern and central sections of the BORR (from Forrest Highway) to Bussell Highway.

The Proposal is located 160-168 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 northern eastern end of the Proposal will join with the southwest end of the BORR Central section, southwest of South Western Highway, approximately 8 km southeast of Bunbury Central Business District (CBD). 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.

Almost 70 % of the land within the Proposal Area is cleared and highly modified, including previously constructed roads. Approximately 30 % 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.

Environmental survey work for the Proposal (including for the current and previous designs) has occurred over many years, covering an extensive area as the design of the Proposal has evolved. Although most of the survey work has been completed, it is acknowledged that further environmental surveys are needed to assess unsurveyed areas within the Proposal Area. These surveys are expected to be completed by Q4 2019. A summary of potential impacts, proposed mitigations and outcomes for the identified environmental factors of the Proposal are provided in the following table.

KEY ENVIRONMENTAL FACTOR – FLORA AND VEGETATION	
EPA objective	*'To protect flora and vegetation so that biological diversity and ecological integrity are maintained.'*
Policy and guidance	Flora and vegetation surveys that informed planning for the Proposal were conducted in accordance with the Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016a) and the Environmental Factor Guideline (EPA, 2016b).
Potential impacts	Loss of up to 98 ha of native vegetation within the 300 ha Proposal Area. Approximately 80 % of the Proposal Area has been surveyed, with approximately 22 ha of native vegetation within the Proposal Area unsurveyed. In the unsurveyed areas, impacts beyond the loss of 22 ha of native vegetation have not yet been quantified. These will be determined through further survey and analysis that will be completed by Q4 2019. The following potential impacts have been estimated within the 76 ha of vegetation in the surveyed area: • 20.8 ha of the federally listed '*Banksia* Woodlands of the Swan Coastal Plain (SCP)' Threatened Ecological Community (TEC), which equates to 0.006 % of the current extent remaining of the TEC in the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (SWA IBRA) region • 36.5 ha of Department of Biodiversity, Conservation and Attractions (DBCA) listed '*Banksia* dominated Woodlands of the SCP Interim Biogeographic Regionalisation of Australia (IBRA) region' Priority Ecological Community (PEC) • 28.6 ha of the DBCA listed 'Tuart (*Eucalyptus gomphocephala*) Woodlands of the SCP' PEC all of which comprises FCT 25 'Southern *Eucalyptus gomphocephala-Agonis flexuosa* Woodlands' which is a PEC in its own right • 15.4 ha of riparian vegetation (associated with watercourses or wetlands) • 71 individuals of the DBCA Priority 4 (P4) species *Caladenia speciosa*, which is less than 2 % of the known number of this species • Potential) loss of individuals of the DBCA listed Priority 4 (P4) species *Acacia semitrullata* and *Aponogeton hexatepalus*, which are considered likely to occur within the Proposal Area • Potential clearing of the recently listed Tuart Woodlands TEC that is considered likely to be present within the Proposal Area, which will be confirmed and quantified during 2019 surveys • Native vegetation associations and complexes (Beard, 1979; Web *et al.* 2016) that have less than 30 % remaining at various scales, including the local government scale (i.e. within the Shire of Capel) • Loss of vegetation that intersects the periphery of two ESAs to protect the values of Conservation Category Wetlands. 0.1 ha of vegetation associated with one wetland is likely to be impacted by the Proposal. Indirect impacts such as fragmentation of native vegetation, possible introduction/ spread of Dieback (*Phytophthora cinnamomi*) or weeds, changes to vegetation structure in surrounding areas and damage to surrounding vegetation through bushfire may occur as a result of the Proposal being implemented.
Mitigation	**Avoid**

	• Clearing of remnant native vegetation was minimised through selection of the Proposal Area (through the 2019 Alignment Review) where the majority of land has been previously disturbed or cleared • Clearing of native vegetation will be avoided where practicable through consideration of potential impacts during the detailed design phase • Cut to fill techniques will be applied where possible to reduce the amount of external fill to be sourced off site. **Minimise** • Implementation of a Construction Environmental Management Plan (CEMP), incorporating a Hygiene Management Plan and Topsoil Management Plan • The disturbance footprint will be minimised by using retaining walls and steepening batters where appropriate. **Rehabilitate** • Implementation of a Topsoil Management Plan and Environmental Offsets Strategy.
Outcomes	Permanent loss of up to 98 ha of native remnant vegetation, including vegetation representative of TECs/PECs, which will require offsets to be determined through an Environmental Offset Strategy. Indirect impacts can be mitigated through implementation of relevant management plans during construction.
KEY ENVIRONMENTAL FACTOR – TERRESTRIAL FAUNA	
EPA objective	*'To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.'*
Policy and guidance	The fauna survey that informed the planning of the Proposal was conducted in accordance with the Technical Guidance – Terrestrial Fauna Surveys (EPA, 2016c) and the Environmental Factor Guideline – Terrestrial Fauna (EPA, 2016d).
Potential impacts	Loss of up to 98 ha of fauna habitat within the 300 ha Proposal Area that comprises breeding and foraging habitat for conservation significant fauna species known to occur within the Proposal Area. Approximately 80 % of the native vegetation has been surveyed, with the remainder to be surveyed and analysed by Q4 2019. In unsurveyed areas, potential fauna habitat has been estimated based on aerial interpretation and comparison with habitat mapping in surveyed areas. Further assessment of impacts to fauna in unsurveyed areas (e.g. verification of fauna habitat and quantification of nesting hollows for Black Cockatoos) will be determined through further survey and analysis. Across the surveyed and unsurveyed areas potential impacts include, approximately: • 80 ha of foraging and potential breeding habitat for Black Cockatoos (Carnaby's Cockatoo [Endangered], Baudin's Cockatoo [Endangered] and Forest Red-tailed Black Cockatoo [Vulnerable]) • 80 ha habitat for Western Ringtail Possums (WRP) (Critically Endangered) and impact the home ranges (to varying degrees) of approximately 73 WRPs estimated to utilise this habitat. (representing approximately 1 % of the regional population) • 63 ha habitat for South-western Brush-tailed Phascogale (Schedule 6) • 98 ha habitat for Southern Brown Bandicoot (Quenda) (Priority 4).

	Potential loss of Black-stripe Minnow habitat within Geomorphic Wetlands intersected by the Proposal Area (where the species was recorded adjacent to but outside of the Proposal Area). Loss of fauna habitat for a further six conservation significant fauna species that are likely to occur or possibly occur within the Proposal Area. Potential for death or displacement of fauna species may occur through vehicle movements, traffic noise exposure, light spill or disturbance of the bed and banks of watercourses. In the surveyed area only, potential impacts include: • Loss of 538 Suitable Diameter Breast Height (DBH) Trees (Black Cockatoos) • Loss of up to 18 trees considered to be Trees with a Suitable Nest Hollow for Black Cockatoos, of which eight are Known Nesting Trees.
Mitigation	**Avoid** • Clearing of fauna habitat was minimised through selection of the Proposal Area where the majority of land has been previously disturbed or cleared • Avoiding the clearing of fauna habitat during the detailed design phase. **Minimise** • Reducing clearing widths through use of retaining walls and steeper batters • Design to include infrastructure to facilitate fauna movement • Implementation of a CEMP and Fauna Management Plan • Timing of clearing to avoid Black Cockatoo nesting period • All known nesting hollows impacted to be mitigated by the installation of a suitably placed artificial hollow nearby. **Rehabilitate** • Revegetating temporarily cleared areas with vegetation known to provide WRT and Black Cockatoo habitat • Implementation of an Environmental Offsets Strategy.
Outcomes	Clearing of native vegetation for the construction of the Proposal will result in reduction of habitat supporting conservation significant fauna. It is considered likely that the Proposal will have minor residual impacts on Black Cockatoos and WRP. The permanent loss of habitat for conservation significant fauna species will be offset in accordance with the WA Offset Policy. Other potential impacts can be mitigated through implementation of relevant management plans during construction.
KEY ENVIRONMENTAL FACTOR – TERRESTRIAL ENVIRONMENTAL QUALITY	
EPA objective	*'To maintain the quality of land and soils so that environmental values are protected.'*
Policy and guidance	Investigations that informed the planning of the Proposal were conducted in accordance of the requirements of the Environmental Factor Guideline – Terrestrial Environmental Quality (EPA, 2016e), Department of Water and Environmental Regulation (DWER) Acid Sulfate Soil (ASS) Guideline Series (DER, 2015a) and Assessment and the Management of Contaminated Sites (DER, 2014).
Potential impacts	Without appropriate management, the Proposal has the potential to have the following impacts.

	Construction • Excavation and exposure of ASS into the receiving environment causing contamination of land and/or waters • Erosion of surrounding soils • Accidental release of environmentally hazardous material from storage or handling areas, causing contamination of land • Indirect impacts such as loss of soil health from erosion and vegetation clearing. **Operations** • Contamination of land and erosion from stormwater runoff • Loss of soil function due to establishment of a permanent bituminised (road base) surface.
Mitigation	**Avoid** • Hydrocarbon and chemical handling will be managed through the implementation of a CEMP • Avoidance of likelihood of soil salinisation through minimising clearing of native vegetation (where practicable) and revegetation • Drainage design to contain hazardous spills. **Minimise** • Implementation of an ASS Management Plan (ASSMP), CEMP and Topsoil Management Plan • Undertake a contamination risk assessment of the entire alignment (when available) and remediate as required. **Rehabilitate** • Soil rehabilitation through implementation of a Topsoil Management Plan.
Outcomes	Construction of the Proposal will result in loss of soil function for the bituminised areas (road base). The remainder of the Proposal Area can be rehabilitated to restore soil function. Risk of ASS impacts through construction of the Proposal can be managed by developing and implementing and effective ASS Management Plan.
KEY ENVIRONMENTAL FACTOR – INLAND WATERS	
EPA objective	*'To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.'*
Policy and guidance	The Inland Waters studies that have informed the planning of the Proposal were conducted in accordance with the Environmental Factor Guideline – Inland Waters (EPA, 2018a) and Contaminated Sites Guidelines (DER, 2014).
Potential impacts	• Temporary and localised alteration of groundwater levels in the superficial aquifer due to dewatering and water abstraction during construction • Potential changes to hydrological regimes of Geomorphic Wetlands and waterways • Erosion and sedimentation in surrounding areas • Impacts to the beds and banks of waterways

	• Contamination of surface and/or groundwater from contaminated stormwater, accidental release of hazardous substances and exposure of Acid Sulfate Soils (ASS) or Potential Acid Sulfate Soils (PASS) during construction • Potential indirect impacts to Groundwater Dependent Ecosystems (GDEs) and vegetation communities from altered groundwater tables and hydrological regimes.
Mitigation	**Avoid** • Road and drainage design to maintain hydrological flow regimes and control stormwater runoff **Minimise** • Implement a CEMP (e.g. ASS management, drainage and groundwater management, dust management, hazardous materials management) • Compliance with groundwater abstraction licence.
Outcomes	Impacts to hydrological flows will be mitigated through road and drainage design. Temporary impacts to surface and groundwater during construction will be managed through the CEMP. Given the nature of the Proposal, permanent change to groundwater regimes due to the Proposal is considered unlikely. No significant residual impacts to inland waters are expected and it is considered the Proposal meets the EPA objective to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.
KEY ENVIRONMENTAL FACTOR – AIR QUALITY	
EPA objective	*'To maintain air quality and minimise emissions so that environmental values are protected.'*
Policy and guidance	The Air Quality studies that have informed the Proposal planning and design were conducted in accordance with the Environmental Factor Guideline – Air Quality (EPA, 2016f) and the National Environment Protection (Ambient Air Quality) Measure (AIR NEPM) (National Environment Protection Council, 2016).
Potential impacts	• Reduced air quality due to increased construction vehicle emissions • Dust generated from construction activities • Smoke from accidental bushfire • Increased greenhouse gas (GHG) emissions • Indirect impacts such as dust deposition on nearby vegetation.
Mitigation	**Avoid** • Select energy efficient assets, renewable energy sources and materials with lower embodied energy • Reduce congestion through alternative design treatments such as roundabouts or modified intersections. **Minimise** • Implement a CEMP (dust management, fire risk management) • Management measures of GHG emissions to be determined through an assessment of direct emissions during construction.
Outcomes	Some visible dust emissions will likely occur during construction. Dust emission are expected to be minor and will be managed through appropriate mitigation measures. An Air Quality Assessment for future road traffic emissions indicates that the Proposal is unlikely to adversely impact local air quality. Street lighting, traffic signals and road maintenance activities are unlikely to produce significant GHG emissions throughout the Proposal. Construction and

	operation phases of the Proposal will be subject to a direct GHG emissions assessment. Given the proposed mitigation measures outlined above, no residual impacts are expected for this aspect and the Proposal meets the EPA objective to maintain air quality and minimise emissions so that environmental values are protected.
KEY ENVIRONMENTAL FACTOR – SOCIAL SURROUNDS	
EPA objective	*'To protect social surroundings from significant harm.'*
Policy and guidance	The social surroundings investigations that have informed the planning and design of the Proposal were conducted in accordance with Environmental Factor Guideline –Social Surroundings (EPA, 2016g), *Environmental Protection (Noise) Regulations 1997* (Noise Regulations) and the *Aboriginal Heritage Act 1972* (AH Act).
Potential impacts	**Construction** • Aboriginal Heritage Site disturbance during clearing and/ or excavation works Unauthorised disturbance to Aboriginal Heritage sites • Reduced visual amenity due to vegetation clearing and construction activities • Noise and dust from equipment and vehicle operation and from increased traffic on local road network. **Operations** • Reduced visual amenity where the new road is visible to nearby residents • Increased noise from a change in rural land use to roadway • Increased glare or light spill from lighting at interchanges and vehicle headlights.
Mitigation	**Minimise** • Minimise noise emissions through site selection and design (e.g. noise walls) and implementation of a CEMP (construction noise management). Design of mitigation measures will ensure the project complies with SPP 5.4. • Design of the Proposal has been informed by the results of environmental and other surveys and adjusted where possible to minimise impacts, including alteration of the alignment to avoid large remnant tuart tree in Gelorup. • Minimise vibration and dust through implementation of a CEMP (incorporating vibration and dust management) • Implement an Aboriginal Heritage Management Plan to minimise the risk of any unauthorised disturbance of Aboriginal Heritage sites • Implement a Landscape Management Plan. **Rehabilitate** • Implement a Landscape Management Plan including site rehabilitation.
Outcomes	Construction and operation of the Proposal will change land use from 'rural' to 'regional roads' for sections of the alignment between South Western Highway and Jilley Road. Social aspects of the environment will change through impacts on Aboriginal Heritage sites, local visual amenity, and increased noise. The EPA objective for Social Environment will be met for the Proposal through implementation of appropriate management and mitigation detailed in the environmental management plans and SPP 5.4 Guidelines (Noise).

ACRONYMS

AH Act	*Aboriginal Heritage Act 1972*
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS	Australian Standard
ASS	Acid Sulfate Soils
BaP	Benzo(a)pyrene
BC Act	*Biodiversity Conservation Act 2016*
Biota	Biota Environmental Sciences
BoM	Bureau of Meteorology
BORR IPT	Bunbury Outer Ring Road Integrated Project Team
BORR	Bunbury Outer Ring Road
CBD	Central Business District
CCW	Conservation Category Wetland
CEMP	Construction Environmental Management Plan
CEO	Chief Executive Officer
CO	Carbon monoxide
CRG	Community Reference Group
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter at Breast Height
DEC	Department of Environment and Conservation
DEE	Department of the Environment and Energy
DER	Department of Environment Regulation
DEWHA	Department of the Environment, Water, Heritage and the Arts
DoW	Department of Water
DPaW	Department of Parks and Wildlife
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DRG	Drainage Reference Group
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DWER	Department of Water and Environmental Regulation
DWSPP	Drinking Water Source Protection Plan
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FCT	Floristic Community Type
GBRS	Greater Bunbury Region Scheme

GDE	Groundwater Dependent Ecosystem
GHG	Greenhouse Gas
GIS	Geographic Information System
GKB NTC	Gnaala Karla Booja Native Title Claim group
GoWA	Government of Western Australia
GSWA	Geological Survey of Western Australia
IBRA	Interim Biogeographic Regionalisation of Australia
IDE	Inflow Dependence Ecosystem
IFD	Intensity Frequency Duration
ILUA	Indigenous Land Use Agreement
IPT	Integrated Project Team
ISCA	Infrastructure Sustainability Council of Australia
IUCN	International Union for Conservation of Nature
LGA	Local Government Area
LWMS	Local Water Management Strategy
MCA	Multi-Criteria Analysis
MNES	Matters of National Environmental Significance
MRWA	Main Roads Western Australia
MSE	Mechanically Stabilised Earth
MSS	Materials Sourcing Strategy
MU	Multiple Use
NEPM	National Environmental Protection Measure
NO_2	Nitrogen dioxide
NO_X	Nitrous oxides
NZS	New Zealand Standard
O_3	Ozone
P	Priority
PAR	Port Access Road
PASS	Potential Acid Sulfate Soils
PDWSA	Public Drinking Water Source Area
PEC	Priority Ecological Community
PM_{10}	Particulate matter less than or equal to 10 microns in diameter
PSWA	Proclaimed Surface Water Area
RE	Resource Enhancement
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
SWREL	South West Regional Ecological Linkage
TEC	Threatened Ecological Community

TSSC	Threatened Species Scientific Committee
UFI	Unique Feature Identifier
UWMP	Urban Water Management Plan
VOC	Volatile organic compound
VT	Vegetation Type
WA	Western Australia
WAPC	Western Australian Planning Commission
WoNS	Weeds of National Significance
WRM	Wetland Research and Management
WRP	Western Ringtail Possum

DEFINED TERMS

TERM	DEFINITIONS
Acid sulfate soils, ASS, potential acid sulfate soils, PASS	**Acid sulfate soils (ASS)** are naturally-occurring soils and sediments whose sulphide minerals, predominantly pyrite, have been exposed to oxygen and have formed sulphuric acid. **Potential acid sulfate soils (PASS)** are ASS where the sulphide minerals have not been oxidised by exposure to air.
Bunbury Outer Ring Road, BORR	A Planned Controlled Access Highway linking the Forrest Highway and Bussell Highway that will provide a high standard route for access to the Bunbury Port and facilitate proposed development to the east of the City of Bunbury. BORR will provide effective bypass of Bunbury for inter-regional traffic. The BORR comprises: • BORR Northern Section – section between Forrest Highway (north) and Boyanup-Picton Road (south) • BORR Central Section – section, already constructed, between Boyanup-Picton Road (north) and South Western Highway (south) • BORR Southern Section – section between South Western Highway (north) and Bussell Highway (south).
Consanguineous wetlands, consanguineous wetland suites	Wetlands that occur within the same region, within the same setting and have formed because of similar, related factors.
Geomorphic wetlands	Wetlands classified according to landform and water permanence, e.g. lake, sumpland, dampland and palusplain. Swan Coastal Plain wetlands management categories are based on their assessed level of management and protection requirements, i.e. Conservation, Resource Enhancement or Multiple Use.
Conservation Category Wetland (CCW)	A wetland with a high level of attributes and functions.
Construction Management Plan, CEMP	A management plan developed to avoid, minimise or mitigate impacts from construction on environmental values through risk management planning, establishing appropriate targets and performance indicators, monitoring and reporting of compliance and making process improvement as necessary.
Dieback, Dieback disease	An invasive, prolifically infectious soil-borne water mould, *Phytophthora cinnamomi*, that causes rot-like symptoms in plant and tree roots.
Environmental Management Plan, EMP	A project-specific plan covering the environmental aspects of asset creation and delivery, i.e. design, construction, commissioning, operation and maintenance
Main Roads	Main Roads Western Australia
Matters of National Environmental Significance (MNES)	Matters protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), i.e.: • World heritage properties • National heritage places • Wetlands of international importance (listed under the Ramsar Convention) • Listed threatened species and ecological communities • Migratory species protected under international agreements

TERM	DEFINITIONS
	• Commonwealth marine areas • The Great Barrier Reef Marine Park • Nuclear actions (including uranium mines) • A water resource, in relation to coal seam gas development and large coal mining development. Under the EPBC Act, actions that have, or are likely to have, a significant impact on a MNES require approval from the Australian Government Minister for the Environment who will decide whether assessment and approval is required.
Multiple Use Wetland	A wetland with few important ecological attributes and functions remaining.
Proposal Area	The area shown in Figure 1, covering approximately 300 hectares (ha), 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). Small part of the Proposal Area also occurs in the City of Bunbury.
Ramsar, Ramsar Convention, Ramsar wetland	An international, intergovernmental treaty for the conservation and sustainable use of wetlands especially as waterfowl habitat. Treaty was established in 1971 in the city of Ramsar, Iran.
Regional distributor	A road designed for efficient movement of people and goods within and beyond regional areas.
Resource Enhancement Wetland	A wetland which may have been partially modified but still supports substantial ecological attributes and functions
Swan Coastal Plain, SCP	Located in the southwest of Australia; characterised by a series of sand dune systems, low-lying coastal plain, mainly covered with woodlands with unique landscape features and wetlands, the **SCP** is one of Western Australia's Interim Biogeographic Regionalisation for Australia (IBRA) regions and is a specific botanical province.

CONTENTS

TABLE INDEX

FIGURES INDEX

APPENDICES

Document *Control*

Revision	Date	Description	Prepared	Reviewed	Approved
A		Draft for Main Roads Review	BORR Team	MB	FH
B	9/9/19	Final draft for Main Roads Review	BORR Team	MB	FH
0	13/09/19	Final document for issue to Main Roads	BORR Team	MB	FH

1 INTRODUCTION

The Bunbury Outer Ring Road (BORR) forms a major component of the planned regional road network for the Greater Bunbury area. The land requirement for the BORR was identified in the original draft Greater Bunbury Region Scheme (GBRS) in 1996, 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 and 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.

The 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 Commissioner of Main Roads Western Australia (Main Roads) is proposing to construct and operate the southern section of BORR (Figure 1, Appendix A). The BORR is a planned Controlled Access Highway linking Forrest Highway and Bussell Highway. The completed project will provide a high standard route for access to the Bunbury Port and facilitate proposed development to the east of the City of Bunbury. The BORR will also provide an effective bypass of Bunbury for inter-regional traffic.

This document pertains to the BORR Southern Section.

1.1 Purpose of this Document

Main Roads is referring the BORR Southern Section proposal to the Environmental Protection Authority (EPA) for a decision on assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act). The purpose of this document is to support that referral. This document provides information on the Proposal activities, potential environmental impacts and proposed mitigation measures associated with construction and operation of the BORR Southern Section.

This document has been prepared in accordance with Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016 (EPA, 2016h) and Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual (EPA, 2018b).

1.2 Proposal Description

The Proposal is located 160-168 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 also occurs in the City of Bunbury.

The Proposal includes construction and operation of 10.5 km of freeway standard, dual carriageway between South Western Highway (south of Bunbury Airport) southwest 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 plus 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 300 hectares (ha) and is referred to as the **Proposal Area**. The Proposal Area connects the

northern and central sections of the BORR (from Forrest Highway) through to Bussell Highway. The components of the Proposal are described in Section 2.2.

The northeast end of the Proposal will join the southwest end of the BORR Central section near South Western Highway, approximately 8 km southeast of Bunbury CBD. 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.

Almost 70 % of the land within the Proposal Area is cleared land and highly modified land including previously constructed roads. Approximately 30 % 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. The Proposal Area has been appropriately sized to accommodate construction and operation of the dual carriageway, regional distributor and associated infrastructure. The Proposal Area is illustrated in (Figure 1, Appendix A)

1.3 The Proponent

The Proponent for the Proposal is the Commissioner of Main Roads and formal contact details are:

PROPONENT	Commissioner of Main Roads Western Australia PO Box 6202 East Perth WA 6002 ABN/ACN 50 860 676 021
PROPOSAL KEY CONTACT	Dominic Boyle Project Director Main Roads Western Australia Don Aitken Centre (DAC) East Perth WA 6004

1.4 Environmental Impact Assessment Process

1.4.1 *Environmental Protection Act 1986,* Part IV Environmental Impact Assessment

The Proposal will be assessed under Part IV of the EP Act which is the primary legislation governing environmental protection and impact assessment in Western Australia (WA). Division 1 of Part IV of the EP Act provides for the referral and assessment of significant and strategic proposals.

The Proposal Area overlaps much of the GBRS BORR corridor proposal that was referred in 1996 and formally assessed by the EPA. The Minister for the Environment approved its implementation in 2005 under Ministerial Statement 697 (Western Australian Minister for the Environment, 2005). Given the Southern Section is not entirely consistent with the GBRS and the public interest in the Proposal, the current Proposal is not being referred as a proposal under the GBRS thus, conditions set out in Ministerial Statement 697 do not apply.

1.4.2 *Environmental Protection and Biodiversity Conservation Act 1999*

A proposed action that may have a significant impact on a Matter of National Environmental Significance (MNES) requires approval from the Commonwealth under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Proposal will be referred to the Department of the Environment and

Energy (DEE) under the EPBC Act due to the potential impacts to protected fauna species and communities. Main Roads does not intend to have this project assessed as an accredited process. Further details on potential MNES within the Proposal Area are provided in Sections 4.3, 4.4 and 6.

1.4.3 Other approvals and regulation

Following primary 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 are summarised in Table 1-1.

Table 1-1 Summary of other regulatory approvals required

PROPOSED ACTIVITIES	TYPE OF APPROVAL	REGULATORY AGENCY	LEGALISATION REGULATING THE ACTIVITY
Interference with bed and banks of a watercourse (clearing of vegetation and construction works)	Application for a permit to authorise interference or obstruction of the bed and banks of a watercourse	Department of Water and Environmental Regulation (DWER)	*Rights in Water and Irrigation Act 1914* (RIWI Act)
Sourcing of construction water	Licence to take	DWER	RIWI Act
Disturbance of a registered Aboriginal heritage site	Section 18 consent	Department of Planning, Lands and Heritage (DPLH)	*Aboriginal Heritage Act 1972* (AH Act)
Land acquisition process	Administration of State Land Transfer of private land	DPLH	*Land Administration Act 1997*
Authorisation to take (flora and fauna) and modify (TEC)	Licence to take and modify	Department of Biodiversity, Conservation and Attractions (DBCA)	*Biodiversity Conservation Act 2016* (BC Act)

Planning approvals

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 (refer to Section 2). This will require an amendment to the GBRS to reserve the alignment for the purposes of Primary Regional Roads.

No development approval is required for road construction works on land reserved by the GBRS for the purpose of Primary Regional Roads or Other Regional Roads. Approval of the WAPC may be required through a development approval, for any works that occur before the land is appropriately reserved by the GBRS. This includes land reserved by the GBRS for any other purpose, and on land zoned by the GBRS.

Clause 27 of the GBRS identifies that the WAPC, by way of resolution, can require development on zoned land to have the approval of the WAPC. The relevant instrument of delegation includes a number of circumstances expected to apply to the Proposal; where construction occurs before gazettal of an amendment to the GBRS, elements of the Proposal will require development approval.

Land within the proposed alignment will be acquired by Main Roads and dedicated as a road pursuant to section 28 (1) of the *Land Administration Act 1997*.

1.4.4 Decision making authorities

The authorities listed in

Table 1-2 have been identified as decision making authorities (DMAs) for the Proposal.

Table 1-2 Decision making authorities for the Proposal

DECISION MAKING AUTHORITY	RELEVANT LEGISLATION
Minister for Lands	*Land Administration Act 1997*
Minister for Planning	*Planning and Development Act 2005*
Western Australian Planning Commission	*Planning and Development Act 2005*
Chief Executive Officer (CEO) of the Department of Water and Environmental Regulation (DWER)	*Rights in Water and Irrigation Act 1914*
Minister for Aboriginal Affairs	*Aboriginal Heritage Act 1972*

2 THE PROPOSAL

2.1 Proposal Justification

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 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.

The Proposal is a major component of the BORR project which is a key part of the planned regional road network for the Greater Bunbury Region aiming to improve port access and accommodate the increase in traffic associated with the anticipated population growth.

The main economic drivers of the South West are mining and mineral processing (predominantly alumina, coal and mineral sands), tourism, construction, timber industry and agriculture/viticulture. Each of these industries are reliant on road transport (South West Development Commission, 2018).

Key benefits of the Proposal include enabling the completed BORR to fulfil its role within the planned regional road network for the Greater Bunbury Region and realising the associated benefits including:

- Reduced congestion
- Reduced air and noise pollution in developed urban areas
- Improved access to Bunbury Port and accommodating future planning, e.g. Draft Wanju District Structure Plan (WAPC, 2016) and Draft Waterloo Industrial Park District Structure Park District Structure Plan (WAPC, 2017a)
- Increasing direct and indirect employment opportunities for the local population during the construction phase
- Improving road user safety on Bussell Highway.

