



**Public Transport Authority**  
Yanchep Rail Extension Part 2  
Biological Factors

July 2018

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## **Appendices**

Appendix A – Figures

# 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 is being 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. Part 2 of the project includes the proposal to construct and operate the rail extension and includes one new intermodal transit station at Yanchep. Part 2 of the project includes approximately 7.2 kilometres (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).

## 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 (direct and cumulative) 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, 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, fauna habitat and parabolic dunes:

1. Describe and quantify the environmental aspects present within the development envelope and footprint.
2. Describe and quantify the environmental aspects present within the development envelope and footprint 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 areas

PTA has defined a development envelope (DE) and development footprint (DF) for this project. The Part 2 DE covers 72.86 ha and the Part 2 DF covers 60.29 ha. The development areas are a combination of vegetation, re-vegetation and cleared areas. The DF is fully contained within the development envelope.

These areas were used for the basis of this assessment. Collectively the DE and DF has been referred to within this report as development areas 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)<br>YRE Development Footprint (PTA)<br>NW subregion (as shown in Perth and Peel@3.5)<br>Perth IBRA subregions  |
| Vegetation                                     | YRE vegetation type mapping (GHD 2018)<br>Pre-European Vegetation (DPIRD-006)<br>Native Vegetation Extent (DPIRD-005)<br>Vegetation Complexes – Swan Coastal Plain   |
| Threatened and Priority Ecological Communities | Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) spatial dataset (Department of Biodiversity, Conservation and Attractions (DBCA) 2017)<br>Interim Recovery Plan (Luu and English 2005)<br>Approved Conservation Advice (Threatened Species Scientific Committee (TSSC) 2016)<br>Priority Ecological Communities of Western Australia (DBCA 2017) |
| Conservation estate and reserves               | Bush Forever Areas 2000 (DOP-071)<br>DBCA – Legislated Lands and Waters (DBCA-011)<br>DBCA – Lands of Interest (DBCA-012)<br>Regional Parks (DBCA-026)   |
| Ecological linkages                            | City of Wanneroo Local Biodiversity Strategy 2011-2016<br>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)<br>Perth and Peel ULDO 2016/17 – Industrial (DOP-097)<br>Local Planning Scheme – City of Wanneroo<br>Local Planning Scheme – City of Joondalup<br>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.

### 2.5.2 Assigning vegetation association and complexes

The GHD Biological Assessment Report (2018) vegetation types for the project have been aligned with previously described/mapped vegetation associations (Beard 1979) and complexes (Hedde et al. 1980) to enable the local, regional and cumulative assessment to occur. Alignment was based on vegetation structure and species present. Where the vegetation types do not clearly align with the previously described vegetation associations and complexes (due to differences in mapping scales, amount of disturbance etc.), the types have been assigned to the association/complex that they are mapped within. The vegetation associations and complexes mapped as present in the development areas are presented in Table 2 and Table 3, respectively.



**Table 2 Vegetation association descriptions (Beard 1979)**

| Association | Description   | Structure                         | Flora  |
|-------------|---|-----------------------------------|--|
| 949         | Low woodland; banksia   | Low woodland or open low woodland | Other <i>Acacia</i> , <i>Banksia</i> , <i>Agonis flexuosa</i> , <i>Callitris</i> , <i>Allocasuarina</i> , <i>Eucalyptus loxophleba</i> . |
| 998         | Medium woodland; tuart  | Woodland southwest                | <i>Eucalyptus gomphocephala</i> .  |
| 1007        | Mosaic: Shrublands; <i>Acacia lasiocarpa</i> & <i>Melaleuca acerosa</i> [now <i>M. systema</i> ] heath / Shrublands; <i>Acacia rostellifera</i> & <i>Acacia cyclops</i> thicket | Scrub-heath / Thicket             | <i>Acacia lasiocarpa</i> , <i>Melaleuca acerosa</i> , <i>A. rostellifera</i> , <i>A. cyclops</i>   |

**Table 3 Vegetation complex descriptions (Hedde et al. 1980)**

| Complex                               | Description   |
|---------------------------------------|---|
| Quindalup complex                     | Coastal dune complex consisting mainly of two alliances- the strand and fore dune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of <i>Melaleuca lanceolata</i> (Rottnest Teatree) – <i>Callitris preissii</i> (Rottnest Island Pine) and the closed scrub of <i>Acacia rostellifera</i> (Summer-scented Wattle). |
| Cottesloe complex – north             | Predominantly low open forest and low woodland of <i>Banksia attenuata</i> (Slender Banksia) – <i>B. menziesii</i> (Firewood Banksia) – <i>Eucalyptus todtiana</i> (Pricklybark); closed heath on the limestone outcrops  |
| Cottesloe complex – central and south | Mosaic of woodland of <i>Eucalyptus gomphocephala</i> (Tuart) and open forest of <i>E. gomphocephala</i> (Tuart) – <i>E. marginata</i> (Jarrah) – <i>Corymbia calophylla</i> (Marri); closed heath on the limestone outcrops  |

### 2.5.3 Threatened and Priority Ecological Communities

In the absence of available spatial data, the local and regional extents of Threatened and Priority Ecological Communities (TECs and PECs) have been estimated using previously described/mapped vegetation associations (Beard 1979) and/or information in publicly available Plans and Advice.

- *Melaleuca huegelii* – *M. acerosa* (*M. systema*) shrublands on limestone ridges (TEC) (SCP26a): The estimated extent of SCP26a was calculated based on that provided in the interim recovery plan for the TEC (CALM 2005) and reported in the GHD Biological Assessment (2018) (which is additional to the previously known extent).
- *Banksia* woodlands of the Swan Coastal Plain (SCP) (TEC) and *Banksia* dominated woodlands of the SCP IBRA region (PEC): Approved Conservation Advice for the TEC (TSSC 2016) provides a list of vegetation associations that are likely to comprise a major component of the Banksia Woodlands ecological community. The vegetation associations mapped in the local and regional areas that have been used to calculate the estimated extent of the TEC and PEC include 949 and 1001.
- Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP (PEC): The Priority Ecological Communities for WA List (DBCA 2017) provides information on the vegetation structure and flora assemblages present with Tuart communities considered the PEC. The vegetation associations mapped in the local and regional areas that have been used to calculate the estimated extent of this PEC include 998 and 1011.
- Northern Spearwood shrublands and woodlands (PEC) (SCP24): This community does not clearly align with previously described/mapped vegetation associations (Beard 1979), therefore, the local and regional extent of this PEC has not been calculated. However,



TSSC (2016) notes that SCP24 is a component of the Banksia Woodland TEC and estimates there is 1009 ha mapped over a range of about 170 km from Nowergup to Binningup.

## 2.6 Terrestrial fauna considerations

### 2.6.1 Estimating the local and regional extent of Black Cockatoo habitat

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

**Table 4 Black Cockatoo habitat**

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

## 2.6.2 Black Cockatoo foraging habitat value

Black Cockatoo foraging habitat value within the development areas 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, medium or low (Table 5). Black Cockatoo habitat types, definitions and species suitability were sourced from DSEWPaC (2012) to guide this determination. The foraging habitat scoring tool (Commonwealth of Australia 2017) was also considered when assigning values.

**Table 5 Black Cockatoo foraging habitat value**

| Fauna habitat type                               | Black Cockatoo foraging habitat | Black Cockatoo foraging habitat value |
|--|---------------------------------|---------------------------------------|
| <i>Banksia sessilis</i> over low mixed shrubland | Yes                             | High                                  |
| <i>Eucalyptus</i> woodland                       | Yes                             | High                                  |
| Limestone ridgeland                              |                                 |                                       |
| <i>Lomandra</i> herbland on secondary dunes      |                                 |                                       |
| Mixed <i>Banksia</i> woodland                    | Yes                             | High                                  |
| Mixed tall shrubland                             | Yes                             | Low / Medium / High <sup>1</sup>      |
| Planted <i>Eucalyptus</i> woodland               | Yes                             | Medium                                |
| Highly Disturbed                                 |                                 |                                       |

<sup>1</sup> The majority of this mixed tall shrubland habitat type is considered to have medium foraging value.

Trees of suitable diameter breast height (DBH) for Black Cockatoos (DSEWPaC 2012) were recorded from the development areas, however as there is no reliable local or regional publicly available data this aspect has not been considered further as part of this assessment.

