



Greater Connect
ALLIANCE



Great Eastern Highway Bypass Interchanges EPBC 2020/8784 Preliminary Documentation

Document Details

Client	Main Roads Western Australia
Document Owner	Environment
Client Contract No.	C197.19
Document Number	GEHBI-GCA-RPT-A000-EN-00001
Revision	11

Revision	Date	Details	Originator	Reviewed	Approved
0	15/10/2021	Issued for Use	A. Chinnery	J. Shaw	
1	23/10/2021	Re-Issued For Use	A. Chinnery	J. Shaw	
2	28/10/2021	Re-Issued For Use	A. Chinnery	J. Shaw	
3	09/11/2021	Re-Issued For Use	A. Chinnery	J. Shaw	
4	17/05/2022	Re-Issued For Use	A. Chinnery	J. Shaw	J. Shaw
5	22/06/2022	Re-Issued For Use	A Chinnery	C Bennison	J Shaw
6	22/7/2022	Re-Issued For Use	A Chinnery	C Bennison	J Shaw
7	05/09/2023	Re-Issued For Use	A Chinnery	C Bennison	J Shaw
8	27/09/2023	Re-Issued For Use	A Chinnery	C Collett	J Shaw
9	16/11/2023	Re-Issued For Use	A Chinnery	C Collett	J Shaw
10	12/01/2024	Re-Issued For Use	A Chinnery	C Collett	J Shaw
11	01/02/2024	Re-Issued For Use	A Chinnery	C Collett	J Shaw

Table of Contents

Executive Summary	6
1. Introduction	7
1.1 Overview of Proposed Action	7
1.2 Purpose and Scope of this Documentation	7
2. Preliminary Documentation	8
3. Description of the Action	9
3.1 Location.....	9
3.2 Layout Plan	9
3.3 Pre-construction, Construction and Operation of the Proposed Action.....	11
3.4 Anticipated Timing	13
3.5 Landscaping Activities	13
3.6 Feasible Alternatives Considered	13
4. Description of the Environment	20
4.1 Existing Land Use	20
4.2 Topography	20
4.3 Geology	22
4.4 Soils.....	22
4.5 Groundwater	23
4.6 Surface Water	23
4.7 Vegetation and Flora	23
4.8 Fauna	26
5. Matters of National Environmental Significance	27
5.1 Description of Protected Matters within the Proposed Action	27
5.2 Biological Surveys	27
5.3 Threatened Ecological Communities	28
5.4 Threatened Fauna	32
5.5 Threatened Flora	41
6. Assessment of Impacts	44
6.1 Summary of Impacts.....	44
6.2 Indirect Impacts.....	44
6.3 Assessment of Impacts on MNES	48
7. Avoidance, Management and Mitigation Measures	63
7.1 Avoidance and Mitigation Measures	63
7.2 Justification for Residual Impacts.....	63
7.3 Management Measures.....	63
7.4 Effectiveness of Avoidance and Mitigation Measures.....	67
7.5 Reporting.....	67
8. Relevant Policies and Publications	68
9. Offsets	77
9.1 Proposed Offset Strategy	77
9.2 Extent to which Offset Package Compensated Potential Significant Residual Impacts	77
9.3 Suitability of Potential Offset Sites	80
9.4 Land Tenure, Acquisition and Management.....	82
9.5 EPBC Act Environmental Offsets Policy	83
10. Economic and Social Matters	84
10.1 Financial Investment.....	84
10.2 Cost and Benefit	84
10.3 Public Consultation Activities and Outcomes	84

10.4	Consultation with Indigenous Stakeholders.....	86
11.	Ecologically Sustainable Development	87
12.	Environmental Record of the Person Proposing to take the Action	88
13.	Other Approvals and Conditions	89
13.1	<i>Environmental Protection Act 1986</i> , Part V Environmental Regulation— Clearing of Native Vegetation ...	89
13.2	Other Approvals and Regulations	89
13.3	Planning Approvals.....	89
14.	Information sources	90
15.	References	91

Appendix A	Great Eastern Highway Bypass Interchanges (Roe Highway and Abernethy Road) Biological Survey	95
Appendix B	Great Eastern Highway Bypass Interchanges Project: Targeted Carter’s Freshwater Mussel Survey	96
Appendix C	Great Eastern Highway Bypass Interchanges Project: <i>Conospermum undulatum</i> Survey.....	97
Appendix D	Great Eastern Highway Bypass Interchanges Project: Offset Strategy	98
Appendix E:	Biological Survey Report, Cowalla	99
Appendix F:	Biological Survey Report, Neaves Rd.....	100
Appendix G:	Biological Survey Report, Boallia.....	101
Appendix H:	Reconnaissance Vegetation and Black Cockatoo Survey Report, Crossman and Hoffman	102
Appendix I:	Great Eastern Highway Bypass Interchanges Project: Offset Management Plan.....	103

List of Tables

Table 1	Additional information requirements reference table	8
Table 2	Details of proposed structures in the Concept Design	11
Table 3	Comparison of impacts within the original referred DE following additional studies.....	15
Table 4	Comparison of impacts between referred DE and revised DE based on latest ecological data.....	17
Table 5	Geological setting.....	22
Table 6	Vegetation types and extent within the DE	25
Table 7	Fauna habitats recorded within the Development Envelope.....	26
Table 8	Studies and surveys relevant to the Proposed Action	27
Table 9	Banksia Woodlands of the Swan Coastal Plain TEC - Patches and Vegetation Condition.....	29
Table 10	Potential Black Cockatoo breeding trees within the DE	34
Table 11	Potential FRTBC within 6 and 12 km of the estimated breeding site (Kalamunda National Park)	35
Table 12	Summary of impacts	44
Table 13	Dieback status.....	46
Table 14	Assessment of the potential impacts of the Proposed Action to the <i>Banksia Woodlands of the Swan Coastal Plain</i> TEC	48
Table 15	Assessment of the potential impacts of the Proposed Action to Carnaby’s and Baudin’s Black Cockatoos	52
Table 16	Assessment of the potential impacts of the Proposed Action to Forest Red-Tailed Black Cockatoos.....	54
Table 17	Assessment of the potential impacts of the Proposed Action to <i>Conospermum undulatum</i>	57
Table 18	Assessment of the potential impacts of the Proposed Action to Carter’s Freshwater Mussel.....	60

Table 19 Management measures and performance targets	65
Table 20 Assessment against Recovery and Threat Abatement Plans.....	69
Table 21 Summary of offset package being considered.....	78
Table 22 Summary of draft offset package to mitigate significant residual impacts	79
Table 23 Land tenure status of the offset sites.....	82
Table 24 Consistency with EPBC Act Environmental Offsets Policy	83
Table 25 Key Stakeholders.....	85
Table 26 EPBC Act Principles of Ecologically Sustainable Development	87
Table 27 Summary of other regulatory approvals required	89
Table 28 Information sources.....	90

List of Figures

Figure 1 Proposed action location	10
Figure 2 Proposed structures.....	12
Figure 3 Historical planning for the GEHB, 1982	14
Figure 4 Change in DE since referral	16
Figure 5 Avoidance and minimisation of Threatened Ecological Communities.....	18
Figure 6 Changes to DE and Black Cockatoo foraging habitat	19
Figure 7 Land use.....	21
Figure 8 Patches of Banksia Woodlands of the Swan Coastal Plain TEC mapped within and adjacent to the DE 30	
Figure 9 Patches of Banksia Woodlands of the Swan Coastal Plain TEC Vegetation Condition Assessment.....	31
Figure 10 Black Cockatoo breeding habitat trees	36
Figure 11 Black Cockatoo foraging habitat (Biota, 2021)	37
Figure 12 Black Cockatoo roosting habitat.....	38
Figure 13 Regional foraging habitat from estimated FRTBC roosting site.....	39
Figure 14 Conospermum undulatum locations within Development Envelope (Biota, 2021)	43

Executive Summary

The Commissioner of Main Roads Western Australia (Main Roads) is proposing to construct a grade separated interchange at the intersection between Roe Highway and Great Eastern Highway Bypass (GEHB) and duplicate the Roe Highway Helena River bridge. The Proposed Action will take place in the City of Swan, Shire of Kalamunda and Shire of Mundaring Local Government Areas (LGA), approximately 15 km east of the Perth Central Business District (CBD) and approximately 5 km east of Guildford.

These upgrades will improve road user safety and enhance transport efficiency through a significant economic corridor. The Proposed Action will also improve long-term access to and from Perth's International and Domestic airports.

The Proposed Action was formally referred to the Department of Agriculture, Water and Environment (DAWE) in September 2020 (EPBC Act referral 2020/8784) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) due to potential impacts on Matters of National Environmental Significance (MNES). DAWE advised in October 2020 that the Proposed Action is a Controlled Action that would be assessed by Preliminary Documentation.

At the time of referral, the Proposed Action was predicted to impact the EPBC-listed *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC (SCP20c) (Endangered), which is listed under the Western Australian *Biodiversity Conservation Act 2016* (BC Act) as Critically Endangered.

Following the referral of EPBC 2020/8784, the Proposed Action was redesigned to avoid and reduce impacts on TECs, Threatened Black Cockatoo species and Threatened flora species *Conospermum undulatum*. This avoided the entire patch of *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC and reduced the number of potential Black Cockatoo breeding trees within the Development Envelope (DE).

The MNES with potential to be impacted by the Proposed Action include:

- Clearing of 14.94 ha of Banksia Woodlands of the Swan Coastal Plain (BWSCP) TEC.
- Clearing up to 33.48 ha of high quality Carnaby's and FRT Black Cockatoo foraging habitat.
- Clearing up to 162 potential Black Cockatoo breeding trees, none with suitable hollows.
- Clearing up to one individual of Threatened flora species *Conospermum undulatum* and up to 2.62 ha of suitable habitat.

The final clearing footprint is expected to be less and during the detailed design phase opportunities will be investigated to further refine the design to minimise disturbance to BWSCP TEC, Black Cockatoo habitat and Threatened flora species *Conospermum undulatum*.

Main Roads has a strong track record of both developing and implementing best practice in environmental management and implementation of management measures. The measures proposed have been successfully implemented on past projects subject to EPBC conditions and management measures.

Main Roads intends to counterbalance the significant residual impacts to BWSCP TEC and Black Cockatoo habitat from the Proposed Action through implementation of an Environmental Offset Strategy.

1. Introduction

1.1 Overview of Proposed Action

In April 2020, the Western Australian Government announced a series of transport construction commitments to address some of Perth's congested intersections and roads. These commitments included \$180 million to build the Roe Highway – Great Eastern Highway Bypass (GEHB) Interchange.

Roe Highway is a major arterial highway that links the southeast corridor with the northeast and northwest corridors of the Perth Metropolitan Area. Roe Highway services the Hazelmere and Forrestfield industrial areas, and is a strategic freight, tourist and inter town route. The Roe Highway and GEHB intersection is one of the last remaining signalised intersections on Roe Highway.

Approximately 60,000 vehicles pass through the Roe Highway and GEHB intersection each day, with heavy vehicles making up to 14% of this figure. The current layout of Roe Highway at GEHB consists of four lanes (two in each direction) with a signalised intersection. In the past five years, 155 crashes have occurred at the intersection, with four requiring hospitalisations (Main Roads Western Australia, 2020).

The Commissioner of Main Roads Western Australia (Main Roads) is proposing to upgrade Roe Highway, comprising:

- Grade separation at the intersection of Roe Highway and GEHB – Roe Highway Straight Line Kilometre (SLK) 37.54.
- Upgrade of Roe Highway between Adelaide Street, Hazelmere and Clayton Street, Bellevue, including a duplication of the bridge over the Helena River.
- Principle Shared Path (PSP) along length of Roe Highway from Kalamunda Road to 300m north of Clayton Street.
- Drainage works, electrical works and other associated road works.

The construction of a grade separated interchange at Roe Highway and GEHB will improve road user safety and enhance transport efficiency through a significant economic corridor. The Proposed Action will also improve long-term access to and from Perth's International and Domestic airports.

1.2 Purpose and Scope of this Documentation

The Proposed Action was formally referred to the Department of Agriculture, Water and Environment (DAWE) in September 2020 (EPBC Act referral 2020/8784) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) due to potential impacts on MNES. DAWE advised in October 2020 that the Proposed Action is a Controlled Action that would be assessed by Preliminary Documentation.

1.2.1 Variations to the proposed action

Subsequent to the controlled action decision, Main Roads requested an amendment to the Development Envelope (DE) for the Proposed Action in October 2021. At the time of referral, the Proposed Action was predicted to impact on the EPBC-listed *Shrublands and Woodlands of the Eastern Swan Coastal Plain* Threatened Ecological Community (TEC) (SCP20c) (Endangered). The *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC is known from only two occurrences, totalling 130 ha. The predicted area of impact was 3.8 ha. In response to feedback from DAWE, Main Roads modified the project design to completely avoid direct impacts to this TEC. This request was accepted by DAWE on 23 November 2021.

Due to ongoing efforts to minimise the project's impact on environmental values, the DE for the Proposed Action was further amended in early 2022. On 21 April 2022 Main Roads submitted a second variation request under section 156A of the EPBC Act for the change to DE, reducing impacts to the EPBC-listed *Banksia woodlands of the Swan Coastal Plain* (BWSCP) TEC, Black Cockatoo foraging habitat and potential breeding trees. The variation request was approved by the Delegate on 25 May 2022.

2. Preliminary Documentation

Table 1 shows a summary of the information requested as part of the Preliminary Documentation and the corresponding section in this report.

Table 1 Additional information requirements reference table

Specific Content to be Included	Additional Information Provided (Y/N)	Section Number
Description of the proposed action	Y	Section 3
Description of the environment and MNES	Y	Section 4 and 5
Assessment of impacts	Y	Section 6
Avoidance, management and mitigation measures	Y	Section 7
Offsets	Y	Section 9
Relevant policies and publications	Y	Section 8
Economic and social matters	Y	Section 10
Ecologically sustainable development	Y	Section 11
Environmental record of the person proposing to take the action	Y	Section 12
Other approvals and conditions	Y	Section 13

3. Description of the Action

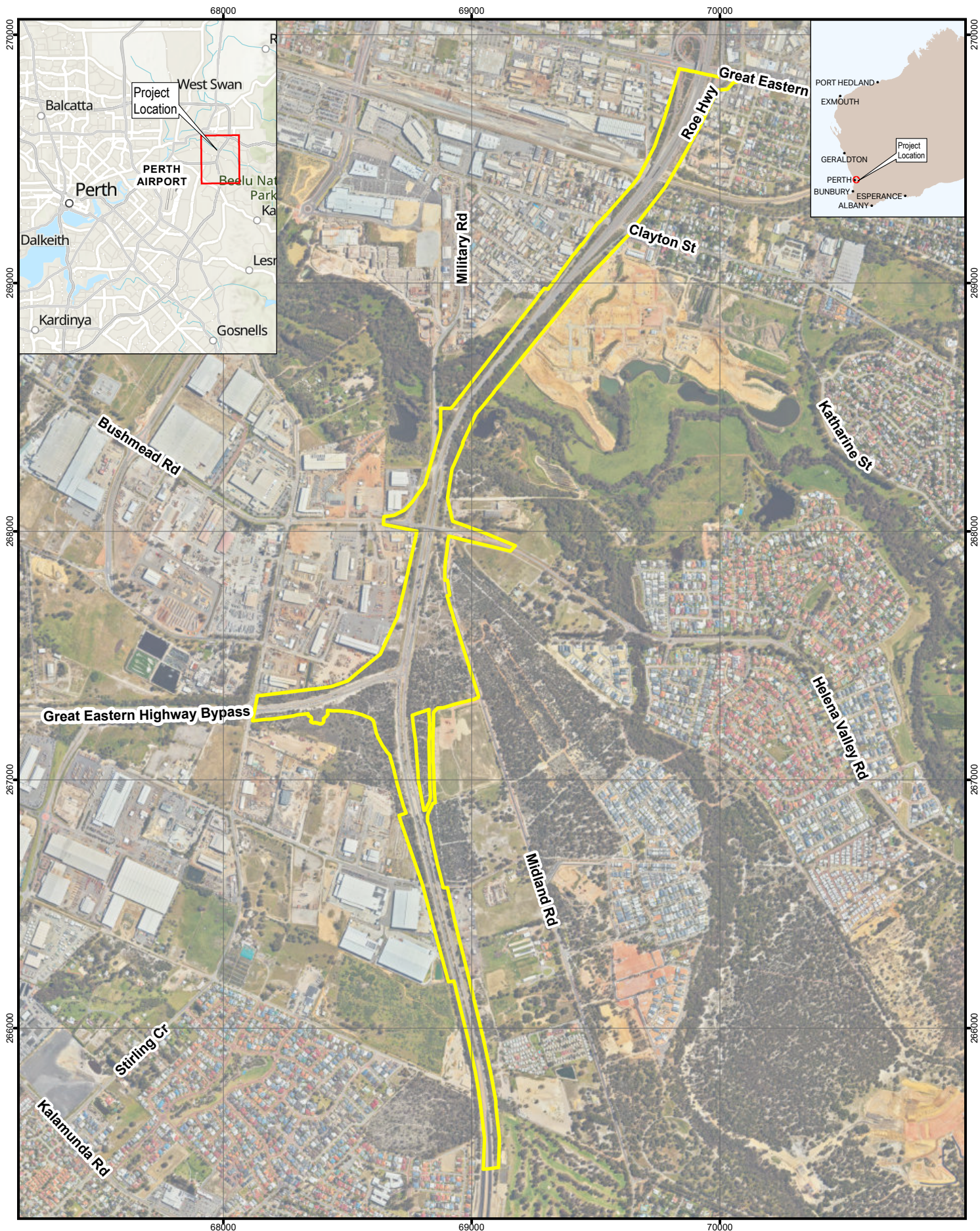
3.1 Location

The location of the Proposed Action is shown in Figure 1. The DE traverses the City of Swan, Shire of Kalamunda and Shire of Mundaring Local Government Areas (LGA). The most southern part of the DE is approximately 15 km east of the Perth Central Business District (CBD). The most northern part of the DE is approximately 5 km east of Guildford. The DE is approximately 4.8 km in length and 68.07 ha in area.

3.2 Layout Plan

The Proposed Action includes construction of a fully connected, free flowing interchange (i.e. removal of all traffic signals), bridges, local road modifications and other associated road infrastructure including, but not limited to, drainage basins, drains, culverts, lighting, noise barriers, fencing, landscaping, road safety barriers and signs. The Proposed Action comprises a DE of 68.07 ha, of which, 23.31 ha comprises native vegetation as shown in Figure 1.

Although the designed footprint of the Proposed Action is significantly smaller than the DE, the potential impacts on MNES have been quantified in terms of the entire DE to allow for flexibility in refining the design. In practice, the Proposed Action will be designed to achieve Main Roads' project objectives with as little impact to MNES as practicable.



PROJECT ID 60657311
 CREATED BY LEIJ
 APPROVED BY SHAWJ
 LAST MODIFIED 28 MAR 2022



LEGEND
 Development Envelope

Proposed Action Location

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS
 INTERCHANGE PROJECT
 GREAT EASTERN HIGHWAY BYPASS
 INTERCHANGES EPBC 2020/8784
 PRELIMINARY DOCUMENTATION

Figure
1

Datum: GDA 1994 Perth Coastal Grid 1994
 1:20,000
 (when printed at A4)
 Data sources: Main Roads WA

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021); Geoscience Australia.

3.3 Pre-construction, Construction and Operation of the Proposed Action

3.3.1 Pre-construction

The design for the Proposed Action has been issued for construction. The design has been developed to minimise environmental impacts as far as practicable. The key objective of the proposed interchange is to improve the flow of traffic movements between Roe Highway and the GEHB, which will have the effect of reducing congestion and improving road user safety.

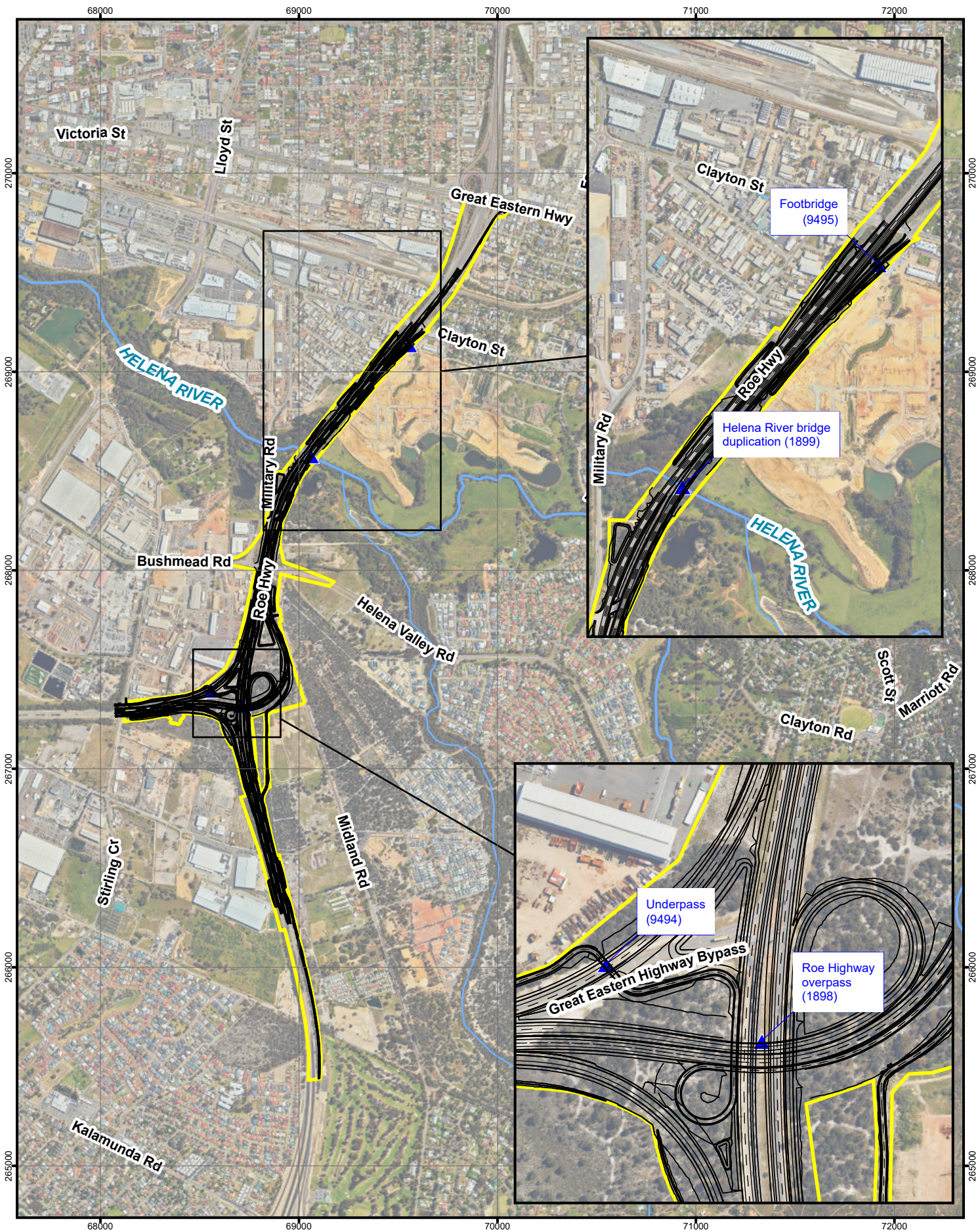
The Proposed Action includes the construction of a new structure over Roe Highway to allow free flowing movements between GEHB and Roe Highway. A new Principal Shared Path (PSP) will be constructed along the eastern side of Roe Highway, which will connect to the existing PSP at the southern end of works and to Great Eastern Highway at the northern end. The existing bridge over Helena River will be duplicated on its eastern side, which will carry southbound traffic, while the existing bridge will be converted to carrying northbound traffic.

The proposed structures included in the concept design are listed in Table 2 and illustrated in Figure 2.

Table 2 Details of proposed structures in the Concept Design

Proposed Structure	Vertical Clearance (m)	Span Length (m)	No of Spans
Helena River bridge duplication (1899)	1% AEP Flood Level freeboard TBC	54 m Total (16.5m-21m-16.5m)	3
Roe Highway overpass (1898)	6.5 m	65 m (29m-34m)	2
Footbridge (9495)	6.7 m	16.5 m	1
Underpass (9494)	2.7 m	22 m	1

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 has addressed key constraints such as groundwater level, bridge and culvert clearances, sight distance, vertical curve lengths and surfacing.



PROJECT ID 60657311
 CREATED BY LEUJ
 APPROVED BY SHAWJ
 LAST MODIFIED 01 APR 2022

Greater Connect ALLIANCE

Datum: GDA 1994 Perth Coastal Grid 1994

1:25,000
 (when printed at A4)

0 100 200 300 400 metres

Data sources: Main Roads WA

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021); Geoscience Australia; Streetpro

- LEGEND**
- Development Envelope
 - WP4 85% Road Design for Approval Application (31 Mar 22)
 - ▲ Proposed Structures

Proposed Structures

<p>MAIN ROADS WA GREAT EASTERN HIGHWAY BYPASS INTERCHANGE PROJECT GREAT EASTERN HIGHWAY BYPASS INTERCHANGES EPBC 2020/8784 PRELIMINARY DOCUMENTATION</p>	<p>Figure 2</p>
--	----------------------------

3.3.2 Construction

Construction will be undertaken using traditional earth-moving equipment and construction techniques. Earthworks are required in order to achieve grade separation between Roe Highway and the proposed overpass. Fill material is also required to construct the approaches to the bridge over the Helena River. The Proposed Action will have a net deficit of approximately 111,000 m³ of fill. Road formation will be built using both fill materials sourced within the DE and where necessary, imported fill. Imported fill will be confirmed as suitable quality for the purposes of road construction. Hydrogeological investigations and modelling have been undertaken to inform site excavation levels and the final design.

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

- Piling works for foundation construction
- Construction of concrete pile caps
- 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.

Lay down areas for construction materials will be established by the contractor in consultation with Main Roads and Local Government Authorities and will be located such that clearing is not required. Construction water will be sourced from groundwater abstraction bores, which will be planned based on the outcomes of hydrogeological investigations.

3.3.3 Operation

The Proposed Action will operate as a four-lane highway, bridge and dual lane PSP. The Proposed Action will be subject to normal routine, recurrent and periodic maintenance during operation of the highway, bridge and PSP. The maintenance operations will be confined to the road corridor and the PSP itself, typically including vegetation, drainage, lighting, signs and pavement.

3.4 Anticipated Timing

Construction is expected to start in 2024 for a period of two to three years, subject to the granting of environmental and statutory approvals. The proposed structures and civil works will have a design life of 100 years, and it is anticipated that operation of the Proposed Action will be ongoing into the foreseeable future.

3.5 Landscaping Activities

Planting along the DE will comply with *Main Roads' Vegetation Placement within the Road Reserve* Doc. No. 6707/022 (Main Roads, 2013). This guide defines the recommended setbacks and clearance requirements that apply to all landscaping associated with new road construction.

All new planting will utilise local native species that will be resilient within three years after the rehabilitation works are completed. Species of foraging habitat for Black Cockatoos, including but not limited to, *Banksia* spp., *Hakea* spp., *Grevillea* spp. and *Eucalyptus* spp. will not be planted within 10 m of the constructed road carriageway to reduce the risk of Black Cockatoo deaths due to vehicle strike.

Main Roads restricts the placement of vegetation near road infrastructure to maintain road safety. These requirements minimise ongoing maintenance and maintain a standard amenity level for road users. Landscape planning will incorporate these restrictions. Landscaping will not include areas required for ongoing operations such as drainage basins, road embankments and median strips.

3.6 Feasible Alternatives Considered

The "no-build" option was not considered feasible as it would result in ongoing and increased traffic congestion and compromised road safety through an important metropolitan transport corridor.

The GEHB concept was originally developed by Main Roads, with early planning occurring in the 1980s (Figure 4). Historical land use planning constrains Main Roads to undertake works within the existing road reserve, with the land surrounding the proposed interchange location being in private tenure and generally developed for urban, industrial, and rural purposes.

As a result, in order to achieve the objective of providing free flowing traffic movement between Roe Highway and GEHB, Main Roads has limited alternatives to the current option.

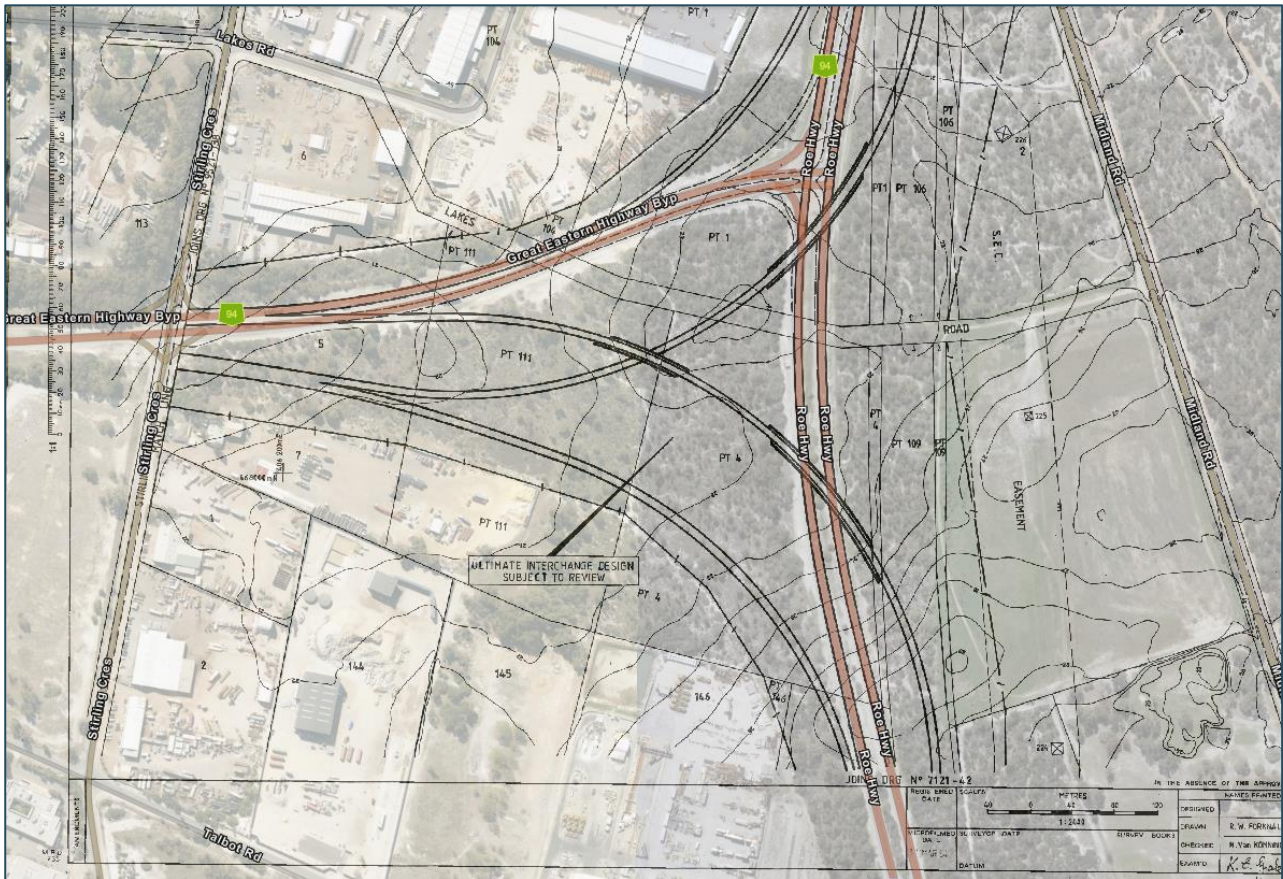


Figure 3 Historical planning for the GEHB, 1982

The DE represents the maximum extent of disturbance, and where practicable, vegetation and fauna habitat within the DE will be retained. The DE will be further refined during the detailed design phase to adjust the road alignment, where possible, to minimise the impact on MNES. All opportunities will be considered at this phase to further reduce clearing impacts, including:

- steepening batter slopes
- reducing median width
- installation of safety barriers.

To further minimise the clearing footprint, all laydown areas, stockpiles and access tracks will be constructed within existing cleared areas or within the permanent footprint of the works. No native vegetation will be cleared for temporary works outside of the permanent footprint.

3.6.1 Revised Mapping

Since the referral, changes in the road design have been implemented to reduce the footprint of the Proposed Action on the environment. The boundary of the DE has been changed as shown in Figure 4. Main Roads has also undertaken additional biological surveys across the DE, to better define the environmental values present. Additional surveys conducted for the Proposed Action are as follows:

- Great Eastern Highway Bypass Interchanges (Roe Highway and Abernethy Road) Level 1 and Level 2 Flora and Vegetation Survey – Biota (2021)

- Great Eastern Highway Bypass Interchanges (Roe Highway and Abernethy Road) Level 1 Fauna Survey including a targeted Black Cockatoo assessment and targeted Carter's Freshwater Mussel assessment – Biota (2021)
- Great Eastern Highway Bypass Interchanges Project: Targeted Carter's Freshwater Mussel Survey – Biologic (2023)

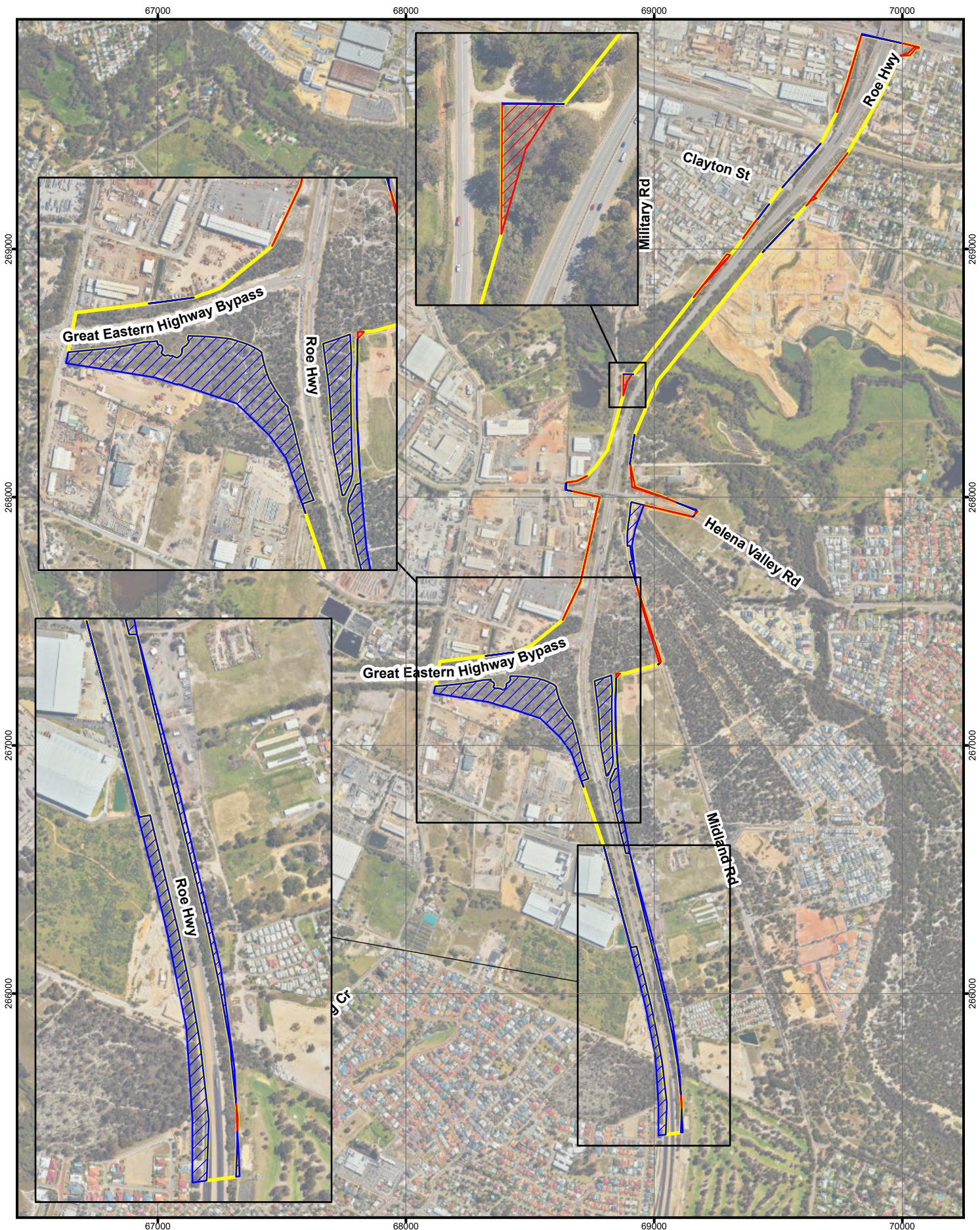
The surveys undertaken by Biota refined and expanded the vegetation and fauna habitat mapping within the DE, which subsequently increased the area of BWSCP TEC and Black Cockatoo foraging habitat mapped. The Biota surveys have been combined into a single updated biological survey report (Appendix A).

