Public Transport Authority

Yanchep Rail Extension Part 2

Biological Factors - Context and Impact Assessment

March 2019

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1. Introduction

1.1 Background

The Public Transport Authority (PTA) is in the planning stage for the extension of the northern suburbs passenger railway, the Yanchep Rail Extension (YRE) (the project). The proposed alignment will ultimately extend from Butler Railway Station to the proposed Yanchep Railway Station.

The YRE project has been referred to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986* (EP Act) in two parts, Part 1: Butler Station to Eglinton Station and Part 2: Eglinton Station to Yanchep Station. The PTA referred Part 1 of the project to the EPA in February 2018, with Part 2 being referred in August 2018. This report is focused on Part 2 of the YRE project.

The Part 2 referral included a proposal to construct and operate approximately 7.2 km of track (beginning north of proposed Eglinton Station) and a turnback facility to the north of the Yanchep Station, to allow for the turning and stowage of trains. The alignment of Part 2 of the project will generally follow the land reserved “Railway” under the Metropolitan Regional Scheme (MRS), before terminating within the northern section of the Yanchep City Local Structure Plan (LSP).

The EPA determined the proposal required assessment at the level of Public Environmental Review (PER) with a six week public comment period. A final Environmental Scoping Document (ESD) was issued to the PTA on 25 October 2018 and included key environmental factors Flora and Vegetation, Terrestrial Fauna and Landforms.

Post submission the PTA has refined the Part 1 Development Envelope (DE) to reduce impacts to the environment. This report has been revised to reflect this change in the cumulative impact assessment.

1.2 Purpose of the report

The purpose of this report is to:

- Provide contextual information of the environmental aspects present within Part 2, as well as at local and regional scales.
- Describe and quantify the potential impacts (including cumulative impacts) associated with Part 2 of the project on the identified environmental aspects at local and regional scales to support the EPA assessment.

2. Methods

2.1 Approach

This report quantifies potential Part 2 project impacts at a local and regional scale to vegetation, flora, fauna habitat and parabolic dunes. The significance of these impacts are presented, taking into consideration foreseeable future development at the local and regional scale (i.e. potential cumulative impacts).

GHD has used the following approach to quantify the impacts in a systematic manner for vegetation, flora, fauna habitat and parabolic dunes:

1. Describe and quantify the environmental aspects present within the development envelope.
2. Describe and quantify the environmental aspects present within the development envelope at a local, regional and bioregional scale.
3. Quantify the potential impacts associated with Part 2 of the project, with consideration given to the cumulative impacts associated with foreseeable future development at a local and regional scale.

2.2 Development envelope

PTA has defined a DE for this project, which covers 72.86 ha. The Part 2 DE is a combination of vegetation, re-vegetation and cleared areas.

The DE was used for the basis of this assessment, and has been referred to within this report as development area and/or Part 2 project.

2.3 Scales

To provide context to the potential Part 2 project impacts, this assessment has considered the extent of vegetation, fauna habitat and parabolic dunes at a local and regional scale.

- The local scale included a 1 km buffer of the DE.
- The North West (NW) subregion, as defined in Perth and Peel@3.5million was used as a regional scale. This subregion comprises the City of Joondalup and the City of Wanneroo local government areas (LGAs).

The local and regional scale are shown in Figure 1, Appendix A.

Where spatial data was available, a larger regional scale was also considered for vegetation and fauna habitat, which encompassed the Perth Interim Biogeographical Regionalisation for Australia (IBRA) subregion.

2.4 Data sources

This assessment has used a combination of project specific and publicly available GIS spatial files largely sourced from Government of Western Australia (GoWA) (2018a). The data sources utilised are presented in Table 1.

Table 1 Data sources

Aspect	Description and source
Boundaries	YRE Development Envelope (PTA) NW subregion (as shown in Perth and Peel@3.5) Perth IBRA subregions
Vegetation	YRE vegetation type mapping (GHD 2018b) Pre-European Vegetation (DPIRD-006) Native Vegetation Extent (DPIRD-005) Vegetation Complexes – Swan Coastal Plain (DBCA-046)
Threatened and Priority Ecological Communities	Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) spatial dataset (Department of Biodiversity, Conservation and Attractions (DBCA) 2018) (not sighted)
Conservation significant flora	Threatened (Declared Rare) and Priority Flora (TPFL) and WA Herbarium (WAHERB) databases (DBCA 2018) *NatureMap* (DBCA 2007–) *FloraBase* (WA Herbarium 1998–)
Black Cockatoos	Carnaby's Cockatoo requiring investigation as feeding habitat in the Swan Coastal Plain (SCP) IBRA Region (DBCA-057) Carnabys Cockatoo Breeding Areas Confirmed (DBCA-054) Carnabys Cockatoo Roost Areas Confirmed (DBCA-050) Carnabys Cockatoo Roost Areas Unconfirmed (DBCA-051) Glossop et al. (2011)
Conservation estate and reserves	Bush Forever Areas 2000 (DOP-071) DBCA – Legislated Lands and Waters (DBCA-011) DBCA – Lands of Interest (DBCA-012) Regional Parks (DBCA-026)
Ecological linkages	City of Wanneroo Local Biodiversity Strategy 2018/19 – 2023/24 Regional Ecological Linkages for the Perth Metropolitan Region (Western Australian Local Government Association (WALGA) (Perth Biodiversity Project) 2003)
Landforms	Soil Landscape Mapping (DPIRD-027)
Planning	Perth and Peel Urban Land Development Outlook (ULDO) 2016/17 – staging (DOP-096) Perth and Peel ULDO 2016/17 – Industrial (DOP-097) Local Planning Scheme – City of Wanneroo Local Planning Scheme – City of Joondalup MRS Region Scheme – Zones and Reserves (DOP-072)

2.5 Flora and vegetation considerations

2.5.1 Vegetation condition

Vegetation rated as Completely Degraded has been excluded from the analysis as it is considered to no longer represent intact native vegetation. This approach is consistent with the methodology used for Part 1 of this project and other recent transport infrastructure environmental assessments assessed by the EPA, such as the Perth Darwin National Highway (Swan Valley Section) project.

One vegetation type (VT13) comprised a mix of degraded native remnant vegetation and native regrowth (>10 years). Although the majority of this vegetation type is mapped as Completely Degraded and not included in the analysis, there are small areas mapped as Degraded in condition, which have been included within the analysis as they meet the definition of intact native vegetation.

2.5.2 Estimating native vegetation extents

To allow a consistent assessment at a local, regional and bioregional scale the decision was made (based on feedback from the PTA and EPA) to utilise the Native Vegetation Extent

(DPIRD-005) remaining dataset as the basis to assess direct and cumulative impacts within this document. To calculate the current extent remaining, intersects between the Native Vegetation Extent, and the Pre-European Vegetation (DPIRD-006) and Vegetation Complexes – Swan Coastal Plain (DBCA-046) datasets were completed. As the Native Vegetation Extent dataset was last updated on 23 May 2018, the numbers obtained from the intersect are slightly different (slightly less) to those published in the Statewide Vegetation Statistics and South West Vegetation Complex Statistics by DBCA on Data WA which are current as of December 2017 and October 2017 respectively. The differences in numbers are a direct result of using the more current Native Vegetation Extent dataset.

GHD has completed a number of detailed surveys throughout the DE and adjacent areas for the YRE project. When using this detailed vegetation mapping, specifically, native vegetation in degraded or better condition, there is a greater amount of native vegetation present when compared with the Native Vegetation Extent dataset for the same area (i.e. the DE). The differences in values is a result of utilising mapping at difference scales (e.g. broad-scale mapping of Beard (1979), Heddle et al. (1980) and Webb et al. (2016) versus fine-scale mapping of a localised area. Vegetation in degraded or better condition mapped within the DE by GHD (2018) that does not intersect the Native Vegetation Extent dataset is considered cleared for the purposes of the native vegetation cumulative impact assessment.

2.5.3 Vegetation associations and complexes

Broad scale (1:250,000) pre-European vegetation mapping completed by Beard (1979) indicates that two vegetation associations intersect the Part 2 DE (Table 2). Regional vegetation on the SCP has also been mapped by Heddle et al. (1980), with updates from Webb et al. (2016); which shows two vegetation complexes intersect the Part 2 DE (Table 3).

Table 2 Vegetation association descriptions (Beard 1979)

Association	Description	Structure	Flora
949	Low woodland; banksia	Low woodland or open low woodland	Other *Acacia*, *Banksia, Agonis flexuosa, Callitris, Allocasuarina, Eucalyptus loxophleba*.
1007	Mosaic: Shrublands; *Acacia lasiocarpa & Melaleuca acerosa* [now *M. systena*] heath / Shrublands; *Acacia rostellifera & Acacia cyclops* thicket	Scrub-heath / Thicket	*Acacia lasiocarpa, Melaleuca acerosa, A. rostellifera, A. cyclops*

Table 3 Vegetation complex descriptions (Webb et al. 2016)

Complex	Description
Quindalup complex	Restricted to the coastal dunes and can be subdivided mainly into two alliances. The strand and fore dune alliance contain *Angianthus cunninghamii, Trachyandra divaricatum, Arctotheca populifolia, Atriplex isatidea, Cakile maritima, Leucophyta brownii, Carpobrotus virescens, Pelargonium capitatum, Senecio lautus, Actites megalocarpus, Spinifex longifolius, Tetragonia implexicoma, T. decumbens*. The mobile and stable dune alliance contains *Acacia cyclops, Anthocercis littorea, Lepidosperma gladiatum, Myoporum insulare, Nitraria billardierei, Olearia axillaris, Scaevola crassifolia, S. nitida, Spyridium globulosum, Westringia rigida* and *Wilsonia backhousei*. The vegetation differs in its physiognomy and species composition from one place to another because of the variations in the dune environment caused by edaphic and topographical factors and the degree of shelter from salt-laden winds (McArthur 1957; Smith 1957). The low closed-forest of *Melaleuca lanceolata, Callitris preissii* is restricted to small localised pockets. This formation was once more widespread along the coast (Baird 1958, Seddon

Complex	Description
	1972). Other local variations include remnant occurrences of *E. foecunda, Pittosporum ligustrifolium, Santalum acuminatum, Exocarpos sparteus* and *Acacia rostellifera* (Seddon 1972).
Cottesloe complex – north	Predominantly low open forest and low woodland of *Banksia attenuata* (Slender Banksia) – *B. menziesii* (Firewood Banksia) – *Eucalyptus todtiana* (Pricklybark); closed heath on the limestone outcrops

2.5.4 Estimating the local and regional extents of Threatened and Priority Ecological Communities

The local and regional extents of Threatened and Priority Ecological Communities (TECs and PECs) used in this assessment were provided by the PTA, calculated using spatial data provided by DBCA. This spatial data was not sighted by GHD.

2.5.5 Priority flora

Records and individual counts of Threatened and Priority flora at all scales (local, regional and state) were estimated by interrogating records on *NatureMap*, *FloraBase* and search results from the DBCA Threatened (Declared Rare) and Priority Flora (TPFL) and WA Herbarium (WAHERB) databases. It is noted that *FloraBase* records often provide the count (frequency) in descriptors such as common, abundant, frequent, occasional and scattered without providing an actual number of individuals. For the purposes of this assessment, these records have been counted as one individual, and therefore the population estimates are underrepresented with the actual number of individuals expected to be much higher.

