# Wattle Avenue East Quarry (EPBC 2022/09326)

Clearing Permit Supporting Documentation

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# Wattle Avenue East Quarry (EPBC 2022/09326)

## Clearing Permit Supporting Documentation

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| **7-May-2024** | **14-May-2024** | **29-May-2024** |

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# 1. Introduction

## 1.1 Background

PMR Quaries (T/A WA Limestone; the Proponent) are proposing to expand the Wattle Avenue East Quarry to facilitate the extraction of limestone to meet future demand for the Perth metropolitan area, extend the operating life of the quarry, and to ensure continued employment for quarry personnel (the 'proposed action'). The area to be impacted by the proposed action is herein referred to as the 'Site'.

The Site is located at 311 Wattle Avenue East, Neerabup within the City of Wanneroo, approximately 40 km north of the Perth Central Business District (Figure 1). The Site is currently zoned as Rural under the Metropolitan Region Scheme (MRS) and as Rural Resource under the City of Wanneroo District Planning Scheme (DPS) No. 2 (City of Wanneroo, 2001; Figure 2).

The quarry is operated by WA Limestone under Crown Mining Lease M 70/143. The mining lease is held by Adelaide Brighton Cement Ltd, with whom WA Limestone has a sublease agreement for limestone extraction.

The limestone deposit within M 70/143 has been identified as a priority resource for extraction under WA *State Planning Policy 2.4: Planning for Basic Raw Materials* (SPP 2.4; DPLH, 2021). Under SPP 2.4 the Site is categorised as a Significant Geological Supply (SGS), which are identified as the highest priority extraction areas by the Department of Mines, Industry Regulation and Safety (DMIRS). These deposits are considered critical to the future development of Perth and Peel region (DPLH, 2021).

The proposed action seeks to access and extract the limestone resource, and involves the construction of the following elements:

- Quarry pit extension.
- Stockpile and storage/ laydown areas.
- Access tracks/roads.
- Associated quarry infrastructure.

## 1.2 Approvals Context

The proposed action was referred under the *Environment Protection and Biodiversity Act 1999* (EPBC Act) and was determined to be a Controlled Action on 28 February 2023 (EPBC 2022/09326) due to potential impacts to threatened species and communities ( Appendix A).

As the proposed action requires assessment and approval under both State and Commonwealth legislation, it will be assessed under the accredited state process in accordance with Part V Division 2 of the *Environmental Protection Act 1986* (EP Act) by DMIRS under delegated authority. The proposed action will then be assessed by the Commonwealth.

The proposed action will be advertised for public consultation for a period of 21 days, as per the *Clearing Regulation Guideline 6* (DER, 2014). If deemed necessary, the Commonwealth may use their discretion to impose further public consultation requirements.

## 1.3 Purpose and Scope

This document has been prepared to support an assessment under both State and Commonwealth legislation, through the accredited state process. The Commonwealth has accredited the native vegetation clearing assessment process in Part V of the EP Act under the EPBC Act. This document therefore informs the clearing permit application with DMIRS, as well the accredited assessment under the EPBC Act. A chapter dedicated to the discussion of MNES is provided as section 5.

The scope of this document is as follows:

- Background information relating to the proposed action, including the significant social and economic benefits.
- Detailed assessment of the existing biogeographic and biological environment of the proposed action area.
- Description of the likely and possible direct and indirect environmental impacts of the proposed action.
- Description of proposed measures to avoid, mitigate, and offset the impacts of the proposed action to ensure an acceptable environmental outcome for all impacted matters.







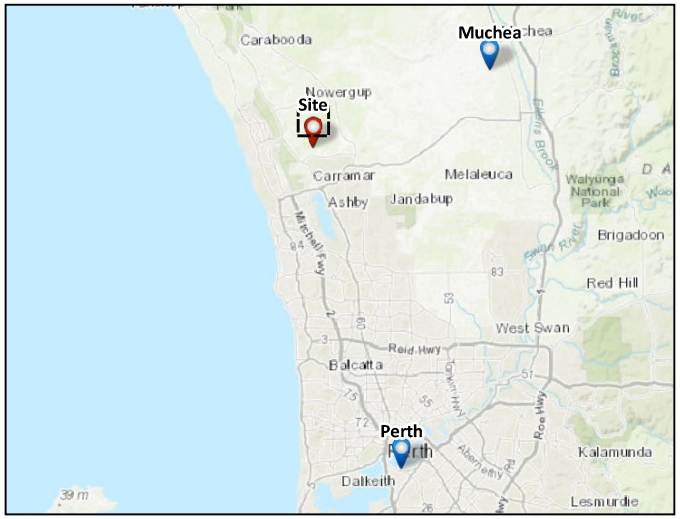



**Figure 1:** Site Location

N

0 100 200 300 400 m

| | |
|---|---|
| PROJECT/REPORT NAME | Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup |
| SCALE | 1:7,000 |
| SHEET SIZE | A3 COLOUR |
| CLIENT | WA Limestone |
| COORDINATE REFERENCE SYSTEM | GDA2020 / MGA zone 50 |
| PROJECT NUMBER | A23.024 |
| VERSION | 0 |
| DATA SOURCE | LANDGATE AERIAL IMAGERY Summer 2023 |
| DRAWN BY / REVIEWED BY | MD / JB |
| DATE | 29/5/2023 |

**Legend**

- Site
- Mining Lease

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | MD | JB | 29/5/2023 |

NOTES:
Cadastral boundary (LGATE-002). Base map ESRI Topo. Townsites (LGATE-248).

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## 1.4 Summary of Impacts

The proposed action will necessitate the removal of up to 14.86 ha of native vegetation and 0.20 ha of highly modified vegetation that provides habitat for threatened species and communities listed under the WA *Biodiversity Conservation Act 2016* (BC Act) and the EPBC Act.

Impacts to matters listed under the BC Act are summarised as:

- Loss of up to 13.27 ha of foraging habitat for Carnaby's black cockatoo (*Zanda latirostris* - Endangered), ranging from 'low to moderate' to 'moderate to high' quality.
- Loss of up to 15.06 ha of habitat that may, on occasion, be utilised by Chuditch (Dasyurus geoffroii fortis - Vulnerable) which is a vagrant to the Site.
- Loss of up to 15.06 ha suitable habitat for Quenda (*Isoodon fusciventer* - Priority 4).
- Loss of up to five individuals within one population of *Pimelea calcicola* (Priority 3).

Impacts to Matters of National Environmental Significance (MNES) protected under the EPBC Act are summarised as:

- Loss of up to 13.27 ha of foraging habitat for Carnaby's black cockatoo (*Zanda latirostris* - Endangered), ranging from 'low to moderate' to 'moderate to high' quality.
- Loss of up to 15.06 ha of habitat that may, on occasion, be utilised by Chuditch (*Dasyurus geoffroii* fortis - Vulnerable) which is a vagrant to the Site.

## 1.5 Stakeholder Consultation

Consultation has been limited to that associated with gaining the approval from the tenement holder, Adelaide Brighton Cement Ltd, to conduct clearing and commence the assessment process.

No other consultation has occurred with the community or Indigenous stakeholders, given the site is an active quarry that has been in operation since 1993.

All stakeholders and interested parties will have the opportunity to comment on the proposed action through the public consultation requirements of the accredited assessment process. This will ensure the proposed action is published for public consultation for a period of 21 business days. The Commonwealth may use its discretion to require further public consultation be undertaken, if deemed necessary.

The Proponent will give due consideration to all comments received during the consultation period.

## 1.6 Legislation and Guidance

This supporting document has been prepared in accordance with all applicable State and Commonwealth legislation, policy, and guidance. A description of applicable legislation and policy, together with a summary of relevance for the proposed action, is provided in Table 1-1.

## Table 1-1. Description of Legislation, Policy, and Guidance Applicable to the Proposed Action

| Legislation, Policy or Guidance Document | Description of Applicability to the Proposed Action |
|---|---|
| **State** | |
| **Western Australia Mining Act 1978** | Wattle Ave East Quarry is located on mining tenement M70/143 which is crown land and regulated under the WA Mining Act 1978. The tenement was granted on 9th December 1983 to Swan Portland Cement Limited. The tenement is currently held by Adelaide Brighton Cement Limited and is leased to WA Limestone (P.M.R Quarries) for the purpose of limestone extraction. |
| **Western Australia Environmental Protection Act 1986** | The Environmental Protection Act 1986 provides for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing.<br>WA Limestone currently holds a Category 12 Crushing and Screening License under Part V of the Environmental Protection Act 1986 to process 800,000 tonnes of limestone product per annum. No changes to this license are currently planned.<br><br>The proposed action will require a permit to clear native vegetation under Part V Division 2 of the Environmental Protection Act 1986. |
| **Western Australia Planning and Development Act 2005** | The subject land is zoned 'Rural Resource' under the City of Wanneroo District Planning Scheme No. 12. The proposed action represents a permissible land use under provisions of the DPS. The quarry of limestone is therefore allowed under local government laws. |
| **Environmental Protection (Clearing of Native Vegetation) Regulations 2004** | To enable the proposed action, WA Limestone require a Clearing Permit under Part V Division 2 of the EP Act.<br>The purpose of this document is to support the application to clear native vegetation. WA Limestone are seeking to have the Commonwealth matters assessed under the assessment bilateral agreement through the accredited state/territory process with WA. MNES will be assessed by DMIRS Native Vegetation Clearing Branch during the Clearing Permit Assessment Process.<br>Clearing was previously approved on the tenement under Part IV of the EP Act - Ministerial Statement 365 which was issued to Swan Portland Cement in 1992. |
| **Environmental Protection (Noise) Regulations 1997** | Operational noise<br>WA Limestone has a current crushing and screening licence where noise emissions have already been assessed as part of the application. |
| **Western Australia State Planning Policy 2.4: Basic Raw Materials** | The limestone deposit has been identified as a priority resource for extraction under WA State Planning Policy 2.4 Planning for Basic Raw Materials (SPP 2.4). Under SPP 2.4 the site is categorised as Significant Geological Supplies which are identified as the highest priority extraction areas as identified by the Department of Mines, Industry and Resources Safety (DMIRS). These deposits are critical to the future development of Perth and Peel region. |

| Legislation, Policy or Guidance Document | Description of Applicability to the Proposed Action |
|---|---|
| **Commonwealth** | |
| ***Environment Protection and Biodiversity Conservation Act 1999*** | The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as matters of national environmental significance. The EPBC Act applies to nine matters of national environmental significance including world heritage places, national heritage places, wetlands of international importance, nationally threatened species and ecological communities, migratory species, Commonwealth marine areas, the Great Barrier Reef Marine Park, nuclear actions, and a water resource in relation to coal seam gas development and large coal mining development.<br><br>The proposed action will require approval under the EPBC Act due to impacts to listed species. |
| **Government of Australia (2013) EPBC Act 1999 Policy Statement 1.1 Significant Impact Guidelines – Matters of National Environmental Significance.** | The significant impact guidelines provide overarching guidance on determining whether an action is likely to have a significant impact on a matter protected under the EPBC Act.<br><br>The guidelines have been implemented in assessing the significance of likely and possible impacts to MNES as a result of the proposed action. |
| **Government of Australia (2022) Referral guideline for three WA threatened black cockatoo species: Carnaby's Cockatoo (*Zanda latirostris*), Baudin's Cockatoo (*Zanda baudinii*) and the Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*).** | The referral guidelines provide guidance to proponents on the need to refer an action to which the EPBC Act applies. The referral guidelines were used to inform the referral of EPBC 2022/09326 and to inform an assessment of the potential impacts to Carnaby's cockatoo arising through the proposed action. |

# 2. Description of the Proposed Action

## 2.1 Project Rationale

WA Limestone propose to expand the Wattle Avenue East quarry within M 70/143 for the purpose of limestone extraction. The proposed limestone extraction is necessary to meet future demand for the Perth metropolitan area, extend the operating life of the quarry, and continue to provide employment for quarry personnel.

The limestone resource within M 70/143 forms part of the Tamala limestone deposits. The particular resource within M 70/143 has been identified by DMIRS as an SGS under SPP 2.4 as shown on Figure 2. These areas are identified based on the size of the resource, relative scarcity, demand, and/or location near growth areas and transport routes (DPLH, 2021). Areas identified as SGS are therefore identified as the highest priority extraction areas for basic raw materials.

The location and quality of the Tamala limestone deposits within the north metropolitan area is critical to the economic viability of public amenity projects. Its proximity to the metropolitan area makes the limestone a valuable economic material for Main Roads WA and DevelopmentWA. The proximity contributes to improved economic viability by reducing transport distance and costs, as well as contributing to lower greenhouse gas emissions compared with hauling from farther away.

## 2.2 Proposed Works

The proposed action will necessitate the removal of 15.06 ha of native vegetation within a disturbance footprint of 15.48 ha (the 'Site'). The proposed action will avoid any direct and indirect impacts to the remaining 74.30 ha of native vegetation within M 70/143 over which the Proponent holds a lease.

The proposed clearing will facilitate construction of the following elements:

- Quarry pit extension.
- Stockpile and storage/ laydown areas.
- Access tracks/roads.
- Associated quarry infrastructure.

The proposed action will involve sequential extraction of the on-site limestone resource. Clearing for the proposed action will be undertaken at a single time, using a bulldozer or loader to push the vegetation into windrows. Smaller vegetation will be mulched and, where possible, transferred to areas under rehabilitation to assist with soil and habitat regeneration. Vegetation will be used on batters to assist with stabilisation and minimisation of soil erosion. Topsoil will be formed into low storage dumps for use in later restoration activities including spreading on the final surface ahead of rehabilitation.

Overburden in the form of yellow and brown sand, and low-grade limestone, will be removed and stored around the perimeter of the site to enable the creation of a flat, level working surface.

Following extraction activities, the Site will be rehabilitated in accordance with an existing Mine Closure Plan for the Wattle Avenue East quarry that will be expanded to include the proposed action. The Mine Closure Plan is attached as Appendix B.

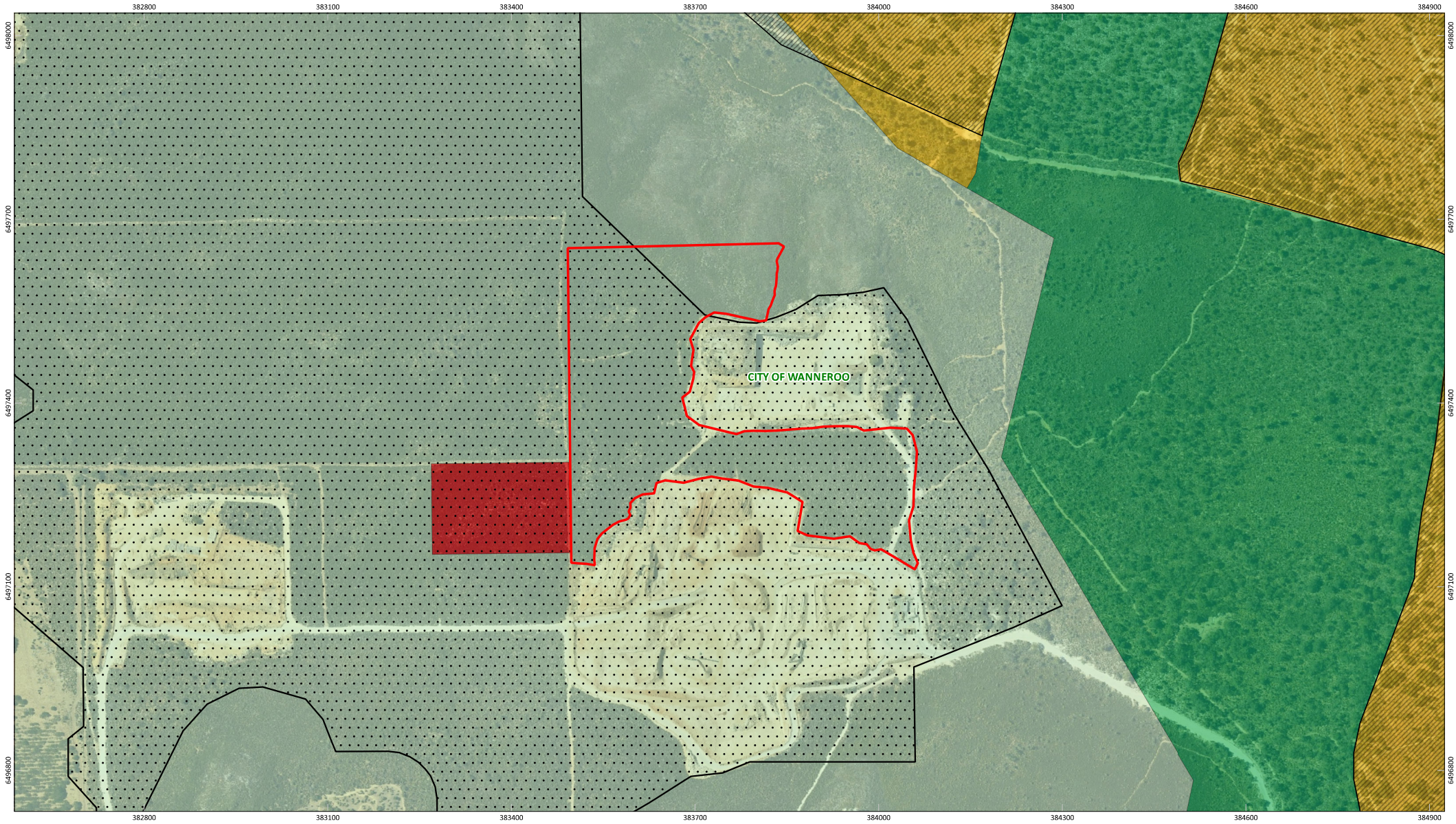



Figure 2: Land Use and Zoning

N

0 75 150 225 300 m

| | |
|---|---|
| PROJECT/REPORT NAME | Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup |
| SCALE | 1:6,000 |
| SHEET SIZE | A3 COLOUR |
| CLIENT | WA Limestone |
| COORDINATE REFERENCE SYSTEM | GDA2020 / MGA zone 50 |
| PROJECT NUMBER | A23.024 |
| VERSION | 0 |
| DATA SOURCE | LANDGATE AERIAL IMAGERY Summer 2023 |
| DRAWN BY / REVIEWED BY | MD / JB |
| DATE | 31/5/2023 |

**Legend**

- Site
- **Region Scheme - Zones and Reserves (DPLH-023)**
  - Parks and recreation
  - Public purposes - Water Authority of WA
  - Rural
  - State forests
- **Significant Geological Supplies (DMIRS-074)**
  - Limestone
  - Sand

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | MD | JB | 31/5/2023 |

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# 3. Existing Environment

## 3.1 Biogeographic and Regional Setting

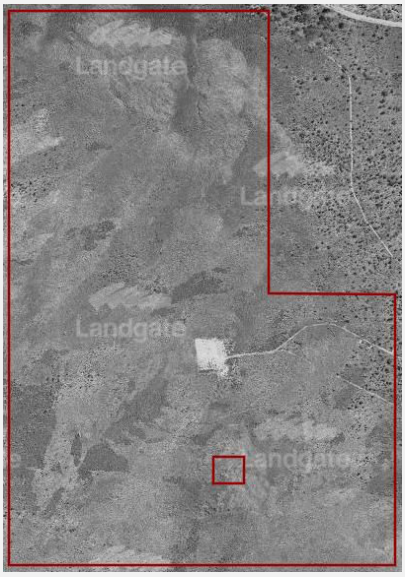
The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 89 bioregions (DCCEEW, 2023a). The Site is located within the Swan Coastal Plain bioregion, as defined by the IBRA. The Swan Coastal Plain has been further subdivided into two sub-regions, being Dandaragan Plateau (SWA1) and Perth (SWA2) the Site located within the Perth (SWA2) sub-region.

The Perth sub-region is described by Mitchell et al. (2003) as a low-lying coastal plain, mainly covered with woodlands. It is dominated by banksia or tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The climate is described as Warm Mediterranean with annual rainfall ranging between 600 and 1,000 mm. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *C. obesa*-marri woodlands and melaleuca shrublands, are extensive only in the south (Mitchell et al., 2003).

## 3.2 Historical Land Use

Historical aerial photographs of the Site and its surrounds were reviewed, which provided information on the Site's use since 1965. This information is summarised below in Table 3-1.

**Table 3-1. Historical Imagery and Land Use**

| Year | Description | Image |
|---|---|---|
| **1965** | The Site contains native vegetation with a small quarry in the centre of the site. |  |

| Year | Description | Image |
|---|---|---|
| **1974** | The quarry has expanded and lines of vegetation have been cleared. It is suspected these clearings were undertaken for resource exploration purposes. |  |
| **2001** | Further expansion with the quarry now reaching up to the eastern boundary of the site. A second quarry has been established north of the first pit. |  |
| **2005** | The current extent of clearing is reached. |  |

WA Limestone lease M70/143 for the purposes of limestone extraction for the construction industry. The lease was granted to Swan Portland Cement Limited (Swan Portland) in 1983. Swan Portland was acquired by Adelaide Brighton Cement Ltd in 1996 and subsequently the tenement was subleased to various local companies to supply limestone to the local market. WA Limestone acquired the sublease in 2017 and continued to supply limestone products to the local market.

## 3.3 Soil Surface Geology and Topography

### 3.3.1 Topography

The Site ranges in elevation from 84 m Australian Height Datum (m AHD) in the east to 96 m AHD in the southwest. The steepest gradient occurs in the northeast and southeast, as shown on Figure 3.

### 3.3.2 Geology and Soils

The geology of the Site comprises Tamala Limestone and sand derived from Tamala Limestone (Gozzard, 1982). The limestone and sand formed as aeolian dune deposits behind a shoreline during the Pleistocene epoch between 2,580,000 to 11,700 years ago. Over time weathering has cemented the shell fragments to form limestone ridges in between sand deposits which stretch from Wanneroo in Northern Perth through to Breton Bay. These ridges have been quarried over many decades, first for agricultural lime sand then construction materials as Perth expanded.

Mapping of the bedrock geology by DMIRS indicates that the Site is located on the Leederville Formation, consisting of interbedded sandstone and siltstone, minor conglomerate and scattered thin coal seams (DMIRS-016).

Soil landscape mapping (DPIRD-064) shows that the Site is located within the Spearwood System, characterised by sand dunes and plains with yellow deep sands, pale deep sands and yellow/brown shallow sands.

One phase of the Spearwood soil system occurs within the Site (DPIRD-027) as shown on Figure 3. This is the Karrakatta shallow soils phase (Kls) which is described as low hills and ridges with bare limestone or shallow siliceous or calcareous sand over limestone. This soil unit is mapped over the majority of the Site.

## 3.4 Acid Sulfate Soils

The DWER Acid Sulfate Soil (ASS) Risk Map (DWER-055) does not indicate the presence of any ASS on Site or within surrounding areas (Figure 4).

## 3.5 Hydrology

Groundwater is situated around 25 to 26 m below the land surface of the Site, and generally flows to the west. Groundwater contours are shown on Figure 5.

There are no wetlands or surface water features mapped within the Site, as shown in Figure 5. The nearest mapped wetland to the Site is Camel Swamp, which is a Resource Enhancement Wetland (REW) situated approximately 800 m north (DBCA-019). The nearest Conservation Category Wetland (CCW) to the Site is Lake Pinjar which is situated 2.2 km east (DBCA-019).




# Figure 3: Soils and Topography

N

0 25 50 75 100 m

| | |
|---|---|
| PROJECT/REPORT NAME | Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup |
| SCALE | 1:3,000 |
| SHEET SIZE | A3 COLOUR |
| CLIENT | WA Limestone |
| COORDINATE REFERENCE SYSTEM | GDA2020 / MGA zone 50 |
| PROJECT NUMBER | A23.024 |
| VERSION | 0 |
| DATA SOURCE | LANDGATE AERIAL IMAGERY Summer 2023 |
| DRAWN BY / REVIEWED BY | MD / JB |
| DATE | 25/5/2023 |

**Legend**

- Site

**Soil Landscape Mapping - (DPIRD-027)**

- Karrakatta Shallow Soils Phase (kls)
- Contours 2m - (DPIRD-072)

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | MD | JB | 25/5/2023 |

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# Figure 4: Acid Sulfate Soils Risk

| | | | |
|---|---|---|---|
| N 0 200 400 600 800 m | | PROJECT/REPORT NAME: Wattle Avenue East Quarry, 311 Wattle Avenue East, Nowergup | |
| SCALE: 1:15,000 | SHEET SIZE: A3 COLOUR | CLIENT: WA Limestone | |
| COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50 | | PROJECT NUMBER: A23.024 | VERSION: 0 |
| DATA SOURCE: LANDGATE AERIAL IMAGERY Summer 2023 | | DRAWN BY / REVIEWED BY: MD / JB | DATE: 25/5/2023 |

**Legend**

Site

**Acid Sulfate Soil Risk Map, Swan Coastal Plain (DWER-055)**

1 - High to moderate risk of ASS occurring within 3m of natural soil surface

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | MD | JB | 25/5/2023 |

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Figure 5: Groundwater Contours and Surface Water Features

N

0 200 400 600 800 m

| | |
|---|---|
| SCALE: 1:15,000 | SHEET SIZE: A3 COLOUR |
| COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50 | |
| DATA SOURCE: LANDGATE AERIAL IMAGERY Summer 2023 | |

| | | |
|---|---|---|
| PROJECT/REPORT NAME: Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup | | |
| CLIENT: WA Limestone | | |
| PROJECT NUMBER: A23.024 | VERSION: 0 | |
| DRAWN BY / REVIEWED BY: MD / JB | DATE: 29/5/2023 | |

**Legend**

- Site
- Water Table Elevation (Contours)- (DWER-100)

**Hydrography Linear (Hierarchy) (DWER-031)**

- Significant Stream
- Major Tributary

**Geomorphic Wetlands, Swan Coastal Plain (DBCA-019)**

- Conservation
- Multiple Use
- Resource Enhancement

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | MD | JB | 29/5/2023 |

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## 3.6 Flora and Vegetation

This section describes the flora and vegetation values within and surrounding the Site based on desktop and field investigations.

### 3.6.1 Pre-European Vegetation

#### *Vegetation Associations*

Pre-European vegetation types and extent in WA was mapped at a regional scale by Beard (1981) who classified vegetation into broad associations at a scale of 1:1,000,000. This is managed in spatial format by the Department of Primary Industries and Regional Development (DPIRD-006). Based on this mapping, the then Department of Agriculture and Food (DAFWA) compiled a list of vegetation extent and types across the state (Shepherd et al., 2002).

As shown on Figure 6, one broad vegetation unit is mapped over the Site, being Spearwood 949 (bLi). This vegetation unit is described as a low woodland or open woodland of *Acacia* spp., *Banksia* spp., *Agonis flexuosa*, *Callitris* spp., *Allocasuarina* spp., and *Eucalyptus loxophleba*.

The pre-European and current extent of native vegetation associations has been interpreted by Shepherd et al. (2002) using data from Beard's regional vegetation mapping, along with other vegetation mapping, satellite imagery, and orthophoto interpretation. According to this extent mapping, the Site contains 0.22% of the current extent of Spearwood 949 (Table 3-2).

**Table 3-2. Extent of Vegetation Association Unit Occurring within the Site, and the Current and Pre-European Extent.**

| Vegetation Association | Pre-European Extent (GovWA 2019a) | Current Extent (GovWA 2019a) | Extent within the Site (ha) (% of Current Extent) |
|---|---|---|---|
| **Spearwood 949** | 13,221.96 ha | 6,797.43 ha | 14.86 ha (0.22%) |

#### *Vegetation Complexes*

Vegetation complexes are a broad level of vegetation description which is based on the underlying geomorphology and rainfall at a scale of 1:250,000 (Heddle et al.,1980). This mapping is maintained in digital form by the Department of Biodiversity Conservation and Attractions (DBCA-046). According to this data, vegetation within the Site is associated with the Cottesloe Complex - Central and South, as shown on Figure 6. This is described as a mosaic of woodland of *Eucalyptus gomphocephala* (tuart) and open forest of *E. gomphocephala*, *E. marginata* (jarrah), and *Corymbia calophylla* (marri); closed heath on limestone outcrops (Heddle et al., 1980).

The pre-European and current estimated extent of the Cottesloe Complex - Central and South is presented in Table 3-3, together with the extent present within the Site. Based on this, the Site contains approximately 0.10% of the remaining extent of Cottesloe Complex - Central and South.

**Table 3-3. Extent of Vegetation Complexes Occurring within the Site, and the Current and Pre-European Extent.**

| Vegetation Complex | Pre-European Extent (GovWA 2019b) | Current Extent (GovWA 2019b) | Extent within the Site (ha) (% of Current Extent) |
|---|---|---|---|
| **Cottesloe Complex - Central and South** | 45,299.61 ha | 14,567.87 ha | 14.86 ha (0.10%) |

### 3.6.2 Flora and Vegetation Surveys

A detailed flora and vegetation assessment was undertaken across the Site by PGV Environmental (2021) on the 14th and 15th of September 2020. The survey area covered a broader area than the Site, as shown in Figure 7.

Information on flora composition and vegetation structure was recorded in thirteen 10 m by 10 m non-permanent quadrats within representative vegetation types. PGV (2021) identified relatively low variation in the main vegetation types, and concluded that the survey effort would have recorded a very high percentage of the plant species that occur within the survey area. PGV (2021) noted that several vegetation types were mapped as separate units but were in fact very similar in terms of structure and composition. The number of quadrats was therefore considered sufficient to describe the variation in vegetation over the survey area.

The PGV (2021) report is provided in Appendix C and the key findings are summarised in Section 3.6.3 to 3.6.6.

A follow-up survey targeting conservation significant flora species that have the potential to occur within the Site was completed in 2023 ( Appendix D). The only species of conservation significance for which suitable habitat is present within the Site was *Melaleuca* sp. Wanneroo (G.J. Keighery 16705). As *M*. sp. Wanneroo has a very strong habitat association, the survey covered only suitable habitat for the species. The survey area is shown on Figure 7 and the survey report is provided as Appendix D.




Figure 6: Regional Vegetation Associations and Complexes

N

0 75 150 225 300 m

| | | |
|---|---|---|
| PROJECT/REPORT NAME<br>Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup | | |
| SCALE<br>1:6,000 | SHEET SIZE<br>A3 COLOUR | CLIENT<br>WA Limestone |
| COORDINATE REFERENCE SYSTEM<br>GDA2020 / MGA zone 50 | | PROJECT NUMBER<br>A23.024 / VERSION<br>0 |
| DATA SOURCE<br>LANDGATE AERIAL IMAGERY Summer 2023 | | DRAWN BY / REVIEWED BY<br>HS / JB / DATE<br>15/2/2024 |

**Legend**

Site

**Vegetation Complexes - Swan Coastal Plain (DBCA-046)**

Karrakatta Complex-Central and South

Cottesloe Complex-Central and South

**Pre-European Vegetation (DPIRD-006)**

SPEARWOOD_6

SPEARWOOD_949

SPEARWOOD_998

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | HS | JB | 15/2/2024 |

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# Figure 7: Survey Areas

0 25 50 75 100 m
N

| | |
|---|---|
| SCALE | 1:3,500 |
| SHEET SIZE | A3 COLOUR |
| PROJECT/REPORT NAME | Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup |
| CLIENT | WA Limestone |
| COORDINATE REFERENCE SYSTEM | GDA2020 / MGA zone 50 |
| PROJECT NUMBER | A23.024 |
| VERSION | 0 |
| DATA SOURCE | LANDGATE AERIAL IMAGERY Summer 2023 |
| DRAWN BY / REVIEWED BY | HS / JB |
| DATE | 15/2/2024 |

**Legend**

- Site
- Survey Area (Bamford, 2022)
- Survey Area (PGV, 2021)
- Survey Area (WEPL, 2024)

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original Issue | HS | JB | 15/2/2024 |

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### 3.6.3 Vegetation Types

The flora and vegetation survey undertaken by PGV (2021) identified five native vegetation types within the Site, together with one highly modified vegetation type and cleared land. The Site contains 14.86 ha of native vegetation, 0.20 ha of highly modified vegetation, and 0.42 ha of cleared land as outlined in Table 3-4 and shown on Figure 8.

**Table 3-4. Vegetation Types Mapped within the Site (PGV, 2021).**

| Vegetation Type | Description | Area within Site (ha) | Proportion of the Site (%) |
|---|---|---|---|
| **BsXpCq** | *Banksia sessilis / Xanthorrhoea preissii / Calothamnus quadrifidus* Closed Tall Scrub over *Hibbertia hypericoides / Melaleuca systena / Jacksonia calcicola* Low Shrubland to Closed Low Heath. | 13.27 | 85.7 |
| **Ed** | *Eucalyptus decipiens* Low Open Woodland over *Xanthorrhoea preissii / Banksia sessilis* Open Shrubland to Tall Open Scrub | 0.14 | 0.9 |
| **MsAst** | *Melaleuca systena / Acacia stenoptera* Closed Heath | 0.01 | 0.1 |
| **MsAt** | *Melaleuca systena / Acacia truncata* Closed Heath | 1.44 | 9.3 |
| **Total area of native vegetation** | | **14.86** | **96.0** |
| **Rehabilitation (OaCs)** | Rehabilitation area: *Olearia axillaris / Cenchrus setaceus* Low Shrubland | 0.20 | 1.3 |
| **Cleared** | Cleared | 0.42 | 2.7 |
| **Total** | | **15.48** | **100.0** |

### 3.6.4 Vegetation Condition

Vegetation condition within the Site ranges from Excellent to Completely Degraded condition, with the majority in Excellent condition (13.98 ha 90.3%) as detailed in Table 3-5 and shown on Figure 9.

**Table 3-5. Vegetation Condition Mapped within the Site and Disturbance Footprint (PGV, 2021).**

| Vegetation Condition | Area within the Disturbance Footprint (ha) | Proportion of the Site (%) |
|---|---|---|
| **Excellent** | 13.98 | 90.3 |
| **Very Good** | 0.24 | 1.5 |
| **Good** | 0.54 | 3.5 |
| **Degraded** | 0.11 | 0.7 |
| **Completely Degraded** | 0.42 | 2.7 |
| **Rehabilitation** | 0.20 | 1.3 |
| **Total** | 15.48 | **100** |

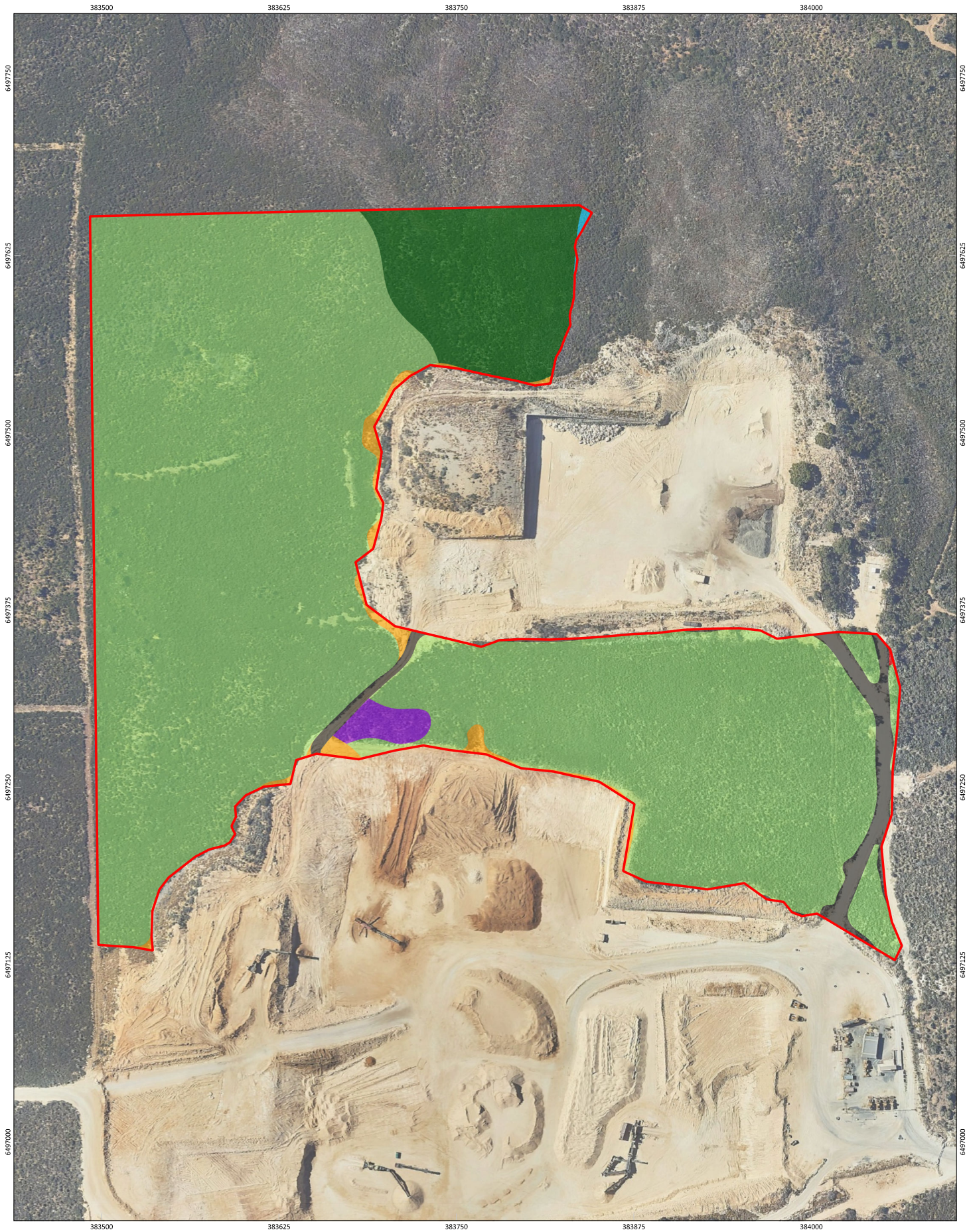
### 3.6.5 Threatened and Priority Ecological Communities

A search of the DBCA database for Threatened Ecological Communities (TEC) and Priority Ecological Communities (PEC) identified that three TECs and four PECs occur within a 5 km radius of the Site.

Of these, one was identified within the survey area but outside of the Site. Banksia Woodlands of the Swan Coastal Plain is listed as a TEC (Endangered) under the EPBC Act and a PEC (Priority 3) under the BC Act, and a patch of the TEC/PEC occurs approximately 40 m east of the Site. The location of the TEC/PEC in relation to the Site is shown on Figure 10.

A small area of vegetation type MhBs in the southwestern portion of the survey area was identified by PGV (2021) as potentially representative of FCT 26a (*Melaleuca huegelii - M. acerosa* (now *M. systena*) shrublands of limestone ridges). This is a TEC at State and Commonwealth level (Critically Endangered). However, its presence was not confirmed. This patch occurs approximately 350 m south of the Site (Figure 10).

As none of the TEC/PECs are located within or near to the Site, none will be directly impacted by the proposed action. On-site mitigation measures will prevent any potential indirect impacts.




# Figure 8: Vegetation Types

N

0 20 40 60 80 m

| | |
|---|---|
| PROJECT/REPORT NAME | Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup |
| SCALE | 1:2,500 |
| SHEET SIZE | A3 COLOUR |
| CLIENT | WA Limestone |
| COORDINATE REFERENCE SYSTEM | GDA2020 / MGA zone 50 |
| PROJECT NUMBER | A23.024 |
| VERSION | 0 |
| DATA SOURCE | LANDGATE AERIAL IMAGERY Summer 2023 |
| DRAWN BY / REVIEWED BY | MD / JB |
| DATE | 29/5/2023 |

**Legend**

- Site
- BsXpCq
- Ed
- MsAst
- MsAt
- SnMs
- Rehabilitation Area
- Cleared

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | MD | JB | 29/5/2023 |

NOTES:

Cadastral boundary (LGATE-002)

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# Figure 9: Vegetation Condition

N

0 20 40 60 80 m

| | | |
|---|---|---|
| SCALE: 1:2,500 | SHEET SIZE: A3 COLOUR | |
| PROJECT/REPORT NAME: Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup | CLIENT: WA Limestone | |
| COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50 | PROJECT NUMBER: A23.024 | VERSION: 0 |
| DATA SOURCE: LANDGATE AERIAL IMAGERY Summer 2023 | DRAWN BY / REVIEWED BY: MD / JB | DATE: 25/5/2023 |

**Legend**

- Site
- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded
- Rehabilitation

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | MD | JB | 25/5/2023 |

NOTES:

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# Figure 10: Threatened and Priority Ecological Communities

0 25 50 75 100 m

N

| | |
|---|---|
| SCALE: 1:3,000 | SHEET SIZE: A3 COLOUR |
| PROJECT/REPORT NAME: Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup | CLIENT: WA Limestone |
| COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50 | PROJECT NUMBER: A23.024 / VERSION: 0 |
| DATA SOURCE: LANDGATE AERIAL IMAGERY Summer 2023 | DRAWN BY / REVIEWED BY: MD / JB / DATE: 29/5/2023 |

**Legend**

- Site
- Flora and Vegetation Survey Area (PGV, 2021)
- Banksia Woodlands of the Swan Coastal Plain Ecological Community – Commonwealth TEC; State PEC
- Potential *Melaleuca huegelii - M. acerosa (now M. systena)* shrublands of limestone ridges (FCT 26a) – State TEC

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | MD | JB | 29/5/2023 |

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### 3.6.6 Threatened and Priority Flora

A desktop assessment was undertaken which involved a search of the DBCA Threatened Flora database search and the Commonwealth Protected Matters Search Tool (PMST), each with a 10 km buffer. These searches identified a number of flora species listed under the EPBC Act and the BC Act as having the potential to occur within the Site based on the presence of suitable habitat. A complete list is provided in Appendix E. Table 3-6 identifies those species for which suitable habitat may be present, and that therefore have the potential to occur. Table 3-6 also indicates whether the species were recorded during the site survey by PGV (2021) or WEPL (2024).

**Table 3-6. Likelihood of Occurrence Assessment for Conservation Significant Terrestrial Flora Species.**

| Species | Conservation Status | | Likelihood of Occurrence | Recorded within the Site |
|---|---|---|---|---|
| | EPBC Act | BC Act/DBCA Listing | | |
| ***Melaleuca* sp. Waneroo (G. J. Keighery 16705)** | EN | Schedule 2 | Possible | No<br>Targeted search undertaken by WEPL (2024) within suitable habitat within the Site. Species not present. |
| ***Eucalyptus argutifolia*** | VU | Schedule 3 | Known to occur within the tenement | Occurrence recorded within the tenement area, outside of the Site. |
| ***Baeckea* sp. Limestone (N. Gibson & M.N. Lyons 1425)** | Not listed | Priority 1 | Possible | No |
| ***Haloragis* sp. Parrot Ridge (G. J. Keighery 11563)** | Not listed | Priority 1 | Possible but would be an extension of the range of this species | No |
| ***Acacia benthamii*** | Not listed | Priority 2 | Possible | No |
| ***Fabronia hampeana*** | Not listed | Priority 2 | Possible if Macrozamia is present | No |
| ***Lecania sylvestris*** | Not listed | Priority 2 | Possible | No |
| ***Beyeria cinerea* subsp. *cinerea*** | Not listed | Priority 3 | Possible | No |
| ***Jacksonia gracillima*** | Not listed | Priority 3 | Possible | No |
| ***Lasiopetalum membranaceum*** | Not listed | Priority 3 | Possible | No |
| ***Leucopogon* sp. Yanchep (M. Hislop 1986)** | Not listed | Priority 3 | Possible | No |
| ***Pimelea calcicola*** | Not listed | Priority 3 | Possible | Yes (see Figure 11) |
| ***Platysace ramosissima*** | Not listed | Priority 3 | Possible | No |

| Species | Conservation Status | | Likelihood of Occurrence | Recorded within the Site |
|---|---|---|---|---|
| | EPBC Act | BC Act/DBCA Listing | | |
| ***Sarcozona bicarinata*** | Not listed | Priority 3 | Possible | No |
| ***Anigozanthos humilis*** subsp. ***chrysanthus*** | Not listed | Priority 4 | Possible | No |
| ***Jacksonia sericea*** | Not listed | Priority 4 | Possible | No |

PGV (2021) recorded two species of conservation significance within the broader survey area:

- *Eucalyptus argutifolia* (Yanchep mallee) listed as Vulnerable under the EPBC Act and Threatened under the BC Act (not present within the Site).
- *Pimelea calcicola* listed as Priority 3 by DBCA (present within the Site).

WEPL (2024) undertook a targeted search for *Melaleuca* sp. Wanneroo within potentially suitable habitat within the Site. No individuals were recorded, and none are considered to occur based on the absence of suitable habitat (with the species known to have a very strong habitat association with limestone ridges).

### *Eucalyptus argutifolia* (Yanchep Mallee)

*Eucalyptus argutifolia* is a Mallee species which grows to a height of 1.5 to 4 m with smooth bark and white flowers (March to April). The species grows in shallow soils over limestone, on slopes or gullies of limestone ridges and outcrops (WAH, n.d.)

The species is known from 18 populations comprising an estimated 730 plants (DEWHA, 2008). Seven populations occur in State Forest, two occur in unallocated Crown land, and nine occur on private property (DEWHA, 2008). The extent of species occurrence is estimated at 1,940 $m^2$ (DEWHA, 2008).

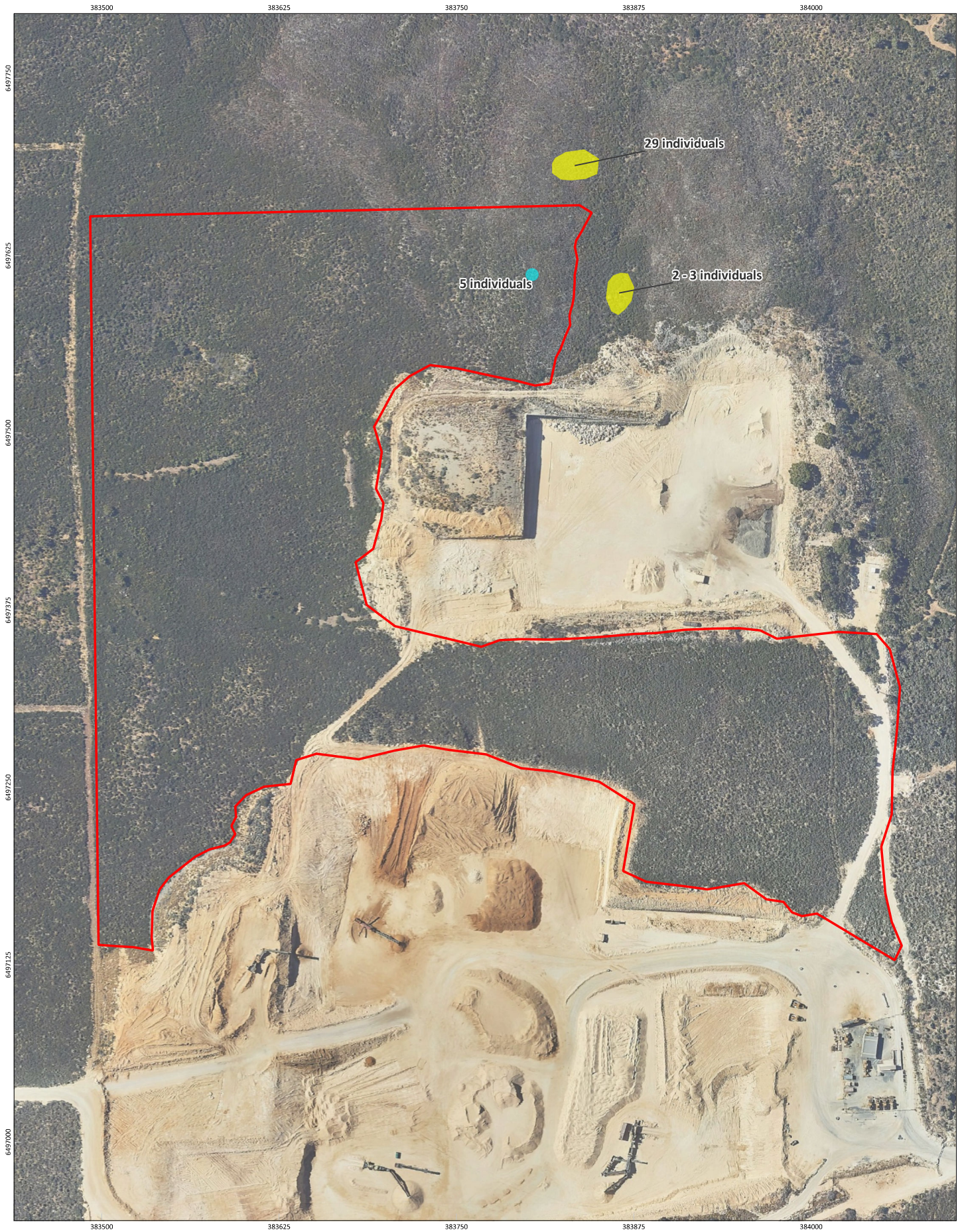
Two populations of *Eucalyptus argutifolia* (Yanchep mallee) are known to occur approximately 40 m outside of the Site (Figure 11). One population comprises two or three individuals, and the other comprises 29 individuals. The species does not occur within the Site and will not be impacted by the proposed action.