## 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/Eglinton. 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 systema*, *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 2011-2016 shows an extension to Link No. 7, extending further west connecting Bush Forever Sites No. 289 and 397. 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.

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          | -             |
| <b>TOTAL</b>           |  | <b>7,257.49</b> | <b>995.71</b> |

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 70.2 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

Twelve vegetation types as well as cleared areas were recorded in the DE (Table 7). All of these vegetation types were also recorded in the DF. The majority of the vegetation types could be aligned to previously described/mapped vegetation associations or complexes based on structure and species present. The remaining vegetation types were aligned with those associations and complexes they occur within. One type (VT12 – Planted) was not considered representative of previously mapped vegetation associations/complexes.

The vegetation condition within the DE was rated from Excellent to Completely Degraded. The extents of each vegetation type in Degraded or better condition are provided in Table 7.

### 4.1.2 Direct impacts

The remaining extent of the aligned vegetation associations and complexes at a local, regional and bioregional scale are above 32% 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 998, which will account for a reduction of 100% at a local scale. However, at a regional and bioregional scale this impact is significantly less at 0.8% and 0.01%, respectively (Table 8). At a regional scale the current extent of vegetation association 998 remains greater than 40% after development of the Part 2 project.

Clearing the entire DE will remove up to 100% of the remaining extent of the Cottesloe complex – central and south at a local scale; however at a regional and bioregional scale this impact is 0.13% and 0.05%, respectively (Table 10). At a regional scale the current extent of Cottesloe complex – central and south remains greater than 33% after development of the Part 2 project.

The perceived impact to vegetation association 998 and Cottesloe complex – central and south is likely associated with utilising broad-scale mapping (Beard 1979, Heddle et al. 1980) at a local scale, where the resolution does not include all local occurrences (i.e. previously mapped in GoWA 2000). This appears to be compounded by the limited extent of the vegetation association and complex within a 1 km buffer of the DE.

Of the aligned vegetation associations, the remaining extent within conservation areas ranges from 42.52% to 100% at a local scale and from 21.59% to 87.41% at a regional scale (Table 9). Similarly of the aligned vegetation complexes, the remaining extent within conservation areas ranges from 42.05% to 82.67% 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 and DF**

| ID   | Vegetation type  | Conservation significance   | Aligning vegetation association/complex                   | Extent       |              | Extent in Degraded+ condition |                      |
|------|--|---|---|--------------|--------------|-------------------------------|----------------------|
|      |  |   |   | DE (ha)      | DF (ha)      | DE (ha) (%)                   | DF (ha) (%)          |
| VT01 | <i>Acacia saligna</i> and <i>Xanthorrhoea preissii</i> tall shrubland  |   | Association 1007<br>Quindalup complex                     | 10.72        | 9.53         | 8.78 (81.9%)                  | 7.83 (82.1%)         |
| VT02 | <i>Banksia sessilis</i> and <i>Melaleuca systema</i> mid-shrubland     | Northern Spearwood shrublands and woodlands (PEC) (SCP24)   | Association 949<br>Cottesloe complex - north              | 4.82         | 3.90         | 4.82 (100%)                   | 3.90 (100%)          |
| VT03 | <i>Banksia sessilis</i> and <i>Spyridium globulosum</i> tall shrubland | Northern Spearwood shrublands and woodlands (PEC) (SCP24)   | Association 949<br>Cottesloe complex - north              | 11.02        | 10.53        | 10.90 (98.9%)                 | 10.40 (98.8%)        |
| VT04 | <i>Banksia attenuata</i> , <i>B. menziesii</i> low woodland            | <i>Banksia</i> woodlands (TEC) / <i>Banksia</i> dominated woodlands (PEC)   | Association 949<br>Cottesloe complex - north              | 5.81         | 3.86         | 5.81 (100%)                   | 3.86 (100%)          |
| VT05 | <i>Lomandra</i> sp. herbland   |   | Association 1007<br>Cottesloe complex – central and south | 5.32         | 5.06         | 5.18 (97.5%)                  | 4.93 (97.3%)         |
| VT06 | <i>Eucalyptus gomphocephala</i> tall woodland                          | Tuart ( <i>Eucalyptus gomphocephala</i> ) woodlands of the SCP (PEC)  | Association 998<br>Cottesloe complex – central and south  | 2.14         | 2.14         | 2.14 (100%)                   | 2.14 (100%)          |
| VT07 | <i>Eucalyptus</i> sp. and <i>Agonis flexuosa</i> woodland              |   | Association 998<br>Cottesloe complex – central and south  | 0.32         | 0.32         | 0.32 (100%)                   | 0.32 (100%)          |
| VT08 | <i>Melaleuca huegelii</i> and <i>M. systema</i> shrubland              | <i>Melaleuca huegelii</i> – <i>M. acerosa</i> ( <i>M. systema</i> ) shrublands on limestone ridges (TEC) (SCP26a) | Association 1007<br>Cottesloe complex – central and south | 0.05         | 0.05         | 0.05 (100%)                   | 0.05 (100%)          |
| VT09 | <i>Banksia attenuata</i> woodland                                      | <i>Banksia</i> woodlands (TEC) / <i>Banksia</i> dominated woodlands (PEC)   | Association 949<br>Cottesloe complex - north              | 7.09         | 7.09         | 6.83 (96.4%)                  | 6.83 (96.4%)         |
| VT10 | <i>Xanthorrhoea preissii</i> shrubland                                 |   | Association 1007<br>Cottesloe complex - north             | 1.57         | 1.57         | 1.48 (94.1%)                  | 1.48 (94.1%)         |
| VT13 | Scattered Natives  |   | Association 1007<br>Quindalup complex                     | 4.31         | 2.18         | 0.98 (22.8%)                  | 0.43 (19.6%)         |
|      | <b>SUB-TOTAL</b>   |   |   | <b>53.17</b> | <b>46.23</b> | <b>47.29 (88.9%)</b>          | <b>42.17 (91.2%)</b> |
| VT12 | Planted  |   |   | 9.13         | 8.30         |                               |                      |
| CL   | Cleared  |   |   | 10.56        | 5.75         |                               |                      |
|      | <b>TOTAL</b>   |   |   | <b>72.86</b> | <b>60.28</b> | <b>47.29</b>                  | <b>42.17</b>         |

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

| Vegetation association | Corresponding GHD VTs        | Scale           | Pre-European extent <sup>1</sup> (ha) | Current extent <sup>1</sup> (ha) | Remaining (%) | Extent in project <sup>2</sup> (ha) |       | % of current extent within project |       | Current extent after project developed (ha) |                        |
|------------------------|------------------------------|-----------------|---------------------------------------|----------------------------------|---------------|-------------------------------------|-------|------------------------------------|-------|---|------------------------|
|                        |                              |                 |                                       |                                  |               | DE                                  | DF    | DE                                 | DF    | DE  | DF                     |
| 949                    | VT02, VT03, VT04, VT09       | Perth subregion | 184,475.82                            | 103,972.25                       | 56.36         | 28.36                               | 25.00 | 0.03                               | 0.02  | 103,943.89<br>(56.35%)                      | 103,947.25<br>(56.35%) |
|                        |                              | NW subregion    | 38,330.32                             | 17,173.49                        | 44.80         |                                     |       | 0.17                               | 0.15  | 17,145.13<br>(44.73%)                       | 17,148.49<br>(44.74%)  |
|                        |                              | 1 km buffer     | 243.65                                | 97.973721                        | 40.21         |                                     |       | 28.94                              | 25.51 | 69.62<br>(28.57%)                           | 72.98<br>(29.95%)      |
| 998                    | VT06, VT07                   | Perth subregion | 50,867.50                             | 18,286.07                        | 35.95         | 2.46                                | 2.46  | 0.01                               | 0.01  | 18,283.61<br>(35.94%)                       | 18,283.61<br>(35.94%)  |
|                        |                              | NW subregion    | 7,473.03                              | 3,016.23                         | 40.36         |                                     |       | 0.08                               | 0.08  | 3,013.77<br>(40.33%)                        | 3,013.77<br>(40.33%)   |
|                        |                              | 1 km buffer     | 1.612376                              | 1.612376                         | 100           |                                     |       | 100                                | 100   | -   | -                      |
| 1007                   | VT01, VT05, VT08, VT10, VT13 | Perth subregion | 30,109.89                             | 20,681.70                        | 68.69         | 16.48                               | 14.71 | 0.08                               | 0.07  | 20,665.22<br>(68.63%)                       | 20,666.99<br>(68.64%)  |
|                        |                              | NW subregion    | 10,801.16                             | 5,048.24                         | 46.74         |                                     |       | 0.33                               | 0.29  | 5,031.76<br>(46.59%)                        | 5,033.53<br>(46.60%)   |
|                        |                              | 1 km buffer     | 1,817.51                              | 1,055.75                         | 58.09         |                                     |       | 1.56                               | 1.39  | 1,039.27<br>(57.18%)                        | 1,041.04<br>(57.28)    |

<sup>1</sup> Pre-European and Current extents: calculated using Native Vegetation Extent (DPIRD-005), Pre-European Vegetation (DPIRD-006). <sup>2</sup> Vegetation in Degraded or better condition (GHD 2018).