2.6 Terrestrial fauna considerations

2.6.1 Estimating fauna habitat extents

Fauna habitat extents are based on native vegetation extents and were calculated using the same approach as described in section 2.5.2. Similarly, when using detailed fauna habitat mapping of the DE, there is a greater amount of fauna habitat available when compared with that inferred from the Native Vegetation Extent dataset for the same area (i.e. the DE). As noted in section 2.5.2, this difference in values is a result of utilising mapping at difference scales. Fauna habitat mapped within the DE by GHD (2018) that does not intersect the Native Vegetation Extent dataset is considered cleared for the purposes of the fauna habitat cumulative impact assessment.

2.6.2 Estimating the local and regional extent of Black Cockatoo habitat

Potential Breeding habitat

The extent of Black Cockatoo potential breeding habitat was estimated by reviewing previously described/mapped vegetation associations (Beard 1979), and based on vegetation structure and species present, assessing the suitability as breeding habitat. Black Cockatoo habitat types, definitions and species suitability were sourced from DSEWPaC (2012) and DEE (2017). The vegetation associations mapped in the local and regional areas, and their suitability as Black Cockatoo breeding habitat is provided in Table 4.

Table 4 Black Cockatoo potential breeding habitat

Association	Description	Black Cockatoo suitability
6	Description: Medium woodland; tuart & jarrah Structure: Woodland southwest Flora: Jarrah, Marri, Wandoo	Breeding
37	Description: Shrublands; teatree thicket Structure: Thicket Flora: *Acacia, Allocasuarina, Melaleuca* alliance.	No
51	Description: Sedgeland; reed swamps, occasionally with heath Structure: Sedgeland Flora: Cyperaceae, Restionaceae, Juncaceae	No
126	Description: Freshwater Lake	No
949	Description: Low woodland; banksia Structure: Low woodland or open low woodland Flora: Other *Acacia, Banksia,* Peppermint, *Callitris*, *Allocasuarina*, York Gum.	No
965	Description: Medium woodland; jarrah & marri Structure: Woodland southwest Flora: Jarrah, Marri, Wandoo	Breeding
998	Description: Medium woodland; tuart Structure: Woodland southwest Flora: Jarrah, Marri, Wandoo	Breeding
1001	Description: Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina Structure: Low forest, woodland or low woodland with scattered trees Flora: Jarrah, *Banksia*, *Allocasuarina*	Breeding
1007	Description: Mosaic: Shrublands; *Acacia lasiocarpa & Melaleuca acerosa* [now *M. systena*] heath / Shrublands; *Acacia rostellifera & Acacia cyclops* thicket. Structure: Scrub-heath / Thicket	No
1011	Description: Medium open woodland; tuart Structure: Woodland southwest Flora: Jarrah, Marri, Wandoo	Breeding

Trees of suitable diameter breast height (DBH) for potential Black Cockatoos breeding (DSEWPaC 2012) were recorded from the DE, however as there is no reliable local or regional publicly available data, this aspect has not been considered further as part of this assessment. Carnaby's Cockatoo breeding area datasets were sourced from DBCA to review breeding locations in relation to the DE to provide context. These datasets provided buffered locations of confirmed and possible breeding locations based on observations relating to Carnaby's Cockatoo breeding (as defined by Glossop et al. (2011)), not the presence of suitable DBH trees for potential Black Cockatoos breeding.

Foraging habitat

The extent of Black Cockatoo foraging habitat was estimated using Carnaby's Cockatoo data sourced from DBCA. The current extent of potential Carnaby's Cockatoo foraging habitat was determined by intersecting available layers (e.g. Carnabys Cockatoo Feed Areas Investigation required SCP) with available Native Vegetation Extent. It is noted this dataset excludes pine plantations, which are not native vegetation, but important Carnaby's Cockatoo feeding areas. Further information on the Carnaby's Cockatoo dataset is provided by Glossop et al. (2011).

Black Cockatoo foraging habitat value within the DE has been determined by reviewing the described/mapped fauna habitat types present within the Part 2 project (GHD 2018), and based

on vegetation structure, species (and food items) present and vegetation condition, assigned a value of either high, moderate or low (Table 5). Black Cockatoo habitat types, definitions and species suitability were sourced from DSEWPaC (2012) and the foraging habitat scoring tool (DEE 2017) used to guide this determination. All fauna habitat types contained species known to support foraging (noting in some habitat types these are scattered, isolated species), however, those types considered to have a low foraging value have been excluded from foraging calculations.

Table 5 Black Cockatoo foraging habitat value

Fauna habitat type	Foraging habitat	Foraging habitat value
Banksia sessilis over low mixed shrubland	Yes	High
Eucalyptus woodland	Yes	Moderate
Limestone ridgelands		Low
Lomandra herbland on secondary dunes		Low
Mixed *Banksia* woodland	Yes	High
Mixed tall shrubland	Yes	Moderate
Planted *Eucalyptus* woodland	Yes	Moderate
Highly Disturbed		Low

Roosting habitat

Carnaby's Cockatoo roost areas datasets were sourced from DBCA to review roost locations in relation to the DE to provide context. These datasets provided locations of confirmed, unconfirmed and buffered roost areas based on observations (as outlined by Glossop et al. (2011)). Whilst suitable roosting habitat was identified within the development areas, the extent of this has been captured within breeding and foraging extents and therefore will not be further assessed in this report.

2.7 Landform considerations

2.7.1 Estimating the extent of parabolic dune formations

The parabolic dune formation extent has been estimated by extracting the units Quindalup South oldest dune Phase (211Qu_Q1), Quindalup South second dune Phase (211Qu_Q2), Quindalup South third dune Phase (211Qu_Q3) and Quindalup South youngest dune Phase (211Qu_Q4) from Soil Landscape Mapping (DPIRD-027) spatial data. The current extent of the parabolic dune formation has been determined by estimating cleared areas (using Local Planning Scheme – City of Wanneroo and Perth and Peel ULDO 2016/17 - staging (DOP-096) layers) and overlaying the relevant mapping units listed above. Whilst aerial imagery (from Landgate) was also viewed to validate this approach visually, the imagery was not used to further refine the 'current' extent as the approach was deemed fit for purpose.

2.8 Assumption and Limitations

This report has been prepared by GHD for PTA and may only be used and relied on by PTA for the purpose agreed between GHD and the PTA as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than PTA arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by PTA and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has relied on spatial data available from Data WA and other government entities to quantify vegetation, fauna habitat and parabolic dune extents and foreseeable future development. It is noted in some instances there is very minor discrepancies between the spatially calculated results and those published by the provisioning organisations. These discrepancies do not adversely impact the analysis or validity of the conclusions drawn from the analysis.

3. Project context

3.1 Local and regional context

The project is situated in the South West Botanical Province of WA within the Swan Coastal Plain bioregion and the Perth subregion as described by IBRA. The project is located approximately 2 km east of the WA coastline extending from the suburbs of Eglinton to Yanchep. Conservation areas and ecological linkages discussed in the following section are presented in Figure 2, Appendix A.

3.1.1 Conservation areas

No DBCA-managed conservation areas are located within the Part 2 DE. The closest DBCA managed area is Yanchep National Park (R 9868, Class A) located directly adjacent to the north east corner of the Part 2 project.

Much of the DE resides within an Environmentally Sensitive Area (ESA). This ESA likely aligns with the presence of TECs and their buffer zones, and Bush Forever within the local area. The presence of TECs (and PECs) within the DE is discussed further in Section 4.2.

The DE corridor intersects approximately 3 km of Bush Forever Site No. 289, Ningana Bushland, Yanchep/Eglington. This site covers 640.83 ha and extends from near Bush Forever Site No. 288 (Yanchep National Park) in the east to Bush Forever Site No. 397 (Coastal strip from Wilbinga to Mindarie) in the west.

Bush Forever Site No. 289 is characterised by coastal dune, parabolic dune and blowout landscape features. The vegetation of the site has been previously mapped by Tingay, Alan and Associates (1991, 1992) who recognised four structural units including:

- Spearwood Dunes:
  - Uplands – sands derived from Tamala Limestone: *Eucalyptus gomphocephala* open woodland to woodland; *Banksia attenuata* and *B. menziesii* low woodland.
  - Uplands – Tamala limestone surfaces (come close to the coast): open to closed low heaths dominated by *Banksia sessilis* var. *cygnorum*, *Hakea trifurcata, Calothamnus quadrifidus, Scaevola nitida, Acacia truncata* and *Allocasuarina humilis, Xanthorrhoea preissii* shrubland.
- Quindalup Dunes:
  - Uplands – older dunes and plains: open low heaths of *Melaleuca systena, Acacia rostellifera, A. lasiocarpa* and *Hibbertia racemosa* over herblands dominated by *Lomandra maritima*; *A. rostellifera* closed tall scrub to closed heath.
  - Uplands – younger dunes: open to closed low heaths to shrubland dominated by *Scaevola crassifolia, Olearia axillaris; Scaevola nitida, Acanthocarpus preissii* and *Hemiandra pungens* or *Acacia rostellifera* strand; *Spinifex longifolius* and *S. hirsutus* grassland.

3.1.2 Ecological Linkages

Three regional ecological linkages mapped in the Regional Ecological Linkages for the Perth Metropolitan Region (PMR) dataset occur in the vicinity of the Part 2 project; Links No. 1, 6 and 7 (Figure 2).

- Link No. 1 occurs west of the DE, running parallel and links Bush Forever sites 406 through to 315 (including Bush Forever sites 322 and 397), maintaining connectivity along the Coast for the Quindalup Complex.

- Link No. 6 occurs east of the DE, running parallel and links Bush Forever sites 284, 288, 129, 130, 383, 299, 202.
- Link No. 7 occurs east of the DE, running perpendicular and links Bush Forever sites 288, 381, 380.

A 500 metre (m) wide buffer (250 m each side) is considered to be the minimum required to promote the inclusion of more viable natural areas within the ecological linkage (Del Marco et al. 2004). In addition to the three ecological linkages mapped in the PMR, the City of Wanneroo Local Biodiversity Strategy 2018/19 – 2023/24 shows Link ID: 0, an extension to Link No. 7, extending further west connecting Bush Forever Sites No. 289 and 397. The City of Wanneroo Local Biodiversity Strategy 2018/19 – 2023/24 also shows local ecological linkage, Link ID: 22, which runs north-east to south-west connecting Link No. 1 to the top part of Bush Forever Site No. 289. This Link is located west of the DE. All links have been impacted by previous vegetation clearing and urban development.

3.2 Cumulative considerations

There are a number of existing, approved or proposed developments within the vicinity of the Part 2 project, which have the potential to contribute to cumulative impacts at a local and regional scale. Whilst the impacts of each development may be limited in isolation, they have the potential to become more substantial due to additional impacts from other developments. The reported and/or potential impacts from these local and regional developments (where information is available) have been used to determine potential cumulative impacts.