The Targeted Carter's Freshwater Mussel survey recorded a population of CFM within the wetland to the east of Roe Highway (Appendix B).

Main Roads has revised the calculations for potential impacts on MNES to incorporate the additional data collected as shown in Table 3. The revised map redefined the area of Shrublands and Woodlands of the Eastern Swan Coastal Plain TEC to a smaller area and increased the area of BWSCP TEC and Black Cockatoo foraging habitat mapped within the original DE.

Table 3 Comparison of mapped extents within the original referred DE following additional studies

Description	Referred extent	Revised mapping within referred DE	Change from Referral
Threatened Ecological Communities			
Shrublands and Woodlands of the Eastern Swan Coastal Plain	3.80 hectares	1.6 hectares	2.2 ha decrease
BWSCP TEC	18.93 hectares	22.83 hectares	3.93 ha increase
Threatened Species			
Black Cockatoo foraging habitat	35.12 hectares	47.28 hectares	12.16 ha increase
Black Cockatoo potential breeding trees	222	222 trees	No change
<i>Conospermum undulatum</i>	3 individuals	3 individuals	No change
Carter's Freshwater Mussel	Not referred	No suitable habitat	No change



PROJECT ID 60657311
 CREATED BY LEUJ
 APPROVED BY SHAWJ
 LAST MODIFIED 05 APR 2022

Greater Connect
 ALLIANCE

Datum: GDA 1994 Perth Coastal Grid 1994

1:20,000
 (when printed at A4)

Data sources: Main Roads WA

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021); Geoscience Australia; Streetpro

LEGEND

- ▬ Proposed DE accepted October 2021
- ▬ Area added to DE since Referral
- ▬ Area removed from DE since Referral

Change to DE since Referral

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS
 INTERCHANGE PROJECT
 GREAT EASTERN HIGHWAY BYPASS
 INTERCHANGES EPBC 2020/8784
 PRELIMINARY DOCUMENTATION

Figure
 4

3.6.2 Avoidance of TEC and other MNES

Post referral, Main Roads carried out a design review and development process in response to stakeholder feedback to balance the needs of improving safety performance with avoiding significant environmental values. These changes were primarily made to allow the Proposed Action to avoid the entire 3.8 ha of Endangered Shrublands and Woodlands of the Eastern Swan Coastal Plain TEC, which was identified as a potential impact in the referral. Key re-design initiatives included:

- tightening the radius of the ramp that carries movements from Roe Highway northbound to GEHB westbound. As a result of this realignment, Main Roads has had to reduce the design speed of this movement
- shifting the Roe Highway – GEHB interchange further to the north
- tightening the radius of the ramp that carries movements from Roe Highway southbound to GEHB westwards and movements from GEHB eastbound to Roe Highway southbound.

In late 2021, the project design was reviewed again to further reduce clearing impacts on vegetation, in particular the Commonwealth listed BWSCP TEC and a population of Threatened *Conospermum undulatum*. The resulting design changes reduced the size of the DE to 68.07 ha.

The most significant design change was realignment of the Principal Shared Path (PSP), to excise two portions of BWSCP TEC from the DE, these areas included:

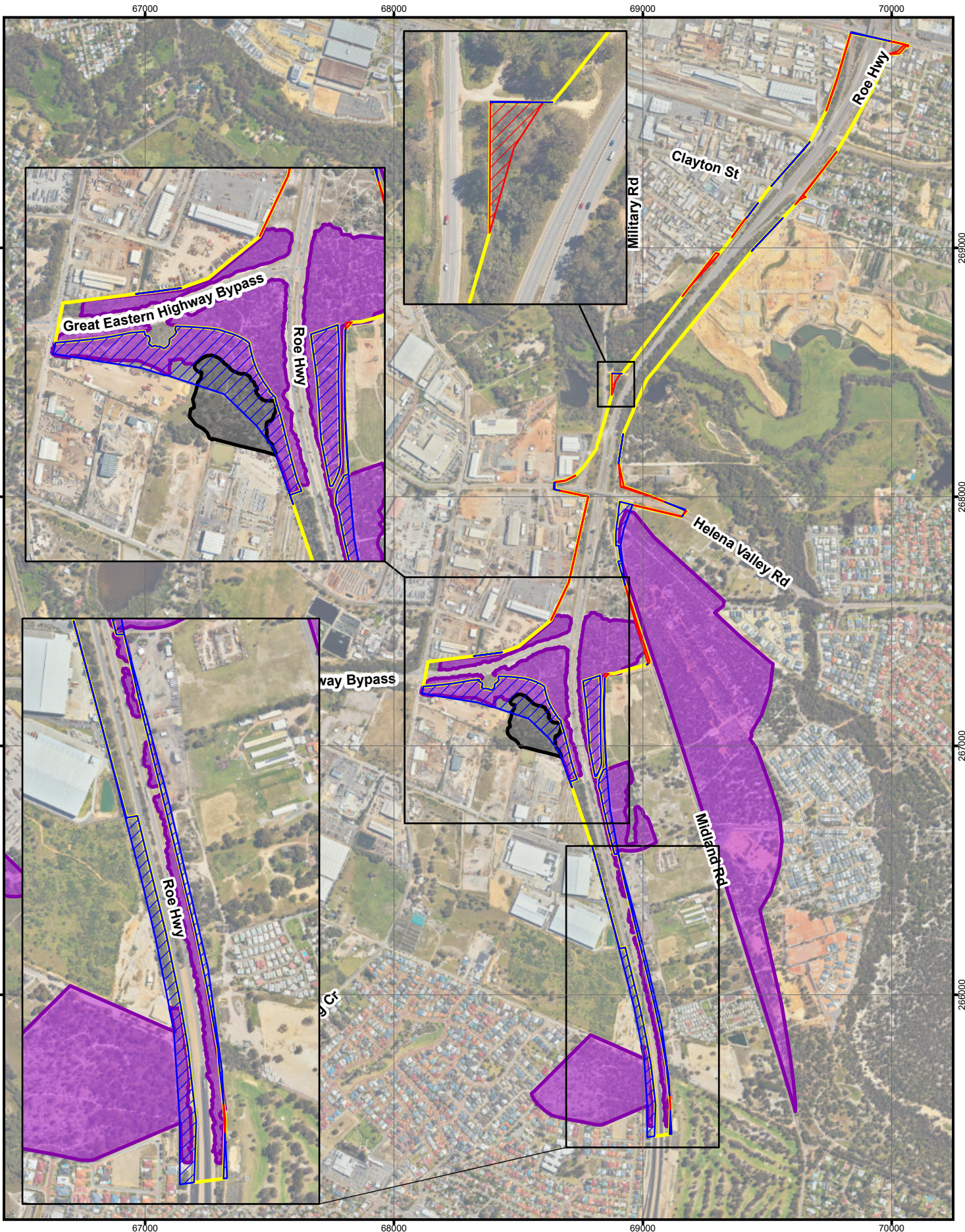
- 1.77 ha between the road alignment and PSP.
- 3.01 ha south of the intersection.

Where the PSP crosses the TEC, it will be less than 30 m wide, which is the maximum separation between two areas of BWSCP TEC before they are considered to be separate patches BWSCP (TSSC, 2016). The retained vegetation within the two areas either side of the PSP will therefore continue to represent one single patch of TEC, approximately 4.78 ha in size. Alternatives would require additional clearing of the TEC and the retention of small areas that do not meet the criteria for minimum patch size.

A comparison of impacts between the referral and varied Proposed Action is provided in Table 4. The amended DE against TEC and Black Cockatoo foraging habitat is presented in Figure 5 and Figure 6.

Table 4 Comparison of impacts between referred DE and revised DE based on latest ecological data.

Description	Area within referred DE	Area within October 2021 amended DE	Area within April 2022 amended DE
Threatened Ecological Communities			
Shrublands and woodlands of the Eastern Swan Coastal Plain	1.6 hectares	0 hectares	0 hectares
Banksia Woodlands of the Swan Coastal Plain TEC	22.83 hectares	21.77 hectares	14.94 hectares
Threatened Species			
Black Cockatoo Foraging Habitat	47.28 hectares	43.89 hectares	36.54 hectares
Black Cockatoo potential breeding trees	222 trees	211 trees	162 trees
<i>Conospermum undulatum</i>	3 individuals	3 individuals	1 individual
Carter's Freshwater Mussel	No direct impact, habitat unsuitable	No direct impact, habitat unsuitable	No direct impact, habitat unsuitable



PROJECT ID 60657311
 CREATED BY LEUJ
 APPROVED BY SHAWJ
 LAST MODIFIED 05 APR 2022

1:20,000
 (when printed at A4)
 Datum: GDA 1994 Perth Coastal Grid 1994
 Data sources: Main Roads WA

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021); Geoscience Australia; Streetpro

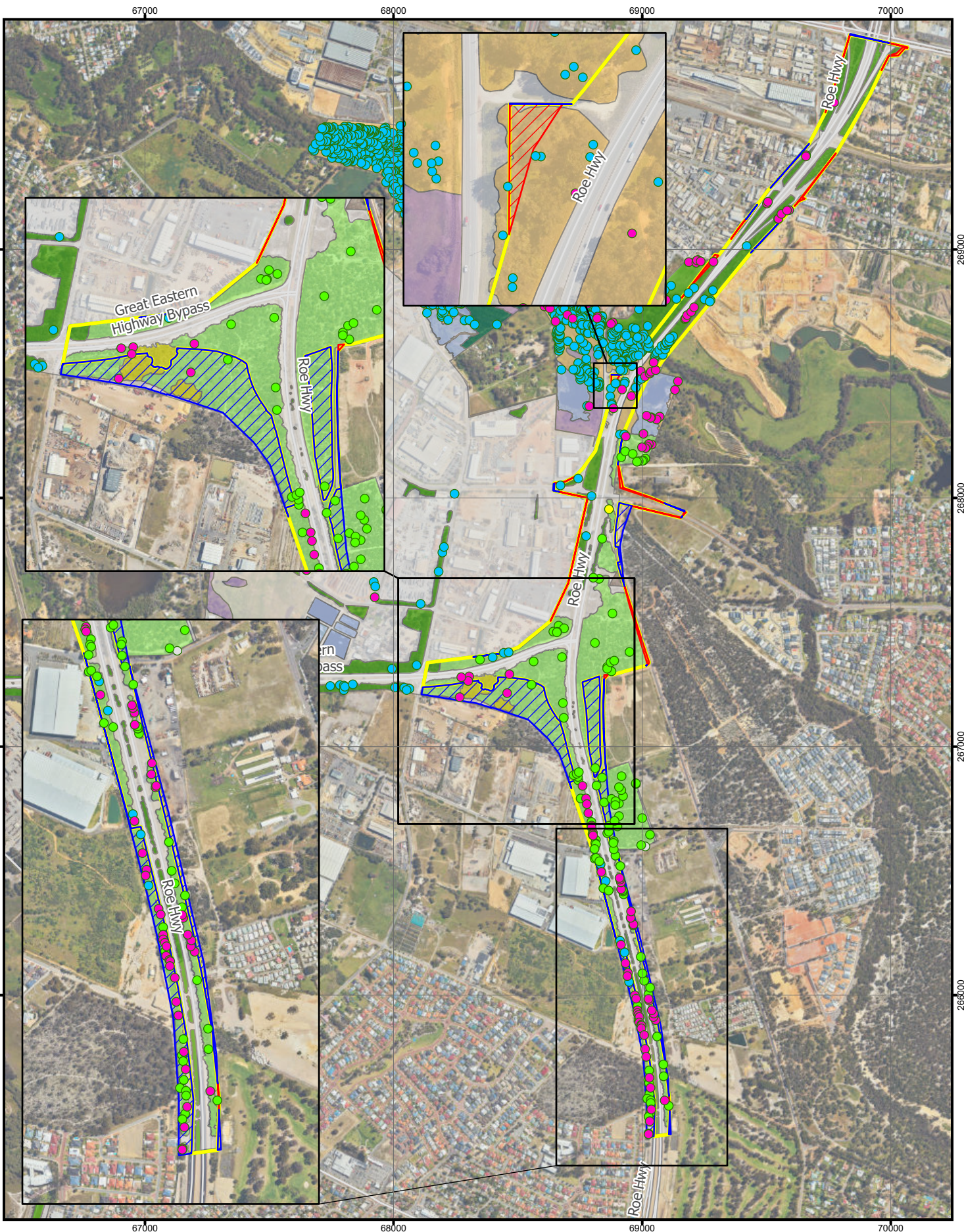
LEGEND

- ▬ EPBC 2020/8784 Development Envelope Referred September 2020
- ▨ Area added to DE since Referral
- ▨ Area removed from DE since Referral
- ▨ Banksia Woodlands of the Swan Coastal Plain
- ▨ Shrublands and woodlands of the eastern Swan Coastal Plain

Avoidance and Minimisation of impacts to TEC

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGE PROJECT
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGES EPBC 2020/8784
 PRELIMINARY DOCUMENTATION

Figure 5



PROJECT ID 60657311
 CREATED BY LEUJ
 APPROVED BY CHINNERYA
 LAST MODIFIED 06 APR 2022

1:20,000
 0 100 200 300 400 500 metres
 Datum: GDA 1994 Perth Coastal Grid 1994
 Data sources: Main Roads WA

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021); Geoscience Australia; Streetpro

LEGEND

- ▨ Area added to DE since Referral
- ▨ Area removed from DE since Referral
- ▨ Proposed DE accepted October 2021
- Potential Future Black Cockatoo Habitat
- *Corymbia calophylla*
- *Eucalyptus gomphocephala*
- *Eucalyptus marginata*
- *Eucalyptus rudis*
- Indeterminate
- Fauna Habitat (Aug 21)
- Banksia woodland with scattered Eucalyptus/Marri
- Eucalyptus/Marri in road reserve
- Fabbaceous heathland
- Flooded Gum over grasslands
- Planted Eucalyptus/Marri
- Scattered Eucalyptus/Marri in cleared areas
- Wetlands/River
- Cleared area

Changes to DE and Black Cockatoo Foraging Habitat

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGE PROJECT
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGES EPBC 2020/8784
 PRELIMINARY DOCUMENTATION

Figure 6

4. Description of the Environment

4.1 Existing Land Use

The Proposed Action intersects with multiple land use zones under the Metropolitan Region Scheme (MRS) including:

- Primary Regional Road (94.99%)
- Rural (3.23%)
- Urban (1.55%)
- Industrial (0.21%)
- Railways (0.01%)

Land uses surrounding the Proposed Action, from approximately north to south, comprise:

- Predominately industrial and urban land use to the north, east and west
- Parks and recreation to the east and west
- Rural land uses to the east, west and south
- Privately owned land adjacent to the road corridor.

The northern section of Roe Highway crosses the Helena River, which is zoned as Parks and Recreation.

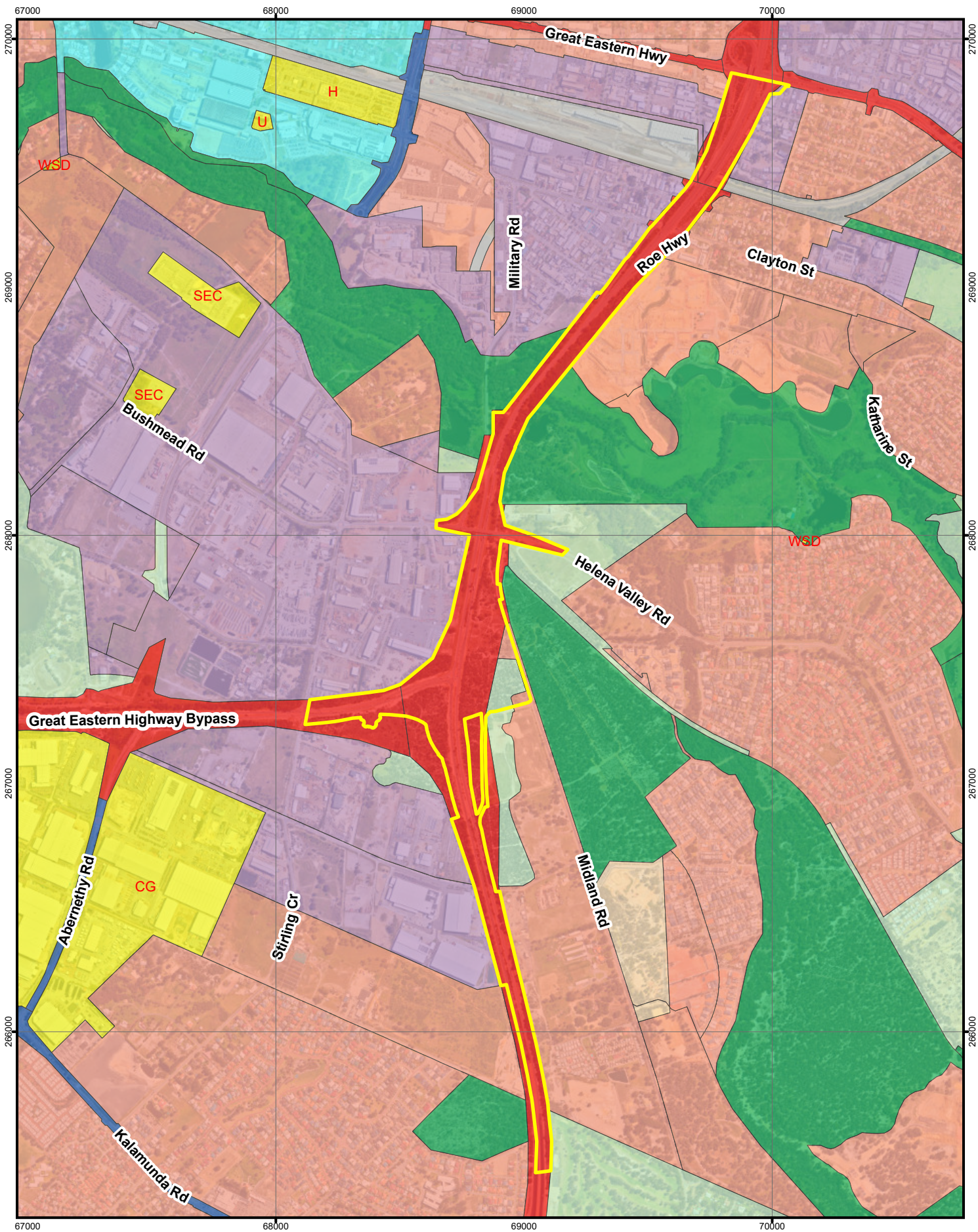
The Proposed Action will result in the resumption of some land classified as Rural and Urban as shown in Figure 7. Main Roads will undertake consultation with any affected landholders and will acquire all land required for the Proposed Action prior to commencement of construction through negotiated settlement, or under the *WA Land Administration Act 1997*.

4.2 Topography

The Helena River bridge duplication involves the existing bridge (Bridge 1148) to be duplicated on its eastern side, which will carry southbound traffic, while the current bridge will be converted to carry northbound traffic. The existing Bridge 1148 abutments on Roe Highway stand at approximately 12 m to 13 m Australian Height Datum (AHD), with the Helena River valley floor lying at approximately 8 m to 10 m AHD below. The natural ground level on both sides of Roe Highway is between 10 m to 12 m AHD.

The PSP bridge is planned to cross the south-bound on ramp to Roe Highway from Clayton Street. This on ramp lies to the east of Bridge 1663, an existing bridge that spans Clayton Street to the north of the Helena River crossing (Bridge 1148) and represents the northern extent of the Proposed Action. The landscape surrounding Bridge 1663 is relatively flat, varying between 14 m to 16 m AHD to the east. The Roe Highway embankments either side of Bridge 1663 have been constructed to approximately 20 m AHD.

The areas outside of the bridge locations is relatively flat topography. The road is raised between approximately 0.5 m to 1.5 m.



PROJECT ID 60657311
 CREATED BY LEUJ
 APPROVED BY SHAWJ
 LAST MODIFIED 06 APR 2022

Datum: GDA 1994 Perth Coastal Grid 1994
 1:20,000
 0 100 200 300 400 metres
 (when printed at A4)
 Data sources: Main Roads WA

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021); Geoscience Australia; Streetpro

LEGEND	
	Development Envelope
	Central city area
	Industrial
	Other regional roads
	Parks and recreation
	Primary regional roads
	Public purposes - Commonwealth Government CG
	Public purposes - hospital H
	Public purposes - State Energy Commission SEC
	Public purposes - university U
	Public purposes - Water Authority of WA WSD
	Railways
	Rural
	Urban
	Urban deferred

Land Use

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS
 INTERCHANGE PROJECT
 GREAT EASTERN HIGHWAY BYPASS
 INTERCHANGES EPBC 2020/8784
 PRELIMINARY DOCUMENTATION

Figure
7

4.3 Geology

Review of the 1:50,000 and 1:2,500,000 Western Australian Geological Map Series for Perth and 1:500,000 State interpreted bedrock geology indicates that the DE is underlain by the following geological units summarised in (Table 5).

Table 5 Geological setting

Unit	Expected Strata	Description	Comments
Superficial Geology	Alluvium	Clay of alluvial origin with variable silt content	Within the Helena River channel
	Colluvium	Valley filled deposits, variably laterised and podsolised	Within the Helena River channel
	Bassendean Sand	Basal conglomerate overlain by dune quartz sand with heavy mineral concentrations (Qdcb)	Underlies to the site south of the Helena River and existing Bridge 1663
	Guildford Formation	Alluvial sand and clay with shallow-marine and estuarine lenses and local basal conglomerate (Qag)	Underlying entire DE
Bedrock Geology	Warnbro Group	Interbedded sandstone, siltstone, and shale; minor conglomerate (K-WR-ss)	Underlying entire DE

4.4 Soils

The DE occurs within the Bassendean Zone of the Swan Province. The Bassendean Zone is described as mid-Pleistocene Bassendean sand with fixed dunes inland from coastal dune zone. Non-calcareous sands, podsolised soils with low-lying wet areas (Purdie et al., 2004).

The soil units within the DE (mapped at 1:1,000,000) are:

- Cb38 Sandy dunes with intervening sandy and clayey swamp flats: chief soils are leached sands (Uc2.33) and (Uc2.21), sometimes with a clay D horizon below 5 ft, on the dunes and sandy swamps. Associated are various soils in the clayey swamps, such as (Ug6.4) and some (Dy) and (Dg) soils.
- Mu11 River terraces: chief soils are neutral red earths (Gn2.15) and neutral yellow earths (Gn2.25) on the higher terrace. Associated are (Um6.11) soils on the lower terrace and some areas of (Dy3.4) soils.
- Sp2 Gently sloping bench or terrace--the Ridge Hill Shelf: chief soils are hard acidic yellow soils (Dy2.61) containing ironstone gravels. Associated are brown sands (Uc4.2) often containing ironstone gravels at depth and forming a western fringe to the bench; and some (Dy3.4) soils on dissected areas. As mapped, areas of units Wd6 and Gb16 may be included.
- Wd6 Plain: chief soils are sandy acidic yellow mottled soils (Dy5.81), some of which contain ironstone gravel, and in some deeper varieties (18 in. of A horizon) (Uc2.22) soils are now forming. Associated are acid yellow earths (Gn2.24). Other soils include (Dy3.81) containing ironstone gravel; (Dy3.71); low dunes of (Uc2.33) soils; and some swamps with variable soils.

The majority of the DE is mapped as clay horizon (Cb38), which is widespread in the surrounding area.

A Preliminary Site Investigation was undertaken in July 2020 by Jacobs Group (Australia) Pty Ltd (Jacobs) throughout the DE (Jacobs, 2020). The Jacobs Study Area includes the entirety of the DE and its immediate surrounds when the 150 m buffer is applied (Jacobs, 2020). The northern portion of the DE is identified as having an extremely low (1 - 5 %) probability of Acid Sulfate Soils (ASS), with the central portion considered to have an extremely low (1 - 5%) to low (6 - 70%) probability of ASS occurring. The southern portion of the DE is considered to have a low (6 - 70%) probability of ASS. The area of the DE with the highest probability of ASS occurring (6 - 70%) is located within the southern part of the DE (Jacobs, 2020).

4.5 Groundwater

Three distinct aquifers occur beneath the Proposed Action and surrounding area. The superficial Swan aquifer is the topmost layer and is usually accessed for groundwater abstraction. Beneath this lies the semi-confined Leederville aquifer, which overlies the confined Yarragadee North aquifer. Groundwater movement and recharge is very slow in these confined aquifers.

Groundwater levels range 7 m to 11 m Australian Height Datum (mAHD) across the DE, with depth of the bottom of the superficial aquifer in the DE approximately 22 m below ground level (Stratagen, 2020)

The Proposed Action is not located in a Public Drinking Water Source Area (PDWSA). The nearest PDWSA, Middle Helena Catchment Area, is located approximately 4.1 km from the DE (DWER, 2018).

4.6 Surface Water

The Proposed Action is located within the Swan-Avon Lower Swan catchment. It is intercepted by the Helena River, which is an ephemeral river system that flows into the upper Swan Estuary at Guildford (DoW, 2011). The Roe Highway bridge duplication traverses a narrow section of the Swan and Canning River Development Control Area (SCRDCA), which is defined by the Helena River channel. The SCRDCA is managed under the *Swan Canning River Management Act 2006* (SCRM Act).

The DE intersects a portion of two geomorphic wetlands, a Conservation Category Wetland (CCW) and Multiple Use Wetland (MUW) (DBCA, 2020a). The CCW comprises the Helena River and its floodplain, and the MUW intersects with the GEHB to the west of the proposed interchange with Roe Highway.

4.7 Vegetation and Flora

4.7.1 Broad vegetation

The Proposed Action lies within the Swan Coastal Plain 2 (SWA02) subregion of the Swan Coastal Plain (SWA) bioregion as defined by the Interim Biogeographic Regionalisation for Australia (IBRA) (DSEWPaC, 2012a). This sub-region is described as low-lying coastal plain, mainly covered with woodlands, dominated by Banksia or Tuart on sandy soils, *Allocasuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrust Mesozoic sediments dominated by Jarrah woodland. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *A. obesa*-Marri woodlands and Melaleuca shrublands, are extensive only in the south (Mitchell et al., 2003).

According to Beard's (1981) broad scale (1:1,000,000) pre-European vegetation mapping of the Swan Coastal Plain, the DE intersects three vegetation associations:

- Association 1001 – Bassendean: Medium very sparse woodland; Jarrah, with low woodland; *Banksia* and *Casuarina*.
- Association 1018-Bassendean: Medium Forest; Jarrah-Marri/low woodland Banksia; Banksia low forest; teatree/ low woodland; *Casuarina obesa*
- Association 1009 – Pinjarra Plain: Medium woodland; Marri and river gum.

Regional vegetation complex mapping based on major geomorphic units of the Swan Coastal Plain identified the following vegetation complexes as described by Heddle et al. (1980) within the DE:

- Forrestfield Complex – Ranges from open forest of *Corymbia calophylla*, *Eucalyptus wandoo* and *Eucalyptus marginata* to open forest of *Eucalyptus marginata*, *Corymbia calophylla*, *Allocasuarina fraseriana*, and *Banksia* species. Fringing woodland of *Eucalyptus rudis* in the gullies that dissect this landform.
- Guildford Complex-Mixture of open forest to tall open forest of *Corymbia calophylla*-*Eucalyptus wandoo* - *Eucalyptus marginata* and woodland of *Eucalyptus wandoo* with rare occurrences of *Eucalyptus lanepoolie* (Salmon White Gum), Small areas of *Eucalyptus rudis*-*Melaleuca raphiophylla*.
- Southern River Complex – Open woodland of *Corymbia calophylla*, *Eucalyptus marginata*, *Banksia* species with fringing woodland of *Eucalyptus rudis* and *Melaleuca raphiophylla* along creek beds.
- Swan Complex – Fringing woodland of *Eucalyptus rudis*, *Melaleuca raphiophylla* with localised occurrence of low open forest of *Casuarina obesa* and *Melaleuca cuticularis*.

Biota (2021) mapped remnant vegetation within the Forrestfield, Southern River and Swan vegetation complexes. Whilst the Proposed Action also intersects the Guilford vegetation complex, no remnant native vegetation representative of this complex is present within the DE.

4.7.2 Vegetation types

Biota (2021) identified nine native vegetation types within the 23.31 ha of remnant native vegetation occurring within the DE, as described below in Table 6.

Table 6 Vegetation types and extent within the DE

ID	Vegetation Type	Vegetation Type Description	Extent in DE (ha)	Condition
L3	Marri over <i>Melaleuca</i> Low Open Woodland on Clay Pits	<i>Corymbia calophylla</i> open woodland over <i>Melaleuca rhaphiophylla</i> low open forest over * <i>Bromus diandrus</i> , * <i>Briza maxima</i> , * <i>Briza minor</i> , * <i>Ehrharta calycina</i> , * <i>Avena fatua</i> very open tussock grassland over <i>Schoenus clandestinus</i> , <i>Juncus articulatus</i> , <i>Juncus capitatus</i> , <i>Isolepis cernua</i> var. <i>setiformis</i> sedgeland over <i>Cycnogeton huegelii</i> scattered herbs.	0.15 ha (0.22%)	Degraded
L5	<i>Jacksonia</i> over <i>Xanthorrhoea</i> with Sedges	<i>Jacksonia floribunda</i> scattered tall shrubs over <i>Xanthorrhoea preissii</i> , <i>Melaleuca seriata</i> open shrubland over * <i>Ehrharta calycina</i> , * <i>Pentameris pallida</i> scattered grasses over <i>Lyginia barbata</i> , (<i>Lyginia imberbis</i>) open sedgeland over <i>Alexgeorgea nitens</i> , (<i>Dasypogon bromeliifolius</i> , * <i>Ursinia anthemoides</i>) herbland.	0.08 ha (0.12%)	Excellent to Very Good Good
P1	<i>Allocasuarina</i> and <i>Banksia</i> over <i>Xanthorrhoea</i> with Sedges	<i>Allocasuarina fraseriana</i> open woodland over <i>Eucalyptus todtiana</i> , <i>Banksia menziesii</i> (<i>Banksia attenuata</i>) low woodland over <i>Jacksonia floribunda</i> scattered tall shrubs over <i>Xanthorrhoea preissii</i> open shrubland over <i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i> , <i>Bossiaea eriocarpa</i> , <i>Stirlingia latifolia</i> , <i>Scaevola repens</i> var. <i>repens</i> low open shrubland over <i>Mesomelaena pseudostygia</i> , <i>Lyginia barbata</i> very open sedgeland over <i>Alexgeorgea nitens</i> very open herbland.	15.29 ha (22.46%)	Excellent to Degraded, with the majority considered Very Good and Good.
P2	Marri over <i>Kingia australis</i> with Sedges	<i>Corymbia calophylla</i> low open woodland over <i>Kingia australis</i> tall open shrubland over <i>Xanthorrhoea preissii</i> open shrubland over <i>Verticordia densiflora</i> , <i>Banksia dallanneyi</i> var. <i>dallanneyi</i> , <i>Stirlingia latifolia</i> low shrubland over <i>Caustis dioica</i> , <i>Mesomelaena pseudostygia</i> , <i>M. tetragona</i> , <i>Lyginia imberbis</i> , <i>Patersonia occidentalis</i> var. <i>occidentalis</i> open sedgeland over <i>Alexgeorgea nitens</i> , <i>Desmocladius fasciculatus</i> very open herbland.	0.35 ha (0.51%)	Excellent to Very Good.
P3	Flooded Gum over Weedy Grasses on Floodplain	<i>Eucalyptus rudis</i> subsp. <i>rudis</i> open forest over * <i>Bromus diandrus</i> , * <i>Avena fatua</i> , * <i>Ehrharta longiflora</i> grassland over * <i>Fumaria capreolata</i> herbland.	2.35 ha (3.45%)	Excellent to Very Good to Degraded with the majority Degraded
P4	<i>Eremaea</i> Open Heath	<i>Jacksonia floribunda</i> tall shrubs over <i>Eremaea pauciflora</i> open heath over <i>Astroloma xerophyllum</i> low open shrubs over <i>Lyginia imberbis</i> open sedgeland	0.37 ha (0.54%)	Excellent to Very Good
P5	Jarrah over <i>Xanthorrhoea</i> with Mixed Shrubs and Herbs	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> open forest over <i>Adenanthos cygnorum</i> , <i>Xanthorrhoea preissii</i> tall open shrubland over <i>Hibbertia hypericoides</i> , <i>Gompholobium tomentosum</i> scattered low shrubs over * <i>Eragrostis curvula</i> * <i>Briza maxima</i> very open grassland over <i>Lyginia barbata</i> , <i>Lomandra preissii</i> scattered sedges over <i>Alexgeorgea nitens</i> open herbland	1.99 ha (2.92%)	Very Good to Degraded, with the majority considered being Very Good
P6	Flooded Gum over Weedy Understorey on Riverbank	<i>Eucalyptus rudis</i> subsp. <i>rudis</i> open forest over <i>Melaleuca rhaphiophylla</i> low open woodland over * <i>Ehrharta longiflora</i> , * <i>Bromus diandrus</i> open grassland over * <i>Fumaria capreolata</i> , <i>Cycnogeton huegelii</i> open herbland.	0.12 ha (0.18%)	Good to Degraded
P7	Jarrah and <i>Banksia</i> over <i>Xanthorrhoea</i> with Sedges	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> , <i>Banksia attenuata</i> , <i>Allocasuarina fraseriana</i> and <i>Banksia menziesii</i> low open woodland over <i>Xanthorrhoea preissii</i> , <i>Allocasuarina humilis</i> open shrubland over <i>Dasypogon bromeliifolius</i> , <i>Hibbertia hypericoides</i> , <i>Bossiaea eriocarpa</i> , <i>Banksia dallanneyi</i> var. <i>dallanneyi</i> low open shrubland over <i>Mesomelaena pseudostygia</i> , <i>Schoenus efoliatus</i> very open sedgeland over <i>Alexgeorgea nitens</i> scattered herbs.	2.62 ha (3.85%)	Excellent to Degraded, with the majority considered Very Good.
Total	Remnant native vegetation		23.31 ha (34.26%)	
	Planted/revegetated		13.16 ha (19.33%)	
	Heavily modified or cleared land		31.58 (46.39%)	
Total DE			68.07 ha	

* Denotes introduced species

4.7.3 Flora

Biota has recorded 287 native taxa belonging to 145 genera and 53 families within the survey area. Based on this information, a total of 179 flora taxa were recorded within the DE, representing 109 genera, including of 32 introduced taxa (Biota, 2021). A desktop assessment identified a total of 24 Threatened flora species and 43 Priority flora species within 5km of the DE (Biota, 2021). A targeted Threatened and Priority flora search (Biota, 2021) confirmed the presence of four significant flora species within the DE, namely:

- *Conospermum undulatum* (Listed as Vulnerable under both the EPBC Act (C'wth) and the *Biodiversity Conservation Act 2016* (BC Act, WA))
- *Johnsonia pubescens* subsp. *cygnorum* (Listed as Priority 2 by the Western Australian Department of Biodiversity Conservation and Attractions (DBCA))
- *Isopogon autumnalis* (Listed as Priority 3 by the DBCA)
- *Hypolaena robusta* (Listed as Priority 4 by the DBCA).