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

| Vegetation association | Scale           | Current extent <sup>1</sup> (ha) | Remaining (%) | Current extent in conservation areas <sup>2</sup> (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               |
| 998                    | Perth subregion | 18,286.07                        | 35.95         | 9,510.68   | 2,284.60 | 11,795.28  | 64.50               |
|                        | NW subregion    | 3,016.23                         | 40.36         | 1,528.72   | 868.08   | 2,396.80   | 79.46               |
|                        | 1 km buffer     | 1.61                             | 100           | 0.59   | 1.02     | 1.61       | 100                 |
| 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               |

<sup>1</sup> Current extents: Taken from Table 7 <sup>2</sup> 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 and DF at local, regional and bioregional scales**

| Vegetation complex                    | Corresponding GHD VTs        | Scale           | Pre-European extent <sup>1</sup> (ha) | Current extent <sup>1</sup> (ha) | Remaining (%) | Extent in project <sup>2</sup> (ha) |       | % of current extent within project |       | Current extent after project developed (ha) |                    |
|---------------------------------------|------------------------------|-----------------|---------------------------------------|----------------------------------|---------------|-------------------------------------|-------|------------------------------------|-------|---|--------------------|
|                                       |                              |                 |                                       |                                  |               | DE                                  | DF    | DE                                 | DF    | DE  | DF                 |
| Cottesloe complex - north             | VT02, VT03, VT04, VT09, VT10 | Perth subregion | 43,474.30                             | 25,162.35                        | 57.88         | 29.83                               | 26.47 | 0.12                               | 0.11  | 25,132.52 (57.81%)                          | 25,135.88 (57.82%) |
|                                       |                              | NW subregion    | 8,715.75                              | 5,950.36                         | 68.27         |                                     |       | 0.50                               | 0.44  | 5,920.53 (67.93%)                           | 5,923.89 (67.97%)  |
|                                       |                              | 1 km buffer     | 326.55                                | 125.33                           | 38.38         |                                     |       | 23.80                              | 21.12 | 95.50 (29.24%)                              | 98.86 (30.27%)     |
| Cottesloe complex – central and south | VT05, VT06, VT07, VT08       | Perth subregion | 45,030.93                             | 14,571.13                        | 32.36         | 7.69                                | 7.44  | 0.05                               | 0.05  | 14,563.44 (32.34%)                          | 14,563.69 (32.34%) |
|                                       |                              | NW subregion    | 17,272.13                             | 5,841.12                         | 33.82         |                                     |       | 0.13                               | 0.13  | 5,833.43 (33.77%)                           | 5,833.68 (33.78%)  |
|                                       |                              | 1 km buffer     | 1.45                                  | 1.45                             | 100           |                                     |       | 100                                | 100   | -   | -                  |
| Quindalup complex                     | VT01, VT13                   | Perth subregion | 53,007.07                             | 32,954.86                        | 62.17         | 9.77                                | 8.26  | 0.03                               | 0.03  | 32,945.09 (62.15%)                          | 32,946.60 (62.16%) |
|                                       |                              | NW subregion    | 11,184.24                             | 5,634.59                         | 50.38         |                                     |       | 0.17                               | 0.15  | 5,624.82 (50.29%)                           | 5,626.33 (50.31%)  |
|                                       |                              | 1 km buffer     | 1,734.76                              | 1,028.55                         | 59.29         |                                     |       | 0.95                               | 0.80  | 1,018.79 (58.73%)                           | 1,020.29 (58.81%)  |

<sup>1</sup> Pre-European and Current extents: calculated using Native Vegetation Extent (DPIRD-005), Vegetation Complexes – Swan Coastal Plain. <sup>3</sup> Vegetation in Degraded or better condition (GHD 2018).

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

| Vegetation association                | Scale           | Current extent <sup>1</sup> (ha) | Remaining (%) | Current extent in conservation areas <sup>2</sup> (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               |
| Cottesloe complex – central and south | Perth subregion | 14,571.13                        | 32.36         | 6,936.51   | 2,357.75 | 9,294.26   | 63.79               |
|                                       | NW subregion    | 5,841.12                         | 33.82         | 2,382.93   | 1,218.78 | 3,601.72   | 61.66               |
|                                       | 1 km buffer     | 1.45                             | 100           | 0.39   | 0.81     | 1.20       | 82.67               |
| 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               |

<sup>1</sup> Current extents: taken from Table 9. <sup>2</sup> 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                                |
| 998                    | NW Subregion | 7,473.03                 | 3,016.23            | 82.80                                 | 2.75                                 |
|                        | 1 km buffer  | 1.612376                 | 1.61                | -                                     | -                                    |
| 1007                   | NW Subregion | 10,801.16                | 5,048.24            | 3,431.41                              | 67.97                                |
|                        | 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                                |
| Cottesloe complex – central and south | NW Subregion | 17,272.13                | 5,841.12            | 841.39                                | 14.40                                |
|                                       | 1 km buffer  | 1.45                     | 1.45                | -                                     | -                                    |
| Quindalup complex                     | NW Subregion | 11,184.24                | 5,634.59            | 3606.11                               | 64.00                                |
|                                       | 1 km buffer  | 1,734.76                 | 1,028.55            | 539.30                                | 52.43                                |

#### Part 2 project

The Part 2 DE comprises 47.29 ha of vegetation in degraded or better condition. Of this 23.44 ha intersect areas likely to support future development, with the remaining 23.85 ha not currently intersecting areas considered for future land development.

#### Part 1 project

The Part 1 DE comprises 43.14 ha of vegetation in degraded or better condition. Of this 38.20 ha intersect areas likely to support future development, with the remaining 4.94 ha not currently intersecting areas considered for future land development. Of the 43.14 ha, 11.13 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 1 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 ULDO areas account for up to 67% and 63% reduction in association and complex extent, respectively at all scales.

The impact of the Part 1 and Part 2, by comparison is predicted to reduce the current extents of the vegetation associations and complexes by less than 29% at all scales (with the exception of vegetation association 998 and Cottesloe complex – central and south vegetation complex). The largest predicted cumulative impact will result in a 100% reduction to the current extents of

vegetation association 998 and Cottesloe complex – central and south vegetation complex at a local scale. However, at a regional scale the predicted cumulative impact will reduce the current extent of this vegetation by less than 14% (less than 3% for vegetation association 998 and less than 14% for Cottesloe complex – central and south). Furthermore, at the regional and bioregional scales there is greater than 61% of the current extents of vegetation association 998 and the Cottesloe complex – central and south in conservation areas.