The spatial distribution of the cumulative considerations quantified as part of this assessment are shown in Figure 3, Appendix A.

Future residential, commercial and industrial development

The Urban Land Development Outlook (ULDO) 2016/17 is based on an assessment of future land supply at all stages of the planning, zoning, approval, development and redevelopment pipeline. The ULDO output covers Perth to Peel and includes scheme amendments, developer intentions, structure planning in progress, subdivision applications/approvals (Western Australian Planning Commission) and local government development applications/approvals. There have been a number of local and regional scheme amendments in the vicinity of the project, with these largely associated with rezoning and subsequent urban development. The ULDO 2016/2017 spatial data has been used to capture future residential, commercial and industrial development at a local and regional scale.

The ULDO 2016/17 data indicates that within the NW Subregion approximately 1,350 ha will support likely future residential/commercial development within the next 5 years. Of this, approximately 848 ha (62.8%) has current conditional approval. Similarly, the data indicates that within 1 km of the project footprint approximately 366 ha will support likely future residential/ commercial development within the next 5 years with approximately 160 ha (43.65 %) having current conditional approval (Table 6). The total future development within the NW Subregion and 1 km buffer is considerably more than this when the longer term development is also considered.

When considering the ULDO 2016/17 data all staging levels were used in calculations. The Part 2 DE intersects ULDO foreseeable future development areas. To avoid double counting of potential impacts, this overlap in areas has been accounted for by extracting these common areas from the ULDO extents as part of the cumulative assessment.

Table 6 Future residential and industrial development at local and regional scales

Development type	Staging	Extent (ha)	
		NW Subregion	1 km buffer
Residential/ commercial	Short term (0-5 years) with current conditional approval	847.47	159.98
	Short term (0-5 years)	501.99	206.50
	Medium term (6-10 years)	789.73	78.11
	Long term (10+ years)	4,370.36	551.12
Industrial	Short term (0-5 years)	39.94	-
	Medium term (6-10 years)	27.23	-
	Long term (10+ years)	680.77	-
TOTAL		**7,257.49**	**995.71**

Data sources: Perth and Peel Urban Land Development Outlook 2016/17 - staging (DOP-096), Perth and Peel Urban Land Development Outlook 2016/17 - Industrial (DOP-097). Note: the areas presented in this table do not consider the overlap with the Part 1 and Part 2 project areas.

Other potential projects

Other proposed projects in the vicinity of the Part 2 project include the YRE Part 1 project. The Part 1 DE covers 63.33 ha.

The Part 1 DE also intersects ULDO foreseeable future development areas. Similar to the Part 2 project, to avoid double counting of potential impacts, this overlap in areas has been accounted for by extracting these common areas from the ULDO extents as part of the cumulative assessment.

4. Assessment of impacts – flora and vegetation

4.1 Native vegetation

4.1.1 Receiving environment

Thirteen vegetation types as well as cleared areas were recorded by GHD (2018b) in the DE (Table 7). Eleven of the vegetation types comprised remnant native vegetation, one vegetation type (VT12) was dominated by planted taxa and one vegetation type (VT13) comprised a mix of degraded native remnant vegetation and native regrowth (>10 years). The vegetation condition within the DE was rated from Excellent to Completely Degraded. There is 49.17 ha of native vegetation in Degraded or better condition within the DE (Table 7).

Two vegetation associations (Beard 1979) and two vegetation complexes (Heddle et al. 1980, Webb et al. 2016) intersect the Part 2 DE.

4.1.2 Direct impacts

The Part 2 project will result in the direct loss of up to 49.17 ha of native vegetation. The remaining extents of the vegetation associations and complexes at a regional and bioregional scale, taking potential clearing associated with the Part 2 project into account, are above 38% of the mapped pre-European extents (Table 8 and Table 10), with greater than 21% of the remaining extents occurring in conservation areas at one or more scales (Table 9 and Table 11).

The largest % impact to a remaining vegetation association extent by clearing the DE is linked to vegetation association 1007, which will account for a reduction of 3.97% at a local scale. However, at a regional and bioregional scale this impact is less at 0.83% and 0.20%, respectively (Table 8). The current extents remaining of vegetation association 1007 remains greater than 56% at a regional scale and 55% at a local scale after development of the Part 2 project.

Clearing the entire DE will remove up to 4.04% of the remaining extent of the Quindalup Complex at a local scale; however at a regional and bioregional scale this impact is 0.74% and 0.13%, respectively (Table 10). The current extents remaining of the Quindalup Complex remains greater than 62% at a regional scale and 56% at a local scale after development of the Part 2 project.

Of the vegetation associations, the remaining extent within conservation areas ranges from 42.52% to 46.98% at a local scale and from 21.59% to 87.41% at a regional scale (Table 9). Similarly of the vegetation complexes, the remaining extent within conservation areas ranges from 42.05% to 50.12% at a local scale and from 29.08% to 92.94% at a regional scale (Table 11).

Table 7 Vegetation types recorded in the Part 2 DE

ID	Vegetation type	Conservation significance	Extent in DE (ha)	Extent in DE in Degraded+ condition (ha)
VT01	*Acacia saligna* and *Xanthorrhoea preissii* tall shrubland		15.75	13.81 (87.7%)
VT02	*Banksia sessilis* and *Melaleuca systena* mid-shrubland	Northern Spearwood shrublands and woodlands (PEC) (SCP24)	5.24	5.24 (100%)
VT03	*Banksia sessilis* and *Spyridium globulosum* tall shrubland	Northern Spearwood shrublands and woodlands (PEC) (SCP24)	8.57	8.44 (98.5%)
VT03a	*Spyridium globulosum* tall shrubland		2.80	2.80 (100%)
VT04	*Banksia attenuata, B. menziesii* low woodland	*Banksia* woodlands (TEC) / *Banksia* dominated woodlands (PEC)	4.75	4.75 (100%)
VT05	*Lomandra* sp. herbland		5.31	5.31 (100%)
VT06	*Eucalyptus gomphocephala* tall woodland	Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP (PEC)	2.13	2.13 (100%)
VT07	*Eucalyptus* sp. and *Agonis flexuosa* woodland		0.32	0.32 (100%)
VT08	*Melaleuca huegelii* and *M. systena* shrubland	*Melaleuca huegelii – M. acerosa (M. systena*) shrublands on limestone ridges (TEC) (SCP26a)	0.05	0.05 (100%)
VT09	*Banksia attenuata* woodland	*Banksia* woodlands (TEC) / *Banksia* dominated woodlands (PEC)	4.01	4.01 (100%)
VT10	*Xanthorrhoea preissii* shrubland		1.46	1.46 (100%)
VT12	Planted		8.87	0.00 (0%)
VT13	Scattered Natives		3.04	0.84 (27.7%)
	SUB-TOTAL		**62.30**	**49.17 (92.0%)**
CL	Cleared		10.56	**-**
	TOTAL		**72.86**	**49.17**

Table 8 Extents of vegetation associations mapped within the Part 2 DE at local, regional and bioregional scales

Vegetation association	Scale	Pre-European extent[1] (ha)	Current extent[1] (ha)	Remaining (%)	Extent in DE[2] (ha)	% of current extent within DE	Current extent after DE developed (ha)
949	Perth subregion	184,475.82	103,972.25	56.36	0.79 (0.08)	<0.01	103,972.17 (56.36%)
	NW subregion	38,330.32	17,173.49	44.80		<0.01	17,173.41 (44.80%)
	1 km buffer	243.65	97.97	40.21		0.08	97.90 (40.18%)
1007	Perth subregion	30,109.89	20,681.70	68.69	48.38 (41.87)	0.20	20,639.83 (68.55%)
	NW subregion	10,801.16	5,048.24	46.74		0.83	5,006.37 (46.35%)
	1 km buffer	1,817.51	1,055.75	58.09		3.97	1,013.89 (55.78%)

[1] Pre-European and Current extents: calculated using Native Vegetation Extent (DPIRD-005), Pre-European Vegetation (DPIRD-006). [2] Vegetation in Degraded or better condition mapped by GHD (2018), (vegetation that intersects the Native Vegetation Extent dataset).

Table 9 Current extent of vegetation associations mapped within the Part 2 DE in conservation areas

Vegetation association	Scale	Current extent[1] (ha)	Remaining (%)	Current extent in conservation areas[2] (ha)			
				DBCA	BF	Total (ha)	% of current extent
949	Perth subregion	103,972.25	56.36	21,353.50	5,997.14	27,350.64	26.31
	NW subregion	17,173.49	44.80	12,047.74	2,963.67	15,011.41	87.41
	1 km buffer	97.97	40.21	37.89	8.14	46.03	46.98
1007	Perth subregion	20,681.70	68.69	3,049.76	1,954.09	5,003.85	24.19
	NW subregion	5,048.24	46.74	93.63	996.31	1,089.93	21.59
	1 km buffer	1,055.75	58.09	83.73	365.18	448.91	42.52

[1] Current extents: Taken from Table 8 [2] DBCA extent: calculated using DBCA – Legislated Lands and Waters (DBCA-011) and DBCA – Lands of Interest (DBCA-012); BF extent; calculated using Bush Forever Areas 2000 (DOP-071) that lies outside of calculated DBCA extent.

Table 10 Extents of vegetation complexes mapped within the Part 2 DE at local, regional and bioregional scales

Vegetation complex	Scale	Pre-European extent[1] (ha)	Current extent[1] (ha)	Remaining (%)	Extent in DE[2] (ha)	% of current extent within DE	Current extent after project developed (ha)
Cottesloe complex - north	Perth subregion	43,474.30	25,162.35	57.88	1.04 (0.39)	<0.01	25,161.96 (57.88%)
	NW subregion	8,715.75	5,950.36	68.27		0.01	5,949.97 (68.27%)
	1 km buffer	326.55	125.33	38.38		0.31	124.95 (38.26%)
Quindalup complex	Perth subregion	53,007.07	32,954.86	62.17	48.13 (41.56)	0.13	32,913.30 (62.09%)
	NW subregion	11,184.24	5,634.59	50.38		0.74	5,593.03 (50.01%)
	1 km buffer	1,734.76	1,028.55	59.29		4.04	986.99 (56.90%)

[1] Pre-European and Current extents: calculated using Native Vegetation Extent (DPIRD-005), Vegetation Complexes – Swan Coastal Plain (DBCA-046). [2] Vegetation in Degraded or better condition mapped by GHD (2018), (vegetation that intersects the Native Vegetation Extent dataset).

Table 11 Current extent of vegetation complexes mapped within the Part 2 DE in conservation areas

Vegetation association	Scale	Current extent[1] (ha)	Remaining (%)	Current extent in conservation areas[2] (ha)			
				DBCA	BF	Total (ha)	% of current extent
Cottesloe complex - north	Perth subregion	25,162.35	57.88	16,431.54	1,252.43	18,789.29	74.67
	NW subregion	5,950.36	68.27	4,857.77	672.49	5,530.25	92.94
	1 km buffer	125.33	38.38	38.16	24.65	62.82	50.12
Quindalup complex	Perth subregion	32,954.86	62.17	6,785.53	3,948.51	10,734.03	32.57
	NW subregion	5,634.59	50.38	109.69	1,528.79	1,638.47	29.08
	1 km buffer	1,028.55	59.29	83.65	348.88	432.53	42.05

[1] Current extents: taken from Table 10. [2] DBCA extent: calculated using DBCA – Legislated Lands and Waters (DBCA-011) and DBCA – Lands of Interest (DBCA-012); BF extent: calculated using Bush Forever Areas 2000 (DOP-071) that lies outside of calculated DBCA extent.