4.7.4 Introduced and invasive species

Ninety-six (96) species of introduced flora species were recorded during the Biota (2021) survey, including 32 introduced taxa within the DE. Of these, six are listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act, WA) and / or as a Weeds of National Significance (WoNS) known to be present within the DE (Biota, 2021). These six species are:

- **Asparagus asparagoides* (Bridal Creeper) (Listed as a Declared Pest under the BAM Act and WoNS)
- **Echium plantagineum* (Paterson's Curse) (Listed as a Declared Pest under the BAM Act)
- **Hydrocotyle ranunculoides* (Robust Pennywort) (Listed as a Declared Pest under the BAM Act)
- **Rubus ulmifolius* (Blackberry) (Listed as a Declared Pest under the BAM Act and WoNS)
- **Solanum linnaeanum* (Apple of Sodom) (Listed as a Declared Pest under the BAM Act)
- **Zantedeschia aethiopica* (Arum Lily) (Listed as a Declared Pest under the BAM Act)

The remaining introduced species are considered environmental weeds, and all have previously been recorded on the Swan Coastal Plain. Locations of the Declared Pests are shown in the Biota (2021) report (Appendix A).

4.8 Fauna

Biota (2021) identified seven fauna habitats within the survey area, five of which comprise an area of 36.57 ha within the DE (53.72%), as detailed in Table 7. A further 31.50 ha (43.14%) of the DE is comprised of cleared areas, roads, buildings, or heavily degraded agricultural land with negligible value as fauna habitat.

Table 7 Fauna habitats recorded within the Development Envelope

Habitat Type	Area within Development Envelope (ha)	% of Development Area
Banksia woodland with scattered Eucalyptus/Marri	21.08	30.97
Eucalyptus/Marri in road reserve (not remnant native vegetation)	12.43	18.26
Fabaceous heathland	0.44	0.65
Flooded gum over grasslands	2.35	3.45
Wetlands/River	0.27	0.40
Total	36.57	53.72

5. Matters of National Environmental Significance

5.1 Description of Protected Matters within the Proposed Action

This Preliminary Documentation describes the following MNES listed under the EPBC Act that are, or have the potential to be, in the DE and its surrounds:

5.1.1 Listed ecological communities

- *Shrublands and Woodlands of the Eastern Swan Coastal Plain* Threatened Ecological Community – Endangered
- *Banksia Woodlands of the Swan Coastal Plain* Threatened Ecological Community (BWSCP TEC) – Endangered

5.1.2 Listed species

- Baudin's Black Cockatoo (*Zanda baudinii*) - Endangered
- Carnaby's Black Cockatoo (*Zanda latirostris*) – Endangered
- Forest Red-tailed Black Cockatoo (FRTBC) (*Calyptorhynchus banksii naso*) – Vulnerable
- Carters Freshwater Mussel (CFM) (*Westralunio carteri*) - Vulnerable
- Wavy-Leaved Smokebush (*Conospermum undulatum*) - Vulnerable

5.2 Biological Surveys

Main Roads commissioned Biota Environmental (Biota, 2021) to complete a biological survey over the Proposed Action and its vicinity. The biological survey is included in Appendix A. Other studies undertaken to determine the environmental significance of the Proposed Action are summarised in Table 8.

Table 8 Studies and surveys relevant to the Proposed Action

Survey/Report Name	Location/Extent in Survey Ares	Methodology
Vegetation and Flora		
Roe Highway / Great Eastern Highway Bypass and Roe Highway / Kalamunda Road – AECOM (2015)	The survey covered a portion of the DE, extending to Helena Valley Road in the north, Talbot Road in the south, Stirling Court in the west, and slightly beyond Roe Highway in the east. The survey covered an additional area to the south at the intersection of Roe Highway and Kalamunda Road, which is not relevant to this Proposed Action.	The survey was completed by two personnel over four days to satisfy the requirements of a Level 1 Flora and Vegetation survey in accordance with EPA (2004).
Great Eastern Highway Bypass Flora and Vegetation Survey – Strategen (2018)	The survey covered a total area of 134 ha, extending farther west of the current Development Envelope. The survey covered the western and southern extents of the DE.	The survey was a Detailed Flora and Vegetation Survey per EPA (2016a). A major component of the survey scope was to determine the extent of SCP20c <i>Shrublands and Woodlands of the Eastern Swan Coastal Plain</i> TEC within the survey area.
Great Eastern Highway Bypass Interchanges (Roe Highway and Abernethy Road) Biological Survey– Biota (2021)	The survey covered a broader area than the DE, extending to the east of Abernethy Road.	The survey was undertaken in accordance with EPA (2016a, b) and approved Conservation Advice for the BWSCP TEC (DotEE, 2016). There were two survey areas. The Level 1 survey area (169.9 ha) included a reconnaissance flora survey, targeted significant flora searches and vegetation mapping. The Level 2 survey area (190.6 ha) included a detailed single-phase flora survey, targeted significant flora searches as well as a TEC/PEC assessment and mapping.
Great Eastern Highway Bypass Interchanges: <i>Phytophthora</i> Dieback	The survey covered a broader area than the DE, following a similar alignment to that of Biota (2021).	The survey area was assessed for <i>Phytophthora</i> dieback occurrence in accordance with DPaW (2015).

Survey/Report Name	Location/Extent in Survey Ares	Methodology
Occurrence Assessment – Glevan Consulting (2020)		
Fauna		
Great Eastern Highway Bypass Interchanges (Roe Highway and Abernethy Road) Biological Survey– Biota (2021)	The survey covered a broader area than the DE, extending to the east of Abernethy Road	Level 1 Fauna Survey as per EPA (2016b) and a targeted Black Cockatoo assessment in accordance with the EPBC Act referral guidelines for three Threatened Black Cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the FRTBC (DSEWPaC, 2012a) The survey also included CFM assessment.
Great Eastern Highway Bypass Interchanges Project: Targeted Carter's Freshwater Mussel Survey Biologic Environmental (2022)	The survey covered approximately 500 m of the Helena River, upstream and downstream of Roe Highway, as well as two adjacent wetlands (located east and west of Roe Highway).	Currently, there no technical guidance in Australia applicable to targeted surveys for freshwater mussels. Biologic (2022) follows best practice and employs sampling design, methods, and general approaches consistent with DWER's Recommended Methodology for Monitoring Freshwater Mussels (provided to Main Roads) as well as EPA factor guidelines and previous surveys undertaken in Australia and New Zealand.

5.3 Threatened Ecological Communities

5.3.1 Banksia Woodlands of the Swan Coastal Plain TEC

5.3.1.1 Description

The BWSCP TEC was listed as an Endangered TEC under the EPBC Act in September 2016 and a Priority Ecological Community by DBCA. The Threatened Species Scientific Committee, described the key structural features of the community as:

- A prominent tree layer of *Banksia*, with scattered *Eucalyptus* and other tree species often present among, or emerging above, the canopy
- The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs
- High endemism and considerable localised variation in species composition across its range
- The community is a low woodland forest, but may also include shrubland, open woodland or forest under some classification systems. The percentage canopy cover is more than 2% and typically less than 50%. The structure and appearance may also vary due to disturbance history.

The canopy is commonly dominated by *Banksia attenuata* and / or *B. menziesii*. Other *Banksia* species that may dominate some ecological communities include *B. prionotes* or *B. ilicifolia*. The patch of vegetation must include at least one of these diagnostic species (TSSC, 2016). The taller trees may include *Corymbia calophylla* (Marri), *Eucalyptus gomphocephala* (Tuart) or *Eucalyptus marginata* (Jarrah).

The BWSCP TEC has ongoing threats predominately through clearing and fragmentation for urban development, as well as mining, fire regime, climate change, invasive species and *Phytophthora* dieback (TSSC, 2016).

BWSCP TEC provides habitat for nationally threatened fauna species including Carnaby's Cockatoo, Baudin's Cockatoo and FRTBC. Carnaby's Cockatoo and Baudin's Black Cockatoo are expected to forage on the canopy and understorey of the community, whilst FRTBC is expected to forage on *Eucalypts*, where these are present in the community.

5.3.1.2 Habitat assessment

The BWSCP TEC covers approximately 14.94 ha within the DE based on mapping of the TEC by Biota (2021). The vegetation condition of the TEC varies from degraded to excellent with the majority being in very good condition as shown in Table 9. The patches of the BWSCP TEC are shown in Figure 9. Habitat quality assessment has been carried for the TEC based on DCCEEW's habitat quality scoring tool. The TEC is assessed to have a habitat quality score of 6.

Table 9 Banksia Woodlands of the Swan Coastal Plain TEC - Patches and Vegetation Condition

Patch Number	Total patch size	Extent within the DE		Vegetation condition of patch within DE
	ha	ha	%	ha
1	8.92	4.75	53.25	0.08 – Good 4.05 – Very Good 0.62 – Excellent to Very Good
3 [^]	12.88	6.73	52.25	0.12 – Degraded 3.41 – Good 0.66 – Very Good 2.54 – Excellent to Very Good
4	1.88	1.88	100	0.53 – Good 1.35 – Very Good to Good
5	1.58	1.58	100	1.58 – Excellent to Very Good
6 [^]	11.78	0	0	-
7 [^]	52.06	0	0	-

*note that Patch 2 within the Biota (2021) is SCP20c, *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC, and therefore excluded from the *Banksia Woodlands of the Swan Coastal Plain* TEC

[^]Parts of Patches 3 and 6 and all of Patches 7 are outside the Biota (2021) survey area and are inferred as BWSCP TEC from contextual information.

5.3.1.3 *Local and regional context*

The DE intersects three LGAs: City of Swan, Shire of Mundaring and Shire of Kalamunda. The BWSCP TEC is estimated to cover 336,930.1 ha across the four broad regions of LGA (TSSC, 2016), of which 11,528.6 ha occurs within three LGAs intersected by the DE. About 81,800 ha of the TEC occurs within reserves, most of which are within the Swan Coastal Plain bioregion (TSSC, 2016).

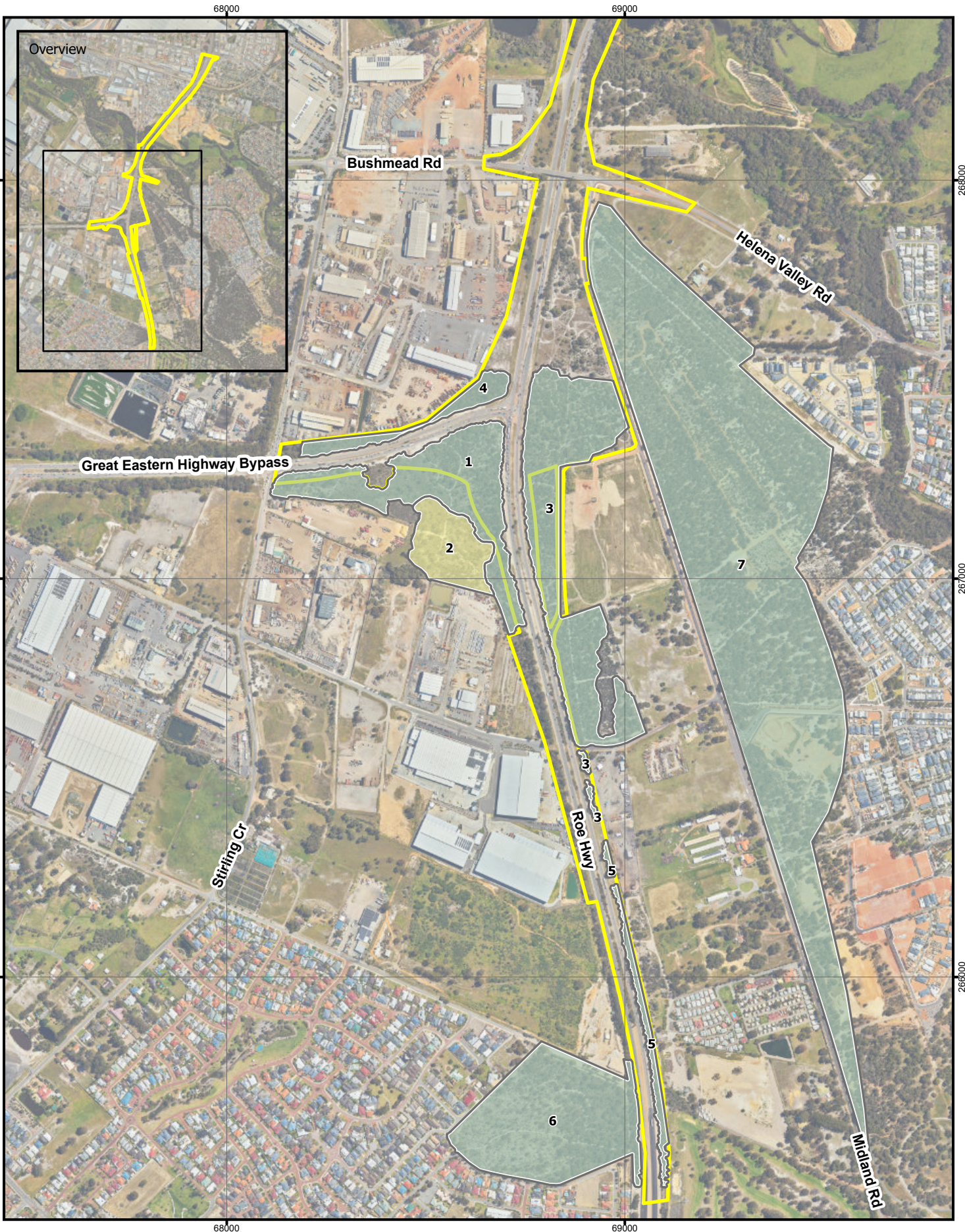
Four patches of BWSCP TEC are located within the DE, all of which meet the key diagnostic characteristics and condition thresholds for the ecological community as shown in Figure 8. All the patches are considered critical for the survival of BWSCP TEC because the ecological community occurs in a landscape that has often been very heavily cleared and modified and now exists as mostly very small and highly fragmented patches (TSSC, 2016).

5.3.1.4 *Adequacy of surveys undertaken*

Biota has carried out a reconnaissance flora survey and detailed level of biological assessment of 360.5 ha, including the DE and its surrounds. As per the EPA's Technical Guidance for flora and fauna surveys for EIA (EPA, 2016a; 2016b), potential constraints and consequent limitations of surveys are summarised in the biological survey report (Appendix A).

Areas of mapped vegetation within the survey area that were considered to align with the BWSCP TEC were assessed in the field against the key diagnostic characteristics and condition thresholds, as per the approved conservation advice (TSSC, 2016).

The majority of the flora and vegetation survey was completed between early October and early November 2019, and November 2020 for the additional survey. This was considered adequate for the recording of annual and cryptic perennial species. A small subsection of the survey was completed in May 2020, outside the recommended timing, as described in EPA (2016a), for a Swan Coastal Plain survey due to limitation on access.



PROJECT ID 60657311
 CREATED BY LEUJ
 APPROVED BY SHAWJ
 LAST MODIFIED 28 MAR 2022

Datum: GDA 1994 Perth Coastal Grid 1994

1:12,500
 (when printed at A4)

0 50 100 150 200 metres

Data sources: Main Roads WA

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021); Geoscience Australia; Streetpro

LEGEND

- Development Envelope
- Patch ID - Banksia Woodlands of the Swan Coastal Plain TEC

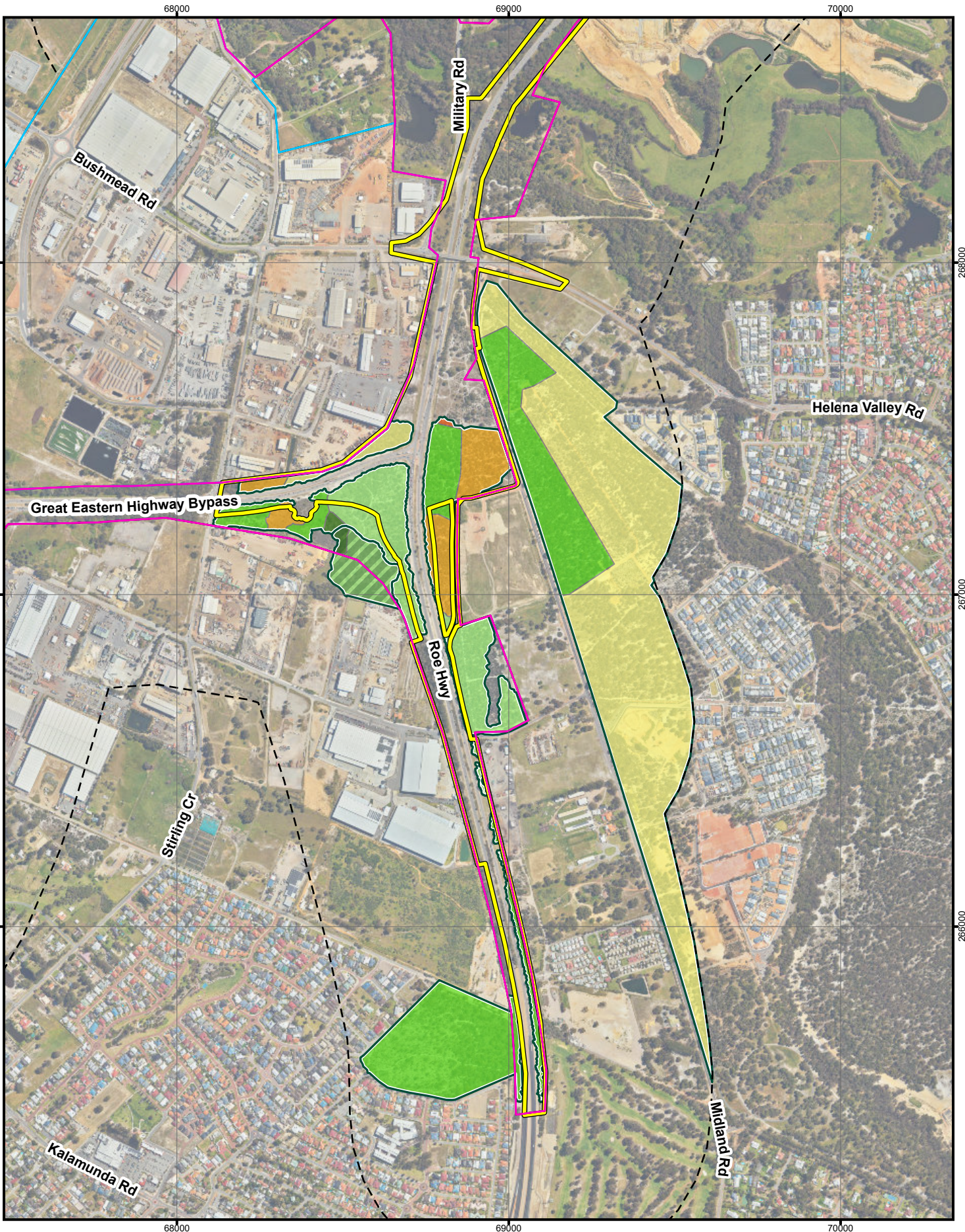
TEC Determination

- Banksia Woodland TEC
- Eastern shrublands and woodlands TEC

Patches of Banksia Woodlands of the Swan Coastal Plain TEC mapped within and adjacent to the DE

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGE PROJECT
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGES EPBC 2020/8784
 PRELIMINARY DOCUMENTATION

Figure 8



PROJECT ID 60657311
 CREATED BY LEUJ
 APPROVED BY SHAWJ
 LAST MODIFIED 06 APR 2022

Datum: GDA 1994 Perth Coastal Grid 1994
 1:15,000
 0 100 200 300 400 metres

Data sources: Main Roads WA

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021); Geoscience Australia; Streetpro

LEGEND

- Development Envelope
- Contextual Area (500m Buffer)
- Biological Level 1 Survey Area
- Biological Level 2 Survey Area
- Banksia Woodlands of the Swan Coastal Plain TEC
- Not Part of Banksia TEC (F2C20c)

Vegetation Condition (Aug 21)

- Excellent
- Excellent to Very Good
- Very Good
- Very Good to Good
- Good
- Degraded
- Completely Degraded

Patches of Banksia Woodlands of the Swan Coastal Plain TEC Vegetation Condition Assessment

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGE PROJECT
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGES EPBC 2020/8784
 PRELIMINARY DOCUMENTATION

Figure 9

5.3.2 Shrublands and Woodlands of the Eastern Swan Coastal Plain TEC

5.3.2.1 Description

The *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC (Endangered) is Woodland mainly on the transitional soils of the Ridge Hill Shelf, on the Swan Coastal Plain adjacent to the Darling Scarp, extending onto the alluvial clays deposited on the eastern fringe of the Swan Coastal Plain, and also into adjacent aeolian deposits (DotEE, 2017a).

The community mainly occurs as a shrubland, or a woodland of *Banksia attenuata* and *Banksia menziesii*, or *Corymbia calophylla*, sometimes with *Allocasuarina fraseriana*, over a shrub layer that can include the species *Adenanthos cygnorum*, *Hibbertia huegelii*, *Scaevola repens* var. *repens*, *Allocasuarina humilis*, *Bossiaea eriocarpa*, *Hibbertia hypericoides* and *Stirlingia latifolia*. A suite of herbs including *Conostylis aurea*, *Trachymene pilosa*, *Lomandra hermaphrodita*, *Burchardia umbellata* and *Patersonia occidentalis*, and the sedges *Mesomelaena pseudostygia*, *Mesomelaena tetragona*, and *Lyginia barbata* often occur in the community (DotEE, 2017a).

5.3.2.2 Habitat assessment

This TEC is found on sandy to gravelly soils on the eastern Swan Coastal Plain and foothills of the Darling Scarp. Areas of similar habitat within 200 m of known occurrences and remnant vegetation that surrounds these areas may also contain the TEC.

Biota (2021) mapped 1.65 ha of the *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC (SCP20c) TEC within the survey area and inferred a further 1.72 ha potentially within the wider contextual area. Since referral, Main Roads modified the DE to completely avoid direct impacts to this TEC. This is discussed further in Section 6.3.2.

As of April 2017, approximately 130 ha of the ecological community has been mapped within two occurrences: one at Talbot Road Bushland in Stratton, and the other at Bushmead Rifle Range in Helena Valley (DotEE, 2017a).

Due to its very restricted distribution, no condition thresholds have been applied to the identification criteria of this TEC, however the vegetation in this area has been mapped as Good (Figure 9). All areas meeting the description of the ecological community are considered critical to its survival. Major threats to the TEC are vegetation clearing, weed invasion, *Phytophthora* dieback, grazing, hydrological changes, pollution, and too-frequent fire (DBCA, 2020b).

5.4 **Threatened Fauna**

5.4.1 Black Cockatoos

5.4.1.1 Description

Carnaby's Cockatoo

Carnaby's Cockatoo (*Zanda latirostris*) is listed as Endangered under the EPBC Act and is endemic to the south-west of Western Australia. Its range and abundance have significantly reduced due to land clearing for agriculture, forestry and urban development. It faces continuing threats on the Swan Coastal Plain as important feeding habitat is cleared. The total population of Carnaby's Cockatoo has been estimated at a maximum of 60,000 (Saunders et al., 1986) and more recently at around 40,000 (DPaW, 2013). The population of the Perth-Peel region is estimated at about 13,000 birds (Peck et al., 2019).

Carnaby's Cockatoos breed in eucalypt woodlands between the Stirling Range and Three Springs. The Proposed Action is within the known breeding range of the species (DSEWPaC, 2012a). The species nests in hollows in live or dead trees of *Eucalyptus salmonophloia* (Salmon Gum), *E. wandoo* (Wandoo), *E. gomphocephala* (Tuart), *E. marginata* (Jarrah), *E. rudis* (Flooded Gum), *E. loxophleba* subsp. *loxophleba* (York Gum), *E. accedens* (Powderbark), *E. diversicolor* (Karri) and *Corymbia calophylla* (Marri). Breeding occurs mainly from July to mid-December.

The breeding range of this species has undergone a shift since the middle of the last century to the west and south, with a more rapid shift in the past 10 to 30 years, moving into the Tuart forests of the SCP and the Jarrah Marri forests of the Darling Scarp (Johnstone & Kirkby, 2009). The closest confirmed breeding site is located approximately 15 km to the south-east of the DE, in Jarrah Forest at Canning National Park (T. Kirkby, pers. comm.).

Breeding success for Carnaby's Cockatoo is largely dependent on suitable feeding habitat adjacent to the nest site, to provide the necessary food for the survival of the chick. As breeding individuals forage no more than approximately 20 km from their nesting hollows, the presence of sufficient foraging resources close to breeding areas (particularly within a 12 km radius) is critical to its breeding success.

The species is a post-nuptial nomad with many individuals spending the non-breeding season on the Swan Coastal Plain (including the Perth metropolitan region) from December to July. Some non-breeding individuals (usually juveniles) will remain on the Swan Coastal Plain during the breeding season. The species feeds in the canopy and understorey. On the Swan Coastal Plain, important foraging species consist of *Banksia attenuata*, *B. menziesii*, *B. grandis*, *B. ilicifolia*, *B. sessilis*, *B. prionotes*, Marri, Jarrah, and non-native *Pinus* species (Valentine & Stock, 2009; Higgins, 1999).

Forest Red-tailed Black Cockatoo

The FRTBC (*Calyptorhynchus banksii naso*) is listed as Vulnerable under the EPBC Act and is endemic to the southwest of Western Australia. The FRTBC occurs in one population of approximately 15,000 birds (DEWHA, 2009).

FRTBC are known to display erratic breeding activity in the summer and winter seasons, peaking from April to June and August to October (Johnston & Kirkby, 2013). The species primarily nests in hollows of large, mature Marri trees and to a lesser extent Jarrah, Blackbutt, Bullich and Wandoo (Johnstone & Kirkby, 2013). Key breeding areas are within the Jarrah Marri Forest of the Darling Scarp/Plateau or adjacent areas of the SCP, with limited records on the western extent of the SCP (e.g. at Murdoch University and possibly Perry Lakes) (Johnstone et al., 2017).

The FRTBC is a canopy feeder, with a diet primarily consisting of seeds of Marri and Jarrah and, in recent times, the seeds of *Melia azedarach* (Cape Lilac) (Johnstone et al., 2017). Other, less important foods include *E. patens* (Blackbutt), *E. diversicolor* (Karri), *Allocasuarina fraseriana* (Sheoak), *Persoonia longifolia* (Snotty Gobble), *Hakea* spp., *E. gomphocephala* (Tuart) and *E. decipiens* (Johnstone, et al., 2017).

Baudin's Cockatoo

The Baudin's Cockatoo (*Zanda baudinii*) is listed as Endangered under the EPBC Act and is endemic to the southwest of Western Australia. This species is generally found in woodland or forest habitat but can be found in fragmented forests. The total population of the Baudin's Cockatoo is estimated at 12,500 individuals, and the species occurs mainly in flocks (up to 300 individuals) and occasionally larger aggregations (up to 1,200 individuals) at roosts (DPC, 2015). They primarily nest in hollows of live or dead Karri, *Corymbia calophylla* ((Marri), *E. wandoo* (Wandoo),) and Tuart trees. This species breeds from August to March in the eucalypt forests of the southwest (DSEWPaC, 2012a). From March, the species flies north to the central and northern parts of the Darling Scarp for the non-breeding season. The species roosts in or near riparian environments or other permanent water sources.

The species forages in eucalypt species of mainly Jarrah, Marri and Karri, and proteaceous woodland and heath. They also feed on nectar, buds and flowers and strips bark from dead trees to search for beetle larvae.

5.4.1.2 Habitat Preferences

Black Cockatoos are known to utilise a range of habitats and plant species for foraging, including introduced species such as pines, **Pinus* spp., although Marri and Jarrah woodlands are particularly important to the FRTBC and Baudin's Cockatoo. Proteaceous heaths (i.e. shrublands dominated by *Banksia*, *Hakea* and *Grevillea* species) are utilised by Carnaby's Cockatoo. Preferred roosting habitat is generally in or near riparian environments or other permanent water sources, including natural or artificial permanent water (DSEWPaC, 2012a). Black Cockatoo breeding habitat includes relevant tree species with a diameter at breast height (DBH) of greater than or equal to 500mm, or 300 mm in the case of Wandoo and Salmon Gum (DSEWPaC, 2012a). This is considered the minimum size required for a tree to begin to develop nesting hollows (which may form Black Cockatoo breeding hollows at some point in the future).

5.4.1.3 Habitat assessment

Observation of presence

The DE is located within the mapped distribution for all three Black Cockatoos. Biota (2021) confirmed that FRTBC and Carnaby's Cockatoos utilise habitat within the DE. Baudin's Black Cockatoos were recorded within 200 m of the DE via satellite tracking data from Murdoch University. The DE is located at the geographical edge of the known foraging range of Baudin's Cockatoo and the nearest breeding site recorded within 35 km south-east. The presence of foraging species indicate that Baudin's Cockatoos are likely to use habitat within the DE for foraging to support nearby roost sites (Biota, 2021). However, Biota found no evidence of Baudin's Black Cockatoo foraging during its biological survey.

Carnaby's Black Cockatoo were observed during the biological survey to be foraging in *Banksia* trees in the BWSCP TEC to the southwest of the Roe Highway/Great Eastern Highway Bypass intersection. Chewed Marri nuts are a common indicator of Black Cockatoo foraging and bite marks indicative of both Carnaby's Black Cockatoo and FRTBC were recorded. Chewed pinecones were observed in a small section of habitat located north of the Helena River and west of Roe Highway however could not be identified at Black Cockatoo species level.

Breeding habitat

Biota (2021) did not identify any known records of Black Cockatoo breeding within the DE or in the immediate vicinity in their desktop review. Biota (2021) undertook a targeted survey for Black Cockatoo habitat. The survey recorded 1,641 breeding habitat trees comprising of Flooded gum, Marri, Jarrah and Tuart with DBH (>500 mm), which may form Black Cockatoo breeding hollows at some point in the future. A total of 162 trees occurs within the DE, as summarised in Table 10 and illustrated in Figure 10. Three trees with hollows occur within the DE, however the hollows are <100mm in diameter and therefore unsuitable for use for breeding by Black Cockatoos. Four trees with hollows potentially suitable for use for breeding by Black Cockatoos were identified within the survey area, however none of these were located within the DE.

Based on the above, the DE is not known breeding habitat for Black Cockatoos and does not currently have any hollows suitable for Black Cockatoo breeding. Areas in the immediate vicinity of the DE are considered potential breeding habitat for Carnaby's and FRTBC, given the presence of trees with potentially suitable hollows for nesting and adjacent foraging habitat. It was considered that Baudin's Black Cockatoo would not breed in the area as most breeding grounds are located 200 km south of the DE at Lowden. A small number of Baudin's Cockatoos are also known to breed approximately 35 km to the south-east at the Wungong catchment, (T. Kirkby, pers. comm.).

Table 10 Potential Black Cockatoo breeding trees within the DE

Black Cockatoo Breeding Tree species	Trees with suitable DBH	Trees containing hollows	Number of hollows	Hollows potentially suitable for Black Cockatoos
<i>Corymbia calophylla</i> (Marri)	54	0	0	Nil
<i>Eucalyptus gomphocephala</i> (Tuart)	1	0	0	Nil
<i>Eucalyptus marginata</i> (Jarrah)	51	2	1 hollow (1 trees), 3 hollows (1 tree)	Nil
<i>Eucalyptus rudis</i> (Flooded Gum)	56	1	1 hollow (1 tree)	Nil
Total	162	3	5	Nil

Foraging habitat

A total of 36.54 ha of potential Black Cockatoo foraging habitat is present within the DE (Figure 11). Of this, 33.48 ha is high quality foraging habitat with habitat quality score of 6 for Carnaby's and FRT Black Cockatoos and a score of 3 for Baudin's Black Cockatoo. The remaining 3.06 ha, which includes planted and remnant native vegetation, is negligible to low quality. Biota (2021) reported that habitat types in which higher quality foraging habitat was recorded include *Banksia* woodland with scattered *Eucalyptus*/Marri, *Eucalyptus*/Marri in road reserve, and Fabaceous heathland as shown in Figure 11. The remaining area was noted to be suitable for occasional foraging by Black Cockatoos and includes Flooded gum over grasslands and wetlands/river habitat types.

The DE is dominated by key foraging species including Marri, Jarrah, *Banksia attenuata*, *Banksia menziesii* and *Xanthorrhoea preissii*. Flooded Gum, considered to be a low value foraging species, occurs within the Helena River flood plain.

The quality of foraging habitat for each Black Cockatoo was determined using DCCEEWS HQS tool resulting in a habitat quality score of 6 for Carnaby's and FRT Cockatoos and 3 for Baudin's Cockatoo. The site, therefore, provides high quality foraging value for Carnaby's and FRT Black Cockatoos but provides a lower foraging value for Baudin's Black Cockatoo.

Roosting habitat

DSEWPaC (2012a) defines roosting habitat as a suitable tree usually the tallest or a group of trees (native or introduced) that is usually located close to an important water source, and within an area of quality foraging habitat within the range of applicable species. Any areas with tall trees, particularly Eucalypts, pines and in association with water bodies, may provide suitable roost sites for Black Cockatoos.

No evidence of roosting was recorded within the DE. However, the Flooded gums present along the banks of the Helena River may be considered potentially suitable roosting habitat, given their tall heights and proximity to permanent water (Biota, 2021). Given the presence of roost sites outside of the DE as shown in Figure 12, the quality of the potentially suitable roosting habitat within DE is considered low.

5.4.1.4 *Local and regional context*

There are known roosting sites for all three species of Black Cockatoos within 5 km of the study area (Biota, 2021; Murdoch University, 2022; Peck et al., 2019; DBCA, 2018a).

The closest known Black Cockatoo breeding site is a FRTBC breeding site located 5 - 7 km to the south-east in the Kalamunda National Park (T. Kirkby, pers. comm.). The exact location is not known, however given the distance from the project it is likely in the western section of the park. Table 11 shows potential FRTBC foraging habitat within 6 and 12 km of the estimated breeding site. These habitat calculations have been based on suitable vegetation complexes (Swan Coastal Plain and South-west Forest), clipped to DPIRD (2020) remnant native vegetation dataset. There is 27,920 ha of potential FRTBC foraging habitat within 12 km of the breeding site, of which approximately 60% is protected within DBCA reserves as shown in Figure 13.

Table 11 Potential FRTBC within 6 and 12 km of the estimated breeding site (Kalamunda National Park)

Potential FRTBC foraging resources	Within 6 km	Within 12 km
Remnant native vegetation	6,943.4 ha	27,920.4 ha
DBCA reserves	3,031.3 ha	16,641.2 ha
Kalamunda National Park	529.6 ha	529.6 ha

The DE is also within the known breeding range of Carnaby's Cockatoo. Mapping by DBCA in 2018 shows one confirmed Carnaby's Black Cockatoo breeding site approximately 12 km east-northeast of the DE. The next closest one is approximately 15 km to the southeast of the DE at Canning National Park (DBCA, 2018b).