### *Pimelea calcicola*

*Pimelea calcicola* grows as erect to spreading shrub with a height of 0.2-1 m. It grows on coastal limestone ridges (WAH, n.d.). It has opposite decussate green leaves and terminal clustered pink flowers, flowering in spring from September to November.

One small population of five plants of *Pimelea calcicola*, which is listed as Priority 3 by DBCA, was recorded in the *Melaleuca systena/Acacia truncata* vegetation type in the central north part of the survey area. The small population of *P. calcicola* falls within the Site and will therefore be impacted by the proposed action.

Priority 3 species are poorly known species that are known from several locations. They are not considered to be under imminent threat, and require further survey (DBCA, 2023b).




# Figure 11: Threatened and Priority Flora

N

0 20 40 60 80 m

| | |
|---|---|
| PROJECT/REPORT NAME | Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup |
| SCALE | 1:2,500 |
| SHEET SIZE | A3 COLOUR |
| CLIENT | WA Limestone |
| COORDINATE REFERENCE SYSTEM | GDA2020 / MGA zone 50 |
| PROJECT NUMBER | A23.024 |
| VERSION | 0 |
| DATA SOURCE | LANDGATE AERIAL IMAGERY Summer 2023 |
| DRAWN BY / REVIEWED BY | MD / JB |
| DATE | 25/5/2023 |

**Legend**

- Site
- *Pimelea calcicola* – Priority 3
- *Eucalyptus argutifolia (Yanchep mallee)* – Threatened; Vulnerable

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | MD | JB | 25/5/2023 |

NOTES:

Cadastral boundary (LGATE-002)

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## 3.7 Fauna

### 3.7.1 Fauna Surveys

A basic (Level 1) fauna assessment (including a black cockatoo habitat assessment) was undertaken by Bamford Consulting Ecologists (2022) on 15 June 2021. The survey area covered a broader area than the Site as shown on Figure 7.

The report is provided as Appendix F and the key findings are summarised in Sections 3.7.2 and 3.7.3.

### 3.7.2 Vegetation Substrate Associations

Based on the detailed vegetation survey by PGV (2021) and the fauna survey (Bamford, 2022), five vegetation substrate associations (VSA) were identified in the context of habitat classification. These are described in Table 3-7, together with the extent of each within the Site. VSAs present within the Site are shown on

Figure 12.

**Table 3-7. Vegetation Substrate Associations within the Site (Bamford, 2022)**

| VSA Type | Dominant species | Description | Area (ha) (Proportion of Site) |
|---|---|---|---|
| **VSA 1 Proteaceous heath** | *Banksia sessilis* | Heath dominated by proteaceous species on orange-brown sands with limestone outcrops.<br><br>*Banksia sessilis* over *Hibbertia hypericoides/Melaleuca systena/Jacksonia calcicola* Low Shrubland to Closed Low Heath. | 13.13 (84.8%) |
| **VSA 2 Myrtaceous / fabaceous heath** | *Melaleuca systena* | Heath dominated by fabaceous species on orange-brown sands with limestone outcrops.<br><br>Vegetation compositions present:<br>• *Melaleuca systena/Acacia stenoptera* Closed Heath.<br>• *Melaleuca systena/Acacia truncata* Closed Heath, and<br>• *Scaevola nitida/Melaleuca systena* Open Heath. | 1.46 (9.4%) |
| **VSA 3 Limestone Marlock woodland** | *Eucalyptus decipiens* | Low Open Woodland dominated by Limestone Marlock on orange-brown sands with limestone outcrops.<br><br>*Xanthorrhoea preissii/Banksia sessilis Open Shrubland* to Tall Open Scrub. | 0.14 (0.9%) |
| **VSA 4 Rehabilitation** | *Olearia axillaris* and *Cenchrus setaceus* | Disturbed areas of low shrubland where some rehabilitation activities were undertaken. | 0.34 (2.2%) |
| **VSA 5 Cleared** | N/A | Largely disturbed areas including operating quarry and associated infrastructures | 0.42 (2.7%) |




# Figure 12: Fauna Habitat Types

N

0 20 40 60 80 m

| | |
|---|---|
| PROJECT/REPORT NAME | Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup |
| SCALE | 1:2,500 |
| SHEET SIZE | A3 COLOUR |
| CLIENT | WA Limestone |
| COORDINATE REFERENCE SYSTEM | GDA2020 / MGA zone 50 |
| PROJECT NUMBER | A23.024 |
| VERSION | 0 |
| DATA SOURCE | LANDGATE AERIAL IMAGERY Summer 2023 |
| DRAWN BY / REVIEWED BY | MD / JB |
| DATE | 25/5/2023 |

**Legend**

- Site
- Cleared
- Limestone Marlock Woodland
- Myrtaceous/fabaceous heath
- Proteaceous heath
- Rehabilitation

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | MD | JB | 25/5/2023 |

NOTES:

Cadastral boundary (LGATE-002)

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### 3.7.3 Conservation Significant Fauna

Bamford (2022) undertook a desktop assessment which found that 173 species of vertebrate fauna are expected to occur within the survey area. Of those, 12 are listed under the EPBC Act or BC Act, or as a Priority species by DBCA. These are shown in Table 3-8 and detailed in Appendix G. Bamford (2022) also identified species with a potential to occur at the Site that are not listed under State or Commonwealth legislation; however, they may be of local significance given their limited distribution pattern. These species are listed in Appendix G.

**Table 3-8. Conservation Significant Fauna Potentially Occurring within the Site (Bamford, 2022)**

| Species and Common Name | Conservation Status | | Presence within Site and Likelihood of Occurrence |
|---|---|---|---|
| | Commonwealth | State | |
| | | | Not recorded by Bamford (2022) |
| ***Apus pacificus*** **Fork-tailed Swift** | Migratory | MI | Expected to be a vagrant. The species is present, unpredictably, within the region and is likely to pass over the Site on an occasional basis. |
| ***Falco peregrinus*** **Peregrine Falcon** | Not listed | OS | Not recorded by Bamford (2022)<br>Expected to be a regular visitor to the Site. The species is wide-ranging and is likely to pass over the Site on a regular basis. |
| ***Calyptorhynchus banksii naso*** **Forest Red-tailed Black-Cockatoo** | Vulnerable | VU | Not recorded by Bamford (2022)<br>Expected to be an irregular visitor to the Site. The Site is at the limit of the species' range and does not provide any suitable foraging, roosting, or breeding habitat. May occur in areas surrounding the Site. |
| ***Zanda latirostris*** **Carnaby's Black-Cockatoo** | Endangered | EN | Extensive foraging evidence was identified throughout the Site (Bamford, 2022).<br>Expected to be a regular migrant. Known to occur within the Site with foraging species (*Banksia sessilis*) present. |
| | | | Not recorded by Bamford (2022) |
| ***Dasyurus geoffroii fortis*** **Chuditch** | Vulnerable | VU | Expected to be a vagrant. Species is wide-ranging and likely to be present within the Site as a vagrant only.<br>One juvenile male was caught approximately 10 km east in 2004 within |

| Species and Common Name | Conservation Status | | Presence within Site and Likelihood of Occurrence |
|---|---|---|---|
| | Commonwealth | State | |
| | | | dense riparian vegetation in the Gnangara pine plantation (Bamford, 2022). |
| ***Isoodon fusciventer*** **Quenda** | Not listed | Priority 4 | Several diggings present within the Site (Bamford, 2022)<br><br>Expected to be a resident of the Site. Species is known to occur within the Site, and suitable habitat is present. |
| ***Notamacropus irma*** **Brush Wallaby** | Not listed | Priority 4 | Not recorded by Bamford (2022)<br><br>Expected to be a regular visitor to the Site. |
| ***Austrosaga spinifer*** **Spiny Katydid [Swan Coastal Plain]** | Not listed | Priority 2 | Not recorded by Bamford (2022)<br><br>Expected to be a resident, if present within the Site. |
| ***Idiosoma sigillatum*** **Swan Coastal Plain Shield-backed Trapdoor Spider** | Not listed | Priority 3 | Not recorded by Bamford (2022)<br><br>Expected to be a resident of the Site. |
| ***Neelaps calonotos*** **Black-striped Snake** | Not listed | Priority 3 | Not recorded by Bamford (2022)<br><br>Expected to be a resident, if present within the Site. Some suitable habitat is present. |
| ***Leioproctus contrarius*** **A short-tongued bee** | Not listed | Priority 3 | Not recorded by Bamford (2022)<br><br>Expected to be a resident of the Site, if present. |
| ***Synemon gratiosa*** **Graceful Sun-Moth** | Not listed | Priority 4 | Not recorded by Bamford (2022)<br><br>Expected to be a resident of the Site. |

Species are listed in taxonomic order.
Conservation status codes:
EPBC Act listings: C = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory
WA Biodiversity Conservation Act 2016 (BC Act) listings: S1 to S7 = Schedules 1 to 7
DBCA Priority species: P1 to P4 = Priority 1 to 4

Of the conservation significant fauna species considered likely to occur within the Site, Bamford (2022) recorded presence of:

- Carnaby's cockatoo (*Zanda latirostris*) - Endangered
- Quenda (*Isoodon fusciventer*) - Priority 4

A description of each conservation significant fauna species considered to potentially occur within the Site (Table 3-8) and the extent to which the proposed action may impact the species, is described in the following sections.

### *Fork-tailed Swift*

Fork-tailed Swifts are nomadic and typically respond to broad-scale weather pattern changes. They are attracted to thunderstorms and cyclonic disturbances where they can be seen in flocks hawking insects from the storm fronts with numbers ranging from a few individuals to flocks of up to 2,000 birds. In WA, the Fork-tailed Swift is considered uncommon to moderately common near the north-west, west, and south-east coasts, common in the Kimberley and rare or scarce elsewhere (Johnstone et al., 1998). They live almost exclusively in the air and rarely land (Simpson et al., 2004).

This species may hunt for insects over the site on a seasonal basis but is unlikely to utilise it for roosting as breeding occurs outside Australia. Therefore, the species is highly unlikely to be affected by the proposed action.

### *Peregrine Falcon*

The Peregrine Falcon is a large bird of prey that occurs throughout WA, from the south near Albany to the north near Kununurra. Whilst considered uncommon, it is widespread across Australia, and occurs across all continents. The species occupies a variety of habitats including inland cliffs, rocky outcrops and gorges, coastal cliffs and islands, open woodlands near water, and can also be found nesting on ledges of high city buildings (PaWST, 2011).

The Peregrine Falcon is expected to pass over the Site on a regular basis, however, is unlikely to be dependent on habitat within the Site.

### *Forest Red-tailed Black Cockatoo*

Forest red-tailed black cockatoos are endemic to the deeper south-west of Western Australia, from around Gingin in the north, east to Mount Helena, North Bannister and Mount Saddleback, and south to around Albany (Johnstone & Storr, 1998). In recent years there appears to have been a distinct expansion of the range of this species on to the Swan Coastal Plain, including many suburbs within the Perth metropolitan area. Generally restricted to areas of Jarrah-Marri forest, farmlands with remnant trees and urban landscapes.

Forest red-tailed black cockatoos are diurnal granivores, feeding predominantly on the seeds of jarrah and marri (Johnstone & Kirkby, 1999; Johnstone et al., 2013b) but is also adapting to foraging on urban (introduced) plant species. The species is reliant on large tree-hollows in eucalypts (especially marri) for breeding (Johnstone et al., 2013a; DCCEEW, 2023b). The species is threatened by habitat loss, habitat degradation, nest hollow shortage, and competition for available nest hollows from other parrots and feral Honeybees (DCCEEW, 2023b).

The Site does not contain any suitable foraging, breeding, or roosting habitat for the species. Despite being at the limit of the species' range, individuals may irregularly visit surrounding areas with suitable habitat.

### *Chuditch*

The Chuditch is a wide-ranging resident in marri-jarrah forest of the southwest of Western Australia and also in heaths and eucalypt woodlands of the eastern wheatbelt and goldfields (Van Dyck & Strahan, 2008). This species was formerly distributed throughout much of western and inland Australia, but its range has contracted to the region approximately south-west of a line between Shark Bay and Esperance (Burbidge, 2004; Van Dyck & Strahan, 2008; DCCEEW, 2023b).

The Chuditch is a nocturnal, terrestrial carnivore, feeding mainly on smaller vertebrates (e.g. reptiles, birds and mammals) and large invertebrates (Burbidge, 2004; Van Dyck & Strahan, 2008). During the day, Chuditch shelter in dens within predominantly hollow logs and earth burrows (Van Dyck & Strahan, 2008). Chuditch have a large home range, with females in the deeper southwest occupying 55-120 ha and males ranging over 400 ha or more (Van Dyck & Strahan, 2008).

Given the species is wide-ranging, it is possible Chuditch may be present within the Site on occasion as a vagrant. However, it is highly unlikely that the species would regularly occur within the Site given the infrequency of occurrence and lack of optimal habitat. A juvenile male was caught around 10 km to the east in 2004, within dense riparian vegetation in the Gnangara pine plantation (Bamford, 2022).

### *Quenda*

The Quenda formerly occurred across the south-west of Western Australia from Geraldton to east of Esperance, including the wheatbelt, but it now has a much-reduced range, with few records north of Yanchep/Muchea on the coastal plain, and it is more or less extinct across the Wheatbelt (Van Dyck & Strahan, 2008; Travouillon & Phillips, 2018). It persists around Perth, particularly in areas of dense vegetation around wetlands, and it remains locally common in suitable environments (Howard et al., 2014).

Omnivorous and cathemeral (active throughout the day and night) Quenda feed on invertebrates, plant material and fungi (Van Dyck & Strahan, 2008). It is one of the few native, terrestrial mammals to persist in semi-urban landscapes in the south-west. Populations of this species have declined due to ongoing threats from feral predators and land-clearing (Van Dyck & Strahan, 2008; Howard et al., 2014).

The majority of the Site is considered to provide suitable habitat for Quenda, and the species was recorded via diggings. Therefore, the proposed action will result in habitat loss for the species and forced relocation away from the Site.

### *Western Brush Wallaby*

The Western Brush Wallaby is found in the south-west coastal region of WA where populations are particularly centralised near the Swan River and the dry sclerophyll Jarrah forests to the east of Perth (Groves, 2005). The species is found in some areas of mallee and heathland but is generally uncommon in wet sclerophyll forest further south. It prefers tall open forests that supply adequate grazing and open, seasonally damp flat areas with low grasses and open scrubby brushes that allow it to move freely and speedily.

The Western Brush Wallaby is a crepuscular animal, unlike many macropod species, and is active mainly at dusk and dawn (Menkhorst & Knight, 2009). It is herbivorous and feeds on many plant species, in particular

on *Carpobrotus edulis*, **Cynodon dactylon*, and *Nuytsia floribunda*. Western Brush Wallabies are commonly recorded around the Swan Coastal Plain in suitable habitat.

The species was not recorded within the Site (Bamford, 2022) however based on the presence of suitable habitat, may be a regular visitor to the Site. Fauna relocation will be completed prior to clearing commencing, and clearing will be undertaken such that any individuals present will be able to move away from the Site. A fauna handler will be present at all times during vegetation clearing to facilitate the capture and relocation of fauna.

### *Black-striped Snake*

The Black-striped Snake occurs on the coastal plain and coastal dune formations supporting low shrublands, heaths, and Banksia woodlands between Mandurah and Cataby (Bush et al., 2010). The species appears to be absent from the eastern coastal plain (M. Bamford pers. obs.). Within the Perth Metropolitan area this species may be restricted to large reserves (How & Shine, 1999).

If present, the species is expected to be a resident of the Site, however it was not recorded by Bamford (2022). Given that some suitable habitat is present within the Site, fauna relocation will be completed prior to clearing commencing, and clearing will be undertaken such that any individuals present will be able to move away from the Site. A fauna handler will be present at all times during vegetation clearing to facilitate the capture and relocation of fauna.

### *Carnaby's Black Cockatoo*

Carnaby's black cockatoo is listed as Endangered under the EPBC Act and the WA BC Act, and was recorded within the Site via foraging evidence (Bamford, 2022).

Carnaby's black cockatoo occurs in the south-west of Western Australia from the wheatbelt to the extreme south-west, including the Swan Coastal Plain and the southern coast. Carnaby's black cockatoo is well known in metropolitan Perth, with birds recorded foraging and roosting across Perth in every month of the year. Over the past 50 years, the distribution of Carnaby's black cockatoo has shifted considerably westwards and southwards.

Carnaby's black cockatoo forage in native shrubland, kwongan heathland and woodland, on the seeds, flowers, and nectar of native proteaceous plant species (*Banksia* spp., *Hakea* spp., and *Grevillea* spp.) as well as on *Callistemon* spp., and marri. The species will also forage on the seeds of introduced species.

Carnaby's black cockatoo generally roost in or near riparian environments of natural and artificial permanent water sources. Any tall trees may provide roosting habitat, but particularly flat-topped yate, salmon gum, wandoo, marri, karri, blackbutt, tuart, as well as introduced eucalypts and pines.

Carnaby's black cockatoo generally breed in woodland or forest, but also breeds in partially cleared woodland or forest including isolated trees. The species will nest in hollows within live or dead trees.

The Site contains foraging habitat suitable for Carnaby's black cockatoo, and the species is considered a regular, non-breeding visitor to the Site (Bamford, 2022). Habitat for the species is limited to foraging, due

to the absence of tall tree species that can support roosting and/or breeding for black cockatoos. A description of habitat values within the Site and in the surrounding area is described in the following sections.

## Site Context

### Foraging Habitat

Bamford (2022) reported that the Site contains 15.06 ha of native vegetation providing foraging habitat for Carnaby's black cockatoo. The quality of habitat varied within the Site, and was assessed by Bamford (2022) under the methodology developed by Dr. Mike Bamford (2020). WEPL subsequently assessed the habitat under a habitat quality scoring tool that was developed by DCCEEW (n.d.) more recently. A summary of the results of both assessments is provided in Table 3-9 and also includes the overall weighted average quality across the Site.

The full assessment against the Bamford (2020) scoring tool is available in Appendix F (Bamford, 2022) and an assessment under the DCCEEW (n.d.) tool is provided as Appendix H.

## Table 3-9. Summary of Carnaby's Black Cockatoo Foraging Assessment (Bamford, 2020; DCCEEW, n.d)

| Habitat Description | Area (ha) | Proportion of Habitat (%) | Black Cockatoo Foraging Habitat Quality Scoring Tool (Bamford Consulting Ecologists, 2020) | | Habitat Scoring System for WA Black Cockatoo Foraging Habitat (DCCEEW) | |
|---|---|---|---|---|---|---|
| | | | Site Condition | Site Context + Species Density | Vegetation Structure and Condition | Site Context |
| **Proteaceous shrubland with *Banksia sessilis* occurring at high density (~30-60%).** | 13.27 | 88.1 | 5 | | 6 | |
| **Limestone marlock woodland comprised of *Xanthorrhoea preissii* and *Banksia sessilis* at lower density (~5%).** | 0.14 | 0.9 | 3 | 2 (for whole of site) | 2[1] | 3 (for whole of site) |
| **Myrtaceous/fabaceous heath and rehabilitated vegetation with limited foraging species.** | 1.65 | 11.0 | 2 | | 1[1] | |
| **Site Weighed Average (rounded to the nearest whole number)** | | | 5 | 2 | 5 | 3 |

[1] DCCEEW (n.d.) identifies that areas with a vegetation condition and structure score of 2 or less are unlikely to constitute suitable habitat due to the low projected foliage cover (<10%) of foraging species. As such, areas within the Site that have a score of 2 or less for vegetation structure and condition are not considered suitable habitat for Carnaby's black cockatoo.

The weighted average quality of foraging habitat within the Site is 'moderate to high' under Bamford (2020) DCCEEW (n.d). The quality and extent of Carnaby's black cockatoo foraging habitat within the Site is summarised in Table 3-9 and shown on Figure 13.

The foraging value scores presented in Table 3-9 recognise that Bamford (2022) recorded extensive evidence of foraging by Carnaby's black cockatoo within the Site, all of which was on *Banksia sessilis* within the proteaceous shrubland habitat type (see Figure 10 of Appendix H).

The habitat quality scoring tool developed by DCCEEW (n.d.) identifies that areas with a vegetation condition and structure score of 2 or less are unlikely to constitute suitable habitat. This is due to the low projected foliage cover (<10%) of foraging species. As such, areas within the Site that have a score of 2 or less for vegetation structure and condition are not considered suitable habitat for Carnaby's black cockatoo. This equates to 1.79 ha (11.9%).

Consequently, and considering the tool developed by DCCEEW (n.d.) occurred more recently, the Site has been assessed to provide 13.27 ha of high quality habitat for Carnaby's black cockatoo.

### Breeding and Roosting Habitat

The Site does not contain any suitable habitat for roosting or breeding by black cockatoos. The Site lacks tree species such as jarrah, marri, or tuart that could form roosting habitat.

### Regional Context

The regional context of Carnaby's black cockatoo habitat is presented, based on habitat features within 6 km and 12 km of the Site. The context presented includes:

- The extent of vegetation cover, including native and non-native vegetation types,
- Potential habitat for the species based on vegetation cover that could include vegetation types likely to include species suitable for foraging and/or roosting,
- Conservation areas that contain foraging habitat,
- Confirmed roost sites based on information available through DBCA and Birdlife Australia, and
- Known breeding sites based on publicly available datasets managed by DBCA.

A summary of habitat values for Carnaby's black cockatoo within 6 km and 12 km of the Site is provided in Table 3-10.

**Table 3-10. Summary of Carnaby's Black Cockatoo Habitat Values within 6 km and 12 km of the Site**

| Habitat Feature | Within 6 km of Site | Within 12 km of Site |
|---|---|---|
| **Native Vegetation Cover** | 6,286.75 ha | 20,873.29 ha |

| Habitat Feature | Within 6 km of Site | Within 12 km of Site |
|---|---|---|
| **Pine Plantation Cover** | 175.32 ha | 1,655.71 ha |
| **Potentially Suitable Foraging Habitat (Native and Plantation)** | Total: 6,198.30 ha<br>6,022.98 ha (native)<br>175.32 ha (plantation) | Total: 20,751.64 ha<br>19,095.93 ha (native)<br>1,655.71 ha (plantation) |
| **Potentially Suitable Habitat within Conservation Areas (Total)** | 1,159.30 ha | 1,498.64 ha |
| **Key Conservation Areas** | Neerabup National Park: 1,072.87 ha<br>Nowergup Nature Reserve: 86.43 ha | Neerabup National Park: 1,118.35 ha<br>Yanchep National Park: 279.54 ha<br>Nowergup Nature Reserve: 86.43 ha<br>Lake Joondalup Nature Reserve: 5.69 ha<br>Jandabup Nature Reserve: 5.31 ha |
| **Roost Sites (Confirmed)** | 6 confirmed (DBCA-050)<br>7 possible (DBCA-064) | 12 confirmed (DBCA-050)<br>27 possible (DBCA-064) |
| **Breeding Sites** | N/A | Known breeding site 10.0 km south |

Table 3-11 provides details of confirmed roosting sites within 6 km and 12 km of the Site, including the maximum number of individuals recorded to use the site, based on information available in DBCA-managed datasets (DBCA-050).

### Table 3-11. Details of Confirmed Roosting Sites within 12 km of the Site (DBCA-050)

| Roost ID | Location | Number of Individuals (Maximum Count) | Distance and Direction from Site |
|---|---|---|---|
| **Within 6 km of Site** | | | |
| **HF11** | Gnangara | 64 | 5.0 km southeast |
| **HF14** | Gnangara | 13 | 5.0 km southeast |
| **HF15** | Gnangara | 200 | 5.7 km northeast |
| **HF17** | Gnangara | 29 | 1.3 km southeast |
| **HF18** | Gnangara | 604 | 0.9 km southeast |
| **Within 12 km of Site** | | | |
| **GCC01** | Joondalup | 11 | 8.0 km south |
| **GCC73** | Marjinup | 858 | 10.6 km southeast |
| **HF07** | Gnangara | 5 | 10.8 km southeast |
| **HF08** | Gnangara | 400 | 10.9 km southeast |
| **HF13** | Gnangara | 312 | 6.7 km northeast |
| **WS07** | Gnangara | 542 | 10.6 km southeast |
| **XK22** | Amarante | 16 | 12 km southeast |

As identified in Table 3-10, there is an estimated 6,286.75 ha of native vegetation that provides potentially suitable foraging habitat for Carnaby's black cockatoo within 6 km of the Site, and approximately 20,873.29 ha within 12 km of the Site. The extent of habitat provided by the Site therefore equates to approximately 0.21% of that within a 6 km radius and 0.07% of that within a 12 km radius.

Approximately 60.7% and 40.5% of the potential foraging habitat within 6 km and 12 km is within lands managed by DBCA, respectively. The majority of this is within Gnangara-Moore River State Forest, providing 6,015.98 ha of potentially suitable habitat within 12 km of the Site. When considering land reserved and managed for conservation, a considerable amount of habitat is protected within Neerabup National Park with approximately 1,118.35 ha within 12 km of the Site.




# Figure 13: Carnaby's Black Cockatoo Habitat within the Site

0 20 40 60 80 m

N

| | |
|---|---|
| SCALE 1:2,500 | SHEET SIZE A3 COLOUR |
| COORDINATE REFERENCE SYSTEM GDA2020 / MGA zone 50 | PROJECT NUMBER A23.024 / VERSION 0 |
| DATA SOURCE LANDGATE AERIAL IMAGERY Summer 2023 | DRAWN BY / REVIEWED BY HS / JB / DATE 15/2/2024 |

PROJECT/REPORT NAME
Wattle Avenue East Quarry
311 Wattle Avenue East, Nowergup

CLIENT
WA Limestone

**Legend**

- Site

**Carnaby's Black Cockatoo Foraging Habitat**

- High Quality
- Low Quality
- Negligible to Low Quality

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original Issue | HS | JB | 15/2/2024 |

NOTES:

Cadastral boundary (LGATE-002)

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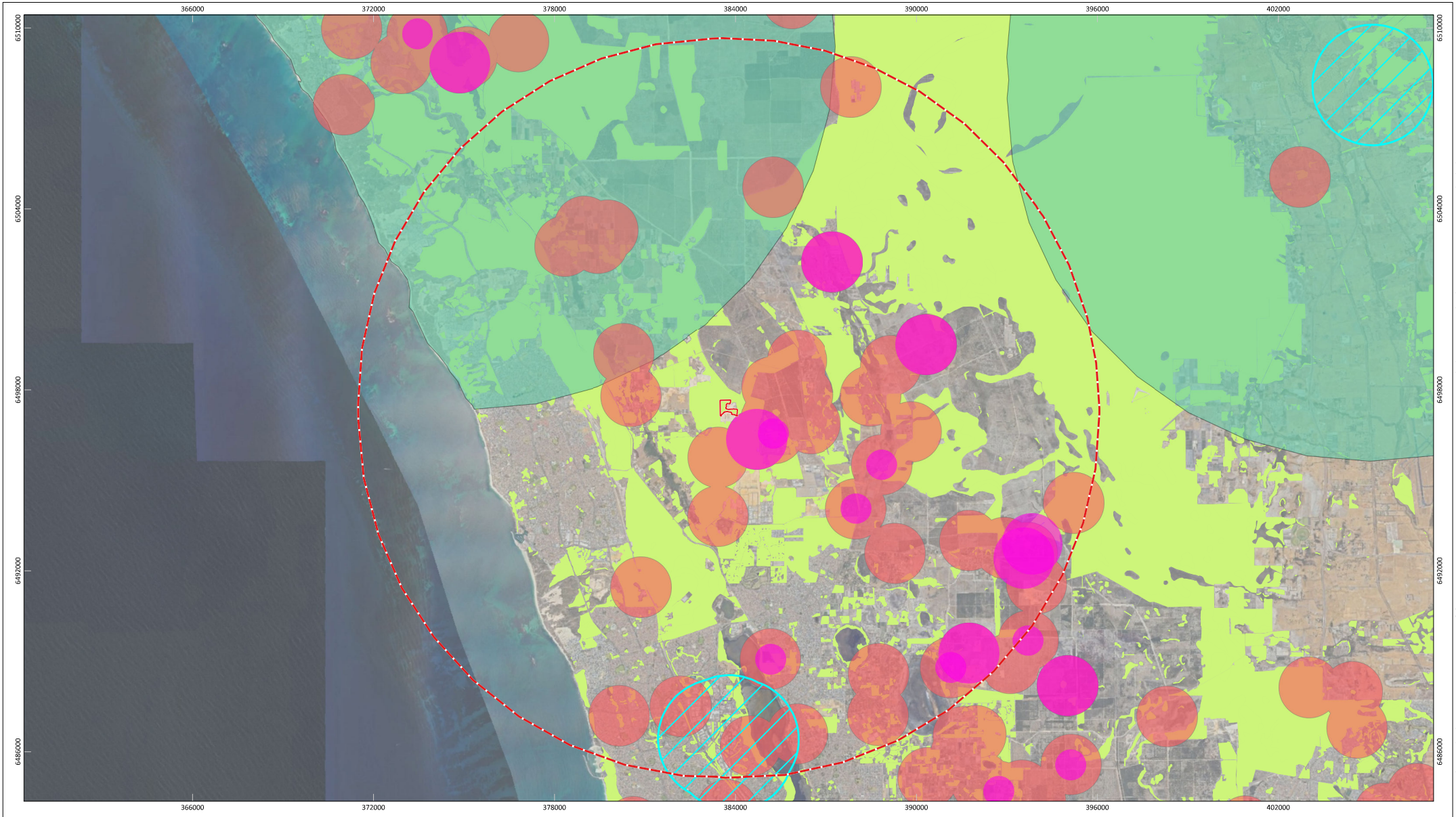



**Figure 14:** Regional Carnaby's Black Cockatoo Foraging, Roosting and Breeding Habitat

N

0 2 4 6 km

| | |
|---|---|
| SCALE | 1:120,000 |
| SHEET SIZE | A3 COLOUR |
| COORDINATE REFERENCE SYSTEM | GDA2020 / MGA zone 50 |
| DATA SOURCE | LANDGATE AERIAL IMAGERY Summer 2023 |

| | |
|---|---|
| PROJECT/REPORT NAME | Wattle Avenue East Quarry<br>311 Wattle Ave East, Nowergup |
| CLIENT | WA Limestone |
| PROJECT NUMBER | A23.024 |
| VERSION | 0 |
| DRAWN BY / REVIEWED BY | HS/JB |
| DATE | 4/6/2024 |

**Legend**

- Site
- 12 km Radius of the Site
- Black Cockatoo Breeding Sites - Buffered (DBCA-063)
- Carnabys Cockatoo Confirmed Roost Sites (DBCA-050)
- Black Cockatoo Potential Roosting Sites - Buffered (DBCA-064)
- Carnabys Cockatoo Confirmed Breeding Areas within the Swan Coastal Plain and Jarrah Forest IBRA Regions (DBCA-054)
- Carnabys Cockatoo Areas requiring investigation as feeding habitat in the Swan Coastal Plain (SCP) IBRA Region (DBCA-057)

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | HS | JB | 4/6/2024 |

NOTES:

Cadastral boundary from LANDGATE 2022. Label corresponds to the vegetation association number.

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## 3.8 Conservation Estate, Bush Forever and Environmentally Sensitive Areas

The southeastern section of the Site intersects Bush Forever Site number 293: Shire View Hill and adjacent bushland (Figure 15). The portion of Bush Forever Site number 293 that intersects with the Site is subject to an approved planning solution for urban, industrial, or resource development in Bush Forever areas under State Planning Policy 2.8.

The Site is situated within the 'Northern Swan Coastal Plain' Key Biodiversity Area, listed because it "supports a considerable portion of the non-breeding population of the endangered Carnaby's Black-Cockatoo and a small number of breeding pairs".

## 3.9 Heritage

A search of the Department of Planning, Lands and Heritage Aboriginal Cultural Heritage (ACH) Inquiry System (DPLH, 2023) identified one ACH place (ID: 3693) within the Site that represents part of the buffer zone of Lake Neerabup. Lake Neerabup is situated 1.9 km southwest of the Site, as shown on Figure 16.

The presence of this ACH place is unlikely to trigger assessment under the WA *Aboriginal Heritage Act 1972*.

A search with the DCCEEW PMST has shown that there are no Commonwealth heritage places overseas or known other non-Indigenous heritage values that apply to the project area.

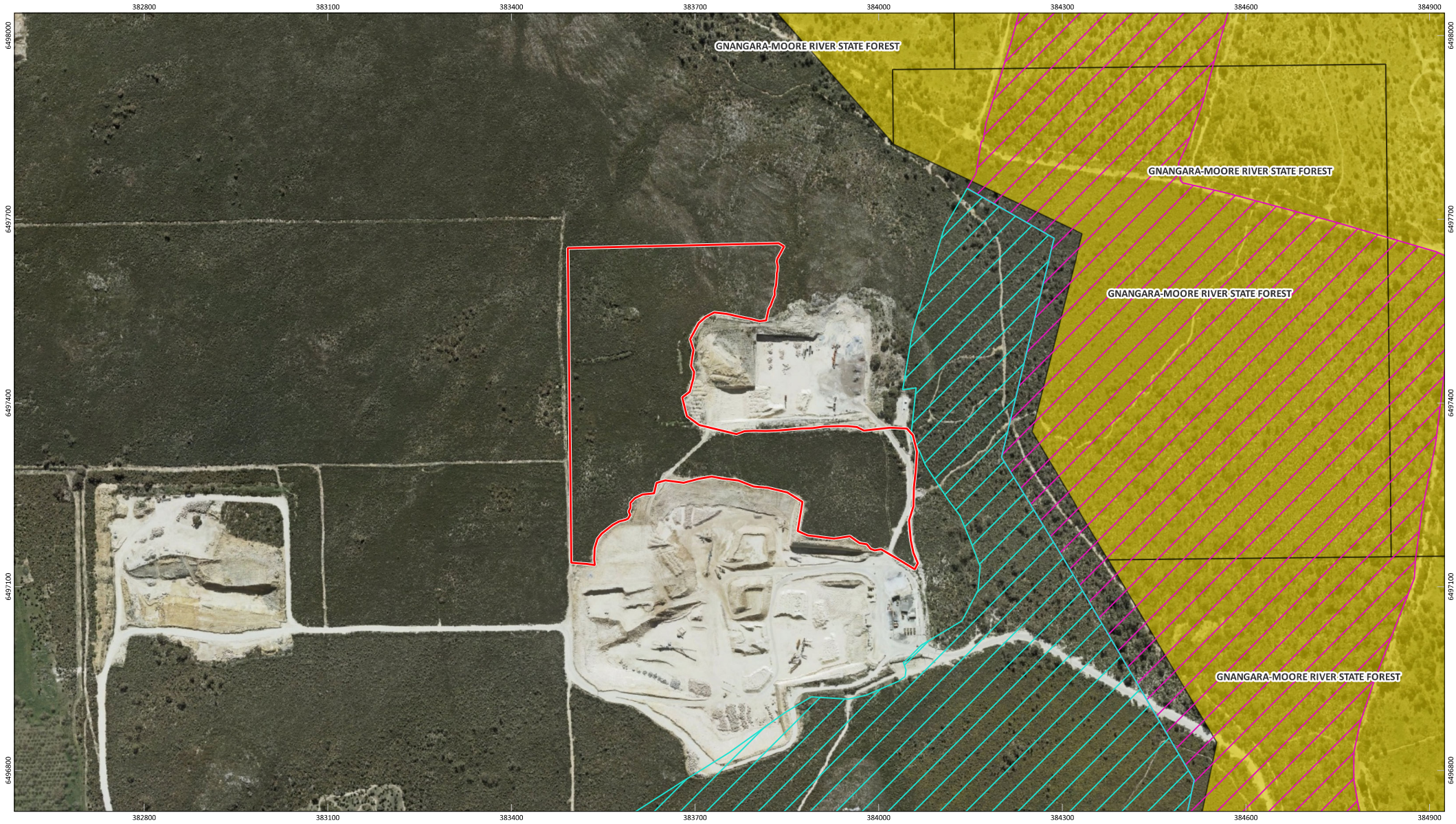



Figure 15: Conservation Areas and Bush Forever

N

0 75 150 225 300 m

| | | |
|---|---|---|
| PROJECT/REPORT NAME<br>Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup | | |
| SCALE<br>1:6,000 | SHEET SIZE<br>A3 COLOUR | CLIENT<br>WA Limestone |
| COORDINATE REFERENCE SYSTEM<br>GDA2020 / MGA zone 50 | | PROJECT NUMBER<br>A23.024 / VERSION<br>0 |
| DATA SOURCE<br>LANDGATE AERIAL IMAGERY Summer 2023 | | DRAWN BY / REVIEWED BY<br>HS / JB / DATE<br>15/2/2024 |

**Legend**

- Site

**State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region**

- SPP 2.8 Negotiated Planning Solution, Urban, Industrial or Resource Development in Bush Forever Areas
- SPP 2.8 Bush Forever Reserves (existing or proposed)

**DBCA - Legislated Lands and Waters (DBCA-011)**

- State Forest

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | HS | JB | 15/2/2024 |

NOTES:

Cadastral boundary from LANDGATE 2022

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Figure 16: Heritage

| | | | |
|---|---|---|---|
| N 0 200 400 600 800 m | | PROJECT/REPORT NAME<br>Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup | |
| SCALE<br>1:15,000 | SHEET SIZE<br>A3 COLOUR | CLIENT<br>WA Limestone | |
| COORDINATE REFERENCE SYSTEM<br>GDA2020 / MGA zone 50 | | PROJECT NUMBER<br>A23.024 | VERSION<br>0 |
| DATA SOURCE<br>LANDGATE AERIAL IMAGERY Summer 2023 | | DRAWN BY / REVIEWED BY<br>HS / JB | DATE<br>15/2/2024 |

**Legend**

- Site
- Heritage Council WA - Local Heritage Survey (DPLH-008)
- Heritage List (DPLH-090)

**Heritage Council WA - Assessment Program (DPLH-007)**

- Precinct / Group

**Aboriginal Heritage Places (DPLH-001)**

- Registered Site
- Other Heritage Place

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | HS | JB | 15/2/2024 |

NOTES:

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# 4. Impacts and Mitigation

## 4.1 Assessment of Alternatives

There are no feasible alternatives due to the geology and distribution of the Tamala limestone, planning restrictions, conservation and economic factors.

Under SPP2.4: Planning for BRM, the Tamala limestone deposits at M 70/143 are recognised as a SGS. These are identified as the highest priority extraction areas for BRM. SGS are BRM identified by DMIRS that represent strategic, long-term supplies of BRM which is critical to the future development needs of the state and the community and requires protection (DMIRS, retrieved 2022).

SPP 2.4 (2021) has been adopted which sterilizes large areas of BRM including sand and limestone as “Exclusion Areas”, including virtually all of WA Limestone’s existing future reserves. This significantly reduces the area available for future limestone extraction and the remaining volume of limestone resource for the future development needs of the state.

Exclusion Areas which came into effect in 2021 after the 2019 permit was approved have sterilised significant amounts of alternative limestone and further reduced alternative sources. This has occurred at M70/143 with a significant portion of the area classified as Exclusion Area under SPP 2.4 ( Appendix I).

The proposed action has minimised any conflict with mapped Exclusion Areas as far as possible, however it is recognised that the northeastern portion of the proposed action intersects an Exclusion Area by approximately 2.03 ha.

The objectives of SPP 2.4 are to identify and protect significant limestone and other BRM resources required by the community and future development. SPP 2.4 identifies the subject site as both a "Priority Resource Location" and "Key Extraction Area". This is the highest level of significance able to be given to a BRM site. Limestone deposits occurring at Wanneroo/Yanchep area remain the only SGS left in the Perth Metropolitan Area and represent the last economically viable high-quality deposits not sterilised by conservation and planning policies (SPP 2.4, 2021).

The next nearest alternative limestone deposits are located at Guilderton and Seabird, around 50 kilometres to the north. However, these limestone deposits are typically shallow and of low quality, unsuitable for construction use, and due to the additional transport costs, they are not economically feasible.

The location and quality of the Tamala limestone in the north metro area is critical to the economic viability of public amenity projects. Its proximity to the north metro area makes the limestone a valuable economic material for Main Roads and Development WA. Other deposits located further to the north at Guilderton and Seabird are low quality and cost prohibitive to these projects.

Transport costs are a significant component of any public development. The distance between the limestone resource and the uses, contributes to higher costs of construction, increasing pressure on public

infrastructure project costs to entities like Development WA and Main Roads. Carbon emissions are also increased by hauling extracted limestone over greater distances, impacting WA's net zero emissions targets.

The only feasible alternative construction material to limestone in the Neerabup/Carabooda region is granite from the Darling Scarp. Granite is substantially more expensive to extract and transport, and the granite quarries are similarly constrained by environmental factors.

The clearing at M 70/143 represents some of the last remaining limestone available for extraction that can still be accessed that is not under conservation, in an exclusion zone under SPP 2.4, or residential development.

## 4.2 Avoidance Measures

The disturbance footprint of the proposed action has been reduced to the minimum required to facilitate safe and economical extraction of the limestone resource within mining tenement M 70/143.

The project area originally considered by WA Limestone for limestone extraction was 57.86 ha in area and covered the entirety of the area surveyed by PGV (2021) (Figure 7). The survey was designed to inform the revised proposed action area, based on the values present. Of the original project area, 26.48 ha had been previously cleared and is used for active quarry operations.

The proposed action area is limited to a 15.48 ha portion of the original project area (comprising 14.86 ha native vegetation and 0.20 ha of highly modified vegetation). The remaining 42.38 ha of the project area is excluded from the proposed action, of which 17.12 ha is comprised of native vegetation and the remainder has been cleared for active quarry operations.

Figure 17 provides a spatial representation of the original project area, proposed action area (to be impacted), and native vegetation to be retained and avoided by the proposed action. Figure 17 also shows the location of significant environmental values that will be avoided by the proposed action (conservation significant flora and ecological communities). Specific values to be retained within these areas are:

- 16.71 ha native vegetation in Good to Excellent condition, 0.01 ha of rehabilitation, and 0.41 ha of Completely Degraded vegetation.
- 3.38 ha of Banksia Woodlands of the Swan Coastal Plain Ecological Community (Endangered).
- Potential 0.11 ha occurrence of possible FCT 26a (*Melaleuca huegelii - M. acerosa* (now *M. systena*) shrublands of limestone ridges) (Critically Endangered).
- All *Eucalyptus argutifolia* (Yanchep Mallee) locations comprising 31-32 individuals, of which 2 to 3 occur within the project area and the remaining 29 situated to the north.
- 13.33 ha of Carnaby's black cockatoo foraging habitat (inferred to be of high foraging value for the species, given the presence and density of *Banksia sessilis*).

## 4.3 Mitigation Measures

A summary of proposed mitigation measures and rehabilitation is provided in sections 5.3 and 5.4, as well as Table 5-14.




# Figure 17: Avoidance and Mitigation Measures

| | | | |
|---|---|---|---|
| N 0 25 50 75 100 m | | PROJECT/REPORT NAME<br>Wattle Avenue East Quarry<br>311 Wattle Avenue East, Nowergup | |
| SCALE<br>1:4,500 | SHEET SIZE<br>A3 COLOUR | CLIENT<br>WA Limestone | |
| COORDINATE REFERENCE SYSTEM<br>GDA2020 / MGA zone 50 | | PROJECT NUMBER<br>A23.024 | VERSION<br>0 |
| DATA SOURCE<br>LANDGATE AERIAL IMAGERY Summer 2023 | | DRAWN BY / REVIEWED BY<br>HS / JB | DATE<br>15/2/2024 |

**Legend**

- Site
- Mining Lease
- Project Area Originally Considered for the Proposed Action
- Areas within the Project Area to be Avoided by the Proposed Action
- 40 m Buffer of Banksia Woodlands of the Swan Coastal Plain TEC

**Conservation Significant Flora**

- Eucalyptus argutifolia (Yanchep mallee)

**Conservation Significant Ecological Communities**

- Banksia Woodlands of the Swan Coastal Plain Ecological Community – Cwlth TEC; State PEC
- Potential Melaleuca huegelii - M. acerosa (now M. systena) shrublands of limestone ridges (FCT 26a) – State and Cwlth TEC

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | HS | JB | 15/2/2024 |

NOTES:

Cadastral boundary (LGATE-002)

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## 4.4 Assessment Against Clearing Principles

To assess whether clearing of 15.34 ha of native remnant vegetation associated with the proposal is likely to have a significant impact on the environment, the results of the biological survey informed an assessment against the ten clearing principles (Schedule 5 of the EP Act). The detailed assessment is provided in Table 4-1.

### Table 4-1. Assessment Against the Ten Clearing Principles

| Principle | Assessed Outcome | Section Reference |
|---|---|---|
| **(a) Native vegetation should not be cleared if it comprises a high level of biological diversity** | Unlikely to be at variance. | Section 4.4.1 |
| **(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.** | At variance. | Section 4.4.2 |
| **(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.** | Not at variance. | Section 4.4.3 |
| **(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.** | Not at variance. | Section 4.4.4 |
| **(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.** | Not at variance. | Section 4.4.5 |
| **(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.** | Not at variance. | Section 4.4.6 |
| **(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.** | Not at variance. | Section 4.4.7 |
| **(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area** | Not at variance. | Section 4.4.8 |
| **(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.** | Not at variance. | Section 4.4.9 |
| **(j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.** | Not at variance. | Section 0 |

### 4.4.1 Comprises a High Level of Biological Diversity

A total of five native vegetation communities were recorded within the Site along with one highly modified (rehabilitated) vegetation type. The most widespread vegetation community is BsXpCq (*Banksia sessilis/Xanthorrhoea preissii/Calothamnus quadrifidus* Closed Tall Scrub over *Hibbertia hypericoides/Melaleuca systena/Jacksonia calcicola* Low Shrubland to Closed Low Heath) comprising 85.5% of the Site.

A total of 114 taxa of terrestrial vascular flora representing 59 genera and 28 families were recorded by PGV (2021) within the Site, including 12 introduced species. Species richness within the four quadrats sampled within the Site ranged from 15 to 34 species with an average of 22.5 (PGV, 2021).

PGV (2021) recorded four dominant families, being Fabaceae (12 native and three introduced species), Myrtaceae (10 native and one introduced species), Proteaceae (nine native species), and Asteraceae (two native and seven introduced species).

One Priority 3 flora species (*Pimelea calcicola*, five individuals) was recorded within the northeastern portion of the Site (PGV, 2021). One Threatened flora species (*Eucalyptus argutifolia*) is known to occur within the area surrounding the Site, with one population approximately 40 m to the east (2-3 individuals) and one population 40 m to the north (29 individuals).

The majority (90.3%) of the Site is in Excellent condition, with relatively low weed incursion. A total of 12 introduced species were recorded within the Site, of which one (**Asparagus asparagoides*) is a Declared Pest under s22(2) of the *Biosecurity and Agriculture Management Act 2007* (BAM Act). **Asparagus asparagoides* is also a Weed of National Significance (WoNS).

The fauna habitat types that dominate the Site (Proteaceous heath and Myrtaceous/fabaceous heath) are common on the Swan Coastal Plain and are well represented outside of the Site in the local area. Based on a desktop assessment, 173 vertebrate fauna species have the potential to occur within the Site (no fish, eight frogs, 46 reptiles, 100 birds, and 19 mammals). Of these, 23 species (20 birds and three mammals) were recorded during the survey (Bamford, 2022).

Two conservation significant fauna species listed under State or Commonwealth legislation were recorded within or in very close proximity to the Site. Carnaby's black cockatoo (*Zanda latirostris*) listed as Threatened (Endangered) was identified as occurring within the Site through widespread foraging residue. Quenda (*Isoodon fusciventer*) listed as Priority 4 was identified as occurring within the Site through diggings. A further six species listed under State or Commonwealth legislation or as a Priority species by DBCA may occur within the Site as less-regular visitors or vagrants. These include fork-tailed swift, peregrine falcon, chuditch, western brush-wallaby, and black-striped snake. While forest red-tiled black cockatoo is known to occur within the area of the Site, as the Site lacks suitable habitat for the species, it is not expected to be impacted by the proposed clearing.

One introduced fauna species, rabbit (*Oryctolagus cuniculus*) was identified within the Site through diggings and scats.

The fauna, flora, and vegetation of the Site demonstrates a moderate level of biodiversity. However, none of the mapped vegetation communities or fauna habitats found within the Site are restricted and all extend well beyond the boundaries of the Site. There is only one Priority flora species known to occur within the Site (*Pimelea calcicola*; Priority 3) and the number of conservation significant fauna species either known or with the potential to occur within the Site is not considered high. The Site is not considered to contain and unusually high level of biological diversity or significant species for this region.

Based on the above, clearing is unlikely to be at variance to this Principle.

### 4.4.2 Potential to Impact Significant Habitat for Fauna Indigenous to Western Australia

A total of 23 native vertebrate fauna species have been recorded within and adjacent to the Site, including 20 birds and three mammals (Bamford, 2022). Of these, two are of conservation significance: Carnaby's black cockatoo (Threatened; Endangered) and Quenda (Priority 4). Chuditch (Vulnerable) may also be an irregular visitor to the Site (vagrant).

The proposed action will cause the removal of confirmed or potential habitat for these three species of conservation significance. The proposed action will cause forced relocation of any individuals present away from the Site, and carries a risk of mortality. Clearing will occur at one time using a bulldozer or loader to push the vegetation into windrows, and will be undertaken in a way that encourages fauna to move into the surrounding vegetation. A fauna relocation program will be undertaken prior to the commencement of clearing. Specific impacts to Carnaby's black cockatoo, Chuditch, and Quenda are discussed in the following two sections.