2.2 Key Proposal Characteristics

Key Proposal characteristics are presented in Table 2-1.

The Proposal Area covers approximately 300 ha, of which almost 70 % is cleared and highly modified land including previously constructed roads. The remaining 33 % 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.

The Proposal Area provides a development envelope where infrastructure will be established; disturbance area is likely to be less than the Proposal Area and will be defined during detailed design. The extent of disturbance includes the carriageway, regional distributor, earthworks, drainage and fencing, see Figure 2 (Appendix A).

Table 2-1 Key Proposal characteristics

ELEMENT	LOCATION	PROPOSED EXTENT
Physical elements		
Overall Proposal footprint (including all physical elements below)	Figure 1 (Appendix A)	Clearing or disturbance of up to 300 ha comprising approximately: • 98 ha native vegetation • 202 ha cleared and highly modified area (agricultural land and existing built infrastructure).
Road construction and associated infrastructure	Figure 1 (Appendix A)	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	Figure 2 (Appendix A)	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 Southern Section		Main Roads will operate the Proposal using standard management and maintenance practices.

2.3 Proposal Stages

2.3.1 Design

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 2-2 and illustrated in Figure 2 (Appendix A).

Table 2-2 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.

2.3.2 Construction

Construction is planned to commence in Quarter Two 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 comprise:

- 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 will 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). 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.

2.3.3 Operation

Along with the BORR Northern and Central sections, 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.

2.4 Alternative Options Considered

2.4.1 Planning history

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).

The BORR concept was originally developed by Main Roads in the early 1970s in consultation with other State Government departments and Local Authorities. The original concept linked the Australind Bypass

(now known as Forrest Highway), north of Bunbury, with Bussell Highway, south of Bunbury, via a 19 km, Controlled Access, four-lane, divided rural highway. The BORR Northern Section Alignment, originally proposed to be situated west of Hynes Road, was included as a regional road along with proposed alignments for the BORR central and southern sections. The BORR formed part of the Bunbury Region Plan (State Planning Commission, 1987), now replaced by the Bunbury Wellington Region Plan (Department of Planning and Urban Development, 1993).

The BORR GBRS corridor alignment was developed in 1995, based on work undertaken by Halpern Glick and Maunsell (HGM) to prepare a BORR Concept Report (Halpern Glick and Maunsell (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. 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 2010, the Department of Planning (now DPLH), approached Main Roads seeking to modify the BORR Northern Section GBRS corridor alignment in order to accommodate future expansion of the Greater Bunbury urban and industrial footprint including the newly identified Wanju Urban and Waterloo Industrial areas. The planning review was prompted by a number of factors including the need to accommodate a future population of Greater Bunbury and to inform Main Roads' understanding of the initially planned population of the proposed Wanju development of around 16,500. This resulted in Main Roads reviewing the alignment of the BORR Northern Section including its intersection with Forrest Highway and the future requirements for passenger rail infrastructure. In 2012, Main Roads finalised a BORR northern section alignment, located slightly east of the GBRS corridor that was referred to as the "BORR Northern Section Western Alignment Corridor" and, based on that alignment, Draft District Structure Plans for the proposed Wanju (urban) and Waterloo (industrial) areas were advertised between 2016 and 2017.

In late 2016, Main Roads commenced a planning review for a future South West Freeway (from Mandurah to Busselton) spanning the Forrest and Bussell highways that included the BORR. It was recognised that updated land use planning surrounding Greater Bunbury and the BORR Northern Section Western Alignment Corridor provided an opportunity for an alternative alignment to be considered. Government agency and stakeholder engagement confirmed broad support for investigating an alternative alignment to the east of the BORR Northern Section Western Alignment Corridor, which came to be known as the "BORR Northern Section Eastern Alignment Corridor"; that review culminated in the recent (June 2019) referral of the BORR Northern and Central Sections to the EPA for a decision on assessment under Section 38 of the EP Act.

In November 2012, Main Roads referred a proposal to the EPA for the BORR Southern Section, where the South Western Highway (north) connects with Bussell Highway (south) (GHD, 2012c), see Figure 3 (Appendix A).

In February 2013, the EPA determined that the proposal for the 2012 BORR Southern Section Project did not require formal environmental assessment. 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 DEE) 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 June 2017, Main Roads withdrew the proposal.

In May 2018, the Commonwealth elevated the conservation status of the Western Ringtail Possum (WRP) from "vulnerable" to "critically endangered". This change raised concerns about the 2012 BORR Southern Section Project and a review was subsequently undertaken to ascertain the most appropriate alignment for the Southern Section.

2.4.2 2019 alignment review

In May 2019, an Environmental Options Assessment was undertaken which identified that a key concern for the 2012 BORR Southern Section Project was the clearing of native vegetation comprising fauna habitat, and in particular, WRP habitat. As a result, the northern and southern alignments set out in the 2012 Referral Project Area for the BORR Southern Section were reviewed, as was a subsequent "Southern Section Alternative Alignment" for the southernmost section.

Review of the 2012 BORR Southern Section alignment options confirmed that the northern option (from South Western Highway, south to Hasties Road) was preferable when considering resource, farming and environmental aspects. A review of the 2012 BORR Southern Section southern alignment option involved assessment of alternative alignments (including those suggested by stakeholders who were involved in the review). Subsequently, a "preferred" Southern Section Alternative Alignment was evaluated against the original alignment proposed in the 2012 BORR Southern Section Project referral.

The Southern Section Alternative Alignment was derived through assessment of a number of proposed alternative alignments using Multi-Criteria Analysis (MCA). MCA was also used to evaluate the Southern Section Alternative Alignment against the alignment in the 2012 BORR Southern Section Project referral. The key findings of the review were:

- Given the constraints and impacts associated with resources in the area, there was no overall advantage to changing the northern alignment of the 2012 BORR Southern Section, i.e. from South Western Highway (north) to Hasties Road (south)
- The MCA indicated that based on environmental, social, heritage, land use planning, engineering constraints, potential impacts on agricultural businesses, raw material and mining tenement, the alignment within the GBRS corridor, i.e. as proposed in the 2012 BORR Southern Section Project referral, scored better than the alternative alignment.

The BORR Southern Section Proposal Area and 2012 Referral Project Area are shown in Figure 3 (Appendix A). The current Proposal Area reflects updated concept design based on refinements in construction planning and constraints assessments. As previously stated; the Proposal is currently at Concept Design phase and further changes are expected during the detailed design process.

3 STAKEHOLDER CONSULTATION

Stakeholder consultation has been a key component to the development of the 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, 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 DEE
  - DBCA
  - DWER
  - EPA Services.

Stakeholder and community engagement is continuing with landowners and local residents, communities of interest, local government authorities and State Government agencies. During 2018, Main Roads consulted with key stakeholders to discuss BORR Project issues and potential impacts including environmental, heritage (Aboriginal and European), social and economic impacts.

A summary of consultation completed to date is provided in Table 3-1. Regulatory agencies consulted to date are shown in Table 3-2. A summary of the key concerns raised during stakeholder consultation is provided in Table 3-3 along with Main Roads responses.

Table 3-1 Recent Key Stakeholder Consultation Summary

STAKEHOLDER CONSULTATION	DATE	PARTICIPANT AGENCIES
Investment Logic Mapping Workshop	4 December 2017	• Main Roads • SWDC • Great Southern Ports • Qube (bulk minerals sand transporter)
Project Steering Committee	June 2018 – ongoing (bi-monthly)	• Chaired by MD Main Roads • Main Roads' Project Director • Department of Treasury

STAKEHOLDER CONSULTATION	DATE	PARTICIPANT AGENCIES
		• DPLH • Department of Infrastructure, Regional Development and Cities • Others by invitation
Project Enabling Group	June 2018 – ongoing (bi-monthly)	• Chaired by Main Roads' Executive Director Planning and Technical Services • City of Bunbury • Shire of Capel • Shire of Harvey • Shire of Dardanup • DPLH • BORR Integrated Project Team (IPT)
BORR Regional Local Government Advisory Group	August 2018 – ongoing (quarterly or at Key Milestones)	• Chaired by Main Roads' Executive Director Planning and Technical Services • City of Bunbury • Shire of Capel • Shire of Harvey • Shire of Dardanup • Bunbury Outer Ring Road Integrated Project Team (BORR IPT)
Economic Advisory Group	October 2018 – ongoing (at Key Milestones)	• City of Bunbury • Bunbury Geographe Economic Alliance (BGEA) • SWDC • Regional Development Australia South West • Chamber of Minerals and Energy • Wespine • Bunbury Geographe Chamber of Commerce and Industry • Main Roads • BORR IPT
Drainage Reference Group (DRG)	August 2018 – ongoing (at Key Milestones)	• DBCA – Parks and Wildlife Service • DWER • Water Corporation • City of Bunbury • Shire of Capel • Shire of Dardanup • Shire of Harvey • Department of Primary Industries and Regional Development (DPIRD) • Harvey Water • Leschenault Catchment Council • South West Catchments Council • BORR Team • Main Roads
Freight and Road Users Group	August 2018 – ongoing (at Key Milestones)	• City of Bunbury • Shire of Capel • Shire of Dardanup • DPLH

STAKEHOLDER CONSULTATION	DATE	PARTICIPANT AGENCIES
		• Department of Transport • Freight and Logistics Council WA • Livestock & Rural Transport Association • Public Transport Authority • RAC WA • WA Pilot Drivers Association
Local Members meetings	Ongoing	• Member for Bunbury, Don Punch • Member for Collie - Preston, Mick Murray • Member for Murray - Wellington, Robyn Clarke • Nola Marino - Federal Member • Adele Farina, MLC
BORR – Bunbury Freight Access Enhancement – Options workshop	25 January 2018	• Department of Transport
Presentation to Chamber of Commerce	14 November 2018	• Main Roads • Chamber of Commerce • BORR IPT
Shire Project Briefing Meetings	May 2018 – ongoing (at Key Milestones)	• City of Bunbury • Shire of Capel • Shire of Dardanup • Shire of Harvey • Main Roads • BORR IPT
Gnaala Karla Boodja WC1998/058 Native Title Claim group (GKB NTC) meeting	7 May 2018, 29 October 2018	• Brad Goode & Associates • Nine representatives from the GKB NTC group • DPLH • Main Roads • BORR IPT
General public and local residents drop in sessions	24, 25, 30 and 31 October 2018	• Community members
Project newsletter	2018	• Local community (distribution) • General public (via website) • Local Government Areas (LGAs) (distribution) • MLAs (distribution)
Community Reference Group (CRG) Southern Alignment	July 2018 – ongoing (monthly)	• Community members

STAKEHOLDER CONSULTATION	DATE	PARTICIPANT AGENCIES
Local landowners and residents	23 Oct 2018	• Landowners within BORR Southern Section GBRS Alignment • Residents (if renting within BORR Southern Section GBRS Alignment)
Local Community Group	July 2018	• Friends of Gelorup Corridor

Table 3-2 Recent Agency Consultation

AGENCY	DATE	PURPOSE
EPA Services	13/03/18	Project update
	05/09/18	Project update
	13/02/19	Project update
DEE	25/05/18	Project briefing
	26/05/18	BORR site walk through – BORR Southern Section Gelorup
	17/07/18	Meeting at Main Roads head office, DAC Perth - Project update
	08/10/18	Meeting at DAC - Project update
	14/02/19	Meeting at DAC - Project update
	09/07/19	BORR site visit
DWER – Environmental Regulation	25/05/18	Briefing South West Regional Office
	26/05/18	BORR site walk through – BORR Southern Section Gelorup
	09/07/19	BORR site visit
DBCA	25/05/17	BORR Project update
	13/11/17	Site visit BORR south wetlands
	30/07/18	BORR Project Update
	24/05/18	BORR and WRP issues
	14/09/18	WRP issues
	28/11/18	BORR Project update
	09/07/19	BORR site visit

Table 3-3 Summary of key concerns raised during consultation

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
CRG Members, Community members	CRG Meetings, Community Drop in Sessions,	**Need for BORR and Strategic Traffic Modelling Basis** There have been numerous enquiries by CRG members into the basis of population statistics used to inform the traffic model. More broadly there have been questions relating to the need for BORR.	There is already significant pressure on the road network around Bunbury, and this is projected to increase due to a number of factors: • Population growth in Greater Bunbury • Proposed development in Wanju, Waterloo and surrounding areas • Increased freight movements, due to mining activity and associated growth in Bunbury Port activities. The existing road network in and around Bunbury supports a range of vehicle movements including freight and light vehicles, regional and local traffic. These combinations of vehicles on local road networks impact on road safety and amenity. As a Port City, Bunbury plays an important role in the WA economy. Twelve per cent of the world exports of alumina leave from the Port of Bunbury. The current access to Bunbury Port is problematic and impacts on freight efficiency. Currently, vehicles travelling between the Bussell Highway and Forrest Highway have to navigate 13 sets of traffic lights and one rail level crossing. When complete, between 10,000 and 15,000 vehicles per day on average are expected to use the new road. These regional / port movements would otherwise mix with local traffic on local roads. Population forecasts used in strategic traffic modelling come from land use planning by the Department of Planning, Land and Heritage and it considers the City of Bunbury, Shire of Dardanup and Shire of Harvey and is based on planned land use changes forecast for the ultimate design life of BORR.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
Community members, CRG members, impacted businesses	CRG Meetings, Community Drop in Sessions, Public Enquiries, Landowner Briefings	**Southern Alignment Investigations** Questions have been raised around why an alternative alignment has been investigated, what were the triggers and what investigations have been undertaken to assist in making a decision. Community members within the 'green' alternative southern alignment voiced anxiety and mental health concerns in regards to the alignment uncertainty and potential for direct impact to their properties. Confusion between the Environmental Impact Assessment (EIA) process for the southern alignment and the environmental referral process for the northern and central alignment.	Land for the southern alignment of has been reserved within the GBRS for many years. It contains habitat for the WRP, Black Cockatoo and Banksia Woodland Threatened Ecological Community (TEC) which are Federally listed. In May 2018, the Commonwealth changed the status of the WRP under the Environment Protection and Biodiversity Conservation Act from Vulnerable to Critically Endangered. This is the highest classification level possible before a species is declared extinct. When referring a Project for environmental assessment it is necessary to demonstrate that there are no feasible alternatives with lesser environmental impact. As a result of the reclassification of the WRP and the presence of other MNES such as the Black Cockatoo, investigations into an alternative alignment located further to the east (green corridor) have been undertaken to support the environmental referral process. These investigations, including detailed site surveys, have been undertaken in addition to those in the existing GBRS alignment to support preparation of EIAs. The Project team consulted with landowners potentially affected by this alternative alignment. Following completion of consultation and environmental surveys, the findings will be presented to landowners, the CRGs established for BORR Project and the wider community. Once an alignment is selected, based on results of the selection study and design progresses, then the southern alignment will be referred to the EPA and DEE for environmental assessment and approval.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
CRG members, Community members	Northern & Central and Southern CRG meetings	**Western Ringtail Possum** Management of impacts to WRPs.	The WRP is critically endangered, which means the Commonwealth Minister for the Environment is responsible for ensuring that any approved actions by The Minister will not put the species at further risk.
		What studies were undertaken and by whom?	Regional surveys of the WRP were commissioned to more accurately estimate the population size and determine the potential impact of the BORR Project on the WRP population. The methodology for these surveys was agreed with the DBCA and the WRP Recovery Team. WRP studies were completed by specialist zoological consultants Biota Environmental Sciences (Biota). Investigations have been undertaken in the Southern Swan Coastal Plain (SCP), Cape to Capes, Southern Forrest and Albany Areas to get a total estimate for the species.
		Will possums be relocated/translocated?	There have been few examples of successful relocations in the region. If we could do it successfully that would be wonderful but we and the federal regulator must be confident that any relocation would be successful. That confidence does not exist currently. This is something we need to better understand to ensure it is successful if adopted with no perfect solution available.
		Offset areas – have they been selected, what offset ratios will be applied and is there a maintenance budget for offsets?	Offsets have not been identified yet. This comes later in the process when the nature and extent of the impacts are known. Main Roads has a bank of offsets available with further acquisitions likely to be required depending upon values impacted. There is a calculator used for determining offsets, which are generally greater in area than the impact. Budgets would depend on the offsets selected. There are previous examples where there are contributions to maintenance.
		If relocation fails what else is there? Are animals' euthanised?	One of the challenges with the WRP is that there is no approved translocation program currently in operation. Other measures are available for birds, such as cockatoos. The first steps are to avoid or minimise impacts wherever possible. Native fauna are not euthanised.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
		Fragmentation of possum/ fauna habitats.	Any alignment resulting in fragmentation will consider mitigation measures including bridges or underpasses.
Community members, CRG Members	Enquiries, Northern & Central and Southern CRG meetings, Drop in Sessions	**Longevity of GBRS Alignment** Queries about investigating an even more eastern alignment have been raised by numerous newly concerned communities including concerns about the redundancy of the GBRS Alignment between Hasties Road and Bussell Highway. This has been raised specifically in the context of a future north south freeway grade road.	Currently there is no planning or consideration for a further outer ring road (more eastern alignment). The capacity provided by the BORR and existing roads will service the region well into the future. The BORR is being designed to cater for the long term planning needs which includes catering for the transport movements of a future population of 200,000 people living in the Greater Bunbury area. The transport movement basis is built upon the Greater Bunbury Strategy (2013) report and includes consideration of the planned expansion of residential and industrial areas at Wanju, Waterloo Industrial Park and Picton Industrial Park as well as other investigation areas for potential urban development rezoning.
CRG members, Community members	Northern & Central and Southern CRG meetings, Drop in Sessions	**Environmental Approvals Process and Studies** The community has been highly interested in the types of environmental studies being completed to support the Project.	An EIA study including multiple investigations has been undertaken for the two alternative southern alignments. We are committed to ensuring that all environmental aspects of the Project are completed with great sensitivity and in accordance with all State and Commonwealth legislative requirements. Detailed reports were completed for a portion (details of the surveyed and unsurveyed areas are provided for each factor in section 4 and Figure 4, Appendix A) of the Project Area including: • Noise management plan • Targeted fauna (including MNES) assessment • Aquatic Fauna • Flora and Vegetation assessment • Air quality impact assessment. There are three opportunities in the environmental approvals process for the public to provide feedback, they are: • At the start of the process when the level of assessment is set

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
			• In review of the information submitted by the BORR Team to the regulator/s • In response to the Draft Ministerial Conditions that result if approval is granted.
		The process of submitting comments on the environmental referral. Concerns around the public comment period.	This is a formal process, managed by the responsible regulatory entity (EPA) and is not a process managed by Main Roads. Detailed information can be found at www.epa.wa.gov.au .
CRG members, Community members	Northern & Central and Southern CRG meetings	**Flora and Fauna** How will impacts to flora and fauna be managed?	The BORR alignment includes habitat for critically endangered species, as determined under the Commonwealth Government's EPBC Act. Avoidance is the first option for impacts, but where avoidance of impacts is not practicable, minimisation of impacts is sought. In the BORR Alignment Selection report, the environmental criteria (alongside other criteria) used in the multi criteria analysis to assess options included: • Rare flora and native vegetation • Rare fauna, fauna habitat and TECs • Waterways or wetlands. When considering BORR interchange options and local connectivity options, assessment of the environmental criteria included: Wetlands (Conservation Category Wetland (CCW) and Resource Enhancement (RE)), remnant native vegetation, rare Fauna (particularly WRP), TECs, European Heritage and Aboriginal Heritage.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
CRG members (local residents, road users and property owners/ farmers)	Northern & Central and Southern Community CRG Meetings (10/18, 11/18, 12/18)	**Social and Economic Bypass Impacts** Primacy of Bunbury and economic impacts of 'bypass'. Consideration of social and economic impacts on community business, particularly of severance on farmers. Formation of an economic advisory group was first discussed in the October North and Central CRG.	An Economic Advisory Group was subsequently developed and is chaired by the SWDC. KPMG has been commissioned by Main Roads to undertake a Social and Economic Study for the wider BORR Project. Impacts for the local farming community will be included in this assessment. The study will be in line with NSW Road Maritime Services Environmental Impact Assessment Practice Note – Socio-economic Assessment (EIA-N05).
		Economic impacts of BORR and impacts on businesses.	Bunbury is the gateway to the South West Region. The Region has a strong economy based on mining, manufacturing, building and construction, agriculture, viticulture, aquaculture, forestry, tourism and emerging smart and creative industries, generating $13 billion in the 2016-2017 financial year (SWDC, 2018). In addition, the Port of Bunbury is a large deep sea port which allows the berthing of commercial cargo vessels and is supporting the development of tourism by welcoming large tourist cruising passengers to our shores. The construction phase of the Project will create jobs and provide economic benefits to the region. Once constructed, BORR will provide more efficient access for freight to the Bunbury Port, and enable the expansion of industrial centres, leading to more manufacturing, agricultural processing and local employment.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
Community members, CRG Members	Main Roads enquiries, CRG meetings and Community Drop In Sessions.	**Noise Impacts** Community members along the alignment have raised concerns in regards to noise from vehicle traffic (particularly trucks), braking vehicles at interchanges and roundabouts and vehicles travelling over bridge joints.	The BORR Team is committed to managing the impacts of noise in line with the State Planning Policy 5.4 "Road and Rail Transport Noise and Freight Considerations in Land Use Planning" with the aim to protect communities from unreasonable levels of transport noise. The BORR Team has committed to undertake a noise study for the Ultimate Planning Design Concept of the Southern Section of BORR. This noise study will be informed by the development of a noise model that will help to identify locations where noise mitigation may be required to comply with State Planning Policy 5.4 The noise model will consider topography, distances between properties and the road, road design levels, gradients and surface type and consideration of future projected traffic volumes and types. Existing noise in the study area will be recorded to be used in the model development.
Community members, CRG Members	Main Roads enquiries, CRG meetings and Community Drop In Sessions.	**Future Development Noise Mitigation** Impacts and management of noise to any future developments.	Where houses pre-date the road it is Main Roads responsibility to mitigate. Where the road pre-dates the development, it is the developer's responsibility to comply with the policy.
CRG Members	Main Roads enquiries, CRG meetings and Community Drop In Sessions.	**Noise Modelling Assumptions** Assumptions used in developing the noise model in regards to exclusion of mitigation measures and choice of road surface treatments.	The noise modelling process is conservative and assumes a worse-case noise scenario to ensure likely noise exceedances are identified and appropriate management implemented.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
Community members, CRG members	Main Roads Enquiries line, CRG Meetings, Community Drop In Sessions	**Light pollution and Visual Amenity** Impact of light pollution from street lights and vehicle headlights, as well as impacts to visual amenity as the result of construction of roads, associated interchanges, bridges and overpasses.	The EIA process considers impacts to visual amenity including lighting. This includes reporting potential visual impacts and identifying likely locations where design measures may be required to mitigate the impacts. Mitigation may include providing screening, which can take a variety of forms including the construction of walls, earth mounds and planting of vegetation. Strategies will be developed to comply with the Australian and New Zealand Standard (AS/NZS 1158) Lighting of public roads (Standards Australia , 2005). This will include consideration of light backspill and treatments such as backshades and reducing light pole height where possible to minimise impact on adjacent properties. Visual amenity is also a key consideration of the Urban and Landscape Design Framework that has been prepared for the BORR Project.
Property owners	Main Roads Enquiries, Southern CRG (07/18, 12/18)	**Air and Water Quality.** Residents of some farming and residential properties, are not connected to scheme water and rely upon rainwater tanks as their primary source of potable water. Impact of traffic pollution particulate matter on water tank water quality is a concern to the community.	There is no comparative air quality policy or legislative requirement for pollutants from traffic in comparison to *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (SPP 5.4) that deals with noise from traffic. Air quality modelling to the relevant standards will be completed to establish baseline conditions. National standards for air and water quality apply for land and water managed under the EP Act, but not necessarily water in rainwater tanks. It is recognised that pollutants are emitted from diesel and petrol powered vehicles. The concentration levels of those chemicals have decreased with improved engine and fuel technology. Fuel used to have lead and sulphur additives but these have been removed or reduced in current vehicle fuels. Vehicle age is another factor with the average vehicle age around 10 or 11 years in Perth. As a result, the pollutants coming out of an exhaust pipe are steadily reducing over time. Pollutants in water tanks is a separate issue that is up to the land owner with various potential pollutant sources to consider.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
Directly impacted property owners	Southern CRG meetings, Main Roads Enquiries	**Land Acquisition and Compensation Process** Property owners, particularly famers, are concerned about the impact of severance on their properties and businesses. Concerns include land compensation process and valuation, impacts to current and future business operations as well as social & mental health impacts that this will have on their families.	Main Roads appoints up to three independent land valuers and pays for the land owner to appoint a valuer of their choice. The valuation process includes business compensation. Main Roads can only compulsorily acquire land needed for the Project but can acquire small remnant land parcels through negotiations. We provide access to small parcels and if unviable it would be part of the compensation calculation.
		Timeline of land acquisition and ability for impact on broader Project implementation timeline.	Main Roads is planning to deliver the Project and will progress the enabling tasks including talking to the owners of property required for the Project to try and agree an early settlement as part of a voluntary acquisition process.
Local community and road users CRG Members	Southern CRG meetings	**Local Access Changes on Journey Times** Is compensation payable as a result of impacts of local road severance on journey times?	Compensation is only payable where land is required for the Project. Main Roads will endeavour to ensure connectivity remains but it will change.
Directly impacted property owners	Southern CRG meetings, Main Roads Enquiries	**Property Severance** Property owners who are likely to have access to their properties altered or their land parcels split are concerned about how they will access their properties/land and how business as usual will take place.	Main Roads will provide access to the portions of land that are severed. Any associated economic loss is included as part of the compensation payable and depends on individual circumstances. Under the Act we can't resume land that isn't required for road purposes. Main Roads often finds that if a convoluted route to provide access results, compensation will be payable. In some cases, other measures are considered to walk or even truck cattle.
Directly impacted property owners	Southern CRG meetings, Main Roads Enquiries	**Property Access** Property owners who are likely to have access to their properties altered are concerned about what form new access will take.	Any existing accesses affected by the ultimate design of the highway will require consideration of alternative routes. The planning, construction and funding of alternative routes will be undertaken by Main Roads WA as part of the Project scope. These works can include the provision of new service roads and upgrades, or realignment of existing driveways. Main Roads does not generally provide slip lanes for individual properties as they are usually only provided for local roads. However, in some

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
			instances where there is a need due to higher traffic volumes or presence of trucks or a road safety risk, a slip lane can be provided. This will be assessed on a case by case basis. If access is required via adjacent privately owned land – we will undertake discussions with the landowners around access routes, acquisition and compensation.
Gelorup residents, local road users	Southern CRG Meeting (07/18, 9/18, 10/18, 11/18, 12/18, 2/19)	**Traffic and Safety** BORR connection to Gelorup via Hasties Rd due to increased traffic through community and past community infrastructure, interaction with school traffic and narrow road reserve. Concern was raised at numerous CRG meetings.	Centenary Road connection concept options were subsequently developed and assessed as part of the Gelorup connectivity assessment. The Centenary Road connection is the preferred connection recommended by the BORR Team.
CRG Members, Fire Emergency Service, Shire of Capel	Southern CRG meetings	**Emergency Service Access and Emergency Egress** The effects of road severance on emergency access e.g. to allow firefighting and provide emergency egress to the community either side of the alignment.	The BORR Team has undertaken consultation with the Shire of Capel and the Bush Fire Service to determine issues which will arise from severance of local roads and determined the requirements for provision of additional water tanks and stand pipes. Local and access road connections are being planned where existing local and access roads will be disrupted.
CRG members	Southern CRG meetings	**Impacts to Cultural Heritage** Potential for loss of cultural heritage.	There are no European heritage sites expected to be impacted within the Project Area.
CRG members	Southern CRG Meetings (03/19)	**Impacts to Aboriginal Heritage** What was the source of data used to show aboriginal sites used to inform field investigations. Concerns around the Aboriginal Heritage values and history of the assessment process and what additional studies are being completed.	The source of mapped Aboriginal Heritage sites used to inform field investigations was publicly available data from the DPLH and a previous Aboriginal Heritage Survey which covered a portion of the Project Area (Brad Goode & Associates, 2012). Main Roads will re-consult with members of the Aboriginal community on the preferred southern alignment to update the 2012 Aboriginal Heritage Survey.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
CRG members	Southern CRG meetings	**Construction Impacts** Construction impacts on access to and from properties – particularly if there is an emergency such as a fire.	Bushfire and other emergency responses will be a prime consideration to manage during and after construction. Main Roads includes requirements to maintain emergency routes during construction in contracts. The same would apply to standpipes and other fire response assets.
		Construction noise/vibration and hours of works.	Point source noises (e.g. horns) and noises during construction are not subject to SPP 5.4. Details on the management of construction noises and vibrations will form part of the construction contract.
DRG	DRG meetings	**Wetlands and Waterways** Concern in relation to two TEC (wetlands) located within the 'green' alternative alignment. DBCA encouraged BORR Team to liaise with DBCA Wetlands unit.	The BORR Team has undertaken a wetland study within a portion of the Project Area as part of a survey located predominantly to the north. The BORR Team have liaised with DBCA officers where appropriate regarding TECs within the Project Area.
		Request for spill management for wetlands, outside of wetland buffers – and be based on risk based approach.	Main Roads has requirements around what is to be provided where spill control is required, but not around where spill control is required. Recommendations from DRG members were discussed.
Land owners	Landowner meetings	**Irrigation and Drainage** Concerns have been raised by landowners in relation to localised flooding impacting on access and egress to and from their properties under BORR.	The BORR Team will undertake discussions with landowners to determine suitable alternate access where access will be directly impacted by BORR once a decision on the southern alignment has been made.
		Landowners have also raised concerns where investigations have been required in relation to use of heavy machinery impacting on contours/ damaging drainage of their land.	Prior to all investigations, landowners were contacted by the BORR Team for approval to access their land and landowners were consulted on the proposed machinery details, size, weight etc. to be used on their property. Investigations with machinery on land vulnerable to becoming waterlogged during wet months was timed to occur where possible prior to the onset of the wet season.
Drainage Reference Group (DRG)	DRG (08/2018)	**Water Quality** Need for spill management (e.g. oil and chemical spills). Oil spill traps were initially only considered for water	The BORR drainage strategy includes the use of oil spill traps to waterways.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
Members, Water Corporation		draining to sensitive environmental receptors (e.g. wetlands). Water Corporation indicated that spill protection was required upstream of their drains.	
DRG Members, Leschenault Catchment Council Inc.	DRG (08/2018)	**Water Quality** Nutrient stripping (via soil amendments using Iron Man Gypsum) in the buffer strip along the alignment.	Options were investigated, but it was identified that the major source of nutrients was farm land. Water, particularly in irrigated plots, is carefully managed on farms by paddock grading and is collected by drains and therefore is unlikely to reach the road alignment. There is limited benefit and a very high cost for undertaking soil improvement measurements within the alignment.