It was considered that Baudin's Black Cockatoo would not breed in the area as the closest breeding record for the species is approximately 35 km to the south-east at the Wungong catchment, where the species has been observed breeding in low numbers (T. Kirkby, pers. comm.).

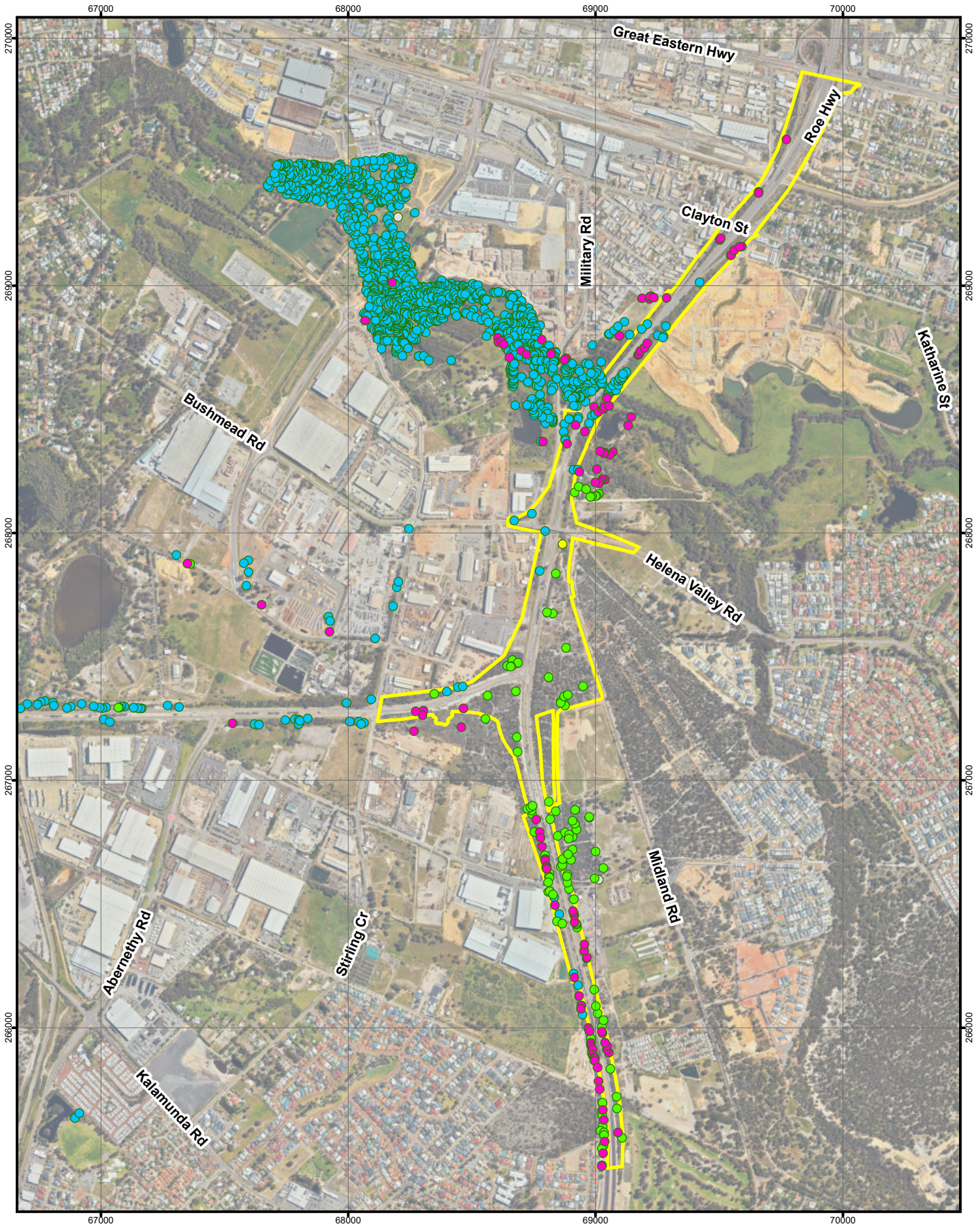
Approximately 16,051 ha of Carnaby's Black Cockatoo foraging habitat remains within 12 km of the Proposed Action, and there is approximately 3,773 ha of suitable Carnaby's Black Cockatoo foraging habitat within 6 km. These habitat calculations have been based on the latest DIPRD (2020) native vegetation extent dataset, clipped to the publicly available Carnaby's Cockatoo datasets (DBCA, 2018c;2018d). Approximately 44% of foraging habitat within 6 km of the Proposed Action is currently within DBCA managed land. This habitat is afforded a higher level of protection and it can be reasonably concluded that under conservation management, it is likely to represent a more intact and higher quality habitat value.

5.4.1.5 *Adequacy of surveys undertaken*


The assessment carried out by Biota provides comprehensive information on significant flora and fauna in the DE and surrounds. As per the EPA's Technical Guidance for fauna surveys for EIA (EPA, 2016b), potential constraints and consequent limitations of the biological survey and targeted Black Cockatoo habitat assessment are summarised in the biological survey (Appendix A). No significant limitations to the survey were identified by Biota.

The survey area was accessed incrementally due to delays in accessing certain private properties. These restrictions meant that the surveys were conducted over multiple events in different seasons, rather than consecutive field days. Access restrictions within the survey area were considered to be a limitation that impacted on survey timing, however all areas were ultimately accessed.

Access restrictions meant that one potential Black Cockatoo breeding hollow was examined outside of the recommended window, in May 2020 (the hollow was found to be unsuitable).









PROJECT ID 60657311
 CREATED BY LEUJ
 APPROVED BY SHAWJ
 LAST MODIFIED 06 APR 2022



Datum: GDA 1994 Perth Coastal Grid 1994
 1:20,000
 0 100 200 300 400 metres
 (when printed at A4)

Data sources: Main Roads WA
 Biota Environmental Sciences (2021). Great Eastern Highway Bypass Interchanges (Roe Highway and Abernethy Road) Biological Survey. Unpublished report prepared for Main Roads Western Australia.
 Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021), Geoscience Australia, Sitewepno

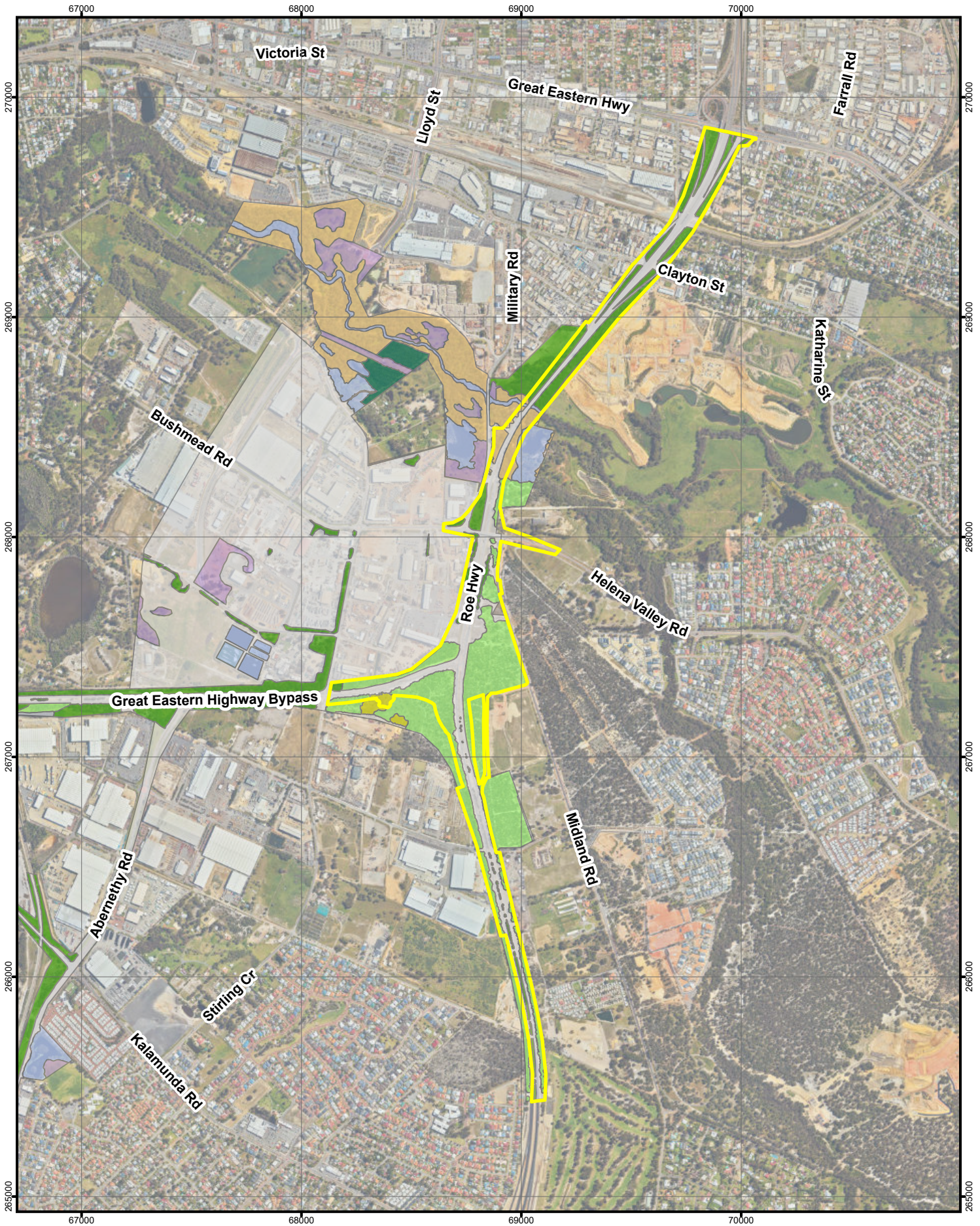
LEGEND

 Development Envelope
 Potential Future Black Cockatoo Habitat
 *Corymbia calophylla*
 *Eucalyptus gomphocephala*
 *Eucalyptus marginata*
 *Eucalyptus rudis*
 Indeterminate

Black Cockatoo Breeding Habitat

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS
 INTERCHANGE PROJECT
 GREAT EASTERN HIGHWAY BYPASS
 INTERCHANGES EPBC 2020/8784
 PRELIMINARY DOCUMENTATION

Figure 10



PROJECT ID 60657311
 CREATED BY LEIJ
 APPROVED BY SHAWJ
 LAST MODIFIED 28 MAR 2022



Datum: GDA 1994 Perth Coastal Grid 1994
 1:22,500
 0 100 200 300 400 metres

Data sources: Main Roads WA
 Biota Environmental Sciences (2021), Great Eastern Highway Bypass Interchanges (Roe Highway and Abernethy Road) Biological Survey. Unpublished report prepared for Main Roads Western Australia.
 Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021), Geoscience Australia, Streetpro

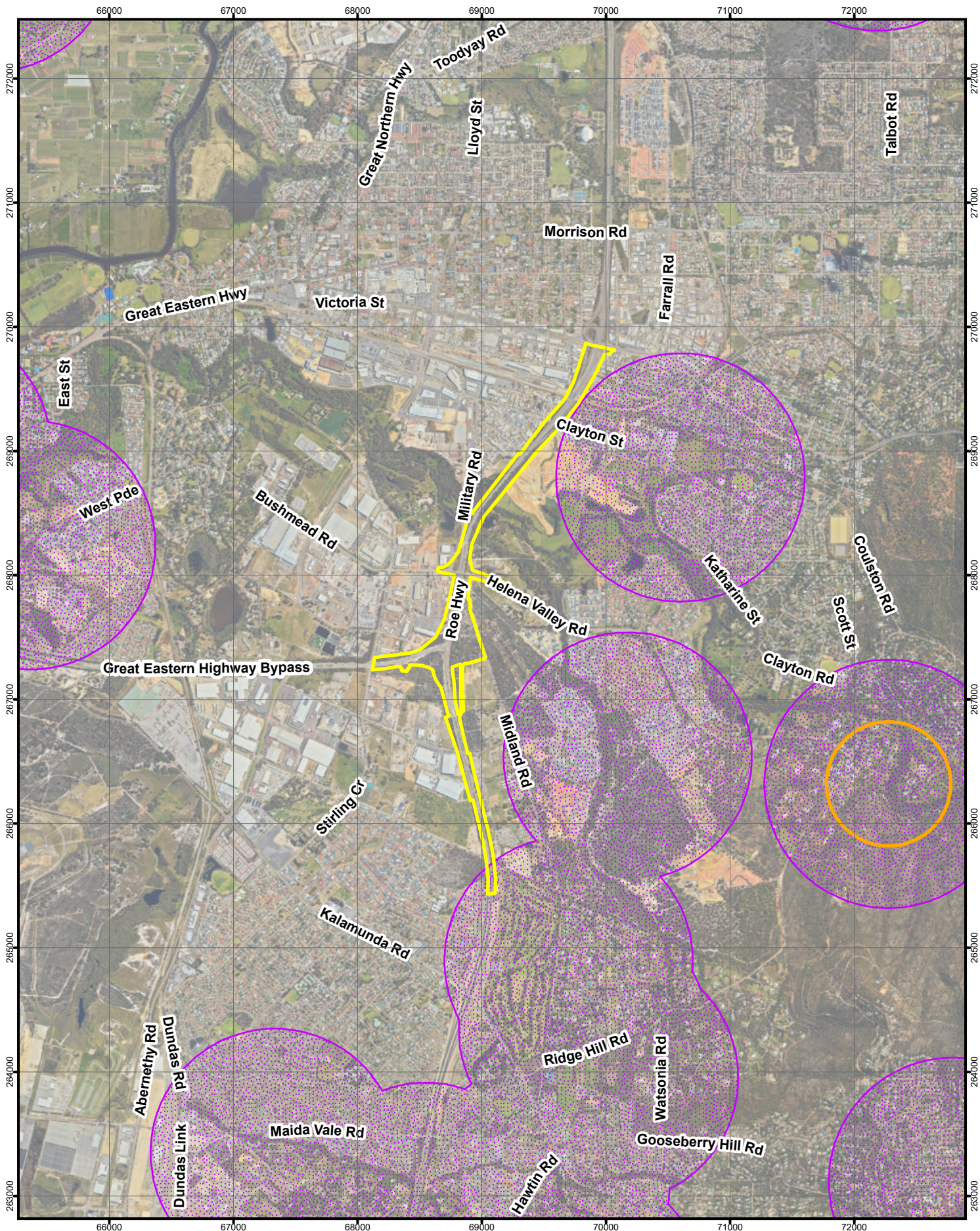
LEGEND

- █ Development Envelope
- Fauna Habitat**
- █ Banksia woodland with scattered Eucalyptus/Marri
- █ Eucalyptus/Marri in road reserve
- █ Fabaceous heathland
- █ Flooded Gum over grasslands
- █ Planted Eucalyptus/Marri
- █ Scattered Eucalyptus/Marri in cleared areas
- █ Wetlands/River
- █ Cleared area

Black Cockatoo Foraging Habitat

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGE PROJECT
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGES EPBC 2020/8784
 PRELIMINARY DOCUMENTATION

Figure
11



PROJECT ID 60657311
 CREATED BY LEUJ
 APPROVED BY SHAWJ
 LAST MODIFIED 28 MAR 2022

Datum: GDA 1994 Perth Coastal Grid 1994
 1:40,000
 0 200 400 600 800 metres
 (when printed at A4)
 Data sources: Main Roads WA

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021); Geoscience Australia; Streetpro

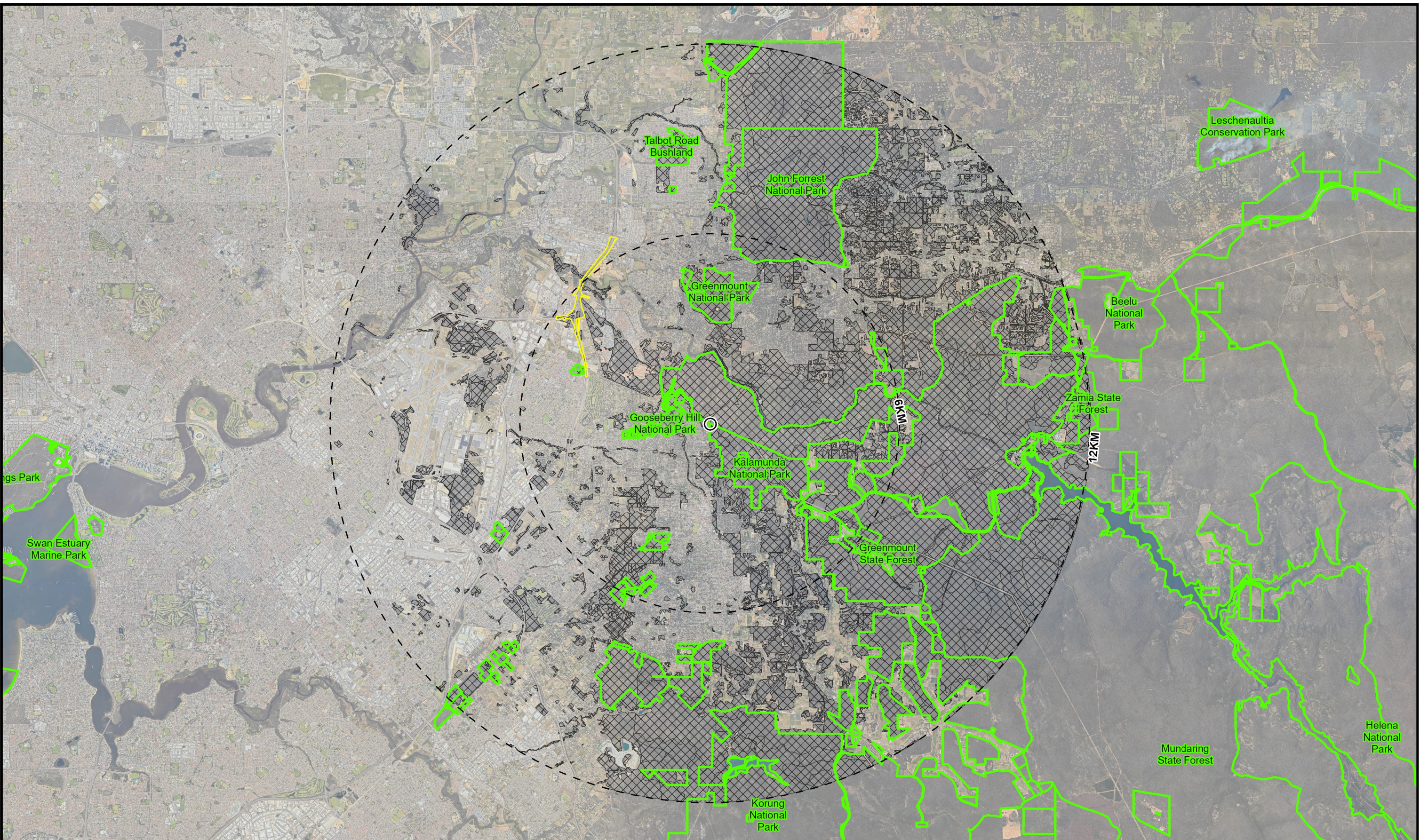
- LEGEND**
- Development Envelope
 - Carnaby's Black Cockatoo Roosting Sites (buffered) (DBCA-050)
 - Black Cockatoo Roosting Sites (buffered) (DBCA-064)

Known Black Cockatoo Roosting Sites

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGE PROJECT
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGES EPBC 2020/8784
 PRELIMINARY DOCUMENTATION

Figure 12

AECOM does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. AECOM shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.



PROJECT ID 60657311
 CREATED BY ROB.MCGREGOR
 APPROVED BY DEMELOS
 LAST MODIFIED 14 NOV 2023

DATUM GDA 1994 Perth Coastal Grid 1994

1:112,500
 (when printed at A3)

Data sources:
 Main Roads WA
 Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021); Geoscience Australia; Streetpro

LEGEND

- Estimated location for FRTBC nesting site
- Development Envelope
- - - Distance Buffer from FRTBC habitat in Kalamunda NP
- ▭ DBCA - Legislated Lands and Waters (DBCA-011)
- ▭ Potential FRTBC foraging habitat
- ⊗ Remnant Vegetation

Potential FRTBC foraging habitat within 12 km of estimated breeding site

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS
 INTERCHANGE PROJECT

Figure
13

5.4.2 Carter's Freshwater Mussel (Vulnerable)

5.4.2.1 Description of species

Carter's Freshwater Mussel (*Westralunio carteri*) (CFM) is the only freshwater mussel occurring in the south-west of Western Australia. CFM was listed as Vulnerable under the EPBC Act and BC Act (WA) in 2018. The listing was in recognition of the estimated contraction of the range of this species by almost 50% in the last 50 years, primarily because of the impacts of secondary salinisation on waterways within its former range.

CFM has brown to red and sometimes black shells. The species is mostly sessile but can move through sediments with a muscular foot (TSSC, 2018a).

The exact population size is unknown (TSSC, 2018a). However, where CFM is found, it can be locally abundant or patchily distributed within rivers, streams, reservoirs and lakes (TSSC, 2018a). The CFM is known to occur in greatest abundance in slower flowing habitats, with stable sediments and low salinity (Klunzinger et al., 2012). CFM is restricted to freshwater waterways within 50 km to 100 km of the coast from Moore River, north of Perth, to west of Esperance.

CFM is known to spawn in winter (June-August). CFM is a spermcaster, with males spawning in July/August. Larvae (glochidia) are retained by the female until October/November when they are released as larva. The lifecycle of CFM involves an obligate host where glochidia attach to a host fish whilst encased in a cyst for 3 - 4 weeks, before detaching to begin life as juveniles (TSSC, 2018a).

The TSSC Conservation Advice for CFM (TSSC, 2018a) list the following key threats:

- Salinity
- Water extraction, dehydration and heat stress
- Climate change – reduction in seasonal water availability
- Habitat loss
- Nutrient pollution
- Loss of suitable host species
- Cattle trampling
- Predation by pigs.

5.4.2.2 Habitat assessment and local context

Two publicly known populations of CFM occur within a 5 km buffer, and one population identified by the Department of Fisheries (DoF) was located immediately upstream (northeast) of the DE. The publicly known populations occur downstream in the Helena River, approximately 2.5 km (west) of the DE, and the other along Bennett Brook (another tributary to the Swan River), approximately 5 km northwest of the DE.

Main Roads commissioned two targeted surveys for CFM, undertaken by Biota (2021) and Biologic (2022). Biota (2021) surveyed the Helena River and did not record any CFM or suitable habitat. The Helena River survey area was described as degraded and turbid and, therefore, unlikely to provide suitable habitat for the species.

The Biologic (2022) survey covered 4.36 ha, which included a 500 m section of the Helena River (upstream and downstream of the DE) and two permanent wetlands located east and west of Roe Highway. The wetlands were designated as Wetland East and Wetland West for the purposes of habitat assessment. Biologic (2022) confirmed no CFM individuals occur within the Helena River survey area, with the habitat in the river considered unsuitable as it does not hold permanent water. This assessment is supported by the high coverage of terrestrial grasses across the riverbed, and there was a lack of native sedges such as *Baumea articulata*. Biologic's targeted CFM survey report is provided as **Appendix B**.

The Wetland West was assessed as having 1.34 ha suitable habitat. No suitable host species were observed in the wetland, which are necessary for the lifecycle of CFM. Biologic (2022) recorded two live CFM and three dead specimens on the northeast portion of the wetland. The wetland is approximately 75 m from the DE, west of Military Road and Roe Highway. No impacts to this wetland are anticipated.

Biologic (2022) assessed the majority of Wetland East (1.17 ha) as having suitable CFM habitat, except for the western portion. The presence of suitable host species (native and introduced fish) was also observed within the wetland. Biologic (2022) recorded 46 live CFM in Wetland East, with the highest density at the wetland's northern end. The DE intersects the western edge of Wetland East, described as unsuitable habitat for CFM due to being covered in a soft/anoxic layer. No suitable habitat was recorded inside the DE. Additionally, no CFM were recorded inside the DE, with the nearest record approximately 35 m east.

Biota (2021) and Biologic (2022) did not record any CFM or suitable habitat inside the DE. The habitat inside the DE was described as degraded (weed-choked), turbid, covered in a soft, anoxic layer or comprised bedrock substrate and highly unlikely habitat for CFM reference sites with recent records of the mussel have clear water with native riparian vegetation (Biota, 2021).

The Proposed Action will result in clearing the western portion of Wetland East, which includes 0.05 ha of unsuitable CFM habitat mapped by Biologic (2022). Biota (2021) mapped this as native vegetation in a Degraded condition. Main Roads will implement appropriate measures during construction to mitigate any impacts on CFM, including clearing buffers, implementation of a sediment control plan and the temporary or permanent relocation of CFM individuals (relocation within Wetland East or elsewhere).

Construction activities have been planned to avoid any impact on the CFM. Due to the degradation and turbidity of Helena Riverbed within the DE, it is unlikely to provide optimal habitat for CFM. Based on this and that no CFM was recorded within the DE, the species is considered highly unlikely to occur within the DE. The Helena River will not be disturbed for the construction or banks operation of the Proposed Action and will not cause any impacts on CFM or habitat fragmentation.

5.4.2.3 Adequacy of survey undertaken

The targeted CFM surveys sufficiently covered the extent of potentially suitable habitat within DE. Both surveys were completed successfully without any major limitations (Biota, 2021; Biologic, 2022).

5.5 Threatened Flora

5.5.1 Conospermum undulatum (Vulnerable)

5.5.1.1 Description

Conospermum undulatum (Waxy-leaved Smokebush) is listed as both Vulnerable under the EPBC Act and Threatened under the BC Act. *C. undulatum* is an erect shrub to 1.5 m tall with distinctive fibrous, longitudinally fissured stems and hairless leaves to 12 cm long and 3.8 cm wide. Leaves taper towards the base and have three distinct, parallel veins and characteristic wavy margins. The woolly flowers have long, white hairs, and are produced in inflorescences held well above the leaves. The fruit are covered with tan-orange hairs. The species is a long-lived shrub that resprouts from rootstock following disturbance such as fire (DEC, 2009).

C. undulatum occurs on sand and sandy clay soils, often over laterite, on flat or gently sloping sites between the Swan and Canning Rivers. A few records are from slightly swampy habitat (DEC, 2009). Species associated with *C. undulatum* include *Banksia menziesii*, *B. attenuata*, *B. grandis*, *Eucalyptus marginata*, *Corymbia calophylla*, *Allocasuarina fraseriana*, *Xanthorrhoea preissii*, *X. gracilis*, *Isopogon drummondii*, *Hakea conchifolia*, *H. lissocarpa*, *Dryandra lindleyana*, *Lambertia multiflora* var. *darlingensis*, *Hibbertia hypericoides*, *Adenanthos cygnorum*, *Anigozanthos manglesii* and *Stirlingia latifolia*. Habitat that is critical to the survival of this species includes the area of occupancy of important populations, as well as areas of similar habitat surrounding important populations, as these areas provide potential habitat for natural range extension (DEC, 2009).

C. undulatum is recorded from 25 populations comprising 83 subpopulations with an estimated total known population of 11,400 individuals and a local population of 391 individuals. Twenty (20) populations currently contain extant plants. This species is known from the Shires of Kalamunda and Gosnells in the Department of Environment and Conservation's (DEC's) Swan Coastal and Perth Hills Districts (DEC, 2009). The species is geographically restricted due to a loss of suitable habitat and is only found in fragmented remnant bushland in an area of approximately 72 km², including the foothills of the Darling Scarp (DEC 2009).

5.5.1.2 Assessment of habitat and presence of species

The Biota (2021) survey recorded three individuals of *Conospermum undulatum* within vegetation type P7 Jarrah *lissocarpa* and *Banksia* over *Xanthorrhoea* with Sedges. The individuals are known to exist in two previously known locations. Two *C. undulatum* plants were recorded from quadrat GBQ17, which likely forms part of Population 2 within Hawkesvale Reserve (Bush Forever Site 122). A further one individual was recorded through the targeted survey adjacent to an existing record, representing Population 23. The Biota (2021) records were made within vegetation type P7 Jarrah and *Banksia* over *Xanthorrhoea* with Sedges. Only one individual is located within the DE. The *C.undulatum* survey report is provided as **Appendix C**.

The DE is located towards the northern end of the known geographical range of the species and comprises a total of 2.62 ha of suitable habitat for the species (DAWE, 2021). The presence of the *C. undulatum* individuals are mapped at the southern end of the DE on either side of Roe Highway south of Adelaide Street as shown on Figure 14.

5.5.1.3 Local context

There are 391 individuals of *C. undulatum* known from the local area, including three individuals recorded by Biota (2021), three individuals recorded by Main Roads (2020), and 385 recorded by DBCA at Hawkesvale Reserve. The DE was refined post-referral to avoid two individuals recorded by Biota (2021), leaving only one individual within the DE. All the individuals in the local area have been attributed to two known populations of the species, Populations 23 (within the DE, east of Roe Hwy) and Population 2 (outside the DE, west of Roe Hwy and within Hawkesvale Reserve). Historic records also show that an additional population, Population 21, was previously recorded within the DE by DBCA in 2001. DBCA records showed that Population 21 contained only one individual, which was recorded over 20 years ago. Given the age of the record and that the individual plant was not relocated (Biota, 2021) Population 21 is considered to be extinct.

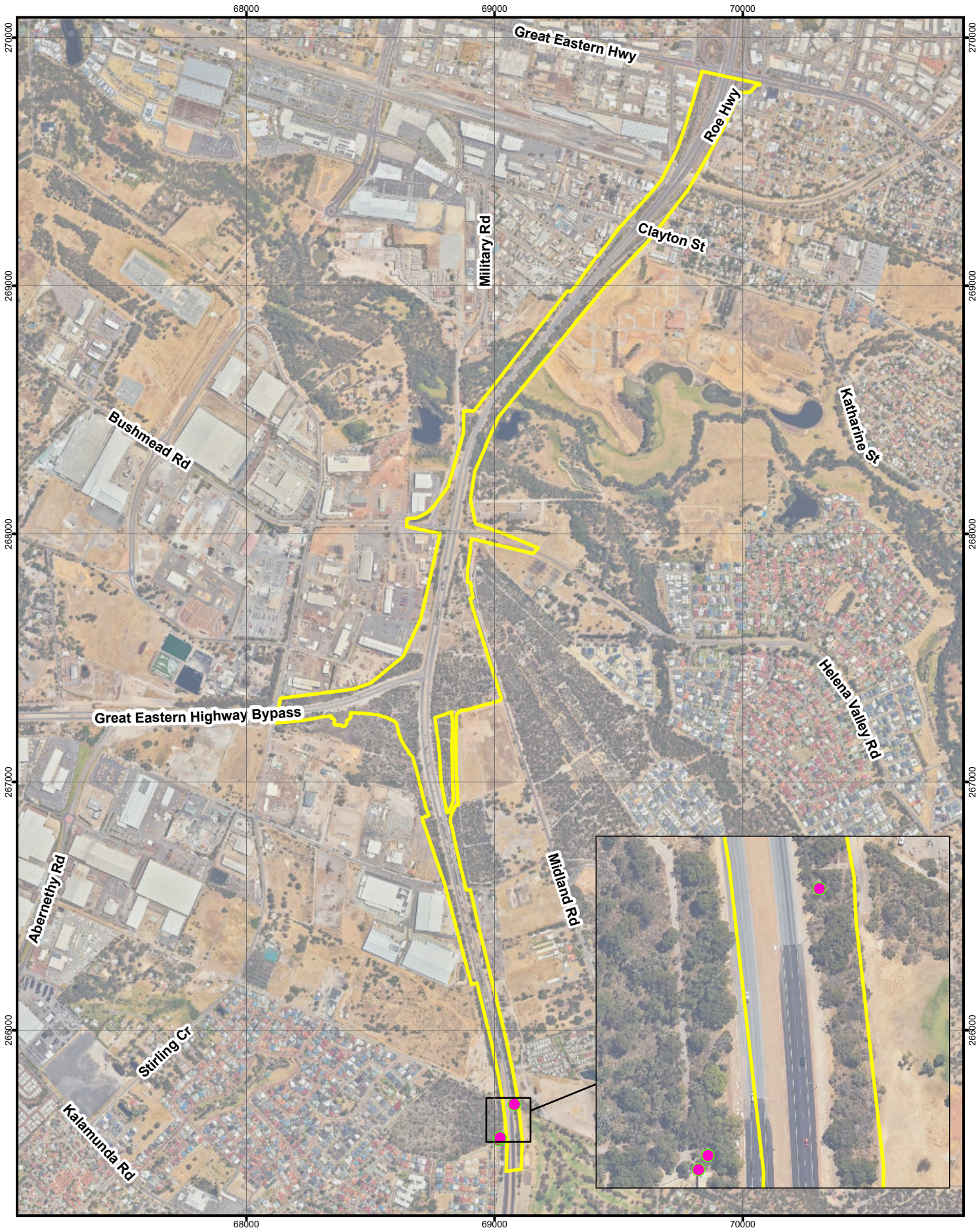
Historic records show population 23 comprised three sub-populations 23a, 23b and 23c. During the biological survey conducted by Biota (2021), areas associated with the historic records were extensively searched and it was confirmed that sub-population 23a no longer exists. This area has been extensively cleared. Prior to being surveyed by Biota (2021) sub-populations 23b and 23c were last surveyed in 2009 and only three and two plants were recorded, respectively. No monitoring of these populations has been conducted for the 13 years since.

Biota conducted an exhaustive search of the area and is confident that the site does not contain any individuals of this species. It is therefore reasonable to conclude these five plants of subpopulations 23b and 23c no longer exist, and the individual recorded by Biota (2021) is the only extant individual in the DE. Based on its location, this individual is likely to form part of sub-population 23b.

Further east, outside the DE and the Biota (2021) survey area, Main Roads recorded three additional individuals in 2020 and records were submitted to DBCA. Based on their location, these plants could be associated with either sub-population 23a or 23b.

5.5.1.4 Adequacy of surveys undertaken

Biota has carried out exhaustive searches for the threatened species in the DE. As per the EPA's Technical Guidance for flora surveys for EIA (EPA, 2016a), potential constraints and consequent limitations of this survey are summarised in the biological survey (Appendix A).



PROJECT ID 60657311
 CREATED BY FLETTN
 APPROVED BY SHAWJ
 LAST MODIFIED 22 JUN 2022



LEGEND
 Development Envelope
 Conospermum Undulatum

Conospermum undulatum locations within Development Envelope

MAIN ROADS WA
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGE PROJECT
 GREAT EASTERN HIGHWAY BYPASS INTERCHANGES EPBC 2020/8784
 PRELIMINARY DOCUMENTATION

Figure
14

Datum: GDA 1994 Perth Coastal Grid 1994
 1:20,000
 0 100 200 300 400 metres
 (when printed at A4)

Data sources: Main Roads WA
 Biota Environmental Sciences (2021). Great Eastern Highway Bypass Interchanges (Roe Highway and Abernethy Road) Biological Survey. Unpublished report prepared for Main Roads Western Australia.
 Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2021). Geoscience Australia, Shiremapro

6. Assessment of Impacts

6.1 Summary of Impacts

This section addresses the Proposed Action's potential direct and indirect impacts on MNES that are likely to be present within and adjacent to the DE. The potential impacts on each MNES are assessed in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DotE, 2013). Conservation advice, recovery plans and other relevant guidance were considered where applicable to specific MNES. A summary of the potential impacts of the Proposed Action is provided in Table 12. With appropriate management, mitigation and monitoring measures (see Section 7), significant residual impacts requiring an offset are expected to be limited to the direct impacts on BWSCP TEC and Black Cockatoos.