**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) (%) | Current extent within Part 1 DE (ha) (%) | Current extent within ULDO areas (ha) | Cumulative extent (ha) (%) |
|------------------------|--------------|---------------------|--|--|---------------------------------------|----------------------------|
| 949                    | NW Subregion | 17,173.49           | 28.36 (0.17%)                            | 33.83 (0.20%)                            | 746.60 (4.35%)                        | 808.79 (4.71%)             |
|                        | 1 km buffer  | 97.97               | 28.36 (28.94%)                           | 10.26 (10.48%)                           | 3.07 (3.13%)                          | 41.69 (42.55%)             |
| 998                    | NW Subregion | 3,016.23            | 2.46 (0.08%)                             | 0.32 (0.01%)                             | 82.58 (2.74%)                         | 85.36 (2.83%)              |
|                        | 1 km buffer  | 1.61                | 2.46 (100%)                              | -  | -                                     | 2.46 (100%)                |
| 1007                   | NW Subregion | 5,048.24            | 16.48 (0.33%)                            | 8.99 (0.18%)                             | 3,420.84 (67.76%)                     | 3,446.31 (68.27%)          |
|                        | 1 km buffer  | 1,055.75            | 16.48 (1.56%)                            | 1.10 (0.10%)                             | 541.88 (51.33%)                       | 559.46 (52.99%)            |

**Table 15 Extents of vegetation complexes mapped within the Part 2 project at location 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) (%) | Current extent within Part 1 DE (ha) (%) | Current extent within ULDO areas (ha) | Cumulative extent (ha) (%) |
|---------------------------------------|--------------|---------------------|--|--|---------------------------------------|----------------------------|
| Cottesloe complex – north             | NW Subregion | 5,950.36            | 29.83 (0.05%)                            | 33.83 (0.57%)                            | 114.18 (1.92%)                        | 198.17 (3.33%)             |
|                                       | 1 km buffer  | 125.33              | 29.83 (23.80%)                           | 10.26 (8.19%)                            | 10.02 (7.99%)                         | 33.83                      |
| Cottesloe complex – central and south | NW Subregion | 5,841.12            | 7.69 (0.13%)                             | 8.51 (0.15%)                             | 830.94 (14.23%)                       | 842.00 (14.41%)            |
|                                       | 1 km buffer  | 1.45                | 7.69 (100%)                              | 1.10 (75.85%)                            | -                                     | 8.80 (100%)                |
| Quindalup complex                     | NW Subregion | 5,634.59            | 9.77 (0.17%)                             | 0.80 (0.01%)                             | 3,604.70 (63.97%)                     | 3,615.27 (64.16%)          |
|                                       | 1 km buffer  | 1,028.55            | 9.77 (0.95%)                             | -  | 538.70 (52.37%)                       | 548.47 (53.32%)            |

## 4.2 Threatened and Priority Ecological Communities

### 4.2.1 Receiving environment

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

- *Banksia* woodlands of the SCP (TEC)
- *Melaleuca huegelii* – *M. acerosa* (*M. systema*) 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 Conservation significant ecological communities recorded in the Part 2 DE and DF**

| Community ID  | Condition rating    | Extent (ha)          |                      |
|---|---------------------|----------------------|----------------------|
|   |                     | DE                   | DF                   |
| <i>Melaleuca huegelii</i> – <i>M. acerosa</i> ( <i>M. systema</i> ) shrublands (TEC) (SCP26a)                             | Very Good           | 0.05                 | 0.05                 |
|   | <b>Subtotal</b>     | <b>0.05</b>          | <b>0.05</b>          |
| <i>Banksia</i> dominated woodlands of the SCP IBRA region (PEC) ( <i>Banksia</i> woodlands of the SCP (TEC)) <sup>1</sup> | Excellent           | 2.05 (2.05)          | 1.35 (1.35)          |
|   | Very Good           | 7.57 (7.57)          | 6.94 (6.94)          |
|   | Good                | 2.48 (2.48)          | 2.04 (2.04)          |
|   | Degraded            | 0.54                 | 0.36                 |
|   | Completely Degraded | 0.25                 | 0.25                 |
|   | <b>Subtotal</b>     | <b>12.89 (12.10)</b> | <b>12.20 (10.34)</b> |
| Northern Spearwood shrublands and woodlands (PEC) (SCP24)   | Excellent           | 1.29                 | 1.08                 |
|   | Very Good           | 7.15                 | 6.61                 |
|   | Good                | 4.39                 | 4.10                 |
|   | Degraded            | 2.89                 | 2.51                 |
|   | Completely Degraded | 0.13                 | 0.13                 |
|   | <b>Subtotal</b>     | <b>15.85</b>         | <b>14.43</b>         |
| Tuart ( <i>Eucalyptus gomphocephala</i> ) woodlands of the SCP (PEC)  | Degraded            | 2.14                 | 2.14                 |
|   | <b>Subtotal</b>     | <b>2.14</b>          | <b>2.14</b>          |

<sup>1</sup> *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. systema*) shrublands (TEC) (SCP26a)

The *Melaleuca huegelii*-*Melaleuca systema* 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 interim recovery plan (CALM 2005) identifies approximately 79 occurrences of the TEC covering an estimated extent of 164 ha. A breakdown of extents by land tenure for the NW Subregion and Perth Subregion are provided in Table 17.

The GHD Biological Assessment Report (2018) identified a further 1.28 ha of the *Melaleuca huegelii*-*Melaleuca systema* shrublands of limestone ridges TEC within the survey area extent,

which was not previously identified or included in the interim recovery plan for this community (CALM 2005).

Of the estimated extent of the *Melaleuca huegelii-Melaleuca systema* shrublands of limestone ridges TEC, a large portion (80.5%) is located within National Park and State Forest (Table 17).

**Table 17 Estimated extent of SCP26a TEC**

| Land tenure                       | NW Subregion | Perth Subregion | Total (ha)    |
|-----------------------------------|--------------|-----------------|---------------|
| Interim Recovery Plan (CALM 2005) |              |                 |               |
| Crown Reserve                     | -            | 7.50            | 7.50          |
| Freehold, State                   | 0.40         | -               | 0.40          |
| National Park                     | 26.30        | -               | 26.30         |
| Private Property                  | 6.70         | 8.00            | 14.70         |
| Shire Reserve                     | 3.60         | -               | 3.60          |
| State Forest                      | 40.70        | 65.20           | 105.90        |
| Unallocated Crown Land            | 1.40         | 3.00            | 4.40          |
| GHD Biological Assessment (2018)  |              |                 |               |
| Freehold                          | 1.28         | 1.28            | 1.28          |
| <b>Total</b>                      | <b>80.38</b> | <b>84.98</b>    | <b>164.08</b> |

The development of the Part 2 project will remove 0.05 ha of the *Melaleuca huegelii-Melaleuca systema* shrublands of limestone ridges TEC. Based on the current extent (extracted from CALM 2005 and GHD 2018), the project is predicted to reduce the extent of this TEC by up to 0.06% at a regional scale and 0.03% at a bioregional scale (Table 18).

**Table 18 Estimated extent of SCP26a TEC mapped within the Part 2 DE and DF at local and regional scales**

| Scale           | Estimated extent <sup>1</sup> (ha) | Extent in Part 2 project (ha) |      | % of current extent within Part 2 project |      | Extent remaining after Part 2 project developed (ha) (%) |                 |
|-----------------|------------------------------------|-------------------------------|------|---|------|--|-----------------|
|                 |                                    | DE                            | DF   | DE  | DF   | DE   | DF              |
| Perth subregion | 164.08                             | 0.05                          | 0.05 | 0.03                                      | 0.03 | 164.03 (99.97%)  | 164.03 (99.97%) |
| NW subregion    | 80.38                              |                               |      | 0.06                                      | 0.06 | 80.33 (99.94%)   | 80.33 (99.94%)  |

<sup>1</sup> Estimated extents: CALM (2005) and GHD (2018).

***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 12.89 ha of the *Banksia* dominated woodlands PEC, with 12.10 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 13.16% reduction in the PEC at a local scale and a 0.07% reduction in the PEC at a regional scale (Table 19).

Of the estimated current extent remaining, there is 18.89% within conservation areas at a local scale and 87.33% within conservation areas at a regional scale (Table 20).

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

The Part 2 DE will result in the loss of 2.14 ha of the Tuart (*Eucalyptus gomphocephala*) woodlands PEC. The clearing loss associated with the DE is estimated to contribute a 100% reduction in the PEC at a local scale and a 0.06% reduction in the PEC at a regional scale (Table 19). The perceived impact to the Tuart (*Eucalyptus gomphocephala*) woodlands PEC at the local scale is likely a reflection of utilising broad-scale mapping (Beard 1979) to infer extent and the limited extent of this PEC within a 1 km buffer of the DE. It is noted that Bush Forever Site No. 289 includes a *Eucalyptus gomphocephala* community as part of the mapped vegetation structural units (Tingay, Alan and Associates 1991, 1992). The inclusion of this community as a structural unit may suggest its occurrence more broadly throughout the Bush Forever, than regional mapping indicates.

Of the estimated current extent remaining, there is 79.48% within conservation areas at a local scale and 100% within conservation areas at a regional scale (Table 20).