4.1.3 Cumulative considerations

Future residential and industrial development

The current extents of vegetation associations and complexes mapped within the Part 2 project that will support future development in the NW Subregion and within 1 km of Part 2 (as reported by ULDO 2016/17 data) are shown in Table 12 and Table 13.

Table 12 Extents of vegetation associations mapped within the Part 2 project at local and regional scales taking into consideration ULDO

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Current extent within ULDO areas (ha)	Current extent within ULDO areas (%)
949	NW Subregion	38,330.32	17,173.49	795.91	4.63
	1 km buffer	243.65	97.97	32.86	33.54
1007	NW Subregion	10,801.16	5,048.24	3,432.70	68.00
	1 km buffer	1,817.51	1,055.75	546.25	51.74

Table 13 Extents of vegetation complexes mapped within the Part 2 project at local and regional scales taking into consideration ULDO

Vegetation complex	Scale	Pre-European extent (ha)	Current extent (ha)	Current extent within ULDO areas (ha)	Current extent within ULDO areas (%)
Cottesloe complex - north	NW Subregion	8,715.75	5,950.36	163.96	2.76
	1 km buffer	326.55	125.33	39.81	31.76
Quindalup complex	NW Subregion	11,184.24	5,634.59	3,607.40	64.02
	1 km buffer	1,734.76	1,028.55	539.30	52.43

Part 2 project

Of the 49.17 ha of native vegetation in the Part 2 DE, 20.72 ha intersect areas likely to support future development, with the remaining 28.45 ha not currently intersecting areas considered for future land development.

Part 1 project

The Part 1 DE comprises 37.72 ha of native vegetation. Of this 31.55 ha intersect areas likely to support future development, with the remaining 6.17 ha not currently intersecting areas considered for future land development. Of the 37.72 ha, 11.37 ha is within the Part 2 DE 1 km buffer.

Cumulative impacts

Table 14 and Table 15 show the cumulative impacts on the vegetation associations and complexes mapped within the Part 2 DE at local and regional scales. The assessment shows there will be substantial pressure on the remaining vegetation at a local and regional scale primarily due to future residential, commercial and industrial development.

The largest cumulative impact is associated with vegetation association 1007 and the Quindalup Complex, where the current extents are predicted to be reduced by more than 53.75% at all scales. By comparison, the impact of Part 1 and Part 2 only, is predicted to reduce the current extents of the vegetation associations and complexes by less than 5.11% at all scales.

Table 14 Extents of vegetation associations mapped within Part 2 project at location and regional scales taking into consideration YRE Parts 1 and 2 and ULDO

Vegetation association	Scale	Current extent (ha)	Current extent within Part 2 DE (ha) (%)[1]	Current extent within Part 1 DE (ha) (%)[1]	Current extent within ULDO areas (ha)[2]	Cumulative extent (ha) (%)
949	NW Subregion	17,173.49	0.79 (<0.01%)	11.27 (0.05%)	788.38 (4.59%)	797.52 (4.64%)
	1 km buffer	97.97	0.79 (0.08%)	0 (0%)	32.86 (33.54%)	32.94 (33.62%)
1007	NW Subregion	5,048.24	48.38 (0.83%)	26.44 (0.55%)	3,387.97 (67.11%)	3,455.41 (68.45%)
	1 km buffer	1,055.75	48.38 (3.97%)	11.37 (1.05%)	514.50 (48.73%)	567.42 (53.75%)

[1] Percentages based on intersect with Native Vegetation Extent dataset. [2] ULDO areas include all levels of staging for residential, commercial and industrial development where applicable.

Table 15 Extents of vegetation complexes mapped within the Part 2 project at local and regional scales taking into consideration YRE Parts 1 and 2 and ULDO

Vegetation complex	Scale	Current extent (ha)	Current extent within Part 2 DE (ha) (%)[1]	Current extent within Part 1 DE (ha) (%)[1]	Current extent within ULDO areas (ha)[2]	Cumulative extent (ha) (%)
Cottesloe complex – north	NW Subregion	5,950.36	1.04 (0.01%)	0 (0%)	163.96 (2.76%)	164.35 (2.76%)
	1 km buffer	125.33	1.04 (0.31%)	0 (0%)	39.81 (31.76%)	40.20 (32.07%)
Quindalup complex	NW Subregion	5,634.59	48.13 (0.74%)	26.81 (0.46%)	3,561.78 (63.21%)	3,629.24 (64.41%)
	1 km buffer	1,028.55	48.13 (4.04%)	11.37 (1.07%)	507.55 (49.35%)	560.16 (54.46%)

[1] Percentages based on intersect with Native Vegetation Extent dataset. [2] ULDO areas include all levels of staging for residential, commercial and industrial development where applicable.

4.2 Threatened and Priority Ecological Communities

4.2.1 Receiving environment

Five conservation significant ecological communities were recorded in the DE, these included:

- *Banksia* woodlands of the SCP (TEC)
- *Melaleuca huegelii – M. acerosa (M. systena)* shrublands on limestone ridges (TEC) (SCP26a)
- Northern Spearwood shrublands and woodlands (PEC) (SCP24)
- *Banksia* dominated woodlands of the SCP IBRA region (PEC)
- Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP (PEC).

A breakdown of community type by vegetation condition rating is provided in Table 16.

Table 16 Condition and extent of conservation significant ecological communities recorded in the Part 2 DE

Community ID	Condition rating	Extent (ha)
Melaleuca huegelii – M. acerosa (M. systena) shrublands (TEC) (SCP26a)	Very Good	0.05
	Subtotal	**0.05**
Banksia dominated woodlands of the SCP IBRA region (PEC) (*Banksia* woodlands of the SCP (TEC))[1]	Excellent	2.05 (2.05)
	Very Good	4.45 (4.09)
	Very Good – Good	0.10 (0.10)
	Good	1.84 (1.79)
	Degraded	0.32
	Subtotal	**8.76 (8.03)**
Northern Spearwood shrublands and woodlands (PEC) (SCP24)	Excellent	1.29
	Very Good	7.46
	Good	2.04
	Degraded	2.89
	Subtotal	**13.68**
Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP (PEC)	Good – Degraded	0.05
	Degraded	2.08
	Subtotal	**2.13**

[1] *Banksia* woodlands (TEC) extent is a subset of the PEC. To be representative of the *Banksia* Woodlands TEC, vegetation must meet key diagnostic characteristics which include minimum patch size and condition thresholds. Only vegetation in Good or better in condition was considered representative of the *Banksia* Woodlands TEC.

4.2.2 Direct impact

Melaleuca huegelii – M. acerosa (M. systena) shrublands (TEC) (SCP26a)

The *Melaleuca huegelii-Melaleuca systena* shrublands of limestone ridges TEC occurs on skeletal soils on ridge slopes and ridge tops with limestone outcropping. The community is highly restricted and known from massive limestone ridges around Yanchep north of Perth, and south of Perth near Lake Clifton.

The development of the Part 2 project will remove 0.05 ha of the *Melaleuca huegelii-Melaleuca systena* shrublands of limestone ridges TEC. Based on the current extent (provided by DBCA), the project is predicted to reduce the extent of this TEC by up to 100% at a local scale and 0.05% at a regional scale (Table 17). The perceived impact to the *Melaleuca huegelii-Melaleuca systena* shrublands TEC at the local scale is likely a reflection of its restricted and isolated occurrences and the limited extent of this TEC within a 1 km buffer of the DE.

Of the estimated extent of the *Melaleuca huegelii-Melaleuca systena* shrublands of limestone ridges TEC, a large portion (80.5%) is located within National Park and State Forest (Table 18).

Banksia woodlands of the SCP (TEC) and Banksia dominated woodlands of the SCP IBRA region (PEC)

The Part 2 DE will result in the loss of 8.76 ha of the *Banksia* dominated woodlands PEC, with 8.03 ha of this vegetation also representing the *Banksia* woodlands of the SCP (TEC). The clearing loss associated with the DE is estimated to contribute a 6.98% reduction in the PEC at a local scale and a 0.05% reduction in the PEC at a regional scale (Table 17).

Of the estimated current extent remaining, there is 50.14% within conservation areas at a local scale and 92.25% within conservation areas at a regional scale (Table 18).

Northern Spearwood shrublands and woodlands (PEC) (SCP24)

The Part 2 DE will result in the loss of 13.68 ha of the Northern Spearwood shrublands and woodlands (SCP24) PEC. The clearing loss associated with the DE is estimated to contribute a 100% reduction in the PEC at a local scale and a 4.11% reduction in the PEC at a regional scale (Table 17). The impact at a local scale is a reflection of the limited extent of this PEC within a 1 km buffer of the DE.

Of the estimated current extent remaining, a large portion (98.9%) is within conservation areas at a regional scale (Table 18).

Tuart (Eucalyptus gomphocephala) woodlands of the SCP (PEC)

The Part 2 DE will result in the loss of 2.13 ha of the Tuart (*Eucalyptus gomphocephala*) woodlands PEC. The clearing loss associated with the DE is estimated to contribute a 11.35% reduction in the PEC at a local scale and a 0.06% reduction in the PEC at a regional scale (Table 17).

Of the estimated current extent remaining, there is 98.08% within conservation areas at a local scale and 56.20% within conservation areas at a regional scale (Table 18).

4.2.3 Cumulative considerations

Table 19 shows the cumulative impacts on the TECs and PECs mapped within the Part 2 DE at local and regional scales. The assessment shows there will be pressure on the remaining extents of the *Banksia* dominated woodlands of the SCP IBRA region (PEC) and Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP (PEC) at a local scale primarily due to future residential and commercial development. However, based on the data provided by PTA and sourced from DBCA it can be concluded much of the current extents occur within conservation areas (greater than 50% at a local scale and 56% at a regional scale). Therefore it is reasonable to assume there will remain a relatively high level of protection afforded to these TECs and PECs.

The largest cumulative impact indicates 100% removal of the *Melaleuca huegelii – M. acerosa (M. systena)* shrublands TEC and Northern Spearwood shrublands and woodlands PEC at the local scale. This calculated impact is a result of the limited extent of this TEC and PEC within a 1 km buffer of the DE.