4 ENVIRONMENTAL PRINCIPLES, THEMES AND FACTORS

4.1 Principles

Section 4A of the EP Act establishes the object and principles of the Act. In accordance with the EPA's Statement of Environmental Principles, Factors and Objectives (EPA, 2018c), this section describes how each of the five principles of the EP Act has been applied to the Proposal (Table 4-1).

Table 4-1 *Environmental Protection Act 1986* Principles

NO.	PRINCIPLE	CONSIDERATION OF PRINCIPLE IN THE PROPOSAL
1	**The precautionary principle** *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* *In the application of the precautionary principle, decision should be guided by:* ○ *careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* ○ *an assessment of the risk-weighted consequences of various options.*	A wide range of comprehensive desktop and field studies were undertaken within and adjacent to the corridor for the last two decades to assess the impact of the Proposal (including studies undertaken to support the previous referral). Studies included: • Flora and vegetation • Terrestrial fauna • Inland Waters • Amenity • Heritage (Aboriginal) • Air quality. Impacts have been identified and described under each key environmental factor. Information gathered during these studies has reduced the uncertainty surrounding prediction of impacts for the assessment. Mitigation and management measures have been proposed to ensure impacts are environmentally acceptable. Main Roads has ensured that the Proposal's design (where practicable) avoids serious or irreversible damage to the environment.
2	**The principle of intergenerational equity** *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.
3	**The principle of the conservation of biological diversity and ecological integrity** *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	There are patches of limited biological diversity and ecological integrity within and adjacent the Proposal. Main Roads has sought to preserve as much of the remnant biodiversity as possible by avoiding areas of native vegetation where practicable.

NO.	PRINCIPLE	CONSIDERATION OF PRINCIPLE IN THE PROPOSAL
4	**Principles relating to improved valuation, pricing and incentive mechanisms** *a. Environmental factors should be included in the valuation of assets and services* *b. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement* *c. The users of goods and services should pay prices based on the full life cycle costs of providing goods and services including the use of natural resources and assets and the ultimate disposal of any wastes* *d. Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.*	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 within the Proposal Area 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 will be subject to an Infrastructure Sustainability Council of Australia (ISCA) sustainability rating, which will assess the environmental, social and economic impacts of the Proposal including its waste stream and the resources utilised for construction. The Infrastructure Sustainability Council of Australia (ISCA) rating scheme is designed such that goals are established for a proposal, then the proposal is assessed against the achievement of those goals.
5	**The principle of waste minimisation** *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	The Proposal will be subject to an ISCA sustainability rating, which will assess the environmental, social and economic impacts including waste minimisation and associated discharges. Cut to fill materials sourced from the Proposal Area to minimise external fill requirements. Use of otherwise waste materials such as crushed concrete will be considered in road construction. The Proposal design includes drainage designed to minimise discharge of contaminated water into the environment. Management strategies will be implemented to ensure that generation of waste during the construction phase is minimised. All activities shall be carried out with the principles of cleaner production and waste minimisation.

4.2 Identification of Environmental Factors

Environmental factors are those parts of the environment that may be impacted by an aspect of a proposal. The EPA has 13 environmental factors, organised into five themes: Sea, Land, Water, Air and People.

The environmental factors and EPA objectives are provided in Table 4-2. The relevance of each factor to the Proposal is summarised and the significant environmental factors that require further consideration are identified.

Table 4-2 Environmental factors relevant to the Proposal

THEME	FACTOR	OBJECTIVE	RELEVANCE TO PROPOSAL	SIGNIFICANT ENVIRONMENTAL FACTOR
Sea	Benthic Communities and Habitats	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.	No impacts to benthic habitats.	No
	Coastal Processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.	No impacts to coastal processes.	No
	Marine Environmental Quality	To maintain the quality of water, sediment and biota so that environmental values are protected.	No impacts to marine environmental quality.	No
	Marine Fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.	No impacts to marine fauna.	No
Land	Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	Construction requires vegetation clearing.	Yes
	Landforms	To maintain the variety and integrity of significant physical landforms so that environmental values are protected.	Distinctive landforms are not present.	No
	Subterranean Fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	No conservation significant subterranean fauna given the location of the Proposal Area (South West Australia).	No
	Terrestrial Environmental Quality	To maintain the quality of land and soils so that environmental values are protected.	Acid Sulfate Soils (ASS) are present within the Proposal Area.	Yes
	Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	Construction will result in habitat clearing.	Yes

THEME	FACTOR	OBJECTIVE	RELEVANCE TO PROPOSAL	SIGNIFICANT ENVIRONMENTAL FACTOR
Water	Inland Waters	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	Wetlands and rivers present within the Proposal Area.	Yes
Air	Air Quality	To maintain air quality and minimise emissions so that environmental values are protected.	Air emissions will be generated during construction of the Proposal	Yes
People	Social Surroundings	To protect social surroundings from significant harm.	Proposal Area is within a populated area with potential Aboriginal heritage disturbance and noise and amenity issues.	Yes
	Human Health	To protect human health from significant harm.	No human health impacts expected. No radiation emissions.	No

Figure 4 (Appendix A) shows the flora and fauna survey area, gaps and reference sites in relation to the Proposal Area. Whilst environmental survey work for the BORR has occurred over many years and has covered an extensive area, the final BORR Southern Section Proposal Area has only recently been established. It is anticipated that these knowledge gaps will be closed by Q4 2019.

4.3 Key Environmental Factor – Flora and Vegetation

4.3.1 EPA objective

The EPA's objective for flora and vegetation is '*to protect flora and vegetation so that biological diversity and ecological integrity are maintained*' (EPA, 2018c).

4.3.2 Policy and guidance

- Environmental Factor Guideline 'Flora and Vegetation' (EPA, 2016b)
- Technical Guidance 'Flora and Vegetation Surveys for Environmental Impact Assessment' (EPA, 2016a)
- 'Protection of Naturally Vegetated Areas Through Planning and Development, Environmental Protection Bulletin No. 20' (EPA, 2013)
- *Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations)*

4.3.3 Receiving environment

Flora and vegetation studies

The flora and vegetation values have been primarily derived from the flora and vegetation report (BORR IPT, 2019a) provided as Appendix B. The flora and vegetation study was completed prior to the finalisation of the Proposal Area. As a result, approximately 22 ha of native vegetation within the Proposal area has not been surveyed (see Figure 4, Appendix A). Surveys for these unsurveyed areas will be completed by Q4 2019.

There is approximately 98 ha of native vegetation within the Proposal Area, of which 76 ha has been surveyed. For the remaining 22 ha that is yet to be surveyed, results from desktop assessments are provided.

The flora and vegetation study included:

- A desktop assessment (5 km buffer of the flora field survey area) and review of previous flora and vegetation assessments undertaken within or close to the flora field survey area. The previous surveys are summarised in Table 4-3
- Biological field survey to identify:
  - Vegetation community types present, including presence of any Threatened or Priority Ecological Communities (TECs or PECs) or other significant vegetation
  - Vegetation condition, including the location of any Weeds of National Significance (WoNS) or Declared Weeds
  - Flora species present including introduced species
  - The presence or potential presence of any Threatened or Priority (P) Flora
- Preparation of a biological survey report that:
  - Documents the results of the desktop assessment and field survey, including mapping
  - Identifies and discusses significant flora and vegetation communities which potentially occur
- Spatial files in GIS format.

The description of flora and vegetation values have also been informed by the results of additional investigations including (see Table 4-3):

- BORR Southern Section Alternative Alignment Vegetation and Flora Study (BORR IPT, 2019b)
- BORR Southern Section GBRS Alignment– Banksia Woodlands TEC Assessment (Biota, 2018a)

- Targeted Rare Flora Survey for *Diuris drummondii* along four sections of the BORR proposed alignment (Ecoedge, 2017)
- BORR Southern Section GBRS Alignment – Reassessment of Floristic Communities (Biota, 2016)
- BORR, South Western Highway to Bussell Highway Flora and Vegetation Assessment, Phase 1 and Phase 2 (GHD, 2015c).

Locations relevant to the Proposal that have undergone desktop assessment but not been surveyed, total approximately 22 ha and are shown on Figure 4 (Appendix A).

Table 4-3 Summary of flora and vegetation surveys undertaken for the Proposal

SURVEY/REPORT NAME	SURVEY EFFORT AND AREA	RELEVANCE TO PROPOSAL AREA
GHD 2014 – Lot 1 Ducane Road Environmental Values Assessment **(GHD, 2014)**	GHD completed a flora and vegetation assessment of Lot 1 Ducane Road on the 13 June 2013. The assessment described vegetation types present and their conditions and also searched for conservation significant flora.	Assessment of vegetation types and floristic diversity for Lot 1 Ducane Road, which is within the Biota Survey Area
GHD 2015 – Vegetation and Flora survey of the BORR South Alignment **(GHD, 2015c)**	The GHD 2015 survey area was 112 ha and the report included a review of previous flora surveys for the alignment including: • Bennett Environmental Consulting (2003) Vegetation and Flora of Selected Areas – BORR and PAR for Main Roads (Bennett Environmental Consulting, 2003). • Bennett Environmental Consulting (2008) Significant Flora along Proposed Bunbury Ring Road for Main Roads (Bennett Environmental Consulting, 2008). • GHD (2002) BORR and PAR – Wetlands and Threatened Community Survey for Main Roads (GHD, 2002). • GHD (2009) Flora and Vegetation Survey for Main Roads (GHD, 2009). • GHD (2012) Flora and Vegetation Survey for Main Roads (GHD, 2012a). The survey was considered to be a level 2 assessment (as per the now superseded EPA guidelines). Phase 1 was carried out on the 21 – 23 September 2011 and Phase 2 from the 16 – 18 June 2014. A total of 21 quadrats were assessed and the vegetation types / their condition described.	Provides a basis for current information on vegetation types, condition and species composition
Biota 2016 – BORR Southern Section – Reassessment of Floristic Communities **(Biota, 2016)**	Biota completed a targeted flora survey to further resolve the conservation status of vegetation types identified in the GHD ((GHD, 2012a), (GHD, 2015c) flora surveys for BORR South. Two Biota botanists completed an additional seven (7) quadrats on the 25 – 26 October 2016 and re-ran statistical analysis against both Biota and GHD quadrats to align vegetation types with Gibson	Re-assessment of FCTs and assessment of an additional 7 quadrats (4 within the survey area)

SURVEY/REPORT NAME	SURVEY EFFORT AND AREA	RELEVANCE TO PROPOSAL AREA
	et al. (1994) FCTs. The focus of this assessment was potential TEC / PEC vegetation types.	
Biota 2018 – BORR Southern Section – Banksia Woodlands TEC Assessment **(Biota, 2018a)**	This assessment included a desktop component to identify potential areas of Banksia woodland TEC that were then targeted in the field survey. The field survey was carried out to determine the extent of Banksia Woodland TEC within the BORR South area and surrounds. The survey was carried out 4 - 6 November 2017 by Biota botanists. 24 target areas were sampled using either quadrats (10 x 10 m) or mapping notes. A floristic analysis using PATN v3.1 was carried out to compare quadrats within the study area with those from the existing SCP vegetation data set arising from Gibson *et al.* (1994).	Provides the location of Banksia Woodland TEC within the survey area and surrounding vegetation
Ecoedge 2017 – Report of a Targeted Rare Flora Survey for *Diuris drummondii* along four sections of the BORR proposed alignment **(Ecoedge, 2017)**	Ecoedge completed a targeted assessment on the 19th and 30th November 2016 of portions of the BORR South proposed alignment that provide suitable habitat for *Diuris drummondii*. 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. A total of 18.6 ha was searched, however no *D. drummondii* plants were found.	Provides information on potential presence of *D. drummondii* within the BORR IPT flora field survey area

Regional biogeography

The Proposal Area is located in the South West Botanical Province of Western Australia (Beard, 1990) and experiences a Mediterranean climate with distinctly hot, dry summers and cool, wet winters. The Proposal Area is located in the SCP IBRA bioregion and SWA02 (Perth) subregion as described by the Interim Biogeographic Region of Australia (IBRA) (DEE, 2016).

The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone. Heath and/or Tuart Woodlands occur on limestone, Banksia and Jarrah-Banksia Woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvial soils. The subregion also includes a complex series of seasonal wetlands (Mitchell, Williams, & Desmond, 2002).

Broad scale (1:250,000) pre-European vegetation mapping (Beard, 1979) of the Proposal Area indicates 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 northeast of the Proposal Area (Figure 5, Appendix A).

Regional vegetation complex mapping (Heddle, Loneragan, & Havel, 1980; Mattiske & Havel, 1998) indicates that four vegetation complexes are present within the Proposal Area (Webb, Kinloch, Keighery, & Pitt, 2016):

- 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.

Vegetation communities and condition

BORR IPT (2019a) described the surveyed area as comprising sandy low dunes and plains dominated by *Eucalyptus / Banksia* forests, in particular, *Eucalyptus / Agonis* and *Banksia* Woodlands / forests, creek lines, swamps and low relief / seasonally inundated areas dominated by *Eucalyptus rudis / Melaleuca preissiana / Melaleuca rhaphiophylla* Woodlands and agricultural areas and some road reserves. The condition of forests and woodland vegetation varied from Excellent to Completely Degraded. Creek lines, swamps and low relief areas were generally disturbed and dominated by introduced grasses and herbs in the ground-layer. The agricultural areas and road reserves comprised native vegetation as scattered remnant trees or stands over introduced grasses.

The surveyed area includes 10 vegetation types considered to be remnant native vegetation as well as highly disturbed areas, non-native vegetation and revegetation / regrowth. A summary of the vegetation types identified within the surveyed area during BORR IPT (2019a) assessment is presented in Table 4-4 and mapping is provided in Figure 5 (Appendix A).

Based on the DPIRD native vegetation extent dataset (GoWA, 2019a) and interpretation of aerial imagery, it is estimated that only 22 ha of the 113 ha of unsurveyed area is native vegetation (although additional areas of isolated trees in paddocks occur). Combining this with the results of BORR IPT (2019a) vegetation survey, the Proposal Area contains up to 202 ha (67 %) of highly modified area (cleared paddock, existing infrastructure and non-native vegetation), 98 ha (33 %) of native vegetation (this includes scattered trees in paddocks) and 0.4 ha of revegetation / regrowth (<1 %).

Table 4-4 Vegetation types within the Proposal Area

VEGETATION TYPE DESCRIPTION[1]	EXTENT IN PROPOSAL AREA
***Eucalyptus / Banksia* forests on sand dunes and plains**	
Open forest of *Eucalyptus marginata*, *Corymbia calophylla* and *Banksia attenuata* on Karrakatta deep sands (VT1) Open forest of *Eucalyptus marginata* and *Corymbia calophylla +/- Agonis flexuosa* with isolated occurrences of *Eucalyptus gomphocephala* over low open forest of *Banksia attenuata* over shrubland of *Hibbertia hypericoides*, *Macrozamia riedlei* and *Xanthorrhoea brunonis* over grassland over **Ehrharta* spp.[2], **Briza maxima* over herbland of *Dasypogon bromeliifolius*, *Lomandra* species and *Phlebocarya ciliata* over open sedgeland of *Lepidosperma pubisquameum*.	**25.1 ha** 5.4 ha Excellent to Very Good 3.3 ha Very Good 0.5 ha Very Good to Good 1.5 ha Good 13.6 ha Good to Degraded 0.4 ha Degraded 0.4 ha Degraded to Completely Degraded
Open forest of *Eucalyptus marginata*, *Corymbia calophylla, Banksia attenuata* and *Agonis flexuosa* on Bassendean dunes (VT2) Open forest of *Eucalyptus marginata, Corymbia calophylla* and *Agonis flexuosa* over low forest of *Banksia attenuata* and *Banksia ilicifolia* over tall shrubland of *Kunzea glabrescens, Jacksonia furcellata* and *Xylomelum occidentale* over shrubland of *Hibbertia hypericoides*, *Acacia* spp. and *Xanthorrhoea brunonis* over grassland / Sedgeland of *Tetraria octandra*, *Desmocladus fascicularis* and introduced grasses.	**8.3 ha** 0.1 ha Excellent 3.1 ha Good to Degraded 4.7 ha Degraded 0.1 ha Degraded to Completely Degraded 0.3 ha Completely Degraded
***Corymbia calophylla* and *Eucalyptus marginata* +/- *Banksia* spp. (VT3)** 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 grassland over introduced grasses. Occurs in paddocks and road reserves. In the road reserve along South Western Highway, shrubland is largely absent and *Agonis flexuosa* is present in the tree layer.	**2.4 ha** All Degraded to Completely Degraded
Open forest of *Banksia attenuata* and *Agonis flexuosa* (VT4) 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** 0.7 ha Very Good 2.8 ha Very Good - Good

[1] 8.3 ha of the surveyed area was not included in the BORR IPT (2019a) field survey area. This was included in the flora and vegetation assessment conducted for the Alternative alignment (BORR IPT, 2019b).

[2] * Denotes introduced species

VEGETATION TYPE DESCRIPTION[1]	EXTENT IN PROPOSAL AREA
Closed tall scrub of *Melaleuca preissiana*, *Astartea scoparia* and *Kunzea glabrescens* over sedgeland (VT6) 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.*	**2.9 ha** 2.1 ha Very Good to Good 0.3 ha Good 0.5 ha Good to Degraded
Woodland of *Melaleuca preissiana* and *M. rhaphiophylla* (VT7) Low woodland of *Melaleuca preissiana* and *M. rhaphiophylla* over tall sparse shrubland of *Astartea scoparia* +/- *M. lateritia* over sedgeland of *Juncus pallidus, Lepidosperma longitudinale* over herbland of **Cotula coronopifolia, *Lotus subbiflorus* and *Isolepis cernua* var. *setiformis* with **Callitriche stagnalis* in open water.	**13.2 ha** 6.3 ha Good 1.9 ha Good to Degraded 0.2 ha Degraded 3.0 ha Degraded to Completely Degraded 1.8 Completely Degraded
Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland (VT8) 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. Occurs along drainage lines and seasonally inundated areas.	**2.1 ha** 1.5 ha Degraded 0.6 ha Degraded to Completely Degraded
Shrublands in creeklines / swamps and seasonally wet areas	
VT5 - Tall shrubland *Kunzea 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.*	**0.1 ha** All in Completely Degraded (7)
Scattered remnant vegetation / Highly modified vegetation types	
Scattered remnant vegetation present in agricultural areas and along road reserves: • **VT09a** - *Corymbia calophylla* and *Eucalyptus marginata* +/- *Agonis flexuosa* with very occasional *E. gomphocephala* • **VT09b** – *Melaleuca rhaphiophylla* • **VT09c** – *Agonis flexuosa* stands • **VT09d** – *Eucalyptus rudis* and *Corymbia calophylla* +/- *M. rhaphiophylla.*	**14.3 ha** All Degraded to Completely Degraded
Parkland cleared with native / non-native trees (VT10) Parkland cleared with occasional *Corymbia calophylla, Eucalyptus marginata* and *Agonis flexuosa* trees with planted tree species over an understorey of weedy herbs and grasses.	**3.9 ha** All Completely Degraded
Revegetation / Regrowth (VT10b) This includes revegetation as well as areas planted with a mixture of native and non-native vegetation. There are scattered remnant trees	**0.4 ha**

VEGETATION TYPE DESCRIPTION[1]	EXTENT IN PROPOSAL AREA
occasionally present (including *Corymbia calophylla, Eucalyptus marginata, E. rudis*, *Agonis flexuosa* and *Casuarina obesa).* Common shrubs include *Melaleuca nesophila, M. lanceolata*, *Kunzea glabrescens* and *Acacia saligna*. The understorey was mostly dominated by introduced grasses and herbs.	All Degraded to Completely Degraded
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.	**111 ha**
Total Surveyed	**187 ha** Native Vegetation (76 ha) Cleared (111 ha)

Vegetation condition within the Proposal Area

Vegetation condition in surveyed areas ranges from Excellent (2) to Completely Degraded (7) (BORR IPT 2019a). Almost half (45 %) of surveyed vegetation is in Degraded or worse condition. Historical clearing and aggressive weed species have influenced the structure and composition of the native vegetation. Approximately 23 ha, or 30 %, of the surveyed vegetation was in Good or better condition.

A summary of vegetation conditions within the Proposal Area is provided in Table 4-5; vegetation condition mapping is shown in Figure 6 (Appendix A).

Table 4-5 Extent of vegetation condition ratings mapped within the Proposal Area

VEGETATION CONDITION	EXTENT IN SURVEYED AREA (ha)	POTENTIAL EXTENT IN UNSURVEYED AREAS (ha)	ESTIMATED EXTENT IN PROPOSAL AREA (ha)
Excellent	0.1	-	0.1
Excellent - Very Good	5.4	-	5.4
Very Good	4.0	-	4.0
Very Good - Good	5.3	-	5.3
Good	8.0	22^	30.0
Good – Degraded	19.0	-	19.0
Degraded	13.8	-	13.8
Degraded - Completely Degraded	11.0	-	11.0
Completely Degraded	9.4	-	9.4
Cleared / Highly modified	111.0	91	202
Total	187.0	113.0	300.0

^ Estimated from the aerial imagery and DPIRD Native Vegetation Extent dataset (GoWA, 2019a).

Threatened and Priority Ecological Communities

BORR IPT (2019a) identified one TEC and two PECs within the Proposal Area. There is substantial overlap between the areas of TEC and PEC identified in the surveyed area, with some areas of vegetation simultaneously meeting the definition of all of the identified TECs/PECs. The total area of vegetation meeting the definitions of TEC or PECs within the surveyed area is 36.5 ha. The extent of individual TEC and PEC and overlaps between communities within the surveyed area are presented in Table 4-6.

TEC identified within the surveyed area:

- 'Banksia Woodlands of the Swan Coastal Plain ecological community' (Endangered) ('Banksia Woodlands TEC') (Floristic Community Types (FCT) 21a and 25).

The Banksia Woodlands TEC can incorporate vegetation that is also representative (meets the definition) of both PECs identified within the surveyed area:

- 'Banksia dominated Woodlands of the Swan Coastal Plain IBRA region' PEC (P3) (FCTs 21a and 25) ('Banksia Woodlands PEC')
- 'Southern Swan Coastal Plain *Eucalyptus gomphocephala - Agonis flexuosa* Woodlands' PEC (P3) (FCT25). Also forms a component of the Tuart Woodlands of the Swan Coastal Plain PEC (P3) ('Tuart Woodlands PEC').

The extent and condition of each of these communities within the surveyed area is summarised in Table 4-7 and presented in Figure 6 (Appendix A).

'The Tuart Woodlands and Forests of the Swan Coastal Plain' TEC (Critically Endangered) ('Tuart Woodlands TEC') was listed as a MNES on 4 July 2019, after the flora and vegetation surveys were completed. The extent of this TEC is not quantified in the BORR IPT (2019a) report however, it is likely to occur within the Proposal Area and will be targeted during the 2019 surveys. There is also potential for overlap between the Tuart Woodland TEC and PECs listed above i.e. vegetation classed

as the Tuart TEC could also satisfy definitions for both of the PECs. This will be assessed following the 2019 surveys.

Table 4-6 Extent of overlap between TECs/PECs within the Surveyed area

TEC/PEC	Total extent within Surveyed area	Extent unique to this TEC/PEC	Extent overlapping with Banksia Woodlands PEC	Extent overlapping with Banksia Woodlands TEC	Extent overlapping with Tuart Woodlands PEC	Extent overlapping with 'Southern SCP *Eucalyptus gomphocephala - Agonis flexuosa* woodlands' (FCT25)
Banksia dominated Woodlands of the SCP IBRA region (PEC)	**36.5**	7.9		20.8	28.6	28.6
Banksia Woodlands of the SCP (TEC)	**20.8**	0	20.8		20.7	20.7
The Tuart (*Eucalyptus gomphocephala*) Woodlands of the SCP (PEC) (incorporating FCT25)	**28.6**	0	28.6	20.7		28.6
Southern SCP *E. gomphocephala – Agonis flexuosa* Woodlands (FCT25)	**28.6**	0	28.6	20.7	28.6	
Total area of TEC/PEC	**36.5**					

Table 4-7 TEC/PEC within the Surveyed area

TEC/PEC	EPBC ACT	DBCA	Extent in Surveyed area (ha) and Condition
Banksia Woodlands of the SCP (TEC). VT1, VT2 and VT4 are considered to be potentially representative of this TEC (when	Endangered		**20.8** Excellent: 0.1 Excellent to Very Good: 5.4 Very Good: 4.0 Very Good to Good: 3.1 Good: 1.3 Good to Degraded: 6.8

TEC/PEC	EPBC ACT	DBCA	Extent in Surveyed area (ha) and Condition
condition and size thresholds were met).			Degraded to Completely Degraded: 0.1
Tuart Woodlands and Forests of the Swan Coastal Plain (TEC)	Critically Endangered		To be determined through future survey
Banksia dominated Woodlands of the SCP IBRA region (PEC). Vegetation types VT1, VT2 and VT4 are considered to be potentially representative of this PEC	-	Priority 3	**36.5** Excellent: 0.1 Excellent to Very Good: 5.4 Very Good: 4.0 Good to Very Good: 3.3 Good: 1.5 Good to Degraded: 16.6 Degraded: 5.1 Degraded to Completely Degraded: 0.5
The Tuart (*Eucalyptus gomphocephala*) Woodlands of the SCP (PEC) (incorporating FCT25). Vegetation types VT1 and VT4 are considered to be potentially representative of this PEC	-	Priority 3	**28.6 ha** Excellent to Very Good: 5.4 Very Good: 4.0 Very Good to Good: 3.3 Good: 1.5 Good to Degraded: 13.6 Degraded: 0.4 Degraded to Completely Degraded: 0.4

Other significant vegetation

Approximately 15.4 ha of vegetation within the Proposal Area occurs in association with a watercourse and/or wetland. This vegetation has a restricted distribution and has been impacted by extensive clearing throughout the area. Vegetation types that represent riparian/wetland vegetation include:

- VT5 – Tall shrubland of *Kunzea micrantha* subsp. *micrantha* and *Melaleuca viminea* – 0.1 ha in Completely Degraded condition
- VT7 – Woodland of *Melaleuca preissiana* and *M. rhaphiophylla* – 13.2 ha in Good to Completely Degraded condition
- VT8 – Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland – 2.1 ha in Degraded to Completely Degraded condition.