### ***Northern Spearwood shrublands and woodlands (PEC) (SCP24)***

The Part 2 DE will result in the loss of 15.85 ha of the Northern Spearwood shrublands and woodlands (SCP24) PEC. The clearing loss associated with the DE is estimated to contribute a 1.57% reduction in the PEC at a bioregional scale based on the estimated extent provided in TSSC (2016).

**Table 19 Estimated extent of Banksia PEC and Tuart PEC at local and regional scales**

| Scale  | Pre-European extent <sup>1</sup> (ha) | Current extent <sup>1</sup> (ha) | Remaining (%) | Extent in project (ha) |       | % of current extent within project |       | Current extent after project developed (ha) |                       |
|--|---------------------------------------|----------------------------------|---------------|------------------------|-------|------------------------------------|-------|---|-----------------------|
|  |                                       |                                  |               | DE                     | DF    | DE                                 | DF    | DE  | DF                    |
| <i>Banksia</i> dominated woodlands of the SCP IBRA region (PEC)    |                                       |                                  |               |                        |       |                                    |       |   |                       |
| NW subregion   | 38,993.53                             | 17,355.02                        | 44.51         | 12.89                  | 12.20 | 0.07                               | 0.07  | 17,338.57<br>(44.47%)                       | 17,342.82<br>(44.48%) |
| 1 km buffer  | 243.65                                | 97.97                            | 40.21         | 12.89                  | 12.20 | 13.16                              | 12.45 | 85.08<br>(34.92%)                           | 85.77<br>(35.20%)     |
| <i>Tuart (Eucalyptus gomphocephala)</i> woodlands of the SCP (PEC) |                                       |                                  |               |                        |       |                                    |       |   |                       |
| NW subregion   | 8,468.42                              | 3,650.50                         | 43.11         | 2.14                   | 2.14  | 0.06                               | 0.06  | 3,648.36<br>(43.08%)                        | 3,648.36<br>(43.08%)  |
| 1 km buffer  | 1.61                                  | 1.61                             | 100           | 2.14                   | 2.14  | 100                                | 100   | -   | -                     |

<sup>1</sup> Pre-European and Current extents: calculated using Native Vegetation Extent (DPIRD-005), Pre-European Vegetation (DPIRD-006).

**Table 20 Estimated extent of Banksia PEC and Tuart PEC in conservation areas**

| Scale  | Current extent <sup>1</sup> (ha) | Remaining (%) | Current extent in conservation areas <sup>2</sup> (ha) |          |            |                     |
|--|----------------------------------|---------------|--|----------|------------|---------------------|
|  |                                  |               | DBCA   | BF       | Total (ha) | % of current extent |
| <i>Banksia</i> dominated woodlands of the SCP IBRA region (PEC)    |                                  |               |  |          |            |                     |
| NW subregion   | 17,355.02                        | 44.51         | 12,131.25  | 3,024.82 | 15,156.07  | 87.33               |
| 1 km buffer  | 97.97                            | 40.21         | 37.89  | 8.14     | 46.03      | 18.89               |
| <i>Tuart (Eucalyptus gomphocephala)</i> woodlands of the SCP (PEC) |                                  |               |  |          |            |                     |
| NW subregion   | 3,650.50                         | 43.11         | 1,860.12   | 1,041.47 | 2,901.59   | 79.48               |
| 1 km buffer  | 1.61                             | 100           | 0.59   | 1.02     | 1.61       | 100                 |

<sup>1</sup> Current extents: taken from Table 19. <sup>2</sup> 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.

### 4.2.3 Cumulative considerations

Regional spatial data was not available to inform a cumulative assessment for TECs or PECs at a local or regional scale. However, based on the interim recovery plan for the *Melaleuca huegelii-Melaleuca systena* shrublands of limestone ridges TEC (CALM 2005) it can be concluded much of the remaining extent occurs within National Park and State Forest (80.5%), with less than 9% located on private property. Similarly, the inferred extents of the Banksia dominated woodlands PEC (and Banksia woodlands of the SCP TEC) and Tuart (*Eucalyptus gomphocephala*) woodlands PEC indicates there is greater than 79% currently contained in conservation areas 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.

At a local scale the small extent of inferred Tuart (*Eucalyptus gomphocephala*) woodlands PEC is wholly contained within conservation areas. Whilst the calculated impact of the Part 2 project indicates 100% removal of this PEC at the local scale, the small inferred extent of this PEC is considered conservative and the calculated impact a result of comparing broad-scale mapping by Beard (1979) with finer scale project-specific mapping (e.g. GHD 2018).

The cumulative extent of TECs and PECs within the Parts 1 and 2 are provided in Table 21.

**Table 21 Cumulative impacts**

| Community                      | Current extent within Part 2 DE (ha) | Current extent within Part 1 DE (ha) | Cumulative extent (ha) |
|--------------------------------|--------------------------------------|--------------------------------------|------------------------|
| SCP26a TEC                     | 0.05                                 | 1.12                                 | 1.17                   |
| Banksia PEC (TEC) <sup>1</sup> | 12.89 (12.10)                        | 16.45 (12.12)                        | 29.34 (24.22)          |
| SCP24 PEC                      | 15.85                                | 17.18                                | 33.02                  |
| Tuart PEC                      | 2.14                                 | 0.32                                 | 2.45                   |

<sup>1</sup> TEC is a subset of the PEC.

## 5. Assessment of impacts – terrestrial fauna

### 5.1 Fauna habitat

#### 5.1.1 Receiving environment

Seven fauna habitat types as well as highly disturbed areas were recorded in the Part 2 DE and DF (Table 22). Of the fauna habitat mapped within the DE, approximately 66% was considered high value, with approximately 19% considered medium value and the remaining 15% considered low value (i.e. highly disturbed areas).

**Table 22 Fauna habitat types recorded in the Part 2 DE and DF**

| Fauna habitat type                               | Habitat value | Extent (ha)  |              |
|--|---------------|--------------|--------------|
|  |               | DE           | DF           |
| <i>Banksia sessilis</i> over low mixed shrubland | High          | 15.85        | 14.43        |
| <i>Eucalyptus</i> woodland                       | High          | 2.14         | 2.14         |
| Limestone ridgeland                              | Medium        | 0.05         | 0.05         |
| <i>Lomandra</i> herbland on secondary dunes      | Medium        | 5.32         | 5.06         |
| Mixed <i>Banksia</i> woodland                    | High          | 12.89        | 10.95        |
| Mixed tall shrubland                             | High          | 16.92        | 13.60        |
| Planted <i>Eucalyptus</i> woodland               | Medium        | 9.13         | 8.30         |
| <b>Subtotal</b>                                  |               | <b>62.30</b> | <b>54.53</b> |
| Highly Disturbed                                 | Low           | 10.56        | 5.75         |
| <b>Total</b>                                     |               | <b>72.86</b> | <b>60.28</b> |

#### 5.1.1 Direct impacts

The Part 2 project will result in the direct loss of up to 62.30 ha of fauna habitat, although the estimated loss is 54.53 ha based on the DF. The clearing loss associated with the DE is estimated to contribute a 5.39% reduction in fauna habitat at a local scale; and as little as 0.20% 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*

The Part 2 DE comprises 62.30 ha of fauna habitat. Of this 26.06 ha intersect areas likely to support future development, with the remaining 36.24 ha not currently intersecting areas considered for future land development.



### ***Part 1 project***

The Part 1 DE comprises 61.42 ha of fauna habitat. Of this 54.88 ha intersect areas likely to support future development, with the remaining 6.54 ha not currently intersecting areas considered for future land development. Of the 61.42 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 15.11% reduction to fauna habitat at a regional scale and 53.28% 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 6.41% at the local scale and 0.40% at the regional scale.

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

| Scale           | Pre-European extent <sup>1</sup> (ha) | Current extent <sup>1</sup> (ha) | Remaining (%) | Extent in project (ha) |       | % of current extent within project |      | Current extent after project developed (ha) |                        |
|-----------------|---------------------------------------|----------------------------------|---------------|------------------------|-------|------------------------------------|------|---|------------------------|
|                 |                                       |                                  |               | DE                     | DF    | DE                                 | DF   | DE  | DF                     |
| Perth subregion | 1,117,336.01                          | 465,369.28                       | 41.65         | 62.30                  | 54.53 | 0.01                               | 0.01 | 465,306.98<br>(41.64%)                      | 465,314.75<br>(41.65%) |
| NW subregion    | 77,112.88                             | 30,791.42                        | 39.93         | 62.30                  | 54.53 | 0.20                               | 0.18 | 30,729.12<br>(39.85%)                       | 30,736.89<br>(39.86%)  |
| 1 km buffer     | 2,062.77                              | 1,155.34                         | 56.01         | 62.30                  | 54.53 | 5.39                               | 4.72 | 1,093.04<br>(52.99%)                        | 1,100.81<br>(53.37%)   |

<sup>1</sup> Pre-European and Current extents: calculated using Native Vegetation Extent (DPIRD-005), Pre-European Vegetation (DPIRD-006).