#### *Carnaby's Black Cockatoo*

The Site contains 13.27 ha of high quality foraging habitat for Carnaby's black cockatoo foraging. The balance of the Site provides negligible to low quality foraging habitat and has therefore been omitted from further discussion (see Section 3.7.3 for further detail).. *Banksia sessilis* is the dominant foraging species within the Site and is considered a mainstay of the Carnaby's black cockatoo diet (Bamford, 2022). Foraging residue was recorded throughout the Site, primarily within the proteaceous shrubland habitat type where *Banksia sessilis* was reported to occur at a relatively high density. The Site does not provide any suitable habitat for roosting or breeding by Carnaby's black cockatoo given the complete absence of tree species with the potential to reach a suitable height or to form nesting hollows.

In the context of the surrounding landscape, there is an estimated 472.20 ha of potential foraging habitat for Carnaby's black cockatoo within the immediate vicinity (1 km radius) of the Site, 6,286.75 ha within the local area (6 km radius), and 20,873.29 ha within the broader region (12 km radius). The extent of foraging habitat within the Site therefore represents approximately 2.81% of that within the immediate area, 0.21% of that within the local area, and 0.06% of that within the broader region.

The proposed action is considered to result in significant residual impact to 13.27 ha of high-quality foraging habitat for Carnaby's cockatoo, given this clearing cannot be avoided. An environmental offset to compensate for the clearing will be required. WA Limestone has identified a potential offset site that meets

both State and Commonwealth requirements. Details of the proposed offset strategy are summarised in section 6 and elaborated further in Appendix I.

As there is a significant residual impact to Carnaby's black cockatoo foraging habitat, clearing for the proposed action is considered at variance to this principle.

### *Chuditch*

The majority of the Site (15.06 ha) may comprise suitable habitat for Chuditch (Vulnerable). Bamford (2022) identified that given Chuditch is wide-ranging, the species may occur within the Site only as a vagrant. The species was not directly or indirectly observed within the survey area, and the nearest known record was a juvenile male which was caught approximately 10 km to the east in 2004 within dense, riparian vegetation in the Gnangara pine plantation (M. Bamford pers obs.).

The habitat types represented by the Site are not considered of high quality for Chuditch. The Chuditch National Recovery Plan (DEC, 2012) states that it is not possible to list a set of characteristic habitats that should be preserved for Chuditch, given their historic presence in a vast range of habitats. However, vegetation that contains dense stands of large mature trees may be more suitable than vegetation that does not. This is due to the contraction of their historic range to the larger forest stands to the south and east of Perth as well as the species' requirement for adequate den resources (predominantly hollow logs) and shelter from invasive predators (DEC, 2012). This is consistent with the nearest known record of the species within dense riparian vegetation in the Gnangara pine plantation.

The Site itself lacks mature, tall trees and is within an area where existing quarry operations are likely to preclude the species from occurring in the local area. Given this, however recognising that the species may occur on occasion as a vagrant to the Site, 15.06 ha of habitat with low importance for the species is considered to be present.

Given the relatively small area of clearing in the context of the overall landscape, the proposed action is not considered to significantly reduce the extent of habitat available for the species. Impacts of the proposed action on the species are related to the risk of mortality during clearing. The risk of mortality to quenda during clearing will be mitigated through trapping and relocation of quenda individuals prior to clearing. Impacts to Quenda will be managed through an EMP that will be developed for the proposed action.

### *Quenda*

The majority of the Site (15.06 ha) is likely to comprise suitable habitat for Quenda, which is a Priority 4 fauna species. Several diggings from the species were recorded within the Site (Bamford, 2022). *Xanthorrhoea preissii* (grass tree) is a highly important habitat species of quenda for nesting and protection from predators (Haby et al., 2013; Keiper & Johnson, 2004) and the species does not tend to foraging too far from nesting sites (Watson, 2018). Approximately 87.5% of the Site is dominated by *Xanthorrhoea preissii*, and therefore can be considered to provide important habitat for the species.

Given the relatively small area of clearing in the context of the overall landscape, the proposed action is not considered to significantly reduce the extent of habitat available for the species. Impacts of the proposed

action on the species are related to the risk of mortality during clearing. The risk of mortality to quenda during clearing will be mitigated through trapping and relocation of quenda individuals prior to clearing. Impacts to Quenda will be managed through an EMP that will be developed for the proposed action.

### 4.4.3 Potential Impact to any Rare Flora

No rare flora species listed under the BC Act have been recorded within the Site (PGV, 2021).

Two populations of *Eucalyptus argutifolia* (Yanchep mallee) are known to occur to the east and north of the Site, comprising two-three individuals and 29 individuals, respectively. Neither population will be impacted by the proposed action, either directly or indirectly, given the separation distance of approximately 40 m.

There is a minor risk of indirect impacts from the proposed action during vegetation clearing and ongoing operation through:

- Uncontrolled access to areas of retained vegetation adjacent to the proposed action.
- Degradation of surrounding habitat due to weed introduction and spread.
- Changes to hydrology.
- Changes to fire regime.

Management measures will be implemented during the clearing and operational phases to ensure the risk of these indirect impacts occurring is minimised as far as possible. These will be enacted through the preparation and implementation of an EMP. A summary of these measures is provided in Table 5-10.

It is important to note that the populations of Eucalyptus argutifolia located in proximity to the Site are situated 40 m from current quarry operations (as observable by the cleared areas on Figure 11). PGV (2021) assessed the vegetation in this area as 'Excellent' condition with minimal signs of disturbance. As quarry operations in this specific area have been ongoing since 2001, it is evident that no impact to retained vegetation, including Eucalyptus argutifolia populations, have resulted. As such, and given the mitigation measures proposed in Table 5-10, no direct or indirect impacts are expected to result from the proposed action.

One population of *Pimelea calcicola* was recorded within the Site (five individuals) which is listed as Priority 3 by DBCA. Priority 3 is assigned to taxa that are poorly known, some of which are not thought to be under immediate threat and some of which are candidates for declaration as rare but are in need of further survey. Being a Priority 3 species, *P. calcicola* is not declared rare under the BC Act.

Given the absence of rare flora from the Site, the proposed action is not at variance to this Principle.

### 4.4.4 Presence of any Threatened Ecological Communities

There are no State-listed TECs within nor adjacent to the Site.

PGV (2021) identified a small area of native vegetation occurring approximately 300 m south of the Site as potentially representative of the Critically Endangered *Melaleuca huegelii - Melaleuca systena* shrublands on limestone ridges (floristic community type 26a as originally described in Gibson et al. [1994]). Given the considerable separation distance, this patch of potential TEC will not be impacted directly or indirectly by the proposed action.

As there are no State-listed TECs present within the Site, the proposed action is not at variance to this Principle.

### 4.4.5 Significance as a Remnant of Native Vegetation that has been Extensively Cleared.

Vegetation within the Site is representative of the Cottesloe Complex - Central and South. The current extent of the vegetation complex is approximately 14,567.87 ha, which is 32.2% of the pre-European extent. Of this, 14% is being managed for conservation purposes.

The Site therefore represents approximately 0.10% of the remaining extent of the vegetation complex.

The Cottesloe Complex - Central and South is not considered constrained, with over 30% of the pre-European extent remaining. Therefore, the proposed action is there not at variance to this Principle.

### 4.4.6 Impact on any Watercourses or Wetlands

The Site does not intersect any surface water features or wetlands.

The nearest wetland is Camel Swamp (ID: 1354), situated approximately 800 m north of the Site, which is classified as a Resource Enhancement Wetland. The nearest Conservation Category Wetland, Lake Pinjar (ID:13373), is situated approximately 2.2 km east of the Site.

As the proposed action will not impact any watercourses or wetlands, clearing is not at variance with this principle.

### 4.4.7 Potential to Cause Appreciable Land Degradation

The Site will be cleared at a single time, by pushing vegetation to be removed into windows to enable the limestone resource to be extracted. WA Limestone proposes to manage potential impacts associated with clearing and extraction, such as land degradation from erosion, sedimentation, and spread of weeds, through an EMP that applies to both the construction and operation of the proposed action. Specific outcome-based actions to mitigate any potential indirect impacts of the proposed action will be included as part of the EMP, together with monitoring requirements and corrective actions.

The Extractive Industry Licence for the proposed action is conditional on various environmental and rehabilitation conditions, as required by DMIRS. These conditions will be reflected in the EMP. Any contractors engaged to work within the Site will act in accordance with the EMP through contract arrangements.

One Declared Pest species was recorded within the Site, being **Asparagus asparagoides*. Weed hygiene measures will be adopted for the duration of the proposed action to mitigate the risk of spread by this species as well as other introduced and weed species.

As the proposed action is not anticipated to cause appreciable land degradation, clearing is not at variance to this Principle.

### 4.4.8 Potential to Impact the Environmental Values of Adjacent or Nearby Conservation Areas

The Site is situated adjacent to Bush Forever Site 293 (BF 293). A very small portion of the Site intersects with BF 293 within land that has already been cleared for an access track. The intersecting portion of BF 293 is subject to a negotiated planning solution under SPP 2.8 for the purpose of urban, industrial, or resource development. Notwithstanding, as the overlapping portion of BF 293 has already been disturbed and is outside of the area subject to clearing, the proposed action will not impact the environmental values of BF 293.

The nearest area managed for conservation by DBCA is Neerabup National Park, which is situated over 3 km west of the Site. The proposed clearing will therefore not have an impact on the environmental values of the National Park.

Given the above, the proposed clearing is not at variance to this Principle.

### 4.4.9 Potential Deterioration in the Quality of Surface or Underground Water

There are no regionally significant wetlands or watercourses with permanent water within the area of the tenement. The Site does not intersect with any surface water or occur within any Public Drinking Water Source Areas.

The Site is undulating with natural elevations ranging between 82 m and 96 m AHD (DPIRD-072). Groundwater lies at approximately 24 to 27 m below the natural land surface (DWER-100). It is anticipated that limestone will be extracted to a maximum depth of 30 m AHD, remaining approximately 3-5 m above the water table.

Water Quality Protection Note (WQPM) no. 15 (DWER, 2019) requires adequate vertical separation distance between the base of extraction and the highest groundwater level to protect quality and ensure evaporation does not occur, both during and after extraction. Further, WQPN 15 identifies that separation should allow for sufficient clearance to allow accidental fuel spills to be contained in the unsaturated zone for a reasonable period of time, ensure evaporation losses during mining are minimised, and ensure evapotranspiration losses from the rehabilitated mine site do not unacceptably reduce aquifer recharge (DWER, 2019). The proposed separation of 3 to 5 m across the Site is greater than that recommended as a minimum under WQPN 15 (DWER, 2019) and is therefore considered sufficient to avoid impacting groundwater.

Given the separation from groundwater and that there are no surface water or wetland features within the Site, no significant impacts to surface or underground water will result from the proposed clearing. Therefore, clearing is not at variance with this Principle.

### 4.4.10 Potential to Cause, or Exacerbate, the Incidence of Flooding

There are no water bodies or permanently flowing drainage lines located within or around the Site.

According to the NRInfo mapping application (DPIRD, 2022) the Site is not identified as having a risk of flooding, waterlogging, or inundation. In accordance with the existing MCP (to be updated to include the quarry expansion area) the pit will be internally draining. Given the porosity and permeability of the limestone, all stormwater will collect on the porous floor of the pit and infiltrate into the ground, as per all limestone pits.

Given the relatively small amount of clearing required, the permeability of the land, the proposed action is not expected to have a significant impact on natural surface and groundwater processes. The proposal is therefore not likely to cause, or exacerbate, the incidence or intensity of flooding and is not at variance with this Principle.

# 5. Description and Assessment of Potential Impacts to Matters of National Environmental Significance

The EPBC Act seeks to protect matters of national environmental significance (MNES). These are:

- World heritage areas.
- National heritage places.
- Wetlands of international importance (listed under the Ramsar Convention).
- Listed threatened species and ecological communities.
- Listed migratory species (protected under international agreements).
- Commonwealth marine areas.
- Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mines).
- Water resources (in relation to coal seam gas development and large coal mining development).

The Minister for the Environment and Water deemed the proposed action a controlled action (EPBC 2022/09326) based on the potential for significant impact on the following EPBC protected matters:

- Listed threatened species and ecological communities.

The Department considered that the proposed action has the potential to impact the species and communities identified in Table 5-1.

### Table 5-1. MNES Identified as being Potentially Impacted by the Proposed Action

| Species or Community | Conservation Status (EPBC Act) |
|---|---|
| **Carnaby's cockatoo (*Zanda latirostris*)** | Endangered |
| **Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*)** | Vulnerable |
| **Chuditch (*Dasyurus geoffroii*)** | Vulnerable |
| **Yanchep mallee (*Eucalyptus argutifolia*)** | Vulnerable |
| ***Melaleuca* sp. Wanneroo** | Endangered |
| **Banksia Woodlands of the Swan Coastal Plain Ecological Community** | Endangered |

Section 5.1 provides a description of MNES within the proposed action area, and section 5.2 provides an assessment of the proposed impacts. Section 5.3 then summarises the proposed avoidance and mitigation measures that will apply for the duration of the proposed action to achieve an acceptable environmental impact.

## 5.1 Description of MNES within the Proposed Action

This section provides an overview of the MNES within the Site and the likely and potential impacts associated with the proposed action. An assessment of impacts is provided in section 5.2.

### 5.1.1 Carnaby's Black Cockatoo (*Zanda latirostris*)

#### *Abundance, Distribution, and Ecology*

The total population of Carnaby's black cockatoo was estimated at between 11,000 and 60,000 birds in the 1980's (Saunders et al., 1985). In 2010, the population was refined to an estimated 40,000 individuals (DPaW 2013). As of September 2019, the total population of Carnaby's black cockatoo is estimated to be 40,000 individuals, of which at least 13,984 individuals occur in the Greater Perth-Peel Region (Peck et al., 2019).

Carnaby's black cockatoo is endemic to the south west of Western Australia, with a widespread distribution range from Kalbarri in the north-west through to Nuytsland Nature Reserve in the south-east (DAWE, 2022). Breeding takes place between late July and December and most commonly occurs in the inland parts of the species' distribution range, in areas receiving between 300 and 700mm of annual average rainfall (DAWE, 2022).

The majority of the population migrates seasonally, coinciding with breeding, with birds moving to the higher rainfall coastal areas during non-breeding season. On the Swan Coastal Plain, breeding is restricted to isolated pockets around Yanchep, Rockingham, Bunbury and Busselton. Carnaby's black cockatoo breed predominantly in woodland or forest where species such as salmon gum, wandoo, tuart, jarrah, flooded gum, karri and marri are present, although they may also breed in areas of former woodland or forest in isolated trees (DAWE, 2022).

Foraging habitat includes proteaceous woodlands and shrublands typically comprising *Banksia* spp., *Hakea* spp., and *Grevillea* spp., however the traditional diet of mostly native seeds and nectar has changed to include increased amounts of seeds from introduced plant species such as broad-acre crops and plantation pines (DPaW, 2013).

#### *Description of Habitat within the Proposed Action*

A basic (Level 1) fauna assessment, including a black cockatoo habitat assessment, was undertaken by Bamford Consulting Ecologists (2022) on 15 June 2021. The survey area covered a broader area than the Site (as shown on Figure 7). The survey report is provided as Appendix F.

### Foraging Habitat

Bamford (2022) identified 15.06 ha of foraging habitat for Carnaby's black cockatoo within the Site. Of this, 1.79 ha was assessed to have low to negligible foraging value, given the low foliage cover of suitable foraging species (*Banksia sessilis*). In accordance with the habitat quality scoring (HQS) tool developed by DCCEEW (n.d.) areas with a Vegetation Structure and Condition score of 2 or less are considered unlikely to constitute suitable foraging habitat. As such, these areas have been omitted from further discussion. The complete assessment against the HQS is provided as Appendix H.

The Proteaceous Shrubland VSA was assessed as having high quality foraging value under DCCEEW (n.d.) given the presence of *Banksia sessilis* at relatively high density (ranging from 30% to 60%). Extensive evidence of recent and intermediate foraging by Carnaby's black cockatoo was recorded within areas where *B. sessilis* occurred at high density.

The extent and quality of habitat within the Site is summarised in

Table 5-2.

**Table 5-2: Summary of Carnaby's Black Cockatoo Foraging Assessment after Removal of Low Quality Habitat (Bamford, 2020; DCCEEW, n.d)**

| Habitat Description | Area (ha) | Assessed Quality for Carnaby's Black Cockatoo (Combined Site Condition and Site Context) | |
|---|---|---|---|
| | | Bamford (2020) | DCCEEW (n.d.) |
| **Proteaceous shrubland with Banksia sessilis occurring at high density (~30-60%).** | 13.27 | Moderate to High (7) | High (9) |
| **Total Foraging Habitat** | 13.27 | | |

### Roosting and Breeding Habitat

As shown on Figure 14, the nearest confirmed roost site for Carnaby's black cockatoo is approximately 0.9 km southeast of the site (HF18) which has been reported to support up to 604 birds. The next closest is approximately 1.3 km southeast of the Site, which has been reported to support up to 29 birds. The number of birds reported relates to the cumulative total at each roost, as identified in a publicly available dataset managed by DBCA (DBCA-050). There is, however, no existing habitat suitable for roosting within the Site given the absence of tall tree species.

As shown on Figure 14, the Site is located 10 km north of a known breeding site for black cockatoos (DBCA-063). Two confirmed breeding areas are known to occur to the northeast and northwest of the Site (DBCA-054). There is no existing habitat suitable for black cockatoo breeding within the Site, given the complete absence of mature trees of a suitable species (such as jarrah, marri, or tuart) that have the ability to develop hollows suitable for nesting.

The Site does not contain any suitable habitat for roosting or breeding by black cockatoos. The Site lacks tree species such as jarrah, marri, or tuart that could form roosting habitat.

#### Watering Habitat

Proximity of foraging habitat and water resources has been demonstrated to be critical in supporting Carnaby's black cockatoo roosting and breeding sites (Groom, 2011; Le Roux, 2017; Saunders, 1990). In particular, foraging habitat within 7 km of a breeding site is important to adequately support breeding cockatoos. In the Perth-Peel region, individual night roosts require food and water resources within 6 km, wither overlapping foraging ranges within 12 km to supporting roosting sites and maintain habitat connectivity and movement across the landscape.

There are no wetlands, surface water feature, or artificial water bodies intersecting the Site. Therefore, the Site does not provide watering habitat to support foraging, roosting, and breeding habitats in the surrounding area.

#### Regional Importance

Based on mapping of native vegetation extent and vegetation complexes containing species known to provide foraging habitat for Carnaby's black cockatoo, there is approximately 20,873.29 ha of potential foraging habitat available within 12 km of the proposed action, 6,286.75 ha within 6 km, and 472.20 ha within 1 km (Table 5-3).

**Table 5-3. Potential Foraging Habitat for Carnaby's Cockatoo within the Surrounding Area**

| Distance from Proposed Action | Extent of Potential Foraging Habitat (DBCA-057) | Proportion Represented by the Proposed Action (%) |
|---|---|---|
| **1 km radius** | 472.20 ha | 2.81% |
| **6 km radius** | 6,286.75 ha | 0.21% |
| **12 km radius** | 20,873.29 ha | 0.06% |

Considering this, the vegetation within the Site forms part of a network of foraging habitat within 6 km of around 17 confirmed and possible roosting sites. However, given the extent of clearing is relatively small in the landscape context, the foraging habitat within the Site itself is highly unlikely to be critical in supporting the roosts. Instead, the Site contributes to a network of foraging resources of 6,286.75 ha within 6 km and 20,873.29 ha within 12 km.

### 5.1.2 Forest Red-tailed Black Cockatoo (*Calyptorhinchus banksii naso*)

#### *Abundance, Distribution, and Ecology*

As of September 2019, the total population of Forest red-tailed black cockatoo was estimated to be 15,000 individuals (Peck et al. 2019).

Forest red-tailed black cockatoo are characterised by the significant size of their bill (Ford, 1980). They are geographically distinct from other red-tailed black cockatoos, preferring the humid and sub-humid zones of

southwest Western Australia in an area stretching from Gingin in the northeast through to Boxwood Hill in the southeast (DAWE, 2022).

Foraging habitat for the species is made up of almost exclusively marri and jarrah fruits, however the species is known to feed on the fruit of other plants. This species prefers to nest in large hollows of marri, jarrah, and karri trees (Johnstone and Kirkby, 1999). Breeding may occur at any time of the year, with peaks in April to June and August to October (DAWE, 2022).

#### *Description of Habitat within the Proposed Action*

The Site is located at the outer boundary of the known distribution and breeding range of Forest Red-tailed black cockatoo. The species is expected to be an irregular visitor to the area; however, the Site lacks any suitable habitat for the species (Bamford, 2022).

The Site does not provide suitable foraging habitat for Forest Red-tailed black cockatoo due to a lack of feed tree species such as jarrah (*Eucalyptus. marginata*) or marri (*Corymbia calophylla*). There are also no introduced feed tree species present within the Site. Some foraging species occur within the surrounding area.

### 5.1.3 Chuditch (*Dasyurus geoffroii*)

#### *Abundance, Distribution, Ecology and Habitat Preferences*

The Chuditch is a wide-ranging, nocturnal, terrestrial carnivore that feeds primarily on smaller vertebrates (e.g. reptiles, birds and mammals) and large invertebrates (Burbridge, 2004; Van Dyck & Strahan, 2008). At maturity, males weigh an average of 1.3 kg and females an average of 0.9 kg (DEC, 2012). The Chuditch is distinguishable from other mammals within its present range by its white spotted brown pelage, large rounded ears, pointed muzzle, large dark eyes and a non-hopping gait. The tail is about three quarters of the head and body length, and has a black 'brush' over the dorsal surface of the distal portion (DEC, 2012).

During the day, Chuditch shelter in dens within hollow logs or earth burrows (Van Dyck & Strahan, 2008). They are predominately solitary mammals, which occupy relatively large home ranges; with males and females occupying areas of up to 15 $km^2$ and three to four $km^2$ respectively (DEC, 2012).

While the historic distribution of the Chuditch originally extended across approximately 70% of the continent, following the advent of European settlement this range has contracted significantly (DEC, 2012). The major portion of remaining natural populations now occur in jarrah forests and woodlands in the south-west corner of Western Australia, and in woodlands, mallee shrublands and heaths along the south coast to Ravensthorpe (DEC, 2012).

As of 2007, the total population of Chuditch was estimated to be less than 10,000 individuals, of which approximately 75% occurred in the eucalypt forests and woodlands, as well as mallee heath and shrublands of the southwest (DEC, 2012).

Reproduction occurs seasonally, with females entering oestrus in late April to early July. Between two to six young are then reared for approximately 110 days, by which time individuals are fully weaned and ready to disperse (DEC, 2012).

While the average lifespan for established adults is two years (Soderquist, 1988), numerous factors impede the survival of Chuditch in the wild. In the jarrah forest where the project area is located, these include vehicle strike, illegal shooting, predation by foxes, cats and raptors, natural accidents, and disease (DEC, 2012).

### *Description of Habitat within the Proposed Action*

A basic (Level 1) fauna assessment, including a black cockatoo habitat assessment, was undertaken by Bamford Consulting Ecologists (2022) on 15 June 2021. The survey area covered a broader area than the Site (as shown on Figure 7). The survey report is provided as Appendix F. The assessment identified VSAs that provide fauna habitats, assessed the likelihood of occurrence for conservation significant fauna species, and reported any opportunistic fauna observations.

Bamford (2022) identified that given Chuditch is wide-ranging, the species may occur within the Site only as a vagrant. The species was not directly or indirectly observed within the survey area, and the nearest known record was a juvenile male which was caught approximately 10 km to the east in 2004 within dense, riparian vegetation in the Gnangara pine plantation (M. Bamford pers obs.).

The habitat types represented by the Site are not considered of high quality for Chuditch. The Chuditch National Recovery Plan (DEC, 2012) states that it is not possible to list a set of characteristic habitats that should be preserved for Chuditch, given their historic presence in a vast range of habitats. However, vegetation that contains dense stands of large mature trees may be more suitable than vegetation that does not. This is due to the contraction of their historic range to the larger forest stands to the south and east of Perth as well as the species' requirement for adequate den resources (predominantly hollow logs) and shelter from invasive predators (DEC, 2012). This is consistent with the nearest known record of the species within dense riparian vegetation in the Gnangara pine plantation.

The Site itself lacks mature, tall trees and is within an area where existing quarry operations are likely to preclude the species from occurring in the local area. Given this, however recognising that the species may occur on occasion as a vagrant to the Site, 15.06 ha of habitat with low importance for the species is considered to be present.

### *Regional Importance*

Given the historic presence of Chuditch over a vast range of habitats (DEC, 2012), it is difficult to accurately identify the regional extent of Chuditch habitat. There is also no statewide or regional Chuditch habitat mapping available. Given that Chuditch have been recorded more frequently within larger forest stands to the south and east of Perth as well as the species' requirement for adequate den resources and shelter (DEC, 2012), for the purpose of this report, the regional extent of remnant native vegetation is considered to potentially provide Chuditch habitat. There are approximately 27,298 ha within 15 km of the Site (DPRID, 2023). Therefore, the Site comprises 0.06% of the local native vegetation and potential Chuditch habitat.

### 5.1.4 Yanchep Mallee (*Eucalyptus argutifolia*)

#### *Abundance, Distribution, Ecology and Habitat Preferences*

*Eucalyptus argutifolia* (Yanchep Mallee) is a mallee to 4 m tall, with smooth, grey to pale coppery bark (DEWHA, 2008). The species flowers from March to April, and differs from its close relative Dongara Mallee (*E. obtusiflora*) in its rounder juvenile leaves, broader glossy green adult leaves with fewer oil glands, and non-glaucous buds and fruit with shorter, stouter pedicels (Grayling & Brooker, 1992; Brown et al., 1998).

Yanchep Mallee is endemic to Western Australia, where it is found between Wanneroo and Guilderton in the Perth area, and at Lake Clifton near Mandurah. It is known from 18 populations, seven of which occur in State Forest, two in unallocated Crown land and nine on private property. The number of plants is estimated to be 730. Thirteen of the 18 populations had surveys undertaken in 2006 and of these, half of the populations showed a decline in plant numbers and the other half showed an increase in plant numbers.

Yanchep Mallee grows on slopes or gullies close to the summits of limestone ridges, where soils are shallow, well drained and grey with outcrops of limestone. Vegetation in association includes heath of Parrotbush (*Banksia sessilis*) and Chenille Honey-myrtle (*Melaleuca huegelii*) (Grayling & Brooker, 1992; Brown et al., 1998; DEC, 2008). This species occurs within the Swan and South West (Western Australia) Natural Resource Management Regions. The distribution of this species overlaps with the "Sedgelands in Holocene dune swales of the southern Swan Coastal Plain" EPBC Act-listed threatened ecological community (DEWHA, 2008).

The extent of occurrence of Yanchep Mallee is 1,940 km$^2$. The approved conservation advice states that whilst insufficient data are available to determine any trends in population size or area of occupancy, it is considered that given the species occurs on a substrate that is commonly mined it is likely that the area of occupancy will decline in future (DEWHA, 2008). Insufficient data are available to determine any trends in population or area of occupancy, however, given that the species occurs on a substrate that is commonly mined, it is likely that the area of occupancy will decline in the future (DEC, 2008).

#### *Description of Habitat/Individuals within the Proposed Action*

A detailed flora and vegetation assessment was undertaken by PGV Environmental (2021) over the Site on the 14th and 15th of September 2020. The survey area covered a broader area than the Site and is shown in Figure 6.

Information on flora composition and vegetation structure was recorded in thirteen 10 m by 10 m non-permanent quadrats within representative vegetation types. PGV (2021) identified relatively low variation in the main vegetation types and considered that the survey effort would have recorded a very high percentage of the plant species that occur within the survey area. PGV (2021) noted that several vegetation types were mapped as separate units but were very similar in terms of structure and composition. The number of quadrats was therefore considered sufficient to describe the variation in vegetation over the survey area.

The PGV (2021) report is provided in Appendix C and the key findings are summarised in Section 3.6.3 to 3.6.5.

A follow-up survey targeting conservation significant flora species that have the potential to occur within the Site was completed in 2023 (WEPL, 2024). The targeted search covered the vegetation type MsAt which, of the habitat present within the Site, was the most likely to comprise suitable habitat for *E. argutifolia*. The Site, however, lacks limestone ridges and gullies with which *E. argutifolia* has a very strong habitat association. No individuals were located during the search, and none are expected to occur. The nearest occurrences are approximately 40 m north and east of the Site.

### 5.1.5 *Melaleuca* sp. Wanneroo

#### *Abundance, Distribution, Ecology and Habitat Preferences*

*Melaleuca* sp. Wanneroo (G.J. Keighery 16705) is an erect shrub up to 2.5 m tall and 2-3 m wide with a grey furrowed bark. It flowers between late November and late December, developing numerous terminal inflorescences of yellow colour. Branchlets grow out once flowering is finished.

*Melaleuca* sp. Wanneroo (G.J. Keighery 16705) occurs on limestone ridges 35 km north of Perth, WA within the area of Nowergup. Its subpopulations are scattered occurring across an area that spans from 3.3 km in an east to west direction and 3.0 km north to south. He region has been extensively cleared.

The species is known to occur alongside *Melaleuca systena*, often forming part of the *M. systena* complex. It differs from *M. systena* in its longer and wider hairy, non-crowded leaves with a flat rather than a triquetrous cross-section, less prominent oil glands and blunt-acute rather than acute tips. *M. systena* subsp. Kemerton differs by being taller (3-5 m), glabrous leaves, terete with a long pungent point, lacking oil glands (Threatened Species Scientific Committee [TSSC], 2019).

The extent of occurrence of *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) is 12 km$^2$, consisting of two populations. The approved conservation advice anticipates a potential population decline of 71% with a potential decline of 21% occurring within two generations (TSSC, 2019). Given its occurrence on high quality limestone resources, mining is considered the biggest threat to the species, followed by bushfires, clearing, habitat degradation from feral goat grazing and isolation.

#### *Description of Habitat and/or Individuals within the Proposed Action*

A targeted search was undertaken by WEPL on 7th December 2023 within the flowering period of *Melaleuca* sp. Wanneroo (late November to early December) (TSSC, 2019). Given *Melaleuca* sp. Wanneroo has a very strong habitat association with limestone ridges, and occurs alongside the common *Melaleuca systena*, the survey area was limited to vegetation type MsAt which comprised the only potentially suitable habitat within the Site.

A known subpopulation occurring within Lot 8 Wattle Avenue West was visited earlier on the same day to confirm the suitability of the survey. The known subpopulation was observed in full flower and could be easily identified in the field alongside *Melaleuca systena* which had finished flowering (WEPL, 2024). Additionally, given the ability to observe the limestone ridges via a low-flying drone, WEPL (2024) flew a drone over the Site to identify any other potentially suitable habitat. One other potentially suitable area was identified and

inspected on foot; however, this was found to be a man-made stockpile of limestone rather than a naturally occurring ridge and was therefore not suitable habitat for the species.

No *Melaleuca* sp. Wanneroo individuals were recorded within the Site, and none are considered to occur.

### 5.1.6 Banksia Woodlands of the Swan Coastal Plain Ecological Community

#### *Abundance, Distribution, Ecology and Habitat Preferences*

Banksia woodlands of the Swan Coastal Plain is an ecological community associated with the Swan Coastal Plain of southwest Western Australia. A key diagnostic feature is a prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among or emerging above the Banksia canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range.

The ecological community is located in the southwest of Western Australia, which is recognised as a global biodiversity hotspot (Hopper and Gioia, 2004). The ecological community is largely restricted to the Perth (SWA02) and Dandaragan (SWA01) subregions of the Swan Coastal Plain IBRA bioregion, from around Jurien Bay in the north to Dunsborough in the south.

#### *Description of Habitat and/or Individuals within the Proposed Action*

One patch of Banksia Woodlands of the Swan Coastal Plain was recorded by PGV (2021) in the eastern portion of the survey area (outside of the Site). The patch is 40 m from the boundary of the proposed action at its closest point. The location of the TEC/PEC in relation to the proposed action is shown on Figure 10.

## 5.2 Assessment of Impacts to MNES

### 5.2.1 Carnaby's Cockatoo (*Zanda latirostris*)

#### *Direct Impacts - Quantum and Quality of Habitat and Number of Individuals or Habitat Values*

*Banksia sessilis* is the dominant foraging species within the Site and is considered a mainstay of the Carnaby's black cockatoo diet (Bamford, 2022). Foraging evidence was recorded throughout the Site, primarily within the proteaceous shrubland habitat type where *Banksia sessilis* was reported to occur at a relatively high density.

The Site contains 13.27 ha of high quality Carnaby's black cockatoo foraging habitat. The Site does not provide any suitable habitat for roosting or breeding by Carnaby's cockatoo given the complete absence of tree species with the potential to reach a suitable height or DBH to form nesting hollows.

Direct impacts to Carnaby's black cockatoo are summarised in Table 5-5.

As the temporary removal of up to 13.27 ha of foraging habitat for Carnaby's black cockatoo cannot be avoided, and the extent of clearing has been reduced as far as possible (see section 4.2), the proposed action

is considered to result in a significant residual impact to the species that requires an appropriate environmental offset. WA Limestone have identified a potential offset site that meets both State and Commonwealth requirements. Details of the proposed offset strategy are summarised in section 6.

### *Indirect and Consequential Impacts*

There is a potential for indirect, consequential, and cumulative impacts to arise from the proposed action during vegetation clearing and ongoing operation.

Indirect and consequential impacts may include:

- Uncontrolled access to areas of retained vegetation adjacent to the proposed action.
- Degradation of surrounding habitat due to weed introduction and spread.
- Negative species interactions (i.e. increased predation).
- Changes to hydrology indirectly affecting adjacent foraging habitat.
- Changes to fire regime.
- Dust, light, vibration, noise emissions.

Management measures will be implemented during the clearing and operational phases to ensure the risk of these indirect impacts occurring is minimised as far as possible. These will be enacted through the preparation and implementation of an EMP. A summary of these measures is provided in Table 5-5.

### *Cumulative Impacts*

In the context of the surrounding landscape, there is an estimated 472.20 ha of potential foraging habitat for Carnaby's black cockatoo within the immediate vicinity (1 km radius) of the Site, 6,022.98 ha within the local area (6 km radius), and 19,095.93 ha within the broader region (12 km radius). The extent of foraging habitat within the Site therefore represents approximately 2.84% of that within the immediate, 0.22% of that within the local area, and 0.07% of that within the broader region.

Based on mapping of native vegetation extent and vegetation complexes containing species known to provide foraging habitat for Carnaby's black cockatoo, there is approximately 20,873.29 ha of potential foraging habitat available within 12 km of the proposed action, 6,286.75 ha within 6 km, and 472.20 ha within 1 km (Table 5-4).

**Table 5-4. Potential Foraging Habitat for Carnaby's Cockatoo within the Surrounding Area**

| Distance from Proposed Action | Extent of Potential Foraging Habitat (DBCA-057) | Proportion Represented by the Proposed Action (%) |
|---|---|---|
| **1 km radius** | 472.20 ha | 2.81% |
| **6 km radius** | 6,286.75 ha | 0.21% |

| Distance from Proposed Action | Extent of Potential Foraging Habitat (DBCA-057) | Proportion Represented by the Proposed Action (%) |
|---|---|---|
| **12 km radius** | 20,873.29 ha | 0.06% |

Considering this, the vegetation within the Site forms part of a network of foraging habitat within 6 km of around 17 confirmed and possible roosting sites. However, given the extent of clearing is relatively small in the landscape context, the foraging habitat within the Site itself is highly unlikely to be critical in supporting the roosts. Instead, the Site contributes to a network of foraging resources of 6,286.75 ha within 6 km and 20,873.29 ha within 12 km, of which 99.8% and 99.9% will remain following the clearing associated with the proposed action, respectively.

Approximately 60.7% and 40.5% of the potential foraging habitat within 6 km and 12 km is within lands managed by DBCA, respectively. The majority of this is within Gnangara-Moore River State Forest, providing 6,015.98 ha (31.5%) of potentially suitable habitat within 12 km of the Site. When considering land reserved and managed for conservation, a considerable amount of habitat is protected within Neerabup National Park with approximately 1,118.35 ha (5.9%) within 12 km of the Site.

### *Avoidance and Mitigation*

The Potential indirect and consequential impacts to Carnaby's black cockatoo habitat are summarised in Table 5-5.

**Table 5-5: Summary of Direct and Indirect Impact to Carnaby's Black Cockatoo by the Proposed Project**

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| **Direct** | Habitat loss leading to population decline /local extinction | Minor (<1% decline in habitat extent within 12 km). | The proposed action will result in the temporary removal of 13.27 hectares of foraging habitat for Carnaby's black cockatoo. The habitat was assessed as high quality under DCCEEW (n.d.).<br>There is an estimated 20,873.29 ha of suitable foraging habitat within a 12 km radius of the proposed action, based on the extent of native vegetation of complexes that contain known foraging species.<br>The removal of 13.27 ha of foraging habitat will reduce the extent of habitat in a 12 km radius by approximately 0.06%.<br>Following the completion of quarrying activities, the entirety of the Site will be rehabilitated in accordance with the MCP (which will be expanded to include the proposed action). This will ensure the Site provides foraging habitat at an equivalent extent and quality to what currently exists. | The project area originally considered for expansion was surveyed by PGV (2021). As a result, the Site for the proposed action was limited to areas that did not contain threatened flora or threatened ecological communities. In doing so, the extent of proposed impact to Carnaby's black cockatoo was reduced from 28.64 ha to 13.27 ha.<br>Habitat for Carnaby's black cockatoo will be returned to the area following the cessation of extractive activities in accordance with the MCP. The objective of rehabilitation will be to return foraging habitat for the species to an equivalent extent and quality to what is proposed to be impacted. |
| **Direct** | Vegetation clearing resulting in injury or mortality to fauna within the Site | Moderate | There is a risk of mortality to Carnaby's black cockatoo during clearing activities, in an unmanaged scenario. | Measures will be applied prior to and during clearing activities to minimise the risk of impacting fauna (including black cockatoos) both within and adjacent to the proposed action.<br>The area to be cleared will be clearly demarcated to avoid unauthorised clearing and potential impacts to fauna in the neighbouring areas. Measures to avoid accidental unauthorised clearing shall include:<br>• Provision of GPS co-ordinates of areas approved to be cleared and retained to the contractor(s). |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | | | | • Clearly demarcate clearing boundaries with tagging and/or fencing and communicating those areas to clearing personnel prior to activities commencing.<br>• Restrict access to retained vegetation.<br>• Install appropriate signage to restrict unauthorised access to retained areas.<br>• Ensure no machinery, equipment or laydown areas are located within areas of native vegetation to be retained.<br><br>Fauna management measures shall also be applied, including:<br>• All construction personnel taking due care to avoid injury to fauna and maintain low speed limits.<br>• Report to the Site Supervisor in the event that fauna is struck by a vehicle or machinery.<br>• Personnel to observe, but not handle, injured fauna until a suitably qualified person can attend to the animal.<br>• Maintain a fauna interaction register to capture observations and interactions with fauna.<br>• All excavations must have adequate egress to fauna that may become trapped.<br>An EMP will be developed that includes all measures that must be taken during construction and operation of the proposed action to minimise the risk of directly impacting individuals.<br><br>The residual risk posed to Carnaby's black cockatoo by the proposed action is considered Minor, recognising the avoidance and mitigation measures described. |
| **Direct** | Operation of vehicles and machinery | Moderate | There is a risk of ongoing mortality arising through the operational phase of the proposed action, for example through vehicle or machinery strike.. | Fauna management measures shall be applied throughout the operation of the proposed action, including: |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | resulting in injury or mortality to fauna within the Site. | | | • All construction personnel taking due care to avoid injury to fauna and maintain low speed limits.<br>• Report to the Site Supervisor in the event that fauna is struck by a vehicle or machinery.<br>• Personnel to observe, but not handle, injured fauna until a suitably qualified person can attend to the animal.<br>• Maintain a fauna interaction register to capture observations and interactions with fauna.<br>• All excavations must have adequate egress to fauna that may become trapped.<br>• An EMP will be developed that includes all measures that must be taken during construction and operation of the proposed action to minimise the risk of directly impacting individuals.<br><br>The residual risk posed to Carnaby's black cockatoo by the proposed action is considered Minor, recognising the avoidance and mitigation measures described. |
| **Indirect (ecosystem function)** | Fragmentation of an existing population | Negligible | Carnaby's black cockatoo is a strong-flying species known to cross large areas of open land and to move through built environments to access feeding areas. As a result, the proposed quarry extension is unlikely to result in fragmentation of existing populations. | Following the completion of excavation and quarry operations, the Site will be rehabilitated and revegetated to provide foraging habitat of a comparable quality and extent to what is proposed to be removed. Rehabilitation will be undertaken in accordance with the MCP, which will be extended to cover the Site. |
| **Indirect (ecosystem function)** | Degradation of surrounding habitat due to weed invasion | Minor | The extension of the Wattle Ave East mine site will result in all native vegetation being cleared from the Site. There is a risk of weed introduction and spread to neighbouring, retained native vegetation through clearing activities and the disturbance that results. | Standard hygiene measures will be implemented for the duration of clearing for and operation of the proposed action. These measures include:<br>• All vehicles and machinery are to be cleaned down of all soil and vegetation prior to arriving on site. |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | | | It should be noted, however, that weed occurrence in the Site is very low, with the majority of vegetation being in Excellent condition. Recognising the existing quarry operations adjacent to the Site, and the Excellent condition vegetation within the Site, the existing clearing and quarrying operations do not appear to have had a measurable impact on vegetation condition including through the spread of weeds. The operation of the proposed action will be consistent with the existing quarrying operations. As such, degradation of surrounding vegetation through factors such as weeds is not expected to result from the proposed action.<br><br>Notwithstanding, strict controls will be put in place to ensure clearing and vegetation disturbance does not occur beyond the approved clearing boundaries, and that hygiene measures will be implemented for the duration of the proposed action to avoid the spread of weeds. | • All imported landscaping soil or other potential weed mediums are certified as weed free sources prior to arrival on site.<br>• Any weed-contaminated topsoil must be stockpiled separately and sign-posted.<br>• Spot-spraying and/or hand weeding may be required within retained vegetation if weeds are found to have spread to neighbouring areas. |
| **Indirect (ecosystem function)** | Species interactions (i.e. increased predation). | Negligible | Not relevant to Carnaby's black cockatoo. Existing feral management procedures will continue to be implemented. | To avoid attracting predatory, feral animals to the Site, housekeeping shall be maintained and no fauna shall be fed on site. In addition, no domestic animals will be permitted within the Site. |
| **Indirect (ecosystem function)** | Changes to hydrology | Negligible | There is negligible risk of Carnaby's black cockatoo through altered hydrology.<br><br>There are no surface water features or geomorphic wetlands within the Site.<br><br>Limestone is very porous and, as with all limestone quarries, surface water will infiltrate through the pit floor. The pit floor will remain approximately 3 to 5 m | The pit floor will remain at least 3 m above the groundwater level, consistent with WQPN 15 which recommends a buffer of at least 2 m. |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | | | above the groundwater level, ensuring there is adequate separation at all times.<br><br>No excavation will occur beyond the groundwater level. As such, the potential for hydrogeological change and indirect impacts to black cockatoo habitat are extremely minor. | |
| **Indirect (ecosystem function)** | Changes to fire regime | Negligible | No changes to the fire regime are expected to result from the proposed action. Surrounding habitat (outside of the Site, but within the mining tenement M 70/143) can be managed with existing fire management protocols. | Existing fire management and suppression around the mining tenement M 70/143. |
| **Indirect (ecosystem function)** | Dust, light, vibration, noise | Negligible | Not relevant to Carnaby's black cockatoo as the species is very tolerant to noise and light in urban environments. | Application of dust suppression during all clearing activities to minimize dust emissions, particularly during windy conditions. |

### *Rehabilitation*

Following the completion of quarry operations, the Site will be rehabilitated and revegetated to return suitable habitat for Carnaby's black cockatoo as required by MCP commitments. An approved MCP exists for the Wattle Avenue East Quarry that will be revised to include the proposed action.

The MCP includes specific details on how and when topsoils, vegetation fragments, and overburden will be removed, stored, and returned to the Site to facilitate landform restoration and revegetation.

The MCP identifies several objectives relevant to rehabilitation, including:

- Rehabilitation vegetation will be a sparse cover of local native vegetation on the perimeter dunes and islands to match the pre-excavation habitat.
- Rehabilitated areas will form a sustainable habitat that will be capable of improving with time as vegetation growth continues.
- The rehabilitated vegetation will have similar resilience to the adjoining vegetation.
- Soil properties will be appropriate to sustaining revegetated local native species.
- Revegetation will be free from Declared or Environmental weeds that could compromise the success of the revegetation or spread into adjoining native vegetation.
- The Mine Closure Plan identifies several completion criteria relevant to rehabilitation, including:
- All species used in rehabilitation are to be local provenance species suited to limestone ridges. Species are to mimic FCT 26a, 28 and 24 on sand. A plant density that is variable but with an average plant density of 100 plants per 100 $m^2$.
- Habitat values increase with time, measured by soil development, soil litter increases, increased plant matter, cover, vegetation, structure, and habitat niches.
- The vegetation is to include a mixture of species that grow in local, limestone substrates and be resilient to fire or readily regenerate following fire.
- The soils are to be constructed from overburden overlain by topsoil, leaf litter, and vegetation fragments as available in areas of native vegetation.

Revegetation will focus on re-establishing locally native species with a focus on Proteaceous species that provide foraging resources for black cockatoos of equal or greater quality than that being impacted by the proposed action. Revegetation will focus on establishing *Banksia sessilis* and other similar species to reinstate the current dominant overstorey and provide foraging habitat in the long term.

### *Assessment against MNES Significant Impact Guidelines*

The potential impacts of the proposed action have been assessed against the Significant Impact Guidelines 1.1 (DoE, 2013) as summarised in Table 5-6.