According to the Geomorphic Wetlands dataset (DBCA, 2019), there is approximately 64.1 ha of mapped wetland within the Proposal Area (see also Section 4.6.3), comprising:

- 0.1 ha of Conservation Category
- 3.5 ha of Resource Enhancement
- 60.0 ha of Multiple Use
- 0.5 ha of unassessed wetlands.

There is a remnant mature Tuart tree located within the Proposal Area between Five Mile Brook and Woods Road, Gelorup, which is listed as an Australian Champion Tree (National Register of Big Trees, 2019) and was assessed by an arborist on 5 March 2019. The assessment found the specimen to be:

- Large for its genus and likely well in excess of 100 years old
- Over-mature, displaying evidence of multiple large branch fractures
- Providing numerous hollows which could potentially be used by fauna
- Likely to live for another 100 years if left undisturbed.

Flora diversity

BORR IPT (2019a) recorded 267 plant taxa (including subspecies and varieties) representing 62 plant families and 182 genera within the study area. This comprised 178 native species and 89 introduced (exotic) and planted species.

Dominant families recorded from the study area included:

- Fabaceae (34 taxa including 14 introduced taxa)
- Cyperaceae (20 taxa including 5 introduced)
- Asteraceae (18 taxa including 10 introduced species)
- Poaceae (18 taxa including 17 introduced species)
- Myrtaceae (16 taxa including four planted species).

BORR IPT (2019a) flora field survey intersected 178.7 ha of the Proposal Area. The surveys provided a preliminary indicator of flora diversity and identified the requirements for additional surveys during detailed project planning to address knowledge gaps.

Conservation significant flora

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 30 conservation significant flora taxa within the BORR IPT (2019a) study area (approximately 5 km buffer around the Proposal Area). This included 7 taxa listed under the EPBC Act and / or as Threatened under the BC Act and 23 listed as Priority species by the DBCA.

No species of flora listed as a MNES under the EPBC Act or as Threatened under the BC Act, were recorded by BORR IPT (2019a) within the surveyed area. Several small populations of one DBCA Priority-listed flora species, *Caladenia speciosa* (Sandplain White Spider Orchid – Priority 4), were confirmed between Yalinda Drive and Bussell Highway, having been previously recorded by (GHD, 2015c) (Figure 7, Appendix A). A total of 71 *Caladenia speciosa* plants have been recorded within the Proposal Area. A conservative estimate of the known populations of this species is 3,906 individual plants (from 59 records on FloraBase). No other Priority listed flora was recorded within the surveyed area.

Conservation significant flora taxa that are known or likely to occur in the Proposal Area, based on analysis of desktop and field data, are listed in Table 4-8 (BORR IPT, 2019a). Further surveys will be undertaken within unsurveyed areas (22 ha).

Table 4-8 Known or likely to occur conservation significant flora within the Proposal Area

TAXA	STATUS	LIKELIHOOD ASSESSMENT	
Caladenia speciosa	P4	Known within the Proposal Area	71 plants recorded in the Proposal Area during the GHD (2015c) survey. Database records also show this species as recorded within and in a 5 km buffer of the flora field survey area.
Acacia semitrullata	P4	May occur within the Proposal Area	Has not been identified within the Proposal Area, however was recorded during the GHD (2015c) and GHD (2014) surveys directly adjacent to (east of) the Proposal Area within Lot 1 and Lot 154 Ducane Road.
Aponogeton hexatepalus	P4	May occur within the Proposal Area	Occurs within 5 km of flora field survey area, however was not identified within the Proposal Area during the GHD (2015c) and BORR IPT (2019a) field surveys.

Environmentally Sensitive Areas

Two Environmentally Sensitive Areas (ESAs) intersect the south west of the Proposal Area. Both are associated with Conservation Category wetlands, Cokelup Swamp and Muddy Lakes, the latter of which also includes an occurrence of a Threatened Ecological Community (Figure 7, Appendix A).

Introduced and invasive species

Eighty nine (89) introduced flora species were recorded in the BORR IPT (2019a) flora field survey area, of these, three that are listed as Declared Pests under the *Biosecurity and Management Act 2007* and / or as a WoNS, are known to be present within the Proposal Area, namely:

- **Asparagus asparagoides* (Bridal Creeper) – Declared Pest and WoNS
- **Moraea flaccida* (One-leaf Cape Tulip) – Declared Pest
- **Zantedeschia aethiopica* (Arum lily) – Declared Pest

The remaining introduced species are considered environmental weeds. Locations of the declared weeds recorded within the Proposal Area are shown in Figure 6 (Appendix A).

Dieback

Based on the soils, vegetation, rainfall (lies within the 600 – 800 mm rainfall zone (CALM, 2003)) and drainage (contains water gaining areas), the Proposal Area is considered to be susceptible to Phytophthora dieback (CALM, 2003).

The Phytophthora dieback field assessment conducted by Glevan Consulting in October 2011 (Glevan Consulting, 2011) noted that the alignment between Jilley Road and Bussell Highway was not infested with dieback and that it was not possible to determine the dieback status of the area east of Jilley Road (to South-West Highway) due to the lack of indicator species and past disturbance.

A Dieback Management Plan will be prepared and implemented for the construction activities in the area.

Dieback mapping, including determination of protectable areas, will be updated during project planning.

4.3.4 Potential impacts

The Proposal will potentially result in direct loss of vegetation and flora through clearing of up to 98 ha. To date, approximately 76 ha of native vegetation has been surveyed, of which:

- 45 % of the vegetation to be cleared is in Degraded or worse condition
- 30 % is in Good or better condition
- 25 % ranges from Good – Degraded

Approximately 22 ha of native vegetation in the unsurveyed areas is potentially in Good or Better condition (condition to be confirmed through surveys).

Within the surveyed area, the potential impacts to native vegetation include clearing of up to:

- 20.8 ha of 'Banksia Woodlands of the SCP' TEC. Approximately 50 % of this vegetation is in Good to Degraded condition and 46 % is in Excellent to Very Good condition, of which:
    - 20.7 ha is also representative of FCT25 which is a PEC in its own right and also forms part of 'The Tuart (*Eucalyptus gomphocephala*) Woodlands of the SCP' PEC
    - The entire area is also representative of the 'Banksia dominated Woodlands of the SCP IBRA region' PEC
- 28.6 ha of native vegetation representative of FCT25 which is a PEC in its own right and also forms part of 'The Tuart (*Eucalyptus gomphocephala*) Woodlands of the SCP' PEC, 50 % of which is in Good or better condition (and includes the aforementioned extent that comprises the Banksia Woodlands TEC)
- 36.5 ha of native vegetation considered to be representative of Banksia dominated Woodlands of the SCP IBRA region (PEC), the majority (60 %) of which is in Degraded to Completely Degraded condition (including the aforementioned extent comprising both the Banksia Woodlands TEC and Tuart Woodlands PEC)
- 15.4 ha of riparian vegetation (associated with watercourses or wetlands)
- An estimated 71 individuals of the Priority listed species, Caladenia speciosa (P4), which is conservatively estimated to represent less than 2% of the population of the species
- Native vegetation associations and complexes (Beard, 1979; Webb, Kinloch, Keighery, & Pitt, 2016) that have less than 30 % within the Shire of Capel
- 0.1 ha of vegetation associated with a Conservation category wetland.

Potential impacts may also include:

- Potential clearing of the recently listed Tuart Woodlands TEC that is considered likely to be present within the Proposal Area, which will be confirmed and quantified during 2019 surveys
- Potential occurrence of priority flora species *Acacia semitrullata* (P4) and *Aponogeton hexatepalus* (P4) taxa, which are considered likely to occur within the Proposal Area.

The Proposal may also result in the following indirect impacts to vegetation and flora:

- Fragmentation of native vegetation remnants within the local area
- Possible introduction and/or spread of Dieback and weeds to adjacent native vegetation (to be managed through Hygiene Management Plan)

- Changes to vegetation structure and floristic composition in surrounding areas through altered surface water drainage patterns and flows (to be managed through Drainage Strategy)
- Damage to surrounding vegetation through accidental bushfire (to be managed through a Construction Environmental Management Plan (CEMP)).

4.3.5 Assessment of impacts

The assessment of impacts is presented at regional (Bioregion) and Local Government Area (LGA) scales. Information is also provided on the extent of vegetation within the broader (BORR IPT, 2019a) study area to supplement local scale assessment.

For the purposes of the Proposal, cumulative impacts have been assessed by comparing known regional / local extents of vegetation associations / complexes and types against published information on their extent to estimate the overall percent impact of the Proposal.

BORR IPT (2019a) provides more detailed vegetation mapping (finer scale) and captures native vegetation in degraded or worse condition (such as scattered trees) which results in a greater amount of native vegetation present when compared with the DPIRD (GoWA, 2019a) dataset for the Proposal Area. The differences in values is a result of utilising mapping at difference scales (e.g. broad-scale mapping of Beard (1979), Heddle et al. (1980) and Webb et al. (2016) versus fine-scale mapping of a localised area) as well as mapping scattered vegetation that is not captured in the DPIRD Native Vegetation Extent dataset.

Regional significance – vegetation associations / complexes

The extent of vegetation associations (remaining uncleared) has been determined from state-wide vegetation area calculations maintained by the DBCA (latest update March 2019) (GoWA, 2019b).

To allow consistent assessment at local, regional and bioregional scales, the DPIRD Native Vegetation Extent dataset (GoWA, 2019a) was used to assess direct and cumulative impacts. To calculate the current extent remaining, intersects between the Native Vegetation Extent and the Pre-European Vegetation and Vegetation Complexes – SCP datasets were completed (GoWA, 2019a).

As shown in Table 4-9, the current extent of Vegetation Association 6 is less than 30 % of its pre-European extent at state, IBRA bioregion and subregion levels, but greater than 30 % at the LGA (Shire of Capel) level.

Vegetation Association 998 has more than 30 % of its pre-European extent remaining within the entire state but less than 30 % remaining in the relevant IBRA bioregion, subregion or LGA (Shire of Capel).

Less than 30 % of the pre-European extent of Association 1000 remains at all levels.

The Government of Western Australia (GoWA, 2019c) assessed vegetation complexes mapped (Webb, Kinloch, Keighery, & Pitt, 2016) against presumed pre-European extents within the SWA IBRA bioregion (Table 4-10) and LGA levels (Table 4-11). Current extents of complexes remaining within the Proposal Area are less than 30 % of their pre-European extents within the SWA IBRA bioregion and within the City of Bunbury and Shire of Capel LGAs with the exception of the Yoongarillup Complex, at the bioregion level, and the Karrakatta Complex - Central and South, at the LGA level (GoWA, 2019c).

The Proposal will result in direct loss of approximately 73 ha of native vegetation mapped by DPIRD (GoWA, 2019a). Loss of this vegetation will result in changes to the remaining extents of vegetation associations and complexes.

Associations

The potential reductions in area of vegetation associations are relatively minor, particularly at a State scale, where all associations have greater than 25 % of their pre-European extent remaining. The potential impacts of the Proposal on vegetation associations are greatest when the potential clearing of Vegetation Association 998 is considered at a local government scale. Association 998 has just over 10 % of pre-European extent remaining in both the City of Bunbury and Shire of Capel. Further clearing of this association through the Proposal will be minimised through detailed design to reduce potential impacts and reduce the likelihood of a significant impact.

Complexes

- SCP: Clearing will not change the status of any of the four complexes. The extent of three of the four complexes will remain below 30 % of their pre-European extent and the Yoongarillup complex will retain > 30 % of its pre-European extent
- Local Government Area scale: Clearing associated with the proposal will not change the status of any of the four vegetation complexes at local government scale. The extent of three of the four complexes will remain below 30 % of their pre-European extent. The Karrakatta Complex – Central and South for the Shire of Capel, will retain > 30 % of its pre-European extent with 48.7 % remaining after implementation of the Proposal.

The reduction in pre-European extent of all four vegetation complexes is less than 1 % on the basis of their extent on the SCP. Further reduction to the clearing area associated with the Proposal will be achieved during detailed design. Particular attention will be paid to mitigating impacts to the Guildford and Southern River vegetation complexes which have 5.1 % and 18.4 % of their pre-European extent remaining on the SCP.

Table 4-9 Extent of vegetation associations mapped within the Proposal Area (GoWA, 2019b)

VEGETATION ASSOCIATION	SCALE	PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (ha)	REMAINING (%)	CURRENT EXTENT IN ALL DBCA MANAGED LAND (%)	AMOUNT WITHIN THE PROPOSAL AREA (ha)	% OF CURRENT EXTENT WITHIN THE PROPOSAL AREA	% REMAINING AFTER PROPOSAL IMPACTS
Swan Coastal Plain IBRA Bioregion		1,501,221.9	579,813.5	38.6	38.5	73.21	<0.1	38.6
6	State: WA	56,343.0	13,362.3	23.7	39.8	41.45	0.3	23.6
	IBRA Bioregion: SWA	56,343.0	13,362.3	23.7	39.8	41.45	0.3	23.6
	Sub-region: Perth	56,343.0	13,362.3	23.7	39.8	41.45	0.3	23.6
	Shire of Capel (LGA)	5,245.3	2,301.1	43.9	16.5	41.45	1.8	43.1
998	State: WA	51,015.3	18,492.6	36.3	48.7	2.2	<0.1	36.2
	IBRA Bioregion: SWA	50,867.5	18,492.3	36.3	48.7	2.2	<0.1	36.3
	Sub-region: Perth	50,867.5	18,492.3	36.3	48.7	2.2	<0.1	36.3
	Shire of Capel (LGA)	234.6	24.3	10.3	0	2.2	9.1	9.4
1000	State: WA	99,835.9	27,768.8	27.8	18.6	29.56	0.1	27.7
	IBRA Bioregion: SWA	94,175.3	24,869.2	26.4	19.2	29.56	0.1	26.3
	Sub-region: Perth	94,175.3	24,869.2	26.4	19.2	29.56	0.1	26.3
	Shire of Capel (LGA)	15,173.8	3,189.9	21.0	7.3	29.56	0.9	20.8

Note: red and orange indicate that less than 10 % and 30 %, respectively, of the pre-European extent remains before and after Proposal impacts.

Table 4-10 Extent of vegetation complex on the Swan Coastal Plain within the Proposal Area (GoWA, 2019c)

VEGETATION COMPLEX	PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (ha)	REMAINING EXTENT (%)	CURRENT EXTENT REMAINING WITHIN ALL DBCA MANAGED LAND (%)	AMOUNT WITHIN THE PROPOSAL AREA (ha)	% OF CURRENT EXTENT WITHIN THE PROPOSAL AREA	% REMAINING AFTER PROPOSAL IMPACTS
Bassendean Complex – Central and South	87,476.3	23,508.7	26.9	5.0	22.5	<0.1	26.9
Karrakatta Complex - Central and South	53,081.0	12,467.2	23.5	8.1	42.2	0.3	23.4
Southern River Complex	58,718.5	10,832.2	18.4	1.6	7.2	<0.1	18.4
Yoongarillup Complex	27,977.9	10,018.1	35.81	18.4	1.4	<0.1	35.8

Table 4-11 Extent of vegetation complex within Shire of Capel within the Proposal Area (GoWA, 2019c)

VEGETATION COMPLEX	PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (ha)	REMAINING EXTENT (%)	PROPORTION OF THE VEGETATION COMPLEX WITHIN THE LGA (%)	AMOUNT WITHIN THE PROPOSAL AREA (ha)	% OF CURRENT EXTENT WITHIN THE PROPOSAL AREA	% REMAINING AFTER PROPOSAL IMPACTS
Bassendean Complex – Central and South	4,946.6	1,162.2	23.5	5.7	29.6	2.6	23
Karrakatta Complex - Central and South	6,902.3	3,400.6	49.3	13.0	41.3	1.2	48.7
Southern River Complex	7,876.1	1,794.3	22.8	13.4	7.2	0.4	22.7
Yoongarillup Complex	1,022.2	233.6	22.9	3.7	0.5	0.2	22.8

Note: red and orange indicate that less than 10 % and 30 %, respectively, of the pre-European extent remains before and after Proposal impacts.

Local scale assessment

Assessment of the local scale impacts has been determined through using DPIRD Native Vegetation Extent data (GoWA, 2019a) for a 5 km buffer surrounding the Proposal area. This shows that the 5 km buffer (20,729 ha) contains 5,932 ha of native vegetation (28.6 %). The Proposal Area includes approximately 73 ha of mapped native vegetation (see 4.3.5), loss of which would result in a 0.6 % reduction in the extent of native vegetation within the 5 km buffer, reducing the native vegetation remaining within five km of the Proposal Area to approximately 28 % of the total area.

Threatened and Priority Ecological Communities

The extent of TEC/PEC within the surveyed area that would be lost under the Proposal is presented in Table 4-12. Table 4-6 describes the degree of overlap between these TEC/PEC extents. Due to overlap (vegetation meeting multiple TEC/PEC definitions) the total area of vegetation classed as TEC/PEC is 36.5 ha. An assessment of this loss within the local and regional scale has been made through comparing the extent within the Proposal Area to that published for the community (regional) and extent within the broader BORR IPT (2019a) study area (Table 4-13).

Table 4-12 Extent of the TECs and PECs within Proposal Area

TEC / PEC	KNOWN EXTENT IN SURVEYED AREA (ha) THAT WOULD BE LOST UNDER THE PROPOSAL
Banksia Woodland TEC	20.8
Banksia Woodland PEC	36.5
Tuart Woodland TEC^	TBC
Tuart Woodland PEC	28.6

^Due to the timing of listing 'Tuart (*Eucalyptus gomphocephala*) Woodlands and forests of the Swan Coastal Plain ecological community' as a MNES, the impact of the proposal on this community has not yet been quantified. This will be undertaken through retrospective analysis of field data collected during BORR IPT (2019a) study and additional targeted field surveys.

Banksia Woodland TEC

The Threatened Species Scientific Committee (TSSC) provides information on the estimated extent of Banksia Woodland TEC within the SCP Bioregion. This indicates that approximately 81,800 ha (~24 %) of the TEC occurs within reserves, most of which are in the Perth subregion of the SCP Bioregion (TSSC, 2016) (Table 4-13), and states that there is approximately 336,489 ha of Banksia TEC remaining within the SCP (TSSC, 2016).

Table 4-13 Extent of the Banksia Woodlands ecological community estimated to be protected in reserves (TSSC, 2016)

SUBREGION	CURRENT EXTENT (ha)	EXTENT IN RESERVES (ha)	% PROTECTED
Dandaragan (SWA01)	81,067.8	24,671.2	30.4
Perth (SWA02)	253,540.6	57,054.9	22.5
Jarrah Forests (JAF01/02)	1,881.4	105.9	5.6

SUBREGION	CURRENT EXTENT (ha)	EXTENT IN RESERVES (ha)	% PROTECTED
Total	336,489.9	81,832.2	24.3

Clearing will result in the loss of 20.8 ha of Banksia TEC within the surveyed area, equivalent to a 0.006 % reduction in the Banksia Woodland TEC in the IBRA region. At the Perth subregion scale, this represents a 0.008 % reduction.

In the Perth sub region alone, there will be an estimated 253,520 ha of Banksia Woodland (with 57,000 ha in reserves) remaining post implementation of the Proposal. Given that further reductions in actual impact will be achieved through detailed design, it is unlikely that the Proposal will have a significant impact on the Banksia Woodlands of the SCP TEC. The extent of the Banksia Woodland TEC in unsurveyed areas will be confirmed through additional targeted surveys.

Tuart Woodland PEC

The Pre-European extent of the 'Tuart (*Eucalyptus gomphocephala*) Woodlands of the SCP' PEC is estimated to be 125,400 ha with approximately 17,060 ha (2015 indicative extent) or 14 % remaining. Of this, 5,535 ha is in 20 reserves (International Union for Conservation of Nature (IUCN) management categories I-IV), comprising 22 % of the remaining extent of the ecological community (DEE, 2017). The surveyed area contains 28.6 ha of native vegetation associated with this PEC, of which approximately 50 % is in Good or better condition. Clearing associated with the Proposal would potentially result in a 0.2 % reduction in the remaining extent of the PEC. Additional surveys will be undertaken to confirm the extent of the Tuart PEC and TEC within the Proposal Area, including unsurveyed areas.

Threatened flora

Based on investigations / surveys undertaken to date, in which no flora listed as Threatened under either the EPBC or BC Acts were located, it is unlikely that any threatened flora species occur within the Proposal Area. Targeted searches for *Diuris drummondii* in areas of suitable habitat were completed by Ecoedge (2017) and did not record any individuals. Whilst additional surveys will be undertaken as part of project planning, the Proposal is not expected to result in negative impacts on any flora listed under the EPBC or BC Acts.

Priority flora

Adequate spatial data were not available to inform a cumulative assessment of conservation significant flora at a local or regional scale. The impacts have been estimated by interrogating records on FloraBase (Western Australian Herbarium, 1998-). It is noted these records often provide the count (frequency) in descriptors such as common, abundant, frequent, occasional and scattered without providing an actual number of individuals. For the purposes of this Proposal, these records have been counted as one individual and therefore the population estimates underestimate the actual number of individuals.

One DBCA Priority listed species was identified in the Proposal Area; *Caladenia speciosa* (P4) of which 71 individuals are estimated to occur within the Proposal Area (Figure 7, Appendix A). *Caladenia speciosa* is a relatively widespread species and occurs from Mundijong to Boyanup with additional populations south towards Donnybrook and further east at Lake Muir (Brown, Dundas, Dixon, & Hopper, 2008). The loss of 71 individuals would represent a less than 2 % reduction in the recorded occurrence of this species, i.e. 3,906 plants, within 59 records, are recorded on the Western Australian Herbarium database (Western Australian Herbarium, 1998-) although it is likely

this underestimates the population of the species as FloraBase and NatureMap (DBCA, 2007) do not always provide the number of plants present.

Acacia semitrullata and *Aponogeton hexatepalus,* the two Priority 4 species considered as may occur within the Proposal Area but not located during field surveys, have relatively wide distributions. *Acacia semitrullata* has been recorded from Waroona to Manjimup and *Aponogeton hexatepalus* has been recorded from Gosnells to Nannup (Western Australian Herbarium, 1998-).

Given the population estimates used are likely to be underestimates and the species are relatively widespread, the potential impacts associated with the Proposal are not considered to be significant for the Priority species recorded. Further surveys will be conducted, especially in the unsurveyed portions of the Proposal Area, to confirm this.

Environmentally Sensitive Areas

The Proposal Area includes 0.1 ha of vegetation associated with two Conservation Category Wetlands, which are identified as ESAs. Although efforts will be made to avoid it, this vegetation could potentially be cleared as a result of construction of interchanges associated with the Proposal.

4.3.6 Mitigation

Impacts to flora and vegetation will be minimised through the following measures:

- Selecting an alignment that fulfils safety objectives with the smallest practicable construction footprint
- Minimisation of clearing impacts through the detailed design process
- Rehabilitation and revegetation using suitable native species in any areas disturbed during construction but not required for road and associated infrastructure
- Development of a Construction Environmental Management Plan (CEMP) to define techniques to minimise risks to the surrounding environment and provide monitoring during construction. Included will be:
  - Measures to minimise the risk of over-clearing, such as clear demarcation of clearing areas and the implementation of an internal clearing permit system
  - Measures to minimise the risk of impacting adjacent vegetation, such as temporary fencing and adherence to Shire fire restrictions
- Development of a Hygiene Management Plan to ensure that dieback and weeds are not introduced and/or spread to adjacent vegetation. The management plan will include procedures such as machinery/vehicle clean down, weed treatments and restrictions on vehicle/machinery movements
- Development of a Topsoil Management Plan, to ensure topsoil health for re-use and to mitigate the risk of introducing weeds into the Proposal Area and surrounds. The management plan will include the development and implementation of a system to allow for traceability of disposed weed infested topsoil, predetermined stockpile locations and instructions on topsoil management procedures
- Development of a Landscape Management Plan to ensure that roadsides and medians will be vegetated and capable of acting as a biological filter for run-off to mitigate the risk of impact to adjacent vegetation
- Indirect impacts to flora and vegetation are mitigated through drainage design, as discussed in Section 4.6.6

- Development of an Environmental Offsets Strategy to mitigate unavoidable impacts on native vegetation
- Preparation of a CEMP, Hygiene Management Plan and Topsoil Management Plan.

4.3.7 Predicted outcome

By selecting an alignment for the Proposal that minimises impacts to flora and vegetation and mitigation measures to address potential impacts of the Proposal, it is expected that the EPA's objective for flora and vegetation, to protect flora and vegetation so that biological diversity and ecological integrity are maintained, will be met. Table 4-14 provides a summary of key residual potential impacts of the Proposal to vegetation and flora. As outlined previously, the extent of clearing associated with the Proposal will be refined through detailed design and the extent of TECs verified through additional surveys.

Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate and offset environmental impacts. Main Roads intends to further counterbalance the residual impacts of the Proposal through implementation of an environmental offset strategy (see Section 5).

Table 4-14 Predicted residual impacts to flora and vegetation

SCALE	SUMMARY DISCUSSION OF RESIDUAL / CUMULATIVE IMPACTS
Subregion / Swan Coastal Plain and Local Government Authority	Clearing of vegetation in associations and complexes that are under-represented (i.e. have less than 30 % of their pre-European extent remaining) at regional and local government scales.
Proposal Area	Loss of approximately 98 ha of native vegetation, comprising: • Approximately 76 ha of surveyed native vegetation of which 30 % is in Good or better condition, 25 % is in Good to Degraded Condition and 45 % is in Degraded to Completely Degraded condition • Approximately 22 ha of native vegetation mapped by DPIRD (GoWA, 2019a) within unsurveyed areas
TECs / PECs	*Banksia Woodland TEC* • Loss of up to an estimated 20.8 ha of Banksia Woodland TEC, which equates to 0.006 % of the current extent remaining of the TEC in the SWA IBRA region *Banksia Woodland PEC* • Loss of up to approximately 36.5 ha of Banksia Woodland PEC *Tuart Woodland PEC* • Loss of up to an estimated 28.6 ha of Tuart Woodland PEC (comprising FCT25), which equates to 0.2 % of the current extent remaining in the SWA IBRA region *Tuart Woodland TEC* • Potential impact to be confirmed through further studies and assessments
Other significant vegetation	Loss of up to 15.4 ha riparian vegetation associated with wetlands and minor waterways / drainage lines
Priority Flora	Potential loss of up to 71 recorded plants of *Caladenia speciosa* (Priority 4) within the Proposal Area, estimated to represent 2 % of the known population

SCALE	SUMMARY DISCUSSION OF RESIDUAL / CUMULATIVE IMPACTS
Environmentally Sensitive Areas	Potential loss of 0.1 ha of vegetation associated with ESAs designated to protect the values of Conservation Category Wetlands

4.4 Key Environmental Factor – Terrestrial Fauna

4.4.1 EPA objective

The EPA's objective for terrestrial fauna is *'to protect terrestrial fauna so that biological diversity and ecological integrity are maintained'* (EPA, 2018c).

4.4.2 Policy and guidance

- Environmental Factor Guideline 'Terrestrial Fauna' (EPA, 2016d)
- Technical Guidance 'Sampling Methods for Terrestrial Vertebrate Fauna' (EPA, 2016i)
- Technical Guidance 'Terrestrial Fauna Surveys' (EPA, 2016c).

4.4.3 Receiving environment

Fauna studies

For the purposes of the Proposal, reports by Biota (2019a; 2019b) (the latter attached as Appendix C) have been used as primary references for fauna species occurring or likely to occur within the Proposal Area and fauna habitats occurring within the Proposal Area. The Biota field surveys included reference sites and other areas outside the Proposal Area; all areas surveyed are referred to as the Biota Study Area. The Biota Study Area was completed before the Proposal Area was finalised and as a result some sections of the Proposal Area were not surveyed. Sections of the Proposal Area that intersect the Biota Study Area are referred to as surveyed areas. Sections of the Proposal Area that were not surveyed are referred to as unsurveyed areas.

Of the 300 ha Proposal Area, 187 ha (62%) has been comprehensively surveyed (Figure 4, Appendix A). Of the 113 ha unsurveyed area, 91 ha is considered to be completely degraded.

Previous surveys within the Proposal Area are listed in Table 4-15. Additional surveys will be undertaken for unsurveyed areas to support further assessment of the Proposal.