Table 17 Estimated extents of TECs and PECs at local and regional scales

Scale	Current extent[1] (ha)	Extent in DE (ha)	% of current extent within DE	Current extent after DE developed (ha)
Melaleuca huegelii – M. acerosa (M. systena) shrublands (TEC) (SCP26a)				
Perth subregion	199.07	0.05	0.03	199.02 (99.97%)
NW subregion	100.84	0.05	0.05	100.79 (99.95%)
1 km buffer	0	0.05	100	-
Banksia dominated woodlands of the SCP IBRA region (PEC)[2]				
Perth subregion	249,544.62	8.76	<0.01	259,535.86 (100%)
NW subregion	16,836.81	8.76	0.05	16,828.05 (99.95%)
1 km buffer	125.45	8.76	6.98	116.69 (93.02%)
Northern Spearwood shrublands and woodlands (PEC) (SCP24)				
Perth subregion	1008.96	13.68	1.36	995.284 (98.64%)
NW subregion	332.59	13.68	4.11	318.91 (95.89%)
1 km buffer	0	13.68	100	-
Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP (PEC)				
Perth subregion	30,319.46	2.13	0.01	30,317.33 (99.99%)
NW subregion	3,643.73	2.13	0.06	3,641.60 (99.94%)
1 km buffer	18.76	2.13	11.35	16.63 (88.65%)

[1] Current extents: provided by DBCA. [2] *Banksia* woodlands (TEC) extent is a subset of the PEC

Table 18 Estimated extents of TECs and PEC in conservation areas

Scale	Current extent[1] (ha)	Current extent in conservation areas (ha)			
		DBCA	BF[2]	Total (ha)	% of current extent
Melaleuca huegelii – M. acerosa (M. systena) shrublands (TEC) (SCP26a)					
Perth subregion	199.07	165.20	4.98	170.18	85.49
NW subregion	100.84	76.23	4.98	81.21	80.54
1 km buffer	0	0	0	0	-
Banksia dominated woodlands of the SCP IBRA region (PEC)[3]					
Perth subregion	259,544.62	79,007.28	12,463.76	91,471.05	35.24
NW subregion	16,836.81	12,409.19	15,452.49	15,532.33	92.25
1 km buffer	125.45	38.23	60.45	62.90	50.14
Northern Spearwood shrublands and woodlands (PEC) (SCP24)					
Perth subregion	1,008.96	387.27	503.37	917.64	90.95
NW subregion	332.59	60.99	328.59	329.22	98.99
1 km buffer	0	0	0	0	-
Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP (PEC)					
Perth subregion	30,319.43	6,831.56	1,358.53	8,190.09	27.01
NW subregion	3,643.73	1,158.17	2,036.79	2,047.84	56.20
1 km buffer	18.76	0.59	18.08	18.40	98.06

[1] Current extents: provided by DBCA. [2] Bush Forever extent: areas that lies outside of calculated DBCA extent. [3] *Banksia* woodlands (TEC) extent is a subset of the PEC

Table 19 Extents of TECs and PECs mapped within the Part 2 project at local and regional scales taking into consideration YRE Parts 1 and 2 and ULDO

TEC/PEC	Scale	Current extent[1] (ha)	Current extent within Part 2 DE (ha) (%)	Current extent within Part 1 DE (ha) (%)	Current extent within ULDO areas (ha)	Cumulative extent (ha) (%)
Melaleuca huegelii – M. acerosa (M. systena) shrublands (TEC) (SCP26a)	NW Subregion	100.84	0.05 (0.05%)	0.53 (0.53%)	0 (0%)	0.58 (0.58%)
	1 km buffer	0	0.05 (100%)	0.40 (100%)	0 (0%)	0.45 (100%)
Banksia dominated woodlands of the SCP IBRA region (PEC)[2]	NW Subregion	16,836.43	8.76 (0.05%)	14.17 (0.08%)	203.01 (1.21%)	225.94 (1.34%)
	1 km buffer	125.06	8.76 (7.00%)	1.01 (0.81%)	39.84 (31.85%)	49.61 (39.66%)
Northern Spearwood shrublands and woodlands (PEC) (SCP24)	NW Subregion	332.59	13.68 (4.11%)	16.05 (4.83%)	0 (0%)	29.73 (8.94%)
	1 km buffer	0.00	13.68 (100%)	9.25 (100%)	0 (0%)	22.93 (100%)
Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP (PEC)	NW Subregion	3,643.46	2.13 (0.06%)	0 (0%)	156.97 (4.31%)	159.10 (4.37%)
	1 km buffer	124.97	2.13 (1.70%)	0 (0%)	13.12 (10.50%)	15.25 (12.20%)

[1] Current extents: provided by DBCA. [2] *Banksia* woodlands (TEC) extent is a subset of the PEC.

4.3 Priority flora

4.3.1 Receiving environment

The DBCA Threatened (Declared Rare) and Priority Flora (TPFL) and WA Herbarium (WAHERB) databases indicate no conservation significant flora occur within a 1 km buffer of the DE. However, four conservation significant flora taxa have been recorded in the DE, these include (GHD 2012, 2018b):

- *Hibbertia spicata* subsp. *leptotheca* (Priority 3)
- *Conostylis pauciflora* subsp. *euryrhipis* (Priority 4)
- *Conostylis pauciflora* subsp. *pauciflora* (Priority 4)
- *Beyeria cinerea* subsp. *cinerea* (Priority 3).

Conostylis pauciflora subsp. *euryrhipis* (P4), *C. pauciflora* subsp. *pauciflora* (P4) and *Beyeria cinerea* subsp. *cinerea* were recorded during the 2012 survey and *Hibbertia spicata* subsp. *leptotheca* (P3) during the 2016-2018 surveys. The three priority flora recorded during the 2012 survey were not relocated during the 2016-2018 field surveys.

A likelihood of occurrence assessment identified no additional taxa are likely to occur within the DE (GHD 2018b).

4.3.2 Direct impacts

The Part 2 project will result in the loss of up to 33 individuals of conservation significant flora within the DE. The loss associated with the DE is estimated to contribute up to a 100% reduction or less at a local scale, up to a 66.67% reduction or less at a regional scale and up to a 15.38% reduction or less at a state scale (Table 20). The perceived impacts to conservation significant flora at the local and regional scales is a reflection of limited targeted survey effort and available count (frequency) data. *FloraBase* records often provide the count (frequency) in descriptors such as common, abundant, frequent, occasional and scattered without providing an actual number of individuals. For the purposes of this assessment these records have been counted as one individual. As such the population estimates are underrepresented with the actual number of individuals expected to be much higher. Therefore, the percent impact calculated is considered very conservative.

Of the current records, there are between 0% and 81.82% of conservation significant flora records within conservation areas at a regional scale. At a local scale there are no conservation significant flora records within conservation areas (Table 21).

4.3.3 Cumulative considerations

Regional spatial data (with sufficient information) was not available to inform a cumulative assessment for conservation significant flora at a local or regional scale. No conservation significant flora were recorded from the Part 1 project.

The perceived impact of the Part 2 project indicates a 100% reduction of *Hibbertia spicata* subsp. *leptotheca* (Priority 3) and *Beyeria cinerea* subsp. *cinerea* (Priority 3) records at a local scale, and up to 66.67% reduction records at a regional scale. However, this is a reflection of limited targeted survey effort and available count (frequency) data at all scales.

Table 20 Conservation significant flora

Scale	Current records[1]	No. of records in DE	% of current records within DE	Current records after project developed
Hibbertia spicata subsp. *leptotheca* (Priority 3)				
State-wide	63 (250+ individuals)	1 (1 individual)	1.61 (0.4)	62 (249 individuals)
NW subregion	11 (110+ individuals)	1 (1 individual)	9.09 (0.91)	10 (109 individuals)
1 km buffer	1 (1 individual)	1 (1 individual)	100 (100)	-
Conostylis pauciflora subsp. *euryrhipis* (Priority 4)				
State-wide	56 (1,270+ individuals)	2 (22 individuals)	3.57 (1.73)	54 (1248+ individuals)
NW subregion	18 (156 individuals)	2 (22 individuals)	11.11 (14.10)	16 (134 individuals)
1 km buffer	2 (22 individuals)	1 (20 individuals)	50 (90.91)	1 (2 individuals)
Conostylis pauciflora subsp. *pauciflora* (Priority 4)				
State-wide	26 (65 individuals)	1 (10 individuals)	3.85 (15.38)	25 (55 individuals)
NW subregion	9 (56 individuals)	1 (10 individuals)	11.11 (17.86)	8 (46 individuals)
1 km buffer	4 (51 individuals)	1 (10 individuals)	25 (19.61)	3 (41 individuals)
Beyeria cinerea subsp. *cinerea* (Priority 3)				
State-wide	63 (134 individuals)	2 (2 individuals)	3.17 (1.49)	61 (132 individuals)
NW subregion	3 (3 individuals)	2 (2 individuals)	66.67 (66.67)	1 (1 individual)
1 km buffer	2 (2 individuals)	2 (2 individuals)	100 (100)	-

[1] Current records: taken from *FloraBase* (WA Herbarium 1998–), *NatureMap* (DBCA 2007–), TPFL and WAHERB databases and GHD (2018b). Estimate of individuals based on count (frequency) data where available. Where no count data is available, record has been counted as one individual.

Table 21 Estimated records of conservation significant flora in conservation areas

Scale	Current records[1]	Current records in conservation areas[2]			
		DBCA	BF	Total (ha)	% of current extent
Hibbertia spicata subsp. *leptotheca* (Priority 3)					
NW subregion	11	4	5	9	81.82
1 km buffer	1	0	0	0	-
Conostylis pauciflora subsp. *euryrhipis* (Priority 4)					
NW subregion	18	9	4	13	72.22
1 km buffer	2	0	0	0	-
Conostylis pauciflora subsp. *pauciflora* (Priority 4)					
NW subregion	9	2	0	2	22.22
1 km buffer	4	0	0	0	-
Beyeria cinerea subsp. *cinerea* (Priority 3)					
NW subregion	3	0	0	0	-
1 km buffer	2	0	0	0	-

[1] Current records: taken from *FloraBase* (WA Herbarium 1998–), *NatureMap* (DBCA 2007–), TPFL and WAHERB databases and GHD (2018b). [2] DBCA and Bush Forever areas will not equal total as areas may overlap.

5. Assessment of impacts – terrestrial fauna

5.1 Fauna habitat

5.1.1 Receiving environment

Eight fauna habitat types, including highly disturbed areas, were recorded in the Part 2 DE (Table 22). Of the fauna habitat mapped within the DE, approximately 65% was considered high value, with approximately 20% considered medium value and the remaining 15% considered low value (i.e. highly disturbed areas).

Table 22 Value and extent of fauna habitat types recorded in the Part 2 DE

Fauna habitat type	Habitat value	Extent (ha)
Banksia sessilis over low mixed shrubland	High	13.81
Eucalyptus woodland	High	2.13
Limestone ridgelands	Medium	0.05
Lomandra herbland on secondary dunes	Medium	5.31
Mixed *Banksia* woodland	High	8.76
Mixed tall shrubland	High	22.75
Planted *Eucalyptus* woodland	Medium	8.87
Subtotal		**61.68**
Highly Disturbed	Low	11.18
Total		**72.86**

5.1.1 Direct impacts

The Part 2 project will result in the direct loss of up to 61.68 ha of fauna habitat. The clearing loss associated with the DE is estimated to contribute a 3.90% reduction in fauna habitat at a local scale; and a 0.11% and 0.01% at a region and subregional scale (Table 23).