**Table 5-6: Assessment of Likely and Potential Impacts to Carnaby's Cockatoo against the Significant Impact Guidelines**

| Significance Criteria Under Guidelines 1.1 | Description and Assessment of Impact |
|---|---|
| **Lead to a long-term decrease in the size of a population (or an important population).** | **Not significant.**<br><br>The temporary removal of up to 13.27 ha of high quality foraging habitat for Carnaby's black cockatoo (without any potential for roosting or breeding) is not expected to lead to a long-term decrease in the size of a population. Removal of 13.27 ha represents only 0.06% of the estimated potential foraging habitat within 12 km of the proposed action, being 20,873.29 ha. Of that 20,873.29 ha, approximately 40.5% occurs within land managed by DBCA.<br><br>Additionally, the Site contributes to a network of foraging habitat within the immediate vicinity (1 km radius) where there is approximately 472.20 ha of native vegetation comprising suitable habitat. Clearing for the proposed action would reduce this by only 2.84%, leaving considerable foraging resources.<br><br>Further, clearing for the proposed action will be temporary in nature. The Site will be rehabilitated following the cessation of extraction activities in accordance with an approved MCP.<br><br>Carnaby's black cockatoo are highly mobile, and are expected to forage outside of the Site, and are not dependent on a particular patch of foraging habitat within the proposed action area. In addition, the proposed action will not require the clearing of any known, potential, or future breeding or roosting habitat.<br><br>Therefore, despite the proposed action requiring the temporary removal of 13.27 ha foraging habitat, no long-term decrease in the size of any Carnaby's black cockatoo population is expected to result. This is due to the habitat within the Site being relatively small in relation to that in the surrounding area, habitat connectivity persisting in the absence of the vegetation to be removed, and that habitat will be restored within a 20-year period. |
| **Reduce the area of occupancy of the species (or an important population).** | **Not significant.**<br><br>The temporary loss of 13.27 ha foraging habitat for Carnaby's black cockatoo is likely to preclude the species from occurring immediately within the Site only.<br><br>The Site contributes to a network of 458.79 ha foraging habitat within a 1 km radius, with the proposed clearing to reduce this temporarily by 2.84%. The area will be rehabilitated and revegetated following the completion of mining, with the objective to return foraging habitat to an equivalent extent and quality to what is proposed to be removed.<br><br>The proposed action will result in a temporary and localised reduction in suitable habitat. It is evident that current quarry |

| Significance Criteria Under Guidelines 1.1 | Description and Assessment of Impact |
|---|---|
| | operations in the area immediately adjacent to the Site do not inhibit Carnaby's black cockatoo from utilising the habitat within, with extensive foraging residue recorded of recent to intermediate age. Therefore, the extent of impact is limited to the 13.27 ha of vegetation within the Site.<br><br>Habitat is expected to be restored to the Site within a 20-year period, in accordance with the MCP. |
| **Fragment an existing population (or important population) into two or more populations.** | **Not significant.**<br><br>The proposed action will not result in any existing populations of Carnaby's black cockatoo being fragmented into two or more populations.<br><br>Carnaby's black cockatoo is a strong flying species known to cross large areas of open land and to move through built environments to access feeding areas.<br><br>Given the proposed action will only reduce local foraging resources (within 1 km radius by 2.84% and habitat connectivity will be maintained with known foraging habitat, the impact is not considered significant. |
| **Adversely affect habitat critical to the survival of a species.** | **Potentially significant.**<br><br>As outlined in the Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan (DPaW, 2013) habitat critical for the survival of the species is defined as:<br><br>• The eucalypt woodlands that provide nest hollows used for breeding, together with nearby vegetation that provides feeding, roosting, and watering habitat hat supports successful breeding.<br>• Woodland sites known to have supported breeding in the past and which could be used in the future, provided adequate food and/or water resources are available or re-established.<br>• In the non-breeding season, the vegetation that provides food resources as well as the sites for nearby watering and night roosting that enable the cockatoos to effectively utilise the available food resources.<br><br>There is a high risk of significant impact where a proposed action will involve the clearing of more than 1 ha of quality foraging habitat (DAWE, 2022). The area to be impacted by the proposed action supports foraging habitat only, with 13.27 ha high quality foraging habitat proposed to be removed.<br><br>While the proposed action seeks to remove only foraging habitat that does not provide potential breeding or roosting habitat, the habitat may be considered critical under the definition provided by DPaW (2013) given the presence of food resources and watering habitat within 2 km. |

| Significance Criteria Under Guidelines 1.1 | Description and Assessment of Impact |
|---|---|
| | On this basis, the proposed action may, temporarily, adversely affect habitat critical to the survival of the species. |
| **Disrupt the breeding cycle of a population (or important population).** | **Not significant.**<br>The Site is situated approximately 10 km north of a known breeding site, and the species is also known to breed to the north.<br>the Site provides foraging habitat likely to support nearby breeding, within a network of foraging resources. The Site contributes 0.21% of foraging resources within the surrounding 6 km and 0.06% of that within the surrounding 12 km.<br>The proposed impact will impact a very small proportion of foraging habitat that may support a few breeding pairs within the area, during the non-breeding season. The foraging habitat will be returned within approximately 20-years.<br>The proposed action is unlikely to disrupt the breeding cycle of any population. |
| **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.** | **Not significant.**<br>The proposed action will necessitate the removal of 13.27 ha of foraging habitat for Carnaby's black cockatoo. This will reduce the availability of foraging resources within 1 km, 6 km, and 12 km of the Site by 2.84%, 0.21%, and 0.06%, respectively. The scale of habitat loss is therefore considered small in the landscape context, and habitat connectivity to surrounding patches will persist following clearing. Further, approximately 60.7% and 40.5% of the foraging habitat within 6 km and 12 km, respectively, is within land managed by DBCA.<br>The Site will be rehabilitated following the cessation of extraction activities and will return foraging habitat of a similar type and quality within a 20-year period.<br>Therefore, the proposed action is unlikely to significantly modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline. |
| **Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat.** | **Not significant.**<br>Feral species such as feral cats and foxes are likely to be occur within the region. The proposed action will result in increased disturbance within the area as well as increased vehicular and human traffic. This may cause greater numbers of feral animals, which will be managed through the implementation of an EMP for the duration of the clearing, operational, and rehabilitation phases.<br>The spread of weeds with the potential to impact Carnaby's black cockatoo foraging habitat in neighbouring areas will be managed through hygiene measures throughout clearing and operation. |
| **Introduce disease that may cause the species to decline.** | **Not significant.**<br>The proposed action will result in disturbance to land nearby to existing Carnaby's black cockatoo habitat. Increased vehicular and human traffic, and the movement of vegetative matter may result |

| Significance Criteria Under Guidelines 1.1 | Description and Assessment of Impact |
|---|---|
| | in the introduction and spread of disease if not mitigated. An EMP including hygiene measures will be implemented for the duration of the clearing, operational, and rehabilitation phases. |
| **Interfere with the recovery of the species.** | **Not significant.**<br>The proposed action is not inconsistent with any objectives or actions of the Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan (DPaW, 2013). |

As a result of the assessment detailed in Table 5-6, it is likely that the proposed action will result in a significant residual impact to Carnaby's black cockatoo through the temporary loss of 13.27 ha of foraging habitat. As such, an environmental offset is proposed, as detailed in Section 6.

### 5.2.2 Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)

Whilst Forest red-tailed black cockatoo is known to occur within the area of the proposed action, the Site does not provide any suitable foraging, roosting, or breeding habitat for the species.

The proposed action will therefore not result in any direct or indirect impacts to Forest red-tailed black cockatoo.

#### *Direct Impacts - Quantum and Quality of Habitat and Number of Individuals or Habitat Values*

No direct impacts to Forest red-tailed black cockatoo have been identified.

#### *Indirect and Consequential Impacts*

Given the absence of Forest red-tailed black cockatoo habitat within or surrounding the Site, no indirect impacts will arise through the proposed action.

#### *Cumulative Impacts*

The proposed action will not contribute cumulative impacts to Forest red-tailed black cockatoo.

#### *Avoidance and Mitigation*

No mitigation measures are proposed as the proposed action will not cause any direct or indirect impacts to forest red-tailed black cockatoo within the Site.

The risk of indirect impacts arising through the clearing and extraction phases of the proposed action on surrounding areas will be mitigated through measures including:

- Clearly demarcating approved clearing areas on-site and providing digital boundaries to appropriate personnel, and educating all on-site personnel of areas to be impacted and avoided.
- Maintaining at least a 2-metre buffer between the floor of excavation and the water table, in accordance with Water Quality Protection Note 15 (Link #3) to ensure there are no direct or indirect impacts to groundwater and consequential impacts to groundwater dependent vegetation.

- Undertaking directional clearing from areas adjacent to existing quarry operations to the eastern and western outside boundaries of the disturbance footprint area in order to encourage fauna to move into adjacent vegetation.
- Dust suppression during all clearing activities to minimize dust emissions, particularly during windy conditions.
- Applying of standard hygiene protocols to minimize the risk of introducing or spreading weeds or pathogens to neighbouring vegetation.

### *Assessment against MNES Significant Impact Guidelines*

The potential impacts to Forest red-tailed black cockatoo have been assessed in accordance with the Significant Impact Guidelines 1.1 (DoE, 2013) as summarised in Table 5-7.

**Table 5-7: Assessment of Likely and Potential Impacts to Forest Red-tailed Black Cockatoo against the Significant Impact Guidelines**

| Significance Criteria Under Guidelines 1.1 | Likelihood of Impact and Rational |
|---|---|
| **Lead to a long-term decrease in the size of a population (or an important population).** | **No impact.**<br>Forest red-tailed black cockatoo may be present in the area, on occasion, however no suitable habitat for foraging, roosting or breeding is present within the Site.<br>As there will be no direct or indirect impacts to the species, the proposed action will not cause a decline in any important population. |
| **Reduce the area of occupancy of the species (or an important population).** | **No impact.**<br>Loss of the native vegetation will not alter the local distribution and abundance of the Forest red-tailed black cockatoo, as the Site does not provide any suitable habitat for the species. The species is likely to occur in areas of habitat surrounding the Site that will not be impacted by the proposed action and remain irregular visitors to the area. |
| **Fragment an existing population (or important population) into two or more populations.** | **No impact.**<br>The proposed action will not cause fragmentation to any population of the species. Forest red-tailed black cockatoo is a strong-flying species known to cross large areas of open land and to move through built environments to access feeding areas. As the proposed action does not constitute habitat for the species, no additional habitat fragmentation will result. |
| **Adversely affect habitat critical to the survival of a species.** | **No impact.**<br>The proposed action does not provide any suitable habitat for the species. Therefore, the proposed action will not adversely affect any habitat critical to the survival of the species. |
| **Disrupt the breeding cycle of a population (or important population).** | **No impact.**<br>The Site does not provide any breeding habitat for the species, or foraging habitat that may support breeding habitat in the surrounding area. |

| Significance Criteria Under Guidelines 1.1 | Likelihood of Impact and Rational |
|---|---|
| | Therefore, the proposed action will not disrupt the breeding cycle of any population of the species. |
| **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.** | **No impact.**<br>The Site does not provide foraging, breeding or roosting habitat for Forest red-tailed black cockatoo and will therefore not modify, destroy, isolate, or decrease the availability or quality of any habitat for the species. |
| **Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat.** | **No impact.**<br>Feral species such as feral cats and foxes are likely to be occur within the region. The proposed action will result in increased disturbance within the area as well as increased vehicular and human traffic. This may cause greater numbers of feral animals, which will be managed through the implementation of an environmental management plan for the duration of the clearing, operational, and rehabilitation phases. Given the absence of suitable habitat for Forest red-tailed black cockatoo, the species is unlikely to occur within the Site for extended periods. Therefore, no increased risk of predation by feral animals is expected.<br>The spread of weeds with the potential to impact habitat in neighbouring areas will be managed through the implementation of standard hygiene measures. It should be noted, however, that the adjacent area also lacks quality foraging habitat for the species. |
| **Introduce disease that may cause the species to decline.** | **Impact possible.**<br>The proposed action may result in limited disturbance to land nearby to existing Forest red-tailed black cockatoo habitat, however habitat in neighbouring areas appear to lack quality habitat. Increased vehicular and human traffic, and the movement of vegetative matter may result in the introduction and spread of disease if not mitigated. An EMP including hygiene measures will be implemented for the duration of the clearing, operational, and rehabilitation phases. |
| **Interfere with the recovery of the species.** | **No impact.**<br>The proposed action is not inconsistent with any objectives or actions of the Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinnii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan (DEC, 2008) as it avoids any direct or indirect impacts to the species. |

As detailed in Table 5-7, no significant residual impacts to Forest red-tailed black cockatoo will result from the proposed action.

### 5.2.3 Chuditch (*Dasyurus geoffroii*)

#### *Direct Impacts - Quantum and Quality of Habitat and Number of Individuals or Habitat Values*

The following potential direct impacts to Chuditch have been identified:

- Clearing of 15.06 ha of habitat with low importance for the species.

Bamford (2022) identified that given Chuditch is wide-ranging, the species may occur within the Site only as a vagrant. The species was not directly or indirectly observed within the survey area, and the nearest known record was a juvenile male which was caught approximately 10 km to the east in 2004 within dense, riparian vegetation in the Gnangara pine plantation (M. Bamford pers obs.).

The habitat types represented by the Site are not considered of high quality for Chuditch. The Chuditch National Recovery Plan (DEC, 2012) states that it is not possible to list a set of characteristic habitats that should be preserved for Chuditch, given their historic presence in a vast range of habitats. However, vegetation that contains dense stands of large mature trees may be more suitable than vegetation that does not. This is due to the contraction of their historic range to the larger forest stands to the south and east of Perth as well as the species' requirement for adequate den resources (predominantly hollow logs) and shelter from invasive predators (DEC, 2012). This is consistent with the nearest known record of the species within dense riparian vegetation in the Gnangara pine plantation.

The Site itself lacks mature, tall trees and is within an area where existing quarry operations are likely to preclude the species from occurring in the local area. Given this, however recognising that the species may occur on occasion as a vagrant to the Site, 15.06 ha of habitat with low importance for the species is considered to be present.

### *Indirect and Consequential Impacts*

There is a potential for indirect, consequential, and cumulative impacts to arise from the proposed action during vegetation clearing and ongoing operation.

Indirect and consequential impacts may include:

- Uncontrolled access to areas of retained vegetation adjacent to the proposed action.
- Degradation of surrounding habitat due to weed introduction and spread.
- Negative species interactions (i.e. increased predation).
- Changes to hydrology indirectly affecting adjacent habitat.
- Changes to fire regime.
- Dust, light, vibration, noise emissions.

Management measures will be implemented during the clearing and operational phases to ensure the risk of these indirect impacts occurring is minimised as far as possible. These will be enacted through the preparation and implementation of an EMP. A summary of these measures is provided in Table 5-8.

### *Cumulative Impacts*

In the context of the surrounding landscape, there is an estimated 6,286.75 ha of habitat for Chuditch within the local area (6 km radius), and 20,873.29 ha within the broader region (12 km radius). The extent of

potentially suitable habitat within the Site therefore represents approximately 0.21% of that within the local area, and 0.06% of that within the broader region.

### *Avoidance and Mitigation*

The potential direct, indirect, and consequential impacts to Chuditch are summarised in Table 5-8.

## Table 5-8: Summary of Direct and Indirect Impact to Chuditch by the Proposed Project

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| **Direct** | Habitat loss leading to population decline /local extinction | Minor<br><br>(<1% decline in habitat extent within 12 km). | The proposed action will result in the temporary removal of 15.06 ha of foraging habitat for Chuditch. Chuditch are not known to occur within the area and were not identified by Bamford (2022), however there is potential for vagrant individuals to utilise the Site on occasion.<br><br>There is an estimated 20,873.29 ha of suitable habitat within a 12 km radius of the proposed action, based on the extent of native vegetation of suitable composition.<br><br>The removal of 15.06 ha of potential habitat will reduce the extent of habitat in a 12 km radius by approximately 0.06%.<br><br>Following the completion of quarrying activities, the entirety of the Site will be rehabilitated in accordance with the MCP (which will be expanded to include the proposed action). This will return native vegetation of a simlar composition to what will be impacted, thereby returning habitat suitable for Chuditch. | The project area originally considered for expansion was surveyed by PGV (2021). As a result, the Site for the proposed action was limited to areas that did not contain threatened flora or threatened ecological communities. In doing so, the extent of proposed impact to native vegetation that is potentially suitable for Chuditch habitat was reduced from 28.64 ha to 15.06 ha.<br><br>Habitat for Chuditch will be returned to the area following the cessation of extractive activities in accordance with the MCP. The objective of rehabilitation will be to return native vegetation to an equivalent extent and quality to what is proposed to be impacted. |
| **Direct** | Vegetation clearing resulting in injury or | Moderate | There is a risk of mortality to Chuditch during clearing activities, in an unmanaged scenario. | Measures will be applied prior to and during clearing activities to minimise the risk of impacting fauna |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | mortality to fauna within the Site | | | (including Chuditch) both within and adjacent to the proposed action.<br><br>The area to be cleared will be clearly demarcated to avoid unauthorised clearing and potential impacts to fauna in the neighbouring areas. Measures to avoid accidental unauthorised clearing shall include:<br><br>• Provision of GPS co-ordinates of areas approved to be cleared and retained to the contractor(s).<br>• Clearly demarcate clearing boundaries with tagging and/or fencing and communicating those areas to clearing personnel prior to activities commencing.<br>• Restrict access to retained vegetation.<br>• Install appropriate signage to restrict unauthorised access to retained areas.<br>• Ensure no machinery, equipment or laydown areas are located within areas of native vegetation to be retained.<br><br>Fauna management measures shall also be applied, including:<br><br>• All construction personnel taking due care to avoid injury to fauna and maintain low speed limits.<br>• Report to the Site Supervisor in the event that fauna is struck by a vehicle or machinery.<br>• Personnel to observe, but not handle, injured fauna until a suitably qualified person can attend to the animal. |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | | | | • Maintain a fauna interaction register to capture observations and interactions with fauna.<br>• All excavations must have adequate egress to fauna that may become trapped.<br>• An EMP will be developed that includes all measures that must be taken during construction and operation of the proposed action to minimise the risk of directly impacting individuals.<br><br>The residual risk posed to Chudtich by the proposed action is considered Minor, recognising the avoidance and mitigation measures described. |
| **Direct** | Operation of vehicles and machinery resulting in injury or mortality to fauna within the Site. | Moderate | There is a risk of ongoing fauna mortality arising through the operational phase of the proposed action, for example through vehicle or machinery strike. | Fauna management measures shall be applied throughout the operation of the proposed action, including:<br><br>• All construction personnel taking due care to avoid injury to fauna and maintain low speed limits.<br>• Report to the Site Supervisor in the event that fauna is struck by a vehicle or machinery.<br>• Personnel to observe, but not handle, injured fauna until a suitably qualified person can attend to the animal.<br>• Maintain a fauna interaction register to capture observations and interactions with fauna.<br>• All excavations must have adequate egress to fauna that may become trapped.<br>• An EMP will be developed that includes all measures that must be taken during construction and operation |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | | | | of the proposed action to minimise the risk of directly impacting individuals.<br>The residual risk posed to Chuditch by the proposed action is considered Minor, recognising the avoidance and mitigation measures described. |
| **Indirect (ecosystem function)** | Fragmentation of an existing population | Negligible | Chuditch are a wide-ranging species, with males having a home range of over 15 $km^2$ and females three to four $km^2$. There are large, intact areas of habitat in proximity to the Site and, following clearing associated with the proposed action, vegetation will persist to the north, east, south, and west.<br><br>As a result, the proposed quarry extension is unlikely to result in fragmentation of existing populations. | Following the completion of excavation and quarry operations, the Site will be rehabilitated and revegetated to return native vegetation of a comparable quality and extent to what is proposed to be removed. Rehabilitation will be undertaken in accordance with the MCP, which will be extended to cover the Site. |
| **Indirect (ecosystem function)** | Degradation of surrounding habitat due to weed invasion | Minor | The extension of the Wattle Ave East mine site will result in all native vegetation being cleared from the Site. There is a risk of weed introduction and spread to neighbouring, retained native vegetation through clearing activities and the disturbance that results.<br><br>It should be noted, however, that weed occurrence in the Site is very low, with the majority of vegetation being in Excellent condition. Recognising the existing quarry operations adjacent to the Site, and the Excellent | Standard hygiene measures will be implemented for the duration of clearing for and operation of the proposed action. These measures include:<br><br>• All vehicles and machinery are to be cleaned down of all soil and vegetation prior to arriving on site.<br>• All imported landscaping soil or other potential weed mediums are certified as weed free sources prior to arrival on site.<br>• Any weed-contaminated topsoil must be stockpiled separately and sign-posted. |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | | | condition vegetation within the Site, the existing clearing and quarrying operations do not appear to have had a measurable impact on vegetation condition including through the spread of weeds. The operation of the proposed action will be consistent with the existing quarrying operations. As such, degradation of surrounding vegetation through factors such as weeds is not expected to result from the proposed action.<br><br>Notwithstanding, strict controls will be put in place to ensure clearing and vegetation disturbance does not occur beyond the approved clearing boundaries, and that hygiene measures will be implemented for the duration of the proposed action to avoid the spread of weeds. | • Spot-spraying and/or hand weeding may be required within retained vegetation if weeds are found to have spread to neighbouring areas. |
| **Indirect (ecosystem function)** | Species interactions (i.e. increased predation). | Negligible | Given the increased human and vehicle movement to the Site, a minor increase in feral animals may result. Existing feral management procedures will continue to be implemented. | To avoid attracting predatory feral animals to the Site, housekeeping shall be maintained to ensure no rubbish or food is left at the site, and no fauna shall be fed by personnel on site. In addition, no domestic animals will be permitted within the Site. |
| **Indirect (ecosystem function)** | Changes to hydrology | Negligible | There is negligible risk of Chuditch through altered hydrology.<br><br>There are no surface water features or geomorphic wetlands within the Site. | The pit floor will remain at least 3 m above the groundwater level, consistent with WQPN 15 which recommends a buffer of at least 2 m. |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | | | Limestone is very porous and, as with all limestone quarries, surface water will infiltrate through the pit floor. The pit floor will remain approximately 3 to 5 m above the groundwater level, ensuring there is adequate separation at all times.<br><br>No excavation will occur beyond the groundwater level. As such, the potential for hydrogeological change and indirect impacts to Chuditch habitat are extremely minor. | |
| **Indirect (ecosystem function)** | Changes to fire regime | Negligible | No changes to the fire regime are expected to result from the proposed action. Surrounding habitat (outside of the Site, but within the mining tenement M 70/143) can be managed with existing fire management protocols. | Existing fire management and suppression around the mining tenement M 70/143. |
| **Indirect (ecosystem function)** | Dust, light, vibration, noise | Negligible | N/A | Application of dust suppression during all clearing activities to minimize dust emissions, particularly during windy conditions. |

### *Assessment against MNES Significant Impact Guidelines*

The potential impacts have been assessed in accordance with the Significant Impact Guidelines 1.1 (DoE, 2013) as summarised in Table 5-9.

**Table 5-9: Assessment of Likely and Potential Impacts to Chuditch against the Significant Impact Guidelines**

| Significance Criteria Under Guidelines 1.1 | Likelihood of Impact and Rational |
|---|---|
| **Lead to a long-term decrease in the size of a population (or an important population).** | **Not significant.**<br>Chuditch is considered to be a vagrant to the Site. The Site does not provide habitat preferred by the species and is located within the margin of its distribution area. The species was not directly or indirectly observed within the survey area, and the nearest known record is a juvenile male which was caught approximately 10 km to the east in 2004 within dense, riparian vegetation in the Gnangara pine plantation (M. Bamford pers obs.).<br>The Site is therefore unlikely to comprise significant habitat for the species and, consequently, the proposed action is unlikely to lead to a decline in an important population or a decline in the numbers at a regional level. |
| **Reduce the area of occupancy of the species (or an important population).** | **Not significant.**<br>The proposed action and associated clearing is highly unlikely to alter the local distribution and abundance of Chuditch. The species is not considered to be a resident or regular visitor of the Site, and the closest known record was found within the Gnangara pine plantation (10 km east), 20 years ago.<br>The species is expected to occur in the broader region and remain as irregular visitors to the surrounding areas of vegetation that will be retained by the proposed action. |
| **Fragment an existing population (or important population) into two or more populations.** | **Not significant.**<br>The Site of the proposed action is not considered to comprise significant habitat for the species. Chuditch is considered likely to occur within the surrounding area irregularly as a vagrant.<br>Despite the proposed action contiguous areas of native vegetation will be retained, and connectivity with areas of native vegetation to the north, east, south and west will be maintained. Therefore, the proposed action is highly unlikely to fragment existing populations. |
| **Adversely affect habitat critical to the survival of a species.** | **Potentially significant.**<br>According to the approved Recovery Plan for the species, habitat considered critical to the survival of Chudtich is defined as:<br>• Areas currently occupied by Chudtich<br>• Areas of natural vegetation in which Chuditch breed |

| Significance Criteria Under Guidelines 1.1 | Likelihood of Impact and Rational |
|---|---|
| | • Areas of natural vegetation in which Chuditch forage<br>• Areas of natural vegetation that Chuditch use to move from one area to another<br>• Areas of suitable vegetation within the recorded range in which undiscovered Chuditch populations may exist<br>• Areas not currently occupied by Chudtich due to recent fire but are capable of supporting Chuditch populations when sufficiently recovered<br>• Areas previously occupied and that still provide suitable habitat and into which Chuditch can be reintroduced.<br>Given the broad definition of critical habitat for Chuditch detailed above, the native vegetation present within the Site may be interpreted as 'critical' for the survival of Chudtich. Therefore, the proposed action will remove 15.06 ha of habitat.<br>However, given the localised and temporary nature of the proposed action, the retention of similar vegetation immediately adjacent and contiguous with surrounding areas, and the fact Chuditch are expected to occur within the Site only as a vagrant, the impact to Chuditch is not significant. |
| **Disrupt the breeding cycle of a population (or important population).** | **Not significant.**<br>The Site does not contain suitable breeding habitat for Chuditch, and the species is expected to be present as a vagrant only. Therefore, the proposed action is highly unlikely to disrupt the breeding cycle of Chuditch. |
| **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.** | **Not significant.**<br>The Site does provide some potential habitat suitable for Chuditch visiting the Site irregularly. However, it does not constitute breeding habitat and is therefore no critical asset for the survival of the species. Habitat continuity will persist to areas of native vegetation in the broader region through retained vegetation. The proposed action is therefore not considered to disturb Chuditch habitat to the extent that the species is likely to decline. |
| **Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat.** | **Not significant.**<br>Feral species, such as cats and foxes, are likely to be occur within the region. The proposed action will result in increased disturbance within the area as well as increased vehicular and human traffic. This may cause greater numbers of feral animals, which will be managed through the implementation of an EMP for the duration of the clearing, operational, and rehabilitation phases. Given that Chuditch are likely to occur irregularly within the Site as a vagrant, the species is unlikely to be present within the Site for extended periods. Therefore, no increased risk of predation by feral animals is expected. |

| Significance Criteria Under Guidelines 1.1 | Likelihood of Impact and Rational |
|---|---|
| | The spread of weeds with the potential to impact habitat in neighbouring areas will be managed through the implementation of standard hygiene measures. |
| **Introduce disease that may cause the species to decline.** | **Not significant.**<br>The proposed action will result in disturbance to suitable habitat for Chuditch and has the potential to cause indirect impacts to surrounding habitat. Increased vehicular and human traffic, and the movement of vegetative matter may result in the introduction and spread of disease if not mitigated. An EMP including hygiene measures will be implemented for the duration of the clearing, operational, and rehabilitation phases. |
| **Interfere with the recovery of the species.** | **Not significant.**<br>The proposed action is not inconsistent with any objectives or actions of the Chuditch (*Dasyurus geoffroi*) National Recovery Plan (DEC, 2012). |

As detailed in Table 5-9, the proposed impact to Chuditch does not constitute a significant impact.

### 5.2.4 Yanchep Mallee (*Eucalyptus argutifolia*)

#### *Direct Impacts - Quantum and Quality of Habitat and Number of Individuals or Habitat Values*

No direct or indirect impacts are expected to occur as a result of the proposed action, given the nearest occurrence is 40 m outside of the Site and that no individuals or suitable habitat for the species will be removed.

#### *Indirect and Consequential Impacts*

Two populations of *Eucalyptus argutifolia* (Yanchep mallee) are known to occur approximately 40 m outside of the Site (Figure 11). One population comprises two-three individuals, and the other comprises 29 individuals.

There is a potential for indirect and consequential impacts to arise from the proposed action during vegetation clearing and ongoing operation.

Indirect and consequential impacts may include:

- Uncontrolled access to areas of retained vegetation adjacent to the proposed action.
- Degradation of surrounding habitat due to weed introduction and spread.
- Changes to hydrology.
- Changes to fire regime.

Management measures will be implemented during the clearing and operational phases to ensure the risk of these indirect impacts occurring is minimised as far as possible. These will be enacted through the preparation and implementation of an EMP. A summary of these measures is provided in Table 5-10.

It is important to note that the populations of *Eucalyptus argutifolia* located in proximity to the Site are situated 40 m from current quarry operations (as observable by the cleared areas on Figure 11). PGV (2021) assessed the vegetation in this area as 'Excellent' condition with minimal signs of disturbance. As quarry operations in this specific area have been ongoing since 2001, it is evident that no impact to retained vegetation, including *Eucalyptus argutifolia* populations, have resulted. As such, and given the mitigation measures proposed in Table 5-10, no direct or indirect impacts are expected to result from the proposed action.

### *Cumulative Impacts*

The proposed works do not contribute to cumulative impacts in the region, as no impacts to *Eucalyptus argutifolia* will result.

### *Avoidance and Mitigation*

The potential direct, indirect, and consequential impacts to Yanchep mallee (*Eucalyptus argutifolia*) are summarised in Table 5-10.

**Table 5-10: Summary of Direct and Indirect Impact to Yanchep Mallee by the Proposed Project**

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| **Indirect** | Vegetation clearing/damage outside of approved boundaries | Minor | There is a risk of accidental damage or loss of vegetation outside of approved boundaries, in an unmanaged scenario. | Measures will be applied prior to and during clearing activities to ensure there is no loss of, or damage to, vegetation outside of approved clearing boundaries (the Site).<br><br>The area to be cleared will be clearly demarcated to avoid unauthorised clearing and potential impacts to vegetation in the neighbouring areas. Measures to avoid accidental unauthorised clearing or damage shall include:<br>• Provision of GPS co-ordinates of areas approved to be cleared and retained to the contractor(s).<br>• Clearly demarcate clearing boundaries with tagging and/or fencing and communicating those areas to clearing personnel prior to activities commencing.<br>• Restrict access to retained vegetation.<br>• Install appropriate signage to restrict unauthorised access to retained areas.<br>• Ensure no machinery, equipment or laydown areas are located within areas of native vegetation to be retained. |
| **Indirect (ecosystem function)** | Degradation of surrounding habitat due to weed invasion | Minor | The extension of the Wattle Ave East mine site will result in all native vegetation being cleared from the Site. There is a risk of weed introduction and spread to neighbouring, retained native | Standard hygiene measures will be implemented for the duration of clearing for and operation of the proposed action. These measures include:<br>• All vehicles and machinery are to be cleaned down of all soil and vegetation prior to arriving on site. |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | | | vegetation through clearing activities and the disturbance that results.<br>It should be noted, however, that weed occurrence in the Site is very low, with the majority of vegetation being in Excellent condition. Recognising the existing quarry operations adjacent to the Site, and the Excellent condition vegetation within the Site, the existing clearing and quarrying operations do not appear to have had a measurable impact on vegetation condition including through the spread of weeds. The operation of the proposed action will be consistent with the existing quarrying operations. As such, degradation of surrounding vegetation through factors such as weeds is not expected to result from the proposed action.<br>Notwithstanding, strict controls will be put in place to ensure clearing and vegetation disturbance does not occur beyond the approved clearing boundaries, and that hygiene measures will be implemented for the duration of the proposed action to avoid the spread of weeds. | • All imported landscaping soil or other potential weed mediums are certified as weed free sources prior to arrival on site.<br>• Any weed-contaminated topsoil must be stockpiled separately and sign-posted.<br>• Spot-spraying and/or hand weeding may be required within retained vegetation if weeds are found to have spread to neighbouring areas. |
| **Indirect (ecosystem function)** | Changes to hydrology | Negligible | There is negligible risk to *Eucalyptus argutifolia* through altered hydrology.<br>There are no surface water features or geomorphic wetlands within the Site.<br>Limestone is very porous and, as with all limestone quarries, surface water will infiltrate through the pit floor. The pit floor will remain | The pit floor will remain at least 3 m above the groundwater level, consistent with WQPN 15 which recommends a buffer of at least 2 m. |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | | | approximately 3 to 5 m above the groundwater level, ensuring there is adequate separation at all times.<br>No excavation will occur beyond the groundwater level. As such, the potential for hydrogeological change and indirect impacts to *E. argutifolia* habitat are extremely minor. | |
| **Indirect (ecosystem function)** | Changes to fire regime | Negligible | No changes to the fire regime are expected to result from the proposed action. Surrounding habitat (outside of the Site, but within the mining tenement M 70/143) can be managed with existing fire management protocols. | Existing fire management and suppression around the mining tenement M 70/143. |

### *Assessment against MNES Significant Impact Guidelines*

The potential impacts have been assessed in accordance with the Significant Impact Guidelines 1.1 (DoE, 2013) as summarised in Table 5-11.

**Table 5-11. Assessment of Likely and Potential Impacts to Yanchep Mallee against the Significant Impact Guidelines**

| Significance Criteria Under Guidelines 1.1 | Likelihood of Impact and Rational |
|---|---|
| **Lead to a long-term decrease in the size of a population (or an important population).** | **Not significant.**<br>The proposed action will not impact any populations of *Eucalyptus argutifolia.* Up to 32 individuals of the species (across two populations) are known to occur near to the Site, approximately 40 m to the north and northeast.<br>Direct impacts have been avoided through restricting the area of disturbance to maintain separation from the populations, and indirect impacts will be avoided through mitigation measures applied through the EMP (outlined in Table 5-10).<br>Therefore, the proposed action will not lead to a long-term decrease in any *E. argutifolia* population. |
| **Reduce the area of occupancy of the species (or an important population).** | **Not significant.**<br>The extent of occurrence of *E. argutifolia* is estimated at 1,940 km$^2$ and, due to insufficient data, trends in the population or area of occupancy are unknown (DEWHA, 2008). The Conservation Advice for the species identifies that the species' area of occupancy is likely to decline over time given it occurs on substrate that is commonly mined (DEWHA, 2008).<br>Given the proposed action will not impact either nearby population, no reduction in the species' area of occupancy will result. |
| **Fragment an existing population (or important population) into two or more populations.** | **Not significant.**<br>The proposed action will not impact any existing populations of *E. argutifolia*. |
| **Adversely affect habitat critical to the survival of a species.** | **Not significant.**<br>The Site was initially identified to contain potentially suitable habitat for E. argutifolia within vegetation type MsAt. This area was surveyed by WEPL (2024) and was determined to lack both the species and true suitable habitat (absence of imestone ridges and their slopes and gullies).<br>Therefore, the proposed action will not impact suitable habitat for the species. |
| **Disrupt the breeding cycle of a population (or important population).** | **Not significant.**<br>The proposed action will not impact any existing populations of *E. argutifolia* or suitable habitat and, therefore, will not disrupt the species' breeding cycle. |

| Significance Criteria Under Guidelines 1.1 | Likelihood of Impact and Rational |
|---|---|
| **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.** | **Not significant.**<br>The proposed action will not impact any existing populations of *E. argutifolia* nor suitable habitat for the species. Further, the two populations to the northeast of the Site will remain connected through native vegetation that will be retained. Therefore, the proposed action will not fragment or isolate the populations. |
| **Result in invasive species that are harmful to a threatened species becoming established in the threatened species' habitat.** | **Not significant.**<br>The proposed action is separated from *E. argutifolia* populations by approximately 40 m. Increased access by vehicles and plant within the Site, and movement of vegetative matter, may result in the introduction and spread of weeds if not mitigated.<br>The spread of weeds with the potential to impact habitat in neighbouring areas will be managed through the implementation of standard hygiene measures. |
| **Introduce disease that may cause the species to decline.** | **Not significant.**<br>The proposed action is separated from *E. argutifolia* populations by approximately 40 m. Increased access by vehicles and plant within the Site, and movement of vegetative matter, may result in the introduction and spread of disease if not mitigated.<br>An EMP including hygiene measures will be implemented for the duration of the clearing, operational, and rehabilitation phases. |
| **Interfere with the recovery of the species.** | **Not significant.**<br>Mining is considered to be a key threat to the persistence of *Eucalyptus argutifolia* given it occurs on a substrate (limestone) that is commonly mined (DEWHA, 2008).<br>The proposed action will avoid all direct and indirect impacts to the species through restricting the disturbance area to well outside of known populations (~40 m separation) as well as the application of hygiene measures to avoid weed and disease spread and avoiding impacts to groundwater by maintaining at least a 2-metre buffer between the water table and excavation activities.<br>Given the above, the proposed action is not inconsistent with the species' recovery. |

As detailed in Table 5-11, the proposed action will avoid any direct or indirect impact to *Eucalyptus argutifolia*.

### 5.2.5 *Melaleuca* sp. Wanneroo

#### *Direct Impacts - Quantum and Quality of Habitat and Number of Individuals or Habitat Values*

No direct impacts to *Melaleuca* sp. Wanneroo will occur as a result of the proposed action as no individuals occur within the Site.

#### *Indirect and Consequential Impacts*

No indirect or consequential impacts to *Melaleuca* sp. Wanneroo will occur as a result of the proposed action as no individuals occur within or adjacent to the Site.

#### *Cumulative Impacts*

Given the absence of *Melaleuca* sp. Wanneroo within or adjacent to the Site, the proposed action will not contribute to cumulative impacts on species populations in the region.

#### *Avoidance and Mitigation*

Given the absence of *Melaleuca* sp. Wanneroo within the Site, no avoidance or mitigation measurements are proposed.

### 5.2.6 Banksia Woodlands of the Swan Coastal Plain Ecological Community

#### *Direct Impacts - Quantum and Quality of Habitat and Number of Individuals or Habitat Values*

No direct impacts to the ecological community will occur as a result of the proposed action as the nearest occurrence is at least 40 m to the east.

#### *Indirect and Consequential Impacts*

No indirect or consequential impacts to the ecological community will occur as a result of the proposed action as the nearest occurrence is at least 40 m from the boundary of the proposed action. The conservation advice (DoEE, 2016) recommends that a buffer of 20 to 50 m be applied from the outer edge of a patch, with the appropriate size being dependent on the nature of the buffer and context of the site. A larger buffer is recommended where patches are of particularly high conservation value, down slope of drainage lines or a source of nutrient enrichment, or where groundwater drawdown is proposed (DoEE, 2016). A buffer distance of 40 m is therefore consistent with the conservation advice.

#### *Cumulative Impacts*

Given the absence of the ecological community within or in close proximity to the Site (noting a buffer of 40 m will be maintained between the proposed action and nearest patch), the proposed action will not contribute to cumulative impacts on the community.

#### *Avoidance and Mitigation*

The potential direct, indirect, and consequential impacts to Banksia woodlands of the Swan Coastal Plain are summarised in Table 5-12.

**Table 5-12: Summary of Direct and Indirect Impact to Banksia Woodlands of the Swan Coastal Plain by the Proposed Action**

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| **Indirect** | Vegetation clearing/damage outside of approved boundaries | Minor | There is a risk of accidental damage or loss of vegetation outside of approved boundaries, in an unmanaged scenario. | Measures will be applied prior to and during clearing activities to ensure there is no loss of, or damage to, vegetation outside of approved clearing boundaries (the Site).<br><br>The area to be cleared will be clearly demarcated to avoid unauthorised clearing and potential impacts to vegetation in the neighbouring areas. Measures to avoid accidental unauthorised clearing or damage shall include:<br>• Provision of GPS co-ordinates of areas approved to be cleared and retained to the contractor(s).<br>• Clearly demarcate clearing boundaries with tagging and/or fencing and communicating those areas to clearing personnel prior to activities commencing.<br>• Restrict access to retained vegetation.<br>• Install appropriate signage to restrict unauthorised access to retained areas.<br>• Ensure no machinery, equipment or laydown areas are located within areas of native vegetation to be retained. |
| **Indirect (ecosystem function)** | Degradation of surrounding habitat due to weed invasion | Minor | The extension of the Wattle Ave East mine site will result in all native vegetation being cleared from the Site. There is a risk of weed introduction and spread to neighbouring, retained native vegetation through clearing activities and the disturbance that results. | Standard hygiene measures will be implemented for the duration of clearing for and operation of the proposed action. These measures include:<br>• All vehicles and machinery are to be cleaned down of all soil and vegetation prior to arriving on site. |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | | | It should be noted, however, that weed occurrence in the Site is very low, with the majority of vegetation being in Excellent condition. Recognising the existing quarry operations adjacent to the Site, and the Excellent condition vegetation within the Site, the existing clearing and quarrying operations do not appear to have had a measurable impact on vegetation condition including through the spread of weeds. The operation of the proposed action will be consistent with the existing quarrying operations. As such, degradation of surrounding vegetation through factors such as weeds is not expected to result from the proposed action.<br>Notwithstanding, strict controls will be put in place to ensure clearing and vegetation disturbance does not occur beyond the approved clearing boundaries, and that hygiene measures will be implemented for the duration of the proposed action to avoid the spread of weeds. | • All imported landscaping soil or other potential weed mediums are certified as weed free sources prior to arrival on site.<br>• Any weed-contaminated topsoil must be stockpiled separately and sign-posted.<br>• Spot-spraying and/or hand weeding may be required within retained vegetation if weeds are found to have spread to neighbouring areas. |
| **Indirect (ecosystem function)** | Changes to hydrology | Negligible | There is negligible risk to Banksia woodlands of the Swan Coastal Plain ecological community through altered hydrology.<br>There are no surface water features or geomorphic wetlands within the Site.<br>Limestone is very porous and, as with all limestone quarries, surface water will infiltrate through the pit floor. The pit floor will remain approximately 3 to 5 m above the groundwater | The pit floor will remain at least 3 m above the groundwater level, consistent with WQPN 15 which recommends a buffer of at least 2 m. |

| Impact Type | Threatening Process | Consequence | Discussion | Proposed Avoidance/Mitigation Measure |
|---|---|---|---|---|
| | | | level, ensuring there is adequate separation at all times.<br>No excavation will occur beyond the groundwater level. As such, the potential for hydrogeological change and indirect impacts to surrounding vegetation are extremely minor. | |
| **Indirect (ecosystem function)** | Changes to fire regime | Negligible | No changes to the fire regime are expected to result from the proposed action. Surrounding habitat (outside of the Site, but within the mining tenement M 70/143) can be managed with existing fire management protocols. | Existing fire management and suppression around the mining tenement M 70/143. |

### *Assessment against MNES Significant Impact Guidelines*

The potential impacts have been assessed in accordance with the Significant Impact Guidelines 1.1 (DoE, 2013) as summarised in Table 5-13

**Table 5-13. Assessment of Likely and Potential Impacts to Banksia Woodlands of the Swan Coastal Plain Ecological Community against the Significant Impact Guidelines**

| Significance Criteria Under Guidelines 1.1 | Likelihood of Impact and Rational |
|---|---|
| **Reduce the extent of the ecological community.** | **Not significant.**<br>The proposed action will not impact any occurrence of Banksia woodlands of the Swan Coastal Plain ecological community. Therefore, no reduction in the community's extent will result. |
| **Fragment or increase fragmentation of an ecological community.** | **Not significant.**<br>The proposed action will not impact any occurrences of the ecological community, therefore no fragmentation will result. |
| **Adversely affect habitat critical to the survival of an ecological community..** | **Not significant.**<br>The proposed action will not impact habitat critical to the survival of the ecologcal community, as none occurs within the Site. |
| **Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soils) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.** | **Not significant.**<br>The proposed action is sepatated by the nearest occurrence of Banksia woodlands of the Swan Coastal Plain by at least 40 m (from the nearest point).<br>There are no surface water features or geomorphic wetlands within the Site.<br>Limestone is very porous and, as with all limestone quarries, surface water will infiltrate through the pit floor. The pit floor will remain approximately 3 to 5 m above the groundwater level, ensuring there is adequate separation at all times.<br>No excavation will occur beyond the groundwater level. As such, the potential for hydrogeological change and indirect impacts to surrounding vegetation are extremely minor. |
| **Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species.** | **Not significant.**<br>No occurrences will be impacted by the proposed action. |
| **Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community via invasive species or any form of contaminants or pollutants.** | **Not significant.**<br>The proposed action is separated from the nearest ecologcal community occurrence by approximately 40 m. This buffer area will prevent any potential edge effects associated with the proposed action. |

| Significance Criteria Under Guidelines 1.1 | Likelihood of Impact and Rational |
|---|---|
| | It should be noted that current quarrying activities adjacent to the Site have not resulted in measurable degradation to adjacent vegetation.<br>Measures to avoid indirect impacts to adjacent vegetation will be implemented through an EMP that will apply to the clearing, operational and rehabilitation phases of the proposed action. |
| **Interfere with the recovery of an ecological community.** | **Not significant.**<br>The ecological community will not be subject to direct or indirect impacts from the proposed action. A large buffer distance of 40 m will be applied to the nearest occurrence which is consistent with the Conservation Advice (DoEE, 2016) which recommends a buffer of 20-50 m.<br>Given the above, the proposed action is not inconsistent with the community's recovery. |

As detailed in Table 5-13, the proposed action will avoid any direct or indirect impact to the Banksia woodlands of the Swan Coastal Plain ecological community.

## 5.3 Summary of Avoidance and Mitigation Measures

Through the avoidance measures detailed in section 4.2, 16.71 ha of native vegetation within the project area will be avoided by the proposed action (as shown in Figure 17). This will facilitate the retention of the following significant environmental values:

- 16.71 ha native vegetation in Good to Excellent condition, 0.01 ha of rehabilitation, and 0.41 ha of Completely Degraded vegetation.
- 3.38 ha of Banksia Woodlands of the Swan Coastal Plain Ecological Community (Endangered).
- Potential 0.11 ha occurrence of possible FCT 26a (*Melaleuca huegelii - M. acerosa* (now *M. systena*) shrublands of limestone ridges) (Critically Endangered).
- All *Eucalyptus argutifolia* (Yanchep Mallee) locations comprising 31-32 individuals, of which 2 to 3 occur within the project area and the remaining 29 situated to the north.
- 13.33 ha of Carnaby's black cockatoo foraging habitat (inferred to be of high foraging value for the species, given the presence and density of *Banksia sessilis*).

In accordance with those outlined for each MNES in section 5.2, a summary of avoidance and mitigation measures proposed for each MNES is provided in Table 5-14.

## 5.4 Revegetation Management Plan

Following extraction activities, the Site will be rehabilitated in accordance with an existing MCP for the Wattle Avenue East quarry that will be expanded to include the proposed action. The MCP is attached as Appendix B.

The MCP includes a revegetation plan, outlining the following actions:

- Topsoil and vegetation fragments will be transferred directly from an area being cleared and spread across the surface to provide seed sources and habitats wherever possible. If direct transfer is not possible, any material stored in dumps will be respread.
- Larger vegetation will be formed into occasional piles for habitat creation on the lower elevations.
- Topsoil will be re-distributed in rehabilitated areas to depths of 50 mm where available.
- Topsoil provides a useful source of seed for rehabilitation when the correct handling of the topsoil is used, stripped and replaced dry (autumn direct return). Maximum depth of 50 mm can be used to optimise revegetation of species-rich plant communities. However, weed affected topsoil can create additional issues and may not be used.

- Studies have shown that topsoil stripping and placement is best undertaken in summer for maximum germination and this will be done, but this raises the potential for additional dust generation from the fine humus particles.

- Topsoil will be spread directly from an area being cleared where possible, otherwise reclaimed from a topsoil dump.

- Pre-seeding weed control is only likely to be required where topsoils are used that contain weed species. This is unlikely to be the case on this site where the existing vegetation is in excellent condition even though some exotic species are currently present within the “natural” vegetation.

- In May, after the first autumn rains, check for weed germination.

- Any weeds likely to significantly impact on the rehabilitation will be sprayed with Roundup or similar herbicide or grubbed out, depending on the species involved. Fusilade will be used where grasses present an impediment to rehabilitation Weed affected topsoil and overburden will be buried.

- Methods of sourcing seed will be:

    - Direct transfer of topsoil.

    - Brushing by cutting branches of adjoining and suitable local vegetation. For example branches of Melaleuca hold their seed and provide a good seed source when placed across the land surface.

    - Sourcing and planting additional tube plants as required as a result of site trials.

    - Collecting and or purchasing local provenance seed at the rate of about 500g/ha. Additional species that do not readily germinate from topsoil are Proteaceous and Eucalyptus species, which will be overseeded or tube planted. Species can also be taken from Coffey environments 2010.

    - Local leguminous species will be over seeded at the rate of 500 g per hectare to mimic the regeneration following fire.

- Rehabilitation will take place during the first winter months following the restoration earth works of each particular section of quarry. Leaving the completed earth works for one season will reduce the success of rehabilitation by at least 50%, due to compaction effects.

- Local provenance seed will be used wherever possible, selected for its ability to not impede the proposed final end use. A species list is attached.

- Seeding conducted in summer will use scarified leguminous seeds that have been “dry smoked”. Seeding conducted in July to August will have the leguminous seeds heat treated and all seeds will be smoke treated by soaking in “smoke water” for 24 hours prior to seeding.

- Seed spreading will be achieved either using mechanical seed dispersal equipment or using manual methods. Bulking with a spreading agent such as sawdust, vermiculite or sand is desirable.
- Rehabilitation will progressively follow mining with completed areas of the excavation being revegetated as soon as practicable.