Table 4-15 Fauna investigations undertaken for the purpose of this Proposal

YEAR SURVEY COMPLETED	CONSULTANT	SURVEY NAME
2019	Biota	BORR Southern Alternative Alignment Targeted Fauna Assessment (Biota, 2019a)
2018	Biota	BORR Southern Section Targeted Fauna Assessment (Biota, 2019b)
2018	Wetland Research & Management (WRM)	BORR Southern Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2018a)
2018	WRM	BORR Alternate Alignment: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2018b)
2018	Biota	BORR (Southern Section GBRS Corridor) Black Cockatoo Tree Survey (Biota, 2018b)

YEAR SURVEY COMPLETED	CONSULTANT	SURVEY NAME
2018	Biota	Western Ringtail Possum Assessment (Biota, 2018c)
2015	GHD	BORR Southern Section GBRS Alignment- Fauna Study (GHD, 2015b)
2015	GHD	BORR Southern Section GBRS Alignment Clearing Permit Supporting Document (GHD, 2015a)
2014	GHD	Lot 1 Ducane Road, Environmental Values Assessment (GHD, 2014)
2013	GHD	BORR Western Ringtail Possum Assessment (GHD, 2013)
2012	GHD	Report for the BORR – Southern Section GBRS Corridor (South Western Highway to Bussell Highway) Environmental Impact Assessment (GHD, 2012c)
2012	GHD	BORR Southern Section GBRS Alignment, South Western to Bussell highways, Fauna Assessment (GHD, 2012b).

Locations relevant to the Proposal that have been identified and have undergone desktop assessment but have not yet been surveyed are shown in Figure 4 (Appendix A).

Terrestrial fauna habitats

Three broad habitat types covering approximately 76 ha were identified within surveyed areas (Biota, 2019a; 2019b) (Table 4-16; Figure 8, Appendix A):

- Marri/Eucalyptus Woodland: Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) dominated over storey, varying understorey of Banksia (*Banksia attenuata* and *B. grandis*) or Peppermint (*Agonis flexuosa*) dominance
- Marri/Eucalyptus in paddocks and road reserves: overstorey consisting of a scattering of mature Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) in upland areas, and Flooded Gum (*Eucalyptus rudis*) and Tuart (*Eucalyptus gomphocephala*) in low lying areas over introduced grasses
- Dampland with Melaleuca shrubland and/or woodland: dominated by *Melaleuca* spp. and sedges often in grazed paddocks. Vegetation comprised *Melaleuca rhaphiophylla* with scattered Flooded Gum (*Eucalyptus rudis*) over mixed sedge species. In some wetland areas, Peppermint (*Agonis flexuosa*) often co-dominant with *Melaleuca* spp.

The remainder of the surveyed area (111 ha) was classified as Cleared. The identified fauna habitats approximately align with vegetation communities outlined in Section 4.3, however additional detailed review of areas was undertaken after considering their likely value as fauna habitat (Biota 2019b).

Approximately 22 ha of potential fauna habitat is estimated to occur within unsurveyed areas, based on interpretation of aerial imagery and the DPIRD Native Vegetation Extent dataset (GoWA, 2019a). When added to the known extent of fauna habitat in the surveyed area (~76 ha), the Proposal Area is estimated to contain up to approximately 98 ha of fauna habitat. NB Biota (2019b) identified an additional 6 ha of mainly isolated trees in paddocks in the unsurveyed areas that will also require confirmation through future surveys.

Table 4-16 Fauna habitat types identified within the surveyed area

HABITAT TYPE AND DESCRIPTION	EXTENT WITHIN THE SURVEYED AREA (ha)
Dampland with Melaleuca shrubland and/or woodland 	16.4
Marri/Eucalyptus Woodland 	42.6
Marri/Eucalyptus in paddocks and road reserves 	16.8
Cleared	111 ha
Total	187 ha

Fauna habitat value

Approximately 202 ha (67 %) of the Proposal Area is cleared and or highly modified land including previously constructed roads and provides limited value as fauna habitat.

The Biota (2019a; 2019b) investigation identified the following key aspects of fauna habitat within the Proposal Area:

- The Marri/Eucalyptus Woodland and Marri/Eucalyptus in paddocks and road reserves habitat types recorded within the Proposal Area have suitable foraging and potential breeding habitat for conservation significant species such as Black Cockatoos (Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Cockatoo) (Biota, 2019a; 2019b). The majority of fauna habitats mapped within the Proposal Area were assessed against the DEE foraging habitat scoring tool as potentially Very High Quality for Black Cockatoo species (Biota, 2019b). This is discussed in more detail in 4.4.3
- Western Ringtail Possums (WRP) were observed utilising habitats ranging from relatively isolated trees through to remnant strips (along road reserves and riparian belts) surrounded by cleared land and to larger remnants either isolated from, or broadly contiguous with, much larger remnants
- Fauna habitat within unsurveyed areas is estimated to comprise approximately 22 ha of native vegetation which may provide additional habitat for conservation significant fauna species.

Fauna habitat types identified within the Biota Study Area are presented in Table 4-16.

Ecological linkages

The Proposal Area intersects the Dalyellup/Gelorup/Crooked Brook, South West Regional Ecological Linkage (SWREL), which connects large vegetation remnants west of Bussell Highway to large vegetation remnants in South Boyanup (approximately 7 km to the east) (Molloy, Wood, Wallrodt, & Whisson, 2009). Bussell Highway also crosses the SWREL northwest of the Proposal Area.

On a local scale, vegetation along road reserves, Five Mile Brook and Gynudup Brook provide local ecological linkages that are intersected by the Proposal Area. These linkages are likely to be used by conservation significant fauna (e.g. WRP) as well as other mammals, birds, reptiles and amphibians.

Fauna diversity

Biota (2019a) completed a desktop *NatureMap* database search of the Biota Study Area and this has been used as an indicator of potential faunal diversity within the Proposal Area. The database search indicated a species inventory of 223 vertebrate fauna species comprising 25 mammals (14 native non-volant, 1 bat and 10 non-native), 159 birds (63 of which are largely reliant on freshwater or marine habitats), 29 reptiles and 10 amphibians.

Conservation significant fauna

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 Biota Study Area (Biota, 2019b). The desktop searches undertaken by Biota (2019b) recorded:

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

Of the fauna listed above, 20 species were considered likely to occur, or possibly occurring, within the Proposal Area. Conservation significant terrestrial species (aquatic species are discussed separately below) considered likely to occur, or possibly occurring within the Proposal Area are summarised in Table 4-17, along with their habitat preferences and potential extents of their

habitat. The likelihood of occurrence assessment on the wider Biota Study Area undertaken by Biota[i] (2019a) is assumed to also apply within the Proposal Area.

Six conservation significant species were directly and indirectly observed within the Biota Study Area by Biota (Biota, 2019b) and WRM (2018a) including:

- Western Ringtail Possum (Critically Endangered)
- Carnaby's Cockatoo (Endangered)
- Baudin's Cockatoo (Endangered)
- Forest Red-tailed Black Cockatoo (Vulnerable)
- Quenda, Southern Brown Bandicoot (Priority 4) (evidence in the form of diggings)
- South-Western Snake-Necked Turtle (Near Threatened, (IUCN, 2019)).

Threatened Fauna observations within the Proposal Area and contextual sites are shown in Figure 9 (Appendix A).

Table 4-17 Terrestrial conservation significant fauna species which likely or possibly occur within the Proposal Area

SPECIES	COMMON NAME	LISTING UNDER BC ACT 2018 OR DBCA PRIORITY LIST	LISTING UNDER EPBC ACT	LIKELIHOOD OF OCCURRENCE ASSESSMENT	FAUNA HABITAT TYPE		
					MARRI/EUCALYPTUS WOODLAND	MARRI/EUCALYPTUS IN PADDOCKS AND RESERVES	DAMPLAND WITH MELALEUCA SHRUBLAND AND/ OR WOODLAND
Mammals							
Pseudocheirus occidentalis	Western Ringtail Possum	S1	CR	Recorded	Breeding, Foraging	Breeding, Foraging	-
Isoodon fusciventer	Quenda, Southern Brown Bandicoot	P4		Recorded	Breeding, Foraging	Breeding, Foraging	Breeding, Foraging
Phascogale tapoatafa wambenger	South-western Brush-tailed Phascogale, Wambenger	S6		Likely to occur	Breeding, Foraging	-	-
Dasyurus geoffroii	Chuditch, Western Quoll	S3	VU	Possible	Foraging	Foraging	-
Falsistrellus mackenziei	Western False Pipistrelle, Western Falsistrelle	P4		Possible	Breeding, Foraging	Foraging	-
Notamacropus irma	Western Brush Wallaby	P4		Possible	Foraging	Foraging	-
Reptiles							
Ctenotus ora	Coastal Plains Skink	P3		Possible	Breeding, Foraging	Breeding, Foraging	-
Birds							
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	S3	VU	Recorded	Breeding, Foraging	Breeding, Foraging	-

SPECIES	COMMON NAME	LISTING UNDER BC ACT 2018 OR DBCA PRIORITY LIST	LISTING UNDER EPBC ACT	LIKELIHOOD OF OCCURRENCE ASSESSMENT	FAUNA HABITAT TYPE		
					MARRI/EUCALYPTUS WOODLAND	MARRI/EUCALYPTUS IN PADDOCKS AND RESERVES	DAMPLAND WITH MELALEUCA SHRUBLAND AND/ OR WOODLAND
Calyptorhynchus baudinii	Baudin's Cockatoo	S2	EN	Recorded	Breeding, Foraging	Breeding, Foraging	-
Calyptorhynchus latirostris	Carnaby's Cockatoo	S2	EN	Recorded	Breeding, Foraging	Breeding, Foraging	-
Falco peregrinus	Peregrine Falcon	S7		Likely to Occur	Foraging	Foraging	-
Oxyura australia	Blue-billed Duck	P4		Possible	-	-	Foraging

Terrestrial conservation significant fauna

Black Cockatoos

The surveyed area provides up to 59.4 ha of suitable foraging and potential breeding habitat for Black Cockatoos (Carnaby's Cockatoo, Baudin's Cockatoo and Forest Red-tailed Black Cockatoo). Suitable foraging and potential breeding habitat for Black Cockatoos includes the Marri/Eucalyptus Woodland and Marri/Eucalyptus in paddocks and road reserves habitat types. Based on a review of aerial imagery and desktop study to identify habitat types potentially present, unsurveyed areas are estimated to contain an additional 20 ha of potential Black Cockatoo breeding and / or foraging habitat. Therefore the Proposal Area is estimated to contain approximately 79 ha of Black Cockatoo habitat.

During the field survey, Black Cockatoos were recorded within the Biota Study Area as described below:

- Four Forest Red-tailed Black Cockatoos were recorded from four observations
- Eight White-tailed Black Cockatoo were recorded from one observation (likely Carnaby's Cockatoo)
- Evidence of Baudin's Cockatoo (Marri nuts with chew marks).

Black Cockatoo breeding habitat, as defined in the Commonwealth referral guidelines (DEE, 2012), 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 DEE (2012) depth, width and angle criteria for nesting by Black Cockatoos, herein referred to a 'Trees with a Suitable Nest Hollow'
- 'Known Nesting Trees' are those trees that have secondary evidence of nesting i.e. feathers, eggs/ shells etc.

A total of 538 Suitable DBH Trees were identified within the surveyed area; of these 129 were found to have one or more hollows. A drone survey identified 18 of these as Trees with a Suitable Nest Hollow, of which eight are Known Nesting Trees, i.e. showing evidence of use. Survey observations and future potential breeding tree locations are shown in Figure 9 (Appendix A).

The Proposal Area is located in what is generally considered the typical breeding distribution of the Forest Red-tailed Black Cockatoo however, all three Black Cockatoo species have breeding areas overlapping the Proposal Area (Biota, 2019b).

Western Ringtail Possum

Biota (2019b) identified approximately 59.4 ha of breeding and foraging habitat for WRPs within the surveyed area comprised of the Marri/Eucalyptus Woodland and Marri/Eucalyptus in paddocks and road reserves habitat types. WRPs were recorded wherever woodland fragments (particularly mixed woodland) occurred (Biota, 2019b).

Seventy three individual WRP were recorded during strip sampling undertaken in August 2019 within the Proposal Area (Note approximately 40 ha could not be surveyed as access was not permitted). Densities of possums recorded were not uniform within areas surveyed, which is likely to reflect the variability in suitability of habitat for WRPs. The broad scale habitat suitability assessment undertaken by Shedley and Williams (2014) mapped the majority of vegetation within the Proposal Area as Medium quality (~81 %). The remaining areas were mapped as High quality (~14 %), Low (~5 %) and Very Low (<1 %). No areas were mapped as Very High suitability.

Biota (2019c) completed additional surveys to provide a regional context for potential impacts of the Proposal on WRPs. Preliminary results from the additional surveys suggest the WRP population for the SCP (Swan Coastal Plain and Crooked Brook populations is approximately 7,166 individuals, significantly higher than the 2014 estimate of 2,000 individuals on the SCP. This estimate does not include suitable habitats in the semi-urban and urban environment that are known to be inhabited by WRPs and is therefore

considered to be a conservative estimate of the WRP population on the SCP. Based on the count of WRPs recorded within the Proposal Area (73 individuals), approximately 1 % of the regional population utilises the Proposal Area.

A summary of WRP observations within the Biota Study Area and within the contextual sites is provided in Figure 9 (Appendix A).

Southern Brown Bandicoot, Quenda

Evidence of Quenda was recorded within the Biota Study Area in the form of diggings. All three habitat types identified within the surveyed area (Marri/Eucalyptus Woodland, Marri/Eucalyptus in paddocks and road reserves, and dampland with Melaleuca shrubland and/or woodland) are considered suitable habitat for Quenda and contain up to 76 ha of suitable Quenda habitat.

Based on a review of aerial imagery and desktop study to identify habitat types potentially present, unsurveyed areas are estimated to contain approximately 22 ha of potential Quenda habitat, so the total estimated extent of Quenda habitat present within the Proposal Area is 98 ha.

South-western Brush-tailed Phascogale, Wambenger

No South-western Brush-tailed Phascogales were observed within the surveyed area, however, six individuals were recorded in close proximity within Reserve 23000 (Figure 9, Appendix A). Approximately 42.6 ha of suitable habitat for the species, comprising the Marri/Eucalyptus Woodland habitat type, was identified within the surveyed area. The species is considered likely to occur in low density (Biota, 2019b).

Based on a review of aerial imagery and desktop study to identify habitat types potentially present, approximately 20 ha of the unsurveyed area is considered likely to provide habitat for South-western Brush-tailed Phascogale. The total estimated extent of South-western Brush-tailed Phascogale habitat present within the Proposal Area is approximately 63 ha.

Aquatic conservation significant fauna

In 2018, WRM undertook targeted conservation significant aquatic fauna surveys in wetlands within the Proposal Area (WRM, 2018a) and alternate alignment. Information for this section is taken from the survey report and supplemented as necessary with results of the survey for the Southern Section Alternative Alignment (WRM, 2018b). Due to changes in the Proposal Area since the surveys were completed, several areas within the Proposal Area are yet to be surveyed. Additional surveys will be undertaken to confirm the presence of aquatic conservation significant fauna within the Proposal Area, including unsurveyed areas.

Black-stripe Minnow

Black-stripe Minnows (*Galaxiella nigrostriata;* listed as Endangered under the EPBC Act) were found in wetland habitats in close proximity to the Proposal Area (<1 km away) but not within the Proposal Area (WRM, 2018a) (Figure 10, Appendix A).

Black-stripe Minnows are known to disperse in years of high rainfall and have been historically recorded intermittently in some wetlands (MBS Environmental, 2009). Due to their high mobility and the high connectivity between wetlands in wetter years, it is likely that Black-stripe Minnow could move between wetlands. In high rainfall seasons, wetlands in the Proposal Area may be hydrologically connected to habitat that supports the known populations. Additional field investigations will be undertaken to further identify suitable habitat for Black-stripe Minnow and to determine the likelihood of their occurrence within the Proposal Area.

Carter's Freshwater Mussel

Despite extensive survey effort, no Carter's Freshwater Mussel (*Westralunio carteri*) (listed as Vulnerable under the EPBC Act) were recorded at sites within the survey area, probably due to the ephemeral nature of the sites and lack of suitable habitat.

Australian Water Rat

Despite extensive survey effort (motion sensor cameras and visual observations), no Australian Water Rats (*Hydromys chrysogaster,* listed as a Priority 4 species by DBCA) were identified at sites within the survey area.

South-Western Snake-necked Turtle

Up to 11 South-Western Snake-Necked Turtles were recorded in wetlands Southern 1, 2 and 3 within the Proposal Area (Figure 10, Appendix A). South-Western Snake-Necked Turtle (*Chelodina colliei*[3]) is endemic to the south-west of WA and is listed on the IUCN Redlist of Threatened Species as Near Threatened (IUCN, 2019) and protected under the provisions of the BC Act.

4.4.4 Potential impacts

Direct impacts

The Proposal Area (approximately 300 ha) comprises approximately 202 ha of cleared or highly modified land that provides limited value as habitat to fauna. The Proposal has the potential to directly and indirectly impact on fauna and fauna habitat in the remaining 98 ha of remnant native vegetation areas during the construction and operational phases.

Potential direct impacts to fauna species known or likely to occur within the Proposal Area include:

- Clearing of up to 98 ha of potential fauna habitat including approximately 76 ha of mapped fauna habitat (within the surveyed area) and an estimated 22 ha of potential fauna habitat within the unsurveyed area
- Clearing of up to approximately 80 ha of Black Cockatoo (Carnaby's Cockatoo (Endangered), Baudin's Cockatoo (Endangered) and Forest Red-tailed Black Cockatoos (Vulnerable)) breeding and foraging habitat (including 59.4 ha in surveyed area and an estimated 20 ha in unsurveyed areas)
- Loss of a total of 538 Suitable DBH Trees identified within the surveyed area, 18 of which were identified as Trees with a Suitable Nest Hollow (drone survey), of which eight are Known Nesting Trees
- Clearing of approximately 80 ha of WRP habitat, including 59.4 ha in surveyed and an estimated 20 ha in unsurveyed areas
- Potential impacts to home ranges of approximately 73 individual WRPs (representing approximately 1 % of the regional population) recorded in strip sampling across the Proposal Area (Noting that approximately 40 ha was not surveyed as access was not permitted)
- Clearing of approximately 98 ha of Southern Brown Bandicoot, Quenda (Priority 4) habitat (including 76 ha in surveyed area and an estimated 22 ha in unsurveyed areas).
- Clearing an estimated 63 ha of South-western Brush-tailed Phascogale habitat (including 42.6 ha in surveyed area and 20 ha in unsurveyed areas)
- Potential loss of habitat for the Black-stripe Minnow. Black-stripe Minnows were recorded within wetlands adjacent to the Proposal Area, however no Black-stripe Minnow were recorded within the Proposal Area. Further field investigations will be undertaken during winter 2019 to identify suitable habitat for Black-stripe Minnow and determine the likelihood of occurrence within the Proposal Area

[3] This species was referred to as *Chelodina oblonga* in the past. However, there was some debate over species names and distributions. In 2013, the ICZN handed down its decision on nomenclature, with *C. colliei* given to the south-western snake-necked turtle, and *C. oblonga* given to the northern snake-necked turtle (previously *C. rugosa*).

- Potential loss of habitat for a further six conservation significant species that possibly occur within the Proposal Area.

Other potential direct impacts to fauna during construction and operations include:

- Temporary, localised impacts on aquatic fauna due to disturbance of wetlands and waterways
- Death or displacement of native fauna species from vehicle movements
- Accidental generation of bushfire.

Indirect impacts

The Proposal may also result in indirect impacts to fauna including:

- Incremental loss of fauna habitat (fragmentation, barrier effects and edge effects)
- Displacement of native fauna species due to traffic noise
- Displacement of native fauna species due to light spill from street lighting and traffic.

4.4.5 Assessment of impacts

Direct impacts

Almost 70 % of the Proposal Area is predominantly cleared with 202 ha of the 300 ha Proposal Area cleared or highly modified. Reduction of potential impacts on the environment has been a key consideration in selection of the alignment and identification of the Proposal Area.

Clearing and loss of habitat

The Proposal will potentially result in clearing of up to 98 ha of potential fauna habitat across the approximately 300 ha Proposal Area. Further reduction in the potential impacts will occur through the detailed design phase with the Proposal Area representing the maximum possible area of disturbance.

Further discussion on potential impacts to conservation significant fauna is provided below.

Impact to conservation significant fauna

Clearing and operation of the Proposal has the potential to impact conservation significant fauna including:

- Black Cockatoos (approximately 80 ha of potential habitat), including Carnaby's Cockatoo (Endangered), Baudin's Cockatoo (Endangered) and Forest Red-tailed Black Cockatoos (Vulnerable)
- WRP (approximately 80 ha of potential habitat) (Critically Endangered).

Black Cockatoos

The Proposal Area is located in what is generally considered typical breeding area for the Forest Red-tailed Black Cockatoo, however all three Black Cockatoo species have breeding areas overlapping the Proposal Area (Biota, 2019b).

A total of 538 Suitable DBH Trees were identified within the surveyed area; 18 of these were identified as Trees with a Suitable Nest Hollow, of which eight are Known Nesting Trees.

Western Ringtail Possums

The clearing associated with this proposal relates to a road corridor, typically no more than 100 m wide in areas that intersect WRP habitat. Where WRP have been recorded, extensive areas of habitat occurs beyond the reserve. Accordingly, it is considered that home ranges of individual WRPs will be affected to varying degrees, with some home ranges expected to only be partially cleared.

Approximately 73 WRPs could potentially have their home ranges reduced/impacted (to varying degrees) as a result of clearing of habitat within the Proposal Area. Based on assessment of local and regional sites

covering approximately 4,700 ha, this represents approximately 1 % of the estimated regional population for the SCP (Biota, 2019b).

The 2019 SCP estimate of WRP individuals does not include suitable habitat in the semi-urban and urban environment, which are known to be utilised by WRPs. The 2019 estimate of the regional population is therefore considered to be conservative (i.e. lower than in reality) and potential impact of displacement of individuals resulting from clearing of habitat associated with the Proposal is approximately 1 % of the regional population.

Black-stripe Minnow (Endangered)

No Black-stripe Minnows were recorded within the Proposal Area, however the Proposal Area includes wetland habitat that may be suitable for this species.

Other potential impacts

Temporary secondary impacts on fauna may also occur through noise, vibration, light and dust during construction. Increased noise, vibration and dust may result in native fauna avoiding the area however, this is unlikely to have any permanent implications on fauna.

Vehicle Strike

Operation of the Proposal will increase local traffic/vehicle movements resulting in greater risk of fauna strikes.

Indirect impacts

Habitat fragmentation

Incremental reduction in fauna habitat has restricted the distribution of a number of conservation significant species known to occur within the Proposal Area including WRP and Black-stripe Minnow. As habitat is cleared, patch sizes decrease and the impact of 'edge effect' increases with likely introduction of weeds and dieback changing the species composition of vegetation communities and reducing the suitability of habitat for local fauna species.

A considerable portion of the Proposal Area overlaps land that has, in the past, been largely cleared for agricultural purposes with consequential reduction in fauna habitat and its connectivity i.e. fragmentation of terrestrial and riparian / wetland vegetation and ecological linkages.

4.4.6 Mitigation

As described in Section 4.3.6, mitigation and management measures for the Proposal will be developed and refined in consultation with key stakeholders. Impacts to fauna will be minimised through implementation of the following measures:

- Detailed design to include infrastructure to facilitate fauna movement, such as overpasses, underpasses, transverse drainage and strategically placed fencing
- Fauna relocation will be considered for conservation significant terrestrial fauna species, including Western Ringtail Possums. A Fauna Management Plan will be prepared for the Proposal
- An appropriately qualified fauna handler will be on site during clearing of Western Ringtail Possum habitat
- Provision of transverse drainage design as discussed in Section 4.6.6, which will include culverts (or similar) to maintain fish passage movement (including Black-stripe Minnow) through the drainage network i.e. drainage design sympathetic to fish movement requirements
- Development of a CEMP to define techniques to minimise risks to native fauna and provide monitoring during construction. Included will be the requirement for check for known Black Cockatoo hollows

- Wherever practical, clearing will be undertaken on one front only, to provide an opportunity for fauna to move out of the Proposal Area into adjacent vegetated areas
- Clearing will be timed to minimise impact on native fauna, particularly Black Cockatoos (i.e. clearing will aim to avoid the Black Cockatoo nesting period, July – December)
- If native fauna is disturbed during clearing, it should be allowed to make its own way to adjacent vegetated areas
- All know nesting hollows impacted will be mitigated by the installation of a suitably placed artificial hollow nearby
- Should trenches be constructed, which native fauna are unable to escape from, they will be inspected by a "fauna spotter" on a regular basis (dawn, midday and prior to sunset). If trenches are left open overnight, ramps will be established to permit native fauna to escape
- Any native fauna injured as a result of the Proposal construction or operation should be taken to a designated veterinary clinic or a DBCA nominated wildlife carer
- Dust, noise and vibration management measures as outlined in a project specific CEMP.
- Strategic revegetation will be completed to reduce the net loss of WRP and Black Cockatoo habitat

4.4.7 Predicted outcome

The alignment selected for the Proposal minimises impacts to fauna and, with implementation of proposed mitigation measures, the EPA's objective for fauna will be met. Table 4-18 provides a summary of key residual impacts to fauna. The clearing extent and impacts to fauna habitats will be refined through detailed design.

Additional surveys will be undertaken to address information gaps in unsurveyed areas and confirm predicted outcomes consistent with the commitment to protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate and offset environmental impacts. Given the potential for impacts to conservation significant fauna (particularly Black Cockatoo species and WRPs) and the loss of under-represented fauna habitat, it is expected that environmental offsets will be required to account for residual impacts of the Proposal. Offsets are discussed in more details in Section 5.

Table 4-18 Predicted residual impacts to fauna

ISSUE	SUMMARY DISCUSSION OF RESIDUAL / CUMULATIVE IMPACTS	OUTCOME
Fauna habitat	Over the total Proposal Area of 300 ha, an estimated maximum of 98 ha of potential fauna habitat will be cleared, including approximately 76 ha within the surveyed area and an estimated 22 ha within unsurveyed areas. Reduction in the clearing of fauna habitats will occur through the detailed design process.	The overall loss of fauna habitats when considered in a local context is not considered significant.
Black Cockatoos	Clearing of up to approximately 80 ha of Black Cockatoo (Carnaby's Cockatoo (Endangered), Baudin's Cockatoo (Endangered) and Forest Red-tailed Black Cockatoos (Vulnerable)) breeding and foraging habitat, including 59.4 ha in surveyed and an estimated 20 ha in unsurveyed areas.	Reduction in foraging and potential breeding habitat for Black Cockatoo species could result in a minor residual impact associated with the Proposal

ISSUE	SUMMARY DISCUSSION OF RESIDUAL / CUMULATIVE IMPACTS	OUTCOME
	In the surveyed area, 18 trees considered to be Trees with a Suitable Nest Hollow were identified, of which eight are Known Nesting Trees. Further assessment of unsurveyed areas is required to quantify habitat values for Black Cockatoos.	
Western Ringtail Possums	Clearing of up to 80 ha of WRP habitat, including 59.4 ha in surveyed and approximately 20 ha in unsurveyed areas. This will potentially result in impact to the home ranges (to varying degrees) of approximately 73 individuals estimated to utilise this habitat, representing approximately 1 % of the regional population.	The clearing of WRP habitat and impact to the home ranges (to varying degrees) of approximately 73 individuals estimated to utilise this habitat (approximately 1 % of the regional population) could result in a minor residual impact associated with the Proposal
South-western Brush-tailed Phascogale	Clearing of an estimated 63 ha of South-western Brush-tailed Phascogale habitat including 42.6 ha of surveyed and approximately 20 ha in unsurveyed areas	Impact on the South-western Brush-tailed Phascogale is unlikely to be significant
Southern Brown Bandicoot, Quenda	Clearing of approximately 98 ha of Southern Brown Bandicoot habitat including 76 ha of surveyed area and 22 ha of unsurveyed areas	The impact to the Southern Brown Bandicoot is unlikely to be significant
Black-stripe Minnow	Potential loss of habitat for Black-stripe Minnow within Geomorphic Wetlands intersected by the Proposal Area (where the species was recorded adjacent but outside the Proposal Area)	Impact on the Black-stripe Minnow is unlikely to be significant

Clearing of native vegetation for construction and operation of the Proposal will result in a reduction of habitat supporting conservation significant fauna and loss of under-represented fauna habitat.