Table 12 Summary of impacts

MNES	Direct Impact	Indirect Impact
Banksia Woodland TEC	Clearing of up to 14.94 ha of BWSCP TEC	Both TECs, Black Cockatoos and <i>C. undulatum</i> could be subject to potential indirect impacts on vegetation adjacent to DE including:
Shrublands and Woodlands of the Eastern SCP TEC	No direct impact	<ul style="list-style-type: none"> • Introduction and/or spread of weeds • Introduction and/or spread of <i>Phytophthora cinnamomi</i> dieback
Black Cockatoo Species	Loss of Black Cockatoo habitat including: <ul style="list-style-type: none"> • Clearing of up to 162 suitable DBH trees, none of which contain hollows suitable for Black Cockatoo nesting • Clearing of up to 33.48 ha of high-quality foraging habitat for Carnaby's and FRT Black Cockatoos and low-quality foraging habitat for Baudin's Cockatoo • No loss of known roosting habitat 	<ul style="list-style-type: none"> • Increased risk of fire • Increased risk from dust generation Black Cockatoos could also be subject to: • Increased risk of vehicle strike <p>However, subject to implementation of management and mitigation measures detailed in Section 7, the residual indirect impacts on these MNES are expected to be negligible in the local context.</p>
Conospermum undulatum	Loss of one individual of <i>Conospermum undulatum</i> and up to 2.62 ha of suitable habitat	
Carter's Freshwater Mussel	No direct impact	Potential indirect impacts outside the DE associated with: <ul style="list-style-type: none"> • Reduced water quality downstream of the Helena River or within Wetland East due to construction works • Alteration of hydrological regimes resulting from bridge and road construction • Reduced connectivity between upstream and downstream populations. <p>However, subject to implementation of management and mitigation measures detailed in Section 7, the residual indirect impacts on CFM are expected to be negligible in the local context.</p>

The above estimates direct impacts on MNES values within the 68.07 ha DE. Construction activities will be planned to reduce clearing further where practicable during actual construction.

The indirect impacts identified in Table 12 above are described in more detail in the section below.

6.2 Indirect Impacts

6.2.1 Introduction and/or spread of weeds

The Proposed Action has potential to result in the introduction and/or spread of weeds through activities such as clearing and earthworks and the increased movement of vehicles or earth-moving machinery.

As described in Section 4.7.4, Biota (2021) recorded 32 introduced taxa within the DE. Of these, six are listed as Declared Pests under the BAM Act, WA and two are also WoNS. The high number of introduced species and significant weeds is a reflection of the highly modified urban setting of the DE and surrounds. The Proposed Action may result in the spread of Declared Pests and WoNS from the DE to adjacent, potentially un-infested native vegetation via earthworks and clearing activities that spread seeds and weeds, and wind-blown spread from weeds already established in the DE.

Weeds have potential to reduce the condition of the vegetation, displace native flora species and modify fauna and flora habitat characteristics. Therefore, introduction and/or spread of weeds has potential to indirectly impact the TECs, Black Cockatoo habitat and *Conospermum undulatum*.

Access controls, weed treatment, hygiene and monitoring will be implemented during and after construction to prevent the introduction and spread of weeds within the DE and to adjacent vegetation resulting from the Proposed Action.

The Proposed Action will incorporate landscaping/revegetation with native species on locally harvested topsoil and weed control will be conducted as part of routine road maintenance. This will reduce the potential spread of weeds from the DE into the surrounding remnant vegetation. Topsoil containing Declared Pests or WoNS will not be reused in the revegetation and landscaping of the Project but will be buried at least 300 mm below surface or disposed offsite (licensed landfill).

The Proposed Action is not expected to spread seeds and weeds in stormwater runoff, as stormwater will be captured and infiltrated within basin/swales in the road reserve. Weeds may become established in the infiltration basins/swales, which have the potential to facilitate the spread via wind-blown seeds to adjacent un-infested native vegetation. Ongoing weed management will occur in drainage areas adjacent to un-infested native vegetation as part of standard road maintenance.

It is noted that the project area and surrounds are located in a highly modified urban setting that is already subject to the risk of weed introduction/spread from a number of surrounding land uses (e.g. garden escapees).

Overall, based on the above and subject to management, mitigation and monitoring measures detailed in Section 7, the Proposed Action is not expected to result in the introduction or spread of weeds that could result in significant indirect impacts to BWSCP TEC, *Shrublands and Woodlands of the Eastern Swan Coastal Plain TEC*, Black Cockatoos, CFM or *C. undulatum*.

6.2.2 Introduction and/or spread of *Phytophthora cinnamomi* Dieback

Phytophthora dieback is caused by the plant pathogen, *Phytophthora cinnamomi*, which kills susceptible plant species including Banksia and Jarrah. Infestation of dieback would result in significant changes in vegetation condition and structure, species composition, food resources and availability of fauna habitat. The Proposed Action could potentially lead to spread of dieback through the movement of vehicles and equipment.

Glevan Consulting (2020) conducted a *Phytophthora* Dieback Occurrence Assessment of the DE in August 2020. The assessment identified 13.2 ha of dieback infested area in the survey area, however, only 6.50 ha is within the DE. Areas adjacent to Roe Highway south of Adelaide Street and patch near the intersection of GEHB with Roe Highway were mapped as infested, along with the fringes of bushland between Roe Highway and Midland Road.

The majority of the survey area and DE was mapped as 'excluded', meaning dieback occurrence could not be determined due to the level of previous disturbance (e.g. already cleared or lacking indicator species) (Glevan 2020). This reflects the urban nature of the area.

Table 13 Dieback status

Dieback Status	Extent within survey area (ha)	Extent within DE (ha)
Infested	13.20	6.50
Uninfested Protectable	5.72	4.86
Uninfested Unprotectable	4.15	2.25
Excluded	135	52.44
TUI	0.60	0.58
Total Mapped	158	66.64

A total of 4.11 ha of the BWSCP TEC was mapped as 'infested' within the DE. There is 4.86 ha of 'uninfested protectable' vegetation, including BWSCP TEC, currently within the DE, however, as the eventual clearing footprint is envisaged to be smaller than the DE, some uninfested habitat may be retained.

Shrublands and Woodlands of the Eastern Swan Coastal Plain TEC within the dieback assessment area was mapped as 'infested' and areas adjacent to this TEC (within the DE) were also mapped as 'infested'. Therefore, the Proposed Action does not pose a risk of introducing dieback to this TEC (as it already occurs there).

Most of the Black Cockatoo habitat both in and out of the DE is currently either 'infested' or 'excluded' and all of the 'uninfested protectable' habitat is located within the DE (Glevan, 2020). Assuming the eventual clearing footprint will be smaller than the DE, some uninfested habitat may be retained.

The areas within the DE where *Conospermum undulatum* was recorded are mapped as 'excluded'. The dieback status of the known important populations of *C. undulatum* adjacent to the DE is not known.

The Proposed Action will incorporate dieback hygiene during construction to protect vegetation adjacent to clearing areas that may be uninfested and protectable, including uninfested patches in close proximity to infested patches. The Proposed Action will establish protectable areas as appropriate along sections of the DE boundary during construction and incorporate access controls, equipment and vehicle washing/segregation, soil movement and monitoring. In particular, soil harvested from infested or unidentified areas will not be reused in protectable areas and equipment and vehicles working in infested areas will not access protectable areas unless cleaned and inspected. Soil harvested from infested areas will only be reused in infested areas in accordance with DBCA guidance or disposed of at a licensed landfill.

The Proposed Action is not expected to spread *Phytophthora* dieback through sediment in stormwater runoff as stormwater will be captured and infiltrated within basins/swales in the road reserve.

It is noted that the areas mapped for dieback outside the current DE are already either 'infested' or 'excluded' (Glevan, 2020) and that there are several existing potential vectors for dieback spread in the area (e.g. movement of animals, people and vehicles). Therefore, the potential for introduction and spread of dieback in the area is not limited to the Proposed Action.

Overall, based on the above and subject to management, mitigation and monitoring measures detailed in Section 7, the Proposed Action is not expected to result in the introduction or spread of dieback that could result in significant impacts to BWSCP TEC, *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC, Black Cockatoos or *C. undulatum*.

6.2.3 Increased risk of fire

Fire may have an indirect impact on the condition of native vegetation comprising BWSCP TEC, *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC, Black Cockatoo habitat, CFM habitat and *C. undulatum* individuals or habitat. Fire may alter the vegetation structure via mortality of native flora and the spread of introduced flora/weeds. The most common risk of a fire ignition source is hot works such as grinding or welding of steel during construction, or vehicles driving over grassy vegetation, but the risk is considered low and will be managed by standard industry management measures. The risk of fire during construction is a short-term risk and no long-term changes to the existing fire regimes in the area are expected.

Based on the above, the Proposed Action is not expected to result in the increased risk of fire that could result in significant impacts to BWSCP TEC, *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC, Black Cockatoos, CFM habitat or *C. undulatum*.

6.2.4 Increased risk of vehicle strike

The existing Roe Highway and GEHB pose a current risk of vehicle strike. The Proposed Action will facilitate an increase in traffic and vehicle movements in the local area and may therefore increase the likelihood of vehicle strike on Black Cockatoos. Johnstone and Kirby (2009) notes Carnaby's Cockatoo are most commonly killed by vehicle strikes whilst drinking from puddles along roads or flying between roadsides that contain foraging trees. For FRTBC, there is an increased incidence and risk of vehicle strike due to their expansion onto the SCP, especially around the Perth area (Johnstone et al., 2017).

To minimise the likelihood of vehicle strikes to Black Cockatoos, no landscaping or revegetating of the DE with flora species that are considered suitable Black Cockatoo foraging species will occur within 10 m of the edge of the road. The risk of vehicle strike cannot, however, be eliminated completely.

6.2.5 Changes in hydrology

The Proposed Action on is expected to result in nil to very minor changes in hydrology due to following:

- The clearing of vegetation is largely linear in nature along an existing road, minimising changes in drainage and recharge at any point location.
- The hydrology of the DE will be maintained in its current regime with appropriate drainage design. The Proposed Action will incorporate infiltration basins and/or swales to capture, treat and infiltrate surface water runoff. The infiltration of surface water runoff within the DE will maintain the existing hydrological regime of the local area that has been previously modified by infrastructure, industrial, residential and former rural land uses.
- The construction and operation of the proposed bridge at Roe Highway over the Helena River will maintain natural flows and associated connectivity.
- The Proposed Action may require dewatering for the construction of bridge piers, abutment footings and possibly for drainage structures. Depth to groundwater is approximately 19 m in the vicinity of the GEHB Interchange and 8 m at the bridge abutments adjacent to the Helena River. Excavations are unlikely to extend to this depth below ground level, however if any excavation below the water table is required, it will be for short duration events, and any resulting cone of depression will recharge as rapidly as it formed once dewatering stops.

Based on the above, no hydrology related impacts on any MNES are expected.

6.2.6 Reduced water quality

The Proposed Action involves vegetation clearing and earthworks in the Helena River floodplain and these activities have potential to result in sedimentation of the waterways and associated reductions in water quality, particularly increased turbidity and reduced dissolved oxygen. Further, the Proposed Action temporarily increases the risk of water contamination through potential hydrocarbon spills and leaks during construction.

Reduced water quality has potential to impact on CFM populations, habitat available for them and potential host fish species and their habitat downstream of the DE.

In order to maintain existing water quality, the Proposed Action will implement management measures for erosion, sedimentation and drainage control, as outlined in the Erosion and Sediment Control Plan (GCA, 2022). These will include installing erosion and sediment control structures/devices (e.g. silt fences), ensuring that no refuelling or servicing of vehicles/machinery occurs in the vicinity of the river or wetlands, and ensuring appropriate spill response equipment is available. Also, surface runoff within the DE will drain into infiltration basins and/or swales constructed within the DE. The infiltration basins/swales will be designed to capture and infiltrate runoff from a 1 in 100-year Average Recurrence Interval (ARI) rainfall event, to prevent stormwater runoff into adjacent areas of native vegetation or directly into Helena River.

It is noted that the area surrounding the DE in the vicinity of Helena River has been significantly disturbed in the past as part of urban development and there are a number of existing activities that have potential to impact on water quality such as vegetation clearing, grazing, industrial areas, and roads.

Overall, based on the above and subject to implementation of measures detailed in Section 7, the residual indirect impacts on CFM are anticipated to be negligible in the local context.

6.2.7 Dust generation

The Proposed Action will involve vegetation clearing and earthworks, which will potentially generate dust, however, it will not have significant impact on the vegetation. The impact on vegetation from dust would be mainly due to deposition of dust on the foliage, during the dry weather, that would disrupt photosynthesis and hence deteriorate foraging habitat for the Black Cockatoo species.

In order to suppress dust generation, Main Roads will implement standard management measures such as water sprinkling on the exposed grounds and restricting vehicle access and controlling speed. Implementation of these management measures will minimize the impacts on vegetation health of the TEC and foraging vegetation species of the three Black Cockatoos. Given the limited amount of dust from the Proposed Action and exposure of the ground being temporary, the impact on vegetation condition of the TEC and the foraging species is not envisaged to be significant.

6.3 Assessment of Impacts on MNES

This section provides an assessment of the significance of the impacts of the Proposed Action on specific protected matters, assessed against the Significant Impact Guidelines 1.1 (DotE, 2013).

6.3.1 Banksia Woodlands of the Swan Coastal Plain TEC (Endangered)

6.3.1.1 Overview of impacts

The Proposed Action will result in the following impacts to BWSCP TEC:

- Clearing of up to 14.94 ha
- Potential indirect impacts from the introduction or spread of weeds and *Phytophthora* dieback and increased incidence of fire.

6.3.1.2 Assessment against MNES Significant Impact Guidelines

Table 14 provides an assessment of the potential impact of the Proposed Action to the BWSCP TEC using the Critically Endangered and Endangered ecological communities significant impact criteria (DotE, 2013).

In summary, the clearing of up to 14.94 ha of BWSCP TEC as part of the Proposed Action is considered potentially significant mainly due to the reduction in the extent of the ecological community that is predominantly in very good condition and that represents habitat considered critical to the survival of the community. However, it is noted that BWSCP TEC extends an estimated 253,540.6 ha across the Perth IBRA Subregion and therefore the proposed clearing will reduce the extent of the TEC in the Perth IBRA subregion by only 0.006% (DBCA, 2021).

The residual indirect impacts on BWSCP TEC are considered negligible as detailed in Section 6.2.

Table 14 Assessment of the potential impacts of the Proposed Action to the *Banksia Woodlands of the Swan Coastal Plain* TEC

Significant Impact Criteria (DotE, 2013)	Assessment for BWSCP TEC
'reduce the extent of an ecological community'	<p>Significant</p> <p>The Proposed Action will result in the clearing of up to 14.94 ha of BWSCP TEC. The BWSCP TEC is predominately in a very good condition within the DE and the condition of surrounding TEC is generally in better condition than within the DE (see Table 9).</p> <p>The Proposed Action will impact Patches 1, 3, 4 and 5 of the TEC as shown in Figure 8. Up to 4.75 ha (53.25%) of Patch 1 will be removed by the Proposed Action. The remaining 4.17 ha of Patch 1 will still be considered a patch of BWSCP TEC due to its size and very good to excellent condition of vegetation retained.</p> <p>Up to 6.73 ha (52.25%) of Patch 3 will be removed by the Proposed Action. The remaining 6.15 ha of Patch 3 will also still be considered a patch of BWSCP TEC due to the very good condition of vegetation retained.</p> <p>All of Patches 4 and 5 will be removed through implementation of the Proposed Action. Both Patches are in long linear strips in the road reserve that have been subject to edge effects and their long-term survival even in the absence of the Proposed Action may be questionable.</p> <p>Patches 6 and 7 will not be cleared for the Proposed Action.</p>

Significant Impact Criteria (DotE, 2013)	Assessment for BWSCP TEC
	<p>The DE is bisected by a major arterial road that has historically disturbed the area resulting in edge effects to the existing TEC patches. The DE will not further disrupt linkages between adjacent green corridors in Hawkesvale Reserve and Bushmead bushland and the Helena River.</p> <p>The Proposed Action will reduce the area of occurrence of the TEC in the local area on the eastern Swan Coastal Plain. However, the BWSCP TEC extends an estimated 253,540.6 ha across the Perth IBRA Subregion and therefore the proposed clearing will reduce the extent of the TEC in the Perth IBRA subregion by only 0.006% (DBCA, 2021).</p>
<p>'fragment or increase fragmentation of an ecological community, for example by clearing for roads or transmission lines'</p>	<p>Not significant</p> <p>Two patches (Patch 4 and 5) of BWSCP TEC will have the full extent cleared. A further two patches (Patch 1 and 3) will be significantly cleared however, the remaining 4.17 ha and 6.15 ha, respectively, still meet the criteria to be considered BWSCP TEC given the condition of the vegetation and size of patches remaining.</p> <p>The existing road reserve already fragments native vegetation, and a large portion of the surrounding land has been developed for industrial and residential uses.</p> <p>While the Proposed Action will further increase the distance between already separated communities, the Proposed Action will not bisect any additional patches of BWSCP TEC to create two or more smaller patches that are still considered viable TEC.</p> <p>The proposed clearing is considered unlikely to result in fragmentation that would significantly impact the viability of remaining TEC.</p>
<p>'adversely affect habitat critical to the survival of an ecological community'</p>	<p>Potentially Significant</p> <p>The BWSCP TEC Conservation Advice defines all patches of TEC and a buffer of 20 – 50 m, as critical for the survival of the TEC (TSSC, 2016).</p> <p>The Proposed Action will directly impact up to 14.94 ha of BWSCP TEC patches. No buffers were able to be implemented for the Proposed Action due to being constrained within an existing corridor and surrounding land uses. The TEC that has been retained that surrounds the DE is generally in equal to or better condition compared to the vegetation within the DE.</p> <p>The BWSCP TEC extends an estimated 253,540.6 ha across the Perth IBRA Subregion. Of this, 57,054.9 ha (22.5%) of TEC occurs within reserves. Clearing of up to 14.94 ha of BWSCP TEC as a result of the Proposed Action represents a reduction of only 0.006% of the reported extent at the Perth IBRA Subregion scale.</p> <p>Locally, there is approximately 3,600 ha of remnant vegetation within 5 km of the DE that may contain the TEC, of which approximately 5% is protected.</p> <p>The Proposed Action will incorporate standard management measures to ensure that BWSCP TEC within the vicinity of the DE is not indirectly impacted by the implementation of the Project.</p>
<p>'modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns'</p>	<p>Not Significant</p> <p>The Proposed Action will not materially modify or destroy abiotic factors necessary for the survival of the BWSCP TEC, including hydrology, nutrients or soil resources.</p> <p>The Proposed Action will incorporate infiltration basins and/or swales to capture, treat and infiltrate surface water runoff. The Proposed Action will minimise runoff outside the DE that may impact adjacent TEC patches.</p> <p>The Proposed Action may require dewatering for the construction of bridge piers, abutment footings and possibly for drainage structures. Dewatering, if required, will be limited as the depth to groundwater is approximately 19 m in the vicinity of the GEHB intersection and 8 m in the vicinity of the Helena River. In the event of dewatering, the cone of depression will be limited due to the short term and temporary nature of dewatering. Dewatering, if</p>

Significant Impact Criteria (DotE, 2013)	Assessment for BWSCP TEC
	<p>required, will cause temporary and localised groundwater drawdown and is not expected to cause significant impacts to adjacent TEC patches.</p> <p>The clearing of vegetation within the DE is not expected to cause noticeable changes to hydrology in the local area. The infiltration of surface water runoff within the DE will maintain the existing hydrological regime of the local area that has been previously modified by infrastructure, industrial, residential and former rural land uses.</p> <p>The Proposed Action is not expected to result in a substantial change in nutrient cycles that could impact TEC patches surrounding the DE as only native fertiliser will be utilised for the establishment of native species in revegetation. There will be no other source for nutrients to potentially be introduced to the retained TEC surrounding the DE.</p>
<p>‘cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting’</p>	<p>Not Significant</p> <p>The Proposed Action will not cause a substantial change to the species composition of the BWSCP TEC. Weeds will be managed through standard routine road maintenance activities and planting of native vegetation within the road reserve will provide a buffer to adjacent TEC patches.</p> <p>The dieback status of BWSCP TEC patches proposed to be cleared is either infested or unprotectable. Standard Dieback hygiene measures will be implemented to ensure that Dieback does not spread as a result of implementation of the Proposed Action.</p> <p>Substantial changes in the species composition of the BWSCP TEC patches adjacent to the DE are not expected to result from implementation of the Proposed Action. Similarly, no decline or loss of functionally important species is expected to occur.</p>
<p>‘cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:</p> <ul style="list-style-type: none"> • assisting invasive species, that are harmful to the listed ecological community, to become established, or • causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community’ 	<p>Not Significant</p> <p>The Proposed Action is not expected to result in a substantial reduction in quality or integrity of TEC patches retained outside the DE. The Proposed Action involves clearing of 14.94 ha of TEC that is generally in a similar or poorer condition compared to the adjacent TEC.</p> <p>The Proposed Action is not expected to result in the introduction or spread of weeds that with significantly impact BWSCP TEC surrounding the DE. This is due to implementation of standard management measures including weed treatment and hygiene, and revegetation / landscaping with native species on locally harvested topsoil with restricted use of fertiliser. Ongoing road maintenance will be undertaken to prevent spread of weeds into adjacent TEC patches.</p>
<p>‘interfere with the recovery of an ecological community’</p>	<p>Not significant</p> <p>There is no recovery plan in place for the BWSCP TEC, however the conservation advice outlines conservation actions and priority research (TSSC, 2016).</p> <p>Planning and design of the Proposed Action will align with relevant protection and recovery measures in the conservation advice, including:</p> <ul style="list-style-type: none"> • Preventing impacts to native vegetation, hydrology and soil structure from construction. This will be through clearing controls, revegetation / landscaping with native species, stormwater drainage and topsoil management • Mapping of existing weed and <i>Phytophthora</i> infestations, pre-construction treatment of weeds and implementation of standard hygiene management measures • Establishing native vegetation using local native species within the road reserve where possible to provide a buffer to adjacent TEC patches <p>Given the planning, design, construction measures and implementation of standard management measures, the Proposed Action is not expected to interfere with the recovery of the BWSCP TEC.</p>

6.3.2 Shrublands and Woodlands of the Eastern Swan Coastal Plain TEC (Endangered)

6.3.2.1 Overview of impacts

The Proposed Action will result in the following impacts to *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC:

- No clearing of this TEC
- Potential indirect impacts from the introduction or spread of weeds and *Phytophthora* dieback and increased incidence of fire.

6.3.2.2 Assessment against MNES Significant Impact Guidelines

At the time of referral, the Proposed Action was predicted to impact 3.80 ha the *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC (SCP20c) (Endangered). Subsequently Biota (2021) refined mapping to 1.65 ha of the *Shrublands and Woodlands of the Eastern Swan Coastal Plain* (SCP20c) TEC within the survey area and inferred a further 1.72 ha potentially within the wider contextual area. The DE was subsequently amended to completely avoid this TEC as discussed in Section 3.6. No direct impact on the *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC is therefore expected as a result of implementation of the Proposed Action.

The residual indirect impacts on the *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC are considered negligible as detailed in Section 6.2.

Overall, based on the above the Proposed Action is not expected to have significant impacts (direct or indirect) on *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC. Therefore, no further assessment against the significant impact guidelines is considered necessary.

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

6.3.3.1 Overview of impacts

The Proposed Action will result in the following impacts to Black Cockatoos:

- Clearing of up to 162 suitable DBH trees for Black Cockatoos, none of which contain hollows suitable for Black Cockatoo nesting
- Clearing of up to 33.48 ha of high-quality (HQS 6) foraging habitat for Carnaby's and Forest Red-tailed Black Cockatoo and lower-quality (HQS 3) foraging habitat for Baudin's Cockatoo.
- Clearing of up 3.06 ha low to negligible quality foraging habitat for the Black Cockatoos.
- Potential indirect impacts from the introduction or spread of weeds and *Phytophthora* dieback, increased incidence of fire and increased vehicle strike.

6.3.3.2 Assessment against MNES Significant Impact Guideline

Table 15 provides an assessment of the potential impact of the Proposed Action on Carnaby's and Baudin's Black Cockatoos using the Critically Endangered and Endangered species significant impact criteria (DotE, 2013) and Table 16 provides an assessment of impact on FRTBC using the Vulnerable species significant impact criteria (DotE, 2013).

In summary, the clearing of up to 33.48 ha of high-quality foraging habitat for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo and lower quality foraging habitat for Baudin's Cockatoo is considered to have potentially significant impacts due to the reduction in the availability of potential foraging habitat by the Proposed Action. The high-quality foraging habitat is attributed to the presence of low to moderate vegetation condition along with its proximity to known foraging habitat and a nesting site located within 12 km. There, are also several known roosting sites for Carnaby's and Baudin's Cockatoos within 6 km. The clearing of up to 3.06 ha of low to negligible quality foraging habitat containing planted and remnant vegetation as part of the Proposed Action is not considered to have potentially significant impacts on these two Black Cockatoo species due the availability of higher quality foraging resources locally and regionally.

The clearing of up to 33.48 ha of high-quality foraging habitat for FRTBC as part of the Proposed Action is considered significant because the foraging habitat is located approximately 6 km from a known FRTBC nesting site and FRTBC roosting is known to occur within 6 km of the site. The clearing of up to 3.06 ha low to negligible quality foraging habitat for FRTBC as part of the Proposed Action is not considered to have potentially significant impacts on the Black Cockatoo species due the availability of higher quality foraging resources available locally and regionally.

The clearing of 162 suitable DBH trees is not considered significant for any of the three Black Cockatoo species as none of these DBH trees contain hollows suitable for Black Cockatoo nesting. Further, at least 1,430 suitable DBH trees are being retained in the immediate vicinity.

The residual indirect impacts on the three Black Cockatoos are considered negligible as detailed in Section 6.2.

Table 15 Assessment of the potential impacts of the Proposed Action to Carnaby's and Baudin's Black Cockatoos

Significant Impact Criteria (DotE, 2013)	Assessment for Black Cockatoo Species
<p>'lead to a long-term decrease in the size of a population'</p>	<p>Not Significant</p> <p>The Proposed Action is not expected to lead to a long term decreased in the size of Carnaby's and Baudin's Black Cockatoo populations as:</p> <ul style="list-style-type: none"> • It will not result in clearing of any hollows suitable for Black Cockatoo nesting. • While the proposal involves clearing of up to 162 suitable DBH trees, at least 1,460 suitable DBH trees remain in close vicinity to the DE in the wider survey area as recorded by Biota (2021). • It will not result in clearing of any known roosting trees. • Black Cockatoos are highly mobile species and are expected to forage outside the DE. Within 12 km of the Proposed Action, approximately 16,051 ha of foraging habitat remains and within 6 km there is approximately 3,773 ha of foraging habitat (DPIRD, 2020; DBCA, 2018c; 2018d) • The clearing of 33.48 ha of high-quality foraging habitat for Carnaby's Cockatoo and low-quality foraging habitat for Baudin's Cockatoo represents a reduction of 0.89% in Black Cockatoo foraging habitat within the 6 km local area and reduction of 0.21% in foraging habitat within 12 km local area. The small reduction in foraging habitat is unlikely to contribute to a long-term decrease in the population.
<p>'reduce the area of occupancy of the species'</p>	<p>Not Significant</p> <p>The Proposed Action is located within the mapped distribution of Carnaby's and Baudin's Black Cockatoos (DotEE, 2017b; DSEWPaC, 2012a), with the presence of Carnaby's Cockatoo confirmed in the field (Biota, 2021). No evidence of the presence of Baudin's Cockatoo was recorded within the Development Envelope or surrounds (Biota, 2021). The distribution for each of the species are slightly different. Baudin's Cockatoo occur predominately within the Jarrah Forest and Swan Coastal Plain zones, approximately from Northam and Muchea near Perth, and south to Albany. Carnaby's Cockatoo distribution extends into the Wheatbelt north to Kalbarri and east to Esperance.</p> <p>Given the available habitat within the broader area, the proposed clearing of 33.48 ha of foraging habitat and 162 suitable DBH trees is unlikely to significantly reduce the area of occupancy of the species.</p>
<p>'fragment an existing population into two or more'</p>	<p>Not Significant</p> <p>The Proposed Action is not expected to fragment populations of Black Cockatoo due to the following:</p> <ul style="list-style-type: none"> • Clearing will occur over linear patches adjacent to already cleared and disturbed areas along Roe Highway and Great Eastern Highway Bypass and will not create a gap of 4 km or more between habitat patches • Black Cockatoos are a highly mobile species and are expected to forage outside the DE. There is approximately 3,773 ha of foraging resources within 6 km and 16,051 ha within 12 km (DPIRD, 2020; DBCA, 2018c; 2018d). Black Cockatoos are not dependent on a particular patch of foraging habitat within the DE • The Proposed Action will not result in clearing of important roosting or breeding habitat nor does the DE lie adjacent to important roosting or breeding habitat.

Significant Impact Criteria (DotE, 2013)	Assessment for Black Cockatoo Species
'adversely affect habitat critical to the survival of a species'	<p>Potentially Significant</p> <p>Habitat critical to the survival of Carnaby's and Baudin's Black Cockatoos has been addressed in the Recovery Plan and Conservation Advice (DPaW, 2013; TSSC, 2018). The Proposed Action will not remove any known or potentially suitable nesting hollows for Black Cockatoos (Biota, 2021). The closest known Carnaby's breeding site is recorded to be just within 12 km of the DE (DBCA, 2018b). Baudin's Black cockatoo is considered unlikely to breed in the area, with the nearest breeding record approximately 35 km south-east of the DE. Foraging habitat within 6km of nesting sites is considered most important for nesting success, however, foraging habitat up to 12 km away has value (DPaW, 2013).</p> <p>There are no known roosting sites within the DE (Biota, 2021) however, multiple roosting sites for Carnaby's and Baudin's within a few kilometres of the DE (Biota, 2021) are recorded and therefore the foraging habitat available within the DE has value in supporting these roosting sites. The availability of water in Helena River also increases the value of the habitat for Black Cockatoos.</p> <p>There is approximately 3,773 ha of foraging habitat within 6 km and 16,051 ha within 12 km (DPIRD, 2020; DBCA, 2018c; 2018d). The clearing of 33.48 ha of foraging habitat represents a reduction of up to 0.89% and 0.21% in this extent.</p> <p>Based on the above, the proposed clearing of up to 33.48 ha of high-quality foraging habitat for Carnaby's Black Cockatoo and low-quality foraging habitat for Baudin's Black Cockatoo is considered potentially significant, however, it is a small decline of habitat critical to the survival of the species in the local area.</p>
'disrupt the breeding cycle of a population'	<p>Not Significant</p> <p>The Proposed Action is not expected to disrupt the breeding cycle of a population of Black Cockatoos as no known breeding of Black Cockatoos occurs in the DE or the vicinity. No known Black Cockatoo nesting hollows are known from within 6 km and no hollows suitable for Black Cockatoo nesting were recorded within the DE (Biota, 2021).</p>
'modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline'	<p>Not Significant</p> <p>The Proposed Action is not expected to impact the availability or quality of habitat to the extent that Black Cockatoos are likely to decline. The Proposed Action will result in the clearing of up to 33.48 ha of high quality Carnaby's Black Cockatoo and, low quality Baudin's Cockatoo foraging habitat and up to 162 suitable DBH trees (no suitable nesting hollows). This reduction in foraging and potential future breeding habitat for Black Cockatoo species may result in a minor residual impact associated with the Proposed Action. However, it is not expected to result in the decline of the species, due to the availability of suitable habitat outside the DE in larger contiguous patches as described earlier.</p>
'result in invasive species that are harmful to a critically endangered, endangered species becoming established in the endangered or critically endangered species' habitat'	<p>Not Significant</p> <p>A total of 96 introduced species are recorded within the DE. The existing weed infestation within the DE is associated with urban development. The Proposed Action is not expected to result in the introduction or spread of weeds that would result in significant impacts to Black Cockatoo habitat. This is due to the implementation of management actions including weed management and hygiene, and revegetation / landscaping with native species on locally harvested topsoil. Further ongoing weed management will be undertaken in road drainage basins / swales to prevent the spread of weeds into adjacent habitat.</p> <p>The Proposed Action is unlikely to result in the introduction of new species to the area. However, competition currently exists for nest hollows with European honeybees and other bird species. The Proposed Action will result in the loss of up to six hollows, all of which are unsuitable for Black Cockatoo nesting. This loss has the potential to marginally increase the competition for remaining hollows by a variety of species.</p> <p>The overall impact on the Black Cockatoo species will not be significant as the Proposed Action is not envisaged to introduce invasive species.</p>

Significant Impact Criteria (DotE, 2013)	Assessment for Black Cockatoo Species
'introduce disease that may cause the species to decline'	<p>Not Significant</p> <p>The Proposed Action will include dieback hygiene management during construction to protect adjacent Black Cockatoo habitat. In line with management actions outlined in Section 7, the Proposed Action will establish protectable areas along sections of the DE boundary and incorporate access controls, equipment and vehicle washing/segregation, soil movement controls and monitoring during construction.</p> <p>The Proposed Action is not expected to spread dieback through sediment in stormwater runoff, as stormwater will be captured and infiltrated via basins/swales in the road reserve and will not discharge into Black Cockatoo habitat located outside the DE.</p> <p>Carnaby's Cockatoo recovery plan (DPaW, 2013) identifies potential bird diseases such as Beak and Feather Disease (BFDV), Avian Polymovirus (APV), and Carnaby's Hindlimb Paralysis Syndrome (CHiPs) that could pose a threat to Black Cockatoos but does not identify any high-risk activities for spreading disease or any management measures that could prevent disease. The presence of any such disease within the DE or surrounds is unknown. It is assumed that the highest risk of introducing/spreading disease would be associated with handling of Black Cockatoos. The Proposed Action is expected to involve none to minimal handling of Black Cockatoos, other than rescue. A suitably qualified fauna handler (with an understanding of animal disease control) will be engaged to undertake this task, if required (see Section 7). Therefore, the Proposed Action is considered unlikely to result in introduction of any disease that could cause the species to decline.</p>
'interfere with the recovery of the species'	<p>Not Significant</p> <p>The Proposed Action is not inconsistent with the Black Cockatoo recovery plans as detailed in Section 8.</p> <p>The Recovery Plans and Conservation Advice (DPaW, 2013; TSSC, 2018b) provide measures for the species' recovery. These include identifying, protecting and managing important habitat. The Proposed Action will result in clearing 33.48 ha of Black Cockatoo foraging habitat and potential breeding habitat, however, this loss is unlikely to interfere with the recovery of the species in the local area.</p>

Table 16 Assessment of the potential impacts of the Proposed Action to Forest Red-Tailed Black Cockatoos

Significant Impact Criteria (DotE, 2013)	Assessment for Black Cockatoo Species
'lead to a long-term decrease in the size of an important population'	<p>Not Significant</p> <p>The Proposed Action is not expected to lead to a long-term decrease in the size of FRTBC populations as:</p> <ul style="list-style-type: none"> • It will not result in clearing of any hollows suitable for Black Cockatoo nesting (Biota, 2021). • While the proposal involves clearing of up to 162 suitable DBH trees, there are at least a further 1,430 suitable DBH trees remain in close vicinity to the DE in the wider survey area as recorded by Biota (2021). • It will not result in clearing of any known roosting trees. • FRTBC are a highly mobile species and are expected to forage outside the DE. Within 12 km of the Proposed Action, approximately 16,051 ha of potential Black Cockatoo foraging habitat remains and within 6 km there is approximately 3,773 ha of foraging habitat (DPIRD, 2020; DBCA 2018c; 2018d). While these estimates are based on foraging habitat suitable for Carnaby's Cockatoo, the same habitat is likely to also provide food sources for the FRTBC.