The MCP also covers the following aspects:

- Land Restoration
- Weed Management
- Monitoring Framework
- Erosion Control
- Dieback Management
- Surface Water Protection

## Table 5-14. Summary of Avoidance and Mitigation Measures Proposed for MNES and Assessment of Effectiveness

| MNES and Summary of Impact | Type of Mitigation | Description of Mitigation | Assessment of Effectiveness |
|---|---|---|---|
| **Carnaby's black cockatoo**<br>**Loss of 13.27 ha of high quality foraging habitat** | Avoidance | Reduction of disturbance footprint within M 70/143 from 57.83 ha to the minimum extent required to extract the limestone resource present safely and efficiently (note 26.48 ha of this is already being quarried).<br>The area initially considered contained approximately 30.61 ha native vegetation and 10.46 highly modified vegetation (rehabilitation). All native vegetation within the area is considered to provide foraging habitat of comparable quality to that being impacted by the proposed action.<br>By restricting the proposed clearing to the Site, impact to Carnaby's cockatoo foraging habitat was reduced from over 30.61 ha to 13.27 ha (reduction of 56.20%). | Avoidance is at the highest hierarchy level of actions used to reduce significant impacts and has been proven to be the most effective. |
| | Mitigation<br>(Avoid unapproved clearing) | Clearly demarcating approved clearing areas on-site and providing digital boundaries to appropriate personnel, and educating all on-site personnel of areas to be impacted and avoided. | • All proposed measures are known and effective strategies, proven to reduce impacts to MNES.<br>• No new or novel strategies to reduce impacts have been put forward as part of the proposed action.<br>• Implementation of an environmental management plans and construction as well as operational environmental management measures is common practice to ensure the risk of environmental impacts are eliminated or reduced as much as possible.<br>• WA Limestone has a strong track record of developing and implementing sound environmental management and implementation of management measures.<br>• Track record indicates a history of effective implementation and monitoring of management measures to ensure effectiveness and implementation of |
| | Mitigation<br>(Water quality) | Maintaining at least a 2-metre buffer between the floor of excavation and the water table, in accordance with Water Quality Protection Note 15 to ensure there are no direct or indirect impacts to groundwater and consequential impacts to groundwater dependent vegetation. | |
| | Mitigation<br>(Directional clearing) | Undertaking directional clearing from areas adjacent to existing quarry operations to the eastern and western outside boundaries of the disturbance footprint area in order to encourage fauna to move into adjacent vegetation. | |

| MNES and Summary of Impact | Type of Mitigation | Description of Mitigation | Assessment of Effectiveness |
|---|---|---|---|
| | Mitigation (Dust) | Application of dust suppression during all clearing activities to minimize dust emissions, particularly during windy conditions. | corrective actions when effectiveness does not meet completion criteria (e.g. EPBC 2010/5649). |
| | Mitigation (Weed management) | • Application of standard hygiene protocols to minimize the risk of introducing or spreading weeds or pathogens.<br>• Ongoing weed control will be undertaken during operations. | |
| | Mitigation (OEMP | Development of an OEMP will reduce the risk of potential impacts during operation. | |
| | Rehabilitation | Rehabilitation is planned that will return suitable habitat for Carnaby's black cockatoo once operations have ceased and as required by Mine Closure Plan commitments. | All activities will be undertaken in accordance with a revegetation management plan that has SMART completion criteria and specific monitoring program with contingency actions to ensure effective rehabilitation. An example for a previously developed WA Limestone revegetation plan is the Tamworth Hill Swamp Reserve Revegetation Plan (WA Limestone, 2021). |
| | Offset | An offset strategy to account for the loss of 13.27 ha of foraging habitat is currently under preparation. | Offsets are the last step in the mitigation hierarchy and common procedure The development of an offset strategy and offset management plan will be in consistence with the EPBC Act Environmental Offsets Policy (DSEWPC 2012). The purpose of offsets is to compensate for significant residual impacts on MNES which cannot be avoided.<br>The offset proposal will be submitted to the Commonwealth for assessment of appropriateness and approval. |
| **Chuditch**<br>**Loss of 15.06 ha of low importance habitat for vagrant species** | Avoidance | Reduction of disturbance footprint reduced the impact on native vegetation and potential Chuditch habitat from 30.61 ha to 15.06 ha (reduction of 49.20%). | Highest level of mitigation hierarchy as considered most effective to reduce environmental impacts. |
| | Mitigation | Refer to mitigation measures listed for Carnaby's black cockatoo. | Refer to assessment for Carnaby's black cockatoo. |

| MNES and Summary of Impact | Type of Mitigation | Description of Mitigation | Assessment of Effectiveness |
|---|---|---|---|
| | Rehabilitation | Rehabilitation is planned that will return suitable habitat for Chuditch once operations have ceased and as required by MCP commitments. | Refer to assessment above |
| **Yanchep Mallee**<br>**No direct impact.** | Avoidance | All direct impact avoided. | N/A |
| | Mitigation | Refer to mitigation measures listed for Carnaby's black cockatoo. | Refer to assessment for Carnaby's black cockatoo. |
| **Banksia Woodlands of the Swan Coastal Plain ecological community.**<br>**No direct impact.** | Avoidance | All direct impact avoided. | N/A |
| | Mitigation | Maintenance of a 40 m buffer (minimum) between the proposed action and the nearest occurrence.<br>Refer to mitigation measures listed for Carnaby's black cockatoo. | Refer to assessment for Carnaby's black cockatoo. |

# 6. Environmental Offsets

WA Limestone understand that the Commonwealth is likely to require a detailed offset management plan. This document will be prepared in consultation with DCCEEW following the initial submission of Native Vegetation Clearing Permit application and subsequent commencement of Commonwealth approvals process.

The proposed environmental offset for Wattle Avenue East is located within Lot 100 Seabird Road, Breton Bay. A description of the proposed offset is provided in the following sections and is summarised Table 6-1.

### Table 6-1. Summary of the Proposed Environmental Offset

| Attribute | Description |
|---|---|
| **Nature** | The proposed offset directly compensates for the impact to 13.27 ha of high quality foraging habitat for Carnaby's black cockatoo. |
| **Size** | The proposed offset site will secure 88.75 ha high quality foraging habitat for Carnaby's black cockatoo. |
| **Location** | The proposed offset is located within Lot 100 Seabird Road, Breton Bay (i.e. a portion of the lot). The proposed offset footprint is shown on Figure 18. |
| **Existing tenure** | The proposed offset is currently on freehold land, and is zoned for Rural land uses under both the MRS and LPS. A description of the existing tenure of the entire lot is provided in this section.<br>Lot 100 Seabird Road was covered by native vegetation in 1999 and was subsequently approved for sand extraction activities (in 2002), with some associated disturbance evident by 2003. The current condition of the site is relatively consistent with that evident in 2000, with some natural regeneration having occurred since (e.g. regrowth within previously cleared minor tracks).<br>The site has been previously approved for sand extraction activities, enabling the extraction of sand from three discrete quarries within the lot, covering a total of 26.3 ha (approximately 10% of the site). The extraction sites are shown on the planning consent provided as Appendix J.<br>The most recent excavation license was provided by the Shire of Gingin in 2012 for the purpose of extracting limestone and sand. |
| **Future tenure** | The proposed offset will be transferred to the State conservation estate, to be managed for conservation in perpetuity by DBCA.<br>DBCA have provided their enthusiastic support for the site to be transferred to the State conservation estate. |
| **Proximity to conservation reserves** | The proposed offset is situated approximately 2 km west of Gnangara-Moore River State Forest, and 7.5 km west of Moore River National Park. |

## 6.1 Tenure and Land Uses

### 6.1.1 Proposed Offset Site

The proposed offset site is currently zoned General Rural under the Shire of Gingin Local Planning Scheme No. 9. The site was formerly part of Lot 89 on Plan 21080, which was subdivided into Lots 100 and 101 on Plan 033432 in 2004.

The earliest available historic aerial imagery online, from 1999 shows the site in a mostly vegetated state, with some perimeter fire breaks and other tracks (Plate 1). In aerial imagery dated between 2000 and 2003, an area of limestone extraction is located near the eastern boundary along with some test pits and tracks, in accordance with approved limestone extraction (Plate 2). This is attributed to approved limestone extraction over the site.

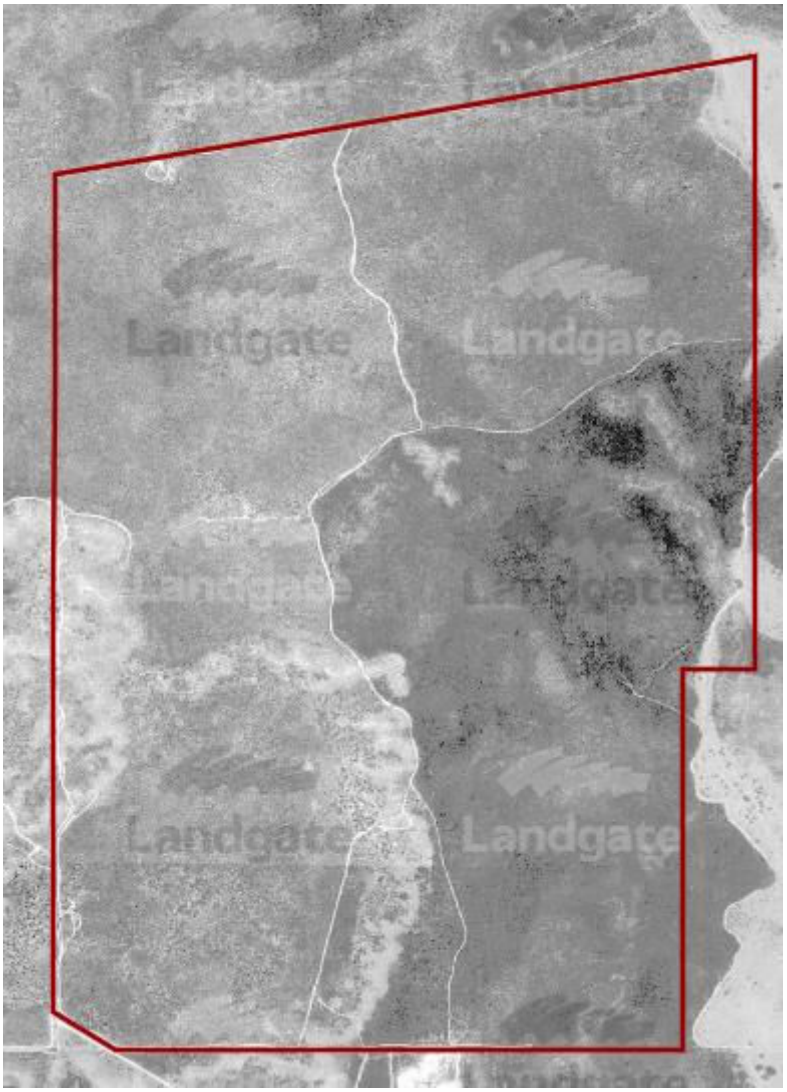



**Plate 1. Aerial Imagery over the Site taken 25-28/11/1999 (Landgate, n.d.)**




**Plate 2. Aerial Imagery over the Site taken between 5/06/2000 and 18/06/2003**

Limestone extraction was approved by the Shire of Gingin on 3 September 2002, with total impact to 26.3 ha of native vegetation across three discrete impact sites (with associated roads/tracks). An Excavation License was subsequently provided to WA Limestone by the Shire of Gingin on 16 February 2012, with a license term of 1 January 2012 to 31 December 2012.

Lot 100 is identified as a SGS Area under SPP 2.4 - Planning for Basic Raw Materials (2021). SGS are identified by DMIRS as having State significance due to the size of the resource, relative scarcity, demand, and/or location near growth areas and transport routes (DPLH, 2021). SGS are therefore identified as the highest priority extraction areas for BRM. Given a significant portion of the site is mapped as an SGS, there is a reasonable likelihood that planning approval would be granted again.

### 6.1.2 Surrounding Area

WA Limestone currently operates an approved, active quarry on Lot 101 immediately east of the proposed offset site, and agricultural land uses also exist to the south and east. Immediately south of the proposed offset site is the Seabird Waste Management Facility.

## 6.2 Biological Values of the Proposed Offset Site

This section provides a summary of the existing environment at the proposed offset site. As such, this section details the existing environment as it relates specifically to the hatched area shown in Figure 18.

### 6.2.1 Vegetation Types and Condition

One native vegetation type exists within the proposed offset site (hatched area shown on Figure 18) which is described as *Banksia sessilis/Calothamnus quadrifidus* Open to Closed Heath over *Hibbertia hypericoides/Melaleuca systena* Low Open Shrubland to Closed Low Heath. The remaining 1.90 ha is currently cleared. A breakdown of vegetation within the proposed offset site is detailed in Table 6-2.

**Table 6-2. Vegetation Types - Proposed Offset Site (PGV, 2022)**

| Vegetation Type | Description | Area (ha) | Proportion of Site (%) |
|---|---|---|---|
| **BsCq** | *Banksia sessilis/ Calothamnus quadrifidus* Open to Closed Heath over *Hibbertia hypericoides/Melaleuca systena* Low Open Shrubland to Closed Low Heath. | 86.85 | 97.9% |
| **Subtotal** | Total extent of native vegetation | 86.85 | 97.9% |
| **Cleared** | Cleared land and tracks | 1.90 | 2.1% |
| **Total** | Total site area | **88.75** | **100.0%** |

Native vegetation within the proposed offset is predominantly in 'Excellent' condition (85.92 ha) with a small amount in 'Very Good' condition (0.93 ha). A total of 1.90 ha is in 'Completely Degraded' condition (comprised of cleared areas). A breakdown of vegetation condition within the Site is provided in Table 6-3.

**Table 6-3. Vegetation Condition - Proposed Offset Site (PGV, 2022)**

| Vegetation Condition | Area (ha) | Proportion of Site (%) |
|---|---|---|
| **Excellent** | 85.92 | 96.8% |
| **Very Good** | 0.93 | 1.0% |
| **Completely Degraded** | 1.90 | 2.1% |
| **Total** | 88.75 | **100.0**% |

### 6.2.2 Carnaby's Black Cockatoo Habitat

Bamford (2022) identified that the proposed offset site contains suitable foraging habitat for Carnaby's black cockatoo, with the dominant foraging species being *Banksia sessilis*. Foraging evidence was recorded during the survey. Bamford (2022) identified that the species is likely to be a visitor to the proposed offset site during the non-breeding season. The species may also be present in small numbers during the breeding season given

the areas of Tuart woodland vegetation present to the east, and Carnaby's black cockatoo has begun to breed in such areas in small numbers (Bamford, 2022).

### Breeding and Roosting Habitat

The proposed offset site does not provide suitable or potential breeding habitat given the absence of tall trees (Bamford, 2022).

### Foraging Habitat

The significant majority (97.9%) of the proposed offset site provides foraging habitat for Carnaby's black cockatoo. The primary foraging species is *Banksia sessilis*, which is an important foraging species.

Bamford (2022) assessed the quality of foraging habitat across the entirety of Lot 100 under a scoring tool developed in 2020. A summary of the foraging scores within the proposed offset site is presented in Table 6-4.

**Table 6-4. Carnaby's Black Cockatoo Foraging Quality within the Proposed Offset Site (Bamford, 2022)**

| Foraging Quality | Area (ha) | Proportion of Site (%) |
|---|---|---|
| **4 (moderate)** | 86.85 | 97.9% |
| **1 (negligible)** | 1.90 | 2.1% |

Given the area identified as having negligible foraging value does not contribute to foraging habitat for Carnaby's black cockatoo, the total extent of foraging habitat present is 86.85 ha.

DCCEEW have, more recently, developed a habitat quality scoring tool specifically for black cockatoo species. An assessment against this tool is presented in Table 6-5.

The extent and quality of foraging habitat for Carnaby's black cockatoo within the proposed offset site is shown on Figure 19.

**Table 6-5. Foraging Habitat Assessment against DCCEEW (n.d.) Habitat Quality Scoring Tool**

| Assessment of Site Condition (out of a possible 7) | | | |
|---|---|---|---|
| **Vegetation Type** | **Presence and Density of Foraging Species** | **Most Consistent Description from DCCEEW (n.d.)** | **Score Applied** |
| **BsCq** | *Banksia sessilis* ranging from 25% to 70% cover | Native kwongan heath and shrubland (>30% projected foliage cover), banksia and eucalypt woodlands with >50% projected foliage cover. Low percentage (< 5%) of tree deaths2. | 7 |

[2] No tree deaths indicate robustness of habitat, unlikely for the habitat to decline in the medium-term. Tree deaths may be owing to disease, water stress, fire, etc.

| Assessment of Site Condition (out of a possible 7) | | | |
|---|---|---|---|
| **Cleared** | Cleared land | No Proteaceae, eucalypts or other potential sources of food. May include bare ground or developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits). | 0 |
| **Weighted Site Average - Site Condition Score** | | | 6.85 |
| **Assessment of Site Context (out of a possible 3)** | | | |
| **Description** | | **Score Applied** | |
| **Site is within 12 km of other foraging resources with site condition of at least 3.** | | 3 | |
| **Combined Score** | | | |
| **Weighted Site Condition Score + Site Context Score** | | 10 (rounded to nearest whole number) | |

## 6.3 Calculation of Offset Size

The anticipated offset requirements to satisfy the EP Act have been determined using the DWER Environmental Offsets Metric (DWER, 2021) and associated guidance (DWER, 2021b; DWER, 2022). The anticipated offset requirements to satisfy the EPBC Act have been determined using the Commonwealth of Australia (2012b) Offset Assessment Guide and associated calculator (Commonwealth of Australia, 2012c).

A summary of inputs to the DWER Environmental Offsets Metric (DWER, 2021) is provided in Table 6-6 and the spreadsheet is provided as Appendix K.

### Table 6-6. Summary of Inputs to the DWER Environmental Offsets Metric

| Criteria | Value | Rationale |
|---|---|---|
| **Area** | 13.27 ha | This figure has been calculated based on the outcomes of the flora and vegetation survey (PGV 2020) and fauna assessment (Bamford 2021) undertaken to inform the Wattle Avenue East EPBC Act referral (2022/09326). |
| **Quality** | 9 | The site was assessed to have an average quality of 9 under the habitat quality scoring tool developed by DCCEEW (n.d.). The site comprises vegetation dominated by *Banksia sessilis* at moderate to high density. This was considered to have a vegetation structure and condition score of 6 (high).<br>The site is within 6 km of foraging resources inferred to have a vegetation structure and condition score of at least 3.<br>Carnaby's black cockatoo is known to forage within the site, and foraging residue was recorded throughout. |
| **Total quantum of impact** | 11.94 ha | Adjusted based on quality. |
| **Proposed offset area** | 88.75 | Offset requirement calculated to satisfy the requirements of the EPBC Act Offsets Calculator (provided in Table 6-7 and Appendix L) |
| **Current quality of offset site** | 10 | Foraging habitat for Carnaby's black cockatoo is present throughout the site, predominantly due to the presence of *Banksia attenuata* and *B. sessilis*. The most widespread foraging species is *B. sessilis*, which generally occurs in moderate |

| Criteria | Value | Rationale |
|---|---|---|
| | | density across the site. Based on an assessment against DCCEEW (n.d.) the majority (97.9%) of the site has a foraging score of 10 (very high). |
| **Future quality without offset** | 8 | Without the offset, the proposed offset site is expected to decline in quality. A report prepared by Maron et al. (2021) for the National Environmental Science Programme states that the quality of high-quality foraging habitat is likely to decline in condition over a 20-year period due to factors such as fire, grazing, natural attrition of foraging species, climate change, and dieback. Maron et al. (2021) identify that foraging habitat with an initial baseline score of 8 is likely to have a baseline score of 5.53 at 20 years (i.e. a reduction of 2.5 points).<br>In addition, further developmental pressures are faced by the proposed offset site given a portion is identified as a SGS (limestone) under SPP 2.4 and that limestone extraction has been previously approved over the site. It is therefore reasonably likely that limestone extraction could be approved within the site in the foreseeable future.<br>Given the site is currently under private ownership, is zoned for Rural land uses, has been previously approved for limestone and sand extraction, and it is expected that high-quality habitat will degrade over time in the absence of management (Maron et al., 2021) the future quality without offset is expected to be 8 (i.e. a reduction of 2 points). |
| **Future quality with offset** | 10 | WA Limestone propose to undertake active habitat improvement activities within the proposed offset site including infill planting within cleared areas (1.90 ha). The site will also be fenced to manage access by humans and vehicles and will reduce grazing by fauna.<br>In the longer term, the offset site is proposed to be transferred into the state conservation estate for management in perpetuity by DBCA. Under this change of management, unauthorised access will be prohibited, and the site will be managed in perpetuity.<br>Maron et al. (2021) identify that habitat protection can achieve an improvement in foraging habitat score (relative to the baseline) of between 1 and 2 points for Carnaby's black cockatoo. In this case, the habitat will be improved, and threats will be managed (in accordance with the above) to prevent any decline in habitat quality and seek to improve overall quality.<br>The transfer of the site to the State conservation estate will also preclude any potential limestone extraction that has been previously approved over the site, and that would have been sought due to the identification as a significant limestone resource under SPP 2.4. |
| **Time until ecological benefit** | 5 years | The environmental benefit of the offset will be realised once the site has been transferred to the State conservation estate, passive habitat protection and improvement activities have been completed (e.g. installation of fencing to control access by humans and reduce fauna grazing) and infill planting and weed management has been undertaken within completely degraded/cleared areas to increase the extent of habitat. |
| **Confidence in offset result (%)** | 80% | There is high confidence that in the absence of an offset over the site, the future quality of Carnaby's black cockatoo habitat would decline. The site is identified as an SGS, and limestone extraction has been approved over the site. This would allow limestone extraction across three quarries (and potentially further disturbance for associated infrastructure). Further, Maron et al. (2021) identify that high-quality foraging habitat is expected to decline over time and that habitat protection can achieve an improvement in foraging habitat score of between 1 and 2 points. |

| Criteria | Value | Rationale |
|---|---|---|
| **Duration of offset implementation (max. 20 years)** | 20 years | The site will be transferred to the State conservation estate and will therefore be managed by DBCA in perpetuity Therefore, the maximum value of 20 years has been assigned. |
| **Time until offset secured** | 2 years | The offset site is currently owned by WA Limestone and can be transferred into the State conservation estate within a short time period. |
| **Rik of future loss without offset** | 20% | A portion of the proposed offset site is identified as a SGS (limestone) under SPP 2.4, and limestone extraction has been previously approved over the site. The most recent approval was granted in 2012. As such, and given the site has been previously impacted by exploration, it is reasonably likely that limestone extraction could be approved within the site in the foreseeable future, resulting in a loss of foraging habitat for Carnaby's black cockatoo comprised of native vegetation in 'Excellent' condition. |
| **Risk of future loss with offset** | 5% | A value of 5% accounts for the risk of loss via unforeseen or unpredictable impacts (e.g. through extended periods of drought or fire). |
| **Offset value** | 23.70 ha | Value that the offset provides to counterbalance the significant residual impact. |
| **% of impact offset** | 198.5% | Calculated result verifying that well over 100% of the significant residual impacts will be offset by the proposed offset. |

A summary of inputs to the Commonwealth Offset Assessment Guide is provided in Table 6-7 and the spreadsheet is provided as Appendix L.

### Table 6-7. Summary of Inputs to the EPBC Act Environmental Offsets Calculator

| Criteria | Value | Rationale |
|---|---|---|
| **Area** | 13.27 ha | This figure has been calculated based on the outcomes of the flora and vegetation survey (PGV 2020) and fauna assessment (Bamford 2021) undertaken to inform the Wattle Avenue East EPBC Act referral (2022/09326). |
| **Quality** | 9 | The site was assessed to have an average quality of 9 under the habitat quality scoring tool developed by DCCEEW (n.d.). The site comprises vegetation dominated by *Banksia sessilis* at moderate to high density. This was considered to have a vegetation structure and condition score of 6 (high).<br>The site is within 6 km of foraging resources inferred to have a vegetation structure and condition score of at least 3.<br>Carnaby's black cockatoo is known to forage within the site, and foraging residue was recorded throughout. |
| **Total quantum of impact** | 11.94 ha | Adjusted based on quality. |
| **Time over which loss is averted** | 20 years | The site will be transferred to the State conservation estate and will therefore be managed by DBCA in perpetuity Therefore, the maximum value of 20 years has been assigned. |
| **Start area** | 88.75 ha | Based on all other values entered into the offset calculator, a total area of 160 ha will be required to offset 100% of the significant residual impacts resulting from the proposed action. |
| **Risk of loss without offset** | 0% | A 0% risk of loss without offset has been applied in accordance with the guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act (Maseyk et al., 2017). |

| Criteria | Value | Rationale |
|---|---|---|
| **Risk of loss with offset** | 0% | A value of 0% has been nominated as the offset site is to be secured via placement into the DBCA's conservation estate. |
| **Confidence in result (top row)** | 80% | A value of 80% has been nominated based on the site being transferred into the State conservation estate to be managed by DBCA. |
| **Time until ecological benefit** | 5 years | A value of five years has been nominated to allow implementation of on-ground activities to improve habitat quality at the site including infill planting, fencing, controlled access, and weed management where appropriate. |
| **Start quality** | 10 | Foraging habitat for Carnaby's black cockatoo is present throughout the site, predominantly due to the presence of *Banksia attenuata* and *B. sessilis*. The most widespread foraging species is *B. sessilis*, which generally occurs in moderate density across the site. Based on an assessment against DCCEEW (n.d.) the majority (97.9%) of the site has a foraging score of 10 (very high). |
| **Future quality without offset** | 8 | Without the offset, the proposed offset site is expected to decline in quality. A report prepared by Maron et al. (2021) for the National Environmental Science Programme states that the quality of high-quality foraging habitat is likely to decline in condition over a 20-year period due to factors such as fire, grazing, natural attrition of foraging species, climate change, and dieback. Maron et al. (2021) identify that foraging habitat with an initial baseline score of 8 is likely to have a baseline score of 5.53 at 20 years (i.e. a reduction of 2.5 points).<br><br>In addition, further developmental pressures are faced by the proposed offset site given a portion is identified as a SGS (limestone) under SPP 2.4 and that limestone extraction has been previously approved over the site. It is therefore reasonably likely that limestone extraction could be approved within the site in the foreseeable future.<br><br>Given the site is currently under private ownership, is zoned for Rural land uses, has been previously approved for limestone and sand extraction, and it is expected that high-quality habitat will degrade over time in the absence of management (Maron et al., 2021) the future quality without offset is expected to be 8 (i.e. a reduction of 2 points). |
| **Future quality with offset** | 10 | WA Limestone propose to undertake active habitat improvement activities within the proposed offset site including infill planting within cleared areas (1.90 ha). The site will also be fenced to manage access by humans and vehicles and will reduce grazing by fauna.<br>In the longer term, the offset site is proposed to be transferred into the state conservation estate for management in perpetuity by DBCA. Under this change of management, unauthorised access will be prohibited, and the site will be managed in perpetuity.<br>Maron et al. (2021) identify that habitat protection can achieve an improvement in foraging habitat score (relative to the baseline) of between 1 and 2 points for Carnaby's black cockatoo. In this case, the habitat will be improved, and threats will be managed (in accordance with the above) to prevent any decline in habitat quality and seek to improve overall quality.<br>The transfer of the site to the State conservation estate will also preclude any potential limestone extraction that has been previously approved over the site, and that would have been sought due to the identification as a significant limestone resource under SPP 2.4. |

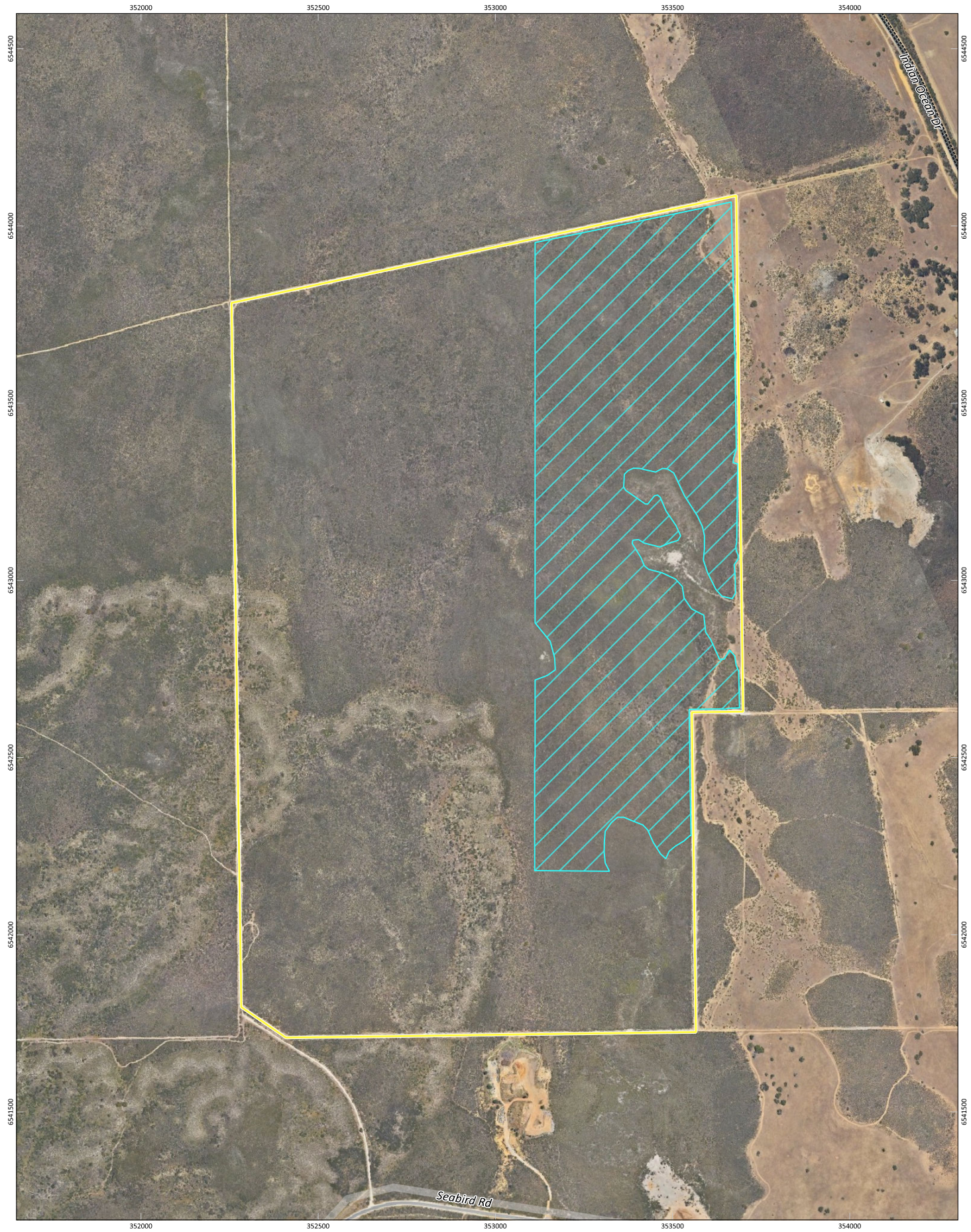
| Criteria | Value | Rationale |
|---|---|---|
| **Confidence in result (bottom row)** | 80% | There is high confidence that in the absence of an offset over the site, the future quality of Carnaby's black cockatoo habitat would decline. The site is identified as an SGS, and limestone extraction has been approved over the site. This would allow limestone extraction across three quarries (and potentially further disturbance for associated infrastructure). Further, Maron et al. (2021) identify that high-quality foraging habitat is expected to decline over time and that habitat protection can achieve an improvement in foraging habitat score of between 1 and 2 points. |
| **% of impact offset** | 112.01% | Calculated result verifying that well over 100% of the significant residual impacts will be offset by the proposed offset. |

## 6.4 Proposed Acquisition and Protection

The proposed offset will result in 86.85 ha high quality foraging habitat for Carnaby's black cockatoo being transferred to the State conservation estate. Consultation with DBCA has identified that the proposed site would be a valuable addition to the State conservation estate. The site will then be managed in perpetuity by DBCA.

## 6.5 Offset Management Plan

It is understood that an Offset Management Plan is likely to be required to facilitate the proposed action's approval under the EPBC Act. This will be developed in consultation with DCCEEW and DMIRS as the accredited assessment progresses.




# Figure 18: Proposed Offset Site

N

0 100 200 300 m

| | | |
|---|---|---|
| SCALE 1:10,000 | SHEET SIZE A3 COLOUR | |
| PROJECT/REPORT NAME: Wattle Avenue East Quarry, 311 Wattle Avenue East, Nowergup | CLIENT: WA Limestone | |
| COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50 | PROJECT NUMBER: A23.024 | VERSION: 0 |
| DATA SOURCE: LANDGATE AERIAL IMAGERY Summer 2023 | DRAWN BY / REVIEWED BY: HS / JB | DATE: 14/5/2024 |

**Legend**

Lot 100 Seabird Road, Breton Bay

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | HS | JB | 14/5/2024 |

NOTES:

Cadastral boundary (LGATE-002)

WESTERN ENVIRONMENTAL
Western Environmental Pty Ltd
08 6244 2310 | enquiries@westenv.com.au
Level 3/25 Prowse St, West Perth WA 6005
westenv.com.au

G:\GIS\Project Data\A23.024\A23.024.qgz

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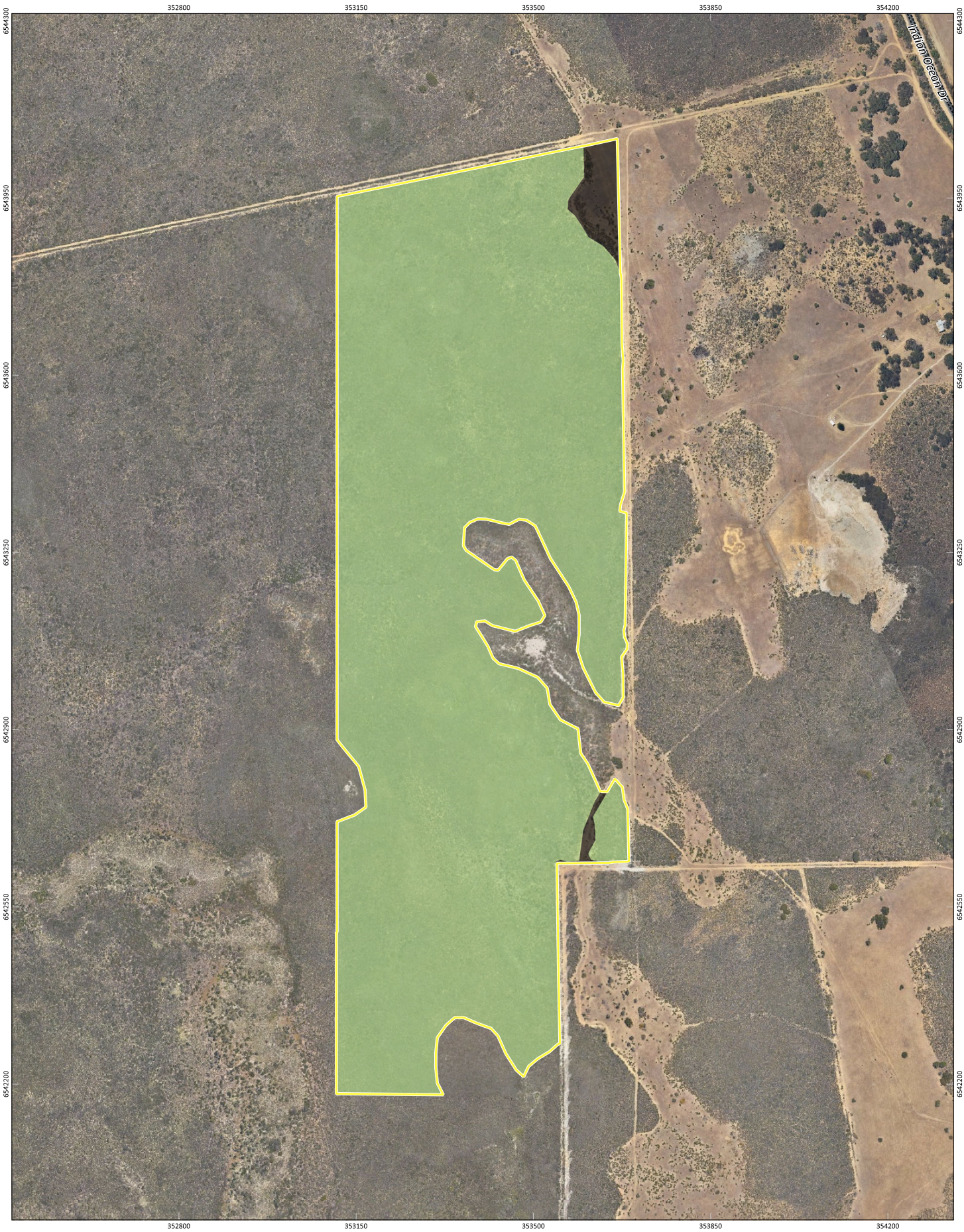



Figure 19: Carnaby's Black Cockatoo Foraging Habitat within the Proposed Offset Site

N

0 50 100 150 200 m

| | | |
|---|---|---|
| SCALE 1:7,000 | SHEET SIZE A3 COLOUR | |
| COORDINATE REFERENCE SYSTEM GDA2020 / MGA zone 50 | PROJECT NUMBER A23.024 | VERSION 0 |
| DATA SOURCE LANDGATE AERIAL IMAGERY Summer 2023 | DRAWN BY / REVIEWED BY HS / JB | DATE 15/5/2024 |

PROJECT/REPORT NAME
Wattle Avenue East Quarry
311 Wattle Avenue East, Nowergup

CLIENT
WA Limestone

**Legend**

Proposed Offset Site

**Carnaby's Black Cockatoo Foraging Habitat Quality**

Very High (10)

None (0)

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original issue | HS | JB | 15/5/2024 |

NOTES:

Cadastral boundary (LGATE-002)

WESTERN ENVIRONMENTAL
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# 7. Economic and Social Matters

### 7.1.1 Costs and Benefits of the Proposed Action

There are no feasible alternatives due to the geology and distribution of the Tamala Limestone, planning restrictions, conservation and economic factors.

The Tamala Limestone Deposits Under State Planning Policy 2.4 Planning for Basic Raw Materials (BRM) the limestone deposit at M 70/143 is recognised as a Significant Geological Source (SGS). SGS are identified as the highest priority extraction areas for BRM. SGS are BRM identified by the Department of Mines, Industry Regulation and Safety (DMIRS) that represent strategic, long-term supplies of BRM which is critical to the future development needs of the state and the community and requires protection (DMIRS, Accessed 2022)

State Planning Policy 2.4 (SPP 2.4) (2021) has been adopted which sterilizes large areas of Basic Raw Materials (BRM) including sand and limestone as “Exclusion Areas”, including virtually all of WA Limestone’s existing future reserves. This significantly reduces the area available for future limestone extraction and the remaining volume of limestone resource for the future development needs of the state (Figure 3, SPP Exclusion Areas)

Exclusion Areas which came into effect in 2021 after the 2019 permit was approved have sterilised significant amounts of alternative limestone and further reduced alternative sources. This has occurred at M70/143 with a significant portion of the area under SPP 2.4 Exclusion Area.

The objectives of State Planning Policy 2.4 (SPP 2.4) are to identify and protect significant limestone and other Basic Raw Materials (BRM) resources required by the community and future development. SPP 2.4 identifies the subject site as both a "Priority Resource Location" and "Key Extraction Area". This is the highest level of significance able to be given to a Basic Raw Materials site. Limestone deposits occurring at Wanneroo/Yanchep area remain the only SGS left in the Perth Metropolitan Area and represent the last economically viable high-quality deposits not sterilised by conservation and planning policies (SPP 2.4 2021).

The next nearest alternative limestone deposits are located at Guilderton and Seabird, around 50 kilometers to the north. However, these limestone deposits are typically shallow and of low quality, unsuitable for construction use, and due to the additional transport costs are not economically feasible.

The location and quality of the Tamala limestone in the north metro area is critical to the economic viability of public amenity projects. Its proximity to the north metro area makes the limestone a valuable economic material for Main Roads and Development WA. Other deposits located further to the north at Guilderton and Seabird are low quality and cost prohibitive to these projects.

Transport costs are a significant component of any public development. The further out limestone is the higher costs of construction increasing pressure on public infrastructure project costs to entities like Development WA and Main Roads. Carbon emissions will rise from hauling from further away impacting WA’s net zero emissions targets.

The only feasible alternative construction to limestone in the Neerabup/Carabooda region is granite from the Darling Scarp. Granite is substantially more expensive to extract and transport, and the granite quarries are similarly constrained by environmental factors.

The clearing at M 70/143 represents some of the last remaining limestone available for extraction that can still be accessed that is not under conservation, in an exclusion zone under SPP 2.4 or residential development.

### 7.1.2 Details of Public and/or Indigenous Stakeholder Consultation

Consultation has been limited to that associated with gaining the approval from the tenement holder, Adelaide Brighton Cement Ltd to conduct clearing and commence the approval process.

No other consultation has occurred with the community or indigenous stakeholders, nor will occur, as the site is an active mining tenement (quarry site) that has been in operation since 1983.

The community and other interested parties will have the opportunity to comment on the proposed clearing when the Clearing Permit application is published by DMIRS, and again when this referral under the EPBC Act is advertised.

# 8. Environmental History of the Person Proposing to Take the Action

## 8.1 Details of any Proceedings under a Commonwealth, State or Territory Law for the Protection of the Environment or the Conservation and Sustainable Use of Natural Resources

WA Limestone has referred the following actions to the Commonwealth under the EPBC Act (not including withdrawn referrals:

- 2020/8726 Wilga Quarry Expansion, WA
- 2020/8830 Lot 170 Hope Valley Road, Hope Valley Commercial Development, WA
- 2017/7873 Roebourne Quarry, WA
- 2013/6832 Continuation of quarrying sand and limestone, Lot 800 Kerosene Lane, Baldivis, WA
- 2010/5649 Clearing of 22 ha vegetation to allow for the continuation of quarrying Millar Road Rockingham, WA
- 2009/5101 Earthworks and Excavation of Lots 2, 13 & 22 Old Coast Road Herron, WA

## 8.2 Details of the Corporation's Environmental Policy and Planning Framework

All WA Limestone sites and projects are certified to ISO 14001 since 2015. No environmental incidents or substantiated complaints in the past 10 years against the company.

WA Limestone is a group of family-owned Western Australian companies that have operated for over 40 years. With a strong emphasis on customer service the WA Limestone group has become one of the largest suppliers of construction materials in Western Australia, with operations strategically located throughout the state. From these locations, WA Limestone supplies over 30 different types of construction materials products to contractors, State government, Local government, and the wider Western Australian public. The WA Limestone Group includes WA Limestone, WA Limestone Contracting, WA Bluemetal, and WA Premix under its banner.

### 8.2.1 Environmental Policy

#### *Vision*

“To minimise harm to the environment by conducting all phases of our operations in an environmentally responsible manner”.

### *Commitments*

WA Limestone is committed to:

- The prevention of pollution and protection of the natural environment Compliance with environmental laws, regulations and obligations Continuous improvement to enhance environmental performance.
- Undertaking all phases of business activities in an environmentally responsible manner through effective management practices.
- Considering environmental aspects as an essential element when evaluating the life cycle of the company's activities, products, and services.

### *Application*

This policy provides the basis for WA Limestone's ISO14001 accredited Environmental Management System (EMS) and Environmental Objectives and Targets. Compliance with the company's EMS, Objectives and Targets is evaluated on a regular basis and action taken where appropriate. The Managing Directors are accountable for ensuring that this policy is implemented. This policy will be reviewed annually. This policy applies to all employees, contractors and visitors engaged in activities under the control of the WA Limestone group of companies.

# 9. Ecologically Sustainable Development

### 9.1.1 Discussion of how the Proposed Action meets the Principles of Ecologically Sustainable Development as defined in s3A of the EPBC Act

WA Limestone is a local family-owned construction materials company, with a strong record of responsible environmental management over more than 50 years' operating sand and limestone quarries in the Perth region.

All WA Limestone sites and projects have been certified to ISO 14001 since 2015. There are no proceedings for the protection of the environment or the conservation and sustainable use of natural resources against the proponent.

WA Limestone's environmental management has been recognized by a number of awards including:

- 2010 Civil Contractors Federation Earth Award (WA) (Category 5).
- 2012 Cement Concrete and Aggregates Australia (CCAA) Environmental Best Practice Award for Extractive Industry Operations (WA).
- 2012 Civil Contractors Federation Earth Award (WA) (Category 1).
- 2013 Civil Contractors Federation Earth Award (WA) (Category 3).
- 2014 Cement Concrete and Aggregates Australia (CCAA) Environmental Best Practice Award for Extractive Industry Operations (WA).
- 2019 Cement Concrete and Aggregates Australia (CCAA) Environmental Innovation (WA) (Special Commendation).
- 2020 Cement Concrete and Aggregates Australia (CCAA) Environmental Innovation (WA).

An assessment of implementation of the Principles of Ecologically Sustainable Development as defined in s3A of the EPBC Act is summarised in Table 9-1.

**Table 9-1: Implementation of the Principles of Ecologically Sustainable Development as defined under the EPBC Act within the Proposed Action**

| Principle | |
|---|---|
| **Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.** | WA Limestone has undertaken an assessment of the proposed excavation works in accordance with State Planning Policy 2.4 4 Planning for Basic Raw Materials to determine long-term as well as short-term impacts and benefits.<br>Avoidance measures have been considered to avoid and reduce short-term as well as potential long-term impacts |

| Principle | |
|---|---|
| | to threatened species, such as Carnaby's cockatoo and Yanchep mallee.<br>Mitigation measures will be implemented to reduce any indirect impacts as far as possible.<br>The existing Mine Closure Plan will be extended to cover the expansion area, which will This includes a rehabilitation plan. |
| **If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.** | Where significant impacts cannot be avoided, offsets will be provided.<br>An offset strategy is currently being developed to offset the loss of 13.41 ha of Carnaby's Cockatoo habitat. WA Limestone acknowledges that the development of an offset management plan will be required which will be developed subsequent Native Vegetation Clearing Permit application. |
| **The principle of inter-generational equity--that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.** | WA limestone has avoided, reduced and mitigated all long-term impacts to the best of their ability. A rehabilitation plan has been included in the existing Mine Closure Plan. Rehabilitation is undertaken for all WA Limestone extraction projects to restore habitat similar to the one lost. Long-term effects are therefore reduced as far as possible while significant raw resources can be extracted to ensure the supply of quality resources for future development. |
| **The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.** | WA Limestone has an environmental policy in place as outlined above.<br>WA Limestone has thoroughly assessed environmental values present and potential impacts resulting from the proposed action. The impact footprint has been reduced accordingly from 30.61 ha to 15.06 ha of native vegetation. Impacts to Yanchep mallee were avoided (Figure 17). |
| **Improved valuation, pricing and incentive mechanisms should be promoted.** | SPP 2.4 identifies the subject site as both a "Priority Resource Location" and "Key Extraction Area" for limestone. This is the highest level of significance able to be given to a Basic Raw Materials site. Limestone deposits occurring at Wanneroo/Yanchep area remain the only SGS left in the Perth Metropolitan Area and represent the last economically viable high-quality deposits not sterilised by conservation and planning policies (DPIRD, 2021).<br>The closest alternative limestone deposits are located 50 km to the north and are of low quality. The associated transport costs and low quality make it unfeasible to use these deposits for construction and public amenity under Main Roads and Development WA.<br>The reduced transport distance from the Wattle Ave quarry to the Perth Metropolitan Area reduces greenhouse gas emissions supporting WA's net zero targets. |

| Principle | |
|---|---|
| | The already existing quarry adjacent to the Site provides access infrastructure that can be used for the expanded Site. Only minor works will have to be undertaken to elongate infrastructure requirements for the expansion. This saves costs as well as carbon emissions and other potential impacts from construction. |

# 10. References

Bamford Consulting Ecologists (Bamford). (2020). Scoring system for the assessment of foraging value of vegetation for Black-Cockatoos. Revised 5th. Retrieved in March 2023 from https://ecologists.bamford.id.au/ecological-consulting/black-cockatoos.

Bamford Consulting Ecologists (Bamford). (2022). WA Limestone Wattle Avenue East Project Fauna Assessment. Unpublished report prepared for WA Limestone.

Beard, J. S. (1981). Vegetation Survey of Western Australia 1:1,000,000 Vegetation Series. Map Sheet 7 - Swan. University of Western Australia Press, Western Australia.

Brown, A., Thomson-Dans, C., & Marchant, N. (eds). (1998). *Western Australia's Threatened Flora*, Department of Conservation and Land Management, Western Australia.

Burbridge, A. A. (2004). *Threatened Animals of Western Australia.* Department of Conservation and Land Management, Kensington, Western Australia.

Bush, B., Maryan, B., Browne-Cooper, R. and Robinson, D. (2010). Field Guide to Reptiles and Frogs of the Perth Region. Western Australian Museum, Welshpool, Western Australia.

Coffey environments (2010) Flora and Vegetation Assessment M70/138 Hopkins Road, Nowergup. Unpublished report.

Department of Biodiversity, Conservation and Attractions (DBCA). (2018). *Carnabys Cockatoo Confirmed Breeding Areas within the Swan Coastal Plain and Jarrah Forest IBRA Regions (DBCA-054).* Retrieved in March 2023 from https://catalogue.data.wa.gov.au/dataset/carnabys-cockatoo-confirmed-breeding-areas.

Department of Biodiversity, Conservation and Attractions (DBCA). (2019). *Black Cockatoo Breeding Sites - Buffered (DBCA-063).* Retrieved in March 2023 from https://catalogue.data.wa.gov.au/dataset/geomorphic-wetlands-swan-coastal-plain.

Department of Biodiversity, Conservation and Attractions (DBCA). (2023). *Geomorphic Wetlands, Swan Coastal Plain (DBCA-019).* Retrieved in March 2023 from https://catalogue.data.wa.gov.au/dataset/geomorphic-wetlands-swan-coastal-plain.

Department of Biodiversity, Conservation and Attractions (DBCA). (2023b). Conservation Category Definitions for Western Australian Fauna and Flora. Available from: file:///C:/Users/hannah.s/Downloads/conservation_codes_for_western_australian_flora_and_fauna.pdf

Department of Climate Change, Energy, the Environment and Water (DCCEEW). (2023a). Interim Biogeographic Regionalisation for Australia (IBRA) Version 7 (Regions). Retrieved in march 2023 from https://fed.dcceew.gov.au/datasets/erin::interim-biogeographic-regionalisation-for-australia-ibra-version-7-regions-1.

Department of Climate Change, Energy, the Environment and Water (DCCEEW). (2023b). Species Profile and Threats Database. Retrieved in March 2023 from http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

Department of Environment and Conservation (DEC). (2008). *Records held in DEC's Declared Flora Database and rare flora files.* Perth, Western Australia: WA DEC.

Department of Environment and Conservation (DEC). (2012). *Chuditch (*Dasyurus geoffroii*) Recovery Plan. Wildlife Management Program No. 54*. Department of Environment and Conservation, Perth, Western Australia. Retrieved in March 2023 from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/dasyurus-geoffroii-2012. In effect under the EPBC Act from 22-Mar-2013.

Department of the Environment and Energy. (2016). *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain Ecological Community*. Canberra: Department of the Environment and Energy. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=131

Department of Environment Regulation. (2014). *A guide to native vegetation clearing processes under the assessment bilateral agreement between the Commonwealth of Australia and Western Australia under the* Environment Protection and Biodiversity Conservation Act 1999 *and* Environment Protection Act 1986. *Clearing Regulation Guideline 6*, DER2014/1118. Perth, Western Australia. https://www.der.wa.gov.au/images/documents/your-environment/native-vegetation/Guidelines/Guide-to-native-vegetation-clearing-processes-under-assessment-bilateral-agreement.pdf.