Of the current extent remaining, there is 42.98% within conservation areas at a local scale and 74.60% and 44.81% within conservation areas at regional and bioregional scales (Table 24).

5.1.2 Cumulative considerations

Future residential, commercial and industrial development

The estimated extent of native vegetation (fauna habitat) that will be impacted by foreseeable future development in the NW Subregion and within 1 km of Part 2 is shown in Table 25.

Part 2 project

Of the 61.68 ha of fauna habitat in the Part 2 DE, 22.36 ha intersect areas likely to support future development, with the remaining 39.32 ha not currently intersecting areas considered for future land development.

Part 1 project

The Part 1 DE comprises 54.97 ha of fauna habitat. Of this 32.19 ha intersect areas likely to support future development, with the remaining 22.78 ha not currently intersecting areas

considered for future land development. Of the 54.97 ha, 11.81 ha is within the Part 2 DE 1 km buffer.

Cumulative impacts

Table 25 shows the cumulative impacts on the fauna habitat at local and regional scales. The assessment shows there may be substantial pressure on the remaining fauna habitat at a local and regional scale primarily due to future residential, commercial and industrial development. The predicted cumulative impact will result in a 10.70% reduction to fauna habitat at a regional scale and 49.34% reduction to fauna habitat at a local scale. The combined impact of the Part 1 and Part 2, by comparison is predicted to reduce the current extents of fauna habitat by 4.98% at the local scale and 0.19% at the regional scale.

Table 23 Extent of native vegetation (fauna habitat) at local, regional and bioregional scales

Scale	Pre-European extent[1] (ha)	Current extent[1] (ha)	Remaining (%)	Extent in DE (ha)[2]	% of current extent within DE	Current extent after project developed (ha)
Perth subregion	1,117,336.01	465,369.28	41.65	61.68 (45.00)	0.01	465,324.28 (41.65%)
NW subregion	77,112.88	42,581.90	55.22		0.11	42,536.90 (55.16%)
1 km buffer	2,062.77	1,155.34	56.01		3.90	1,110.34 (53.83%)

[1] Pre-European and Current extents: calculated using Native Vegetation Extent (DPIRD-005), Pre-European Vegetation (DPIRD-006). [2] Fauna habitat mapped by GHD (2018), (fauna habitat that intersects the Native Vegetation Extent dataset).

Table 24 Current extent of native vegetation (fauna habitat) in conservation areas

Scale	Current extent[1] (ha)	Remaining (%)	Current extent in conservation areas[2] (ha)			
			DBCA	BF	Total (ha)	% of current extent
Perth subregion	465,369.28	41.65	186,970.02	21,553.29	208,523.32	44.81
NW subregion	42,581.90	55.22	16,363.90	6,606.02	22,969.92	53.94
1 km buffer	1,155.34	56.01	122.21	374.34	496.55	42.98

[1] Current extents: taken from Table 23. [2] DBCA extent: calculated using DBCA – Legislated Lands and Waters (DBCA-011) and DBCA – Lands of Interest (DBCA-012); BF extent: calculated using Bush Forever Areas 2000 (DOP-071) that lies outside of calculated DBCA extent.

Table 25 Extent of native vegetation (fauna habitat) at local and regional scales taking into consideration YRE Parts 1 and 2 and ULDO

Scale	Current extent (ha)	Current extent within Part 2 DE (ha) (%)[1]	Current extent within Part 1 DE (ha) (%)[1]	Current extent within ULDO areas[2] (ha)	Cumulative extent (ha) (%)
NW Subregion	42,581.90	61.68 (0.11%)	54.97 (0.08%)	4,477.76 (10.52%)	4,558.03 (10.70%)
1 km buffer	1,155.34	61.68 (3.90%)	11.81 (0.99%)	513.53 (44.45%)	570.02 (49.34%)

[1] Percentages based on intersect with Native Vegetation Extent dataset. [2] ULDO areas include all levels of staging for residential, commercial and industrial development where applicable.

5.2 Bush Forever and ecological linkages

5.2.1 Receiving environment

The Part 2 DE intersects Bush Forever Site No. 289. This site extends from near Bush Forever Site No. 288 to Bush Forever Site No. 397 providing an east-west linkage from Yanchep National Park to coastal reserves. Bush Forever Site No. 289 is currently intersected by Marmion Avenue.

A regional ecological linkage (Link No. 7) runs perpendicular to the Part 2 DE on its eastern side. This regional ecological linkage is shown in the City of Wanneroo Local Biodiversity Strategy 2018/19 – 2023/24 as Link ID: 0, an extension to Link No. 7, extending further west connecting Bush Forever Sites No. 289 and 397. The Part 2 DE intersects the extension of the regional ecological linkage (Link ID: 0) as shown in the City of Wanneroo Local Biodiversity Strategy 2018/19 – 2023/24 (Figure 2).

5.2.2 Direct impacts

The Part 2 DE will impact 28.82 ha of Bush Forever Site No. 289. Of the 28.82 ha, 19.29 ha comprises native vegetation with the remaining 9.53 ha comprising degraded areas, planted species and cleared areas. The Part 2 DE will create an additional barrier within Bush Forever Site No. 289 by further intersecting this Site. The DE extends approximately 3 km through Bush Forever Site No. 289.

The Part 2 DE will impact a regional ecological linkage (Link ID: 0, an extension of Link No. 7), which is associated with Bush Forever Site No. 289.

5.2.3 Cumulative considerations

Future residential and industrial development

There are no foreseeable impacts to Bush Forever Site No. 289 by future development within a 1 km buffer of the Part 2 project. The eastern part of Link ID: 0 will be impacted by foreseeable future development both within a 1 km buffer of the Part 2 project and the NW subregion.

The estimated extent of regional ecological linkage (extension of Link No. 7) that will be impacted by foreseeable future development within a 1 km buffer of the Part 2 project is considered minimal. This linkage is largely contained within areas zoned ‘Parks and Recreation’ under the MRS with no/limited future residential, commercial and industrial development indicated.

Part 2 project

The Part 2 DE comprises 19.29 ha of native vegetation that intersects Bush Forever Site No. 289. No areas within Bush Forever Site No. 289 are considered for future development.

Part 1 project

The Part 1 DE does not intersect Bush Forever Site No. 289 or regional ecological linkage (extension of Link No. 7).

Cumulative impacts

The Part 2 DE will reduce Bush Forever Site No. 289 by removing approximately 4.50 % of this site, with no other foreseeable future development contributing additional impacts. The remaining extent of Bush Forever Site No. 289 post-Part 2 development is 612.01 ha.

5.3 Black Cockatoos

5.3.1 Receiving environment

The Part 2 project is located within the modelled breeding and feeding distribution for Carnaby's Black Cockatoo (DSEWPaC 2012). Suitable breeding and foraging habitat for Carnaby's Black Cockatoo was recorded in the DE. Table 26 provides a breakdown of Black Cockatoo breeding and foraging habitat recorded in the DE by value. Roosting habitat was also identified within the DE, however the extents of roosting habitat within the DE have been captured within breeding and foraging extents.

Approximately 3% of the DE provides potential breeding habitat, and 77% of the DE provides medium or high value foraging habitat for Carnaby's Black Cockatoo. The remaining areas in the DE are highly disturbed or comprise fauna habitat types not considered suitable for Carnaby's Black Cockatoo breeding or foraging.

Table 26 Black Cockatoo habitat types and value recorded in the Part 2 DE

Habitat type	Habitat value	Extent (ha)
Foraging (Breeding[1])	High	22.56
	Medium	33.75 (2.13)
Total		**56.31 (2.13)**

[1] Breeding habitat extent is subset of the foraging habitat extent.

The DE is located within a buffer of a confirmed breeding area. It would appear the known breeding record is approximately 3 km east of the DE (based on the Carnabys Cockatoo Breeding Areas Confirmed dataset). There are two confirmed roosting areas approximately 2 km east of the DE; there is also one unconfirmed roosting area approximately 1.1 km east of the DE. With the exception of the unconfirmed roosting area, all of these records are from Yanchep National Park.

GHD (2018) identified 45 trees of suitable DBH for potential Black Cockatoos breeding within the Part 2 DE. Trees with suitable DBH have not been included in the below assessment as local and regional spatial data was not available to inform the assessment.

5.3.2 Direct impacts

The Part 2 DE will result in the direct loss of up to 56.31 ha of foraging habitat. The clearing loss associated with the DE is estimated to contribute a 5.21% reduction in foraging habitat at a local scale (Table 27). The regional impact of the Part 2 project is estimated to be less than 0.15% for foraging habitat.

Of the current extent remaining, there is 100% and 42.31% of breeding and foraging habitat respectively within conservation areas at a local scale. At a regional scale there is 78.15% and 80.13% of breeding and foraging habitat respectively within conservation areas (Table 28).

5.3.3 Cumulative considerations

Future residential, commercial and industrial development

The estimated extent of Black Cockatoo breeding and foraging habitat that will support future development in the NW Subregion is shown in Table 29. There are no foreseeable impacts to Black Cockatoo breeding habitat by future development within a 1 km buffer of the Part 2 project.

Part 2 project

The Part 2 DE comprises 56.31 ha of Black Cockatoo breeding and/or foraging habitat. Of this, 15.49 ha intersects areas likely to support future development, with the remaining 40.82 ha not currently intersecting areas considered for future land development.

Part 1 project

The Part 1 DE comprises 48.21 ha of Black Cockatoo breeding and/or foraging habitat. Of this 24.03 ha intersects areas likely to support future development, with the remaining 24.18 ha not currently intersecting areas considered for future land development. Of the 48.21 ha, 10.71 ha is within the Part 2 DE 1 km buffer.

Cumulative impacts

Table 29 shows the cumulative impacts on Black Cockatoo breeding and foraging habitat at a local and regional scale. At a local scale, the Part 1 and 2 projects will reduce the available habitat for Black Cockatoo breeding and foraging. There are no impacts to Black Cockatoo breeding from future residential, commercial and industrial development at a local scale. The predicted cumulative impact will result in a 4.96% reduction to Black Cockatoo potential breeding habitat and 9.66% reduction to Black Cockatoo foraging habitat at a regional scale. Furthermore, at a regional scale there is greater than 78% of the current extents of available habitat for Black Cockatoo breeding and foraging in conservation areas.

Table 27 Extents of Black Cockatoo habitat at local and regional scales

Habitat type	Corresponding associations	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Extent in DE (ha)[1]	% of current extent within DE	Current extent after DE developed (ha)
Breeding	6, 965, 998, 1001, 1011	NW subregion	24,442.23	7,268.01	29.74	2.13 (0)	-	7,268.01 (29.74%)
		1 km buffer	1.61	1.61	100		-	1.61 (100%)
Foraging[1]	-	NW subregion	-	25,808.75	-	56.31 (39.92)	0.15	25,768.83
		1 km buffer	-	766.99	-		5.21	727.07

[1] Carnaby's Cockatoo foraging habitat mapped by GHD (2018), (Carnaby's Cockatoo foraging habitat that intersects the Native Vegetation Extent dataset)..