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

| Scale           | Current extent <sup>1</sup> (ha) | Remaining (%) | Current extent in conservation areas <sup>2</sup> (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    | 30,791.42                        | 39.93         | 16,363.90  | 6,606.02  | 22,969.92  | 74.60               |
| 1 km buffer     | 1,155.34                         | 56.01         | 122.21   | 374.34    | 496.55     | 42.98               |

<sup>1</sup> Current extents: taken from Table 22. <sup>2</sup> 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) (%) | Current extent within Part 1 DE (ha) (%) | Current extent within ULDO areas (ha) | Cumulative extent (ha) (%) |
|--------------|---------------------|--|--|---------------------------------------|----------------------------|
| NW Subregion | 30,791.42           | 62.30 (0.20%)                            | 61.42 (0.20%)                            | 4,507.85 (14.64%)                     | 4,653.09 (15.11%)          |
| 1 km buffer  | 1,155.34            | 62.30 (5.39%)                            | 11.81 (1.02%)                            | 541.48 (46.87%)                       | 615.59 (53.28%)            |

## **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 2011-2016 extending further west connecting Bush Forever Sites No. 289 and 397. The Part 2 DE intersects the extension of the regional ecological linkage (Link No. 7) as shown in the City of Wanneroo Local Biodiversity Strategy 2011-2016 (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, 18.10 ha comprises native vegetation in Degraded or better condition with the remaining 10.72 ha comprising native vegetation in completely degraded condition, planted species and cleared areas. The Part 2 DE will create an additional barrier within Bush Forever Site No. 289.

The Part 2 DE will impact a regional ecological linkage (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 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 18.10 ha of native vegetation in Degraded or better condition 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 and DF. Table 26 provides a breakdown of Black Cockatoo breeding and foraging habitat recorded in the DE and DF by value. Roosting habitat was also identified within the DE and DF, however the extents of roosting habitat within the DE and DF have been captured within breeding and foraging extents.

Approximately 3% of the DE provides suitable breeding habitat, and 78% of the DE and 82% of the DF provides suitable foraging habitat for Carnaby's Black Cockatoo. The remaining areas with the DE and DF are highly disturbed or comprise fauna habitat types not considered suitable for Carnaby's Black Cockatoo breeding or foraging.

GHD (2018) identified 37 trees of suitable DBH within the Part 2 DE, of these 25 trees of suitable DBH occur within the DF. Trees with suitable DBH have not been included in below assessment as local and regional spatial data was not available to inform the assessment.

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

| Habitat type                      | Habitat value | Extent (ha)         |                     |
|-----------------------------------|---------------|---------------------|---------------------|
|                                   |               | DE                  | DF                  |
| Foraging (Breeding <sup>1</sup> ) | High          | 31.19 (2.14)        | 27.83 (2.14)        |
|                                   | Medium        | 21.42               | 19.41               |
|                                   | Low           | 4.31                | 2.18                |
| <b>Total</b>                      |               | <b>56.92 (2.14)</b> | <b>49.42 (2.14)</b> |

<sup>1</sup> Breeding habitat extent is subset of the foraging habitat extent.

### 5.3.2 Direct impacts

The Part 2 DE will result in the direct loss of up to 2.14 ha of breeding habitat and 56.92 ha of foraging habitat. Of the 56.92 ha of foraging habitat, 54.8% is considered high value, 37.6% is considered medium value and 7.6% is considered low value. The direct loss of foraging habitat for the DF is 49.42 ha. Of the 49.42 ha of foraging habitat, 56.3% is considered high value, 39.3% is considered medium value and 4.4% is considered low value.

The clearing loss associated with the DE is estimated to contribute a 100% reduction in breeding habitat at a local scale (Table 27). The regional impact of the Part 2 project is estimated to be less than 0.03% for breeding habitat. The perceived impact to breeding habitat is likely associated with utilising broad-scale mapping (Beard 1979) at a local scale, where the resolution does not include all local occurrences. This is likely to be compounded by the limited inferred breeding extent within a 1 km buffer of the DE. Broad-scale mapping (Beard 1979) indicates there is breeding habitat present within Yanchep National Park located approximately 2 km east of the DE.

The clearing loss associated with the DE is estimated to contribute a 57.17% reduction in foraging habitat at a local scale (Table 27). The regional impact of the Part 2 project is estimated to be less than 0.23% for foraging habitat.

Of the current extent remaining, there is 100% and 47.844% of breeding and foraging habitat respectively within conservation areas at a local scale. At a regional scale there is 78.15% and 84.66% 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 and foraging habitat by future development within a 1 km buffer of the Part 2 project.

#### ***Part 2 project***

The Part 2 DE comprises 56.92 ha of Black Cockatoo breeding and/or foraging habitat. Of this, 22.99 ha intersects areas likely to support future development, with the remaining 33.93 ha not currently intersecting areas considered for future land development.

#### ***Part 1 project***

The Part 1 DE comprises 52.42 ha of Black Cockatoo breeding and/or foraging habitat. Of this 46.60 ha intersects areas likely to support future development, with the remaining 5.83 ha not currently intersecting areas considered for future land development. Of the 52.42 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 by 100% and 67.92% respectively. As stated above, the local impact percentage reported may be overstated through the use of broad-scale mapping to estimate the limited extent within a 1 km buffer of the DE.

There are no additional impacts from future residential, commercial and industrial development at a local scale. The predicted cumulative impact will result in a 4.99% reduction to Black Cockatoo breeding habitat and 4.89% 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 project (ha) |       | % of current extent within project |       | Current extent after project developed (ha) |                    |
|--------------|------------------------------|--------------|--------------------------|---------------------|---------------|------------------------|-------|------------------------------------|-------|---|--------------------|
|              |                              |              |                          |                     |               | DE                     | DF    | DE                                 | DF    | DE  | DF                 |
| Breeding     | 6, 965, 998, 1001, 1011      | NW subregion | 24,442.23                | 7,268.01            | 29.74         | 2.14                   | 2.14  | 0.03                               | 0.03  | 7,265.87 (29.73%)                           | 7,265.87 (29.73%)  |
|              |                              | 1 km buffer  | 1.61                     | 1.61                | 100           | 2.14                   | 2.14  | 100                                | 100   | -   | -                  |
| Foraging     | 6, 949, 965, 998, 1001, 1011 | NW subregion | 62,772.55                | 24,441.50           | 38.94         | 56.93                  | 49.42 | 0.23                               | 0.20  | 24,384.57 (38.85%)                          | 24,392.08 (38.86%) |
|              |                              | 1 km buffer  | 245.26                   | 99.59               | 40.60         | 56.93                  | 49.42 | 57.17                              | 49.62 | 42.66 (17.39%)                              | 50.17 (20.46%)     |

**Table 28 Current extent of Black Cockatoo habitat in conservation areas**

| Habitat types | Scale        | Current extent (ha) | Remaining (%) | Current extent in conservation areas <sup>2</sup> (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 | 24,441.50           | 38.94         | 15,859.31  | 4,832.20 | 20,691.52  | 84.66               |
|               | 1 km buffer  | 99.59               | 40.60         | 38.48  | 9.16     | 47.64      | 47.84               |

<sup>1</sup> Current extents: taken from Table 26. <sup>2</sup> 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 taking into consideration YRE Parts 1 and 2 and ULDO**

| Habitat type | Scale        | Current extent (ha) | Current extent within Part 2 DE (ha) (%) | Current extent within Part 1 DE (ha) (%) | Current extent within ULDO areas (ha) (%) | Cumulative extent (ha) (%) |
|--------------|--------------|---------------------|--|--|---|----------------------------|
| Breeding     | NW Subregion | 7,268.01            | 2.14 (0.03%)                             | 0.32 (0.004%)                            | 359.96 (4.95%)                            | 362.42 (4.99%)             |
|              | 1 km buffer  | 1.61                | 2.14 (100%)                              | -  | -   | 2.14 (100%)                |
| Foraging     | NW Subregion | 24,441.50           | 56.93 (0.23%)                            | 52.42 (0.21%)                            | 1,086.18 (4.44%)                          | 1,195.54 (4.89%)           |
|              | 1 km buffer  | 99.59               | 56.93 (57.16%)                           | 10.71 (10.75%)                           | -   | 67.64 (67.92%)             |