Department of Environment, Water, Heritage and the Arts (DEWHA). (2008). Approved Conservation Advice for *Eucalyptus argutifolia* (Yanchep Mallee). Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/24263-conservation-advice.pdf

Department of Parks and Wildlife (DPaW). (2013). Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan. Department of Parks and Wildlife, Perth, Western Australia. Available from: http://www.environment.gov.au/resource/carnaby%E2%80%99s-cockatoo-calyptorhynchus-latirostris-recovery-plan. In effect under the EPBC Act from 30-Jan-2014 as *Calyptorhynchus latirostris*.

Department of Planning, Lands and Heritage (DPLH). (2021). *State Planning Policy 2.4 Planning for Basic Raw Materials* (SPP 2.4).

Department of Planning, Lands and Heritage (DPLH). (2023). Aboriginal Cultural Heritage Inquiry System. Retrieved in March 2023 from https://espatial.dplh.wa.gov.au/ACHIS/index.html?viewer=ACHIS.

Department of Primary Industries and Regional Development (DPIRD). (2019). *Pre-European Vegetation (DPIRD-006).* Retrieved in March 2023 from https://catalogue.data.wa.gov.au/dataset/pre-european-dpird-006.

Department of Primary Industries and Regional Development (DPIRD). (2022a). *Soil Landscape Mapping - Systems (DPIRD-064).* Retrieved in March 2023 from https://catalogue.data.wa.gov.au/dataset/soil-landscape-mapping-systems.

Department of Primary Industries and Regional Development (DPIRD). (2022b). *Soil Landscape Mapping - Best Available (DPIRD-027).* Retrieved in March 2023 from https://catalogue.data.wa.gov.au/dataset/soil-landscape-mapping-best-available.

Department of Primary Industries and Regional Development (DPIRD). (2022). NRInfo (natural resource information) for Western Australia. Available from https://dpird.maps.arcgis.com/apps/webappviewer/index.html?id=662e8cbf2def492381fc915aaf3c6a0f. Accessed 15 January 2024.

Department of Primary Industries and Regional Development (DPIRD). (2023). *Native Vegetation Extent (DPIRD-005*). Retrieved in January 2024 from https://catalogue.data.wa.gov.au/dataset/native-vegetation-extent.

Department of the Environment (DoE). (2013). Matters of National Environmental Significance. Significant Impact Guidelines 1.1. Retrieved in march 2023 from https://www.dcceew.gov.au/sites/default/files/documents/nes-guidelines_1.pdf.

Department of Water and Environmental Regulation (DWER). (2017). *Acid Sulfate Soil Risk Map, Swan Coastal Plain (DWER-055)*. Retrieved in march 2023 from https://catalogue.data.wa.gov.au/dataset/acid-sulphate-soil-risk-map-swan-coastal-plain-dwer-055.

Department of Water and Environmental Regulation (DWER). (2019). *Water Quality Protection Note no. 15: Basic Raw Materials Extraction.* Government of Western Australia. Available from: https://www.wa.gov.au/system/files/2022-06/WQPN-15-Basic-raw-materials-extraction.pdf

Ford, J. (1980). Morphological and ecological divergence and convergence in isolated populations of the Red-tailed Black-Cockatoo. *Emu* 80: 103-120.

GHD (2014) Cockburn Cement Ltd. Nowergup tenements Flora & fauna assessment report. Unpublished report

Government of Western Australia (2019a). *2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis* (Full Report). Current as of March 2019. Department of Biodiversity, Conservation and Attractions, Perth, Western Australia.

Government of Western Australia. (2019b). *2018 South West Vegetation Complex Statistics*. Current as of March 2019. Department of Biodiversity, Conservation and Attractions, Perth, Western Australia.

Grayling, P., & Brooker, M. (1992). *Four new species of Eucalyptus (Myrtaceae) from Western Australia*. Nuytsia, 8(2), pp. 209-218.

Groom, C. (2011). Plants Used by Carnaby's Black Cockatoo. Department of Environment and Conservation, Perth, Western Australia.

Groves C. P. (2005). Order Peramelemorphia. Pp. 38–42 in *Mammal species of the world* (D. E. Wilson D. A. M. Reeder, eds.). 3rd ed. John Hopkins University Press, Baltimore, Maryland.

Haby, N. A., Conran, J. G., and Carthew, S. M. (2013). Microhabitat and vegetation structure preference: an example using southern brown bandicoots (*Isoodon obesulus obesulus*). *Journal of Mammalogy* 94: 4, pp. 801-812.

Heddle, E. M., O. W. Loneragan, and J. J. Havel. (1980). Vegetation complexes of the Darling System, Western Australia. Pages 37–74 Atlas of Natural Resources, Darling System, Western Australia. Department of Conservation and Environment, Perth, Western Australia.

Hopper, S., & Gioia, P. (2004). The Southwest Australian Floristic Region: Evolution and Conservation of a Global Hot Spot of Biodiversity. *Annual Review of Ecological, Evolution, and Systematics* 35:623-50.

How, R. A. and Shine, R. (1999). Ecological traits and conservation biology of five fossorial "sand-swimming" snake species (Simoselaps: Elapidae) in south-western Australia. *Journal of Zoology* 249: 269-282.

Howard, K. H., Barrett, G., Ramalho, C. E., Friend, J. A., Boyland, R. J. I., Hudson, J. and Wilson, B. (2014). Community Quenda Survey 2012. Report prepared by WWF Australia and the Department of Parks and Wildlife, Perth, Western Australia.

IUCN (2011) Guidelines for using the IUCN Red List Categories and Criteria. Version 9.0 (September 2011).

Johnstone, R. E. and Kirkby, T. (1999). Food of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* in south-west Western Australia. *The Western Australian Naturalist* 22: 167-177.

Johnstone, R. E., Kirkby, T. and Sarti, K. (2013a). The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. I. Characteristics of nest trees and nest hollows. *Pacific Conservation Biology* 19: 121-142.

Johnstone, R. E., Kirkby, T. and Sarti, K. (2013b). The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. II. Breeding behaviour and diet. *Pacific Conservation Biology* 19: 143-155.

Keighery, G. J., & Keighery, B. J. (2015). Wild Perth-The past and present plant communities and plants of the bushland between Perth and the coast. WA Wildflower Society, Nedlands.

Keiper, P., and Johnson, C. N. (2004). Diet and habitat preference of the Cape York short-nosed bandicoot (*Isoodon obesulus peninsulae*) in north-east Queensland. *Wildlife Research* 31: 259–65.

Le Roux, C. (2017). Nocturnal roost tree, roost site and landscape characteristics of Carnaby's Black-Cockatoo (*Calyptorynchus latirostris*) on the Swan Coastal Plain. Edith Cowan University. Retrieved in March 2023 from https://ro.ecu.edu.au/theses/2017.

Menkhorst, P. and Knight, F. (2011). A Field Guide to the Mammals of Australia. Oxford University Press, Melbourne, Victoria.

Mitchell, D. S., Williams, K. and Desmond, A. (2003). Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion). In: CALM (Ed.) A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002, pp. 606-623. Department of Conservation and Land Management, Perth, Western Australia.

Peck, A., Barrett, G. and Williams, M. (2019). The 2019 Great Cocky Count: a community-based survey for Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*), Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) and Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*). BirdLife Australia, Perth, Western Australia.

PGV Environmental. (2021). M70/143 Wattle Avenue East, Nowergup. Flora and Vegetation Survey. Unpublished report prepared for WA Limestone.

Saunders, D.A. (1990). Problems of survival in an extensively cultivated landscape: the case of Carnaby's Cockatoo *Calyptorhynchus funereus latirostris*. *Biological Conservation* 54: 277-290.

Saunders, D.A., Rowley, I., and Smith, G.T. (1985). The effects of clearing for agriculture on the distribution of cockatoos in the southwest of Western Australia. In: *Birds of Eucalypt Forests and Woodlands: Ecology, Conservation, Management*. (Eds. A. Keast, H.F. Recher, H. Ford and D. Saunders) Pp. 309-321. Surrey Beatty & Sons, Chipping Norton.

Shepherd, D. P., Beeston, G. R., and Hopkins, A. J. (2002). *Native vegetation in Western Australia: extent, type and status*. Department of Primary Industries and Regional Development, Western Australia, Perth. Report 249.

Soderquist, T. R. (1988). The ecology of Chuditch (*Dasyurus geoffroii*) in the Jarrah forest: a summary of facts relevant to management. Unpublished document.

Threatened Species Scientific Committee (TSSC). (2019). Conservation Advice Melaleuca sp. Wanneroo (G.J. Keighery 16705). Canberra: Department of the Environment and Energy. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/89456-conservation-advice-04072019.pdf. In effect under the EPBC Act from 04-Jul-2019.

Travouillon, K. J. and Phillips, M. J. (2018). Total evidence analysis of the phylogenetic relationships of bandicoots and bilbies (Marsupialia: Peramelemorphia): reassessment of two species and description of a new species. *Zootaxa* 4378: 224-256.

Van Dyck, S., & Strahan, R. (Eds). (2008). Mammals of Australia. New Holland Publishers, Sydney, New South Wales.

Watson, N. (2018). Habitat preferences and the effect of habitat reduction on the quenda (Isoodon fusciventer) in an urban environment.

Western Australian Herbarium (WAH) (n.d.). Florabase—the Western Australian Flora. Department of Biodiversity, Conservation and Attractions. Retrieved in March 2023 from https://florabase.dbca.wa.gov.au/.

Western Environmental Approvals Pty Ltd (WEPL). (2024). Wattle Avenue East Quarry Targeted Flora Searches (EPBC 2023/09326). Unpublished report prepared for WA Limestone.

# Appendix A EPBC 2022/09326

Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC ref: 2022/09326

Campbell Sinclair
Environmental Advisor
P.M.R. Quarries Pty Ltd
401 Spearwood Avenue, Bibra Lake, WA, 6163

## Decision on referral for Wattle Avenue East Quarry

Dear Mr Sinclair

Thank you for submitting a referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This is to advise you of my decision about the referral of the proposed action to clear vegetation to facilitate a quarry pit extension, including stockpile and storage areas, access tracks, and associated infrastructure at 311 Wattle Avenue East, 6032, Nowergup in the City of Wanneroo, Western Australia.

### Decision on referral

As a delegate of the Minister for the Environment and Water, I have decided under section 75 of the EPBC Act that the proposed action is a controlled action. Further assessment is needed before a decision can be made on whether or not approval can be granted under the EPBC Act.

The information I have considered indicates that the proposed action is likely to have a significant impact on the following matters protected by the EPBC Act:

- listed threatened species and communities (section 18 & section 18A).

Based on the information available in the referral, the proposed action is likely to have a significant impact on the following matters of national environmental significance, including but not limited to:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) – Endangered.
    - The proposed action involves clearing 15.34 ha of native vegetation that is known to provide high quality foraging habitat for black cockatoos.
- Yanchep Mallee (*Eucalyptus argutifolia)* – Vulnerable
    - The proposed action is likely to have significant impacts on Yanchep Mallee due to the influence of edge effects.
- *Melaleuca* sp. Wanneroo – Endangered
    - There is the possibility of significant impacts on *Melaleuca* sp. Wanneroo, however further assessment will be required, including to ascertain presence or absence of this species at the project site.

- Chuditch *(Dasyurus geoffroii)* – Vulnerable
    - There is the possibility of significant impacts on Chuditch, however further assessment will be required, including to ascertain presence or absence of this species at the project site.

A copy of the document recording this decision is attached (Attachment A) and will be published on the department's website.

Please note that this decision only relates to the potential for significant impacts on matters protected by the Australian Government under Chapter 2 of the EPBC Act.

**Decision on assessment approach**

At this stage, a decision has not been made on the assessment approach for the proposed action. Based on the information in the referral, I consider that under section 76(3) of the EPBC Act that further information is required to make an informed decision on the assessment approach. Under section 88(4) of the EPBC Act this request for further information pauses the clock on the assessment approach decision. This will be done to allow you to submit an application to the Western Australian Department of Water and Environmental Regulation (DWER) or the Western Australia Environmental Protection Agency (WA EPA). The clock will resume once the Department receives your confirmation that DWER or the WA EPA has agreed to undertake a bilateral or accredited assessment.

**Cost Recovery**

Under subsection 520(4A) of the EPBC Act and the *Environment Protection and Biodiversity Conservation Regulations 2000* (EPBC Regulations), your assessment is subject to cost recovery. We will provide a fee schedule once the assessment approach has been decided. Further details on cost recovery are available on the department's website.

**Further guidance**

I have also written to the following parties to advise them of this decision:

| | |
|---|---|
| State Minister | Michelle Andrews, Delegated contact for the West Australian Minister for Environment and Climate Change, the Hon Reece Raymond MLA |

Please also note that once a proposal to take an action has been referred under the EPBC Act, it is an offence under section 74AA(1) to take any component of the action while the decision-making process is ongoing (some exemptions may apply). Persons convicted of an offence under this provision of the EPBC Act may be liable for a penalty of up to 500 penalty units.

The Department has published an Environmental Impact Assessment Client Service Charter which outlines the Department's commitments when undertaking environmental impact assessments under the EPBC Act.

If you have any questions about the referral process or this decision, please contact the project manager, Milly Filmer, by email to milly.filmer@dcceew.gov.au and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely



Kylie Calhoun
Branch Head
Environment Assessments West (WA, SA, NT) Branch

28 February 2023

**Attachments:**

Attachment A: Notice recording the CA decision.

# Appendix B Mine Closure Plan

# MINE CLOSURE PLAN

## M70/143

## Wattle Avenue East
## Nowergup

## Extraction Limestone
## (Subleases 7 and 8 - UrbanStone)

**PROJECT CODE J02034**
**SITE CODE S02223170**

## ADELAIDE BRIGHTON CEMENT LTD

30 JULY 2015


Address ADELAIDE BRIGHTON CEMENT LTD
C/- Austwide Mining Title Management Pty Ltd
PO Box 1434
Wangara WA 6947

Phone 08 9411 1000
sales@cockburncement.com.au

| No | Mine Closure Plan (MCP) checklist | Y/N NA | Page No. | Comments |
|---|---|---|---|---|
| 1 | Has the Checklist been endorsed by a senior representative within the tenement holder/operating company? (See bottom of checklist) | Y | | |
| 2 | How many copies were submitted to DMP? | Hard Copies = 1<br>Electronic = 1 | | |
| **Cover Page, Table of Contents** | | | | |
| 3 | Does the cover page include:<br>• Project Title;<br>• Company Name;<br>• Contact Details (including telephone numbers and email addresses);<br>• Document ID and version number;<br>• Date of submission (needs to match the date of this checklist). | Y | | |
| 4 | Has a Table of Contents been provided? | Y | | |
| **Scope and Project Summary** | | | | |
| 5 | State why the MCP is submitted (as part of a Mining Proposal of a reviewed MCP or to fulfill other legal requirements) | Y | | Part of ongoing mine management |
| 6 | Does the project summary include:<br>• Land ownership details;<br>• Location of the project;<br>• Comprehensive site plan(s);<br>• Background information on the history and status of the project. | Y | | Section 2.0 |
| **Legal Obligations and Commitments** | | | | |
| 7 | Has a consolidated summary or register of closure obligations and commitments been included? | Y | | Section 3.0 |
| **Data Collection and Analysis** | | | | |
| 8 | Has information relevant to mine closure been collected for each domain or feature (including pre-mining baseline studies, environmental and other data)? | Y | | Section 4.0 |
| 9 | Has a gap analysis been conducted to determine if further information is required in relation to closure of each domain or feature? | Y | | Section 7.3 |
| **Stakeholder Consultation** | | | | |
| 10 | Have all stakeholders involved in closure been identified? | Y | | Section 5.0 |
| 11 | Has a summary or register of stakeholder consultation been provided, with details as to who has been consulted and the outcomes? | Y | | Section 5.0 |
| **Final and use(s) and Closure Objectives** | | | | |
| 12 | Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram? | Y | | Section 8.0 |

| | | | | |
|---|---|---|---|---|
| 13 | Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)? | Y | | Section 6.0 |
| **Identification and Management of Closure Issues** | | | | |
| 14 | Does the MCP identify all key issues impacting mine closure objectives and outcomes? | Y | | Section 6.0 - 8.0 |
| 15 | Does the MCP include proposed management or mitigation options to deal with these issues? | Y | | Section 8.0 |
| 16 | Have the process, methodology, and rationale been provided to justify identification and management of the issues? | Y | | Section 8.0 |
| **Closure Criteria** | | | | |
| 17 | Does the MCP include an appropriate set of specific closure criteria and closure performance indicators? | Y | | Section 8.0 |
| **Closure Financial Provisioning** | | | | |
| 18 | Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring? | Y | | Section 10.0 |
| 19 | Does the MCP include a process for regular review of the financial provision? | Y | | Section 10.0 |
| **Closure Implementation** | | | | |
| 20 | Does the reviewed MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site? | Y | | Section 9.0 |
| 21 | Does the MCP include a closure work program for each domain or feature? | Y | | Section 9.0 |
| 22 | Have site layout plans been provided to clearly show each type of disturbance? | Y | | Figures |
| 23 | Does the MCP contain a schedule of research and trial activities? | Y | | Section 7.1 |
| 24 | Does the MCP contain a schedule of progressive rehabilitation activities? | Y | | Section 8.3 – 12.0 |
| 25 | Does the MCP include details of how unexpected closure and care and maintenance will be handled? | Y | | Section 8.4 |
| 26 | Does the MCP contain a schedule of decommissioning activities? | Y | | Section 8.0 |
| 27 | Does the MCP contain a schedule of closure performance monitoring and maintenance activities? | Y | | Section 9.0 |
| **Closure Monitoring and Maintenance** | | | | |
| 28 | Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance? | Y | | Section 11.0 |
| **Closure Information and Data Management** | | | | |
| 29 | Does the mine closure plan contain a description of management strategies including systems, and processes for the retention of mine records? | Y | | Section 12.0 |
| 30 | Confidentiality | N/A | | |

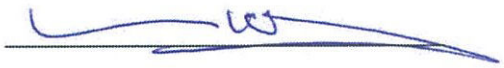
**CORPORATE ENDORSEMENT:**

I hereby certify that to the best of my knowledge, the information within this Mine Closure Plan and checklist is true and correct and addresses all the requirements of the Guidelines for the Preparation of a Mine Closure Plan approved by the Director General of Mines.

**M70/143**

Name: MICHAEL FALCONER

Position: REGISTERED MANAGER

Signed: 

Date: 30 July 2015

(NB: the corporate endorsement must be given by tenement holder (s) or a senior representative authorised by the tenement holder (s), such as a Registered Manager or Company Director.

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**APPENDICES**

**SEE ATTACHED CD**

1 Flora Study – Coffey Environments 2010
3 Department of Aboriginal Affairs Database Search
4 EPBC database Search

Landform Research
Land Systems - Quarries - Environment
ABN 29 841 445 694

Prepared by

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## 1.0 SCOPE AND PURPOSE

This Mine Closure Plan is submitted to fulfill the requirements of the tenement conditions and to prescribe the methods that will be used for mine closure.

## 2.0 PROJECT OVERVIEW

Adelaide Brighton Cement Ltd extracts limestone from M70/143 through a sublease arrangement with Urbanstone on Subleases 7 and 8.

Dimension limestone blocks and limestone rubble are produced for use in the manufacture of reconstituted limestone blocks offsite.

The limestone leaves site as either natural dimension stone or limestone rubble.

Access is from Wattle Avenue East with lockable gates maintained at the entrance.

### CONTACTS

Contact General Manager

URBANSTONE PTY LTD
27 Jandakot Road
Jandakot WA 6164

Phone 08 9414 8151
admin@urbanstone.com.au

### LOCATION

The mining tenement is located off Wattle Avenue East, Nowergup, centred on 31 degrees 39 minutes S and 115 degrees 39 minutes E.

The site lies in part of the State Forest 65, approximately just north of Shire View Hill 11 km north from Wanneroo.

The resource lies on Geological Survey of Western Australia, Perth 1 : 250 000 geological mapsheet; SH 50 14.

## 2.1 Resource Sought

Basic Raw Materials, including the resources on site of limestone, are of State significance.

***Uses of the Limestone***

Basic raw materials are essential for the construction and maintenance of all developments; such as roads, subdivisions, buildings, bridges, ports and rail lines.

- Almost every house on the Swan Coastal Plain is constructed using significant amounts of construction materials including sand for concrete and fill.
- Every road on the Swan Coastal Plain is constructed from limestone.
- The limestone is of high grade, and from this site is used for the sourcing of natural dimension stone blocks that are used for facings of buildings and landscaping and the manufacture of reconstituted limestone construction and landscaping blocks and features.
- The use of the limestone depends on the nature of the limestone, its colour, grade and percentage of $CaCO_3$. These characteristics vary quite quickly both laterally and vertically and as they change the limestone will be extracted for other purposes. The lowest grade materials are used for road base and in future, as the pit is deepened and the grade drops, roadbase will be produced.

## 2.2 Site Layout

Excavation uses limestone from two pits, one located on each sublease.

The southern pit is currently used for cutting natural dimension stone, with excess stone being taken from site as rubble.

The northern pit was previously used for cutting natural dimension stone but is now being used as a source of rubble.

A processing plant with crusher and screens is located on the pit floor adjacent to the cutting floor during campaigns when limestone rubble is being produced.

A fenced secured compound is located near the entrance of the tenement from Wattle Avenue East. Within the compound are a site office and maintenance shed. Fuel is stored in a lined bunded enclosure near the maintenance shed.

The pit is internally draining.

All materials and wastes from maintenance are recovered and recycled where possible or taken to an approved waste disposal site if they cannot be reused.

Vegetation and topsoil cleared ahead of excavation is stored in dumps. Sand, which forms the overburden is stored in separate dumps and windrows. Overburden is stored in dumps and bunds adjacent to the active pit.

Water is obtained from a licensed bore on site. Water is pumped to a holding tank and gravity fed to the cutting machines for dust suppression.

Dust, noise and other environmental issues are being managed by methods outlined in the Notice of Intent.

Currently there are just under 24.69 hectares of ground opened and this is not anticipated to increase. As ground is opened in the future, ground will be closed.

The limestone is crushed and screened on the floor of the pit near the active face to reduce internal vehicle movements, using mobile crushing and screening plant that moves across the floor as the excavation proceeds.

## 2.3 Mining Operations

Annual production varies from around 5 000 tonnes to 25 000 per year of limestone but will change depending on the nature of the markets and contracts won.

### Design of the Pit - Staging

The staging seeks to minimise the disturbance of vegetation clearing by providing a staged clearing, excavation and rehabilitation program that will move across the site.

A large area is currently open because each sublease was opened and excavated by different companies, but now both subleases are held by Urbanstone.

The amount of overburden also dictated a relatively large footprint as that material had to be placed adjacent to the pit.

The anticipated rate of excavation is shown in the Activity Table in 2.4 Disturbance Areas.

The excavations are designed to remove the sand and the limestone until it bottoms on sand or until other factors dictate the final surface such as a useful final land surface.

Government Policies currently provide for a separation of 2 metres to the watertable outside Priority 1 Groundwater Protection Areas. As the natural land surface lies at an elevation of around 90 metres AHD, and the groundwater lies at 27 metres AHD, excavation can extend to depth.

It is anticipated that limestone will be extracted to depths of 30 metres, some 60 metres above water table.

The batter slopes will then rise gently up the existing natural land surface outside the excavation area at slopes of 1 : 2 – 1 : 4 vertical to horizontal and the floor will daylight out to the lower elevations such as to the east.

### Ground Preparation

1. A bulldozer or loader is used to remove any vegetation by pushing it into windrows.

2. Smaller vegetation is track crushed and directly transferred to areas under rehabilitation (when available) to assist soil and habitat generation. The vegetation contains a significant seed source, because of the contained seed on many species. It is also a source of microbial material for soil formation, adds to habitat and assists in managing wind erosion.

3. The vegetation is to be used on the batters to minimise soil erosion and spreading on the final land surface as part of the final rehabilitation.

4. Topsoil is pushed to one side and formed into low storage dumps for later use for rehabilitation using either a loader or bulldozer. Topsoil that is to be stored is located in separate dumps, pushed to the outside of the disturbance area from where it can be spread during the final reconstruction of the land surface.

5. Overburden as yellow and brown sand and low grade limestone is then pushed into bunds and dumps around the perimeter of the disturbance, inside the topsoil bunds, normally by bulldozer. In some locations the dumps and bunds are pushed across low areas to provide flat and level working surfaces.

6. The bunds and dumps can be up to 5 metres high depending on the surrounding landform and security requirements to increase security and provide a barrier to define the operations.

7. This bunding is extended along the perimeters to provide screening and assist in security.

8. At the end of excavation the floor of the quarry will be deep ripped, covered by a layer of overburden and top soil and rehabilitated with pasture and indigenous tree/shrub species.

9. As noted above, subgrade material not used in reconstituted block manufacture will normally be stored in the bunds around the perimeter of the pit and then used to recontour the completed pit as the first stage of rehabilitation.

10. After mining through of the faces the final slopes are to be levelled with some bunds and batters at 1 : 4 or between 1 : 6 vertical to horizontal in compliance with the Mines Safety and Inspection Act (1994) and Regulations (1995).

11. The final slopes and land surface will be reviewed in the light of any future changes to the end use and where possible will be formed to that future end use.

12. Rehabilitation will progressively follow mining, with completed areas of the excavation being revegetated as soon as practicable.

**Excavation**

- ***Limestone Extraction – Roadbase and Rubble***

1. Excavation is carried out as a sequence.

2. Where sand overlies the limestone, sand will be taken at this point to expose the limestone. Mostly on site the sand forms overburden and is stored with the overburden.

3. The void to be left at the end of limestone extraction will normally have a flat floor rising gently to natural land surface and bunds at the perimeter of the excavations.

4. During excavation for rubble the limestone is deep ripped with a bulldozer pushing down a sloping face below the elevation of the perimeter bunding. This track rolls and crushes the limestone.

5. Rubble is then pushed into a stockpile from which it is loaded directly into a mobile crushing plant and screening plant.

6. Water is used for dust suppression, to reduce the potential for dust generation from the movement of machinery and the effect of wind.

7. Blasting is not part of the normal operations.

8. Depending on the depth of the resources, the nature and grade of the resources and their thickness, benches may be required to differentiate product and assist safety.

- ***Limestone Extraction – Natural Dimension Stone***

1. A bull dozer is used to remove the cap rock and surface limestone, to produce a relatively flat cutting floor of soft limestone.

2. Finally a grader is used to smooth and level the floor, as flat as possible, to allow the installation of rails and cutting machines.

3. When dimension stone is cut, sections of the floor is lowered by the depth of one block until the whole floor is lowered. The next set of blocks is cut by the re-installation of the rails and cutting machines on the lowered floor and the process repeated. This method of excavation means that the cutting floor is gradually lowered below the land surface. The cutting saws are electric, using air cooling for the blades.

4. Water is used for dust suppression, to reduce the potential for dust generation from the movement of machinery and the effect of wind.

5. All static and other equipment such as cutting machines, are located on the floor of the quarry or screened by earth bunds where possible to provide visual and acoustic screening. There is currently no proposal to change the location of the existing facilities on site.

**Processing**

- ***Limestone***

1. A mobile plant is used to prepare limestone rubble for raw feed for taking offstite for use in the manufacture of reconstituted blocks.

2. The crushing plant is also used to manufacture roadbase.

3. The crushing plant will normally consist of a mobile crusher together with screens and stackers to sort the products into various sizes. The units fit together linked by conveyors.

4. The crusher is fed by a loader, which collect, the raw materials from the face and also loads road trucks.

5. The mobile plant is located on the floor of the pit, some 5 - 15 metres below natural ground level.

6. All crushers, screens and stockpiles are equipped with water sprays, sprayed, enclosed or the stockpiles wetted down depending on the nature of the materials to be processed. This is the same management as for the approved extractive industry.

7. As required a DER Licence will be applied for if the tonnages screened exceed the DER Guidelines.

- ***Sand***

8. Sand is not normally screened but is when required to be of a particular grade and will be screened on the floor of the pit. As required a DER Licence will be applied for if the tonnages screened exceed the DER Guidelines.

## 2.4 Soil and Waste Characterisation

Topsoil is comprised of natural sand that is typical of the soils across coastal limestone ridges.

Overburden is comprised of sand and low grade limestone fragments and rock. It is natural and pushed, just cleared, from ahead of mining.

There is no processing on site apart from crushing and screening of some of the limestone.

There are no deleterious materials formed from the extraction of limestone. There are no heavy minerals, radioactive substances acidic materials or metallic elements etc, only natural soil materials.

The only waste materials are from normal operational activities, of waste containers, paper, plastic, wood, old pallets and equipment, etc which are periodically removed from site to an approved landfill area.

A septic toilet system is provided.

| **Materials Suitable for Rehabilitation** | **Available** | **Required** |
|---|---|---|
| Volume of topsoil | 2 000 $m^3$ | 2 000 $m^3$ |
| Volume of overburden | 20 000 $m^3$ | 20 000 $m^3$ |
| Volume of waste rock | Nil | No |
| Volume of other growth medium | Nil | No |
| Volume of other suitable capping material | Nil | No |

| Materials to be Managed on closure | Volume | Comments |
|---|---|---|
| Volume of acidic or metallic materials | Nil | |
| Volume of chemically changeable materials | Nil | |
| Volume of physically unstable materials | Nil | |
| Volume of other hazardous materials | Nil | |
| Volume of contaminated soil | 1 $m^3$ | Soil contaminated around the fuel storage. To be regularly removed from site. |

## 2.5 Disturbance Areas

The proposed total disturbance is shown in the table below. The limestone becomes more sandy towards the north and in the future some sand may be extracted from that location.

**ACTIVITY TABLE - M70/143**

| | Current disturbance (ha) | Likely disturbance (ha) at 2025 | Likely disturbance (ha) at end of mining |
|---|---|---|---|
| Pit | 13.9 ha | 15.0 ha | 15.0 ha |
| Overburden dumps | 9.4 ha | 8.0 ha | 8.0 ha |
| Processing area | nil | 1.0 ha | 1.0 ha |
| Hardstand and processing | 0.9 ha | 1.5 ha | 1.5 ha |
| Access road | 0.5 ha | 0.5 ha | 0.5 ha |
| Rehabilitated land | Nil | 4.0 ha | 74.0 ha |
| TOTAL DISTURBED LAND | 24.7 ha | 26.0 ha | 100.0 ha |
| Land to be rehabilitated | 24.7 ha | 26.0 ha | 26.0 ha |
| Undisturbed land | 93.45 | 10.945 ha | 18.15 ha |
| Tenement area | 118.15 ha | 92.15 ha | 118.15 ha |

As excavation will be progressive, with land being cleared as new ground is opened, a progressive disturbance footprint is summarised in Activity Table above.

As excavation progresses the open pit will in turn become the processing area, and then will be rehabilitated. The access road will remain and not change substantially, although internal roads will increase slightly.

Therefore the amount of open ground will be minimised through the life of the operations.

The pit will be staged to enable sequencing of clearing topsoil and restoring the land surface.

## 3.0 CLOSURE OBLIGATIONS AND COMMITMENTS

The site lies on part of State Forest 65, which is managed by the Department of Parks and Wildlife.

The closure obligations and commitments are based on the current Conditions and Approvals and will be adjusted if the Conditions placed on the tenement are changed.

| Department or Authority | Nature of Conditions | Comment |
|---|---|---|
| Department of Mines and Petroleum | General Conditions relating to Closure | The relevant conditions are listed below. |
| Department of Mines and Petroleum | Commitments made in the Mine Closure Plan such as meeting completion criteria. | These cannot be made until DMP have approved the Mine Closure Plan. |
| Department of Mines and Petroleum | Approved Rehabilitation Plan in Notice of Intent M70/143 received 19 March 1996. | The plan has been updated and incorporated into this closure plan. |
| Department of Mines and Petroleum | Clearing Permit | A Clearing Permit will be required prior to the opening of any further new ground. |
| Department of Water | Conditions relating to Groundwater extraction. Licence for use of water from the bore on site. | There are no conditions that relate to ground closure. The normal requirement of 3 m above the water table does not apply because the water table is over 40 metres below the base of the pit. |
| Commonwealth *EPBC Act 1999* | When applying for further clearing the proposed clearing will be considered to see whether it should be referred to the Commonwealth. The Commonwealth would assess any referral to see if the proposed clearing is a Controlled action under the EPBC Act. Conditions may be applied relating to closure and/or offsets. | Application cannot be made until a Clearing Permit Application is made. |
| Department of Parks and Wildlife | May have some requirements relating to rehabilitation that would be incorporated into conditions on the tenement or are included in an updated Mine Closure Plan. | The documentation for the application for the tenement will be sent to DEPAW. |
| Department of Parks and Wildlife | Protect the known populations of *Eucalyptus argutifolia*. | The original Ministerial Conditions have been applied to the tenements. See below. |
| Department of Environment Regulation | Conditions may be placed on any DER Licence. | A Licence for crushing and screening may be required if those activities are using on site and provide for more than a minimum amount of processing. |

### Relevant Tenement Conditions

See the actual tenement conditions for the full text of each condition.

| | **M70/143 LEASE CONDITION (Check actual condition if in doubt)** | **WORK UNDERTAKEN AND COMPLIANCE** | **ACTIONS PROPOSED** |
|---|---|---|---|
| 1 | Lease survey | Completed | NA |
| 2 | Aboriginal Heritage Act 1972 | No recorded sites | NA |
| 3 | No development until a plan to safeguard the environment. | Completed in 1996. | |
| 4 | No mining on Trig Station Reserve 11930 without consent | Noted. | |
| 5 | Mining of road not to exceed 15 metres | NA | NA |
| 7 | Operation to Carabooda Limestone Notice of Intent M70/143 received 19 March 1996. Notice of Intent and Management Plan part M70/143 Wattle Road (East) Nowergup Cashdale Limestone Pty Ltd 29 July 1996. | Noted | Carabooda Limestone is now Urbanstone. Urbanstone will operate in accordance with the Carabooda Notice of Intent. |
| 7 | Minimum practicable disturbance to vegetation and landform. | The minimum amount of land clearing has taken place. The whole disturbed footprint continues to be used. | No land clearing is proposed. A Clearing Permit will be required prior to opening new ground. |
| 8 | All topsoil being removed ahead of mining and retained for later respreading. | Noted. DMP commented on. | Noted |
| 9 | At the completion of excavation all buildings are to be removed . | Noted | Urbanstone has taken over Sublease 7 which was partially abandoned. |
| 10 | All rubbish and scrap to be progressively disposed of. | See above | Committed to and forms part of the operational plan. |
| 11 | On completion all roads and disturbed areas to be ripped and revegetated. | No rehabilitation is possible at this stage. | Noted |
| 12 | No alteration outside the lease boundaries unless approved. | The whole lease is approved for excavation. | |
| 13 | Bond of $97 300 | Paid by Cockburn Cement for the whole of M70/143 | The bond has been retired in favour of the DMP Mining Rehabilitation Fund. |
| 14 | Requirement for a brief annual report in June. | Noted | Complete annual report |
| 15 | All surface holes for exploration to be capped. | No exploration has occurred. | No exploration is proposed. Noted. |
| 16 | All costeans and other exploration disturbances to | No exploration has occurred. | No exploration is proposed. Noted. |

| | | | |
|---|---|---|---|
| | be backfilled and rehabilitated. | | |

**Performance on Ministerial Conditions in Statement 364**

The conditions relating to Ministerial Statement 364 only relate to *Eucalyptus argutifolia* because from those conditions a *Eucalyptus argutifolia* Management Plan was developed.

Two populations of *Eucalyptus argutifolia* occur to the north.

| Condition | Summary | Actions undertaken |
|---|---|---|
| 7 | *Eucalyptus argutifolia* | M70/143 was thoroughly searched for *Eucalyptus argutifolia*. One new population was found, to the north of sublease 7. All populations were surveyed and plans and locations provided to DEC.<br>These were reported to DEC/DPaE and have been on their database from the late 1990's. DPaW regularly inspects the populations. They are closely monitored by Cockburn Cement on a regular basis, at least twice per year.<br>The populations near active areas are fenced and protected. Other populations occur outside the permitted excavation areas.<br>Two populations occur north of Sublease 7. |
| 8 | *Eucalyptus argutifolia* | A Management Plan, "*Vegetation and Eucalyptus argutifolia Management Plan, M70/138, M70/141, M70/143 and Miscellaneous Lease L70/143, Wesco Road, Nowergup*" was prepared and approved by DEC in November 1997.<br>All management follows this plan which has been successful in protecting *Eucalyptus argutifolia.* |
| 9 | *Eucalyptus argutifolia* | The operations near active areas are set back from the populations and regularly inspected by Cockburn Cement. |
| 10 | *Eucalyptus argutifolia* | North of Sublease 7. |
| 11 | *Eucalyptus argutifolia* | Batters and setbacks have been used to protect the populations near working areas. PPaW regularly inspect the populations. |
| 12 | *Eucalyptus argutifolia* | Funding was provided for additional research. Jason Kennington undertook this research which resulted in genetics being used to determine exactly how many individuals there were in each population. The number of individuals in each population is much less than the number of stems as the species has multiple stems and an extensive underground root system. On the basis of the root extensions the plants are suggested to be hundreds and potentially some thousand or so years old. |
| 13 | *Eucalyptus argutifolia* | The populations are protected and have not been subject to impact within the last 15 years. |
| 14 | *Eucalyptus argutifolia* | It is understood that seed assessment conducted by Jason Kennington found that the seeds were sterile. Tissue culture will probably have to be used. Cockburn Cement and Limestone Building Block Company made a number of approaches to DPaW to fund research into this some 10 years ago. In spite of approaches over a number of years, no response was received from DPaW on the matter.<br>It is something that could be considered for the future if approval can be obtained. |

# 4.0 COLLECTION AND ANALYSIS OF DATA

## EXISTING ENVIRONMENT – PRE MINING

### 4.1 Regional Setting

The site lies in an area of native vegetation developed on limestone within State Forest 65.

The location is strategically placed at the northern end of the Perth Metropolitan area in a situation ideally located to supply basic raw materials to the growing city.

### 4.2 Geology – Geomorphology

The limestone and sand formed as aeolian dune deposits behind a shoreline during the Pleistocene. The limestone is ascribed to the Tamala Limestone and consists of foraminifer, shell fragments and quartz grains, and therefore variation in the quality of the stone is normal both laterally and vertically.

It lies on Geological Survey of Western Australia, Perth 1 : 250 000 geological mapsheet; SH 50 14.

The geology is also shown on the Geological Survey of Western Australia 1 : 50 000 Environmental Geology Series, Perth and Muchea Sheets.

In other localities dates of between 25 000 over 350 000 plus years have been obtained for similar limestone.

The resource is essentially a ridge of limestone with overlying lenses of yellow sand. The 1 : 50,000 environmental geological map sheets show that limestone forms a substantial sequence, sitting on top of Mesozoic sediments of the Coolyena Group.

The variations in the limestone occur because of the changes in the proportion of calcium carbonate and quartz sand during the formation of the original dunes, even though the limestone is of high grade and up to >75% calcium carbonate.

The degree of lithification (hardness) changes over the resource, and determines the use to which each type of limestone can be put. On this site the rock is hard and recalcified.

The sand is quartz sand containing small amounts of clay and iron oxide staining.

### 4.3 Soils and Soil profiles

Soils were recorded by Lindsay Stephens of Landform Research during the various times the site has been visited. They are part of the Spearwood land system.

Limestone dominates the site with sand becoming dominant to the north.

All soils are natural and contain no adverse minerals or conditions such as acidity or potential acidity that will impede surface restoration.

The excavation only intersects natural materials of yellow earthy sand and limestone. The natural sands typically have a grey surface topsoil underlain by white sand grading to yellow and dark yellow earthy sand. The depths of sand is variable with the sand being more yellow and brown the closer it is associated with limestone outcrop.

The nature of the sand relates to small amounts of 1 to 3% clay present within the sand. The colour regards to the species and intensity of iron oxide present.

## 4.4 Climate

The climate of the area is Mediterranean with warm to hot summers and cool wet winters.

The closest recording station is Beenyup (Wanneroo), although averages of only six years' data have been recorded. Other weather data must be taken from Perth.

The highest temperatures are in February with 30.0 maxima and the lowest are recorded in July with maxima of 18 degrees Celsius and 7.4 degrees C minima.

Rainfall for the area is slightly less than Perth at 722 mm compared to Perth's 869 mm of which more than 90% falls in the months April to October inclusive. Rainfall has also been recorded at Yanchep with an annual average of 755 mm per year. Evaporation is high and exceeds rainfall in all but the four wettest months, May to September.

The prevailing winds are from the south west, particularly in the afternoon. In summer the easterly in the mornings and the sea breeze in the afternoon can be quite strong. At 3.00 pm wind speeds exceed 10 kph for 80 % of the time in summer but only 30 % to 40 % in winter. At other times the wind speed is calm for 30 % of the time in winter at 9.00 am and 10 % in summer with 40 % of the time exceeding 10 kph in summer and 20 % in excess of 10 kph in winter.

## 4.5 Hydrology

### Surface Water

There is no surface drainage due to the porosity and permeability of the limestone, with precipitation draining to the water table. There are no watercourses and no wetlands.

### Groundwater

Government Policies currently provide for a separation of 2 metres to the water table outside Priority 1 Groundwater Protection Areas. As the natural land surface lies at an elevation of around 90 metres AHD and the groundwater lies at 27 metres AHD excavation can extend to depth.

It is anticipated that limestone will be extracted to depths of 30 metres, some 60 metres above the water table.

With such depths to the groundwater it is estimated that 5% of the rainfall will currently reach the water table based on the depth of the water table and the rainfall.

Groundwater is confined to the underlying sands and these have high lateral transmissivity.

Limestone and sand excavation does not affect the quality of water in the shallow ground water system because the only chemicals used are normal fuels and lubricants; a fact that is recognised by the Department of Water who permit extractive industries in Priority Groundwater areas.

## 4.6 Flora & Fauna

### *Flora*

Coffey Environments was commissioned by Adelaide Brighton Cement Ltd, to undertake a flora and vegetation report for the land immediately to the north on M70/138. Coffey Environments, 2010, Flora and fauna Assessment, M70/138, Hopkins Road, Nowergup

All the information on flora is taken from Coffey Environments 2010. A copy of the study is attached.

A total of 141 vascular plant taxa were recorded within the survey area.

The majority of the taxa recorded were representative of the Fabaceae, Proteaceae and Myrtaceae and Paplionaceae.

### *Plant Communities*

The site lies in the Swan Coastal Plain Unit of the Drummond Botanical Subdistrict, part of the greater South-West Botanical District (Beard 1990).

More recently, the vegetation of Western Australia has been assigned to bioregions and subregions under the Interim Biogeographic Regionalisation for Australia (IBRA), with the project area being within the Swan Coastal Plain subregion.

The Drummond Botanical Subdistrict is characterised by low *Banksia* woodlands on leached sands; *Melaleuca swamps* on poorly-drained depressions; and *Eucalyptus gomphocephala* (tuart), *Eucalyptus marginata* (jarrah) and *Corymbia calophylla* (marri) woodlands on less leached soils (Beard 1990). The Drummond Botanical Subdistrict comprises of twelve physiographic units (systems), with the survey area situated within the Spearwood System.

The Spearwood System comprises of shore-line parallel calcarenite ridges mantled with yellow sands which gradually become more bleached and less calcareous to the east of the system.

The vegetation is typified by the Cottesloe Complex - Central and South.

This system is characterised by two dominant overstorey associations namely *Eucalyptus gomphocephala* woodlands and *E. gomphocephala -Eucalyptus marginata* mixed woodlands. Outside these two, major overstorey transition zones occur in the form of *Banksia-Calothamnus* heaths, low woodlands and *Melaleuca preissiana, Melaleuca rhaphiophylla* and/or *Banksia littoralis* in low lying and/or swampy areas. There are no wet areas or area of Tuart Woodlands on site or nearby. Greater numbers of trees are added off the limestone ridge to the east.

Several vegetation communities were delineated and mapped within the survey area. PATN analysis showed that the vegetation had some affinity to four FCT Communities, FCT 24, FCT 26a, FCT 27 and FCT 28

Closed Tall Scrub of *Melaleuca systena* over Open shrubland of *Melaleuca huegelii*. This is ascribed to have affinities with FCT Community Type 24 (P3) and 27.

Open Heath of *Melaleuca systena* and *Melaleuca hu*egelii over Low Shrubland of *Leucopogon parviflorus*. This is ascribed to FCT Community Types 24 (P3) and FCT 26a (T). The correlation for FCT 26a is at the lowest level.

Tall Open Scrub of *Melaleuca huegelii* and *Melaleuca* sp Wanneroo over Open Shrubland of *Leucopogon parviflorus, Melaleuca systena* and *Acacia lasiocarpa*. This is ascribed to FCT Community Types 24 (P3) and FCT 26a (T).

Open Forest of *Corymbia calo*phylla over Low Woodland of *Banksia grandis* and Open Heath dominated by *Xanthorrohea preissii*. This is ascribed to have affinities with FCT Community Type 28.

Open Woodland of *Corymbia calophylla* over Low Woodland of *Banksia grandis* and Open Heath dominated by *Xanthorrohea preissii*. This is ascribed to have affinities with FCT Community Type 28.

Tall Open Scrub of *Xanthorrhoea preissii, Banksia sessilis* and *Hakea trifurcata*.

### *Significant Flora*

No Declared Threatened Flora species were recorded within the survey area.

*Communities*

Some vegetation on the more “peaky” limestone areas has affinities to the Threatened Ecological Community 26a, but at the lowest level.

3 FCT Community Type 24 Northern Spearwood shrublands and woodlands (FCT 24, Gibson et al. 1994). Has been classified as a (P3) community.

The following significant species were recorded on the adjoining M70/138.

| | |
|---|---|
| *Eucalyptus argutifolia* | (T) occurs on M70/143 north of the limestone excavation as two small populations. |
| *Melaleuca* sp Wanneroo | (P1) |
| *Jacksonia sericea* | (P4) |
| *Petrophile axilaris* | listed as significant in Bush Forever 2000 |

| | |
|---|---|
| *Acacia alata* var *tetrantha* | listed as significant in Bush Forever 2000 |
| *Eucalyptus foecunda* | listed as significant in Bush Forever 20 |

***Vegetation Condition***

The vegetation condition is Excellent.

***Clearing***

A Clearing Permit will be required prior to the disturbance of any other vegetation and the current vegetation and its conservation status will be considered at that time.

***Fauna***

A fauna study was completed in 2009 by Western Wildlife for the adjoining tenement M70/138 to the north. A copy is attached.

The main impact on fauna is clearing and habitat removal, albeit temporary with a return to local native vegetation.

No further clearing can occur without a Clearing Permit issued under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004.*

There are a number of species of Conservation Significance that may occur on M70/143;

- Carpet Python (*Morelia spilota imbricata*) – WC Act (Schedule 4)
- Peregrine Falcon (*Falco peregrinus*) – WC Act (Schedule 4)
- Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) – EPBC Act (Endangered), WC Act (Schedule 1)
- Fork-tailed Swift (*Apus pacificus*) – EPBC Act (migratory)
- Rainbow Bee-eater (*Merops ornatus*) – EPBC Act (migratory) Of these Carnaby's Black-Cockatoo is likely to occur, foraging in the *Banksia* woodland and limestone heath. Any large Tuarts with nesting hollows may be potential breeding habitat. The Rainbow Bee-eater may occur, potentially breeding in sandy areas, and Carpet Python may occur in rocky areas.
- Black-striped Snake (*Neelaps calonotos*) – Priority 3
- Masked Owl (*Tyto novaehollandiae*) – Priority 3
- Quenda / Southern Brown Bandicoot (*Isoodon obesulus*) – Priority 5
- Western Brush Wallaby (*Macropus irma*) – Priority 4
- Western False Pipistrelle (*Falsistrellus mackenziei*) – Priority 4

## 4.7 Social Environment

The land is located in State Forest 65. At the end of excavation the surface will be rehabilitated to local native Heath and Shrubland vegetation to match the adjoining lands.

## Planning

The State Planning Policy Framework provides for the implementation of a planning framework through the recognition and implementation of Regional Planning Policies above Local Planning Schemes and Policies.

Within each layer of planning, there are a number of key policies and strategies to provide guidance to planning and development to enable sustainable communities to develop, expand and prosper without compromising the environment and future generations.

Planning is governed under the *Planning and Development Act 2005*. This Act enables Government to introduce State and Regional Planning Schemes, Policies and Strategies to provide direction for future planning. The State and Regional Schemes sit above Town Planning Schemes and Strategies introduced by Local Government.

The policies have little relevance over mining tenements on Crown Land in State Forest, but they do have relevance to the local roads, and the recognition of the need for limestone for dwellings, roads and construction.

Even though they are implemented under the *Planning and Development Act 2005,* over which the *Mining Act 1978* prevails, the policies have some relevance in providing guidance on the provision of basic raw materials for the community. They also have relevance in that the Department of Mines and Petroleum seeks advice from the Local Authority when assessing mining proposals.

Some policies do have relevance such as the State Industrial Buffer Policy and Basic Raw Materials Policy.

With respect to the supply of sand and limestone, the overarching document is the;

- State Planning Policy 1.0 State Planning Framework.

Complementing this are a number of Relevant State Policies;

- State Planning Policy 2.0, Environment and Natural Resources Policy
- State Planning Policy 2.4, Basic Raw Materials
- State Planning Policy 4.1, State Industrial Buffer Policy

The policies and their implications are discussed in Section 5.2 Land Use and Community in the Mining Proposal.