Table 28 Current extent of Black Cockatoo habitat in conservation areas

Habitat types	Scale	Current extent (ha)[1]	Remaining (%)	Current extent in conservation areas[2] (ha)			
				DBCA	BF	Total (ha)	% of current extent
Breeding	NW subregion	7,268.01	29.74	3,811.58	1,868.53	5,680.11	78.15
	1 km buffer	1.61	100	0.59	1.02	1.61	100
Foraging	NW subregion	25,808.75	-	15,088.44	5,593.07	20,681.51	80.13
	1 km buffer	766.99	-	64.18	260.36	324.54	42.31

[1] Current extents: taken from Table 27. [2] DBCA extent: calculated using DBCA – Legislated Lands and Waters (DBCA-011) and DBCA – Lands of Interest (DBCA-012); BF extent: calculated using Bush Forever Areas 2000 (DOP-071) that lies outside of calculated DBCA extent.

Table 29 Extents of Black Cockatoo habitat at local and regional scales taking into consideration YRE Parts 1 and 2 and ULDO

Habitat type	Scale	Current extent (ha)	Current extent within Part 2 DE (ha) (%)[1]	Current extent within Part 1 DE (ha) (%)[1]	Current extent within ULDO areas[2] (ha) (%)	Cumulative extent (ha) (%)
Breeding	NW Subregion	7,268.01	2.13 (0%)	0 (0%)	360.18 (4.96%)	360.18 (4.96%)
	1 km buffer	1.61	2.13 (0%)	0 (0%)	0 (0%)	0 (0%)
Foraging	NW Subregion	25,808.75	56.31 (0.15%)	48.21 (0.15%)	2,426.39 (9.40%)	2,493.41 (9.66%)
	1 km buffer	766.99	56.31 (5.21%)	10.71 (1.26%)	371.70 (48.46%)	421.26 (54.92%)

[1] Percentages based on intersect with Native Vegetation Extent dataset. [2] ULDO areas include all levels of staging for residential, commercial and industrial development where applicable..

6. Assessment of impacts – landforms

6.1 Parabolic dune formation

6.1.1 Receiving environment

The project intersects parabolic dune formations belonging to the Quindalup dune system along its length.

6.1.2 Direct impacts

The Part 2 DE intersects 17.54 ha which currently support parabolic dune formations.

The remaining extent of parabolic dune formations at a local and regional scale is greater than 65.26% of the mapped pre-European extent (Table 30). However, less than 40% of the remaining extent occurs in conservation areas (DBCA Legislated Lands and Bush Forever) at both scales (29.82% at a regional scale and 39.29% at a local scale) (Table 31).

6.1.3 Cumulative considerations

Future residential, commercial and industrial development

The estimated extent of parabolic dune formations that will be impacted by future development in the NW Subregion and within 1 km of the project is shown in Table 32.

Part 2 project

The Part 2 DE intersects 17.54 ha which currently support parabolic dune formations. Of this, 8.53 ha intersect areas likely to support future development, with the remaining 9.04 ha (supporting current parabolic dune formations) not currently intersecting areas considered for future land development.

Part 1 project

The Part 1 DE intersects 6.98 ha which currently support parabolic dune formations. Of this, 5.87 ha intersect areas likely to support future development, with the remaining 1.12 ha (supporting current parabolic dune formations) not currently intersecting areas considered for future land development. Of this 6.98 ha, 0.88 ha is within the Part 2 DE 1 km buffer.

Cumulative impacts

Table 32 shows the cumulative impacts on parabolic dune formations at a local and regional scale. The Part 2 DE will impact parabolic dune formations, however, it is considered future development will have a much larger impact on the areas supporting current parabolic dune formations at both local and regional scales (53.76% at a local scale and 63.76% at a regional scale).

Table 30 Extent of parabolic dune formation at local and regional scales

Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Extent in DE (ha)	% of current extent within DE	Current extent after DE developed (ha) (%)
NW subregion	5,433.49	3,545.82	65.26	17.54	0.49	3,528.27 (64.94%)
1 km buffer	479.45	385.23	80.35		4.55	367.39 (76.69%)

Table 31 Current extent of parabolic dune formation in conservation areas

Scale	Current extent[1] (ha)	Remaining (%)	Current extent in conservation areas[2] (ha)			
			DBCA	BF	Total (ha)	% of current extent
NW subregion	3,545.82	65.26	59.76	997.75	1,057.50	29.82
1 km buffer	385.23	80.35	12.39	138.98	151.37	39.29

[1] Current extents: taken from Table 30. [2] DBCA extent: calculated using DBCA – Legislated Lands and Waters (DBCA-011) and DBCA – Lands of Interest (DBCA-012); BF extent: calculated using Bush Forever Areas 2000 (DOP-071) that lies outside of calculated DBCA extent.

Table 32 Extents of parabolic dune formation at local and regional taking into consideration YRE Parts 1 and 2 and ULDO

Scale	Current extent (ha)	Current extent within Part 2 DE (ha) (%)	Current extent within Part 1 DE (ha) (%)	Current extent within ULDO areas[1] (ha)	Cumulative extent (ha) (%)
NW Subregion	3,545.82	17.54 (0.49%)	6.98 (0.20%)	2,236.30 (63.07%)	2,260.82 (63.76%)
1 km buffer	385.23	17.54 (4.55%)	0.88 (0.23%)	188.66 (48.97%)	207.08 (53.76%)

[1] ULDO areas include all levels of staging for residential, commercial and industrial development where applicable.

7. Conclusions

7.1 Significance of direct impacts from the Part 2 project

At a local level, the Part 2 project has a more significant impact than when compared to a regional scale. This outcome is not unexpected given the existing development in the immediate area and limited extent of conservation areas within a 1 km buffer of the Part 2 project. Whereas when the regional context is considered, the significance of these impacts are reduced.

The development of the Part 2 project will not decrease any of the vegetation associations and complexes (and associated fauna habitat) mapped within the Part 2 DE below 30% of their pre-European extents at a local scale. Furthermore, all of these vegetation associations and complexes occur within conservation areas at all scales and therefore are afforded some level of protection.

The Part 2 project will remove State and Federally listed TECs and PECs. At a bioregional and regional scale the Part 2 project will reduce TECs and PECs recorded in the DE by less than 4.11%. However, at a local scale the Part 2 project will reduce the Northern Spearwood shrublands and woodlands (PEC) (SCP24) and *Melaleuca huegelii – M. acerosa (M. systena)* shrublands (TEC) (SCP26a) by 100%. This impact is a reflection of the limited extent of these communities within a 1 km buffer of the DE. It is noted at both the local and regional scale, with the exception of the Northern Spearwood shrublands and woodlands (PEC) and *Melaleuca huegelii – M. acerosa (M. systena)* shrublands (TEC), greater than 50% of their current extents are within conservation areas. However, given the level of protection afforded to these TECs the regulator may consider any impact to these communities significant.

The Part 2 project will impact upon four flora species of conservation significance. The loss associated with the DE is diluted with increasing scale (i.e. local, regional, state) with perceived impacts a reflection of limited targeted survey effort and available count (frequency) data at all scales.

The Part 2 project will impact on Bush Forever Site No. 289 and regional ecological linkage (Link ID: 0) (associated with Bush Forever Site No. 289) as shown in the City of Wanneroo Local Biodiversity Strategy 2018/19 – 2023/24. The associated loss of vegetation with respect to the Bush Forever site is relatively small, however, the introduction of an additional barrier within the site is likely to reduce its ecological function. It is noted the Part 2 project will not create a barrier of greater than 500 m between viable natural areas, which is considered the preferred maximum distance between habitats. The Part 2 project will contribute to the cumulative impact on the Bush Forever site potentially reducing its overall viability.

The development of the Part 2 project will impact on parabolic dune formations. The associated loss of the dune formations is relatively small (less than 0.49% at a regional scale) and is not anticipated to adversely affect the function at this scale.

7.2 Cumulative considerations with respect to significance of the Part 2 project impacts

The Draft Perth and Peel@3.5million identified the NW subregion as one of the fastest growing areas in the Perth and Peel regions. It is anticipated this will be the case over the long-term (to 2050) as the subregion has a significant supply of undeveloped Urban and Urban Deferred zoned land available, predominately within the coastal urban growth corridor. The Draft Perth and Peel@3.5million also notes that to provide the capacity to accommodate projected population growth, transit corridors should be identified as a priority for increased density.

The proposed urban growth in the NW subregion, (acknowledging not all is approved at a State level under environmental assessment) will have significant environmental impacts. However, it is reasonable to assume strategic growth will continue, with increasing need/demand for transport networks. The contribution of the YRE project to the various environmental impacts considered in this report are minimal by comparison to the proposed urban growth.

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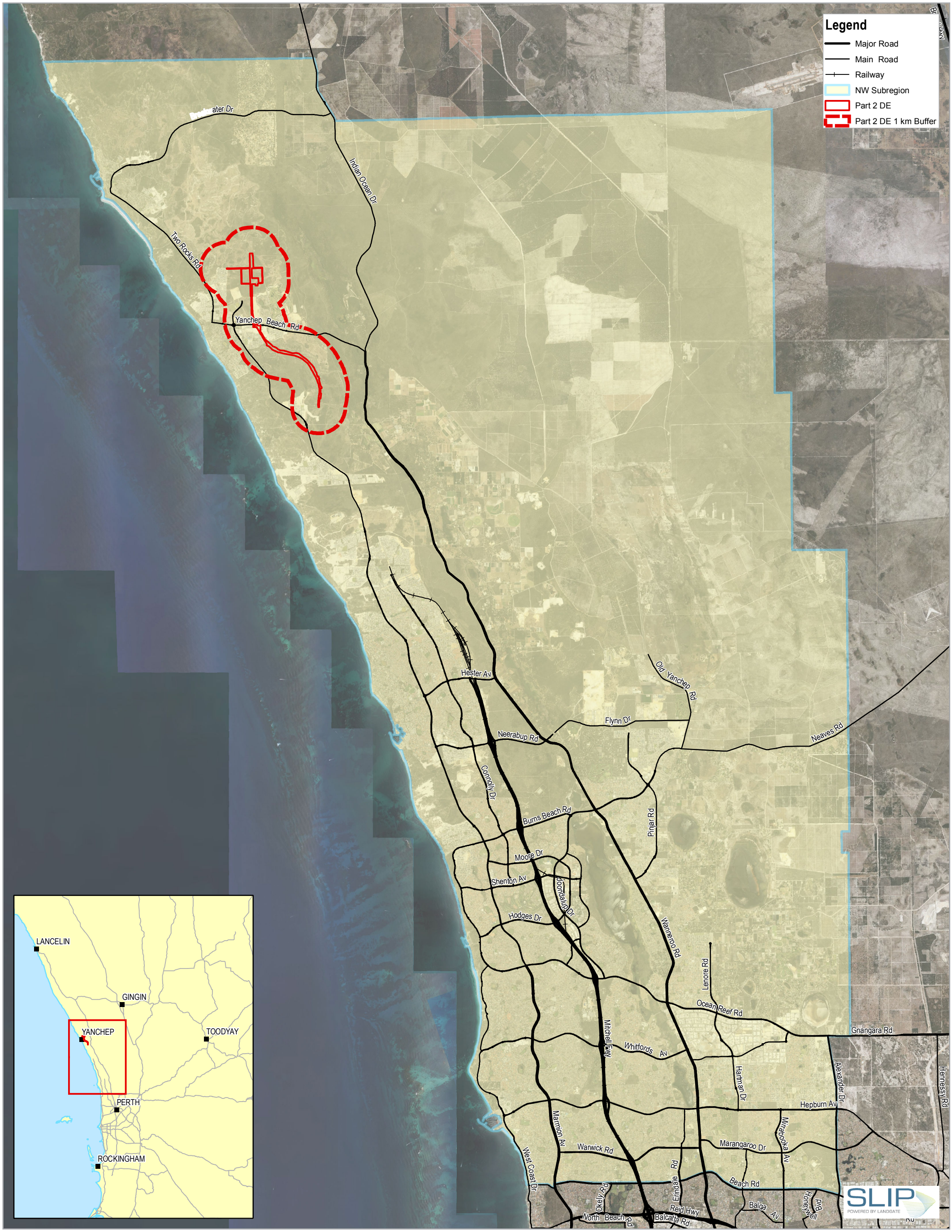
Appendices