## 6. Assessment of impacts – landforms

### 6.1 Parabolic dune formation

#### 6.1.1 Receiving environment

The Alkimos dune system represents parabolic dunes belonging to the Quindalup dune system. The project intersects parabolic dune formations 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 8.47 ha which currently support parabolic dune formations. Of this, 7.11 ha intersect areas likely to support future development, with the remaining 1.37 ha (supporting current parabolic dune formations) not currently intersecting areas considered for future land development. Of this 8.47 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 63.77% 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 project (ha) |       | % of current extent within project |      | Current extent after project developed (ha) (%) |                   |
|--------------|--------------------------|---------------------|---------------|------------------------|-------|------------------------------------|------|---|-------------------|
|              |                          |                     |               | DE                     | DF    | DE                                 | DF   | DE  | DF                |
| NW subregion | 5,433.49                 | 3,545.82            | 65.26         | 17.54                  | 14.32 | 0.49                               | 0.40 | 3,528.27 (64.94%)                               | 3,531.50 (65.00%) |
| 1 km buffer  | 479.45                   | 385.23              | 80.35         | 17.54                  | 14.32 | 4.55                               | 3.72 | 367.39 (76.69%)                                 | 370.91 (77.36%)   |

**Table 31 Current extent of parabolic dune formation in conservation areas**

| Scale        | Current extent <sup>1</sup> (ha) | Remaining (%) | Current extent in conservation areas <sup>2</sup> (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               |

<sup>1</sup> Current extents: taken from Table 29. <sup>2</sup> 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 (ha) | Cumulative extent (ha) (%) |
|--------------|---------------------|--|--|---------------------------------------|----------------------------|
| NW Subregion | 3,545.82            | 17.54 (0.49%)                            | 8.47 (0.24%)                             | 2,235.06 (63.03%)                     | 2,261.07 (63.77%)          |
| 1 km buffer  | 385.23              | 17.54 (4.55%)                            | 0.88 (0.23%)                             | 188.66 (48.97%)                       | 207.08 (53.76%)            |

# 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 reduce two 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. In these instances there is limited occurrences of these vegetation associations/complexes within a 1 km buffer of the Part 2 project. At regional and bioregional scales the Part 2 project impact is diluted. Furthermore, most of these vegetation associations and complexes occur within conservation areas within the Perth subregion and therefore are afforded some level of protection.

The Part 2 project will remove State and Federally listed TECs and PECs. Where local and regional data was available to inform this assessment, the Part 2 project will reduce the known extents by less than 1% at the largest scale investigated. At a local scale the Part 2 project will reduce the inferred extent of the Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP (PEC) by 100%. This perceived impact is a result of comparing broad-scale mapping by Beard (1979) with finer scale project-specific mapping (e.g. GHD 2018) and the limited extent of this vegetation within a 1 km buffer of the DE. It is noted that Bush Forever Site No. 289 includes a *Eucalyptus gomphocephala* community as part of the mapped vegetation structural units (Tingay, Alan and Associates 1991, 1992). The inclusion of this community as a structural unit may suggest its occurrence more broadly throughout the Bush Forever, than regional mapping indicates. Given the level of protection afforded to these TECs (and PECs) the regulator may consider any impact to these communities significant.

The Part 2 project will impact on Bush Forever Site No. 289 and the extension of the regional ecological linkage (Link No. 7) (associated with Bush Forever Site No. 289) as shown in the City of Wanneroo Local Biodiversity Strategy 2011-2016. 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 function. It is noted the Part 2 project will not create a barrier of greater than 500 m between viable natural areas. Furthermore, there are existing barriers within the site therefore the cumulative impact of the Part 2 project is likely to be reduced.

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 that 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

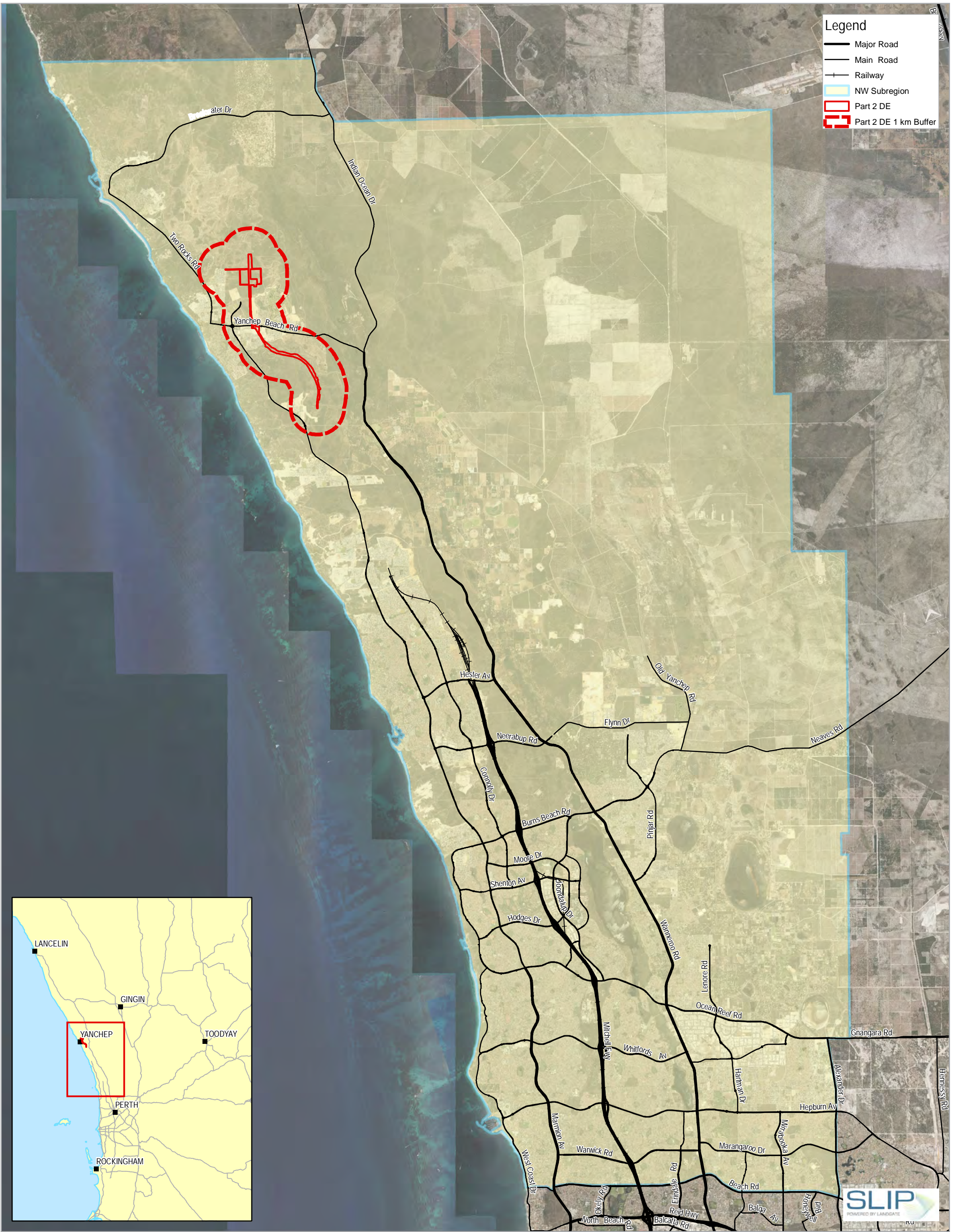
# **Appendix A** – Figures

**Figure 1** Project locality and scales

**Figure 2** Local and regional context

**Figure 3** Cumulative considerations

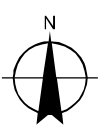




- Legend**
- Major Road
  - Main Road
  - Railway
  - NW Subregion
  - Part 2 DE
  - Part 2 DE 1 km Buffer