State Planning Policy 2.4 recognises the site as Priority Limestone Resource 30/15, and includes it within the Priority Basic Raw Materials Policy area.

This policy makes many statements on the intent and actions which local authorities should use to protect and manage basic raw materials.

Section 3.4 is very specific in explaining that basic raw materials need identification and protection because of increased urban expansion and conservation measures, (3.4.1), (3.4.2) and (3.4.4). Sections 3.4.5 and 3.4.6 recognise that environmental and amenity matters need to be considered. The policy will be revised following the completion of the Strategic Assessment.

State Planning Policy 2.4 is to be updated once the Strategic Assessment is complete.

**Geological Survey Regionally Significant Basic Raw Materials**

The Western Australian Geological Survey has produced mapping identifying Strategically Important Basic Raw Materials across private land and State Forest.

The Geological Survey recognised the limestone resources on all four tenements and surrounding areas as a Strategically Important Basic Raw Material and valuable community asset.

State Planning Policy 2.4 recognises M70/143 as Resource 30/15 and includes it within the Priority Basic Raw Materials Policy area.

This policy makes many statements on the intent and actions which local authorities should use to protect and manage basic raw materials.

Section 3.4 is very specific in explaining that basic raw materials need identification and protection because of increased urban expansion and conservation measures, (3.4.1), (3.4.2) and (3.4.4). Sections 3.4.5 and 3.4.6 recognise that environmental and amenity matters need to be considered.

**Geological Survey Regionally Significant Basic Raw Materials**

The Western Australian Geological Survey has produced mapping identifying Strategically Important Basic Raw Materials across private land and State Forest.

The Geological Survey recognised the limestone resources on M70/143 and surrounding areas as a Strategically Important Basic Raw Material and valuable community asset.

**Heritage**

The State *Aboriginal Heritage Act 1972* and *Heritage of Western Australia Act 1990,* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* have been considered within this proposal.

A search of the Department of Aboriginal Affairs database shows that there are no registered sites on or near the tenement.

Adelaide Brighton will liaise with the traditional owners with respect to the potential for sites to be present and the need for any archeological or ethnographic research on site should any site be identified.

## 5.0 STAKEHOLDER CONSULTATION

There has been some consultation over the years between the Department of Parks and Wildlife, under the various previous names of the department such as CALM, DEC, mostly in the early years of 1995 – 2005, considering the protection of *Eucalyptus argutifolia* and in more recent year in respect to the provision of access to DPaW to inspect the populations.

There has also been ongoing consultation with the Department of Mines and Petroleum and the various old names.

The discussions have been ongoing intermittently in relation to the excavation of limestone from the site.

A list of stakeholders is shown below and will be updated as required as additional consultation is needed prior to and during operations.

A Rehabilitation Management Plan for M70/143 was prepared in 1996 and submitted to the Department of Mines and Petroleum who approved the plan. This Mine Closure Plan incorporates the accepted rehabilitation plan and updates the information as needed.

**Preliminary Stakeholder Consultation Table**

| Date | Description of consultation | Stakeholder | Stakeholder comment/issue | Adelaide Brighton Response | Stakeholder Response |
|---|---|---|---|---|---|
| As required and three years prior to closure | Past and proposed future consultations with DPaW and access to *Eucalyptus argutifolia.* | Department of Parks and Wildlife | DPaW approved excavation and the setbacks for *Eucalyptus argutifoli*a in 1990's and during the Notice of Intent. | This Mine Closure Plan incorporates the approved procedures from the Rehabilitation Notice of Intent and the *Eucalyptus argutifolia* Management Plan | DPaW approved the *Eucalyptus argutifolia* Management Plan and inspects the plants regularly. |
| As required | A Clearing Permit will be applied for | DER/DMP through delegated authority | No comments. The application has not been lodged | The revegetation of the disturbed land is to be in compliance with the guidelines of the Management Plan. Comply with any Clearing Permit. | |
| Prior to final closure | The closure planning complies with DOW Guidelines | Department of Water | As far as is known DOW has had no objection to the operations which comply with DOW guidelines. The Guidelines are jointly prepared by DOW and DMP. | Responses to any requests from DOW will be incorporated into final closure planning. | |

| | | | | | |
|---|---|---|---|---|---|
| As required | Search of DAA databases | Department of Aboriginal Affairs have been searched and no sites have been found. | No comments are available. | There are no known registered sites on M70/143. | |
| Previously | Referral of Mining Proposal to EPA under *Part V of the Environmental Protection Act 1984.* | EPA | No comments are available.<br>The site had previously gained EPA approval for a quicklime plant but that has lapsed. | The proposal did not trigger a formal referral and assessment process through the EPA.<br>Extensive environmental studies were conducted for the quicklime plant. | |
| Previous | Negotiations during the assessment of the Notice of Intent. | DMP | Exclusion of Shire View Hill Trig Station and Fire Tower | Noted and excluded from Notice of Intent. | |
| Prior to commencement and annually | Consultation | DMP Resources Safety Division | A Project Management Plan will be submitted after grant of the tenement and prior to commencement.<br>No comments are currently available. | Adelaide Brighton will comply with normal safety requirements. | |
| Previously | As far as is known the input from the City of Wanneroo was required during the assessment for the operations. | City of Wanneroo | The Notice of Intent was referred to the City. | There does not appear to be any input from the City. | |
| Annually | Consultation | DMP | No conditions currently in place. | Comply with tenement conditions | |

# 6.0 POST MINING LANDUSE AND CLOSURE OBJECTIVES

## 6.1 Post Mining Landuse and Closure Planning

M70/143 lies within State Forest 65, adjacent to old pine plantation to the east which has been removed.

Adelaide Brighton will work with Department of Parks and Wildlife and Department of Mines and Petroleum to ensure that the end use is to local native limestone vegetation.

The excavated land surface will be contoured to a similar landform to that in the pre – excavation situation except that the landform will be some 20 metres lower.

Areas excavated will be gently battered to the natural land surfaces at slopes of 1 : 2 to 1 : 4 vertical to horizontal.

Species selected in the rehabilitation will be designed to match the pre-excavation communities.

## 6.2 Disturbance

Currently there is 24.69 hectares of disturbed ground and none have been rehabilitated. The anticipated rate of excavation is shown in the Activity Table in 2.4 Disturbance Areas.

No expansion of the excavation area will occur prior to the application and granting of a Clearing Permit under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004.*

If approved, as ground is opened and excavated, the excavated areas will be progressively rehabilitated. At any one time there is anticipated to be approximately 26 hectares of open ground. See Activity Table under 2.4 Disturbance Areas.

## 6.3 Closure Objectives

The rehabilitation will be directed towards a cover of local native vegetation on limestone that will match the adjoining and local vegetation and be comprised of local native species.

The post mined land surface is proposed to have a similar habitat and ecological function as the pre-mined habitat.

Rehabilitation will use best practice and be directed towards achieving a sustainable cover of local native vegetation that is capable of forming a similar species richness and diversity to the vegetation that was previously cleared.

1. All plant, foreign materials, buildings and other matter associated with mining will be removed from the completed areas.

2. The disturbed land will be made safe and in compliance with the *Mines Safety and Inspection Act 1994* and DMP *Mine Closure Guidelines*.

3. The reformed land surface will be internally draining grading to a deepened swale matching the land surface nearby.

4. All legally binding conditions and commitments relevant to mine closure and rehabilitation will be met.

5. The re-established surface will be free from Declared or Environmental weeds that could compromise the success of the rehabilitation or impact on adjoining vegetation.

6. The rehabilitated areas will, in time, form a sustainable habitat of local native vegetation of a similar form to that prior to mining.

## 7.0 IDENTIFICATION AND MANAGEMENT OF CLOSURE ISSUES

Rehabilitation will be directed towards the final end land use. In general it should be aimed at the highest level of rehabilitation, however there is no point planting good native vegetation or tree belts if they are to be immediately cleared for an alternative land use. On the other hand it is often beneficial to establish fast growing native vegetation as interim soil cover.

The species chosen, and the planting densities, will visually match pre-excavation vegetation, adjoining vegetation, soil conditions and function of each site.

The species will therefore be selected to match the local plant communities or a restricted number of fast growing species may be used. The species to be used in rehabilitation may be different to that which originally occurred on site, because the land surface will be lower in elevation and may have higher levels of soil moisture.

A completion criteria is developed for the rehabilitated land.

Rehabilitation will contain Dieback and Weed Management in addition to monitoring and replanting failed areas.

There are a number of management actions that can be taken in quarries to maximise rehabilitation effort and these will be used wherever possible. The general management actions are summarised below and will be used where applicable and as the opportunity presents.

Revegetation activities will be integrated into the excavation and land clearing process. The process of collecting local seed and the direct return of topsoils for use in rehabilitation will be pursued wherever possible in order to maintain vegetation provenance.

Appropriate topsoil management is seen to be an important element in achieving successful rehabilitation and plant re-establishment on the restored surface.

The only materials left on site at the end of excavation in the excavation areas will be natural limestone and sand that is substandard in terms of colour, size or uneconomic to extract, in addition to all overburden and topsoil.

There are some concrete wastes generated during limestone batching, but these are recycled and will be removed from site at the end of operations.

### 7.1 Research

The ground open at any one time will be around 26 hectares.

Observational flora studies have been completed on M70/143 with extensive searches for the Threatened *Eucalyptus argutifolia*. It is felt that the extensive walking of the tenement will have identified all *Eucalyptus argutifolia* and these have all been located, surveyed and protected by setbacks from excavation.

A Level 2 Flora and Vegetation Study and fauna study has been completed for the land immediately adjoining to the north.

The vegetation of the local area and for use in rehabilitation is therefore well known. A copy of that report completed by Coffey environments, 2010 is attached. Fauna studies have been completed by Western Wildlife 2008, and are also attached.

Ongoing research will generally take the form of assessing the methods of rehabilitation and the success against the completion criteria once rehabilitation is able to commence. Observations and new rehabilitation procedures will be tried and used as required to achieve a final cover of self sustaining vegetation of local species.

In other locations of limestone and sand such as this, where excavation has occurred, rehabilitation has demonstrated that the excavated substrate is capable of supporting local species, such as on M70/339 undertaken by other operators and at the intersection of Forrest Highway and Old Coast Road for example.

## 7.2 Baseline Data Collection and Analysis

The flora study by Coffey environments 2010 provides the data on species type, communities and other aspects of vegetation prior to excavation.

The data in that study will inform the completion criteria with respect to plant community, species type and vegetation cover.

The soil will be slightly different to the pre- excavation soil in that the depth to limestone will be less variable as there will be no pinnacle limestone within the reconstructed soil structure. This will however be replicated by retaining some loose limestone rock within the profile. The sand covering the limestone will be also be brown and earthy and resemble Cottesloe soils.

To achieve a good vegetation cover the revegetation will use the same local species but will be skewed towards more limestone type communities.

The same species from Coffey environments, 2010 will be used as a baseline but additional species from limestone areas will be added.

## 7.3 Gap Analysis

A large amount of material is already available through the vegetation studies, listed under Baseline Data Collection and Analysis.

Any further material collected during the life of the operations will be stored in the records for the operation and included in any Mine Closure Plan updates.

At this stage the gaps in the knowledge base relate to the methods of rehabilitation. Observations can be made from other operations and incorporated into closure planning prior to the commencement of site restoration and rehabilitation.

The revisions of the Closure Plans will be used to provide a database of rehabilitation techniques to be used and modified from time to time as new techniques become available.

Ongoing monitoring of the end land uses for the site will be undertaken to ensure that rehabilitation and land restoration meets with the most recent plans for end use. This relates to monitoring Government Policy planning and land zoning for the site and working with any authority charged with overseeing the future land use. Any changes or requirements can be incorporated into the revisions of the closure planning

## 8.0 DEVELOPMENT OF COMPLETION CRITERIA

Currently (2013 – 2016) the State and Commonwealth Governments are developing a Strategic Assessment with respect to providing for sufficient basic raw materials including limestone. As part of that assessment all mining tenements and resources are being considered and assessed against conservation values and the need for resources for the next 30 to 100 plus years.

An Assessment Bilateral Agreement between the Commonwealth and the State has been signed and will operate from 1 January 2015. That will enable a Clearing Permit under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004 under Part IV of the Environmental Protection Act 1986* to be recognised under the *EPBC Act 1999.*

This process will apply to any future clearing permit on site.

The post mined land surface is proposed to have a form that is compatible with the surrounding geomorphology, the ridges to the east and the general landform.

The rehabilitated surface is proposed to provide a similar habitat and ecological function to the pre-mined habitat.

Local native species will be used in the restoration of the rehabilitation and final vegetation cover.

A number of objectives relating to rehabilitation and closure are identified above in Section 6.3 Closure Objectives.

Over time the pit will progress across the resource and at any one time there will only be the current pit and hardstand and access road open. This is expected to total under 20 hectares of ground requiring rehabilitation at any one time.

### 8.1 Closure Consideration

The closure of completed areas of the operations will be progressive with closure of all remaining ground at the end of operations.

Maintenance and monitoring will be conducted until completion criteria is met.

Unexpected or early closure will be completed in the same way as permanent closure below but the full rehabilitation will be completed as one operation.

All Completion Criteria will be monitored and adjusted as necessary during the life of the project based on stakeholder input, data collected on the existing environment, the results of research, and any implications that arise from excavation.

The Completion Criteria are identified below as auditable tasks developed from the Assessment of species and success.

The existing operations, when combined with good revegetation of all disturbed land, are consistent with the Management Plan of the Notice of Intent.

## 8.2 Closure objectives and broad risk consideration

| Closure Objective | Un-managed Risk | Indicative Completion Criteria | Completion Criteria | Measurement Tool and Assessment activities | Managed Risk |
|---|---|---|---|---|---|
| | | | | | |
| All legally binding conditions and commitments relevant to mine closure and rehabilitation will be met. | High<br><br>Potential High impact | Comply with all legally binding conditions. | • All conditions of approval from any agency will be complied with. | • Review the latest documentation and assess compliance.<br>• Visually audit against all conditions by establishing an Environmental Management System to AS standards. | Low |
| Comply with the conditions of the Mining Tenement. | High<br><br>Potential High impact | Comply with the requirements of the Mining Tenement. | • Closure and rehabilitation is consistent with all conditions of the tenement. | • Review the latest documentation and assess compliance.<br>• Compile an audit table of all conditions and commitments that relate to closure and conduct an audit of those items upon the completion of each stage of rehabilitation and annually until sign off. | Low |
| All plant, foreign materials, buildings and other matter associated with mining will be removed from the completed areas. | High<br><br>Potential moderate impact | The site will be cleaned, structures and non natural materials will be removed. | • No non natural structures will be retained on site.<br>• All hardstand and road making materials and non natural inert materials are to be removed or buried.<br>• All non inert materials are to be removed from site.<br>• All ground once occupied by structures are deep ripped and soils reconstructed. | • Audit of completed ground, to verify compliance. | Low |
| The disturbed land will be made safe and in compliance with the *Mines Safety and Inspection Act 1994* and DMP *Mine Closure* | Moderate<br><br>Potential High impact | Surfaces will be formed to DMP Guidelines and match natural ground.<br><br>Holes, sumps | • Faces and the landform are to comply with DMP Guidelines and be stable for the long term.<br>• The land surface is to have a landform similar to the natural | • Audit of completed ground, to verify compliance.<br>• Visual observations of the landforms. | Low |

| | | | | | |
|---|---|---|---|---|---|
| *Guidelines*. | | drains, ditches and the like will be filled and removed. | form. | | |
| The reformed land surface will be internally draining and draining to small infiltration basins and pools. | Moderate<br><br>Potential Moderate impact | Drainage will be internal or the ground sufficiently permeable to minimise or negate runoff. | • Slopes are to drain to areas of internal drainage and infiltration basins formed from sand and limestone. | • Audit of completed ground, to verify compliance.<br>• Visual observations of the landforms. | Low |
| The land surface will be resistant to wind and water erosion. | Moderate<br><br>Potential moderate impact | Slopes are to be stable and free from erosion. | • Slopes are to be stable and free from erosion.<br>• Slopes on the floor are to be undulating and less than 1 : 2 to 1 : 4 vertical to horizontal. | • Visual observations of the landforms. | Low |
| Rehabilitation vegetation will be a sparse cover of local native vegetation on the perimeter dunes and islands to match the pre-excavation habitat. | High<br><br>Potential high impact | The vegetation composition of the perimeter dunes and islands is to be representative of the pre excavation form in those locations, in species, diversity and structure. | • All species used in rehabilitation are to be local provenance species suited to limestone ridges.<br>• Species are to mimic FCT Community Types 26a, 28 and 24 on sand.<br>• A plant density that is variable but with an average plant density of 100 plants per $100m^2$ in locations where topsoil is available.<br>• Species richness of 10 species per 100 $m^2$. | • Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard $100m^2$ plots of rehabilitation and adjoining vegetation.<br>• Conduct audits of the completion criteria upon the completion of each stage of rehabilitation and annually until sign off.<br>• Maintain ongoing records. | Low |
| Rehabilitated areas will form a sustainable habitat that will be capable of improving with time as vegetation growth continues. | High<br><br>Potential high impact | Over time there will be an increase in habitat values. | • Habitat values increase with time, measured by soil development, soil litter increases, increased plant matter, cover, vegetation, structure and habitat niches. | • Conduct audits of the key indicators upon the completion of each stage of rehabilitation and annually until sign off, using lists and photographic records.<br>• Maintain ongoing records. | Low |
| The rehabilitated vegetation will have similar | High<br><br>Potential high | The rehabilitated vegetation will be resilient to | • The vegetation is to include a mixture of species that grow in | • Annually conduct an on site audit of completed | Low |

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| resilience to the adjoining local vegetation. | impact | fire impacts, seasonal changes and longer term variable weather impacts. | local, limestone substrates and be resilient to fire or readily regenerate following fire. | rehabilitation for species richness, resilience.<br>• Inspect revegetation to determine its long term survival from environmental and fire impacts.<br>• Until sign off inspect vegetation re-establishment following fire. | |
| Soil properties will be appropriate to sustaining revegetated local native species. | Moderate<br><br>Potential moderate impact | Soil properties will be appropriate to sustaining revegetated local native species. | • The soils are to be constructed from overburden overlain by topsoil, leaf litter, vegetation fragments as available in areas of native vegetation. | • Prior to rehabilitating land before vacating.<br>• Annually check rehabilitated areas.<br>• Undertake to mitigate rehabilitation areas that are deficient or not capable of becoming compliant with the completion criteria. | Low |
| Revegetation will be free from Declared or Environmental weeds that could compromise the success of the revegetation or spread into adjoining native vegetation. | High<br><br>Potential high impact | Revegetation will be free from Declared or Environmental weeds that could compromise the success of the revegetation or spread into adjoining native vegetation. | • Absence of Declared or Environmental weeds that could compromise the success of revegetation.<br>• Exotic species to be no greater richness or density than adjoining vegetation. | • Provide annual inspections at the appropriate time of the year. | Low |

## 8.3 Progressive Permanent Closure of Completed Stages of the Pit

| Completion Criteria | Activity |
|---|---|
| | *To be completed as soon as site activities have been completed on any area and that area will not be required for future operations.* |
| • All conditions of approval from any agency will be complied with. | Prior to undertaking permanent closure.<br><br>• Review the latest documentation and assess compliance requirements.<br>• Design the rehabilitation to comply with and be able to achieve the completion criteria and commitments.<br>• Review the latest documentation and assess compliance.<br>• Visually audit against all conditions. |
| • Closure and rehabilitation is consistent with all conditions of the tenement. | Prior to undertaking permanent closure.<br><br>• Review the latest tenement conditions and design the rehabilitation to comply with all conditions relating to closure.<br>• Review the latest documentation and assess compliance.<br>• Compile an audit table of all conditions and commitments that relate to closure and conduct an audit of those items upon the completion of each stage of rehabilitation and annually until sign off. |
| • No non natural structures will be retained on site.<br>• All hardstand and road making materials and non natural inert materials are to be removed or buried.<br>• All non inert materials are to be removed from site.<br>• All ground once occupied by structures are deep ripped and soils reconstructed. | Prior to earthworks, soil restoration and rehabilitation;<br><br>• Remove any plant or non natural materials and structures.<br>• Remove all hydrocarbons and other fluids.<br>• Remove any soil or limestone contaminated by fluids or non natural materials to an approved disposal area.<br>• Remove waste systems and septics.<br>• Audit of completed ground, to verify compliance.<br>• Remove all non inert products.<br>• Some concrete and other inert products may be removed or buried at depth and covered by overburden. |
| • Faces and the landform are to comply with DMP Guidelines and be stable for the long term.<br>• The land surface is to have a landform similar to the natural form. | Prior to rehabilitation;<br><br>• Complete activities to make the site safe.<br>• Push down faces and reduces slope angles.<br>• Ensure that the batters are formed to comply with the requirements.<br>• Ensure the floor is completed and formed to the proposed final contours.<br>• Match the landform to the adjoining excavated and non excavated surfaces.<br>• Deep rip the floors and batter slopes along contour.<br>• Spread the overburden followed by topsoil.<br>• Spread any local native vegetation removed from ahead of excavation.<br>• Provide fences, bunding and warning signs above faces as required.<br>• Provide locked gates or access restraints as required.<br>• Audit of completed ground, to verify compliance.<br>• Visual observations of the landforms. |
| • Slopes are to drain to areas of internal drainage and infiltration basins formed from sand | Prior to rehabilitation and during audits;<br><br>• Inspect batter slopes, pools and other features and inspect drainage and provide infiltration areas as necessary.<br>• Form small internal sumps and detention basins to ensure all water is |

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| and limestone. | retained on site.<br>• Provide specific fauna habitat, such as logs, uneven land surface and recovered vegetation to provide a habitat suitable for local native fauna.<br>• Audit of completed ground, to verify compliance.<br>• Visual observations of the landforms. |
| • Slopes are to be stable and free from erosion.<br>• Slopes on the floor are to be undulating and less than 1 : 2 to 1 : 4 vertical to horizontal. | Prior to rehabilitation and during audits;<br>• Inspect all areas and ensure the land surfaces are stable to erosion from wind and water.<br>• Check the slope angles for compliance.<br>• Install contour features to retain water.<br>• Visual observations of the landforms. |
| • All species used in rehabilitation are to be local provenance species suited to limestone ridges.<br>• Species are to mimic FCT Community Types 26a, 28 and 24 on sand.<br>• A plant density that is variable but with an average plant density of 100 plants per 100m2 in locations where topsoil is available.<br>• Species richness of 10 species per 100 m2. | Prior to rehabilitation;<br>• Provide additional topsoil or seed to increase the number and diversity of plants.<br>• Spread vegetation fragments or harvested branches capable of providing seed sources from brushing. |
| • Habitat values increase with time, measured by soil development, soil litter increases, increased plant matter, cover, vegetation, structure and habitat niches. | During rehabilitation;<br>• Ensure rehabilitation is conducted at a suitable time to achieve success.<br>• If timing is not suitable undertake remediation earthworks such as re-ripping.<br>• Use Dieback and Weed prevention methods.<br>• Collect seeds from native vegetation well in advance and retain for rehabilitation or grow to tube plants.<br>• Complete pre-rehabilitation weed control, normally in autumn.<br>• Undertake rehabilitation within the first year following ground preparation (Normally within 6 months).<br>• Determine the replanting and seed rates that are likely to achieve the Completion Criteria with an allowance for deaths (Normally 20%).<br>• Determine whether plant protection devices are required and install as necessary.<br>• Provide additional topsoil or seed to increase the number and diversity of plants.<br>• Spread vegetation fragments or harvested branches capable of providing seed sources from brushing.<br>• Add additional species as tube plants or seed for those that do not germinate readily from top soil such as Proteaceous and *Eucalyptus* species.<br>• Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m$^2$ plots of rehabilitation and adjoining vegetation.<br>• Conduct audits of the completion criteria upon the completion of each stage of rehabilitation and annually until sign off.<br>• Ensure that the species selected and rehabilitation techniques are chosen to |

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| | provide species that are suitable for the soil conditions and will in time be able to regenerate after fire and become self sustaining.<br>• Adjust species and rehabilitation methods to enable the completion criteria to be reached.<br>• Maintain ongoing records. |
| • All conditions of approval from any agency will be complied with. | Prior to and During Rehabilitation;<br><br>• Check all conditions and approvals against compliance of the site and rehabilitated surfaces, before commencement, during and on completion of rehabilitation.<br>• Rectify as necessary and recheck for compliance. |
| • The vegetation is to include a mixture of species that grow in local, limestone substrates and be resilient to fire or readily regenerate following fire. | Prior to vacating and during annual inspections.<br><br>• Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m$^2$ plots of rehabilitation and adjoining vegetation.<br>• Conduct audits of the key indicators upon the completion of each stage of rehabilitation and annually until sign off, using lists and photographic records.<br>• Maintain ongoing records.<br>• Improve existing rehabilitated areas as necessary using additional seeding, tube planting and weed control.<br>• Check fencing and damage by predators or disease and take remedial action.<br>• Maintain ongoing records. |
| • The soils are to be constructed from overburden overlain by topsoil, leaf litter, vegetation fragments as available in areas of native vegetation. | Annually;<br><br>• Remove or spray environmental or declared weeds.<br>• Provide annual inspections at the appropriate time of the year.<br>• Provide annual follow up inspections and treatment at the appropriate time of the year.<br>• Carry out all operations and restoration activities using dieback management principles. |

## 8.4 Temporary Seasonal Closure and Campaign Closure

| Tasks to be completed | Seasonal or Campaign Closure<br>Less than 12 months<br>Prior to closure for each campaign | Care and Maintenance<br>Greater than 12 months |
|---|---|---|
| | | **Activity** |
| • All conditions of approval from any agency will be complied with. | Prior to undertaking temporary closure.<br>• Review the latest documentation.<br>• Assess compliance with the conditions and commitments. | Prior to undertaking temporary closure.<br>• Review the latest documentation.<br>• Assess compliance with the conditions and commitments. |
| • Closure and rehabilitation is consistent with all conditions of the tenement. | Prior to undertaking temporary closure.<br>• Review the latest documentation and assess compliance in conjunction with the tenement conditions. | Prior to undertaking temporary closure.<br>• Review the latest documentation and assess compliance in conjunction with the tenement conditions. |
| • Secure the site against spills, leakages and the risks of other adverse impacts. | Prior to vacating;<br>• Secure the site and any plant or structures to be left.<br>• Remove all hydrocarbons and other fluids and other potential pollutants.<br>• Remove contaminated soils and non inert materials.<br>• Ensure wastes are removed or recycled. | Prior to vacating;<br>• Secure the site and any plant or structures to be left.<br>• Remove all hydrocarbons and other fluids.<br>• Remove contaminated soils and non inert materials.<br>• Ensure wastes are removed or recycled. |
| • Secure the safety of the site. | Prior to vacating;<br>• Complete activities to make the site safe.<br>• Provide fences, bunding and warning signs above faces as required.<br>• Provide locked gates or log access restraints as required. | Prior to vacating;<br>• Complete activities to make the site safe.<br>• Provide fences, bunding and warning signs above faces as required .<br>• Provide locked gates or access restraints as required.<br>• Remove any plant susceptible to combustion, stealing or movement. |
| • Ensure the site is geotechnically stable | • Faces and the landform are to comply with DMP Guidelines and be stable for the short and long term.<br>• Inspect all areas and ensure the land surfaces are stable to erosion from wind and water.<br>• | • Faces and the landform are to comply with DMP Guidelines and be stable for the short and long term.<br>• Inspect all areas and ensure the land surfaces are stable to erosion from wind and water. |
| • Ensure surface water is retained onsite or suitably managed. | Prior to vacating;<br>• Slopes are to drain to areas of internal drainage and infiltration basins formed from sand and limestone.<br>• Inspect batter slopes, pools and other features and inspect drainage and provide infiltration | Prior to vacating;<br>• Slopes are to drain to areas of internal drainage and infiltration basins formed from sand and limestone.<br>• Inspect batter slopes, pools and other features and inspect drainage and provide infiltration areas as |

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| | areas as necessary. | necessary. |
| • Rehabilitation | Prior to vacating;<br><br>Rehabilitate any areas that are no longer required.<br><br>Prior to vacating and during audits;<br><br>• Inspect revegetation to determine its long term survival from environmental and fire impacts.<br>• Check species diversity and composition for next excavation campaign.<br>• Undertake to mitigate rehabilitation areas that are deficient or not capable of becoming compliant with the completion criteria. | Prior to vacating;<br><br>• Ensure rehabilitation is conducted at a suitable time to achieve success.<br>• If timing is not suitable undertake remediation earthworks such as re-ripping.<br><br>Check annually. If rehabilitated areas are deficient;<br><br>• Provide additional topsoil or seed to increase the number and diversity of plants.<br>• Undertake to mitigate rehabilitation areas that are deficient or not capable of becoming compliant with the completion criteria.<br>• Spread vegetation fragments or harvested branches capable of providing seed sources from brushing.<br>• Be aware of and assist with actions that help facilitate habitat creation. |
| • Absence of Declared or Environmental weeds that could compromise the success of revegetation. | Prior to vacating and during audits;<br><br>• Inspect the site for environmental and declared weeds.<br>• If found, inspect adjoining native vegetation for edge effects.<br>• Inspect rehabilitation and the edges of access roads. | Annually;<br><br>• Remove or spray environmental or declared weeds.<br>• Provide annual follow up inspections and treatment at the appropriate time of the year. |

## 9.0 CLOSURE MONITORING AND MAINTENANCE

Monitoring of the rehabilitation is to be undertaken at least prior to the wet season and following the wet season.

A weed monitoring and management program will be continued annually during operations and following closure to identify and control significant environmental weeds.

The revegetation will be monitored for 3 – 10 years post closure of each part of the pit or until completion criteria are achieved.

### 9.1 Monitoring Procedures and Remediation

| Completion Criteria | Measurement Tool and Assessment activities | Timing | Remediation Techniques to be Used if Required. |
|---|---|---|---|
| • All conditions of approval from any agency will be complied with. | • Review the latest documentation and assess compliance.<br>• Visually audit against all conditions by establishing an Environmental Management System to AS standards. | Prior to land restoration activities and on completion of rehabilitation. | • Undertake liaison and adjust the land reconstruction and rehabilitation to bring into compliance.<br>• Repeat or undertake required activities. |
| • Closure and rehabilitation is consistent with all conditions of the tenement. | • Review the latest documentation and assess compliance.<br>• Compile an audit table of all conditions and commitments that relate to closure and conduct an audit of those items upon the completion of each stage of rehabilitation and annually until sign off. | Prior to land restoration activities and on completion of rehabilitation. | • Undertake liaison and adjust the land reconstruction and rehabilitation to bring into compliance.<br>• Repeat or undertake required activities. |
| • No non natural structures will be retained on site.<br>• All hardstand and road making materials and non natural inert materials are to be removed or buried.<br>• All non inert materials are to be removed from site.<br>• All ground once occupied by structures are deep ripped and soils | • Audit of completed ground, to verify compliance. | Prior to spreading with topsoil. | • Remove any foreign or other non natural materials.<br>• Deep rip any areas that have not been adequately prepared.<br>• Check that all hardstand and roads that are no longer required are closed and prepared for rehabilitation. |

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| reconstructed. | | | |
| • Faces and the landform are to comply with DMP Guidelines and be stable for the long term.<br>• The land surface is to have a landform similar to the natural form.<br>• | • Audit of completed ground, to verify compliance.<br>• Visual observations of the landforms. | Prior to spreading with topsoil. | • Complete remediation earthworks.<br>• Undertake any earthworks required to bring the land surfaces into compliance with the end use and completion criteria.<br>• Smooth out any non natural looking slopes and features.<br>• Make any non compliant faces safe and in compliance to DMP Guidelines. |
| • Slopes are to drain to areas of internal drainage and infiltration basins formed from sand and limestone. | • Audit of completed ground, to verify compliance.<br>• Visual observations of the landforms. | Prior to spreading overburden and topsoil. | • Complete or revise the remediation earthworks.<br>• Ensure the ground is free draining and the sumps can contain the predicted rainfall events |
| • Slopes are to be stable and free from erosion.<br>• Slopes on the floor are to be undulating and less than 1 : 2 to 1 : 4 vertical to horizontal. | • Visual observations of the landforms. | Annually | • Undertake additional planting or seeding.<br>• Provide additional earthworks or brushing.<br>• Provide temporary wind breaks.<br>• Bring any non compliant faces into compliance by backfill, or pushing down. |
| • All species used in rehabilitation are to be local provenance species suited to limestone ridges.<br>• Species are to mimic FCT Community Types 26a, 28 and 24 on sand.<br>• A plant density that is variable but with an average plant density of 100 plants per 100m2 in locations where topsoil is available.<br>• Species richness of 10 species per 100 m2. | • Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m$^2$ plots of rehabilitation and adjoining vegetation.<br>• Conduct audits of the completion criteria upon the completion of each stage of rehabilitation and annually until sign off.<br>• Maintain ongoing records. | During site audits. | • Ensure rehabilitation is conducted at a suitable time to achieve success.<br>• If timing is not suitable undertake remediation earthworks such as re-ripping.<br>• Program additional rehabilitation work and ensure that it is implemented.<br>• Undertake any non complying or neglected steps in the rehabilitation program.<br>• Add tube plants, topsoil or seeds as required to increase the species richness and density. |
| • Habitat values increase with time, measured by soil development, soil litter increases, increased plant matter, cover, vegetation, structure and habitat niches. | • Conduct audits of the key indicators upon the completion of each stage of rehabilitation and annually until sign off, using lists and photographic records.<br>• Maintain ongoing records. | Annually Continue monitoring for 3 – 10 years until signed off. | • Complete revegetation of completed areas prior to vacating.<br>• Provide specific fauna habitat, such as logs, uneven land surface and recovered vegetation to provide a habitat suitable for local native fauna. |

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| | | | • Improve existing rehabilitated areas as necessary. |
| • All conditions of approval from any agency will be complied with. | • Annually conduct an on site audit of completed rehabilitation for species richness, resilience.<br>• Inspect revegetation to determine its long term survival from environmental and fire impacts.<br>• Until sign off inspect vegetation re-establishment following fire. | Annually Continue monitoring for 3 – 10 years until signed off. Inspect vegetation re-establishment following fire. | • Undertake additional weed control measures using spray or mechanical means.<br>• Treat grass impacts with Fusilade and general weeds with glyphosate or similar.<br>• Treat when appropriate. |

## 10.0 FINANCIAL PROVISION FOR CLOSURE

Financial provisioning at this time can only be indicative. Costs will change over the life of the operations, and costs outlined now will have to take account of inflation and other potential changes.

In addition, the active term of operations will also affect the costs. The greater the length of time the greater the cost of rehabilitation.

As noted previously there will, at any one time, be around 26 hectares of open ground. On the other hand, as rehabilitation will be progressive, a total cost at the end of excavation is unlikely to be required on a staged operation such as this. Officers from DMP regularly inspect the site.

Rehabilitation will be completed as soon as practicable following closure of each campaign. See the Activity Table in 2.4 Disturbance Areas.

With only around around 26 hectares open at any one time, and completed ground restored at the end of each campaign, there will be only a relatively small amount of ground to rehabilitate.

Costings for rehabilitation work for a quarry excavation over a 26 ha area are typically (if it had to be completed in one operation).

The costings will be assessed and adjusted over time as the Mine Closure Plan is regularly revisited.

FINAL CLOSURE COST ESTIMATES

| **Actions to be Completed for Final Closure** | **Estimated Cost** |
|---|---|
| Removal of all structures, buildings and fences.<br>Bulldozer to reform faces, push down to form batter slopes, deep rip the floor.<br>Hardstand and the access road will be deep ripped with tyne attached to a loader, grader or bulldozer but only at the completion of all excavation Sourced from Ubanstone mobile plant. | $ 30 000 |
| Spreading overburden followed by topsoil by bulldozer and loader. | $ 20 000 |

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| Environmental consultant to provide input to the species and methods to be used for rehabilitation. | $ 10 000 |
| Seed collection by a local collector and tube plants sourced from a local supplier of collected from other tenements held by Urbanstone at Carabooda.<br>Preparation of tube plants. Growth of tube plants.<br>Purchase of local provenance seed and tube plants to supplement as required. | $ 15 000 |
| Spreading seed and planting tube plants. | $ 5 000 |
| Monitoring of the rehabilitation, weed management and ongoing assessment using Ubanstone staff, additional replanting and rehabilitation as required.<br>Weed control, using mechanical removal, hand pulling and glyphosphate/Fusilade control. | $ 20 000 |
| Administration, travel and other contingencies | $ 10 000 |
| Annual inspections and tasks by local contractor | $ 10 000 |
| | |
| TOTAL | $ 120 000 |

TEMPORARY CLOSURE COSTS

| **Actions to be Completed for Temporary Closure** | **Estimated Cost** |
|---|---|
| Removal of structures and plant that will not be secure | $ 5 000 |
| Ensuring that faces and operations are geotechnically safe | $ 10 000 |
| Removal of wastes and any potentially adverse materials | $ 1 000 |
| Maintenance and upgrade of safety and security features such as fences, gates, trenches and bunding. | $ 5 000 plus<br>$ 2 000 annually |
| Administration and review of site. | $ 3 000 annually |
| | |
| TOTAL | $ 25 000 |

At all times a close level of communication and contact with DMP and DPaW will be undertaken to ensure a satisfactory level of compliance. The cost of rehabilitation will be reviewed regularly, every time the Mine Closure Plan is revisited; that is every three years.

## 11.0 MANAGEMENT OF INFORMATION AND DATA

All data relating to the operations will be retained as hard copies and electronic copies by UrbanStone. The data will include all materials relating to the project and include updated aerial and ground photography.

An annual environmental report will be prepared and submitted to the Department of Mines and Petroleum in accordance with the tenement conditions.

The Mine Closure Plan will be reviewed every three years or as required by the Department of Mines and Petroleum.

# 12.0 CLOSURE IMPLEMENTATION PROCEDURES

## 12.1 Land Restoration and Rehabilitation

The revegetation will be progressively undertaken to ensure the Completion Criteria is met.

The best means of revegetation is to use;

- Vegetation and topsoil recovered from clearing.
- Brush cut from adjoining vegetation.
- Planting tube plants.
- Providing some seed of local provenance species.

The closure planning will be updated from time to time as the excavation progresses forwards. This will include both anticipated costs and procedures.

The following procedures will be used for final closure and rehabilitation.

Unplanned or temporary closure is addressed under 8.4 Temporary Closure.

***Land Clearing***

1. A Clearing Permit will be required for areas of native vegetation to be cleared under Section 46 of the *Environmental* Protection Act 1984.
2. Dieback management will be undertaken as outlined in the attached Dieback Management.
3. Essentially all topsoil, vegetation fragments and any overburden will be recovered from cleared areas and retained for use in rehabilitation. The vegetation will be stored with the topsoil in low dumps <1 metre high around the perimeter of the pit.
4. Topsoil clearing will be progressive and minimised to that required for each stage of excavation.
5. A bulldozer or loader will be used to remove any vegetation by pushing it into windrows.
6. Any large logs will be either recovered for useable purposes or to form barriers.
7. Smaller vegetation will be track crushed and directly transferred to areas under rehabilitation to assist soil and habitat generation. The vegetation contains a significant seed source, because of the contained seed on many species, it is also a source of microbial material for soil formation, adds to habitat and assists in managing wind erosion.

8. The vegetation will also be used on the batters to minimise soil erosion and spreading on the final land surface as part of the final rehabilitation

9. If direct transfer is not possible the vegetation will be stored in low dumps to 1 metre high or swapped with a nearby operator to try and ensure that the material is not wasted.

10. Topsoil will be pushed to one side and formed into low storage dumps for later use for rehabilitation using either a loader or bulldozer.

11. Overburden, as yellow and brown sand and low grade limestone, will then be pushed to the perimeters, normally by bulldozer, to form bunding around the active area.

***Land Restoration***

1. The following procedures have been selected from observation of the existing operations and experience in the rehabilitation of other limestone and limesand quarries by Landform Research.

2. At any one time it is anticipated that around 26 hectares of ground will require rehabilitation. Progressive rehabilitation of completed land will have taken place previously.

3. Rehabilitation is to occur as soon as soon as possible following the end of excavation on each stage of pit floor and batter slope. This is to be completed progressively by the normal plant that operates on site during campaigns. A loader will be able to undertake this.

4. Land restoration and rehabilitation of any completed areas will be conducted prior to the site being vacated following the yearly excavation campaign at the end of autumn which is an appropriate time for rehabilitation.

5. All buildings, plant and any other foreign materials will be removed from site.

6. All inert materials associated with processing will either be buried or removed from site. All non inert materials will be removed.

7. The onsite waste disposal system (septic system) will be removed from site.

8. The land surface will be formed to be geotechnically stable to the requirements of the *Mines Safety and Inspection Act 1994 and Regulations 1995* as a final land surface.

9. The final land surface will be smoothed to be compatible with the existing natural landform of the area.

10. Slopes are to be stable and free from erosion. Slopes on the floor are to be undulating and no greater than between 1 : 2 and 1 : 4 vertical to horizontal.

11. The limestone floor and batter slopes will be deep ripped at intervals of 1 – 2 metre along contour.

12. A minimum of 300 mm of overburden will be spread over the surface where available to provide a substrate for revegetation. On limestone, rehabilitation can be very successful with minimum overburden when the floor is adequately deep ripped.

13. Experience by Landform Research on limestone shows that good revegetation can be achieved by seeding into soft overburden and deep ripped limestone floor, if suitable local species are used.

14. As the limestone is porous there will be no need for upslope contour or diversion banks to prevent water entering the void. Similarly there will be no need for drainage works on the floor of the void. The floor will be formed to drain to low points to manage storm events.

15. Where possible any disturbed areas that are no longer required will be rehabilitated using the methods described above within 12 months of becoming available.

***Revegetation***

1. Topsoil and vegetation fragments will be transferred directly from an area being cleared and spread across the surface to provide seed sources and habitats wherever possible. If direct transfer is not possible, any material stored in dumps will be respread.

2. Larger vegetation will be formed into occasional piles for habitat creation on the lower elevations.

3. Topsoil will be re-distributed in rehabilitated areas to depths of 50 mm where available.

4. Topsoil provides a useful source of seed for rehabilitation when the correct handling of the topsoil is used, stripped and replaced dry (autumn direct return). Maximum depth of 50 mm can be used to optimise revegetation of species-rich plant communities. However weed affected topsoil can create additional issues and may not be used.

5. Studies have shown that topsoil stripping and placement is best undertaken in summer for maximum germination and this will be done, but this raises the potential for additional dust generation from the fine humus particles.

6. Topsoil will be spread directly from an area being cleared where possible, otherwise reclaimed from a topsoil dump.

7. Pre-seeding weed control is only likely to be required where topsoils are used that contain weed species. This is unlikely to be the case on this site where the existing vegetation is in excellent condition even though some exotic species are currently present within the “natural” vegetation.

8. In May, after the first autumn rains, check for weed germination.

9. Any weeds likely to significantly impact on the rehabilitation will be sprayed with Roundup or similar herbicide or grubbed out, depending on the species involved. Fusilade will be used where grasses present an impediment to rehabilitation Weed affected topsoil and overburden will be buried.

10. Methods of sourcing seed will be;

    - Direct transfer of topsoil.

    - Brushing by cutting branches of adjoining and suitable local vegetation. For example branches of *Melaleuca* hold their seed and provide a good seed source when placed across the land surface.

    - Sourcing and planting additional tube plants as required as a result of site trials.

    - Collecting and or purchasing local provenance seed at the rate of about 500g/ha. Additional species that do not readily germinate from topsoil are Proteaceous and *Eucalyptus* species, which will be overseeded or tube planted. Species can also be taken from Coffey environments 2010.

    - Local leguminous species will be over seeded at the rate of 500 g per hectare to mimic the regeneration following fire.

11. Rehabilitation will take place during the first winter months following the restoration earth works of each particular section of quarry. Leaving the completed earth works for one season will reduce the success of rehabilitation by at least 50%, due to compaction effects.

12. Local provenance seed will be used wherever possible, selected for its ability to not impede the proposed final end use. A species list is attached.

13. Seeding conducted in summer will use scarified leguminous seeds that have been "dry smoked". Seeding conducted in July to August will have the leguminous seeds heat treated and all seeds will be smoke treated by soaking in "smoke water" for 24 hours prior to seeding.

14. Seed spreading will be achieved either using mechanical seed dispersal equipment or using manual methods. Bulking with a spreading agent such as sawdust, vermiculite or sand is desirable.

15. Rehabilitation will progressively follow mining with completed areas of the excavation being revegetated as soon as practicable.

***Fertiliser***

1. Fertiliser is not always required and will add nutrients to the ground water. If used a fertiliser containing low nitrogen, phosphorous and potassium, and trace elements, is recommended to be spread at rates of up to 50 kg/hectare, applied to rehabilitation areas in the year of planting. Nitrogen is provided by using leguminous seed in the seed mix.

### *Weeds*

1. The Weed Management Plan (attached) will form the basis of weed treatment. Depending on the nature of the planting substrate, a broad spectrum spraying program may be used. In areas where grass only is a potential problem, grass specific sprays will be used. In some areas where topsoil from cleared native vegetation is available no spraying may be required.

### *Erosion Control*

1. Soil erosion occurs when soil is exposed and disturbed by wind or water. Erosion involves soil particles being detached from areas not adequately protected by vegetation, and moved down-slope. This is not normally a significant problem in limestone which crusts after the first winter.

2. The soils are very permeable and runoff is normally minimal unless surface materials become non-wetting. Even so experience shows that there is minimal non wetting and surface particle movement under such conditions.

3. Water erosion on the batter slopes can be avoided by the permeability of the materials and by leaving the surface soft, rough and undulating, with the undulations running along contour. The final machinery run should be along contour and not down slope.

4. Limestone, when subjected to rainfall, forms a crust that is impervious to further erosion unless disturbed.

5. Wind erosion will be controlled by rehabilitating the disturbed ground as soon as practicable.

6. If wind erosion and soil stability become an issue measures will be taken to stabilise the soils. These could include but not be limited to fence wind breaks, spray mulching, cover crops, interim native vegetation or spreading mulch and vegetation.

7. For rehabilitation areas, interim revegetation will take place as soon as possible following landform and soil reconstruction.

8. Control of wind erosion potential will be assisted by spreading brush and vegetation across the topsoil on the batter slopes and reconstructed soils where local native vegetation is to be established.

### *Monitoring*

1. During late summer an assessment of the success of the rehabilitation will be made to determine the rehabilitation requirements for the following winter.

2. Monitoring includes visual assessments and, where necessary, counts to determine the success of the rehabilitation and restoration using 100 $m^2$ plots as follows;

    - plant density
    - plant growth

- plant deaths
- regeneration
- weed infestation

3. As necessary steps will be taken to correct any deficiencies in the vegetation.

4. Rehabilitation of each stage will be monitored for a period of three years to ensure that the revegetation meets the completion criteria of providing self sustaining indigenous shrub vegetation.

5. If rabbit damage is detected either place guards around the tube stock or bait using commercial baits laid under low concrete slabs. Kangaroos are difficult to control other than by culling but this is not desired. Normally impact from kangaroos is regarded as acceptable damage.

6. Provide ongoing weed management to identify and treat significant environmental weeds or weeds likely to impact on the rehabilitation.

7. Plants that have not survived are to be assessed to determine the number of replacement plants required. To this is to be added the number of additional plants required to be installed in the following winter to bring any deficiencies up to the completion criteria.

8. In areas of rehabilitation that do not meet the completion criteria measures are to be taken to increase the stem density to achieve the completion criteria. This could include but not be limited to;

    - additional seeding,
    - planting additional tube plants,
    - additional use of fresh topsoil.

## 10.2 Dieback Management

***Dieback Management***

The site is covered by native vegetation.

Therefore there is the potential for plant pathogens to be spread with the movement of soil and plant materials so good plant hygiene is desirable.

In the wetter parts of Western Australia, such as the south west, vegetation hygiene mainly relates to *Phytophthora cinamomi* even though there are other *Phytophthora* species and other diseases such as *Armillaria* that can cause dieback like symptoms. The same conclusions are made in the DER/DPaW Management Plans.

In most cases vegetation death is caused by a pathogen which infects the plant and causes it to lose vigour, with leaves dying, and, overtime, may kill the plant. As such the management of plant disease is essentially related to plant hygiene when coming onto a site and within a site.

The hygiene principles are proposed as part of good site management of potential plant pathogens.

The environment and site conditions on limestone and sand operations are minimal because the high alkalinity of the limestone inhibits such plant pathogens.

CALM generally recognises that Dieback is less likely to impact on vegetation on limestone and Spearwood/Cottesloe Land Systems, Podger F D and K R Vear, 1998*, Management of Phytophthora and disease caused by it*, IN *Phytophthora cinnamomi* and the disease caused by it - protocol for identifying protectable areas and their priority for management, EPA 2000.

There are several guides to the management of plant hygiene (Dieback).