Appendix A – Figures



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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GHD

Public Transport Authority

Yanchep Rail Extension

Project locality and scales

Project No.	**61-3706203**
Revision No.	**0**
Date	**27 Jun 2018**

FIGURE 1

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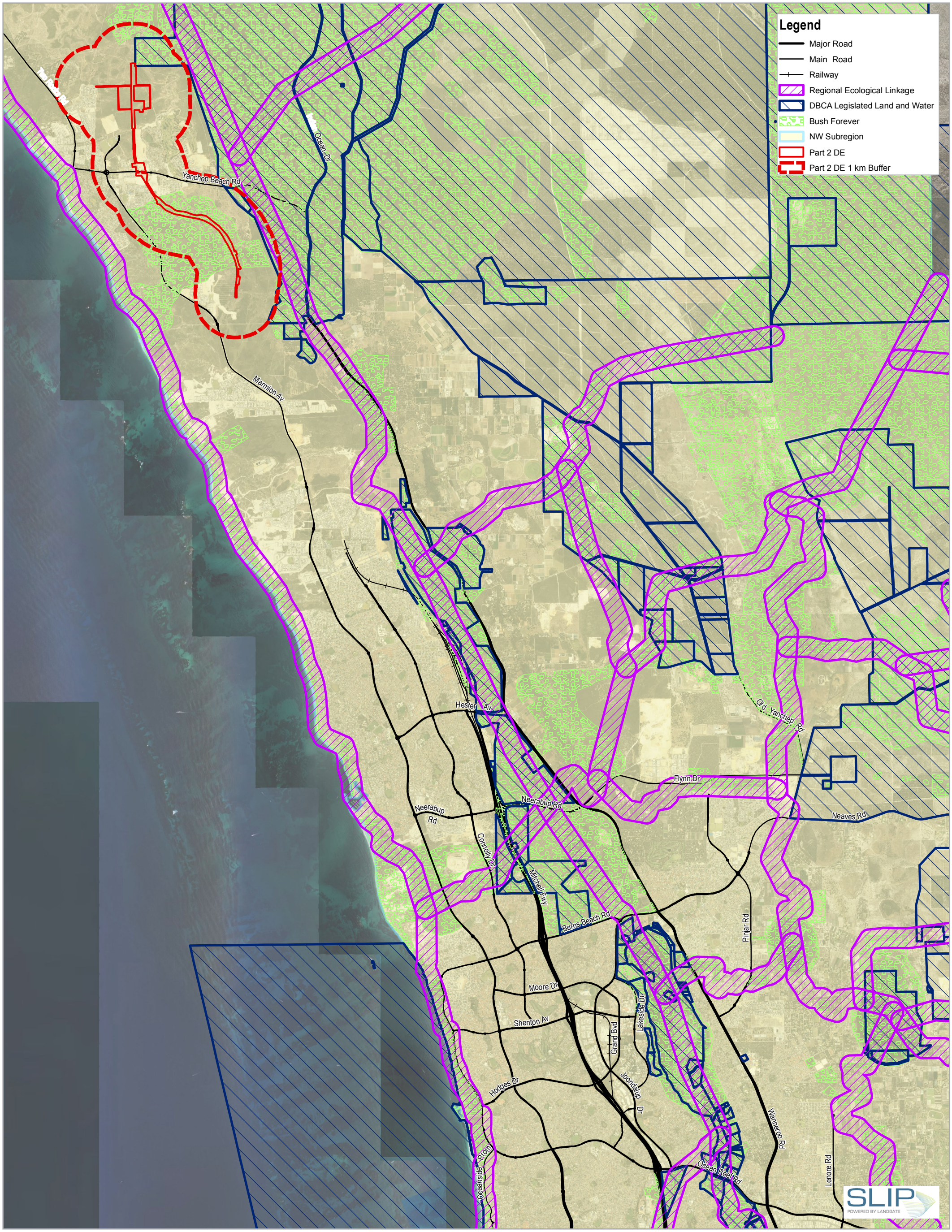
Data source: Geoscience Australia: GeoData Topo 250k Series III; Landgate: Roads - 20160617, Railway - 20170906, Imagery; PTA: Part 2 DE, Part 2 DE 1 km buffer, NW Subregion. Created by: artermulo



Paper Size ISO A3

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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Yanchep Rail Extension

Local and regional context

Project No. **61-3706200**
Revision No. **0**
Date **27 Jun 2018**

FIGURE 2

G:\61\3706203\GIS\Maps\MXD\613706203_002_Fig2Context_RevA.mxd
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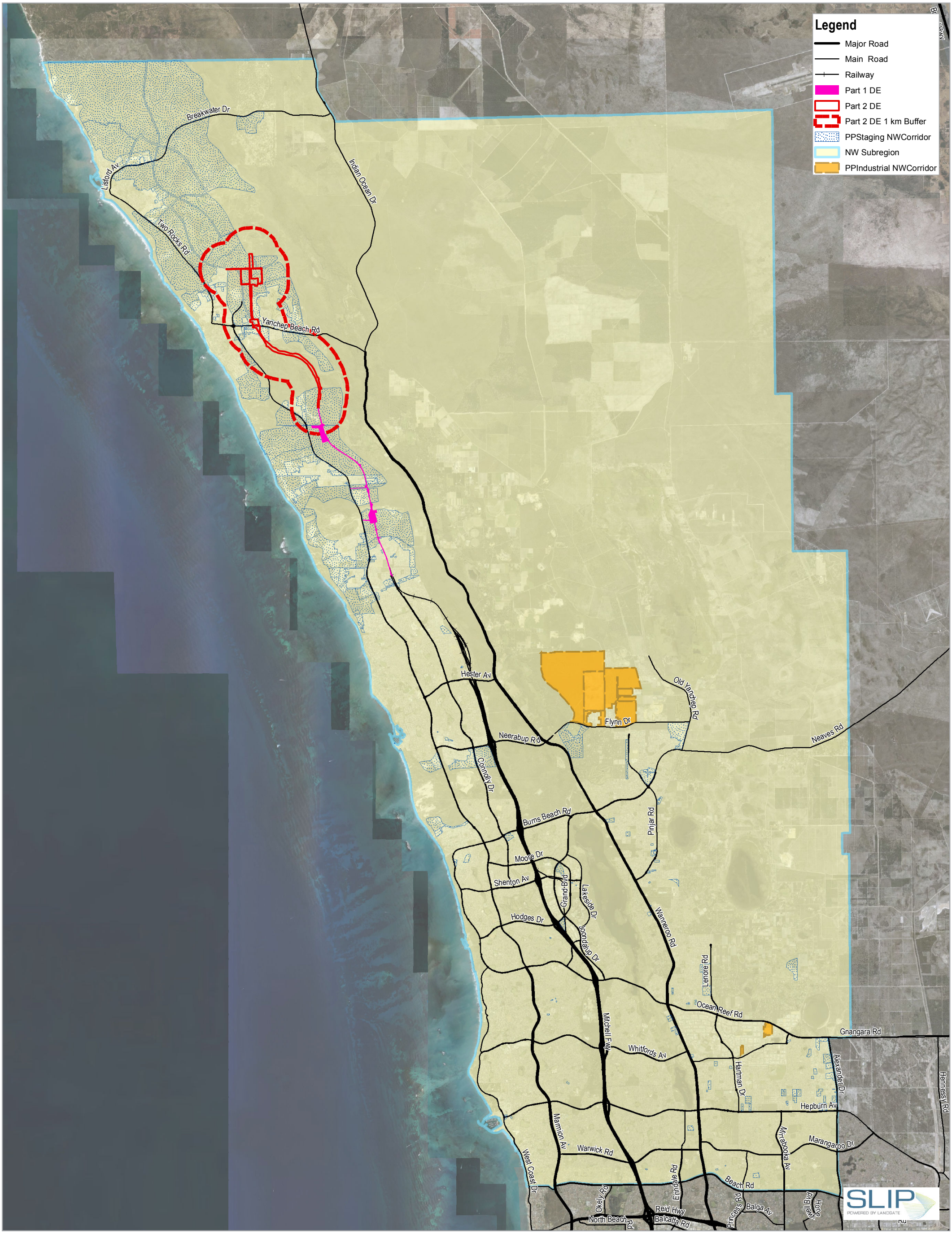
Data source: Geoscience Australia: GeoData Topo 250k Series III; Landgate: Roads - 20160617, Railway - 20170906, Imagery; DBCA: DBCA Legislated Lands and Waters; DoP: Bush Forever ; PTA: Part 2 DE, Part 2 DE 1 km buffer, NW Subregion. Created by: artermulo



Paper Size ISO A3

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Kilometres

Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 50

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Yanchep Rail Extension

Cumulative considerations

Project No.	**61-3706200**
Revision No.	**0**
Date	**01 Mar 2019**

FIGURE 3

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Print date: 01 Mar 2019 - 14:20

Data source: Geoscience Australia: GeoData Topo 250k Series III; Landgate: Roads - 20160617, Railway - 20170906, Imagery; DBCA: DBCA Legislated Lands and Waters, Regional Ecological Linkages ; DoP: Bush Forever ; PTA: Part 2 DE, Part 2 DE 1 km buffer, Part 1 DE, NW Subregion. Created by: krawlinson

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6137062-4863/https://projects.ghd.com/oc/WesternAustralia1/ptametronetenvironme/Delivery/Documents/6137062-REP_YRE Part 2 Biological Factors Additional Information.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	J Tindiglia	D Farrar		D Farrar		05/07/2018
1	J Tindiglia	D Farrar		D Farrar		06/07/2018
2	J Tindiglia	D Farrar		D Farrar		12/07/2018
3	J Tindiglia	D Farrar		D Farrar		18/12/2018
4	J Tindiglia	D Farrar		D Farrar		24/01/2019
5	J Tindiglia	D Farrar		D Farrar		29/01/2019
6	J Tindiglia	D Farrar		D Farrar		08/02/2019
7	J Tindiglia	D Farrar		D Farrar		6/03/2019

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