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



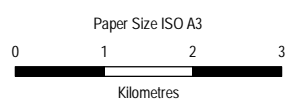
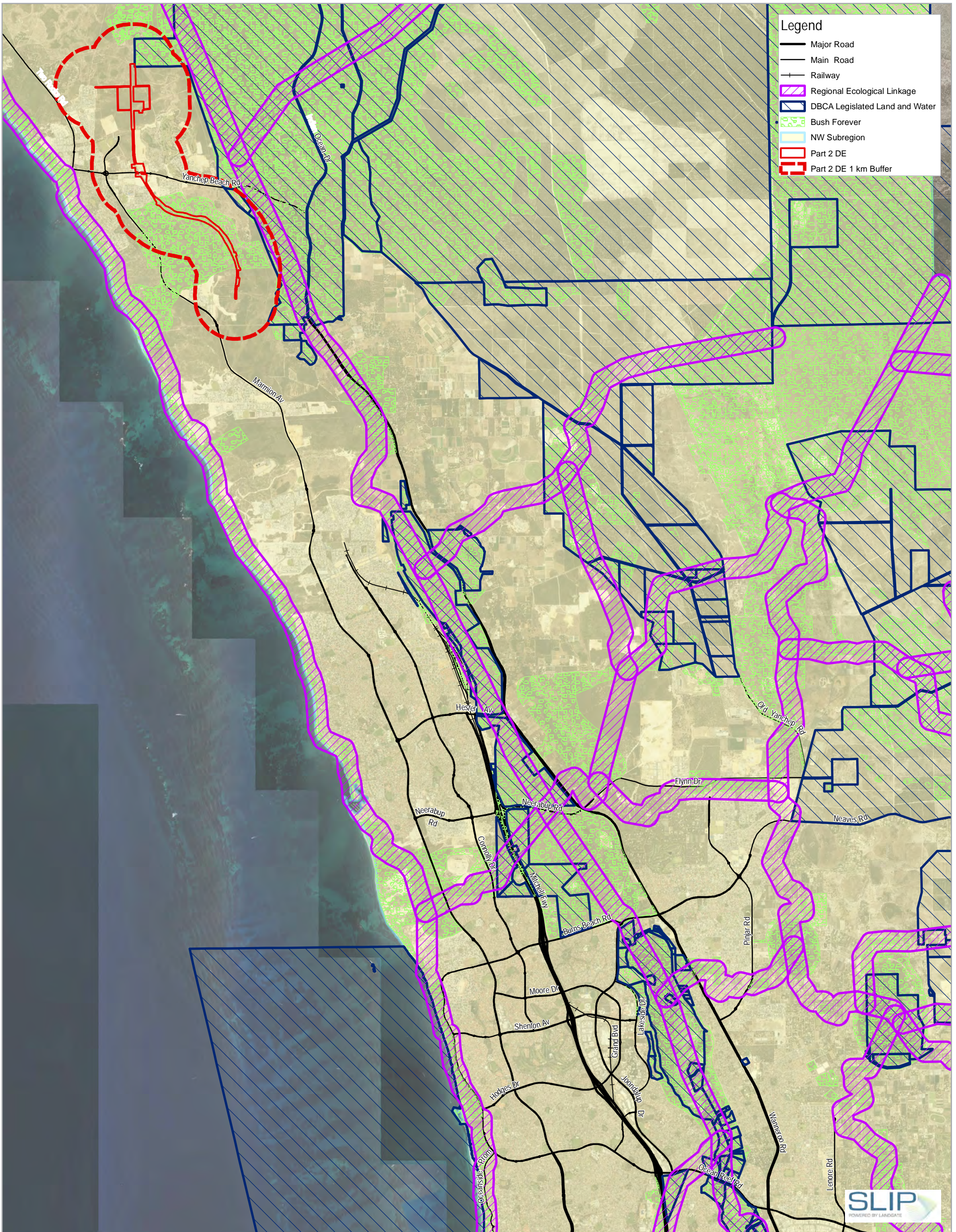
Public Transport Authority  
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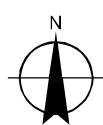
Project locality and scales

FIGURE 1





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



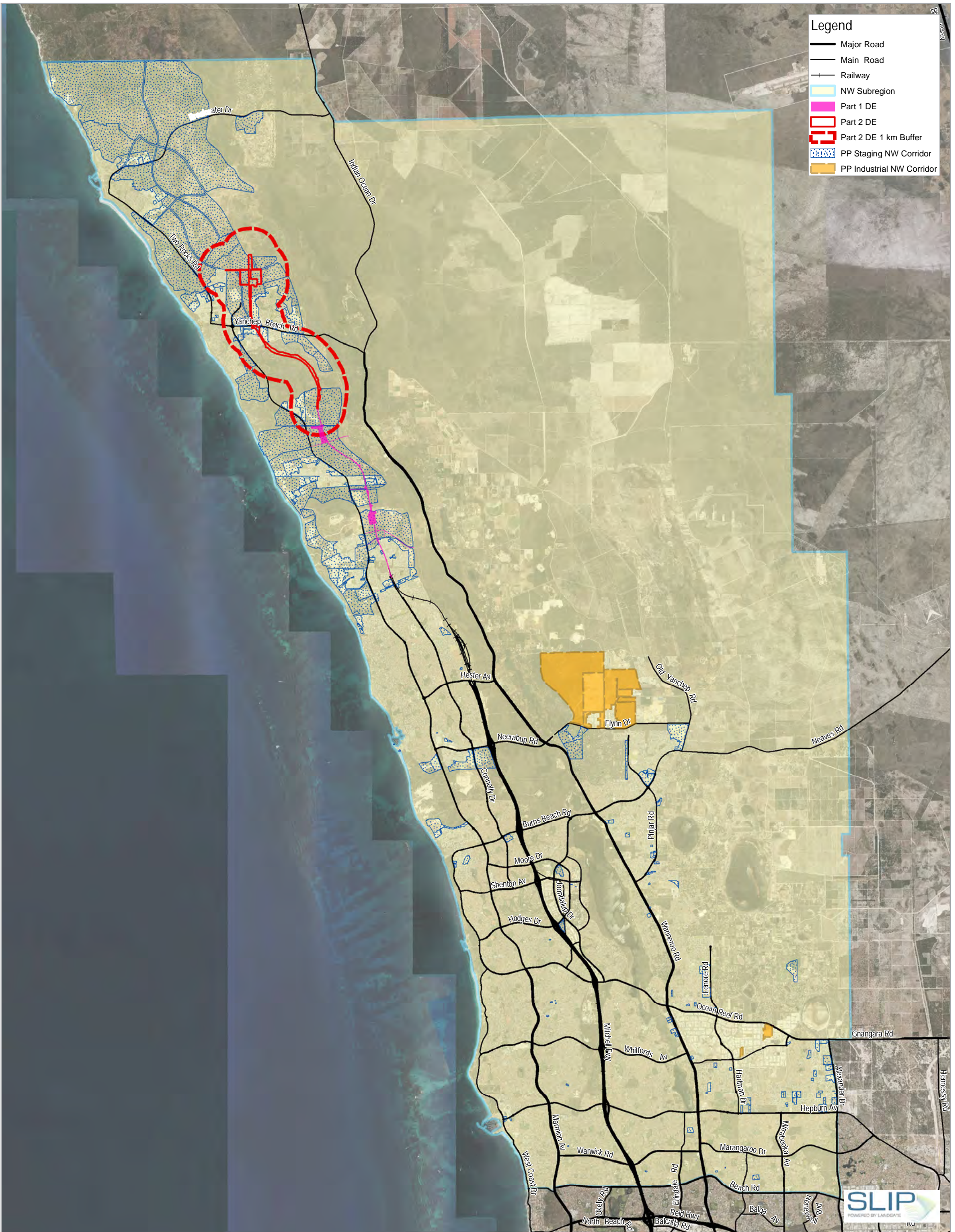
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Local and regional context

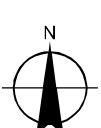
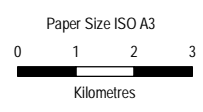
Project No. 61-3706200  
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FIGURE 2





- Legend**
- Major Road
  - Main Road
  - Railway
  - NW Subregion
  - Part 1 DE
  - Part 2 DE
  - Part 2 DE 1 km Buffer
  - PP Staging NW Corridor
  - PP Industrial NW Corridor



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

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Cumulative considerations

FIGURE 3





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