4.5 Key Environmental Factor – Terrestrial Environmental Quality

4.5.1 EPA objective

For the purpose of the Proposal, the EPA defines terrestrial environmental quality as 'the chemical, physical, biological and aesthetic characteristic of soils'.

The EPA's objective for terrestrial environmental quality is '*to maintain the quality of land and soils so that environmental values are protected'* (EPA, 2018c).

4.5.2 Policy and guidance

- 'Assessment and Management of Contaminated Sites' (DER, 2014)
- Environmental Factor Guideline 'Terrestrial Environmental Quality' (EPA, 2016e)
- Water Quality Australia, Australian Government Initiative, 'National ASSs Guidance: National ASSs Sampling and Identification Methods Manual' (Sullivan, Ward, Toppler, & Lancaster, 2018)
- DWER, 'ASS Guideline Series: Identification and Investigation of ASSs and Acidic Landscapes' (DER, 2015a)
- DWER, 'ASS Guideline Series: Treatment and Management of Soils and Water in ASS Landscapes' (DER, 2015b)
- DoW, 'Water Quality Protection Note 13: Dewatering of Soils at Construction Sites' (DoW, 2012)
- WAPC, 'ASSs: Planning Guidelines' (WAPC, 2008).

4.5.3 Receiving environment

Desktop assessments including application of the DWER Contaminated Sites Database (DWER, 2018) and ASS Risk Mapping for the SCP (GoWA, 2019a) have been undertaken for Terrestrial Environmental Quality.

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 4-19.

Table 4-19 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

Acid sulfate soils

The classification of ASS includes both Actual Acid Sulfate Soils (AASS) and Potential Acid Sulfate Soils (PASS). AASS are soils that generate acidity in situ, whereas PASS are soils that have the potential to generate acidity if disturbed and/or oxidised. ASS are soils containing naturally-occurring, fine-grained metal sulphides, typically pyrite (FeS2), formed under saturated, anoxic/reducing conditions.

ASS Risk Mapping for the Proposal Area (Figure 11, Appendix A) indicates low to moderate risk of ASS with minor areas of high risk associated with wetlands and watercourses and the Capel Golf Course (GoWA, 2019a).

Contaminated sites

A search of the DWER *Contaminated Sites Database* indicates that there are no listed contaminated sites within the Proposal Area (GoWA, 2019a).

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.

The Proposal Area traverses agricultural land that may contain sources of contamination such as dumped building materials, kill pits, landfill sites and chemical storage sites. Contaminated sites risk investigations will be undertaken during detailed project design.

4.5.4 Potential impacts

Proposal activities that have the potential to impact the terrestrial environmental quality during construction include earthworks and storage and handling of environmentally hazardous materials.

Potential construction impacts are:

- Disturbance of ASS resulting in acid leachate into the receiving environment causing contamination of land and/or waters
- Stormwater runoff leading to erosion
- Disturbance of unknown contaminated sites resulting in spread of contamination
- Accidental release or spread of wastes, hydrocarbons or chemicals resulting in contamination of land and water bodies.

Operational impacts to Terrestrial Environmental Quality resulting from the Proposal are mainly limited to road use, including pollution and wastes. Road drainage will be designed to prevent direct discharge of run-off to the adjacent environment.

Potential indirect impacts that could arise from construction of the Proposal also include salinisation and soil erosion. The risk of salinisation on the SCP is considered to be low and clearing associated with the Proposal in the context of local and regional water tables is unlikely to result in increased risk of salinisation of soils. The risk of soil erosion will be managed through the implementation of appropriate drainage controls through the detailed design phase and development of a Drainage Strategy.

4.5.5 Assessment of impacts

Direct Impacts

Acid sulfate soils

ASS can be disturbed either by excavation or lowering of the water table below natural seasonal levels (i.e. dewatering). Excavations occurring for the Proposal will be limited mainly to the construction of bridge footings. It is likely that ASS will be encountered within excavations greater than 1.0 m depth, particularly within riparian and wetland zones. Dewatering may be required during construction of bridge footings, which could expose PASS, allowing oxidation of exposed sulphides and consequential formation of sulfuric acid.

In the absence of appropriate management the presence of ASS or the oxidation of PASS, can lead to surrounding land (soil) and nearby waterways becoming acidic (pH<6.5). Under acidic conditions, metals such as aluminium (generally at pH<4.5) and iron as well as trace heavy metals (including arsenic) can become more mobile and potentially be transported off-site in surface and ground waters. As a result, concentrations of metals within surface and / or ground waters can reach concentrations toxic to sensitive terrestrial and aquatic plants and animals.

Hazardous material and waste disposal

Direct contamination of soils and land can occur through release of hazardous materials such as hydrocarbons, chemicals and reagents from storage or handling areas. Storage of hazardous materials during the construction period will be limited to temporary storage areas holding minor quantities of oils and grease for maintenance and fuel supplies for construction equipment.

Hazardous waste will be temporarily stored onsite prior to disposal to an appropriately licensed facility. All such materials will be stored within sealed, covered, bunded areas. Refuelling of larger equipment and generators will occur within the Proposal Area but preferably will be refuelled off-site as practical. Due to the limited scale of hazardous material storage, the quantities of any accidental releases would be small and contamination would be localised and restricted and shallow unless response is delayed.

There will be no soil or land impacts within the Proposal Area associated with disposal of waste products. All wastes including used oils/greases and municipal waste will be disposed or recycled to an appropriate off-site waste management facility.

Contamination and erosion during operation

Stormwater runoff from the operational road is likely to include pollutants deposited on the road by vehicles. Exhaust gases and lubricants release lead, hydrocarbons, nickel and bromine whereas iron and chromium detach from corroded bodywork and sulphur, chlorine and cyanide are dispersed via cooling liquids. Vehicle tyres also shed rubber particles that contain lead, cadmium and zinc onto roadways (ENI School, n.d.). These impacts are not expected to be significant.

Stormwater run-off can result in bank erosion and transport of contaminants to soils and water bodies if not managed appropriately. Drainage infrastructure will be installed to manage and control stormwater, making direct releases to soils or land unlikely. Volumes of hydrocarbons on the road are not likely to be significant during normal operation, however an accident could lead to large-scale discharge if not adequately managed.

Loss of soil function

Soil function beneath bituminised road surfaces will necessarily be impaired.

Indirect impacts

Salinisation and erosion of soils

Clearing of deep-rooted native vegetation can lead to salinisation and erosion of soils, however, the risk of dryland salinity on the SCP as a result of vegetation clearing is low (Simons, George, & Raper, 2013). Furthermore, the scale of clearing associated with the Proposal is unlikely to result in significant changes in groundwater levels and unlikely to result in secondary salinization.

Vegetation clearing, topsoil removal and soil excavation can reduce soil health and increase the potential for wind and water soil erosion because of altered surface water infiltration and drainage patterns and lack of protection of top soil. Erosion can lead to loss of top- and sub-soils.

4.5.6 Mitigation

The risks associated with potential impacts to Terrestrial Ecosystem Quality, specifically ASS and contaminated sites are considered relatively minor and manageable. Main Roads has extensive experience with the management of these risks in similar projects throughout the south west of WA. Impacts will be avoided and minimised through the following mitigation and management measures:

Avoid

- Hydrocarbon and chemical management through the implementation of a CEMP, which will include details on the handling and storage of hydrocarbons, chemicals and hazardous materials
- Avoidance of soil salinisation through minimising clearing of native vegetation (as far as reasonably practicable) and through revegetation
- Avoidance of contaminated stormwater discharge through drainage design (further described in Section 4.6.6).

Minimise

- Implement an ASS Management Plan (ASSMP) throughout construction of the Project
  - An overarching ASSMP has been included in the EMP (BORR IPT, 2019c). The ASSMP will be updated at the detailed design stage when cut and fill volumes are confirmed. Key management measures include:
  - Spoil management including treatment via chemical neutralisation (use of Agricultural Lime or similar)
  - Dewatering management strategies and requirements for disposal of dewatering effluent (see Section 4.6.6)
  - Groundwater monitoring and management (see Section 4.6.6)
- Minimise soil impacts through the implementation of a CEMP:
  - Drainage treatments to minimise and/or direct runoff from cleared areas in order to minimise downslope erosion and sedimentation
  - Stabilisation techniques applied if erosion or sedimentation is evident
  - Vehicle and machinery traffic will be confined to the disturbance area to prevent damage to retained vegetation/land
  - Minimise the loss of soil structure through re-use in landscaped areas where appropriate via a Topsoil Management Plan (see Section 4.3.6)
  - Sediment reduction and control methods for the retention areas of dewatering effluent

  - Monitoring during construction

- Undertake a contamination risk assessment of the entire alignment (when available) and remediating any contamination as required
- If, during construction works within the Proposal Area, contamination is identified, the site will be managed in accordance with the requirements of the Contaminated Sites Act 2003 and DWER guidelines for Assessment and Management of Contaminated Sites (DER, 2014).

4.5.7 Predicted outcome

The potential risks to terrestrial ecosystem quality associated with the construction of the Proposal, specifically ASS, salinisation, contaminated sites and erosion will be effectively managed through implementation of the mitigation measures detailed in the previous section and the EPA objective for this factor will be met.

The risk of ASS exposure during construction of the bridge footings associated with the Proposal can be managed under a detailed ASS Management Plan. The detailed ASS Management Plan will be site specific, and will be developed once the alignment and construction methods have been finalised. It is considered that this risk can be adequately managed and that there will be no residual impact to terrestrial environmental quality from ASS.

The risk of dryland salinity on the SCP as a result of clearing native vegetation for this proposal is considered to be low. The majority of the Proposal Area is historically cleared modified land, and clearing associated with the Proposal is linear in nature. The majority of vegetation to be cleared is associated with fence lines, wind breaks and riparian vegetation where there is contiguous vegetation that will be retained, minimising the risk of potential impacts to local hydrology and rising water tables. Given the scale, nature and location of the clearing required to implement the Proposal, it is considered unlikely that salinisation will occur as a result of this proposal.

The construction of the Proposal will result in a loss of soil function for the bituminised area (road base). The remainder of the Proposal Area can be rehabilitated to restore the soil function.

It is considered that the potential for erosion and soil contamination during construction can be adequately managed under a CEMP. The potential for erosion and contamination from stormwater during the operational phase will be avoided with adequate drainage design.

4.6 Key Environmental Factor – Inland Waters

4.6.1 EPA objective

The EPA's objective for inland waters is *'to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected'* (EPA, 2018c).

4.6.2 Policy and guidance

- Environmental Factor Guideline 'Inland Waters' (EPA, 2018a)
- 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality' (ANZECC & ARMCANZ, 2000)
- Contaminated Sites Guidelines 'Assessment and Management of Contaminated Sites' (DER, 2014).

4.6.3 Receiving environment

Desktop searches of DWER datasets (GoWA, 2019a) were undertaken and are summarised in Table 4-20.

Table 4-20 Hydrology queries within the Project Area

ASPECT	DETAILS	RESULT
Groundwater Areas	Groundwater areas proclaimed under the RIWI Act	Bunbury Groundwater Area Busselton-Capel Groundwater Area
Rivers	Rivers proclaimed under the RIWI Act	None
Proclaimed Surface Water Areas (PSWA)	Surface water area, proclaimed under the RIWI Act; prescribes the taking of water from watercourses and wetlands	None, Capel River PSWA is 1.8 km south of the Proposal Area
Public Drinking Water Source Areas (PDWSA)	Surface water catchments and groundwater areas that provide drinking water to cities, towns and communities, proclaimed under the *Metropolitan Water Supply, Sewage and Drainage Act 1909* or *Country Area Water Supply Act 1947*	Much of the western border of the Proposal Area abuts and in several areas overlaps the eastern boundary of the Bunbury Reserve PDWSA
Urban Water Management Plans (UWMP)	Plans prepared by urban water suppliers to support long-term resource planning	Northwest edge of the Proposal Area crosses the northeast corner of the Dalyellup East UWMP area (Shire of Capel) situated southwest of Centenary Road intersection with Bussell Highway
Local Water Management Strategies (LWMS)	Water management strategies that support local land-use planning (local planning scheme amendments or local structure plans)	Northwest edge of the Proposal Area crosses the southeast corner of the Tuart Brook Precinct LWMS area (City of Bunbury) situated northwest of Centenary Road intersection with Bussell Highway
Waterways Conservation Areas	Areas proclaimed under the *Waterway Conservation Act 1976*	None

Figure 12 (Appendix A) shows preliminary groundwater and surface water test locations in the vicinity of the Proposal Area.

Groundwater hydrology and hydrogeology

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). Whilst not all GDEs are solely reliant on groundwater, the Proposal Area is also mapped as likely to be an Inflow Dependence Ecosystem (IDE) therefore, reliant on water, in addition to rainfall (BoM, 2018).

Figure 13 (Appendix A) shows that annual rainfall in the Bunbury area has been generally declining since record keeping began in 1877 (BoM, 2019b). Declining rainfall in the area has affected groundwater recharge and surface water runoff which, turn, affect groundwater dependent ecosystems (GDEs). GDEs are also susceptible to impacts associated with land clearing, water abstraction, fragmentation of native vegetation, weed invasion and spread of dieback disease.

Surface water and drainage

Surface water hydrology

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. The Proposal includes constructing a bridge over Five Mile Brook at the northern end of the associated Multiple Use (MU) wetland.

There are no PSWAs within the Proposal Area. The closest PSWA is the Capel River PSWA which is 1.8 km south of the southernmost point of the Proposal Area (Bussell Highway, adjacent Capel Golf Course).

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).

A relatively small part of the northwest edge of the Proposal Area crosses the northeast corner of the Dalyellup East UWMP area (Shire of Capel) situated southwest of Centenary Road intersection with Bussell Highway. Similarly, a relatively small part of the northwest edge of the Proposal Area crosses the southeast corner of the Tuart Brook Precinct Local Water Management Strategy area (City of Bunbury) situated northwest of the Centenary Road intersection with Bussell Highway. It is considered unlikely that the Proposal will have significant implications to the UWMP or LWMS strategy areas but these areas will be identified in the CEMP and, if necessary, risk mitigations measures will be established in consultation with the relevant LGAs.

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

Surface water quality

Four wetlands situated south and east of the Proposal Area were sampled as part of studies for the BORR Alternative Alignment (WRM, 2018b). *In situ* water quality was generally good and characterised by being slightly acidic pH (6.23 to 6.68), with variable dissolved oxygen (DO) (28.7 % to 170.8 %), and warm temperatures (18.5 ºC to 25 ºC). Electrical conductivity ranged from 183

µs/cm to 1422 µs/cm (indicating freshwater) and pH was slightly below guideline values (ANZECC & ARMCANZ, 2000) for protection of slightly/moderately disturbed wetland ecosystems in the southwest of WA. Sampling and testing of surface waters within the Proposal Area will occur as part of detailed design.

Flood modelling

The Proposal Area lies within the South West Drainage Division (GoWA, 2019a) and intersects several water courses, wetlands and other water bodies, including Five Mile Brook. No rivers occur within the Proposal Area. Waterways assessments and flood modelling to inform bridge and crossing designs will be undertaken as part of detailed design.

Wetlands

Wetlands of international significance

There are no Ramsar wetlands located within 10 km of the Project Area; the nearest (Vasse-Wonnerup System) is located approximately 19 km southwest of the Project Area (GoWA, 2019a).

Geomorphic wetlands

The Proposal Area overlaps or intersects 24 Geomorphic Wetlands (Figure 10, Appendix A) (GoWA, 2019a). The number of wetlands in each category and the total areas of overlap for each category (approximate) are as follow:

- One Conservation Category – totalling 0.1 ha
- One Resource Enhancement – totalling 3.5 ha
- 21 Multiple Use – totalling 60 ha
- One Not Categorised – totalling 0.5 ha.

Locations of these Geomorphic Wetlands are shown in Figure 10 (Appendix A).

Consanguineous wetlands

The Proposal Area is located within four consanguineous wetland suites; the proportions of the Proposal Area within each suite are as follow:

- Bennett Brook suite - 78.6 %
- Big Swamp suite - 1.5 %
- Vasse-Wonnerup suite - 19.7 %
- Cokelup suite - 0.2 %.

4.6.4 Potential impacts

Direct impacts

Activities associated with the Proposal that have potential to impact on inland waters during construction include vegetation clearing, earthworks, groundwater abstraction (for activities such as dust suppression and dewatering) and construction of bridges and drainage structures. Without suitable management measures applied, the following potential impacts could occur:

- Abstraction of groundwater for construction activities (dust suppression, dewatering bridge footings)
- Changes to groundwater levels in the superficial aquifer associated with vegetation clearing
- Changes to hydrological regimes of Geomorphic Wetlands and waterways – specifically resulting in loss of connectivity and fragmentation of Black-stripe Minnow and other aquatic fauna habitat
- Erosion and sedimentation in surrounding areas, as a result of vegetation clearing, bridge construction, earthworks and alteration of surface water drainage

- Impact on river bed and banks due to construction of bridge structures, such as pylons within, and on the banks of the rivers
- Increase in upstream water levels (backwater) at proposed bridge sites and in the vicinity of the road alignment due to constriction or diversion of the existing flowpaths
- Contamination of surface and/or groundwater as a result of:
  - Contaminated stormwater run-off from storage and handling of environmentally hazardous materials
  - Accidental release of hazardous substances
  - Exposure to PASS and contaminants during excavation.

The potential indirect impacts on inland waters during construction and operation of the Proposal include changes to vegetation structure in surrounding GDEs (geomorphic wetlands), as a result of changes to hydrological regimes.

The operational activity associated with the Proposal is traffic movement associated with the completed road and bridges. The potential impacts associated with the construction and operational phases of the Proposal are discussed in the sections below.

4.6.5 Assessment of impacts

Direct impacts

Dewatering for construction activities

Temporary localised dewatering may be required at proposed bridge sites to facilitate the construction of the bridge footings. After detailed design, construction methods and associated dewatering requirements will be identified.

The location of abstraction bores will be determined prior to commencement of construction and a licence application for dewatering bores will be submitted to DWER. Dewatering and water abstraction activities associated with construction will be temporary and impacts are likely to be spatially restricted and not significant.

Changes to groundwater levels in the shallow aquifer associated with clearing

Vegetation clearing within the Proposal Area has the potential to allow the groundwater level to rise. However, given the amount of land that has been previously cleared within and adjacent to the Proposal Area and the amount of contiguous vegetation that will be retained, it is unlikely that groundwater levels will be significantly affected by clearing associated with the Proposal. Monitoring of groundwater and surface water is currently underway and will be used to inform the management of impacts.

Erosion and sedimentation

Clearing of vegetation, construction earthworks and altered surface water regimes have the potential to destabilise soils and, if unmanaged, result in erosion and sedimentation of surrounding drainage infrastructure, vegetation, wetlands and waterways.

Construction of bridges will require clearing of riparian vegetation and excavations in proximity of the riverbanks, which could potentially destabilise soils. These activities have the greatest potential to cause erosion, resulting in an increase in turbidity and consequent decrease water quality within the watercourses. These potential impacts will be effectively managed through mitigation measures and are considered unlikely to be significant.

Contamination of surface water and groundwater

Contamination of surface and ground-water could occur during construction due to accidental release of hazardous materials, runoff and from contaminated sediments or dust.

Surface and/or ground-water may also become contaminated through exposure of ASS or PASS during construction activities (see Key Environmental Factor – Terrestrial Environmental Quality). ASS impacts could include acidification of surface and ground-water. Contaminated surface and ground-water also has the potential to impact sensitive receptors including neighbouring properties, vegetation, fauna, wetlands and waterways and could manifest downstream as loss of benthic habitat, fish deaths and damage to vegetation health.

These potential contamination impacts will be effectively managed through the mitigation measures detailed in section 4.6.6 and considered unlikely to be significant.

Alteration of hydrological flow to Geomorphic Wetlands and minor waterways

Construction will potentially impact wetlands within the Proposal Area through filling and vegetation clearing and result in changes to surface water flows. This may in turn adversely affect functioning of wetland and river systems.

Once constructed, the bituminised roads will prevent surface water infiltrating. Road runoff and stormwater will be managed with the objective of maintaining local hydrological regimes through enabling infiltration close to the point of collection and it considered that the Proposal will not significantly restrict recharge of the superficial aquifer.

A Drainage Strategy and drainage design will be developed with the objective of maintaining pre-development surface water flows to wetlands retained within the Proposal Area.

Climate change

The drying climate in the South West region could result in reduced groundwater and surface water availability, increased seawater intrusion and greater risk to groundwater dependent ecosystems (GDEs) from water abstraction (DoW, 2015). Sea level rise is also a major consideration for infrastructure within the coastal zone.

In accordance with the Main Roads Guideline on Climate Change (MRWA, 2017), impacts of climate change have been considered during Proposal planning. The Guideline specifies that impacts of a 300 mm sea level rise are to be considered during planning, design and construction for all Proposals in coastal areas. The Guideline also includes consideration of potential changes in rainfall pattern due to climate change and recommends that Intensity Frequency Duration (IFD) rainfall data are adjusted for future climate change. This recommendation will be incorporated in a review of the effects of rainfall intensification for transverse drainage during detailed design.

4.6.6 Mitigation

Potential impacts on inland waters will be minimised during the detailed design phase and implementation of an EMP and CEMP:

- 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 (Black-stripe Minnow) under the constructed road (culverts or other) where appropriate

- 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
- 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 Section 4.5.6, as well as the following management measures:
  - 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 and 50 m, respectively, 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
- Minimise the risk of exposing existing contamination as described in Section 4.5.6
- Monitoring of groundwater and surface water will be required and managed under a CEMP, as detailed in the EMP (BORR IPT, 2019c) and summarised below:
  - 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 EMP)
    - 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.

4.6.7 Predicted outcomes

Hydrological processes within the Proposal Area are in a largely modified state due to historical clearing and land drainage. It is anticipated that potential impacts to inland waters associated with

the Proposal are manageable with implementation of the mitigation measures proposed and no residual impacts are anticipated. Whilst this will be confirmed as part of further studies during detailed design, it is expected that the hydrological regimes and quality of surface and ground-water will be maintained so that environmental values are protected.

Surface water and drainage impacts will be mitigated through the design process to allow predevelopment flows to be maintained.

Temporary impacts on groundwater and surface water during construction will be managed via implementation of a Proposal specific CEMP.

Operation of the Proposal, once built, is considered unlikely to significantly impact on surface water and groundwater quality.

Based on the mitigation measures proposed, no significant residual impacts on inland waters are expected and it is considered the Proposal meets the EPA objective to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

4.7 Key Environmental Factor – Air Quality

4.7.1 EPA objective

The EPA's objective for air quality is *'to maintain air quality and minimise emissions so that environmental values are protected'* (EPA, 2018c).

4.7.2 Policy and guidance

- Environmental Factor Guideline 'Air Quality' (EPA, 2016f)
- 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).

4.7.3 Receiving environment

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).

4.7.3.1 Meteorology

The Proposal Area is subject to a Mediterranean climate, with hot dry summers and mild wet winters, with the majority of the rain falling in winter. The closest BoM weather station to the Proposal Area is the Bunbury Automatic Weather Station (AWS) (Station ID 9965). This station records temperature, rainfall, relative humidity, wind speed and direction and has data available dating back to 1995. Figure 14 to Figure 16 (Appendix A) illustrate recorded average monthly meteorological data for the Bunbury AWS BoM station for years 1995 to 2018 (BoM, 2019b).

Temperatures range from a mean maximum of 30 °C in summer and drop to a mean maximum of 17 °C in winter. Mean minimum temperatures follow a similar trend, reaching 16 °C in summer and 7 °C in winter. Rainfall is low throughout the summer months and peaks in July, with a monthly average of 140 mm. Relative humidity at Bunbury reflects the Mediterranean climate, demonstrating drier summers and a comparatively high relative humidity of 85 % in the morning in winter (BoM, 2019b).

4.7.3.2 Background air quality

Air quality assessment for the 2012 BORR Southern Section referral (GHD, 2012c) estimated the concentrations of pollutants generated by vehicles using projected traffic volumes and vehicle emission rates as inputs to an air dispersion model. Background concentrations adopted for the study were derived from 75th percentile PM_{10} concentrations for Bunbury and 75th percentile CO and Nitrogen Dioxide (NO_2) concentrations for South Lake (the closest air quality monitoring station to the proposal). For all other constituents, a background concentration of zero was assumed. Background concentrations adopted are provided in Table 4-21.

Table 4-21 Ambient background concentrations (GHD, 2012c)

POLLUTANT	AVERAGING PERIOD	BACKGROUND CONCENTRATION	
CO	8-hour	0.3 ppm	375 µg/m^3
NO_2	1-hour	0.025 ppm	51 µg/m^3

POLLUTANT	AVERAGING PERIOD	BACKGROUND CONCENTRATION	
Particulate matter as PM_{10}	24-hour	-	20.8 µg/m^3

4.7.3.3 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). Residential areas are located within 20 m of the Proposal Area.

4.7.4 Potential impacts

Direct impacts

Potential direct construction impacts that may occur to Air Quality as a consequence of the Proposal are:

- Increased construction vehicle emissions
- Dust generated from construction activities
- Increased greenhouse gas (GHG) emissions.

Construction of the Proposal also has the potential to reduce air quality via increased road vehicle traffic and GHG emissions, whilst operation of the Proposal may reduce vehicle emissions as a consequence of improved traffic flows.

Human health effects of the major vehicle emissions (CO, PM_{10}, 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 (O_3), which can also have as photochemical effects.

Indirect impacts

Potential indirect impacts from dust generated during construction may include impacts to vegetation and changes to vegetation communities (smothering) directly adjacent to the Proposal Area.

Indirect impacts may include GHG emissions associated with operation of Main Roads buildings, depots and light vehicle fleet (emission from power generation and vehicles).

4.7.5 Assessment of impacts

Direct impacts

Increased construction vehicle emissions

Construction works for the Proposal will involve operation of heavy machinery and vehicles. Some minor increase in emissions associated with construction activities is anticipated but will be temporary (expected to occur for the duration of construction). Impacts associated with these emissions are not considered likely to be significant.

Dust impacts during construction

Construction works for the Proposal will involve operation of loaders, dozers, graders, excavators and trucks to clear vegetation and to excavate and remove material for use as fill within other areas of the site. There will also be miscellaneous vehicle movements around the Proposal Area as part of construction works. These activities will result in dust emissions due to:

- Movement of vehicles and heavy equipment on unsealed surfaces
- Excavating, spreading and compacting soils
- Wind erosion from exposed and disturbed soil surfaces.

Dust may be a nuisance to nearby sensitive receptors if unmitigated during construction activities, however it is considered unlikely to have any significant adverse impact on local air quality.

Reduced air quality due to bushfire

Construction activities have the potential to ignite bushfires through hot work and vehicle movements, the smoke from which could cause temporary reduction in local air quality. Potential risks associated with bushfires are considered low and will be managed through appropriate mitigation as part of the CEMP. No significant impacts resulting from accidental bushfires are expected.

Impacts from vehicle emissions

The BORR Southern Section air quality report (GHD, 2012c) predicted that all vehicle emission concentrations, except for the pollutant, Benzo(a)pyrene (BaP), would be below the National Environmental Protection Measure (NEPM)/World Health Organisation criterion. The report stated its model for BaP concentrations is conservative and actual BaP concentrations are unlikely to exceed the NEPM criteria.

No significant impacts resulting from vehicle traffic are expected.

Greenhouse gas emission impacts

Operation of site offices, light diesel powered vehicles and heavy equipment for construction of the Proposal will result in generation of GHG emissions throughout construction of the Proposal. The GHG emissions associated with construction activities are expected to occur for approximately 2 – 3 years while construction work is ongoing.

An assessment of GHG emissions for the construction phase of the Proposal will be undertaken to quantify direct emissions and therefore determine the requirement for management measures.

Indirect impacts

Indirect impacts may include GHG emissions associated with operation of Main Roads buildings, depots and light vehicle fleet (emission from power generation and vehicles).

4.7.6 Mitigation

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. Opportunities to reduce on-going energy include, but not limited to the following, where practicable:

- Use of energy efficient electrical assets such as LED street lights
- Reducing the expansion of traffic signals and Main Roads has adopted a policy of alternative design treatments such as roundabouts or modified intersections to assist with reducing congestion
- Use of renewable energy sources
- Use of materials with lower embodied energy

- 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).

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.

The requirement for GHG emission management and mitigation will be determined in an assessment of direct emissions for the construction and operation phases of the Proposal.