Significant Impact Criteria (DotE, 2013)	Assessment for Black Cockatoo Species
	<ul style="list-style-type: none"> The clearing of 33.48 ha of high quality FRTBC foraging habitat represents a reduction of 0.89% in Black Cockatoo foraging habitat within the 6 km local area and a reduction of 0.21% in foraging habitat within 12 km local area. The minimal reduction in foraging habitat is unlikely to contribute to a long-term decrease in the population.
<p>'reduce the area of occupancy of an important population'</p>	<p>Not Significant</p> <p>The Proposed Action is located within the mapped distribution of the FRTBC (DotEE, 2017b; DSEWPaC, 2012b), with their presence confirmed in the field (Biota, 2021). The current distribution of FRTBC extends from north of Perth to Albany and also around Mt. Helena in the east.</p> <p>Given the available habitat within the broader area, the proposed clearing of 33.48 ha of high-quality foraging habitat and 162 suitable DBH trees is unlikely to significantly reduce the area of occupancy of the species.</p>
<p>'fragment an important population into two or more'</p>	<p>Not Significant</p> <p>As FRTBC is a highly mobile species and adult birds will travel up to 19 km from their nests for foraging (Johnston & Kirkby, 2013). The Proposed Action is not expected to fragment any populations of FRTBC due to the following:</p> <ul style="list-style-type: none"> Clearing will occur over linear patches adjacent to already cleared and disturbed areas along Roe Highway and Great Eastern Highway Bypass and will not create a gap of 4 km or more between habitat patches Black Cockatoos are highly mobile species and are expected to forage outside the DE. There is approximately 3,773 ha of foraging resources within 6 km and 16,051 ha within 12 km. Black Cockatoos are not dependent on a particular patch of foraging habitat within the DE.
<p>'adversely affect habitat critical to the survival of a species'</p>	<p>Potentially Significant</p> <p>The Proposed Action will not remove any known or potentially suitable nesting hollows for Black Cockatoos (Biota, 2021). The closest known FRTBC nesting site is located approximately 5-7 km away in the Kalamunda National Park (T. Kirkby, pers. comm). Foraging habitat within 6 km of nesting sites is considered most important for nesting success, however foraging habitat up to 12 km away has value (DPaW, 2013). The Proposed Action will remove foraging habitat within approximately 6 km of a known nesting site. However, an estimated 529.6 ha of suitable foraging habitat remains within Kalamunda National Park, and there is an estimated 6,943.3 ha of suitable foraging habitat within 6 km of the nesting site, of which 43% is protected within DBCA reserves.</p> <p>Foraging habitat available within the DE has value in supporting this roosting site. The availability of water in Helena River also increases the value of the habitat for Black Cockatoos. Habitat critical to the survival of FRTBCs has been generalised in the recovery plan as all Marri, Karri and Jarrah forests, woodlands and remnants in the south-west of Western Australia receiving more than 600 mm of annual average rainfall (DEC, 2008). The Proposed Action involves clearing of up to 33.48 ha of high quality FRTBC habitat, that potentially supports a known FRTBC nesting site and a known FRTBC roosting site. Therefore, the impacts of the Proposed Action on FRTBC are considered potentially significant.</p>
<p>'disrupt the breeding cycle of an important population'</p>	<p>Not Significant</p> <p>The Proposed Action is not expected to disrupt the breeding cycle of a population of FRTBC as no known breeding of FRTBC occurs in the DE or adjacent to it. Whilst one FRTBC nesting hollow is known to occur 5-7 km away, in the Kalamunda National Park, the Proposed Action is not expected to disrupt the breeding cycle at this site due to the distance to the hollow and the availability of other foraging resources within 6 km of the nesting site.</p>

Significant Impact Criteria (DotE, 2013)	Assessment for Black Cockatoo Species
<p>'modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline'</p>	<p>Not Significant</p> <p>The Proposed Action is not expected to impact the availability or quality of habitat to the extent that FRTBC are likely to decline. The Proposed Action will result in the clearing of up to 33.48 ha of high-quality Black Cockatoo foraging habitat including 162 suitable DBH trees (no suitable nesting hollows). This reduction in foraging and potential future breeding habitat for Black Cockatoo species may result in a minor residual impact associated with the Proposed Action. However, it is not expected to result in the decline of the species, due to the availability of suitable habitat outside the DE in larger contiguous patches.</p>
<p>'result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat'</p>	<p>Not Significant</p> <p>A total of 96 introduced species are recorded within the DE (Biota 2021). The existing weed infestation within the DE is associated with urban development. With appropriate weed management and hygiene practices, and revegetation / landscaping with native species on local harvested topsoil, the Proposed Action is not expected to result in the introduction or spread of weeds that will significantly impact FRTBC habitat. Further ongoing weed management will be undertaken in road drainage basins / swales to prevent the spread of weeds into adjacent habitat.</p> <p>The Proposed Action is unlikely to result in the introduction of new species to the area. However, competition currently exists for nest hollows with European honeybees and other bird species. The Proposed Action will result in the loss of up to six hollows all of which are unsuitable for FRTBC nesting. This loss has the potential to marginally increase the competition for remaining hollows by a variety of species. Overall, the impact is not significant.</p>
<p>'introduce disease that may cause the species to decline'</p>	<p>Not Significant</p> <p>The Proposed Action will include dieback hygiene management during construction to protect adjacent Black Cockatoo habitat. In line with management actions outlined in Section 7, the Proposed Action will establish protectable areas along sections of the DE boundary and incorporate access controls, equipment and vehicle washing/segregation, soil movement controls and monitoring during construction.</p> <p>The Proposed Action is not expected to spread dieback through sediment in stormwater runoff, as stormwater will be captured and infiltrated via basins/swales in the road reserve and will not discharge into Black Cockatoo habitat located outside the DE.</p> <p>Carnaby's Cockatoo recovery plan (DPaW, 2013) identifies several potential bird diseases such as Beak and Feather Disease (BFDV), Avian Polymovirus (APV), and Carnaby's Hindlimb Paralysis Syndrome (CHiPs) that could pose a threat to Black Cockatoos but does not identify any high-risk activities for spreading disease or any management measures that could prevent these diseases. The presence of any such disease within the DE or surrounds is unknown. It is assumed that the highest risk of introducing/spreading disease would be associated with handling of Black Cockatoos. The Proposed Action is expected to involve none to minimal handling of Black Cockatoos, other than rescue of injured birds. A suitably qualified fauna handler (with an understanding of animal disease control) will be engaged to undertake this task, if required (see Section 7). Therefore, the Proposed Action is considered unlikely to result in introduction of any disease that could cause the species to decline.</p>
<p>'interfere with the recovery of the species'</p>	<p>Not Significant</p> <p>The Proposed Action is not inconsistent with the FRTBC Conservation Advice as detailed in Section 8.</p> <p>The Approved Conservation Advice (DEWHA, 2009) identified threats to the species. These include habitat loss and restricted quantity of suitable nesting hollows. The Proposed Action will not involve clearing of any known or potential breeding trees with suitable hollows. It will also not involve clearing of any known roosting trees, and other foraging resources within the 6 km of the local area. The Proposed Action is likely to result in minor residual impacts to FRTBC habitat including foraging and potential breeding habitat, however, this loss is unlikely to interfere with the recovery of the species.</p>

6.3.4 Conospermum undulatum (Vulnerable)

6.3.4.1 Overview of impacts

The Proposed Action will result in the following impacts to *Conospermum undulatum*:

- Loss of up to one individual from one location and up to 2.62 ha of potentially suitable habitat in the southern extent of the DE
- Potential indirect impacts from the introduction or spread of weeds and *Phytophthora* dieback and increased incidence of fire.

6.3.4.2 Assessment against MNES Significant Impact Guidelines

The potential impacts of the Proposed Action on *C. undulatum* have been assessed against the significant impact criteria for Vulnerable species in the Significant Impact Guidelines 1.1 (DotE, 2013). For Vulnerable species, the criteria relate to an important population, which is defined as a population that is necessary for a species' long-term survival and recovery (DotE, 2013). According to the recovery plan for *C. undulatum* (DEC, 2009), all known populations of *C. undulatum* (apart from those known to be extinct) within the two bioregions (Swain Coastal Plain and Jarrah Forest) are considered to be important populations.

An assessment of impacts against the Significance Impact Guidelines for MNES is provided in Table 17 below. In summary, the impact of clearing of up to one individual of *C. undulatum* and up to 2.62 ha of suitable habitat for the species as part of the Proposed Action is not considered significant. This is mainly because the Proposed Action only having a small percentage impact on the local population and the *C. undulatum* habitat to be cleared is limited to degraded and dieback infested road reserve where the chance of long-term survival for the species is expected to be low regardless of the Proposed Action. The residual indirect impacts on *C. undulatum* are considered negligible as detailed in Section 6.2.

Table 17 Assessment of the potential impacts of the Proposed Action to *Conospermum undulatum*

Significant Impact Criteria (DoEt, 2013)	Assessment for <i>Conospermum undulatum</i>
'lead to a long-term decrease in the size of an important population'	<p>Not Significant</p> <p>The Proposed Action will remove one individual from an estimated known population of 14,147 individuals in Perth and a known local population of 391 individuals. This local population is located immediately adjacent to the DE and includes three individuals recorded by Biota (2021), three individuals recorded by Main Roads, and 385 individuals recorded as per the data extracted from DBCA database (Population 2).</p> <p>This removal will reduce the total known population by 0.007% and the known local population by 0.3%. This reduction of one individual plant is not considered significant given that numerous populations exist outside the DE and the loss of an individual plant is insignificant on the overall population. As shown in Table 2 of the Recovery Plan, Population 2, which is protected in the conservation estate, has been identified as Healthy, compared with Population 23, which is recorded as being in Moderate condition. The potential impacts of the Proposed Action on the western side of Roe Hwy have been avoided during re-design to minimise impact on this population.</p>
'reduce the area of occupancy of an important population'	<p>Not Significant</p> <p>The Proposed Action is anticipated to clear a single plant, considered to be part of Population 23, located on the eastern side of Roe Highway. This Population initially consisted of three sub-populations.</p> <p>An individual plant recorded for subpopulation 21 has not been re-located since 2001, and no <i>C. undulatum</i> plants were present in this location when searched by Biota (2021), suggesting that this population no longer exists. DBCA correspondence in response to the State clearing permit application confirmed that sub-population 23a is likely to be extinct as the area has been extensively cleared. DBCA also explained in this correspondence that subpopulations 23b and 23c were last surveyed in 2009 and only three and two plants respectively were recorded at these locations. It is important to note that no monitoring of subpopulations 23b and 23c was conducted for 13 years and these locations currently lie adjacent to extensively cleared areas.</p> <p>Despite exhaustive search, Biota did not record the species within the DE. It is therefore reasonable to conclude that the five plants of subpopulations 23b and 23c no longer exist at these locations. This is supported by the findings of the Delnevo</p>

Significant Impact Criteria (DoEt, 2013)	Assessment for <i>Conospermum undulatum</i>
	<p>study (Delnevo et al., 2019) on the basis that the five plants of subpopulations 23b and 23c could have disappeared as their population was fragmented and could have produced less attractive floral display with a low or no seed set.</p> <p>Considering the three individuals recorded by Biota (2021), three individuals recorded by Main Roads, and 385 individuals recorded by DBCA (Population 2), the proposed removal of one individual is predicted to reduce the local abundance by 0.26%. It is unlikely that a reduction in 0.26% would result in a significant impact at a local level.</p>
'fragment an existing important population into two or more'	<p>Not Significant</p> <p>The Proposed Action will not fragment an existing important population or the habitat of an existing important population into two or more populations. Clearing will occur over narrow linear patches adjacent to the existing Roe Highway.</p>
'adversely affect habitat critical to the survival of a species'	<p>Not Significant</p> <p>Habitat that is considered critical to <i>C. undulatum</i> includes areas of current occupancy of important populations, areas of similar habitat surrounding important populations, and the local catchment for the surface or groundwater that maintains the habitat of the species. All populations occurring in the Swan Coastal Plain and Jarrah Forest bioregion are considered important populations and all habitat for known population in this region are considered critical for survival of the species (DEC, 2009).</p> <p>The Proposed Action will clear up to 2.62 ha of habitat suitable for <i>C. undulatum</i>. Results of the Biota (2021) survey indicate that in the DE this species was associated with vegetation type P7, which represents 2.62 ha of the DE. This represents approximately 21.6% of the 12.11 ha of habitat (P7 vegetation type) mapped by Biota (2021) in the broader survey area. A further 61.9 ha of suitable habitat occurs in the surrounding contextual area and at least 1,206 ha of additional suitable habitat is known to occur approximately 7 km south of the Proposed Action in an area recently surveyed by Woodman (2021) for the Tonkin Grade Separation Interchanges project. The Proposed Action is therefore expected to impact 0.2% of the suitable habitat within the region.</p> <p>Additionally, the results of the Biota (2021) survey confirm most of the suitable habitat mapped in the DE is not populated by <i>C. undulatum</i>, which instead is typically found in more dense, clumped populations such as Hawkesvale Reserve neighbouring the DE.</p>
'disrupt the breeding cycle of an important population'	<p>Not Significant</p> <p>The breeding cycle of <i>C. undulatum</i> is dependent on an adequate supply of pollinators and disturbance from fire, as most of the species reproduce through re-sprouting. The Proposed Action impact the pollination success of the individuals remaining outside of the DE nor result in a reduction, in the instances of fire occurring in the area, as fire management is not proposed to change from current practice. Therefore, the Proposed Action is not expected to disrupt the breeding cycle of an important population of <i>C. undulatum</i>.</p>
'modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline'	<p>Not Significant</p> <p>The Proposed Action will clear up to 2.62 ha of habitat suitable for <i>C. undulatum</i> which represents 4.23% of likely suitable habitat within the wider contextual area and 0.2% of suitable habitat in the region. The Proposed Action will incorporate standard management measures as outlined in Section 7 to protect the integrity of critical habitat for <i>C. undulatum</i> outside the DE.</p> <p>Given the small scale of direct impacts, mitigation of indirect impacts and the proposed management measures, the Proposed Action is not expected to impact habitat to the extent that the species is likely to decline.</p>
'result in invasive species that are harmful to a critically endangered, endangered species becoming established in the endangered or critically endangered species' habitat'	<p>Not Significant</p> <p>Biota has recorded 96 introduced species in the DE. The existing weed infestation in the DE is associated with urban development. The Proposed Action is not expected to introduce or spread weeds that would result in significant impacts to <i>C. undulatum</i> habitat. This is due to the implementation of the standard management measures</p>

Significant Impact Criteria (DoEt, 2013)	Assessment for <i>Conospermum undulatum</i>
	<p>outlined in Section 7, which include weed treatment and hygiene during construction, and revegetation / landscaping with native species on local harvested topsoil. Ongoing weed management will be undertaken in road drainage basins / swales to prevent the spread of weeds into adjacent habitat.</p> <p>The Proposed Action is not expected to introduce any invasive fauna species into the DE (rabbits are already present as recorded by Biota [2021]). The Proposed Action will be facilitating flow of traffic and will not introduce or facilitate movement of invasive species into the surrounding areas of native vegetation.</p> <p>The Proposed Action is, therefore, not expected to introduce or spread invasive species that could cause <i>C. undulatum</i> to decline.</p>
<p>'introduce disease that may cause the species to decline'</p>	<p>Not Significant</p> <p>The Recovery Plan does not indicate dieback as a threat to this species but notes that further research on the species' susceptibility to <i>Phytophthora</i> spp. is needed (DEC, 2009). However, <i>C. undulatum</i> can be potentially impacted should the condition of its habitat (Banksia woodland) degrade due to dieback infestation.</p> <p>The Proposed Action will include dieback hygiene measures during construction to protect adjacent protectable uninfested areas. The Proposed Action will establish protectable areas along sections of the DE boundary and incorporate access controls, equipment and vehicle washing/segregation, soil movement controls and monitoring during construction.</p> <p>The Proposed Action is not expected to spread dieback through sediment in stormwater runoff, as stormwater will be captured and infiltrated within basins/swales in the road reserve and will not discharge into <i>C. undulatum</i> habitat outside of the DE.</p> <p>Based on the above, the Proposed Action is not expected to introduce a disease that could cause <i>C. undulatum</i> to decline.</p>
<p>'interfere with the recovery of the species'</p>	<p>Not Significant</p> <p>As indicated by DBCA, this species is known from 25 historical populations with 14,147 plants recorded in total (DEC, 2009). Removal of one individual of this regionally restricted but locally abundant species is therefore predicted to result in a 0.007% reduction in regional abundance. While this is a measurable reduction in total abundance of the species, it is not likely to result in a significant impact at a regional level.</p> <p>Due to the small scale of the anticipated impact on the species, the Proposed Action will not interfere with the recovery of the species and is unlikely to have any long-term impacts upon species numbers. The Proposed Action is not inconsistent with the species Recovery Plan (DEC, 2009) as detailed in Section 8.</p>

6.3.5 Carter's Freshwater Mussel (Vulnerable)

6.3.5.1 Overview of impacts

The Proposed Action will result in the following impacts to CFM:

- No direct impacts to any CFM individuals or suitable habitat.

The Proposed Action has the potential to result in indirect impacts on CFM outside the DE, with populations recorded in Wetland East (Biologic, 2022) and 2.5 km downstream (west) of the DE in the Helena River (Biota 2021). Potential indirect impacts could arise from:

- Increased erosion and sedimentation related turbidity and reduced dissolved oxygen resulting from earthworks adjacent to watercourses during construction.
- Increased risk of water contamination (particularly hydrocarbon contamination) due to increase in vehicles/machinery in the vicinity of the Helene River crossing.
- Alteration of hydrological regimes resulting from bridge and/or road construction (e.g. dewatering, water extraction, channel works) that might change flow volumes and timing.
- Reduced connectivity of upstream and downstream areas.

The above could adversely impact CFM individuals and populations and their habitat and interfere with CFM reproduction (e.g. by impacting host fish and their movement). The potential impacts are mostly relevant to populations downstream of the DE and within 'Wetland East', however reduced connectivity of upstream and downstream areas could result in fragmentation of populations. As detailed in Section 6.2, these potential indirect impacts can be significantly reduced through effective management, mitigation, and monitoring.

6.3.5.2 Assessment against MNES Significant Impact Guidelines

Table 18 provides an assessment of the potential impact of the Proposed Action to the CFM using the Vulnerable species significant impact criteria (DotE, 2013). For Vulnerable species, the criteria relate to an important population, which is defined as a population that is necessary for a species' long-term survival and recovery (DotE, 2013). It is noted that no recovery plan is in place for CFM and that the conservation advice (TSSC, 2018aa) does not identify any important populations as further research into the species is required to identify these.

The Proposed Action is not expected to have significant impacts on CFM due to the following key reasons: the Proposed Action will not directly impact any CFM or their current habitat within DE and the residual indirect impacts on CFM outside the DE are not expected to be significant with appropriate management, mitigation, and monitoring.

Table 18 Assessment of the potential impacts of the Proposed Action to Carter's Freshwater Mussel

Significant Impact Guidelines (DotE 2013)	Assessment for Carter's Freshwater Mussel
'lead to a long-term decrease in the size of an important population'	<p>Not Significant</p> <p>No CFM were recorded within the DE during recent targeted searches and the presence of degraded and turbid habitat within the DE was considered unsuitable (Biota, 2021; Biologic, 2022). Therefore, no direct impacts are expected. Indirect impacts to downstream populations on the Helena River (closest known 2.5 km away) and within 'Wetland East' will be managed through minimising potential changes to water quality or hydrology anticipated to cause by the Proposed Action (see Sections 6.2.5, 6.2.6, 7). Therefore, it is not expected that impacts associated with the Proposed Action will lead to a long-term decrease in the size of a population.</p>
'reduce the area of occupancy of an important population'	<p>Not Significant</p> <p>No evidence of CFM or suitable habitat were recorded inside the DE during the targeted searches (Biota, 2021; Biologic, 2022). The nearest records of live CFM were approximately within 35 m east of the DE, within 'Wetland East' and 100m west in "Wetland West" (Section 5.4.2). Most of the Wetland East contains suitable habitat for CFM. Biologic (2022) recorded no evidence of CFM or suitable habitat within a 500 m corridor of the Helena River (upstream and downstream of the DE).</p> <p>The DE intersects the western edge of Wetland East. A vegetation buffer will be maintained between the project works and edge of the wetland, which, along with appropriate management measures outlined in Section 7, will ensure that there are no discernible impacts on the CFM population.</p> <p>The Proposed Action also does not reduce the extent of potential future CFM habitat available within the Helena River, should the general condition of the waterway improve. The Proposed Action may involve short-term disturbance of the bed and banks of the Helena River. However, water quality management measures (Section 7) will ensure that there are no discernible downstream impacts and resultant reduction in area of occupancy resulting from implementation of the Proposed Action.</p> <p>Therefore, the Proposed Action is not expected to reduce the area of occupancy of the species.</p>
'fragment an existing important population into two or more'	<p>Not Significant</p> <p>No evidence of CFM or suitable habitat were recorded inside the DE during the targeted searches (Biota, 2021; Biologic, 2022).</p> <p>The proposed bridge at Roe Highway over the Helena River will not obstruct the movement of CFM and associated host fish species within the Helena River when water is flowing during construction and operation.</p>

Significant Impact Guidelines (DotE 2013)	Assessment for Carter's Freshwater Mussel
	<p>Clearing of vegetation on the western portion of 'Wetland East' will not fragment the existing population. The Proposed Action will also not clear any suitable habitat for the species.</p> <p>The Proposed Action will therefore not fragment a population into two or more populations.</p>
<p>'adversely affect habitat critical to the survival of a species'</p>	<p>Not Significant</p> <p>Biota (2021) and Biologic (2022) confirmed no CFM or suitable habitat occurs inside the DE. Biologic (2022) recorded suitable habitat adjacent to the DE within 'Wetland East'.</p> <p>Biologic (2022) determined the Helena River section within the DE is unlikely to be a permanent water body, which excludes this area from providing suitable habitat for CFM. The nearest CFM records on the Helena River are 2.5 km downstream (Biota, 2021).</p> <p>The Proposed Action will clear vegetation adjacent to suitable habitat within 'Wetland East'. However, management of construction impacts (refer to Section 7) will ensure that the Proposed Action will not adversely affect the species' habitat in 'Wetland East' and downstream of the Helena River, where CFM is known to be present.</p> <p>Therefore, the Proposed Action is considered unlikely to adversely affect habitat critical to the survival of the species.</p>
<p>'disrupt the breeding cycle of an important population'</p>	<p>Not Significant</p> <p>No evidence of CFM or suitable habitat were recorded inside the DE (Biota, 2021; Biologic, 2022). The nearest records of live CFM were within 35 m east of the DE, within 'Wetland East' (Section 5.4.2).</p> <p>CFM require a suitable host species (fish) to complete their breeding cycle. Two species of fish (the pygmy perch (native) and common carp (non-native) were observed within 'Wetland East'. No juveniles were recorded within 'Wetland East', despite extensive searching (Biologic, 2022). Biologic (2022) was unable to determine if this was due to a reduction in recruitment (long-term population decline).</p> <p>Management of construction impacts (Section 7) will ensure that the Proposed Action will not disrupt the breeding cycle of CFM within 'Wetland East'. Clearing of vegetation adjacent to 'Wetland East' will not impact the movement of CFM or suitable host species.</p> <p>The Helena River section within the DE is not a permanent water body and is therefore, assessed to be unable to support fauna that rely on perennial surface water. However, the movement of CFM and host species within the Helena River will remain unimpacted by the proposed bridge at Roe Highway over the Helena River.</p> <p>Therefore, no temporary or permanent disruption to the breeding cycle of the species is expected.</p>
<p>'modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline'</p>	<p>Not Significant</p> <p>No evidence of CFM or suitable habitat were recorded inside the DE (Biota, 2021; Biologic, 2022). The DE intersects western edge of Wetland East, where potential habitat has been assessed, however, will not directly remove or damage the suitable habitat (Biologic, 2022).</p> <p>Water quality management measures (see Section 7) will ensure that any potential impacts from the Proposed Action will not adversely affect the species habitat within 'Wetland East' or downstream of the Helena River.</p> <p>Therefore, the Proposed Action is not anticipated to modify, destroy, remove or decrease the availability or quality of habitat to the extent that the species is likely to decline.</p>
<p>'result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat'</p>	<p>Not Significant</p> <p>According to Biota (2021), the vegetation along Helena River is associated with vegetation unit P6 (Flooded Gum over weedy understorey on riverbank) and vegetation around the wetlands associated with vegetation unit L3 (Marri over Melaleuca low open woodland on clay pits) (Biota, 2021). Biota (2021) assessed the vegetation condition along the banks of Helena River as degraded due the presence of weeds and lack of native understorey. The vegetation in the suitable CFM habitat (outside the DE) within 'Wetland East' and 'Wetland</p>

Significant Impact Guidelines (DotE 2013)	Assessment for Carter's Freshwater Mussel
	<p>West' was mapped Good to Degraded in condition due to the presence of weeds. Six species of environmental weeds are recorded in this vegetation unit.</p> <p>Standard hygiene and water quality management measures (see Section 7) will ensure that implementation of the Proposed Action will not introduce harmful invasive species that may adversely affect the species' habitat downstream where CFM is known to be present.</p> <p>Therefore, it is not expected that the Proposed Action will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat.</p>
<p>'introduce disease that may cause the species to decline'</p>	<p>Not Significant</p> <p>No known diseases that can potentially impact CFM have been identified in the conservation advice (TSSC, 2018a). Moreover, with the implementation of standard hygiene management measures, no adverse impact is anticipated due to construction and operation of the Proposed Action.</p>
<p>'interfere with the recovery of the species'</p>	<p>Not Significant</p> <p>There is currently no recovery plan for CFM but the conservation advice (TSSC, 2018a) lists measures for the recovery and management of the species. The Proposed Action will not interfere with the recovery/management of the species as detailed in Section 8 and is unlikely to have any long-term impacts upon species numbers. Bridge structures are thought to create shade and may potentially offer potential future habitat for this species.</p>

7. Avoidance, Management and Mitigation Measures

7.1 Avoidance and Mitigation Measures

Substantial changes to the Proposed Action's design have been made to avoid and reduce impacts on TECs, Threatened Black Cockatoo species, Vulnerable CFM and Threatened flora species *C. undulatum*. Avoidance measures undertaken by Main Roads for the Proposed Action include:

1. Construction will occur within a predominately cleared corridor that is reserved for 'Primary Regional Roads' and 'Other Regional Roads' under the MRS
2. All laydowns, stockpiles and access tracks will be located within existing cleared areas or within the DE. As such, no native vegetation will be cleared for temporary works outside of the DE
3. Earthworks have been reduced in fill height and/or cut depth in areas where native vegetation exists, which reduces the horizontal footprint of the Proposed Action
4. Shifting the Roe Highway – GEHB interchange further to the north has resulted in complete avoidance of *Shrublands and Woodlands of the Eastern Swan Coastal Plain* TEC
5. All the Proposed Action associated infrastructure will be contained within the DE, including road pavements, footpaths, noise walls, stormwater drainage and fencing.
6. Surface runoff within the DE will drain into infiltration basins and/or swales constructed within the DE. The infiltration basins/swales will be designed to capture and infiltrate runoff from a 1 in 100-year ARI rainfall event, to prevent stormwater runoff into adjacent areas of native vegetation or directly into Helena River. The infiltration basins/swales will be planted with native vegetation to assist with nutrient stripping of stormwater during infiltration.
7. A retaining wall has been designed alongside wetland east to avoid the impact of fill on the wetland and CFM habitat and to maintain a vegetation buffer between the works and the wetland.

Further opportunity to reduce the impact to communities and species may be possible during detailed design and construction works for the Proposed Action, where construction methodology allows.

7.2 Justification for Residual Impacts

Following the avoidance and minimisation measures presented in this chapter, the Proposed Action will result in the impacts presented in Section 6 (summarised in Table 12). The direct impacts will be reduced, where practicable during detailed design and construction planning. Avoidance and reductions have limitations as the Proposed Action is required to meet road safety standards. Road vertical and horizontal geometry, land widths, steepness of roadside batters and road pavements construction are dictated by a series of Australian Standards and Austroads guidelines. This therefore may only allow a further small reduction in residual impacts.

The impacts presented in Section 6 are required in order to provide the required functionality of the Proposed Action to fulfil the social and economic objectives of the Proposed Action in consideration to stakeholder objectives and concerns.

7.3 Management Measures

Management measures will be implemented for the following aspects:

- Clearing and access controls
- Dieback and weed management
- Fauna management
- Sediment and erosion controls
- Drainage management
- Soil management.

Pre-construction and construction procedures have been developed to ensure MNES are adequately delineated in the field, protected, and managed to minimise impacts. These are detailed in Table 19, along with performance and completion criteria and monitoring and reporting arrangements.

During the detailed design phase opportunities will be investigated to further refine the design to minimise disturbance to BWSCP TEC, Black Cockatoo and CFM habitat and Threatened flora species *Conospermum undulatum*. Where disturbance is unavoidable, additional management actions will be implemented to minimise the extent of impacts. Main Roads intends to counterbalance the significant residual impacts of the Proposed Action through implementation of an Environmental Offset Strategy (Section 9).

Table 19 Management measures and performance targets

Management Objective	Management Measures	Performance Target / Completion Criteria	Monitoring / Reporting	Potential Risk / Threat
<ul style="list-style-type: none"> Prevent unauthorised entry and clearing of TECs, Black Cockatoo habitat and Threatened flora outside the DE. 	<ul style="list-style-type: none"> Clearing boundary to be demarcated and approved by Main Roads prior to clearing commencement Vegetation to be retained to be clearly demarcated prior to clearing commencing. Restricting entry into the DE by barricading the worksites and check points for entry and exit. 	<ul style="list-style-type: none"> No unauthorised clearing of TECs, Black Cockatoo habitat or <i>Conospermum undulatum</i>. 	<p>During construction:</p> <ul style="list-style-type: none"> Site inspections prior to clearing confirm clearing areas are demarcated. Post-clearing survey confirms clearing remained within approved limits. Areas cleared will be recorded by construction contractor and reported to Main Roads 	<p>Clearing more than:</p> <ul style="list-style-type: none"> 0 ha of Shrublands and Woodlands of the Eastern SCP TEC 14.94 ha of BWSCP TEC 33.48 ha of Black Cockatoo high quality foraging habitat One individual of <i>C. undulatum</i>
<ul style="list-style-type: none"> Prevent decline on the extent or condition of TECs, Black Cockatoo habitat, <i>C. undulatum</i> habitat adjacent to the DE and CFM habitat adjacent to the DE, attributable to the Proposed Action. 	<p>Weed and disease management:</p> <ul style="list-style-type: none"> During construction Declared Pests and WONS within the DE will be treated according to their Control Codes and advice from the Department of Primary Industries and Regional Development (DPIRD). For three years post construction, Main Roads will undertake control of Declared Pests and WoNS. Maintain maps and record of existing weeds and newly identified weeds through periodic inspections. All heavy plant and machinery entering the work site will be inspected and confirmed to be clean (free of vegetation and soil material). Dieback protectable areas within the DE will be identified and mapped and demarcated on site and managed by: <ul style="list-style-type: none"> Restricting movement between infested and protectable areas where practicable Developing and implementing a dieback hygiene program Clearing activities will occur during the dry months, as far as practicable, to reduce the risk of spreading <i>Phytophthora</i> dieback Stormwater drainage will be captured and infiltrated via basins/swales in the road reserve and will not discharge into TECs, Black Cockatoo habitat or <i>C. undulatum</i> habitat located outside the DE. Topsoil containing Declared pests or WONS will be treated, buried on site under at least 300mm of fill or disposed offsite. Topsoil from infected or potentially infected dieback areas will be segregated and not used in uninfected areas. Dieback management will be carried out in accordance with DBCA's <i>Phytophthora Dieback Management Manual 2020</i>. <p>Fire management</p> <ul style="list-style-type: none"> Refuelling will be conducted in designated areas, away from TECs where practicable All Department of Fire and Emergency Services (DFES) and LGA restrictions on fire and machinery movement will be adhered to 	<ul style="list-style-type: none"> No new <i>Phytophthora</i> dieback infestations identified adjacent to the DE, attributable to the Proposed Action. No new WoNS or Declared Pests identified in the DE or vegetation adjacent to the DE, attributable to the Proposed Action. Topsoil records show topsoil containing WoNS or Declared pests was treated or appropriately disposed. No fires in TECs, Black Cockatoo habitat or <i>C. undulatum</i> habitat adjacent to the DE attributable to Proposed Action. 	<p>Pre-construction:</p> <ul style="list-style-type: none"> Baseline weed and dieback mapping <p>During construction:</p> <ul style="list-style-type: none"> Monthly inspections to confirm compliance Develop and implement a dieback hygiene program <p>Post-construction:</p> <ul style="list-style-type: none"> Weed and dieback survey. 	<ul style="list-style-type: none"> Decline in the extent or condition of TECs, Black Cockatoo habitat or <i>C. undulatum</i> habitat adjacent to the DE due to weed or dieback disease intrusion or bushfire caused by the Proposed Action.

Management Objective	Management Measures	Performance Target / Completion Criteria	Monitoring / Reporting	Potential Risk / Threat
<ul style="list-style-type: none"> Avoid injury or mortality to Black Cockatoos 	<ul style="list-style-type: none"> During Black Cockatoo breeding season, any tree with hollows suitable for Black Cockatoo breeding will be inspected by a suitably qualified ecologist for evidence of Black Cockatoo breeding within seven days prior to clearing (Note: no such hollows were recorded within DE by Biota 2021) Any tree and vegetation within 10 m of the tree identified as being used by Black Cockatoos for nesting will not be cleared until a suitably qualified person has verified that the tree is not in use. (Note: No such trees were recorded by Biota 2021 or are known to occur from other sources) If Black Cockatoo breeding is detected in any hollows, then all the trees within 10 m of the hollow will be demarcated and retained until hollows are no longer in use. (Note: No such hollows recorded by Biota (2021) or are known from other sources) Revegetation and landscaping will incorporate Black Cockatoo habitat species endemic to the region, where practicable Revegetation and landscaping designs shall not include foraging of breeding species within 10 m of the road. Assess the risk of fauna strike to determine the requirement for wildlife hazard signage should the trees that are known to be Black Cockatoo habitat be retained within 10 m of the road seal. A list of contact information for local wildlife rescue organisations and carers will be maintained on site to contact in the event of a fauna injury. 	<ul style="list-style-type: none"> Survey of trees with suitable hollows for use by Black Cockatoos carried out within seven days prior to clearing events undertaken during Black Cockatoo breeding season. Survey to confirm the usage of hollows by Black Cockatoo species undertaken, where necessary. Vegetation trees within 10m of a Black Cockatoo breeding hollow to be retained and demarcated prior to clearing. Black Cockatoo habitat species endemic to the region included in Species lists in landscape plan. A list of contacts details of local wildlife rescue organisations and carers maintained on site at all times. 	<ul style="list-style-type: none"> Surveys of suitable Black Cockatoo hollows prior to clearing Landscape design documentation including species list Fauna strike risk assessments, as required Any injury or death of Black Cockatoos as part of the Proposed Action recorded and investigated to determine any potential future avoidance measures. Offset Strategy to include maintenance and monitoring of offset sites where revegetation is included as part of the proposed offset 	<ul style="list-style-type: none"> Direct impacts to Black Cockatoos (e.g. injury or mortality)
<ul style="list-style-type: none"> No impacts to water quality in Helena River or 'Wetland East' that could impact CFM populations outside the Proposed Action 	<ul style="list-style-type: none"> Implement suitable soil stabilisation and sediment control prior to commencement of ground disturbing works and maintain these as appropriate for the duration of the works. Fuel and chemicals in bunded areas located away from drainage lines and areas where spills could flow into the water bodies including Helena River and 'Wetland East'. No refuelling or servicing of vehicles/machinery in the vicinity of Helena River or 'Wetland East'. Spill response equipment available in the vicinity of Helena River and 'Wetland East'. Construction phase stormwater and runoff will be captured via retention basins, sediment traps, filter strips and gross pollutant traps as appropriate. Operational phase stormwater drainage will be captured and infiltrated via basins/swales and, sediment trap, filter strip, gross pollutant traps, whichever is appropriate, in the road reserve and will not directly discharge into Helena River. Nutrient stripping basins shall be considered and positioned, where required, to minimise the transport of pollutants into the environment. 	<ul style="list-style-type: none"> Minimal suspended solids entering Helena River and wetlands Any spills/leaks cleaned up. Treatment of stormwater pollutants located at seven critical discharge points. 	<ul style="list-style-type: none"> Visual inspections of Helena River and 'Wetland East', and associated soil stabilisation and sediment controls and stormwater drainage structures (particularly during rainfall events) to ensure they remain effective. To be undertaken every two weeks during construction. Fortnightly inspections to ensure appropriate spill response equipment remains available in the vicinity of the Helena River and 'Wetland East'. Recording spills/leaks. 	<ul style="list-style-type: none"> Degradation of CFM habitat in Helena River or 'Wetland East' resulting in decline of populations nearby or adjacent populations.