4.7.7 Predicted outcomes

Dust is expected to be generated during construction. This impact will be controlled using standard mitigation measures, such as watering trucks. 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 for future road traffic emissions indicate that the constructed Proposal is unlikely to have an adverse impact on local air quality.

It is considered unlikely that ongoing street lighting, traffic signals and road maintenance activities would produce significant GHG emissions for the Proposal. However, construction and operation of the Proposal will be subject to an assessment for direct GHG emissions.

The EPA's objective for the factor air quality is to maintain air quality and minimise emissions so that environmental values are protected.

Given the proposed measures outlined above, no residual impacts are expected for this aspect and the Proposal meets the EPA objective to maintain air quality and minimise emissions so that environmental values are protected.

4.8 Key Environmental Factor – Social Surrounds

4.8.1 EPA objective

The EPA's objective for social surroundings is '*to protect social surroundings from significant harm'* (EPA, 2018c).

4.8.2 Policy and guidance

- Environmental Factor Guideline 'Social Surroundings' (EPA, 2016g)
- Guidance for the Assessment of Environmental Factors 'Assessment of Aboriginal Heritage No. 41' (EPA, 2004)
- 'State Planning Policy (SPP) 5.4: Road and Rail Transport Noise and Freight Considerations in land Use Planning' (WAPC, 2009)
- 'Implementation Guidelines for State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning' (WAPC, 2014).

4.8.3 Receiving environment

Cultural heritage

European heritage

No World Heritage Properties or Commonwealth Heritage Places occur within 10 km of the Proposal Area (DEE, 2018).

The State Heritage Office dataset indicated one heritage site within the Proposal Area, the Tuart Tree, Gelorup (Place No. 26059), located at Lot 48 between Yalinda Drive and Woods Road, Gelorup (GoWA, 2019d). This heritage site is listed as "Other Heritage Listings" by the Heritage Council (adopted 14 December 2018).

There are six other Municipal Inventory Places located within 2 km of the Proposal Area (GoWA, 2019d) (Figure 17, Appendix A):

- Sherwood Lodge (Place No. 15157) located approximately 1.9 km from the Proposal Area. Listed on the Municipal Inventory by the Shire of Capel (adopted August 1999)
- Bunbury Cathedral Grammar School (Place No. 14969) located approximately 1.8 km from the Proposal Area. Listed on the Municipal Inventory by the Shire of Capel (adopted August 1999)
- South West College of TAFE (Place No. 5684) located approximately 2 km from the Proposal Area. Listed on the Municipal Inventory by the Shire of Capel (adopted August 1999)
- Edith Cowan University, Bunbury Campus (fmr) (Place No. 5685) located approximately 2 km from the Proposal Area. Listed on the Municipal Inventory by the City of Bunbury in 1996
- 'Bushbelt – Ocean-Preston Regional Park' (Place No 5670), a 7 km length of Conservation Corridor, Tuart Valley and The Maidens. Located approximately 0.5 km from the most eastern point. Listed on the Municipal Inventory by the City of Bunbury (adopted July 1996)
- Astronomical Observatory and wetland vegetation (Place No. 04260) located approximately 2 km from the Proposal Area. Listed on the Municipal Inventory in 1996 and again in 2001 by the City of Bunbury.

Aboriginal heritage

A search of the Aboriginal Heritage Inquiry System (Appendix D) identified three sites lodged as 'Other Heritage Places' (DPLH, 2019) within the Proposal Area (Figure 17, Appendix A). They are:

- Place ID 18884 Bunbury Bypass Archaeological Site 1 – Artefact Scatter
- Place ID 37869 Paper bark wetlands – Modified Tree, Birth Place, Hunting Place, Water Source
- Place ID 37870 The Gelorup Corridor – Artefacts / Scatter, Ceremonial, Skeletal Material, Burial.

The Proposal Area occurs within the Gnaala Karla Booja (GKB) People Indigenous Land Use Agreement (ILUA). Aboriginal heritage surveys for the BORR were conducted in 1995 (McDonald Hales and Associates, 1995), updated in 2002 and again in 2009 (Brad Goode & Associates, 2009) and 2012 (Brad Goode & Associates, 2012). The 2012 survey included both archaeological and ethnographic components. A recommendation of the 2012 investigation was that Main Roads make application under Section 18 of the *Aboriginal Heritage Act* for consent to use land that may contain an Aboriginal site.

Land use

Existing land use

Much of the land within the Proposal Area is reserved for Primary Regional Road (approximately 39 %) and approximately 57 % is zoned Rural (Table 4-22) (DPLH, 2018). The Proposal Area also intersects land reserved as primary regional road (e.g. Bussell Highway, Hasties Road, Allenville Road, Centenary Road and the current BORR alignment as identified in the GBRS), regional open space and urban (Figure 18, Appendix A).

Table 4-22 Land zoning and reservation within the Proposal Area

REGIONAL SCHEME DESCRIPTION	RESERVED LANDS/ ZONES	AREA WITHIN PROPOSAL AREA (ha)	PROPORTION OF PROPOSAL AREA (%)
Primary regional roads	Reserve	114.7	38.6
Regional open space	Reserve	4.0	1.3
Rural	Zone	170.6	57.5
Urban	Zone	7.6	2.6
Total		296.9	100

Demography and economy

The Greater Bunbury Region, which includes the Shires of Harvey, Dardanup and Capel and the City of Bunbury had a population of 89,628 in 2016 (Shire of Capel, 2018) and construction was the main industry (approximately 12.8 % of employment) followed by manufacturing (approximately 11.8 % of employment).

Visual amenity

The SCP 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 (Mitchell, Williams, & Desmond, 2002). 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 existing amenity of the Proposal Area includes urban and semi-rural properties, pockets of native vegetation, rural/ agricultural areas, existing roads (including Bussell Highway) and previously cleared areas. An Urban and Landscape Design Framework (BORR IPT, 2018) has been developed which outlines the urban and landscape design vision, objectives and principles for the Proposal. A site analysis identified 13 Landscape Character Units which are located in the Proposal Area (Figure 19, Appendix A) and described in the BORR IPT (2018) Urban and Landscape Design Framework.

Noise

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 Bussell Highway and other roads
- Natural (leaves rustling, wind in trees and bird and insect calls).

Existing road traffic noise was assessed in 2012 by Lloyd George Acoustics (Lloyd George Acoustics, 2012) at existing roads near to sensitive receptors and the BORR alignment to gather baseline noise levels to support noise modelling. Further noise modelling will be undertaken to inform the impact assessment and the design of mitigation measures.

Lighting

The existing lighting environment within the vicinity of the Proposal Area is considered to be limited to:

- Lighting on existing roads
- Residential dwellings and associated buildings
- Vehicle headlights.

4.8.4 Potential impacts

Direct Impacts

In the absence of suitable mitigation measures, construction of the Proposal could potentially result in the the following impacts to social surrounding:

- Aboriginal Heritage Site disturbance during clearing and/ or excavation works
- Reduced visual amenity due to vegetation clearing, dust and where construction occurs in areas visible to surrounding residential and rural properties
- Noise and vibration impacts to sensitive receptors, from noise emissions generated by construction activity within the Proposal Area (equipment and vehicle operation, increased traffic on local road network).

The potential operational impacts that may occur to social surroundings as a consequence of developing the Proposal are:

- Reduced visual amenity where the new road is visible to residents surrounding the Proposal Area
- Increased noise impacts to sensitive receptors from a change in rural land use to a roadway
- Increased glare or light spill on sensitive receptors from lighting at interchanges and vehicle headlights
- Change in land use from predominantly rural to regional roads.

Indirect Impacts

Indirect impacts from the Proposal on social surroundings are anticipated to be limited or negligible.

4.8.5 Assessment of impacts

Direct Impacts

Heritage site disturbance during clearing and/or excavation works

A search of the State Heritage Office database identified one heritage site (Tuart Tree, Gelorup – Place No. 26059), listed as “Other Heritage Listings”, within the Proposal Area (GoWA, 2019d), which will be avoided by this Proposal.

The Aboriginal Heritage Inquiry System (AHIS) identified three 'Other Heritage Places' (ID 18884 Bunbury Bypass Archaeological Site 1, ID 37869 Paperbark wet lands and ID 37870 Gelorup Corridor) which will be directly impacted by this Proposal (DPLH, 2019). Additional Aboriginal and Ethnographic surveys will be conducted during detailed design to address knowledge gaps in the Proposal Area. Risks to sites of Aboriginal Heritage significance will be managed through consultation with relevant groups and where necessary additional approvals (including Section 18 clearance) will be obtained via the AH Act.

Noise and vibration impacts from construction and operation

Noise and vibration impacts during construction are expected to be short in duration and are not considered significant. Noise and vibration impacts during construction will be managed through a CEMP.

The Proposal will result in exposure of residences near the Proposal Area to traffic noise. A noise assessment carried out by Lloyd George Acoustics (Lloyd George Acoustics, 2014) concluded that, up until 2031, noise levels at 19 of the 54 potentially affected residences will be above the SPP 5.4 outdoor noise criterion target of 55 dB $L_{Aeq(Day)}$, however the SPP 5.4 outdoor noise criterion limit of 60 dB $L_{Aeq(Day)}$ will not be exceeded at any residences. The assessment concluded that noise levels will comply with SPP 5.4 (Lloyd George Acoustics, 2014). A further traffic noise assessment will be undertaken during detailed design. Noise mitigation and management will be developed during detailed design to comply with SPP 5.4 (WAPC, 2009) and may include installation of noise walls and/or treatments to individual properties.

Reduced visual amenity

Direct and permanent impacts to visual amenity are expected to result from this Proposal. The impacts are expected to be greatest between South Western Highway and Bussell Highway. An assessment of the impacts to visual amenity will be completed during detailed design.

The existing built form within the Proposal Area is generally low in height. The Proposal will include a number of elevated structures which will change the built form character of the predominately rural area. Potential impacts on visual amenity are illustrated in Figure 20 (Appendix A).

Key views of the Proposal Area where visual amenity will potentially be reduced are:

- Residents of Gelorup on Woods Road, Brockway Drive, Banksia Road, Eucalypt Drive, Yalinda Drive, Ducane and Marchetti Road will potentially have views of the BORR. Residents will have dappled views through retained vegetation. Noise walls are proposed to generally screen the road.
- Rural dwellings either side of the BORR will have significant views of the road and some will have views of bridges, lighting, retaining walls, traffic and signage, particularly near elevated intersections. Some views will be dappled by vegetation and others will be unobstructed.

Key views from the Proposal Area with reduced visual amenity are:

- The Hanson quarries may be seen from the BORR. Currently the quarries are screened from existing roads through earth bunding. The BORR will likely have views of quarry activities which are void of screening and include features such as large pits and mounds.

Glare or light spill on sensitive receptors

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.

Indirect Impacts

Construction of the Proposal will potentially affect the amenity of residents through changes to the landscape. These impacts will be further investigated during visual impact assessment during detailed design.

4.8.6 Mitigation

Impacts to social surroundings will be reduced through consideration of impacts during the detailed design phase and minimised during construction through the following mitigation and management measures included in an EMP and CEMP:

- including alteration of the alignment to avoid large remnant tuart tree in Gelorup
- Impact on Aboriginal heritage sites will be minimised and managed through the implementation of a CEMP and an Aboriginal Heritage Management Plan. Main Roads will undertake consultation with all relevant groups and will undertake work in accordance with the AH Act
- Impacts to visual amenity addressed through the detailed design of the Proposal and will be minimised and suitably managed through the implementation of a CEMP
- Landscaping will be managed in accordance with a CEMP and a Landscape Management Plan (as discussed in Section 4.3.6).

Construction noise:

- The CEMP prepared for the Proposal will:
  - Ensure compliance with the requirements of the Environmental Protection (Noise) Regulations 1997
  - Limit construction activity to normal business hours and liaise with the local Shire/LGA if construction activities are required outside of these hours
  - Communicate the need to undertake out of hour's project activities to the community, if necessary
  - Install alternative requirements to audible reversing alarms, where practicable
  - Adopt construction techniques that will minimise vibration impacts within nearby sensitive receptors, particularly for compaction operations
  - Undertake compaction operations during normal business hours and maximise separation distances between vibration inducing activities and nearby sensitive receptors
  - A complaints register to be maintained by the Contractor.

Operational noise - Noise mitigation will be required to reduce received noise levels at selected properties. Noise mitigation treatments typically consist of the following for road projects:

- Earth bunds, located on the road or property boundary. In some areas constrained by the required surface area to obtain sufficient height. Most effective for groups of properties rather than single rural properties
- Noise walls, located on the road or property boundary. Require less area for installation than earth bunds. Like earth bunds, most effective for groups of properties rather than single rural properties

Architectural treatment package consisting of, for example, upgraded glazing (such as double glazing) and mechanical ventilation (to allow windows to be kept closed). The development of appropriate noise mitigation measures will be determined through the detailed design phase of the Proposal.

4.8.7 Predicted outcome

Potential impacts on Aboriginal heritage sites associated with the Proposal will be managed through consultation with all relevant groups and in accordance with State and Commonwealth legislation. Where necessary additional approvals (including Section 18 consent) under the AH Act will be sought.

Construction and operation of the Proposal is likely to result in impacts to visual and noise amenity and localised change in the landscape. Mitigation measures, including for sensitive receptors identified through noise modelling will be developed during detailed design.

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, 2014). 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, 2014) and the Australian Government's EPBC Act Environmental Offset Policy (DSEWPaC, 2012). 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 the EMP and finally, an offset proposal. Application of the management hierarchy has been documented throughout this document.

5.2 EPBC Act Environmental Offsets Policy

The EPBC Environmental Offsets Policy (DSEWPaC, 2012) requires that the following Principles are met by an offset:

- Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter
- Suitable offsets must be built around direct offsets but may include other compensatory measures
- Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter
- Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter
- Suitable offsets must effectively account for and manage the risks of the offset not succeeding
- Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs
- Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable
- Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

5.3 WA Environmental Offset Policy

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 Significant residual impact

Residual impacts associated with the Proposal will be determined through application of the residual impact significance model detailed in the WA Environmental Offsets Guidelines (GoWA, 2014).

5.5 Offset strategy

Main Roads proposes to develop an offset strategy for the Proposal. Identification of suitable direct and indirect offsets will occur in accordance with state and federal offset policies and guidelines. Development of the strategy will include liaison with relevant agencies and other stakeholders to identify suitable offsets, assessment of proposed offsets sites to determine their environmental value, acquisition of the offset site and implementation of the strategy.

Main Roads has successfully delivered environmental offsets for Projects throughout the State through working closely with relevant agencies and other stakeholders to identify suitable offsets (direct and indirect), acquire offsets and implement the strategy.

5.5.1 Quantification of offsets

There are two parts to quantification of an appropriate offset:

- Quantification of the significant residual impact to be offset
- Quantification of the value of environmental benefit provided from the proposed offset (GoWA, 2014).

DEE's Offsets Assessment Guide will be used to assess the quantum of residual impact associated with the Proposal and to quantify offset requirements. This is a recognised tool in WA (GoWA, 2014).

5.5.2 Identify suitable offset sites (direct offsets)

Main Roads intends to offset through land acquisition to provide on-ground improvement, rehabilitation and conservation of habitat. Direct offsets will be 'like-for-like' where impacts to an environmental value are offset by a property/properties that benefit the same environmental value.

5.5.3 Identify suitable indirect offsets

The indirect offsets under consideration include actions aimed at improving scientific or community understanding and awareness of environmental values; these are likely to include research on the federally listed WRP or Black Cockatoo species.

6 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

6.1 Controlled action provisions

Controlled action provisions will be discussed with the DEE as part of future consultation.

6.2 Policy and guidelines

MNES are listed and protected under the following legislation and guidelines:

- *Environment Protection and Biodiversity Conservation Act 1999* Act
- *Environment Protection and Biodiversity Conservation Regulations 2000*
- Significant Impact Guidelines (No. 1.1): Matters of National Environmental Significance (DEE, 2013).

6.3 Summary of existing environmental values and potential impacts on MNES

A number of desktop and targeted field surveys have been undertaken for the Proposal in order to assess the presence of MNES which trigger the requirement for referral (Sections 4.3 and 4.4) and have been summarised in (Table 6-1).

A referral of the Proposal will be made to the DEE on the basis that threatened species and ecological communities listed under the EPBC Act will be impacted within the Proposal Area.

Extensive consultation with the DEE and consideration has been made during the alignment selection process to avoid impact on MNES. Amendment to the Proposal Area during the early preliminary design stage has been the result of an iterative process and information from the findings of desktop and field assessments has been incorporated to further minimise impacts where practicable (refer to Section 2.4).

Table 6-1 Matters of National Environmental Significance within the Proposal Area

MNES	IMPACT OF PROPOSAL
Listed Threatened Ecological Communities	Field investigations show that one TEC is present within the Proposal Area and will be impacted, namely: • Banksia Woodlands of the SCP ecological community, of which approximately 20.8 ha is present within the surveyed area of the Proposal Area Since the field investigations that underpinned this referral were concluded, the 'Tuart (*Eucalyptus gomphocephala*) Woodlands and forests of the SCP ecological community' has been listed as Critically Endangered. Additional, targeted field surveys and retrospective analysis of data collected to date, will be undertaken to quantify the area of the Tuart Woodlands and forests TEC potentially impacted by the Proposal.
Listed Threatened Flora	No EPBC Act listed flora were identified during field surveys within the Proposal Area. No EPBC Act listed flora were identified through desktop searches as 'known' or 'likely to occur' in the Proposal Area. Seven listed species were identified through desktop searches as 'possibly' occurring (Section 4.3.3).
Listed Threatened Fauna	Direct loss of habitat for the following EPBC Act listed fauna species known to occur within the Proposal Area (see Section 6.3 "Conservation significant fauna"), including approximately:

MNES	IMPACT OF PROPOSAL
	• 80 ha of Carnaby's Cockatoo habitat (Endangered) • 80 ha of Baudin's Cockatoo habitat (Endangered) • 80 ha of Forest Red-tailed Black Cockatoo habitat (Vulnerable) • 538 Black Cockatoo Suitable DBH Trees, including 18 Trees with a Suitable Nest Hollow, eight of which are Known Nesting Trees • 80 ha of Western Ringtail Possum habitat (Critically Endangered) and potential impact to the home ranges (to varying degrees) of approximately 73 individuals estimated to utilise this habitat (approximately 1 % of the regional population) • Black-stripe Minnow may be indirectly impacted by removal of potential wetland habitat. The following risks have the potential to impact listed threatened species and communities but risks will be managed and mitigated through appropriate actions during detailed design, construction and operation of the Proposal: • Habitat decline due to: – Possible introduction and/ or spread of invasive pathogens (Section 4.3.3) – Possible introduction/ spread and/ or abundance increase of invasive plant species (weeds) (Section 4.3.3) – Changes to surface water hydrology (Section 4.6.4) – Disturbance of waterways during and post bridge construction works (Section 4.6.4) – Smothering of vegetation by dust generated from the operational activities (Section 4.7.5). • Impact on fauna species: – Damage to, and loss of habitat or mortality of fauna through accidental generation of a bushfire (Section 4.4.4) – Death, injury or displacement of native fauna species due to vehicle interaction or entrapment (Section 4.4.4) – Disruption or disturbance to fauna as a result of noise, vibration, light and dust emissions from construction activities (Section 4.8.4).

6.4 Mitigation measures

Mitigation measures to address potential impacts on MNES are outlined in relevant sections for each environmental factor in this document and will also be detailed in the project EMP.

6.5 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 6-2 and Table 6-3. A discussion of how the Proposal conforms to the Advice or Plan requirements is included in the Tables.

Table 6-2 Relevant Recovery Plans, Threat Abatement Plans and Conservation Advice for MNES

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
Banksia Woodland TEC	**DEE (2016), 'Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community'** (DEE, 2016)		
	1	Land clearing and impacts associated with fragmentation	The Proposal may exacerbate this threat due to direct impact on 20.8 ha of the TEC (equivalent to a 0.006 % reduction in extent) in the survey area. Additional survey required to confirm whether vegetation in unsurveyed areas meets criteria for listing as TEC.
	2	Groundwater drawdown	The Proposal may cause temporary (dewatering activities) change to groundwater levels associated with the TEC.
	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. 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 EMP 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 EMP, to minimise risk of the impact of spread of invasive flora.
	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.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
Tuart Woodlands TEC	**DEE (2019), 'Approved Conservation Advice (incorporating listing advice) for the Tuart (*Eucalyptus gomphocephala*) Woodlands and forests of the Swan Coastal Plain ecological community'** (DEE, 2019)		
	1	Clearing and fragmentation of vegetation	The Proposal may exacerbate this threat. Impacts to this TEC from clearing and fragmentation will be quantified through further survey and analysis.
	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 EMP, 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 EMP 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. 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.
	7	Loss of fauna supporting key ecological processes	The Proposal is may exacerbate this threat through the loss of suitable fauna habitat. These impacts will be quantified through further survey and analysis.
Black Cockatoos	**WA Department of Parks and Wildlife (DPaW) (2013), 'Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan'** (DPaW, 2013)		
	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.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
			Up to an estimated 80 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 538 Black Cockatoo Suitable DBH Trees will be removed for the Proposal including 18 Trees with a Suitable Nest Hollow, eight of which are Known Nesting Trees within the Proposal Area. Clearing of a Known Nesting Tree hollow will be mitigated by the installation of a nearby artificial nesting hollow.
	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 foraging and night-roosting 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 EMP to minimise risk of the impact of disease.
	4	Illegal shooting	The Proposal will not exacerbate this threat. No firearms will be permitted on site as per the EMP.
	5	Illegal taking	The Proposal will not exacerbate this threat. Only qualified fauna handlers will relocate fauna as per the Fauna Management Plan.
	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) (2009), 'Approved Conservation Advice for *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo)' (DEWHA, 2009)		
	1	Illegal shooting	The Proposal will not exacerbate this threat. No firearms will be permitted on site as per the EMP.
	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 80 ha of native vegetation that has been assessed as potential Black Cockatoo (breeding and foraging) habitat will be removed for the Proposal.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
	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 80 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 538 Black Cockatoo Suitable DBH Trees will be removed for the Proposal including 18 Trees with a Suitable Nest Hollow, eight of which are Known Nesting Trees within the Proposal Area. Clearing of a Known Nesting Tree hollow will be mitigated by the installation of a nearby artificial nesting hollow.
	4	Competition from other species	The Proposal is unlikely to exacerbate this threat. 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 18 Trees with a 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' (DEC, 2008)		
	1	Killing by illegal shooting	The Proposal will not exacerbate this threat. No firearms will be permitted on site as per the EMP.
	2	Feral honeybees	The Proposal is unlikely to exacerbate this threat. The Proposal will result in clearing 18 Trees with a Suitable Nest Hollow 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. An estimated maximum of approximately 80 ha of native vegetation that has been assessed as potential Black Cockatoo (breeding and foraging) habitat will be removed for the Proposal.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
	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 An estimated maximum of approximately 80 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 538 Black Cockatoo Suitable DBH Trees will be removed for the Proposal including 18 Trees with a Suitable Nest Hollow, eight of which are Known Nesting Trees within the Proposal Area Clearing of a Known Nesting Tree hollow will be mitigated by the installation of a nearby artificial nesting hollow.
	5	Nest hollow competition	The Proposal is unlikely to exacerbate this threat. The Proposal will result in clearing of up to 18 Trees with a Suitable Nest Hollow for Black Cockatoo. A general reduction in the amount of tree hollows may increase competition between fauna and other species using hollows.
	TSSC (2018), 'Conservation Advice *Calyptorhynchus baudinii* Baudin's Cockatoo' (TSSC, 2018a)		
	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 EMP.
	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 18 Trees with a Suitable Nest Hollow 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 EMP.
	5	Phytopathogens (Dieback)	The Proposal is not expected to exacerbate this threat.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
			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 EMP 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'** (DPaW, 2017)		
	1	Habitat loss and fragmentation	The Proposal may exacerbate this threat. Clearing of up to an estimated 80 ha of potential habitat and impact to the home ranges (to varying degrees) of approximately 73 individuals estimated to utilise this habitat (approximately 1 % of the estimated regional population) could result in a minor residual impact associated with the Proposal.
	2	Timber harvesting	The Proposal is not considered 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 increasing competition for tree hollows within habitat surrounding the Proposal Area.
	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 EMP 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. Fauna relocation will be considered for conservation significant terrestrial fauna species, including trapping for Western Ringtail Possums. A Fauna Management Plan will be written for the Proposal.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
			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 to minimise risk of impact of the disease.
	8	Gaps in knowledge	The Proposal will not exacerbate this threat as numerous studies and investigations have been conducted for the purpose of addressing knowledge gaps and more will be undertaken as part of detailed design.
	TSSC (2018), 'Conservation Advice *Pseudocheirus occidentalis* Western Ringtail Possum' (TSSC, 2018b)		
	1	Groundwater depletion and altered hydrology	The Proposal is not expected to exacerbate this threat. A Drainage Strategy will be developed with the main objectives of maintaining the water cycle balance within the project area whilst also seeking to improve surface and groundwater 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 80 ha potential habitat for an estimated 73 WRP individuals (2.9 % 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.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
			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 increasing competition for tree hollows within habitat surrounding the Proposal Area.
	6	Logging	The Proposal will not exacerbate this threat. Timber harvesting will not be undertaken other than to recover timber within clearing area.
	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 (2018) 'Conservation Advice *Galaxiella nigrostriata* Black-stripe Minnow'** (TSSC, 2018c)		
	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 practices	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 implementation of a Drainage Strategy. Where appropriate, drainage design will facilitate movement of aquatic fauna.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS	RESPONSE
	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.	

Table 6-3 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*'** (DEE, 2018)		
	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. A Hygiene Management Plan will be implemented for construction of the Proposal to minimise risk of the impact of disease.
	2	*Reduce the spread and mitigate the impacts of Phytophthora to protect priority biodiversity assets and susceptible landscapes*	
	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 3.

6.6 Predicted outcome

The predicted outcomes for MNES impacted by the Proposal are:

- Direct loss of up to 80 ha Banksia Woodlands of the SCP TEC (Endangered) (Section 4.3.4) (affected area to be confirmed during 2019 surveys)
- Direct loss of Tuart Woodlands of the SCP TEC (Critically Endangered) (Section 4.3.4) (affected area to be quantified during 2019 surveys)
- Direct loss of habitat for the following EPBC Act listed fauna species known to occur within the Proposal Area (impacts for full Proposal Area to be confirmed during 2019 surveys):
  - Approximately 80 ha of Carnaby's Cockatoo habitat (Endangered)
  - Approximately 80 ha Baudin's Cockatoo habitat (Endangered)
  - Approximately 80 ha Forest Red-tailed Black Cockatoo habitat (Vulnerable)
  - Approximately 538 Suitable DBH Trees including 18 Trees with a Suitable Nest Hollow, eight of which are Known Nesting Trees
  - Approximately 80 ha of WRP habitat (Critically Endangered)
- Clearing of a Known Nesting Tree hollow will be mitigated by the installation of an artificial nesting hollow nearby
- Potential loss of habitat for the Black-stripe Minnow. No Black-stripe Minnow were found within the Proposal Area, however the species was found within the survey area in a wetland adjacent to the Proposal Area. Further field investigations will be undertaken during winter 2019 to identify suitable habitat for Black-stripe Minnow and determine the likelihood of occurrence within the Proposal Area.

7 HOLISTIC IMPACT ASSESSMENT

The EIA process needs to consider the connections and interactions between parts of the environment to inform a holistic view of impacts to the whole environment. This requires consideration of the impacts of the Proposal in a regional context as well as at the local scale.

The primary purpose of the Proposal is to:

- Provide connection to the northern and central sections of the BORR; thereby completing the BORR link between Forrest Highway and Bussell Highway
- Enable the completed BORR to fulfil its role within the planned regional road network for the Greater Bunbury Region
- Increase direct and indirect employment opportunities for the local population during construction
- Improve road user safety on Bussell Highway
- Achieving best practicable outcomes based on assessments of Environmental, Social, Engineering and Economic issues.

The preliminary environmental and social impact studies undertaken for the Proposal have considered and assessed potential impacts at both local and regional scales; results have informed the impact assessment and development of mitigation measures.

Whilst it is considered that the Proposal will not have significant adverse impacts on environmental and social factors, it is recognised that there is a high level of public interest in this proposal, particularly among nearby residents and landowners.

The Proposal's predicted outcomes have been considered in relation to the environmental principles (see Section 4.1) and the EPA's environmental objectives for each Key Environmental Factor.

Main Roads considers that the significant measures undertaken to date to reduce the Proposal's social impacts, the efforts made to locate the Proposal Area to avoid or minimise impacts on environmental values and the commitment to develop and implement a CEMP will ensure that the EPA's objectives for each key environmental factor will be met.

8 CONCLUSION

The BORR Southern Section will provide connection to the northern and central sections of the BORR, thereby completing the BORR link between Forrest Highway and Bussell Highway. The BORR forms a major component of the planned regional road network for the Greater Bunbury area aimed at enabling expansion of existing and proposed industrial centres, supporting population and economic growth and creating jobs. The BORR is a project of regional and State significance that, by separating high speed regional and freight traffic from local movements, will deliver substantial efficiency and road safety benefits.

Environmental survey work for the BORR has occurred over many years, covering an extensive area as the proposal and options have evolved. Given the final BORR Southern Section Proposal Area has been only recently established, it is recognised that additional environmental surveys/studies and survey/study areas are needed to fill knowledge gaps and these are being planned for the second half of 2019.

8.1 Flora and vegetation

The Proposal's impact on vegetation includes loss of approximately 98 ha of native vegetation, ranging in condition from excellent to completely degraded, and comprising 33 % of the Proposal Area (300 ha). The remaining area is predominately cleared or highly modified agricultural land. Detailed design of the BORR is likely to reduce further the area of native vegetation to be cleared.

Due to recent changes to the Proposal Area, flora and vegetation has not been surveyed in 114 ha (38 %) of the Proposal Area, of which 91 ha is cleared/highly modified (based on aerial interpretation). Survey for these areas is planned for the second half of 2019. Within the survey area, there will be losses of up to 20.8 ha of Banksia Woodlands of the SCP TEC, 36.5 ha of Banksia Woodlands of the SCP PEC, 28.6 ha of Tuart Woodlands of the SCP PEC (these vegetation communities overlap) and an undetermined amount of Tuart Woodlands of the SCP TEC. Due to the timing of Commonwealth listing of 'Tuart (*Eucalyptus gomphocephala*) Woodlands and forests of the SCP' as Critically Endangered, the occurrence of this community within the Proposal Area has not yet been quantified. Targeted field surveys and retrospective analysis of data collected to date will be completed to quantify the area of the Tuart TEC in the Proposal Area.

There will also be loss of 0.1 ha of vegetation from Conservation Category Wetlands which are also listed as ESAs. No known Threatened flora will be impacted by the Proposal, although there is likely to be loss of 71 individual (P4) *Caladenia speciosa* plants (less than 2% of the known population) and possible loss of (P4) *Acacia semitrullata* and (P4) *Aponogeton hexatepalus* individuals.

As there will be residual loss of vegetation representative of TECs/PECs and ESAs, the Proposal will require offsetting.

By selecting an alignment for the Proposal that minimises impacts to flora and vegetation and the mitigation measures to be applied to address the potential impacts of the Proposal, it is expected that the EPA's objective for flora and vegetation, to protect flora and vegetation so that biological diversity and ecological integrity are maintained, will be met.

8.2 Terrestrial fauna

The Proposal will result in direct loss of up to 98 ha of fauna habitat, including the following potential impacts to conservation significant fauna:

- Clearing of up to an estimated 80 ha of potential foraging and breeding habitat for Black Cockatoos. Within the surveyed area, this includes loss of 18 Trees with a Suitable Nest Hollow for Black Cockatoos, of which eight are Known Nesting Trees
- Clearing of up to an estimated 80 ha of Western Ringtail Possum habitat and impact to the home ranges (to varying degrees) of approximately 73 individuals estimated to utilise this habitat, representing approximately 1 % of the regional population
- Clearing of up to an estimated 63 ha of South-western Brush-tailed Phascogale habitat
- Clearing of up to an estimated 98 ha of Southern Brown Bandicoot (Quenda) habitat.

The Proposal also has the potential to have impact on Black-strip Minnow through loss of potential habitat and habitat for a further six conservation significant fauna species that possibly occur within the Proposal Area.

The alignment selected for the Proposal minimises impacts to fauna and with implementation of proposed mitigation measures, the EPA's objective for fauna will be met. Surveys to fill fauna knowledge gaps in the Proposal Area are planned for the second half of 2019. As there will be residual loss of habitat for conservation significant fauna species, the Proposal will require offsetting.

8.3 Terrestrial environmental quality

The Proposal will impair soil function through establishing a permanent constructed surface. It is anticipated that soil function will be maintained outside constructed surfaces through re-use of stockpiled topsoil during the rehabilitation and landscaping. Potential for contamination of soils will be mitigated through standard construction management measures. Accidently spillages during operation of the BORR will be managed by dedicated response teams.

Although manageable, the Proposal's most significant risk to terrestrial environmental quality is exposure of ASS and PASS during construction, leading to acidification of soils and surface- and ground waters. The risk will be quantified during detailed design and development of an ASS Management Plan.

Whilst it is recognised that further investigations will be necessary to address knowledge gaps and validate findings, based on the current information, it is likely that Terrestrial Ecosystem Quality risks associated with construction and operation of the Proposal can be effectively managed through implementation of mitigation and management measures and that the EPA's objective to maintain the quality of land and soils so that environmental values are protected will be met

8.4 Inland waters

Hydrological processes within the Proposal Area are in a largely modified state due to historical clearing and land drainage. Project design will include consideration of transverse drainage to maintain the existing water balance and flows within the Proposal Area, particularly with regards to wetlands and waterways. Design of bridge structures will include consideration of impacts on beds and banks of waterways. Construction of the Proposal will require limited dewatering which is likely to cause minor temporary and localised impacts on groundwater levels. Surface water will be managed during construction through development and implementation of a CEMP. Risk of water contamination during construction and operation will be mitigated through appropriate management and monitoring.

It is anticipated that potential impacts to inland waters associated with the Proposal are manageable with implementation of the mitigation measures proposed and no residual impacts are anticipated.

8.5 Air quality

Appropriate measures will be implemented to ensure short term construction-related air quality impacts are effectively managed. Construction of the Proposal will result in emissions of dust, which will be managed through implementation of a CEMP. Noise emissions will increase during construction and

operation of the Proposal; mitigation measures will be identified during detailed design to meet requirements of State Planning Policy 5.4. No residual impacts are expected for this aspect and it is expected that air quality will be maintained and emissions will be minimised so that environmental values are protected.

8.6 Social surrounds

Potential impacts on Aboriginal heritage sites associated with the Proposal will be managed through consultation with relevant groups and undertaken in accordance with State and Commonwealth legislation, including gaining any necessary approvals (including Section 18 clearance).

Noise mitigation measures identified in the Traffic Noise Assessment will be developed during detailed design and in accordance with the State Planning Policy 5.4. Noise and vibration impacts during the construction phase will be managed through development and implementation of a CEMP.

8.7 Impact summary

The Proposal to construct the Southern Section of BORR will complete the BORR, enabling expansion of existing and proposed industrial centres, supporting economic growth and creating more jobs. The Proposal will also improve road safety and provide substantial efficiency benefits by separating high speed regional and freight traffic from local movements.

There has been significant attention to locating the BORR to minimise its impacts and further reduction will be achieved during detailed design. Some residual impacts to key environmental factors vegetation and flora and fauna are expected which will require offsetting. It is considered that potential residual impacts to other key environmental factors will not be significant and will be manageable through implementation of a CEMP to ensure the EPA's objective for each key environmental factor is met.

9 REFERENCES

ANZECC & ARMCANZ. (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

Beard, J. S. (1979). *Vegetation Survey of Western Australia: The Vegetation of the Perth Area Western Australia, Map and Explanatory Memoir 1:250,000 Series.* Applecross: Vegmap Publications.

Beard, J. S. (1990). *Plant Life of Western Australia.* Perth: Kangaroo Press.

Bennett Environmental Consulting. (2003). *Vegetation and Flora of Selected Areas – Bunbury Outer Ring Road and Port Access Road.* Unpublished report prepared for Main Roads Western Australia.

Bennett Environmental Consulting. (2008). *Significant Flora along Proposed Bunbury Ring Road.* Unpublished report for Main Roads Western Australia.

Biota. (2016). *Bunbury Outer Ring Road Southern Section - Reassessment of Floristic Communities.* Unpublished report prepared for Main Roads Western Australia.

Biota. (2018a). *Bunbury Outer Ring Road Southern Section - Banksia Woodlands TEC Assessment.* Unpublished report prepared for Main Roads Western Australia.

Biota. (2018b). *Bunbury Outer Ring Road (Southern Section) Black Cockatoo Tree Survey.* Unpublished report prepared for Main Roads Western Australia.

Biota. (2018c). *Bunbury Outer Ring Road Southern Section Western Ringtail Possum Assessment.* Unpublished report prepared for Main Roads Western Australia.

Biota. (2019a). *Bunbury Outer Ring Road Southern Alternative Alignment Targeted Fauna Assessment.* Unpublished report prepared for Main Roads Western Australia.

Biota. (2019b). *Bunbury Outer Ring Road Southern Section Targeted Fauna Assessment.* Unpublished report prepared for Main Roads Western Australia.

Biota. (2019c). *Draft Western Ringtail Possum Southern Swan Coastal Plain Regional Context.* Unpublished report prepared for Main Roads Western Australia.

BoM. (2018). *Groundwater Dependent Ecosystem Atlas*. Retrieved December 2018, from http://www.bom.gov.au/water/groundwater/gde/map.shtml

BoM. (2019, January). *Climate statistics for Australian locations*. Retrieved from Bureau of Meteorology: http://www.bom.gov.au/climate/averages/tables/cw_009965.shtml

BoM. (2019a). *Climate Data Online.* Retrieved from Bureau of Meteorology: http://www.bom.gov.au/climate/data/

BoM. (2019b, January). *Climate statistics for Australian locations*. Retrieved from Bureau of Meteorology: http://www.bom.gov.au/climate/averages/tables/cw_009965.shtml

BORR IPT. (2018). *Urban and Landscape Design Framework (draft).* Unpublished report prepared for Main Roads Western Australia.

BORR IPT. (2019a). *Bunbury Outer Ring Road Southern Section Vegetation and Flora Study.* Unpublished report prepared for Main Roads Western Australia.

BORR IPT. (2019b). *Bunbury Outer Ring Road South Alternate Section Vegetation and Flora Study.* Unpublished report prepared for Main Roads Western Australia.

BORR IPT. (2019c). *Bunbury Outer Ring Road Northern and Central Sections Environmental Management Plan.* Unpublished report for Main Roads Western Australia.

BORR IPT. (2019d). *Major Waterways Assessment.* Unpublished report for Main Roads Western Australia.

Brad Goode & Associates. (2009). *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.

Brad Goode & Associates. (2012). *Aboriginal Heritage Survey Report of the Proposed Bunbury Outer Ring Road Stage 2, Western Australia.* Unpublished report prepared for GHD Pty Ltd on behalf of Main Roads Western Australia.

Brad Goode & Associates. (2018). *Report of an Aboriginal Heritage Survey of the Bunbury Outer Ring Road (BORR) North Project: Brunswick to North Boyanup, Western Australia.* Report prepared for Main Roads Western Australia.

Brown, A., Dundas, P., Dixon, K., & Hopper, S. (2008). *Orchids of Western Australia.* Perth: University of Western Australia Press.

CALM. (2003). *Phytophthora cinnamomi and disease caused by it, Volume I – Management Guidelines.* Perth: Department of Conservation and Land Management.

Churchward, H. M., & McArthur, W. M. (1980). *Landforms and Soils of the Darling System, Western Australia.* Perth: Department of Conservation and Environment.

Commonwealth of Australia. (2013). *Draft Survey Guidelines for Australia's Threatened Orchids .* Canberra: Commonwealth of Australia.

DBCA. (2007). *NatureMap: Mapping Western Australia's Biodiversity*. Retrieved January 2019, from Parks and Wildlife Services: https://naturemap.dpaw.wa.gov.au/

DBCA. (2019, July). *Geomorphic Wetlands Swan Coastal Plain data set*. Retrieved from https://maps.slip.wa.gov.au/datadownloads/SLIP_Public_Services/Environment/GeomorphicWetlandsSwanCoastalPlainDBCA_019/GeomorphicWetlandsSwanCoastalPlainDBCA_019.gpkg.zip

DEC. (2008). *Forest Black Cockatoo (Baudin's Cockatoo Calyptorhynchus Baudinii and Forest Red-Tailed Black Cockatoo Calyptorhynchus Banksii Naso) Recovery Plan.* Perth: Government of Western Australia.

DEE. (2012). *EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) Calyptorhynchus latirostris Baudin's Cockatoo (Vulnerable) Calyptorhynchus baudinii Forest Red-tailed Black Cockatoo (Vulnerable) Calyptorhynchus.* Canberra: Department of the Environment and Energy.

DEE. (2013). *Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999.* Canberra: Department of Environment.

DEE. (2016). *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain Ecological Community.* Canberra: Commonwealth of Australia.

DEE. (2016). *Australia's Bioregions (IBRA)*. Retrieved December 2018, from Department of the Environment and Energy: https://www.environment.gov.au/land/nrs/science/ibra

DEE. (2017). *Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain Ecological Community.* Department of the Environment and Energy.

DEE. (2018). *Protected Matters Search Tool*. Retrieved October 2018, from Department of the Environment and Energy: https://www.environment.gov.au/epbc/protected-matters-search-tool

DEE. (2018). *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi.* Canberra: Commonwealth of Australia.

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

DEE. (n.d.). Offsets Assessment Guide. Commonwealth of Australia. Retrieved from http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy

Department of Planning and Urban Development. (1993). *Bunbury Wellington Region Plan.*

DER. (2014). *Assessment and Management of Contaminated Sites, Contaminated Sites Guidelines.* Perth: Department of Environment Regulation.

DER. (2014). *Assessment and Management of Contaminated Sites, Contaminated Sites Guidelines.* Perth: DER.

DER. (2015a). *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes.* Perth: Department of Environment Regulation.

DER. (2015b). *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes.* Perth: Department of Environment Regulation.

DEWHA. (2009). *Approved Conservation Advice for Calyptorhynchus banksii naso (Forest Red-tailed Black Cockatoo).* Canberra: Department of the Environment, Water, Heritage and the Arts.

DoW. (2008). *Bunbury Water Reserve drinking water source protection plan (Report 96).*

DoW. (2009). *Protecting public drinking water source areas (WQPN 36).*

DoW. (2012). *Water Quality Protection Note (WQPN) 13: Dewatering of Soils at Construction Sites.* Perth: Department of Water.

DoW. (2015). *South West Groundwater Areas Allocation Plan: Evaluation Statement 2012 - 2015.* Government of Western Australia.

DPaW. (2013). *Carnaby's Cockatoo (Calyptorhynchus latirostris) Recovery Plan.* Perth: Department of Parks and Wildlife.

DPaW. (2017). *Western Ringtail Possum (Pseudocheirus occidentalis) Recovery Plan, Wildlife Management Program No. 58. .* Perth: Department of Parks and Wildlife.

DPLH. (2018). *Greater Bunbury Region Scheme - Western Australia Map Sheet 15 Amended 20th September 2018.* Retrieved July 2019, from Department of Planning Lands and Heritage: https://www.dplh.wa.gov.au/departmentofplanninglandsheritage/media/mapping/gbrs/20180920_gbrs_map15_25000_picton_east_to_dalyellup_and_north_boyanup.pdf

DPLH. (2019). *Aboriginal Heritage Inquiry System*. Retrieved July 2019, from Department of Planning, Lands and Heritage: https://maps.daa.wa.gov.au/AHIS/

DSEWPaC. (2012). *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Retrieved from http://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsets-policy_2.pdf

DWER. (2018). *Contaminated Sites Database.* Retrieved October 2018, from Department of Water and Environmental Regulation: https://secure.dec.wa.gov.au/idelve/css/

Ecoedge. (2017). *Report of a Targeted Rare Flora Survey for Diuris drummondii along four sections of the Bunbury Outer Ring Road proposal alignment.* Unpublished report for Main Roads Western Australia.

Ecoedge. (2019). *Review of Potential Claypan Occurrences in the BORR Southern Section.* Unpublished memorandum to BORR IPT.

ENI School. (n.d.). *Road runoff and environmental pollution.* Under the patronage of the Ministry of Education, Universities and Research and Ministry of Environment and Protection of Land and Sea.

EPA. (2004). *Guidance for the Assessment of Environmental Factors, Assessment of Aboriginal Heritage No. 41.* Perth, Western Australia: EPA.

EPA. (2005). *Guidance for the Assessment of Environmental Factors, Separation Distances between Industrial and Sensitive Land Uses No. 3.* Perth: Government of Western Australia.

EPA. (2013). *Protection of Naturally Vegetated Areas Through Planning and Development, Environmental Protection Bulletin No. 20.* Perth: Environmental Protection Authority.

EPA. (2016a). *Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment.* Retrieved August 2018, from http://www.epa.wa.gov.au/policies-guidance/technical-guidance-flora-and-vegetation-surveys-environmental-impact-assessment

EPA. (2016b). *Environmental Factor Guideline: Flora and Vegetation.* Prepared for the Government of Western Australia. Retrieved August 2018, from http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-flora-and-vegetation

EPA. (2016c). *Technical Guidance Terrestrial Fauna Surveys.* Retrieved August 2018, from http://www.epa.wa.gov.au/policies-guidance/technical-guidance-terrestrial-fauna-surveys

EPA. (2016d). *Environmental Factor Guideline: Terrestrial Fauna.* Retrieved August 2018, from http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-terrestrial-fauna

EPA. (2016e). *Environmental Factor Guideline: Terrestrial Environmental Quality.* Retrieved August 2018, from http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-terrestrial-environmental-quality

EPA. (2016f). *Environmental Factor Guideline: Air Quality.* Prepared for the Government of Western Australia. Retrieved August 2018, from http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-air-quality

EPA. (2016g). *Environmental Factor Guideline: Social Surroundings.* Prepared for the Government of Western Australia. Retrieved August 2018, from http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-social-surroundings

EPA. (2016h). *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures.* Perth, Western Australia: EPA.

EPA. (2016i). *Technical Guidance Sampling Methods for Terrestrial Vertebrate Fauna.* Retrieved August 2018, from http://www.epa.wa.gov.au/policies-guidance/technical-guidance-sampling-methods-terrestrial-vertebrate-fauna

EPA. (2018a). *Environmental Factor Guideline: Inland Waters.* Prepared for the Government of Western Australia. Retrieved August 2018, from http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-inland-waters

EPA. (2018b). *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual.* Perth, Western Australia: EPA.

EPA. (2018c). *Statement of Environmental Principles, Factors and Objectives.* Prepared for the Government of Western Australia. Retrieved August 2018, from http://www.epa.wa.gov.au/statement-environmental-principles-factors-and-objectives

GHD. (2002). *Bunbury Outer Ring Road and Port Access Road – Wetlands and Threatened Community Survey* . Unpublished report prepared for Main Roads Western Australia.

GHD. (2009). *Report for Bunbury Outer Ring Road (Stage 1) and Port Access Road (Stage 2) – Flora and Vegetation Spring Survey.* Unpublished report prepared for Main Roads Western Australia.

GHD. (2012a). *Bunbury Outer Ring Road Southern Section, South Western Highway to Bussell Highway, Flora and Vegetation Assessment.* Unpublished report prepared for Main Roads Western Australia.

GHD. (2012b). *Bunbury Outer Ring Road Southern Section, South Western to Bussell Highways Fauna Assessment.* Unpublished report prepared for Main Roads Western Australia.

GHD. (2012c). *Bunbury Outer Ring Road Southern Section Air Assessment.* Unpublished report prepared for Main Roads Western Australia.

GHD. (2012c). *Environmental Impact Assessment Bunbury Outer Ring Road - Southern Section (South Western Highway to Bussell Highway).* Unpublished report prepared for Main Roads Western Australia.

GHD. (2013). *Bunbury Outer Ring Road Western Ringtail Possum Assessment.* Unpublished report prepared for Main Roads Western Australia.

GHD. (2014). *Lot 1 Ducane Road, Environmental Values Assessment.* Unpublished report prepared for Main Roads Western Australia.

GHD. (2015a). *Bunbury Outer Ring Road Southern Section Clearing Permit Supporting Document.* Unpublished report prepared for Main Roads Western Australia.

GHD. (2015b). *Bunbury Outer Ring Road Southern Section Fauna Study.* Unpublished report prepared for Main Roads Western Australia.

GHD. (2015c). *Bunbury Outer Ring Road, South Western Highway to Bussell Highway, Flora and Vegetation Assessment, Phase 1 and Phase 2.* Unpublished report prepared for Main Roads Western Australia.

Gibson, N., Keighery, B. J., Keighery, G. J., Burbridge, A. H., & Lyons, M. N. (1994). *A Floristic Survey of the Southern Swan Coastal Plain.* Perth: Unpublished Report for the Australian Heritage Commission prepared by Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc).

Glevan Consulting. (2011). *Assessment for the presence of Phytophthora cinnamomi - Bunbury Outer Ring Road, Stage 2.* Unpublished report prepared for Main Roads Western Australia.

GoWA. (2011). *WA Environmental Offsets Policy*. Retrieved from http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/WAEnvOffsetsPolicy-270911.pdf

GoWA. (2014). *WA Environmental Offsets Guidelines*. Retrieved from http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/WA%20Environmental%20Offsets%20Guideline%20August%202014.pdf

GoWA. (2019a, June). *data.wa.gov.au*. Retrieved June 2019, from http://www.data.wa.gov.au/

GoWA. (2019b). *2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of March 2019.* Retrieved from WA Department of Biodiversity, Conservation and Attractions: https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics

GoWA. (2019c). *2018 South West Vegetation Complex Statistics. Current as of March 2019.* Retrieved from WA Department of Biodiversity, Conservation and Attractions: https://catalogue.data.wa.gov.au/dataset/dbca

GoWA. (2019d). *Heritage Council InHerit Database.* Retrieved July 2019, from Department of Planning, Lands and Heritage: http://inherit.stateheritage.wa.gov.au/public

GSWA. (2009). *Bunbury, 1:100,000 resource potential for land use planning.* East Perth: Geological Survey of Western Australian (GSWA).

Halpern Glick and Maunsell (HGM). (1995). *Bunbury Outer Ring Road Concept Report.*

Heddle, E. M., Loneragan, O. W., & Havel, J. J. (1980). *Vegetation Complexes of the Darling System, Western Australia, in Atlas of Natural Resources, Darling System Western Australia.* Perth: Department of Conservation and Environment.

IUCN. (2019). *IUCN Red List of Threatened Species. Version 2019-1.* International Union for Conservation of Nature. Retrieved from www.iucnredlist.org

Lloyd George Acoustics. (2012). *Preliminary Noise Management Plan, Bunbury Outer Ring Road - Southern Section, South West Highway to Bussell Highway.* Unpublished report for GHD.

Lloyd George Acoustics. (2014). *Noise Manageemnt Plan Bunbury Outer Ring Road - Southern Section.* Unpublished report prepared for GHD.

Mattiske, E. M., & Havel, J. J. (1998). *Vegetation Mapping in the South West of Western Australia.* Perth: Department of Conservation and Land Management.

MBS Environmental. (2009). *Kemerton Silica Sand Public Environmental Review, Extension of Kemerton Silica Sand, Dredge Mining.* Perth: Public Environmental Review submitted to the Environmental Protection Agency (WA) on behalf of Kemerton Silica Sand.

McArthur, W. M., & Bettenay, E. (1960). *The Development and Distribution of the Soils on the Swan Coastal Plain, Western Australia.* Melbourne: CSIRO.

McDonald Hales and Associates. (1995). *Report of an Aboriginal Heritage Survey Bunbury Bypass Road, Bunbury WA.* Unpublished report prepared for Halpern Glick Maunsell on behalf of Main Roads Western Australia.

Mitchell, D., Williams, K., & Desmond, A. (2002). *Swan Coastal Plain 2 (SWA2 - Swan Coastal Plain Subregion).* Perth: Department of Conservation and Land Management.

Molloy, S., Wood, J., Wallrodt, S., & Whisson, G. (2009). *South West Regional Ecological Linkages Technical Report.* Perth: Western Australian Local Government Association and Department of Environment and Conservation.

MRWA. (2017). Climate Change. Retrieved from https://www.mainroads.wa.gov.au/BuildingRoads/StandardsTechnical/RoadandTrafficEngineering/Pages/Climate_Change.aspx

National Environment Protection Council. (2016). *National Environment Protection (Ambient Air Quality) Measure.* Department of the Environment.

National Register of Big Trees. (2019). *Australia's Champion Trees*. Retrieved from https://www.nationalregisterofbigtrees.com.au/contactus.php

NSW Department of Environment and Conservation. (2005). *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.* Sydney: Department of Environment and Conservation.

Shepherd, D. P., Beeston, G. R., & Hopkins, A. J. (2002). *Native Vegetation in Western Australia – Extent, Type and Status, Resource Management Technical Report 249.* Perth: Department of Agriculture WA.

Shire of Capel. (2018). *Shire of Capel District Profile.* Engineering and Development Services Division of the Shire of Capel. Retrieved from http://capel.wa.gov.au/wp-content/uploads/sites/167/2018/09/Shire-of-Capel-District-Profile-2018.pdf

Simons, J., George, R., & Raper, P. (2013). *'Dryland salinity'. In: Report card on sustainable natural resource use in agriculture. Department of Agriculture and Food, Western Australia.*

SKM. (2003). *Aggregated Emissions Inventory of NPI Substances for the Bunbury Regional Airshed.* Perth: Department of Environmental Protection.

South West Development Commission. (2018). *Impressive Economic Growth*. Retrieved from South West Development Commission: http://www.swdc.wa.gov.au/economy/impressive-economic-growth.aspx

Standards Australia . (2005). *AS/NZS 1158.0 Lighting for roads and public spaces Introduction.*

Sullivan, L., Ward, N., Toppler, N., & Lancaster, G. (2018). *National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual.* Canberra: Department of Agriculture and Water Resources.

TSSC. (2016). *Banksia Woodlands of the Swan Coastal Plain Ecological Community.* Department of the Environment and Energy.

TSSC. (2018a). *Conservation Advice Calyptorhynchus baudinii (Baudin's Cockatoo).* Canberra: Department of the Environment and Energy.

TSSC. (2018b). *Conservation Advice Pseudocheirus occidentalis (Western Ringtail Possum).* Canberra: The Department of the Environment and Energy.

TSSC. (2018c). Conservation Advice Galaxiella nigrostriata black-stripe minnow. Department of the Environment and Energy.

TSSC. (2018d). *Conservation Advice Westralunio carteri Carter's Freshwater Mussel.* Canberra: Department of the Environment and Energy.

WAPC. (2008). *Acid Sulfate Soil Planning Guidelines.* Perth: WAPC.

WAPC. (2009). *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning.* Retrieved Feburary 2019, from https://www.dplh.wa.gov.au/spp5-4

WAPC. (2014). *Implementation Guidelines for State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning.* Perth: Department of Planning.

WAPC. (2016). *Draft Wanju District Structure Plan.* Perth, Western Australia: WAPC.

WAPC. (2017a). *Draft Waterloo Industrial Park District Structure Plan.* Perth, Western Australia: WAPC.

WAPC. (2017b). *GBRS Amendment 0041/57 Amendment Report, Public Drinking Water Source Protection Areas.* Perth: WAPC.

WAPC. (2018). *City of Bunbury Local Planning Strategy.* Retrieved March 26, 2019, from https://www.dplh.wa.gov.au/bunbury

Webb, A., Kinloch, J., Keighery, G., & Pitt, G. (2016). *The Extension of Vegetation Complex Mapping to Landform Boundaries with the Swan Coastal Plain Landform and Forested Region of South-west Western Australia.* Perth: Department of Biodiversity, Conservation and Attractions.

Western Australian Herbarium. (1998-). *FloraBase-the Western Australian Flora, Department of Biodiversity, Conservation and Attractions.* Retrieved from http://florabase.dpaw.wa.gov.au

Western Australian Minister for the Environment. (2005). *Statement that a Scheme may be Implented - Greater Bunbury Region Scheme. Ministerial Statement 000697.*

WRM. (2018a). *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.

WRM. (2018b). *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.

BORR Team

APPENDIX A

Figures

APPENDIX B

Bunbury Outer Ring Road Southern Section Vegetation and Flora Study (BORR IPT 2019a)

APPENDIX C

Bunbury Outer Ring Road Southern Section Targeted Fauna Assessment (Biota 2019b)

APPENDIX D

Aboriginal Heritage Desktop Searches

BORR
Team

Australian Government

BUILDING OUR FUTURE

mainroads
WESTERN AUSTRALIA

BUNBURY OUTER RING ROAD | PLANNING AND DEVELOPMENT