7.4 Effectiveness of Avoidance and Mitigation Measures

Main Roads has a strong track record of developing and implementing best practice in environmental management and implementation of management measures. The measures proposed herein have been successfully implemented on past projects subject to EPBC conditions and management measures, including the following projects for which Compliance Reports have been issued in the past year:

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

Main Roads is a State agency with an assured record of responsible environmental management and environmental management systems. Main Roads is not subject to any past or present proceedings under Commonwealth or State law for protection of the environment or conservation and sustainable use of natural resources. Main Roads' track record indicates a history of effective implementation and monitoring of management measures to ensure effectiveness. Main Roads has also demonstrated effective implementation of corrective actions when effectiveness does not meet completion criteria.

7.5 Reporting

Results of monitoring and compliance with proposed management actions will be reported to DCCEEW as part of the Annual Compliance Report in line with the Annual Compliance Report Guideline. The format of this report will be consistent with requirements stipulated by DCCEEW. The report will document compliance with conditions of approval.

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

The number and type of contingency actions to be implemented in the case of environmental incidents will depend upon various factors, including the state of the natural surrounding environment, the location of the trigger and the works undertaken at the time of the exceedance. The contingency actions will include changes to equipment / processes / management measures if required. Any changes to processes / management will be updated in the management actions. These changes will be communicated through site inductions / toolbox meetings.

8. Relevant Policies and Publications

The relevant recovery plans and threat abatement plans considered during the assessment of the Proposed Action have been outlined in Table 20.

Table 20 Assessment against Recovery and Threat Abatement Plans

Recovery Plan / Abatement Plan	Priority Actions	Assessment against Plan
<p>Shrublands and Woodlands of the Eastern Swan Coastal Plain TEC</p> <p>(DotEE 2016) Approved Conservation Advice for Shrublands and Woodlands of the Eastern Swan Coastal Plain TEC</p>	<p>The Conservation Advice outlines the priority actions suggested for threat abatement and to support the recovery of the ecological community. The key threats include clearing, altered fire regimes, weed invasion, grazing, introduction of disease, hydrological changes, pollution and erosion. The following are the key approaches to achieve conservation objective relevant to the Proposed Action;</p> <ul style="list-style-type: none"> • Preventing vegetation clearing and direct habitat damage; minimising clearing, fragmentation or detrimental modification of the remnants of the TEC; mapping the boundaries; protect mature trees, particularly with hollows; retain remnant native vegetations. • Manage access to remnant vegetation to prevent disturbance and spread of plant pathogens and weeds. • Avoid the requirement for offsetting, by avoiding and mitigating impacts to the ecological community first. • Prior to removal of any trees, or use of heavy machinery that may also damage the understorey, ensure comprehensive flora and fauna surveys have identified threatened species on site and their potential shelter and nesting sites. • Prevent weed invasion by minimising any soil disturbance. • Following disturbances implement a weed control program that responds to weed establishment. • Use appropriate hygiene to minimise the introduction or spread of weeds at susceptible sites 	<p>The Proposed Action is consistent with the recommendation of the Conservation Advice as there is no clearing of this TEC. There will be no significant hydrological changes or pollution that could impact on the TEC.</p> <p>Management measures for indirect impacts include treatment and hygiene to avoid the introduction and spread of weeds and dieback</p>
<p>Banksia Woodlands of the Swan Coastal Plain TEC</p> <p>Threatened Species Scientific Committee 2016, Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community, Department of the Environment and Energy</p>	<p>A Recovery Plan is absent for the TEC and the Conservation Advice is considered to sufficiently outline the conservation actions needed for the ecological community. The Conservation Advice outlines the following key approaches to achieve conservation objective relevant to the Proposed Action:</p> <ul style="list-style-type: none"> • Preventing vegetation clearance and direct habitat damage; Prevent further clearance, fragmentation, or detrimental modification of remnants of the ecological community and of surrounding native vegetation; Avoid the requirement for 	<p>The Proposed Action is consistent with the recommendations of the Conservation Advice as follows:</p> <ul style="list-style-type: none"> • The Proposed Action will result in the direct loss of 14.94 ha of BWSCP TEC vegetation, which is equivalent to a 0.006 % reduction in extent at the Perth IBRA Subregion scale. The potential impact area on the TEC has been reduced from 22.83 ha to 14.94 ha through changes in design, which involved realignment of the Principal Shared Path to remove two sections of the TEC from the DE. Three sites with a total area

Recovery Plan / Abatement Plan	Priority Actions	Assessment against Plan
	<p>offsetting, by avoiding and mitigating impacts to the ecological community first.</p> <ul style="list-style-type: none"> • Prevent weed invasion by minimising any soil disturbance • Retain habitat features for fauna • Prior to removal of any trees, or use of heavy machinery that may also damage the understorey, ensure comprehensive flora and fauna surveys have identified threatened species on site and their potential shelter and nesting sites. • Control runoff to prevent movement of weed material into natural areas. • Prevent further introduction of feral animals • Monitor for <i>Phytophthora cinnamomi</i> and other plant pathogens to minimise the risk of new infestations in areas that are not yet infested. • Use appropriate hygiene to minimise the introduction or spread of weeds and diseases at susceptible sites. • Manage groundwater extraction by monitoring changes to levels of groundwater over the long-term. • Identify and implement appropriate fire management regimes. 	<p>containing 163 ha of TEC will be set aside for conservation purposes to offset the residual impact.</p> <ul style="list-style-type: none"> • The Proposed Action may result in changes to groundwater levels associated with the TEC due to dewatering activities, however, it is temporary in nature. • Runoff will be controlled through the drainage strategy prepared for the Proposed Action. According to the strategy, various drainage options such as drainage via pit and pipe networks, table drains towards existing/proposed infiltration basins, linear infiltration basins and overflow channels will be developed depending on the site and existing drainage system. • The area is at low risk of accidental fire from 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. An emergency management plan will be prepared. • Weeds and dieback have been mapped throughout the DE (Biota 2021; Galvan 2020). • Comprehensive flora and fauna surveys have been undertaken across the DE and surrounds (Biota, 2021). Biota conducted survey on weeds and dieback presence in the Proposed Action. The information of weed and dieback infested location are recorded and mapped. The biological report also comprises detailed information on vegetation and fauna in the DE. • A Hygiene Management Plan will be implemented for construction of the Proposed Action to minimise risk of the impact of disease and impact of spread of invasive flora. • Access to the Project will be managed with restriction through appropriate fencing, gate installation and vehicle hygiene management. • The Proposed Action will not lead to significant loss of the ecological community.

Recovery Plan / Abatement Plan	Priority Actions	Assessment against Plan
<p>Carnaby's Cockatoo</p> <p>Department of Parks and Wildlife 2013, Carnaby's Cockatoo (<i>Calyptorhynchus latirostris</i>) Recovery Plan, Department of Parks and Wildlife, Perth, Western Australia</p>	<p>The objective of this Recovery Plan is to stop further decline in the distribution and abundance of Carnaby's Cockatoo by protecting the birds throughout their life stages and enhancing habitat critical for survival throughout their breeding and non-breeding range, ensuring that the reproductive capacity of the species remains stable or increases.</p> <p>The recovery actions within the plan include:</p> <ul style="list-style-type: none"> • Protect and manage breeding habitat and associated feeding habitat • Protect and manage non-breeding habitat • Undertake regular monitoring • Conduct research to inform management • Manage other impacts • Engage with the broader community • Undertake information and communication activities. <p>The Recovery Plan specifies activities that will adversely affect Carnaby's Cockatoo should be avoided, and then minimised or mitigated if avoidance cannot be achieved.</p>	<p>The Proposed Action is consistent with the recommendations of the Recovery Plan, through the following.</p> <ul style="list-style-type: none"> • The Proposed Action will involve clearing of 33.48 ha of high-quality foraging habitat for Carnaby's Cockatoo. However, seven sites will be set aside for conservation purposes to offset the loss. One offset site involves revegetation guided by the revegetation plan. • Change in design of the Proposed Action was implemented which led to reduction of impact area on the foraging habitat for the species from 47.28 ha to 33.48 ha. • The Proposed Action will not involve clearing of any known roosting trees. • The Proposed Action will not involve clearing of any trees with suitable hollows for Black Cockatoo breeding. • Biota (2021) carried out targeted surveys to identify Carnaby's Cockatoo habitat in the DE and the assessment included consideration of Carnaby's Cockatoo habitat mapping by DBCA. • The Proposed Action has been planned and designed to minimise clearing of potential breeding and foraging habitat for Carnaby's Cockatoo. • 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. An Emergency Response Management Plan has been prepared (GCA, 2023). • The Proposed Action incorporates design, construction and management measures to protect potential breeding and foraging habitat in adjacent native vegetation. • Planning and design of the Proposed Action has involved consultation with relevant stakeholders including the broader community. <p>The Proposed Action is not inconsistent with the Carnaby's Cockatoo Recovery Plan (2013).</p>

Recovery Plan / Abatement Plan	Priority Actions	Assessment against Plan
<p>Baudin's Cockatoo and TSSC 2018b Conservation Advice <i>Calyptorhynchus baudinii</i> Baudin's Cockatoo</p>	<p>The recovery plan adopted for the species ceased to be in effect from 1/10/21 and has not been replaced. The Approved Conservation Advice is considered sufficient for assessing the Proposed Action.</p> <p>The primary threats listed in the conservation advice include:</p> <ul style="list-style-type: none"> • Habitat loss from land clearing activities due to agriculture, forestry and mining • Nest hollow shortages • Fire events • Competition with native and invasive species (European Honeybees) • Illegal shooting by orchardists • Phytopathogens • Climate change <p>The primary conservation actions include:</p> <ul style="list-style-type: none"> • Limiting the amount of illegal shooting. • Increasing number of nest hollows through limiting loss of mature trees. <p>With respect to habitat loss, disturbance and modifications, the priorities include:</p> <ul style="list-style-type: none"> • Develop and implement a policy for the identification of old-growth forest areas for retention and protection of existing hollow-bearing trees and future habitat trees that may develop hollows in the next 50-100 years. • Develop and implement a policy for the retention and mapping of hollow-bearing trees in urban and agricultural areas, and managed forests. • Undertake habitat restoration by revegetating suitable area with key tree species • Manage fire regime • Develop and implement control program for reduction of feral European honeybees 	<p>The Proposed Action is consistent with the recommendations of the Conservation Advice, through the following:</p> <ul style="list-style-type: none"> • The Proposed Action is not related to mining, orchards, or forest management, nor is the Proposed Action expected to increase the prevalence of feral honeybees or risk of illegal shooting • Changes in design of the Proposed Action have led to reduction of impact area on the foraging habitat for the species from 47.28 ha to 33.48 ha. • The Proposed Action will involve clearing of 33.48 ha of low-quality foraging habitat for Baudin's Cockatoo. However, five sites will be set aside for conservation purposes to offset the residual impact. • Biota has undertaken extensive survey of the potential Black Cockatoo foraging, breeding and nesting area within the DE. The area is at low risk from accidental fire due to the Proposed Action. • The Proposed Action will not involve clearing of any known or potential breeding trees with suitable hollows. • The Proposed Action will not involve clearing of any known roosting trees. • 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. An Emergency Response Management Plan has been prepared (GCA, 2023). • The DE has been planned and designed to minimise clearing of Baudin's Cockatoo foraging habitat. • A Hygiene Management Plan will be implemented for construction of the Proposed Action to protect non-infested areas, minimise risk of the impact of disease and impact of spread of invasive flora. <p>The Proposed Action is not inconsistent with the Approved Conservation Advice for Baudin's Cockatoo.</p>

Recovery Plan / Abatement Plan	Priority Actions	Assessment against Plan
<p>Forest Red-tailed Black Cockatoo DEWHA 2009 Conservation Advice <i>Calyptorhynchus banksii naso</i> Forest Red-tailed Black Cockatoo</p>	<ul style="list-style-type: none"> Implement management actions to reduce spread of phytopathogens, manage and contain infested areas and protect non-infested areas. <p>The recovery plan adopted for the species ceased to be in effect from 1/10/21 and has not been replaced. The Approved Conservation Advice is considered sufficient for assessing the Proposed Action.</p> <p>The primary threats listed in the conservation advice include:</p> <ul style="list-style-type: none"> Habitat loss from land clearing and fire Nest hollow shortages Competition with other species Injury or death from invasive species (European Honeybees) Illegal shooting. <p>The priority actions include:</p> <ul style="list-style-type: none"> Determine and implement measures to reduce effect of the Proposed Action on habitat loss Determine and implement measures to manage forest for the conservation of the species <p>Develop and implement management plan for the control and reduction of feral European Honeybees.</p>	<p>The Proposed Action is not inconsistent with the recommendations of the Conservation Advice, through the following:</p> <ul style="list-style-type: none"> The Proposed Action will involve clearing of 33.48 ha of quality foraging habitat for Forest Red Tailed Cockatoo. However, five sites will be set aside for conservation purposes to offset the loss. The Proposed Action will involve clearing of 33.48 ha of low-quality foraging habitat for Baudin’s Cockatoo. However, five sites will be acquired for conservation to offset the residual impact The Proposed Action is not expected to increase the prevalence of feral honeybees or risk of illegal shooting Black Cockatoo habitat identification was carried out extensively by Biota as a part of biological survey for the Proposed Action. The assessment also considered DBCA’s data on the species. The Proposed Action will not involve clearing of any known or potential breeding trees with suitable hollows The Proposed Action will not involve clearing of any known roosting trees. A Hygiene Management Plan will be implemented for construction of the Proposed Action to protect non-infested areas, minimise risk of the impact of disease and impact of spread of invasive flora. The DE has been planned and designed to minimise clearing of FRTBC foraging habitat <p>The Proposed Action is not inconsistent with the Approved Conservation Advice for FRTBC.</p>

Recovery Plan / Abatement Plan	Priority Actions	Assessment against Plan
<p>Carter's Freshwater Mussel TSSC 2018a Conservation Advice <i>Westralunio carteri</i> Carter's freshwater mussel</p>	<p>No recovery plan has been prepared for this species, as it is considered that the Approved Conservation Advice provides sufficient direction to implement priority actions and mitigate against key threats (TSSC, 2018a)</p> <ul style="list-style-type: none"> • Increased salinity. The species is considered unlikely to survive in waters where salinity is >2ppt. • Water extraction, dehydration, heat stress • Loss of suitable host species • Nutrient pollution • Cattle tramping • Predation by pigs 	<ul style="list-style-type: none"> • The Proposed Action does not involve agricultural practices or land clearing at a scale that may increase salinity and will not result in an increase in salinity levels in the Helena River and Wetland East. • The Proposed Action does not involve practices that would result in significant changes in nutrient status of the Helena River or Wetland East. • The Proposed Action will be designed so that there will be no significant changes to the hydrology of the Helena River or Wetland East. • The Proposed Action is likely to reduce rather than increase the cattle access to potential habitat. No activities associated with the Proposed Action will influence behaviour of feral pigs and no evidence of them has been recorded in the DE (Biota, 2021). • Runoff will be controlled through the drainage strategy prepared for the Proposed Action. According to the strategy, various drainage options such as drainage via pit and pipe networks, table drains towards existing/proposed infiltrations basins, linear infiltration basins and overflow channels will be developed depending on the site and existing drainage system. • Sediment will be controlled during construction through the implementation of an Erosion and Sediment Control Plan (GCA, 2022).
<p>Wavy-leaved Smokebush Department of Environment and Conservation (2009a). Wavy-leaved Smokebush (<i>Conospermum undulatum</i>) Recovery Plan. Commonwealth Department of the Environment, Water, Heritage and the Arts, Canberra</p>	<p>The objective of this Recovery plan is to maintain or improve the conservation status of <i>Conospermum undulatum</i> during the term of this plan by abating identified threats. The Recovery Plan states the following recovery actions for <i>C. undulatum</i>:</p> <ul style="list-style-type: none"> • Coordinate recovery actions • Monitor populations • Liaise with relevant land managers regarding management of bushland containing <i>C. undulatum</i>. 	<ul style="list-style-type: none"> • The Proposed Action will not contribute to the failure criteria of the Recovery Plan: • A targeted survey was conducted within the DE and adjacent habitats • The Proposed Action will not interfere with the monitoring of populations, liaison with land managers, the collection of seed, assessment of development applications, research trials, fire management strategies, or raising awareness of the species • A Hygiene Management Plan will be implemented for construction of the Proposed Action to protect non-infested areas, minimise risk of the impact of disease and impact of spread of invasive flora.

Recovery Plan / Abatement Plan	Priority Actions	Assessment against Plan
	<ul style="list-style-type: none"> • Install DRF markers at Populations 14,17 and 23 and sub populations 1c-e, 4g, 4k, 4o, 8b, 10a+d, 11b, 16b-l, 18i,18j, 18n and 22a and b. • Fence subpopulations • Collect seed and other material to preserve genetic diversity • Undertake weed control • Develop and implement a rabbit control strategy • Reassess population numbering and size based on tenure • Assess development applications for lands containing <i>C. undulatum</i> • Increase area of <i>C. undulatum</i> the conservation estate - • Conduct further surveys • Develop and implement a fire management strategy • Promote awareness • Develop and implement fire and soil disturbance trials • Obtain biological and ecological information • Map habitat critical to the survival of <i>C. undulatum</i> • Review the plan and need for further recovery actions. 	<ul style="list-style-type: none"> • As indicated by DBCA, this species is known from 25 populations with 14,147 plants recorded in total. Only one individual of the total population will be impacted, which will result in its regional abundance being reduced by 0.007%. • The recovery plan states that in the future the importance of populations and subpopulations may be modified based on new and specific site information and that similarly decisions on the protection or management should be based on site-specific information in conjunction with a whole species consideration. During consultation for the State native vegetation clearing application, DBCA has advised that the one plant recorded for subpopulation 21 has not been re-located since 2001, and no <i>C. undulatum</i> plants were present at this location when searched by Biota (2021), suggesting that this population no longer exists. DBCA also indicated that sub-population 23a is unlikely to be extant as the area has been extensively cleared. Similarly, subpopulations 23b and 23c were last surveyed in 2009 with only three and two plants recorded, respectively. However, the plants could not be located during the survey by Biota and no monitoring has been carried out in the last 13 years. It is therefore reasonable to conclude the five plants of subpopulations 23b and 23c no longer exist at these locations. Population 23 is located between an existing road and other patches of cleared land. Other populations in the local area are larger and in better condition. Potential impacts of the Proposed Action on population -2 at the western side of Roe Hwy have been avoided during re-design. <p>The above matters have been considered when assessing the proposed action against the following threats to the species defined in the Recovery Plan:</p> <p>Land Clearing – the DE has been refined to minimise the number of individuals and area of critical habitat requiring clearing. The change in design of the Proposed Action has reduced clearing requirement of this species from 3 individuals to 1 plant.</p> <p>Degradation of natural habitat – the Proposed Action will not result in a significant change to the condition of habitat in the local area, which the Recovery Plan recognises is already degraded.</p> <p>Road and firebreak maintenance – the proposed action will take place in an existing road reserve. The proposed action is consistent with the approved land use.</p>

Recovery Plan / Abatement Plan	Priority Actions	Assessment against Plan
		<p data-bbox="1444 220 2089 272">Lack of fire – the proposed action will not result in a significant change to fire regime.</p> <p data-bbox="1444 288 2089 373">Weeds – a weed and hygiene management plan will be implemented to make sure introduction and spread of weeds is appropriately mitigated.</p> <p data-bbox="1444 389 2089 474">Recreational activities – the proposed action is not associated with recreation activities such as horse riding, or off-road motor biking or four-wheel driving.</p> <p data-bbox="1444 489 2089 542">Rabbit grazing – the proposed action is unlikely to result in a significant change to grazing by rabbits.</p>

9. Offsets

9.1 Proposed Offset Strategy

Main Roads has developed a package of offsets to counterbalance the significant residual impacts of the Proposed Action to BWSCP TEC, Carnaby's Cockatoo, FRTBC and Baudin's Cockatoo. The options comprise freehold land owned by Main Roads and land acquisition to form 100% of the Banksia Woodland TEC and 90% for Black Cockatoos foraging, Research offset forms up to 10% of impacts to Black Cockatoo species as summarised in Table 21.

Land acquisition offsets involve acquisition of land by the Crown and land transfer to the conservation estate, which will enable land management by DBCA as the lead agency in WA responsible for conservation management. DBCA will be responsible for vesting the land with the Conservation and Parks Commission of WA, which will provide a conservation mechanism to maintain the offset ecological values in perpetuity. For each of the land offsets acquired, Main Roads will fund twenty years of DBCA land management activities. These land management costs are negotiated on a site-by-site basis, and costs are formalised through separate Memoranda of Understanding (MoU).

The MoU commits Main Roads funding to assist DBCA in the implementation of management activities at the offset sites. Acquisition of suitable offset land aims to satisfy Commonwealth and State environmental compliance requirements.

9.2 Extent to which Offset Package Compensated Potential Significant Residual Impacts

The proposed offset package is expected to provide adequate compensation and environmental benefit for potential significant residual impacts to BWSCP TEC, Carnaby's Cockatoo, FRTBC and Baudin's Cockatoo. Table 22 provides a summary of the offset package to counterbalance the potential significant residual impacts to BWSCP TEC, Carnaby's Cockatoo, FRBTC and Baudin's Cockatoo.

Offsets include areas already managed by Main Roads, acquisition and transfer of properties to DBCA Conservation estate, and revegetation of land held by Main Roads, to provide a 100% direct offset for significant residual impacts to BWSCP TEC and 90% direct offset to foraging habitat for the three Black Cockatoo species. The remaining 10% of impacts to Black Cockatoo species will be offset through funding Black Cockatoo research being conducted by Murdoch University. These offsets would counterbalance 100% of the residual impacts to BWSCP TEC, Carnaby's Cockatoo, FRBTC and Baudin's Cockatoo.

The offset sites have been surveyed with information on the environmental values at each offset site summarised in the sections below. The quality of values associated with MNES were assessed as a part of offset strategy and found to be adequate to achieve offset requirements.

An Offset Strategy, **Appendix D**, has been prepared and is intended to be implemented as a condition of the Commonwealth Approval. The Offset Strategy (GCA 2023) meets the requirements of the DCCEEW's EPBC environmental offsets policy including details of the proposed offset suitability such as locations and areas, level of certainty attached to achieving the environmental outcomes of the offset, and the quality of the offset.

The Offset Strategy is based on the findings of biological surveys and consultation with DBCA. It will achieve a minimum 100% offset for the four MNES.

Table 21 Summary of offset package being considered

No	Offset Type	Offset Summary	Property Location	Tenure
1	Direct	163 ha of land transfer to DBCA	Durigen Road and Cowalla Road, Cowalla	Owned by State of WA, management order to DBCA. MR funded acquisition
2	Direct	Revegetation of 29.29 ha of land managed by Main Roads	Neaves Road, Bullsbrook	Freehold land owned by Main Roads
3	Direct	62.16 ha of land transfer to DBCA	Jacka Rd, Boallia	Owned by State of WA, management order to DBCA. MR funded acquisition
4	Direct	91 ha land transfer to DBCA	Crossman	Owned by State of WA, management order to DBCA. MR funded acquisition
5	Direct	80 ha of land transfer to DBCA	Hoffman	Owned by State of WA, management order to DBCA. MR funded acquisition
6	Indirect	<p>Funding contribution to Murdoch University Research</p> <p>Conservation Management for the long-term survivorship of Black Cockatoos endemic to the south-west of Western Australia: the application of telemetry to determine spatial ecology on the Perth-Peel Coastal Plain, south-west forest region and key breeding sites in response to a changing environment.</p>		

Table 22 Summary of offset package to mitigate significant residual impacts

Offset Site	MNES Values Confirmed	Residual Impacts to MNES				Total area
		Banksia Woodland TEC <i>14.94 ha x quality 6 (impact)</i>	Baudin's Cockatoo <i>33.48 ha x quality 6 (impact)</i>	Carnaby's Cockatoo <i>33.48 ha x quality 6 (impact)</i>	FRTBC <i>33.48 ha x quality 6 (impact)</i>	
Offset 1 Cowalla	Surveyed (FVC, 2022)	163 ha (HQS 8) 100.27% of impact offset	Nil. Outside modelled distribution	163 ha (HQS 6), 44.74% of impact offset	Nil. Outside modelled distribution	163 ha
Offset 2 Neaves Road	Inferred (AECOM 2020; Coffey, 2014)	Nil. No TEC present	Nil. Outside modelled distribution	29.29 ha (HQS 4), 19.41% of impact offset	29.29 ha (HQS 6), 14.29% of impact offset	29.29 ha
Offset 3 Boallia	BC habitat surveyed (SW Environmental, 2022)	Nil. No confirmed TEC present	62.16 ha (HQS 9), 34.13% of impact offset	62.16 ha (HQS 9), 17.06% of impact offset	62.16 ha (HQS 9), 20.81% of impact offset	62.16 ha
Offset 4 Crossman	BC habitat surveyed (AECOM2023,)	Nil. No TEC present	91 ha (HQS 7), 49.96% of impact offset	91 ha (HQS 8), 24.98% of impact offset	91 ha (HQS 7), 30.47% of impact offset Nil.	91 ha
Offset 5 Hoffman	BC habitat surveyed (AECOM, 2023)	Nil. No TEC present	63 ha (HQS 8), 34.59%	80 ha (HQS 6), 21.96% of impact offset	74 ha (HQS 9), 24.78% of impact offset	80 ha
Offset6 Research		Nil. No research offsets	0 ha, 0%, research offset not required	0 ha, 0%, research offset not required	0 ha, 10% of impact offset	
Total impact of offsets to MNES		163 ha, 100.27% of impact offset	216.16 ha, 118.67% of impact offset	425.45 ha, 128.16% of impact offset	256.45 ha, 100.35% of impact offset	425.45 ha

9.3 Suitability of Potential Offset Sites

All proposed sites are suitable to offset BWSCP TEC and Black Cockatoo habitat. Additional vegetation, flora and fauna surveys will be conducted where required to confirm the environmental values present at the offset sites. More details on the offset site are included in the Offset Strategy including the suitability of each site as an offset.

9.3.1 Offset 1 – Lots 87 and 88 Durigen Road, Cowalla

Offset 1 covers 163 ha located within 1,383 ha across two adjacent lots on Durigen Road, Cowalla, Shire of Gingin, approximately 95 km from Perth CBD. The site is proposed as an offset for BWSCP TEC and foraging habitat for Carnaby's Cockatoos.

Main Roads commissioned Focused Vision Consulting (FVC) (2022) to undertake a biological assessment of this site, as well as two adjacent lots. The dominant vegetation unit comprises low lying *Banksia attenuate* woodlands, *B. ilicifolia* and *B. attenuate-B. menziesii* woodlands. The biological survey report is provided as **Appendix E**.

FVC (2022) mapped 890.43 ha of BWSCP TEC within Offset 1, with more than half considered to be in Excellent condition. Approximately 70% of the vegetation within the 163 ha offset site was assessed to be in Excellent condition.

The offset site is within the known distribution range of Carnaby's Cockatoo, and therefore are considered likely to use offset 1. The quality of foraging habitat ranges from 'low to moderate' to 'very high' for the Black Cockatoo species. A total of 21 potential breeding trees were recorded in the survey area, of which one contains a suitable hollow. The offset site provides 'high' quality foraging habitat for Carnaby's Cockatoo but 'low quality' foraging habitat for FRTBC. The offset site will offset 100.27% and 44.74% of total quantum of impact on BWSCP TEC and foraging habitat of Carnaby's Cockatoo, respectively. Main Roads proposes to allocate 163 ha of the BWSCP TEC within this site to offset 100% of the residual impacts.

The survey report is provided as **Appendix E**.

9.3.2 Offset 2 – Neaves Road, Lot 156 on Plan P056488

Offset 4 is 29.29 ha, located on the corner of Neaves Road and Tonkin Highway, in Bullsbrook, City of Swan, on Lot 156 on Plan P056488 located approximately 25 km north of the Proposed Action. The site is proposed as a revegetation offset for Carnaby's Cockatoo and FRTBC foraging habitat.

The site was surveyed by Coffey Environments Australia Pty Ltd (Coffey) in 2014 as part of a biological survey for the Perth to Darwin National Highway. Native vegetation was mapped as predominantly Degraded-Completely Degraded, followed by Completely Degraded, and Good-Degraded condition (Coffey, 2015). The vegetation associations providing the most suitable foraging habitat include revegetated *Corymbia* sparse mid woodland, and *Eucalyptus* sparse mid Woodland Creek line/floodplain. The *Melaleuca* open low woodland vegetation association also provides moderate quality habitat (AECOM, 2020; Coffey, 2015). Most of these vegetation associations are dominated by remnant *Corymbia calophylla* (Marri), *Eucalyptus camaldulensis* (River Redgum), *Eucalyptus tottiana* (Coastal Blackbutt/ Pricklybark), and open paddocks with remnant *Corymbia calophylla* (Marri) and *Eucalyptus rudis* subsp. *rudis* (Flooded gum) (Coffey 2015)

The vegetation condition is assessed as 'low' for Carnaby's Cockatoo and 'low to moderate' for FRTBC. The 29.29 ha offset site is considered suitable to offset 19.22 % of the total quantum of impact of foraging habitat for Carnaby's Cockatoos and 14.15 % of the total quantum of impact of foraging habitat for FRTBC by the Proposed Action. The offset site provides high quality foraging habitat for both Carnaby's Cockatoo and FRTBC.

The site was partially surveyed again in 2020 by AECOM Australia Pty Ltd (AECOM, 2020), on behalf of the Department of Planning, Lands and Heritage (DPLH) to inform planning of future works. AECOM (2020) observed six Carnaby's Cockatoo flying over the Offset 4 area and foraging evidence (chewed Marri nuts). AECOM (2020) also recorded both male and female FRTBC foraging within Tuart trees located approximately 2.5 km east of the offset site.

The survey reports are provided as **Appendix F**.

This land is owned by Main Roads and it is proposed to be revegetated to enhance the quality of Carnaby's and FRTBC habitat at the site to offset impacts associated with the proposed action.

9.3.3 Offset 3 – Lot 2628 Jacka Rd, Boallia

Offset 5 is 62.16 ha, located on Lot 2628 on Plan 203052, Jacka Road Boallia, City of Busselton. The site is approximately 210 km south of the Perth CBD and the DE. The site is proposed as an offset for the foraging habitat for three Black Cockatoo species.

Main Roads commissioned SW Environmental to undertake a fauna survey of Offset 5. SW Environmental (2022) mapped 61.36 ha Jarrah and Marri open forest habitat, which provides high quality foraging habitat for all three Black Cockatoo species. SW Environmental (2022) recorded direct and indirect evidence of foraging by all three Black Cockatoo species.

DBCA conducted a preliminary fauna assessment of Lot 2628 in March 2022. No direct observations of significant fauna species were recorded. Old indirect evidence of Brushtail Possum (dry scats), Quenda (diggings) and Black Cockatoos (chewed nuts) were recorded (Williams, 2022). The site is expected to contain suitable foraging habitat for Black Cockatoos and suitable habitat for the Western Ringtail Possum.

Andrew Webb completed a site inspection of Lot 2628 in 2015. Webb (2015) mapped five vegetation communities, with the entire site considered to be in Excellent-Pristine condition. Webb (2015) recorded Baudin's Cockatoo and the FRTBC foraging within the site. The 61.30 ha offset site is considered suitable to offset 33.65% of the total quantum of impact on foraging habitat for Baudin's Cockatoos, 20.52% of the total quantum of impact on the foraging habitat for FRTBC, and 16.83% of a total quantum of impact on foraging habitat for Carnaby's Cockatoos.

The biological survey reports are provided as **Appendix G**.

9.3.4 Offset 4 – Albany Hwy, Crossman

Lot 3 Albany Highway, Crossman, is located approximately 100 km south-east of the Proposed Action in the Wheatbelt region within the Shire of Boddington. The offset site measures 91 ha which will be used to offset foraging habitat for the three Black Cockatoos.

In a recent survey carried out by AECOM (2023), a total of 205.23 ha of habitat for Carnaby's Cockatoo, 147.70 ha for FRTBC and 205.23 ha, for Baudin's Cockatoo, was recorded. The upper storey vegetation is dominated by Jarrah (*Eucalyptus marginata*), Wandoo (*Eucalyptus wandoo*), and Powderbark Wandoo (*Eucalyptus accedens*), with limited Marri (*Corymbia calophylla*). Dominant understorey and midstorey species used by Black Cockatoos as food included Rock Sheoak (*Allocasuarina hugeliana*), *Hakea lissocarpha*, *Banksia sessilis*, *B. dallanneyi*, *B. fraseri* and *B. squarrosa* (AECOM, 2023). All species, except Powderbark Wandoo are used by Black Cockatoo as food resources.

Foraging evidence was recorded for Carnaby's Cockatoo at six locations by AECOM (2023). Evidence for foraging was also recorded within the offset site at 21 locations for Baudin's Cockatoo and 10 locations for FRTBC.

The vegetation condition and structure were assessed as 'Moderate to high' for Carnaby's Cockatoo and 'Moderate' for Baudin's Cockatoo and FRTBC and provides an overall high quality foraging habitat for the three Black Cockatoo species.

The 91 ha offset site is considered suitable to offset 49.96% of the total quantum of impact on foraging habitat for Baudin's Cockatoo, 24.98% of the total quantum of impact on foraging habitat for Carnaby's Cockatoo and 30.47% of the total quantum of impact on foraging habitat for FRTBC.

The survey report is provided as **Appendix H**

9.3.5 Offset 5 – Hoffman

Offset 7 is 80 ha located in Hoffman, Shire of Harvey, approximately 130 km south of the Perth CBD and DE. The site is proposed as an offset for foraging habitat for the three species of threatened Black Cockatoos. The 85 ha land parcel include 5 ha of land which has been cleared or falls with the gazetted Western Power easement. The offset site of 80 ha has been set aside to accounting 5 ha for the future clearing of the easement by Western Power. The offset site is dominated by Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) with some large Marri and Blackbutt (*E. patens*). 74 ha, 63 ha and 80 ha of the offset site provides high quality foraging habitat for FRTBC, Baudin's Cockatoo and Carnaby's Cockatoos, respectively (**Appendix H**). The 80 ha offset site is considered suitable to offset 34.59 % of the total quantum of impact on foraging habitat for Baudin's Cockatoos, 24.78 % of the total quantum of impact on the foraging habitat for FRTBC, and 21.96 % of a total quantum of impact on the foraging habitat for Carnaby's Cockatoos from the Proposed Action. This site comprises remnant vegetation with a contiguous connection to lands being managed by DBCA and therefore would provide a valuable addition to the State's conservation estate.

The survey report is provided as **Appendix H**.

9.3.6 Murdoch University Research Agreement

The Black Cockatoo offset strategy is built around direct offsets with only 10% of the total proposed offset package being indirect, in the form of research. Except for FRTBC, 100% offset for Banksia Woodland TEC, Carnaby's Cockatoo and Baudin's Cockatoo are met by direct offset. 100% of the FRTBC offset comprise 90% direct offset and 10% indirect offset through this research agreement. The research offset includes funding contribution of \$861,467 to the Murdoch University Research Agreement for Black Cockatoo research over the period 2019 to 2024. The funding intends to provide an offset bank to counterbalance impacts to Black Cockatoos resulting from Main Roads' projects. To date \$556,970 has been paid to Murdoch University. The research will investigate conservation management for the long-term survival of Black Cockatoos endemic to the south-west of Western Australia. The research includes the application of telemetry to determine spatial ecology on the Perth-Peel Coastal Plain, south-west forest region and key breeding sites in response to a changing environment.

The Research Agreement commenced in 2019 and generates data to identify key habitats and areas for conservation/revegetation, determining threatening processes for Black Cockatoo species across their range, and information for decision making in relation to conservation and land management planning at both State and Commonwealth government levels. The Research proposal addresses major priority actions in the Carnaby's Cockatoo and FRTBC recovery plans and is fully supported by the chairs of the Carnaby's Cockatoo and FRTBC recovery teams.

9.3.7 Conservation gain, timing and certainty

A conservation gain will be achieved for offsets that involve transfer of land to DBCA through protection against loss and land management to maintain MNES values. Management actions such as fencing, weed management and dieback hygiene will ensure conservation gain at the offset sites. It will be further strengthened by the Offset Management Plan (GCA 2023) that details how these actions will be implemented. The Offset Management Plan is provided in **Appendix I**. Aside from offset 2 which is owned by Main Roads, Main Roads has provided funding for the acquisition of all other offset land that will be transferred to the conservation estate under the management of DBCA. The sites will be managed by DBCA for 20 years in accordance with the MoUs signed with Main Roads.

Where offsets are planned for rehabilitation and management, the time until ecological benefit was estimated to be 10 years, to allow time for plant establishment and maintenance until it becomes suitable foraging habitat for Black Cockatoos

9.4 **Land Tenure, Acquisition and Management**

DBCA will be responsible for the management and conservation of the offset sites under the 20 years MoU signed with Main Roads. Offset site 2 is located within land managed by Main Roads, within which Main Roads will have control of future land use planning.

The status of land tenure and acquisition is as given in the Table 23.

Table 23 Land tenure status of the offset sites

Offset no.	Offset Site	Acquisition status
1	Lots 5324 and 8037 Durigen Road, Cowalla	Owned by State of WA, management order to DBCA. MR funded acquisition
2	Neaves Road, Lot 156 on Plan P056488	MR Owned
3	Lot 2628 Jacka Rd, Boallia	Owned by State of WA, management order to DBCA. MR funded acquisition
4	Albany Hwy, Crossman	Owned by State of WA, management order to DBCA. MR funded acquisition
5	Hoffman	Owned by State of WA, management order to DBCA. MR funded acquisition

9.5 EPBC Act Environmental Offsets Policy

The proposed Offset Strategy is consistent with the principles of the EPBC Act Environmental Offsets Policy (DSEWPaC, 2012b) as presented in Table 24.

Table 24 Consistency with EPBC Act Environmental Offsets Policy

Policy Overarching Principles	Comment
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter	The offsets will provide a conservation outcome that maintains or improves the viability of the BWSCP TEC and foraging habitat for the three species of Black Cockatoo.
Suitable offsets must be built around direct offsets but may include other compensatory measures	The offset strategy is built around direct offsets, involving a package of suitable offset properties to provide direct offsets for 100% BWSCP TEC and 90% foraging habitat for the three Black Cockatoos. Indirect offset constitutes only 10% towards offsetting foraging habitat for Black Cockatoos through research.
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	The offset strategy is guided by DCCEEW's habitat quality scoring system and the Offset Assessment Guide, which includes input for current listing of the MNES, to ensure that the offset is in proportion to the level of statutory protection of the protected matter.
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	The provision of direct offsets is based on completed offset assessment guide calculations, incorporating evidence-based justification for all inputs.
Suitable offsets must effectively account for and manage the risks of the offset not succeeding	<p>The estimation of direct offsets is based on completed offset assessment guide calculations, incorporating a conservative assessment of risk of the offset not succeeding and Main Roads track record for achieving DBCA's acceptance of land into the conservation estate.</p> <p>Management actions proposed to be undertaken on the offset sites will include:</p> <ul style="list-style-type: none"> • Access control – fencing and gates • Fire breaks • Weed control • Dieback assessment and management • Rubbish removal. <p>These actions will prevent the decline or deterioration of the protected matters within the offset sites.</p>
Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs	The proposed offsets are additional to any other requirements and are selected to counterbalance the residual impact from the Proposed Action.
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	<p>The proposed Offset Strategy will be a transparent document developed in consultation with DBCA, DCCEEW and other relevant local stakeholders.</p> <p>Main Roads has a long history of providing suitable offsets on other projects. Main Roads has a MoU with DBCA that commits Main Roads funding to assist DBCA in identifying and acquiring suitable land offsets to be added to the conservation estate. The purpose of this MoU is to assist DBCA in acquiring suitable land offsets and placing them in an 'offset bank' which can then be utilised for future projects. With this MoU in place, it reduces the risk of Main Roads not being able to secure an appropriate offset as there are currently DBCA resources allocated to identifying and acquiring suitable offsets to satisfy Commonwealth and State environmental compliance requirements.</p>
Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	The estimation of direct offsets is based on completed offset assessment guide calculations, incorporating a conservative assessment of risk of the offset not succeeding. The governance of each offset site, including monitoring, auditing and reporting, will be documented within the Offset Management Plan (GCA 2023) and implemented in consultation with DBCA.

10. Economic and Social Matters

10.1 Financial Investment

In April 2020, the Western Australian Government announced a series of transport construction commitments to address some of Perth's congested intersections and roads. These commitments included \$180 million to build the Roe Highway – GEHB Interchange.

10.2 Cost and Benefit

The construction of a grade separated interchange at Roe Highway and GEHB will act to alleviate congestion and improve safety for local, regional and freight growth within the transport route. The Proposed Action will also improve long-term access to and from Perth's International and Domestic airports.

Approximately 60,000 vehicles pass through the intersection each day, with heavy vehicles making up to 14% of this figure. The current layout of Roe Highway at GEHB consists of four lanes (two in each direction) with a signalised intersection.

In the past five years, there has been 155 accidents at the intersection, with four requiring hospitalisations (Main Roads, 2020). The construction of a Grade Separated Interchange at the intersection of Roe Highway and GEHB will improve road user safety and enhance the efficiency of a significant economic corridor.

The objective of the project is to reduce congestion and delay at the Roe Highway – GEHB intersection and surrounding road network, so as to increase both the safety and efficiency of the movement of freight and people in the strategically significant Kewdale / Forrestfield / Welshpool area. This project will deliver the following benefits:

- Improve safety for road users and freight operators
- Time travel savings for over 60,000 road users per day
- Remove traffic lights from congestion hot spots
- Complete missing link in the 30km PSP between Midland and Jandakot
- Hundreds of construction jobs and opportunities for local suppliers
- Support commercial development in Midland
- Improve key links to Hazelmere, Forrestfield, Kewdale and Perth Airport industrial areas
- Improve access to south of Midland.

10.3 Public Consultation Activities and Outcomes

Main Roads has commenced consultation with key government stakeholders such as DCCEE, DWER EPA Services Unit (WA) and DBCA (WA). Stakeholder and community engagement is continuing with landowners and local residents, communities of interest, local government authorities and State Government agencies and will continue through the Proposed Action development timeline.

Main Roads has developed a comprehensive Community and Stakeholder Engagement Plan (CSEP) for this Project, which has determined the risks, expected issues and mitigation, communication activities and tools. This includes pre-construction communication and engagement to ensure directly impacted stakeholders have an understanding of the project prior to the commencement of construction works. The CSEP identified stakeholders to be consulted for the Proposed Action and is provided in Table 25.

Stakeholder consultation has been undertaken in accordance with the CSEP. Ongoing engagement will take place as the project progresses through design and construction. The CSEP is an evolving document designed to underpin communication and engagement of the Project through the development and delivery of the Project and incorporate stakeholder interests via ongoing review or feedback and activities. The Stakeholder Communication Strategy provides:

- A comprehensive project narrative and messaging around key issues to ensure consistency of communication.
- Identification of key issues, risks and challenges requiring careful management, along with proposed mitigation methods.
- A summary of Main Roads' approach to communication and engagement and the tools and methods utilised to maximise community involvement.

The overarching objectives of the stakeholder engagement program are to:

- Generate awareness of and support (where possible) for the project.
- Understand stakeholder and community aspirations, opportunities, issues and concerns associated with the project.
- Obtain community buy-in to the design and construction methodology, ensuring, where possible, that the project addresses community concerns.
- Minimise social and environmental impact of works.
- Build strong, ongoing relationships with the local community, generating trust and confidence in Main Roads and our vision for the road network.

Table 25 Key Stakeholders

Stakeholder Type	Stakeholder
Commonwealth Government	<ul style="list-style-type: none"> • Department of Infrastructure, Transport, Cities and Regional Development • Department of Agriculture, Water and Environment
State Government	<ul style="list-style-type: none"> • Department of Transport (DoT) • Department of Planning, Lands and Heritage (DPLH) • Public Transport Authority • Department of Water and Environmental Regulation (DWER) • Environmental Protection Authority (EPA) • Department of Biodiversity, Conservation and Attractions (DBCA)
Local Government	<ul style="list-style-type: none"> • City of Swan • City of Kalamunda • Shire of Mundaring
Utility providers	<ul style="list-style-type: none"> • Atco Gas • APA Gas • Dampier Bunbury Pipeline • Water Corporation • Western Power • Telstra • NBN • Optus • Vocus
Community	<ul style="list-style-type: none"> • Southwest Aboriginal Land and Sea Council (SWALSC) • WestCycle • Hillview Public Golf Course
Land owners	<ul style="list-style-type: none"> • Properties both north and south of the GEHB and along the conjoining roads
General public and local residents	<ul style="list-style-type: none"> • Freight and Logistics Council of WA • WA Road Transport Association • Freight Operators • Heavy Vehicle Services (HVS) • Arc Infrastructure (rail operator)
Committees and Reference Groups	<ul style="list-style-type: none"> • Helena River Catchment Group • Lower Helena River Catchment Group

10.4 Consultation with Indigenous Stakeholders

In July 2020, Main Roads commissioned Brad Goode & Associates Pty Ltd (BGA) to conduct a Site ID Archaeological and Ethnographic Aboriginal Heritage Survey of the Roe Highway - GEHB Interchanges Project. BGA Archaeologists along with Whadjuk Noongar representatives undertook an archaeological survey of the area between 21st and 23rd July 2020. No archaeological material had been found. BGA advised that no archaeological material had been identified not because it was not there, but that it was likely that it could now not be seen due to extensive modification to the landscape, poor visibility, and natural processes that cover materials over time.

BGA undertook an ethnographic survey of the area with seven nominated representatives of the Whadjuk Working Party on 28th July 2020. This was followed by another ethnographic consultation with Whadjuk representatives undertaken by BGA on 26th August 2020.

During the consultations, the Whadjuk representatives reported that it was their belief that the Helena River (Site ID 3758) in its entirety was a sacred site associated with the Waugal, and that this deity was believed to be both responsible for the river's creation and the maintenance of its water and its flows. As such it was advised that, to protect this significance, it was the jural responsibility of the Whadjuk People to provide comments and advice to proponents to ensure that any activity that would impact this significance was done in a culturally appropriate manner.

During the consultations the Whadjuk representatives advised that the plans to duplicate the bridge on Roe Highway would in their view directly and negatively impact upon the religious values held for the site. In relation to these effects, the Whadjuk representatives consulted were concerned that the bridge designs were not culturally appropriate and could block the flow of the waters of the Helena River with too many pylons in the rivers channel and floodplain, and that the abutment design could restrict the natural flood events along the river margins denying the riparian vegetation the waters that are required to sustain life.

In relation to the bridge, Main Roads advised that while they could make some adjustments to the pylon structures shape, they could not change the design greatly as the bridge design was constrained to fit in with what is already there so it would not be possible to remove the piers at this location.

BGA consultants advised that this issue could be managed by way of drafting a Cultural Heritage Management Plan in consultation with the Whadjuk working party at SWALSC, that could also include processes for the management of cultural material that is believed to be likely unearthed because of construction activities for the whole of the project. Here it was advised that it was the belief that the entire project area would need careful archaeological monitoring by Whadjuk People to properly identify archaeological material.

In terms of the balance of the project, the Whadjuk group advised that they supported the work as long as all Aboriginal sites and materials are properly managed, and that Main Roads continue to consult with and work with the Whadjuk People working party administered by SWALSC.

BGA advised that any impact to the Registered Aboriginal Sites at Helena River (Site ID 3758), Holding Paddock 1 – 4 (Site ID 3966), Helena River A – C (Site ID 3967), and lodged place Midland/Helena Valley Roads (ID 4337) will require consent under Section 18 of the AHA. It was advised that Main Roads had no further obligations under the *Aboriginal Heritage Act 1972* (AH Act) (WA) in relation to Great Eastern Highway/Stirling Crescent Scatter (Site ID 16110), however there may be sub-surface material in the area and is thus included in this application. Consent under Section 18 of the AH Act was granted on the 25th May 2021.

11. Ecologically Sustainable Development

Ecologically Sustainable Development is defined by the National Strategy for Ecologically Sustainable Development (1992) as “Using, conserving and enhancing the community’s resources so that ecological processes, in which life depends, are maintained, and the total quality of life, now and in the future, can be increased.” Section 3A of the EPBC Act enshrines the principles of ecologically sustainable development as listed in the table below. Table 24 outlines how each of the five principles has been applied to the Proposed Action.

Table 26 EPBC Act Principles of Ecologically Sustainable Development

No	Principle	Considerations of Principle in the Proposed Action
a)	Decision making processes should effectively integrate both long term and short term economic, environmental, social and equitable considerations	A holistic decision making process has been established for the Proposed Action with the aim to provide an integrated and transparent approach. A comprehensive decision-making tool was used to assist in making a range of significant decisions, through consideration of the triple bottom line (environment, social, local economic). The tool allows some flexibility in the weightings allocated to each sustainability aspect while maintaining a holistic balance. Where the tool has been used to inform and document significant design decision, the inputs, selection criteria and outcomes have been documented in the design reports.
b)	If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation	Comprehensive desktop and field studies were conducted to assess the baseline conditions and impact of the Proposed Action. Information gathered during these studies was used to inform this Proposed Action and has reduced the uncertainty surrounding the prediction of impacts for the assessment. Main Roads has ensured that, where possible, the Proposed Action design avoids serious or irreversible damage to the environment. Impacts to MNES have been identified and described. Mitigation and management measures have been proposed to ensure they are environmentally acceptable.
c)	The principle of intergenerational equity- that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The Proposed Action will ensure the health, diversity and productivity of the environment is maintained through retaining as much habitat as possible. The Proposed Action will contribute to improved transport efficiency and safety and strengthen cycling infrastructure, contributing to the well-being of the community.
d)	The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision making	Main Roads has avoided the <i>Shrublands and Woodlands of the Eastern Swan Coastal Plain</i> TEC. Impact on Banksia Woodland TEC and Black Cockatoo foraging habitat have been reduced by approximately 11 ha and 8 ha, respectively, with the change in design of the Proposed Action. Further refinement of the design will aim to minimise impacts on remnant vegetation where practicable.
e)	Improved valuation, pricing and incentive mechanisms should be promoted	Main Roads acknowledges the need for improved valuation, pricing and incentive mechanisms and endeavours to pursue these principles when appropriate. For example, environmental factors will greatly determine the location of road corridors, with the Proposed Action 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 Proposed Action must include environmental impact mitigation, management and maintenance activities. These requirements will be incorporated into the overall Proposed Action costs. The Proposed Action has been assessed under the Infrastructure Sustainability Council of Australia (ISCA) Infrastructure Sustainability (IS) rating framework, which considers environmental, social and economic impacts to project outcomes. The framework supports the integration of sustainability on infrastructure projects and provides criteria beyond the business- as -usual approach, against which projects are assessed. The GEHBI Proposed Action is aiming for Silver ISCA accreditation.

12. Environmental Record of the Person Proposing to take the Action

Main Roads is a State agency with an assured record of responsible environmental management and a certified Environmental Management System. Main Roads is not subject to any past or present proceedings under Commonwealth or State law for protection of the environment or conservation and sustainable use of natural resources. All work undertaken by Main Roads is completed in accordance with their Environmental Policy and Environmental Management System (EMS), which is certified with the requirements of ISO 14001:2015 Environmental management systems comprising 'Activities, products and services associated with delivering Road Management (planning, building and maintaining) on Western Australia's State Road Network' (Certificate #MRWQ51-CCE04). Main Roads' environmental policy can be found at <https://www.mainroads.wa.gov.au/OurRoads/Environment/Pages/environmentalmanagement.aspx#policy>

Main Roads EMS is independently certified and covers the processes and activities that have the potential to impact the environment, including mitigation and management measures proposed as part of the action. The EMS ensures compliance with Main Roads environment and heritage compliance obligations, providing the framework for driving environmental requirements through leadership, planning, support, operation, performance evaluation and improvement actions. The action, therefore, will be undertaken, monitored and measured in accordance with the Main Roads EMS.

Main Roads EMS covers processes and activities that have the potential to impact on the environment and ensures compliance with environment and heritage compliance obligations. The EMS responsibilities includes appropriate resource allocation to ensure compliance costs are appropriately budgeted and assessed as part of the overall business case for the project. This ensures that the costs of proposed management measures and offsets is considered in the budget approvals and ensures compliance is appropriately funded and resourced.

13. Other Approvals and Conditions

Other than an approval under the EPBC Act, requirements for approval or conditions that apply, or that are likely to apply, to the Proposed Action include various approvals from Western Australia state agencies and have been outlined below.

13.1 *Environmental Protection Act 1986, Part V Environmental Regulation— Clearing of Native Vegetation*

The Proposed Action will be assessed by DWER, under Part V of the EP Act which is the primary legislation governing environmental protection and clearing of native vegetation in Western Australia. Division 2 of Part V of the EP Act provides for the assessment of clearing of native vegetation.

13.2 Other Approvals and Regulations

Following primary environmental approval of the Proposed Action under Part V of the EP Act, additional regulatory approvals will be required to develop and operate the Proposal. These have been summarised in Table 27.

Table 27 Summary of other regulatory approvals required

Proposed activities	Type of approval	Regulatory Agency	Legislation regulating the activity	Status
All activities associated with the Proposal	Development Application	Department of Planning, Lands and Heritage (DPLH)	<i>Planning and Development Act 2005</i> (PD Act)	Not yet lodged
Interference with the bed and banks of a watercourse or wetland (clearing of vegetation and construction works)	Application for a permit to authorise the interference or obstruction of the bed and banks of a watercourse or wetland	Department of Water and Environmental Regulation (DWER)	<i>Rights in Water and Irrigation Act 1914</i> (RIWI Act)	Not yet lodged
Abstraction of water during construction	Licence to take	DWER	RIWI Act	Not yet lodged
Authorisation to take (flora and fauna) and modify (TEC)	Licence to take and modify	Department of Biodiversity, Conservation and Attractions (DBCA)	<i>Biodiversity Conservation Act 2016</i> (BC Act)	Not yet lodged
Disturbance of a registered Aboriginal heritage site	Section 18 (S18) consent	DPLH	<i>Aboriginal Heritage Act 1972</i> (AH Act)	Granted 25 th May 2021.
Bridge construction over the Helena River	Form 7 – application for part 4 permit	DBCA	<i>Swan and Canning Rivers Management Act 2006</i>	Not yet lodged
Land acquisition process	Administration of State Land	DPLH	<i>Land Administration Act 1997</i>	In progress

13.3 Planning Approvals

The alignment of the Proposed Action will not be fully located within land that is currently reserved under the MRS for Primary Regional Roads or Other Regional Roads. Areas that are located outside of the MRS will be subject to a development approval under the Planning and Development Act 2005. No development approval is required for any road construction works located on lands reserved by the MRS for the purpose of Primary Regional Roads or Other regional Roads.

Upon completion of the Proposed Action, all areas outside the existing Primary Regional Roads reservation will be incorporated into Primary Regional Roads or zones appropriately through an edition amendment to the MRS pursuant to the *Planning and Development Act 2005*. Any land requirements within the Proposed Action will be acquired by Main Roads pursuant to section 28 (1) of the *Land Administration Act 1997*.

14. Information sources

The reliability and uncertainties in the technical studies undertaken in preparation of the Preliminary Documentation for the Proposed Action have been outlined in Table 28

Table 28 Information sources

Reference source	Reliability	Uncertainties
Biota Environmental Sciences. (2021). Great Eastern Highway Bypass Interchanges (Roe Highway and Abernethy Road) Biological Survey. Unpublished report prepared for Main Roads Western Australia.	Information is reliable	There are no uncertainties
Biologic Environmental. (2022). Great Eastern Highway Bypass Interchanges Project: Targeted Carter's Freshwater Mussel Survey. Unpublished report prepared for Main Roads Western Australia	Information is reliable	There are no uncertainties
Brad Goode & Associates. (2020) Draft report on an Aboriginal Heritage Survey for the Roe Highway / Great Eastern Highway Bypass Interchanges Project, Western Australia.	Information is reliable	There are no uncertainties
Brad Goode & Associates (2020) Addendum Draft report on an Aboriginal Heritage Survey for the Roe Highway / Great Eastern Highway Bypass Interchanges Project, Western Australia.	Information is reliable	There are no uncertainties
Glevan Consulting (2020) Great Eastern Highway Bypass Interchanges Project <i>Phytophthora</i> Dieback occurrence assessment.	Information is reliable	There are no uncertainties
AECOM. (2015). Roe Highway/Great Eastern Highway Bypass and Roe Highway/Kalamunda Road. Unpublished report prepared for Main Roads Western Australia.	Information is reliable	Information may be out of date and is superseded by more recent surveys
Strategen Environmental (Strategen). (2018). Great Eastern Highway Bypass – Flora and vegetation survey. Unpublished report prepared for Main Roads Western Australia.	Information is reliable	Information may be out of date and is superseded by more recent surveys
AECOM. (2023). Reconnaissance vegetation and Black Cockatoo survey for Crossman and Hoffman.	Information reliable	There are no uncertainties

15. References

- AECOM Australia Pty Ltd (AECOM). (2020). Rutland Road Ecological Surveys. Unpublished report prepared for the Department of Planning, Lands and Heritage, dated 28 May 2020.
- AECOM Australia Pty Ltd (AECOM). (2015). Roe Highway/Great Eastern Highway Bypass and Roe Highway/Kalamunda Road. Unpublished report prepared for Main Roads Western Australia.
- AECOM Australia Pty Ltd (AECOM). (2023). Reconnaissance Survey for Vegetation and Black Cockatoo at Crossman and Hoffman. Unpublished report prepared for Main Roads Western Australia.
- Bamford Consulting Ecologists (BCE). (2020). Scoring System for the Assessment of Foraging Value of Vegetation for Black Cockatoos.
- Beard, JS. (1981). Swan, 1:1000000 vegetation series: explanatory notes to sheet 7: the vegetation of the Swan area, University of Western Australia Press, Nedlands, Western Australia.
- Biologic Environmental Survey (2023(Biologic). (2022). Great Eastern Highway Bypass Interchanges Project: Targeted Carter's Freshwater Mussel Survey. Unpublished report prepared for Main Roads Western Australia.
- Biota Environmental Sciences (Biota). (2021). Great Eastern Highway Bypass Interchanges (Roe Highway and Abernethy Road) Biological Survey. Unpublished report prepared for Main Roads Western Australia.
- Coffey. (2014). Perth-Darwin National Highway (Swan Valley Section). Public Environmental Review Document prepared on behalf of Main Roads.
- Delnevo, N., A. Piotti, E. J. van Etten, W. D. Stock and M. Byrne. (2019). Isolation, characterization, and cross-amplification of 20 microsatellite markers for *Conospermum undulatum* (Proteaceae). Applications in Plant Sciences, 7(8), Article e11283.
- Department of Agriculture, Water and the Environment (DAWE). (2021). Species Profile and Threats Database: *Conospermum undulatum* — Wavy-leaved Smokebush. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=24435.
- Department of Agriculture, Water and the Environment (DAWE). (2020). EPBC Act Referral 2020/8784. Available from: <https://onlineservices.environment.gov.au/about-online-services/epbc-act-referral>.
- Department of Biodiversity Conservation and Attractions (DBCA). (2021). Threatened Ecological Communities (DBCA-038). Government of Western Australia. Available from: <https://catalogue.data.wa.gov.au/dataset/threatened-ecological-communities>.
- Department of Biodiversity, Conservation and Attractions (DBCA). (2020a). Geomorphic Wetlands, Swan Coastal Plain (DBCA-019). Government of Western Australia. Available from: <https://catalogue.data.wa.gov.au/dataset/geomorphic-wetlands-swan-coastal-plain>.
- Department of Biodiversity, Conservation and Attractions (DBCA). (2020b). Recovery plans and interim recovery plans. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatenedecological-communities>. Department of Biodiversity Conservation and Attractions (DBCA). (2018a). Carnaby's Cockatoo Confirmed Roost Sites Buffered 6 km (DBCA-052) shapefile. Available from: https://services.slip.wa.gov.au/public/rest/services/SLIP_Public_Services/Plants_and_Animals/MapServer/14.
- Department of Biodiversity Conservation and Attractions (DBCA). (2018b). Carnaby's Cockatoo Confirmed Breeding Areas within the Swan Coastal Plain and Jarrah Forest IBRA Regions (DBCA-054) shapefile. Available from: https://services.slip.wa.gov.au/public/rest/services/SLIP_Public_Services/Plants_and_Animals/MapServer/16.
- Department of Biodiversity Conservation and Attractions (DBCA). (2018c). Carnaby's Cockatoo Areas requiring investigation as feeding habitat in the Jarrah Forest IBRA Region (DBCA-056) shapefile. Available from: https://services.slip.wa.gov.au/public/rest/services/SLIP_Public_Services/Plants_and_Animals/MapServer/18.

- Department of Biodiversity Conservation and Attractions (DBCAs). (2018d). Carnaby's Cockatoo Areas requiring investigation as feeding habitat in the Swan Coastal Plain (SCP) IBRA Region (DBCAs-057) shapefile. Available from: https://services.slip.wa.gov.au/public/rest/services/SLIP_Public_Services/Plants_and_Animals/MapServer/19.
- 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. Commonwealth Department of Agriculture, Water and the Environment.
- Department of Environment and Conservation (DEC). (2009). Wavy-leaved smokebush (*Conospermum undulatum*) Recovery Plan. Commonwealth Department of the Environment, Water, Heritage and the Arts, Canberra.
- Department of Parks and Wildlife (DPaW). (2015). FEM047 Phytophthora Dieback Interpreters Manual for lands managed by the Department. Unpublished.
- Department of Parks and Wildlife (DPaW). (2013). Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan: Western Australian Wildlife Management Program No. 52. Available from: <https://www.environment.gov.au/system/files/resources/94138936-bd46-490e-821d-b71d3ee6dd04/files/carnabys-cockatoo-recovery-plan.pdf>.
- Department of Primary Industries and Regional Development (DPIRD). (2020). Native Vegetation Extent (DPIRD-005) shapefile. Available from: https://services.slip.wa.gov.au/public/rest/services/SLIP_Public_Services/Environment/MapServer/18.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). (2012a). EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species: Carnaby's Cockatoo *Calyptorhynchus latirostris*; Baudin's Cockatoo *Calyptorhynchus baudinii*; Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*. Department of Sustainability, Environment, Water, Population and Communities.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). (2012b). *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Available from: http://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsets-policy_2.pdf.
- Department of the Environment (DotE). (2013). Matters of National Environmental Significance – Significant Impact Guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999.
- Department of the Environment and Energy (DotEE). (2017a). Approved Conservation Advice for Shrublands and Woodlands of the Eastern Swan Coastal Plain. Canberra: Department of the Environment and Energy. Available from: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/20-conservation-advice.pdf>. In effect under the EPBC Act from 13-Jul-2017.
- Department of the Environment and Energy (DotEE). (2017b). Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*). Department of the Environment and Energy, Commonwealth of Australia.
- Department of the Environment and Energy (DotEE). (2016). Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community. Australian Government, Canberra.
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009). Approved Conservation Advice for *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo). Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/67034-conservation-advice.pdf>.
- Department of Water (DoW). (2011). Helena River – Swan Canning Catchment Nutrient Report 2011.
- Department of Water and Environmental Regulation (DWER). (2018). Public Drinking Water Source Areas (DWER-033) shapefile. Available from: https://services.slip.wa.gov.au/public/rest/services/SLIP_Public_Services/Water/MapServer/24.
- Environmental Protection Authority (EPA). (2016a). Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment. EPA, Western Australia.

- Environmental Protection Authority. (2016b). Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna, EPA, Western Australia.
- Environmental Protection Authority (EPA). 2004. Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, Guidance Statement 51, Environmental Protection Authority, Perth.
- Focused Vision Consulting (FVC). 2022. Biological Survey Lots 5324 And 8037 Daringen Road, Cowalla. Unpublished report prepared for Main Roads Western Australia, dated February 2022.
- Glevan Consulting (2020). Great Eastern Highway Bypass Interchanges Project Phytophthora Dieback Occurrence Assessment. Unpublished report prepared for Main Roads Western Australia.
- Goode, B., G. Preller and T. O'Reilly. (2020). Report on an Aboriginal Heritage Survey for the Roe / Great Eastern Highway Bypass Interchanges Project, Western Australia. A report prepared for Main Roads Western Australia.
- Greater Connect Alliance (GCA). (2022). Great Eastern Highway Bypass Interchanges Emergency Response Management Plan. Prepared for the GEHBI project construction phase.
- Greater Connect Alliance (GCA). (2023). Great Eastern Highway Bypass Interchanges Helena River Bridge 1899 – Erosion and Sediment Control Plan. Prepared for the GEHBI project construction phase.
- Hedde, E. M., Loneragan, O. W. & Havel, J. J. (1980). Vegetation Complexes of the Darling System, Western Australia. Department of Conservation and Environment, Atlas of Natural Resources, Darling System, Western Australia.
- Higgins, P. J. (1999). (Ed.) Handbook of Australian, New Zealand and Antarctic Birds, Volume 4. Parrots to Dollarbird. Oxford University Press: Melbourne.
- Jacobs Group Australia (Jacobs). (2020). Great Eastern Highway Bypass Interchange Project Preliminary Site Investigation. Unpublished report prepared for Main Roads Western Australia.
- Johnstone R.E., T. Kirkby and K. Sarti. (2017). The distribution, status movements and diet of the Forest red-tailed Black Cockatoo in the South-West with emphasis on the Greater Perth Region, Western Australia, The Western Australian Naturalist, Vol. 30 No. 4.
- Johnstone, R. E., and T. Kirkby. (2013). The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. II. Breeding behaviour and diet. Pacific Conservation Biology Vol. 19, No. 2, pp. 143 – 155.
- Johnstone, R. E., and T. Kirkby. (2011). Black Cockatoos on the Swan Coastal Plain. Department of Planning, Western Australia.
- Johnstone, R. E., and T. Kirkby. (2009). Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) on the Swan Coastal Plain (Lancelin–Dunsborough), Western Australia. Studies on distribution, status, breeding, food, movements and historical changes. Report for the Department of Planning, Western Australia.
- Klunzinger, M. W., S. J. Beatty, D. L. Morgan, A. J. Lymbery, A. M. Pinder and D. J. Cale. (2012). Distribution of *Westralunio carteri iredale* 1934 (Bivalvia: *Unionoidea*: *Hyriidae*) on the south coast of Southwestern Australia, including new records of the species. Journal of the Royal Society of Western Australia, 95(2), 77–81.
- Main Roads Western Australia (Main Roads). (2013). Environmental Guideline – Vegetation Placement Within the Road Reserve. Available from <https://www.mainroads.wa.gov.au/technical-commercial/technical-library/>.
- Main Roads Western Australia (Main Roads). (2020). Crash Summary for Intersections (Last 5 years) shapefile. Available from: mrgis.mainroads.wa.gov.au. Accessed November 2020.
- Mitchell, D., K. Williams, and A. Desmond (2003). Swan Coastal Plain 2 (SWA2 - Swan Coastal Plain subregion). Pages 606–623 in J. E. May and N. L. McKenzie, editors. A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions. Department of Conservation and Land Management, Western Australia.
- Murdoch University. (2022). Black Cockatoo Conservation Management Project Annual Progress Report August 2022.

- Peck, A., G. Barrett and M. William. (2019). The 2019 Great Cocky Count: a community-based survey for Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*), Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) and Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*). BirdLife Australia, Floreat, Western Australia.
- Purdie, B. R., P. J. Tille, and N. R. Schoknecht. (2004). Soil-landscape mapping in south-Western Australia: an overview of methodology and outputs. Resource Management Technical Report 280, 1-11-2004, Department of Agriculture and Food, Western Australia.
- Saunders, D. A. (1986). Breeding season, nesting success and nestling growth in Carnaby's Cockatoo, *Calyptorhynchus funereus latirostris*, over 16 years at Coomallo Creek, and a method for assessing the viability of populations in other areas. Australian Wildlife Research 13:261–273.
- Strategen Environmental (Strategen). (2018). Great Eastern Highway Bypass – Flora and vegetation survey. Unpublished report prepared for Main Roads Western Australia.
- Strategen JBS&G. (2020). Great Eastern Highway Bypass Interchanges (Roe Highway and Great Eastern Highway Bypass). EPA Environmental Referral Supporting Document. Unpublished report prepared for Main Roads Western Australia.
- SW Environmental. (2022). Basic and Targeted Fauna Survey, Lot 2628 Jacka Road, Boallia. Report prepared on behalf of Main Roads.
- Threatened Species Scientific Committee (TSSC). (2016). Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community. Threatened Species Scientific Community via DotEE.
- Threatened Species Scientific Committee (TSSC). (2018a). Conservation Advice *Westralunio carteri* Carter's freshwater mussel. Canberra: Department of Environment and Energy.
- Threatened Species Scientific Committee (TSSC). (2018b). Conservation Advice *Calyptorhynchus baudinii* Baudin's Cockatoo. Canberra: Department of Environment and Energy.
- Valentine, L., W. Stock and H. Finn. (2009). Pines and the ecology of Carnaby's Black-Cockatoos (*Calyptorhynchus latirostris*) In the Gnangara Sustainability Strategy study area. Published report by Edith Cowan University, Murdoch University and the Department of Environment and Conservation, Western Australia.
- Webb, A. (2015). Site Inspection of Lot 2829 Jacka Road, Boallia. Unpublished Report.
- Williams, K. (2022). Field Inspection of Lot 2628 Jacka Rd, Boallia on Friday 11 March 2022 – Fauna Comments. Unpublished Report Report.
- Woodman Environmental. (2021). Tonkin Grade Separated Interchanges Biological Survey and Targeted Black Cockatoo Habitat Assessment. Unpublished report prepared for Main Roads Western Australia.