- Department of Environment and Conservation CALM *Dieback Hygiene Manual 1992* is a practical guide to Dieback management.
- Department of Environment and Conservation CALM *Best Practice Guidelines for the Management of Phytophthora cinamomi, draft 2004.*
- Dieback Working Group 2005, *Management of Phytophthora Dieback in Extractive Industries.*
- Dieback Working Group 2009, *Managing Phytophthora Dieback in Bushland.*

As the location of the project is within native vegetation, which will be progressively cleared and rehabilitated, and adjoins native vegetation to the north, it is important that dieback management principles are used and these are proposed. Even though dieback is not normally associated with the Tamala and Spearwood systems there are other aspects that need to be managed such as weeds and other pathogens.

Plant pathogens are only likely to be an issue when equipment is brought to the site from an affected area either through vehicles or plant and soil materials.

The general principles to be used as the opportunities are presented, are listed below.

- Plant diseases are more likely to be transported under moist soil conditions.

- All vehicles and equipment to be used during excavation or land reinstatement are to be clean and free from soil or plant material prior to arriving at a site. Normally the only vehicle used is the loader that is retained on site.

- Vehicles and earth moving equipment are required to be clean prior to entering the site if they originate from another site. This is conducted offsite, independent of the tenement, by either brushing or washing. No dirty vehicle will be permitted onto the tenement.

- No soil and vegetation is to be brought to the site.

- Excavation vehicles are restricted to the excavation area apart from clearing land.

- Unwanted access to vegetated areas is discouraged through reduced tracks, signage, site marking and/or fencing, as appropriate

- A split operation is to be worked where practicable, where the road transport vehicles only access one side of the stockpile or processing area and excavation vehicles operate on the other side of the stockpiles and processing, reducing the risk of contamination from road transport.

- The site is to be secured from unwanted access with signs, fencing and other low impact measures as required.

- The Weed Management Policy will be complied with.

- Rehabilitated surfaces are free draining and do not contain wet or waterlogged conditions apart from dedicated sump and soakage areas.

- Illegally dumped rubbish is to be removed promptly.

- Roads are to be maintained as free draining and hard surfaced. All road vehicles will be confined to the dedicated roads.

### 10.3 Weed Management

A weed management program is in place for the quarry which includes spraying as necessary to minimise the impact of exotic taxa.

Weed management is to be used to minimise impact on site, remnant vegetation and on adjoining properties. Good management practices are to be used as part of the ongoing normal quarry operations.

The management of weeds therefore is to ensure that weeds are controlled, that there are no Declared or Significant environmental weeds that compromise the existing vegetation and the rehabilitated native vegetation, and that weed levels are not sufficient to impede future conservation land uses.

Weeds are most likely to impact on;

- Disturbed areas such as overburden dumps, topsoil stockpiles

- Edges of access roads

- Parking and amenity areas

- Locations accessible to the public on which rubbish is dumped.

The main sources of weeds are;

- Naturally occurring in soils. It is possible for remnant vegetation to contain a weed load that is not apparent in the natural vegetation.

- When disturbed during land clearing or road works it is not uncommon for weeds to germinate from topsoil and be carried to site on vehicles. Such weeds are not likely to gain a hold in such hostile conditions.

Ongoing visual assessment needs to be made on the type of weeds and the potential impact of each species. This provides a guidance on the methods of treatment.

- Weeds from edge effects from access roads and disturbed areas that may be carried to site.
- Gradual creep of weeds along access roads.
- Rubbish dumped by the public.
- Materials or waste brought to site by employees.
- Soil and seeds from vehicles arriving at site. This often applies to trucks that have carried something else such as grain, or vehicles to be used in earthworks.
- Wind blown or seed from outside the site.
- Birds and other vectors. This is more common than is often given credit for. eg *Solanum* species.

Any weed management is to utilise the most appropriate on ground measures to minimise the risk of spread of Declared and Environmental weeds.

The information provided here summarises the key points of the on ground weed management.

- The Plant Disease Management Actions are to be used to assist weed management.
- Inspections are to be conducted to monitor the presence and introduction of Environmental and Declared Weeds twice per year.
- On identification of Declared and Environmental weeds, a method and timing is to be agreed on to treat the weeds. This will either be removal, burial to a minimum of 500 mm, or spray with a herbicide. There are two main type of spray, grass selective such as Fusilade or general such as Roundup.
- Large plants are to be grubbed out or spot sprayed with a herbicide.
- All vehicles and equipment used during land clearing or land reinstatement, are to be clean and free from soil or plant material when arriving at site.
- Vegetated areas ahead of excavation are quarantined to excavation vehicles until required.
- Access to vegetated areas of the disturbed areas is to be discouraged through signage, marking, log barriers and a lack of tracks and the like as required.
- Illegally dumped rubbish is the major source of weeds and will be removed promptly.

- No weed contaminated or suspect soil or plant material is to be brought onto the site.

- When clearing land or firebreaks vehicles will work in conjunction with dieback principles and push from areas of better vegetation towards areas of lower quality vegetation.

- Weed management will work best from the least affected areas to most affected.

## 10.4 Surface and Ground Water Protection

The sand and limestone is very porous and direct infiltration of rainfall is normal without any detention basins or other collection systems. There is no surface water runoff.

All surface water runoff from the disturbance and rehabilitation footprint is contained on site.

As the disturbance footprint is located on elevated ground, and there is no surface water flow, no flows will come into the disturbance footprint, and none will need to be diverted around the disturbance.

Whilst limestone batching is undertaken on site, the materials are inert and commonly used in developments and across the Swan Coastal Plain such as cement and reconstituted products. These are known to not provide any increased risk to groundwater and are used for landscaping even in wetlands, creeks and other drainage areas.

The rehabilitated surface will be over 20 metres above the highest known water table thereby further minimising any risks to groundwater quality.

## REFERENCES

Acid Sulfate Soil Management Advisory Committee NSW, 1998, in their *Acid Sulfate Manual*.

Abeysinghe P B, 1998, *Limestone and Limesand Resources of Western Australia*, Geological Survey of Western Australia, Mineral Resources Bulletin 18.

Abeysinghe P B, 2003, *Silica resources of Western Australia*, Geological Survey of Western Australia, Mineral resources Bulletin No 21.

Australian Geomechanics Society, 2003, *Engineering Geology of Perth, Parts 1 and 2*, Volume 38 No 3 and No 4.

*Basic Raw Materials Resource Protection Working Plan*, prepared for the Department of Planning and Urban Development (DPUD, 1996).

Bastian L V, 1996, *Residual soil mineralogy and dune subdivision, Swan Coastal Plain, Western Australia*, Australian Journal of Earth Sciences 43, 31-44

Chamber of Commerce and Industry, 1995 and 1996, *Managing the Basic Raw materials of Perth and the Outer Metropolitan Region*, Parts 1 and 2.

Chamber of Commerce and Industry, 2008, *Basic Raw Materials Access and Availability*.

Coffey Environments, 2010*, Flora and Vegetation Assessment M70/143, Cutler Road, Carabooda,* (unpublished report prepared for Adelaide Brighton Cement Ltd).

Department of Conservation and Environment, 1980, *Atlas of Natural Resources Darling System, Western Australia.*

Department of Environment and Conservation 2004, *Perth Groundwater Atlas*.

Department of Environmental Protection (1996*). Land development sites and impacts on air quality: A guideline for the prevention of dust and smoke pollution from land development sites in Western Australia.*

Department of Environmental Protection (1997b*). Environment Protection (Noise) Regulations 1997: Summary of the Regulations.* Department of Environmental Protection, Perth.

DEC, 2011, *Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and other Related Activities.*

Department of Minerals and Energy (1991). *Environmental Management of Quarries: Development, Operation and Rehabilitation Guidelines.* DOIR, Perth.

Department of Water (1999b). *Water Quality Protection Note: Above Ground Chemical Storage Tanks in Public Drinking Water Source Areas*. Water and Rivers Commission, Perth.

Department of Water (1999d). *Draft Statewide Policy: Pesticide use in Public Drinking Water Source Areas.* Water and Rivers Commission Perth.

Department of Water (1999a). *Water Resource Protection Series WRP16: Draft Policy and Guidelines on Construction and Silica Sand Mining in Public Drinking Water Source Areas.* Water and Rivers Commission, Perth.

Department of Water (1999c). *Water Quality Protection Note: Recharge Criteria for Public Drinking Water Source Areas.* Water and Rivers Commission, Perth.

Department of Water, *Water Quality Protection Note: Washdown of Mechanical Equipment*, Perth.

Department of Water, 1998*, Manual for Managing Urban Stormwater Quality in Western Australia.*

*Environmental Protection (Kwinana) (Atmospheric Wastes) Regulations 1992* Area B.

EPA, 1995, *Criteria of environmental acceptability for land use proposals within the catchment of Lake Clifton,* Bulletin 788.

EPA Guidance Statement No 10, January 2003*, Level of assessment for proposals affecting natural areas within the System 6 region and Swan Coastal Plain portion of the System 1 region.*

EPA, 2000, *Phytophthora cinnamomi and the disease caused by it – a protocol for identifying protectable areas and their priority for Management.*

Firman J B, 2006, *Ancient weathering zones, pedocretes and palaeosols on the Australian Precambrian shield and in adjoining sedimentary basins: a review*, IN Journal of the Royal Society of Western Australia, Volume 89 part 2.

Geological Survey of Western Australia, 1990, *Geology and Mineral Resources of Western Australia*, Memoir 3.

Geoscience Australia, 2005, *Natural hazard risk in Perth*, Western Australia.

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

Gozzard J R, 1987, *Information on Industrial Minerals - Coastal Plain between Lancelin and Fremantle,* Geological Survey of Western Australia record 1978/11.

Gozzard J R, 1987, *Limesand and Limestone Resources between Lancelin and Bunbury*, Geol Surv WA, Record 1987/5

*Grimes K G, 2006 Syngenetic karst in Australia: a review, Helictite 39 (2) 200*

*Guidelines for Groundwater Protection in Australia*, ARMCANZ, ANZECC, September 1995.

Landcorp, 2010, Spring Flora Survey and Significant Tree Survey, 2010 Unpublished draft report prepared by GHD Mattiske Consulting Pty Ltd, 2013, Level 2 Flora and Vegetation Survey of the Ridges Survey Area, Unpublished Report.

Mattiske Consulting Pty Ltd, 2003, Flora and Vegetation Report, Unpublished Report prepared for Ubanstone.

Playford, P E, A E Cockbain and G H Low, 1976, *Geology of the Perth Basin Western Australia*, Geological Survey of Western Australia Bulletin 124.

Tiller K G, 1993, Micronutrients, IN Soils and Australian Viewpoint, CSIRO

Water Authority 1989, South West Coastal Groundwater Area Groundwater Management Review, Report WG 84

Western Australian Planning Commission, 2010, *Directions 2031*.

Western Australian Planning Commission, Planning Bulletin 64, *Acid Sulfate Soils*.

Western Australian Planning Commission*, State Planning Policy 2.4, Basic Raw Materials.*

Western Australian Planning Commission, *State Planning Policy No 4.1, State Industrial Buffer Policy, (draft July 2004).*

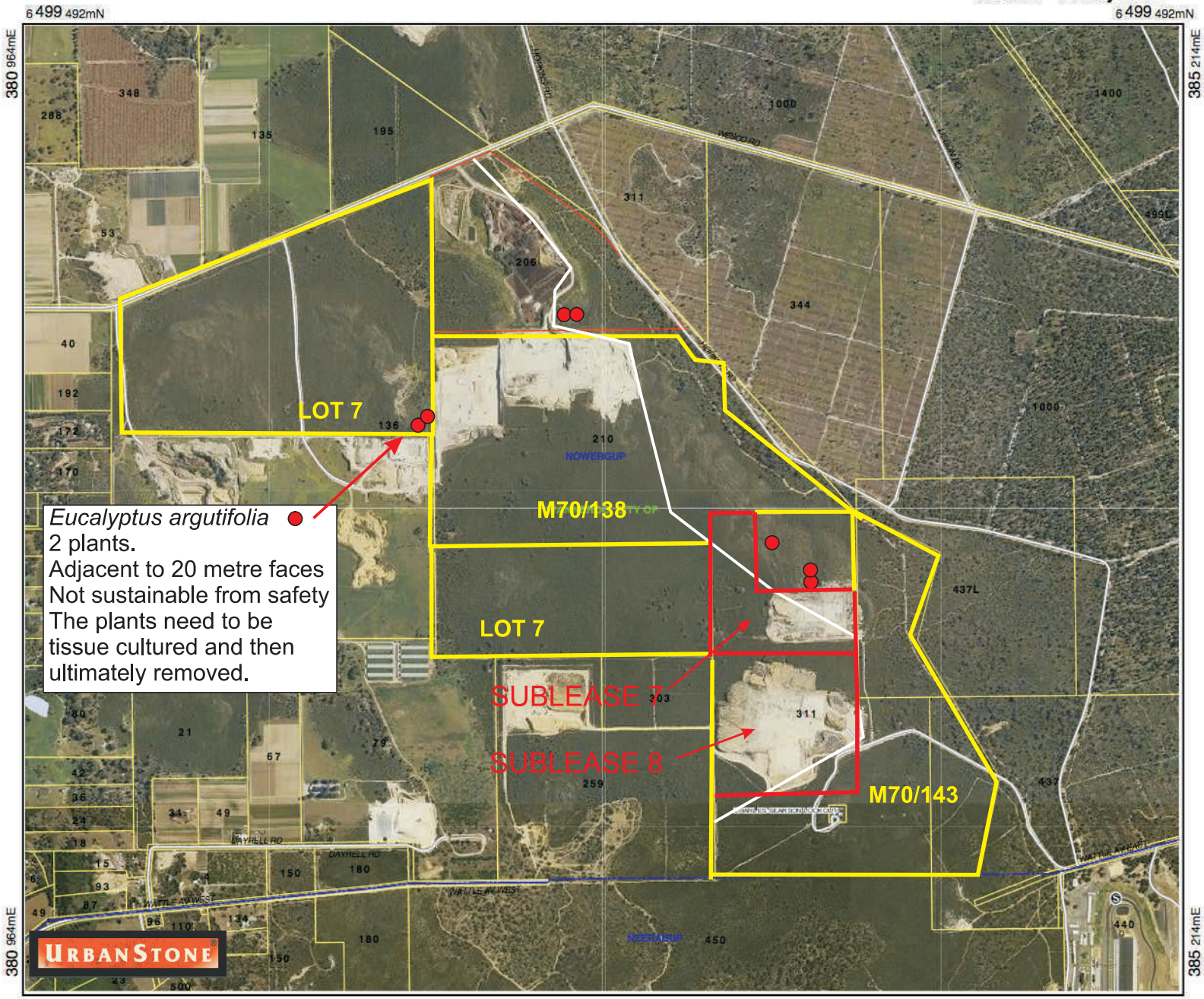
*Western Australian Water Quality Guidelines for Fresh and Marine Waters,* EPA Bulletin 711, 1*993.*

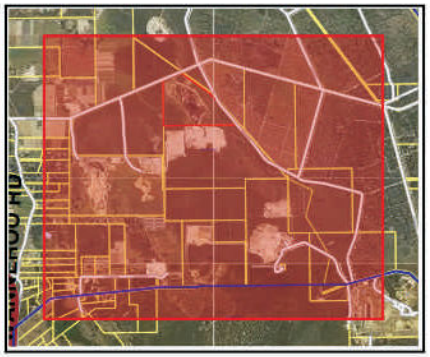
Western Wildlife, 2009, *Fauna assessment of M70/143,* (Unpublished report to Adelaide Brighton Cement Ltd).

Willett, I R, 1993, Oxidation-reduction reactions IN Soils and Australian Viewpoint,

# Wesco Road South ADELAIDE BRIGHTON

Created 12 May 2014



**Scale:** 1:21,104

**Description**

- *Eucalyptus argutifolia*

**Map Projection:** MGA 94 Zone 50 (Eastings/Northings)

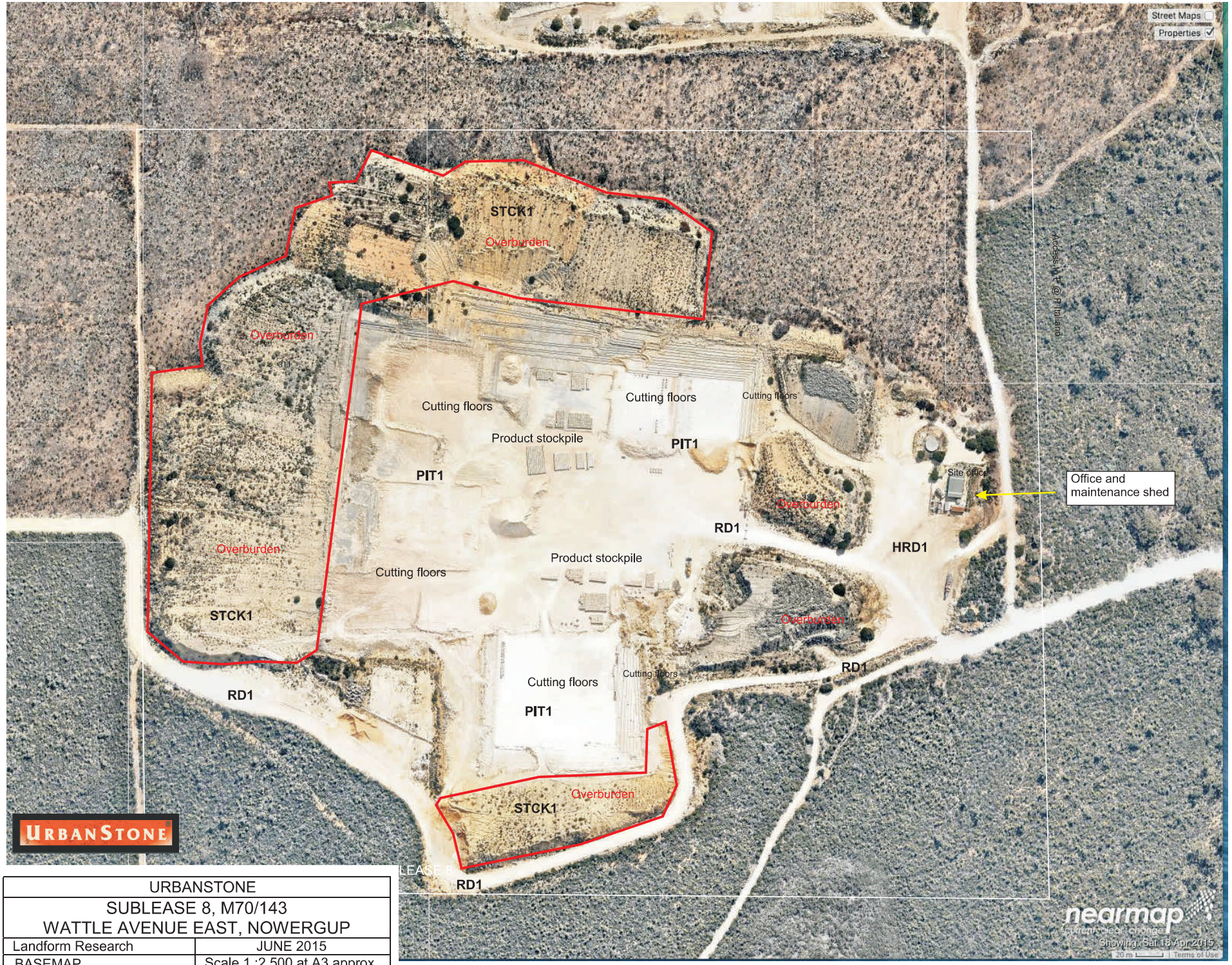
**Datum:** Geocentric Datum of Australia 1994


1 Midland Square
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customerservice@landgate.wa.gov.au
www.landgate.wa.gov.au


**Figure 1**

Landgate

© Western Australian Land Information Authority 2007




URBANSTONE

| URBANSTONE | |
|---|---|
| SUBLEASE 8, M70/143<br>WATTLE AVENUE EAST, NOWERGUP | |
| Landform Research | JUNE 2015 |
| BASEMAP<br>NEARMAP April 2015 | Scale 1 :2 500 at A3 approx |

**Figure 2**



Overview of cutting floors



Overview of cutting floors



Overview of cutting floors

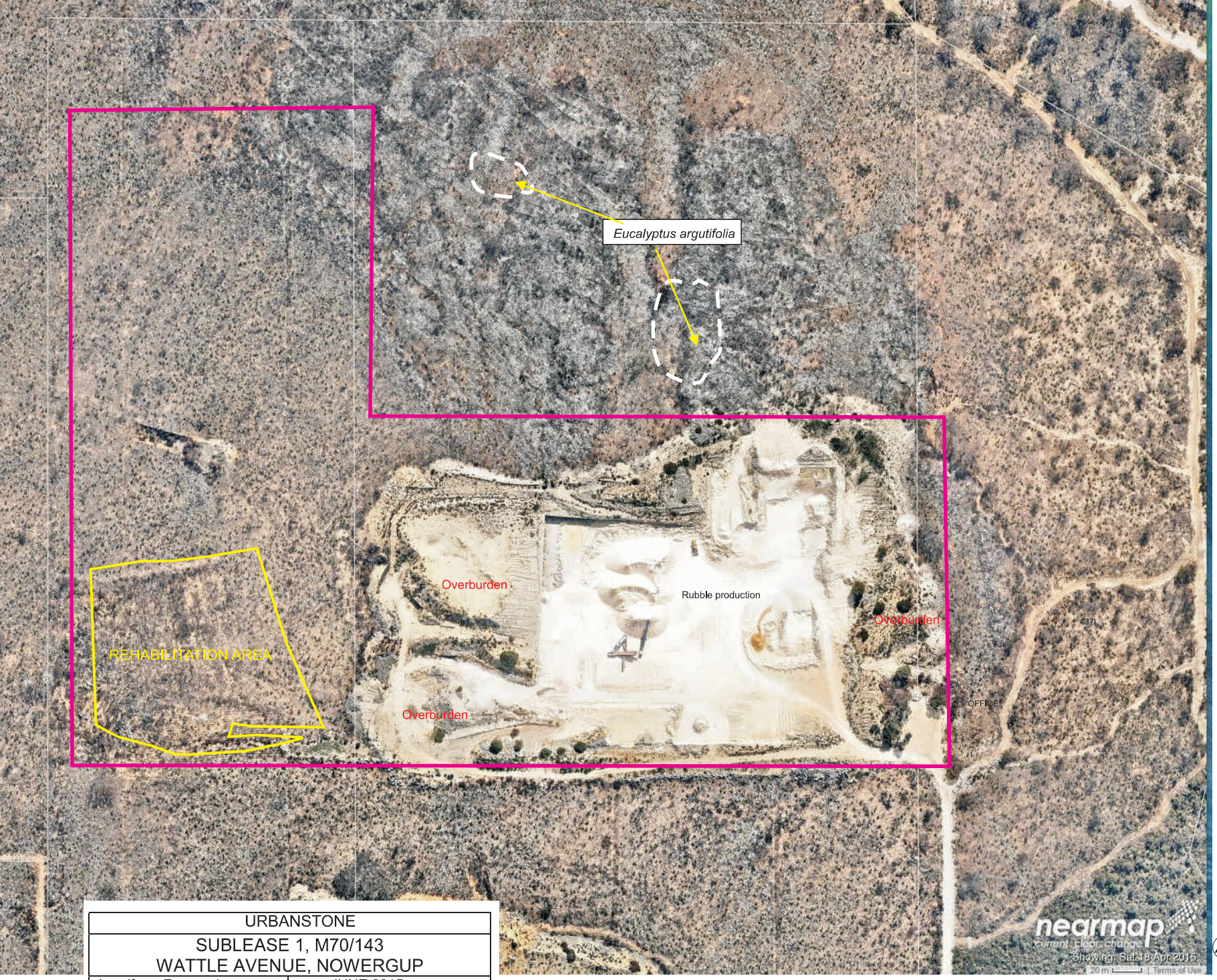


Overview of cutting floors

URBANSTONE

M70/143 SUBLEASE 8

**Figure 3**




| URBANSTONE | |
|---|---|
| SUBLEASE 1, M70/143<br>WATTLE AVENUE, NOWERGUP | |
| Landform Research | JUNE 2015 |
| BASEMAP NEARMAP<br>April 2015 | Map scale 1 : 2 000 approx |

**Figure 4**

URBANSTONE

0 50m

M70/143 SUBLEASE 7



Overview of cutting floors



Overview of cutting floors



Overview of cutting floors - west



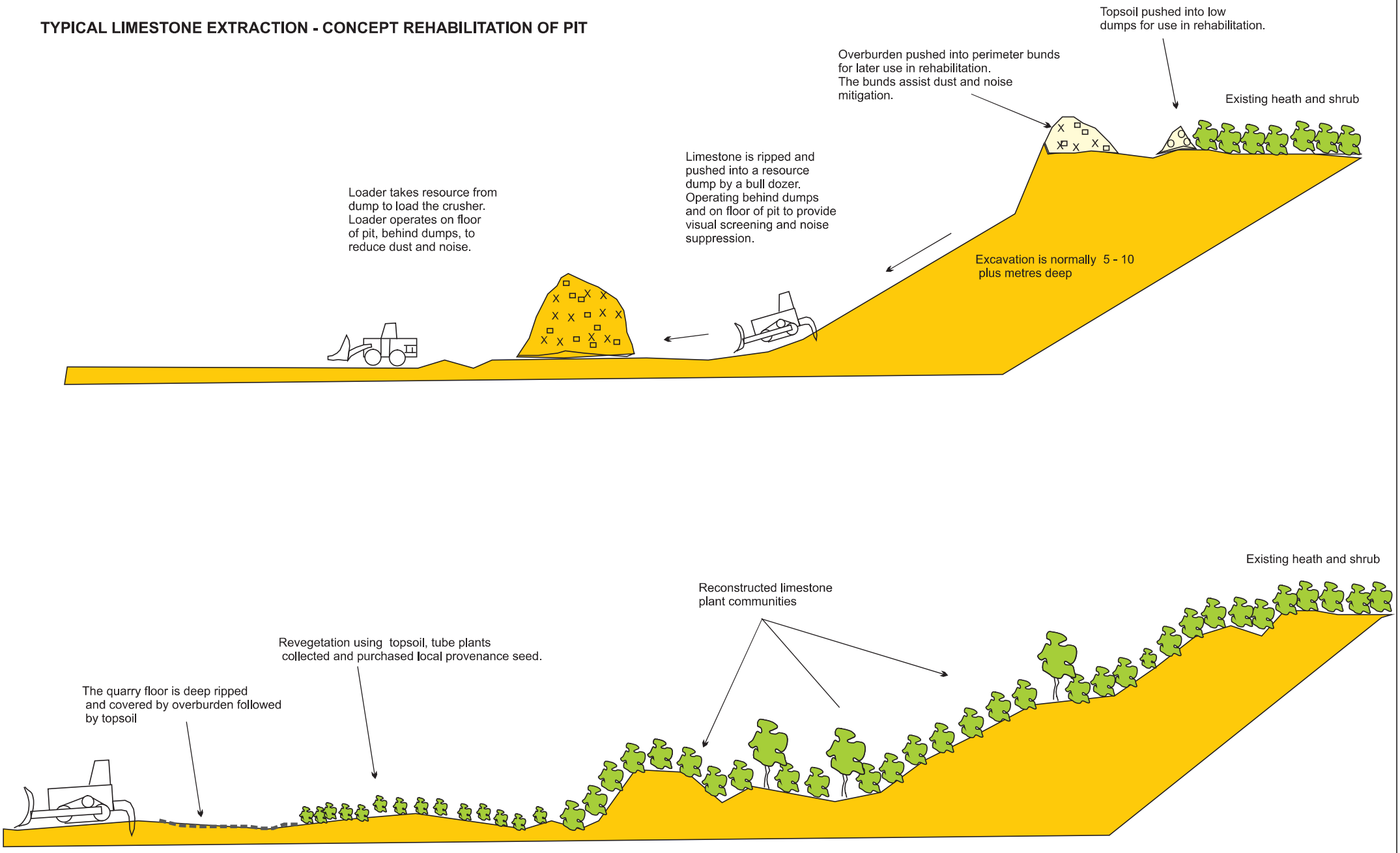
Current excavations

URBANSTONE

M70/143 SUBLEASE 7

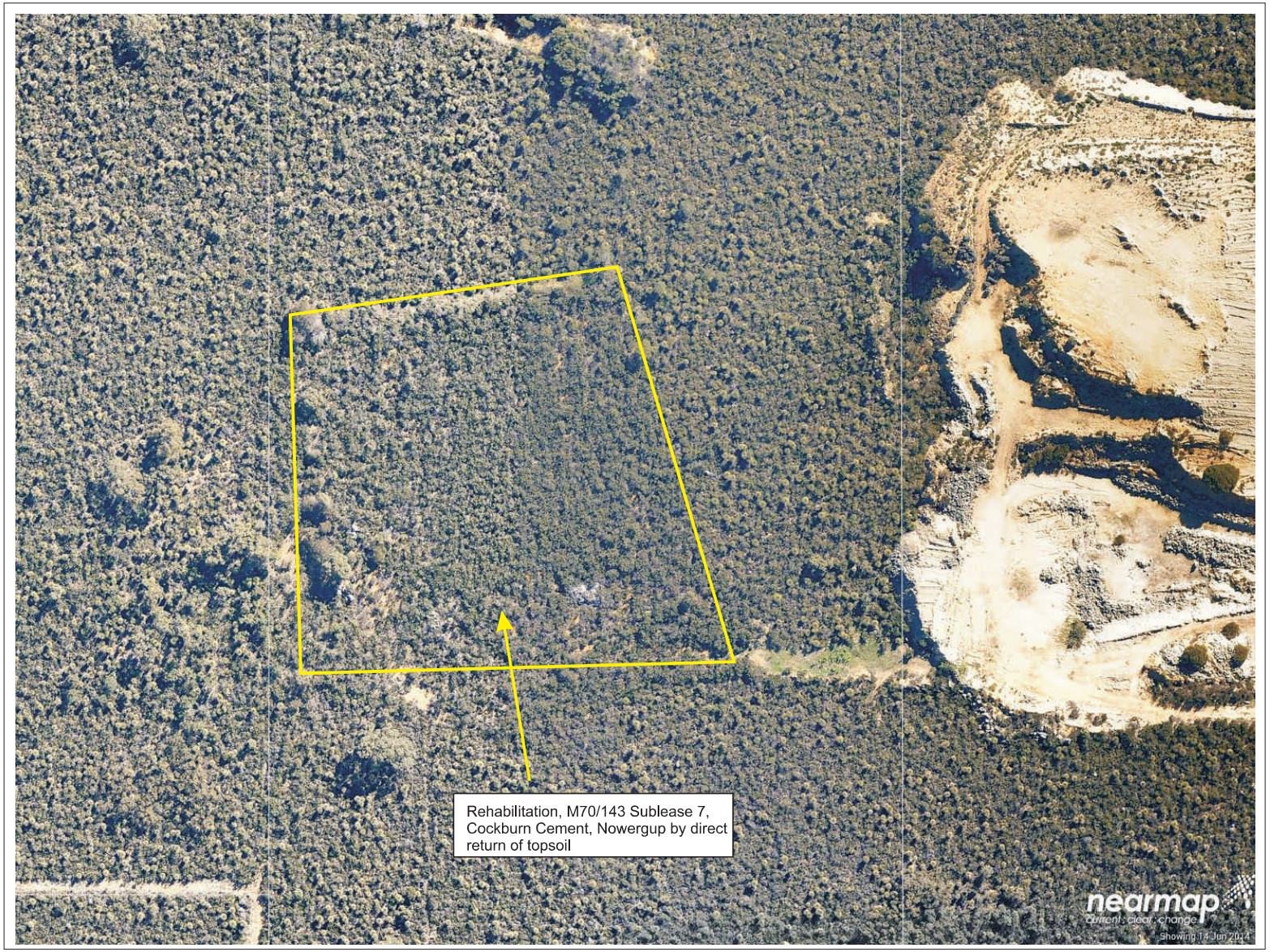
**Figure 5**

## TYPICAL LIMESTONE EXTRACTION - CONCEPT REHABILITATION OF PIT




URBAN STONE

CUTLER ROAD - CARABOODA **Figure 6**




EXAMPLE OF REHABILITATION ON LIMESTONE WHEN NO WEEDS AND GOOD TECHNIQUES WERE. THIS IS REGROWTH FROM TOPSOIL

M70/143, NOWERGUP

URBAN STONE

**Figure 7**



M70/339



Forrest Highway Clifton



M70/339



Forrest Highway Clifton

EXAMPLES OF REHABILITATION ON LIMESTONE

URBAN STONE

**Figure 8**

# Appendix C PGV (2021) Flora and Vegetation Assessment

# M70/143 WATTLE AVENUE EAST, NOWERGUP

## FLORA AND VEGETATION SURVEY

| | |
|---|---|
| Prepared for: | WA Limestone |
| Report Date: | 15 February 2021 |
| Version: | 2 |
| Report No. | 2020-544 |

pgv ENVIRONMENTAL

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Table 4: Threatened and Priority Ecological Communities likely to occur within 5km of the Site

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Table 6: Vegetation Condition Rating Scale


**Plates**


Plate 1: Aerial Photography from 1965 (Landgate, 2018)

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Figure 1: Site Location

Figure 2: Site Boundary and Topography

Figure 3: Vegetation Types

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Appendix 1: DBCA Flora Database Search

Appendix 2: Naturemap Report

Appendix 3: Protected Matters Search Tool Report

Appendix 4: Conservation Codes

Appendix 5: DBCA TEC/PEC Database Search

Appendix 6: Flora Species List

Appendix 7: Quadrat Data

# 1 INTRODUCTION

## 1.1 Background

WA Limestone is currently quarrying limestone from two pits within Mining Tenement M70/143, located in the City of Wanneroo approximately 35km north of the Perth Central Business District (Figure 1).

The existing mine is proposed to be expanded to respond to the growing need for limestone resource in the northern development corridor of Perth. The area being considered for expansion is around 58ha of which around 31ha contains native vegetation.

PGV Environmental was commissioned by WA Limestone to undertake a flora and vegetation survey of the area being considered for the expansion (the site) to assist in determining the ecological values with respect to the future mining of the site.

## 1.2 Scope of Works

A Detailed Flora and Vegetation Survey was undertaken in accordance with EPA Technical Guidance *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016). The survey included the following:

- Desktop search and review of the Department of Biodiversity, Conservation and Attractions (DBCA) Threatened and Priority flora and ecological community Databases;
- A search of the Naturemap website (DBCA, 2020);
- A search of the Commonwealth Government's Protected Matters Search Tool (DAWE, 2020) to identify species potentially occurring within the area that are protected under the *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999*;
- Examination of historic and recent aerial photography and contour and soil maps to provisionally identify vegetation types and condition;
- Field survey using quadrats to record native and introduced species as well as a thorough site walkover of any areas of native vegetation;
- Recording of any significant plant species using a hand-held GPS;
- Description and mapping of vegetation types and vegetation condition; and
- Compilation of a flora list.

# 2 EXISTING ENVIRONMENT

## 2.1 Land Use

The site is currently zoned 'Rural' under the Metropolitan Region Scheme (National Map, 2020) and 'Rural Resource' under the City of Wanneroo Local Planning Scheme No. 2 (WAPC, 2001).

The earliest available historic aerial photograph on-line from 1965 (Landgate, 2020) shows that the site contains native vegetation with a small quarried area in the centre (Plate 1). The 1974 aerial shows the quarry has expanded and lines of vegetation have been cleared most likely for resource exploration purposes (Plate 2).

**Plate 1: Aerial Photograph 1965**



**Plate 2: Aerial Photograph 1974**



The current extent of mining was cleared by 2005 (Plate 3).

**Plate 3: Aerial Photograph 2005 (Landgate, 2020)**



## 2.2 Topography

The site is undulating with an elevation ranging between 74m and 96m Australian Height Datum (AHD) (Figure 2).

## 2.3 Geology and Soils

### 2.3.1 Geology

The site is mapped as part of the Spearwood System which has the highest relief of the dune systems on the Swan Coastal Plain (Bolland, 1998). The Spearwood system consists of slightly calcareous Aeolian sand remnant from leaching of the underlying Pleistocene Tamala limestone (Davidson, 1995).

### 2.3.2 Soils

Two Spearwood soil units are mapped on the site and are described as follows:

- Karrakatta Shallow Soils Phase (211Sp_Kls) which are low hills and ridges with bare limestone or shallow siliceous or calcareous sand over limestone and are mapped over the majority of the site; and
- Karrakatta Sand Yellow Phase (211Sp_Ky) which are on low hilly to gently undulating terrain and are yellow sand over limestone at 1-2 m (DPIRD, 2020). This soil phase is located in a very small area on the eastern boundary.

## 2.4 Hydrology

Groundwater is at approximately 26 to 28m AHD, which is 51 to 69m below the surface level, and generally flows to the west (DWER, 2020). There are no wetlands mapped on the site (National Map, 2020).

# 3 METHODOLOGY

## 3.1 Database Searches

Searches of the following databases were undertaken for a 10km radius around the central point of the site prior to the site survey:

- Department of Biodiversity, Conservation and Attractions (DBCA) Declared Rare and Priority Flora database and Threatened Ecological Communities database (Appendix 1);
- DBCA Naturemap Database (DBCA, 2020) (Appendix 2); and
- The Commonwealth Government's Protected Matters Search Tool to identify species potentially occurring within the area that are protected under the *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999* (DAWE, 2020). A radius of 5km was used for this database (Appendix 3).

## 3.2 Site Survey

A flora and vegetation survey of the site was conducted by Dr Paul van der Moezel of PGV Environmental over 2 full days on 14 and 15 September 2020.

Information on flora composition and vegetation structure was recorded in thirteen 10m x 10m non-permanent quadrats in representative vegetation types.

The site was walked as thoroughly as possible within each different vegetation type to record all species in the survey area. The dense limestone heath vegetation that occurred on most of the site was difficult to walk through. Therefore, the site was not able to be surveyed efficiently using parallel transects. PGV Environmental considers the survey effort over the site with a relatively low amount of variation in the main vegetation types would have recorded a very high percentage of the plant species that occur on the site.

The number of quadrats is considered sufficient to describe the variation in vegetation over the site. Several vegetation types were mapped as separate units but were very similar with respect to structure and composition.

Most plant species were identified in the field. Some specimens were photographed or taken for identification at the Perth Reference Herbarium or office using standard reference guides.

## 3.3 Survey Conditions

The conditions that the survey was undertaken in are presented in Table 1 in order to assess the adequacy of the survey. In summary, there were no constraints to the survey.

**Table 1: Statement of Botanical Survey Conditions**

| Issue | Constraints (Y/N)* | Comment |
|---|---|---|
| Competency/experience of the consultant conducting the survey | No | Dr Paul van der Moezel has extensive botanical survey experience in the Perth Metropolitan Region. |
| Proportion of the flora identified^ | No | The timing of the survey in mid-September was optimal to identify most flora species on the site including all potential Threatened and Priority Flora. No follow-up survey required. |
| Sources of information (historic/recent or new data) | No | The flora in the Perth Metropolitan Region is well documented. |
| Proportion of the task achieved and further work that may need to be undertaken | No | No follow-up survey required as no Threatened Flora expected to occur in other seasons. |
| Timing/weather/season/cycle | No | The spring survey was optimal for most flora species. 2020 was a good year for ephemeral species, including orchids. |
| Disturbances (Fire) | No | The fire age of the vegetation was mostly greater than 5 years. |
| Intensity of survey (e.g. In retrospect was the intensity adequate) | No | Two days spent on the site was sufficient for an area of approximately 31ha of vegetation |
| Completeness (e.g. was relevant area fully surveyed) | No | |
| Resources (e.g. degree of expertise available for plant identification) | No | Experienced botanist undertook most plant identifications on site. |
| Remoteness and/or access problems | No | Easily accessible site in the Perth Metropolitan Region. |
| Availability of contextual (e.g. bioregional) information for the study area. | No | Bush Forever |

*Constraints have been rated as Significant, Moderate or No constraints

^Fungi and nonvascular flora (e.g. algae, mosses and liverworts) were not specifically surveyed for during the survey.

# 4 RESULTS

## 4.1 Flora Database Searches

A search of the DBCA Threatened Flora Databases: the WA Herbarium database (WAHerb), the Threatened (Declared Rare) and Priority Flora Species List (TFPL) (Appendix 1) and Naturemap Database (Appendix 2) indicates that a number of species that are listed as Endangered, Threatened or Priority have been located within a 10km radius of the site. The and the EPBC Act Protected Matters Search Tool (Appendix 3) indicates species that may have habitat within 5km radius of the site. The results from these database searches are shown in Table 2. None of the species has been recorded from the survey area according to the databases. However, *Eucalyptus argutifolia* is known to occur in the Mining Lease north of the northern pit.

Table 3 lists the likelihood that any of these species could occur on the site based on the soil types and vegetation condition.

**Table 2: Conservation Significant Flora Identified in Database Searches**

| Scientific Name | Common Name | Conservation Status (WA) | Status under EPBC Act |
|---|---|---|---|
| *Caladenia huegelii* | King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid | Schedule 1 | Endangered |
| *Calectasia cyanea* | Blue Tinsel Lily | Schedule 1 | Critically Endangered |
| *Drakaea elastica* | Glossy-leafed Hammer Orchid | Schedule 1 | Endangered |
| *Grevillea curviloba* | Curved-leaf Grevillea | Schedule 1 | Endangered (as subsp. *curviloba* and *incurva*) |
| *Darwinia foetida* | Muchea Bell | Schedule 2 | Critically Endangered |
| *Diuris purdiei* | Purdie's Donkey-orchid | Schedule 2 | Endangered |
| *Drakaea micrantha* | Dwarf Hammer-orchid | Schedule 2 | Vulnerable |
| *Marianthus paralius* | | Schedule 2 | Endangered |
| *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) | | Schedule 2 | Endangered |
| *Acacia anomala* | Grass Wattle, Chittering Grass Wattle | Schedule 3 | Vulnerable |
| *Andersonia gracilis* | Slender Andersonia | Schedule 3 | Endangered |
| *Anigozanthos viridis* subsp. *terraspectans* | Dwarf Green Kangaroo Paw | Schedule 3 | Vulnerable |
| *Diuris micrantha* | Dwarf Bee-orchid | Schedule 3 | Vulnerable |
| *Eleocharis keigheryi* | Keighery's Eleocharis | Schedule 3 | Vulnerable |
| *Eucalyptus argutifolia* | Yanchep Mallee, Wabling Hill Mallee | Schedule 3 | Vulnerable |

| Scientific Name | Common Name | Conservation Status (WA) | Status under EPBC Act |
|---|---|---|---|
| *Baeckea* sp. Limestone (N. Gibson & M.N. Lyons 1425) | | Priority 1 | |
| *Drosera patens* | | Priority 1 | |
| *Drosera x sidjamesii* | | Priority 1 | |
| *Grevillea* sp. Ocean Reef (D. Pike Joon 4) | | Priority 1 | |
| *Haloragis* sp. Parrot Ridge (G.J. Keighery 11563) | | Priority 1 | |
| *Hydrocotyle striata* | | Priority 1 | |
| *Leucopogon maritimus* | | Priority 1 | |
| *Acacia benthamii* | | Priority 2 | |
| *Amanita wadulawitu* | Long-spored Lepidella | Priority 2 | |
| *Calectasia elegans* | Elegant Tinsel Lily | Priority 2 | |
| *Fabronia hampeana* | | Priority 2 | |
| *Lecania sylvestris* | | Priority 2 | |
| *Lecania turicensis* var. *turicensis* | | Priority 2 | |
| *Leucopogon squarrosus* subsp. *trigynus* | | Priority 2 | |
| *Poranthera moorokatta* | | Priority 2 | |
| *Rinodina bischoffii* | | Priority 2 | |
| *Stenanthemum sublineare* | | Priority 2 | |
| *Tetraria* sp. Chandala (G.J. Keighery 17055) | | Priority 2 | |
| *Thelymitra variegata* | Queen of Sheba | Priority 2 | |
| *Adenanthos cygnorum* subsp. *chamaephyton* | | Priority 3 | |
| *Amanita carneiphylla* | Miller's Pink-Gilled Lepidella | Priority 3 | |
| *Austrostipa mundula* | | Priority 3 | |
| *Beyeria cinerea* subsp. *cinerea* | | Priority 3 | |
| *Chamaescilla gibsonii* | | Priority 3 | |
| *Conostylis bracteata* | | Priority 3 | |
| *Cyathochaeta teretifolia* | | Priority 3 | |
| *Dampiera triloba* | | Priority 3 | |
| *Guichenotia tuberculata* | | Priority 3 | |
| *Hibbertia leptotheca* | | Priority 3 | |
| *Jacksonia gracillima* | | Priority 3 | |
| *Lasiopetalum membranaceum* | | Priority 3 | |

| Scientific Name | Common Name | Conservation Status (WA) | Status under EPBC Act |
|---|---|---|---|
| *Leucopogon* sp. Yanchep (M. Hislop 1986) | | Priority 3 | |
| *Pimelea calcicola* | | Priority 3 | |
| *Pithocarpa corymbulosa* | | Priority 3 | |
| *Placynthium nigrum* | Blackthread Lichen | Priority 3 | |
| *Platysace ramosissima* | | Priority 3 | |
| *Sarcozona bicarinata* | | Priority 3 | |
| *Sphaerolobium calcicola* | | Priority 3 | |
| *Stylidium maritimum* | | Priority 3 | |
| *Stylidium paludicola* | | Priority 3 | |
| *Verticordia serrata* var. *linearis* | | Priority 3 | |
| *Anigozanthos humilis subsp. chrysanthus* | Golden Cats Paw | Priority 4 | |
| *Conostylis pauciflora* subsp. *euryrhipis* | | Priority 4 | |
| *Conostylis pauciflora* subsp. *pauciflora* | | Priority 4 | |
| *Drosera occidentalis* | Western Sundew | Priority 4 | |
| *Hibbertia helianthemoides* | | Priority 4 | |
| *Hydrocotyle lemnoides* | Aquatic Pennywort | Priority 4 | |
| *Jacksonia sericea* | Waldjumi | Priority 4 | |
| *Lepidium pseudotasmanicum* | | Priority 4 | |
| *Schoenus griffinianus* | | Priority 4 | |
| *Stylidium longitubum* | Jumping Jacks | Priority 4 | |
| *Tripterococcus* sp. Brachylobus (A.S. George 14234) | | Priority 4 | |

Conservation Codes are shown in Appendix 4

**Table 3: Likelihood of Identified Significant Flora Species Occurring on the Site**

| Scientific Name | Common Name | Habitat* | Likelihood to occur on the site |
|---|---|---|---|
| *Caladenia huegelii* | King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid | The Grand Spider-orchid prefers sand or clay loam. This species generally does not survive in disturbed areas. | Highly Unlikely – habitat not typical to the species |

| Scientific Name | Common Name | Habitat* | Likelihood to occur on the site |
|---|---|---|---|
| *Calectasia cyanea* | Blue Tinsel Lily | The Blue Tinsel Lily prefers white, grey or yellow sand or gravel and is known from the Albany region. | No – this species is restricted to the Albany region |
| *Drakaea elastica* | Glossy-leafed Hammer Orchid | The Glossy-leafed Hammer Orchid prefers low-lying situations adjoining winter-wet swamps. This species does not survive in disturbed areas. | Highly Unlikely – no low-lying habitat |
| *Grevillea curviloba* | Curved-leaf Grevillea | Narrow curved-leaf Grevillea occurs in grey sand in winter-wet heath. There are 17 known populations in an area between Muchea and Badgingarra (Phillimore and English, 2000). | Highly Unlikely – not winter wet heath habitat |
| *Darwinia foetida* | Muchea Bell | The Muchea Bell is found in grey-white sand on swampy, seasonally wet sites. | Highly Unlikely – no swamp habitat |
| *Diuris purdiei* | Purdie's Donkey-orchid | Purdie's Donkey Orchid occurs in grey-black sand in moist winter-wet swamps. | Highly Unlikely – no swamp habitat |
| *Drakaea micrantha* | Dwarf Hammer-orchid | Dwarf Hammer-orchid occurs in grey sands over dark, grey to blackish, sandy clay-loam substrates in winter wet depressions or swamps. | Highly Unlikely – no swamp habitat |
| *Marianthus paralius* | | *Marianthus paralius* occurs in white sand and brown loam amongst heath on coastal limestone cliffs (DEC, 2009). | Highly Unlikely – no coastal habitat |
| *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) | | *Melaleuca* sp. Wanneroo occurs in very shallow soils over limestone 'caprock' on ridges. | Possible |
| *Acacia anomala* | Grass Wattle, Chittering Grass Wattle | The Grass Wattle prefers lateritic soils and slopes. | Highly Unlikely – no lateritic habitat |
| *Andersonia gracilis* | Slender Andersonia | Slender Andersonia occurs in white/grey sand, sandy clay, gravelly loam in winter-wet areas, near swamps. | Highly Unlikely – no swamp habitat |
| *Anigozanthos viridis* subsp. *terraspectans* | Dwarf Green Kangaroo Paw | The Dwarf Green Kangaroo Paw occurs on grey sand, clay loam in winter-wet depressions. | Highly Unlikely – no wetland habitat |
| *Diuris micrantha* | Dwarf Bee-orchid | The Dwarf Bee-orchid is usually found on cleared firebreaks or open sandy patches that have been disturbed with in Jarrah Banksia woodland or thickets of Spearwood (*Kunzea ericifolia/ glabrescens*) (Williams *et al.*, 2001). | Highly Unlikely – no suitable habitat |

| Scientific Name | Common Name | Habitat* | Likelihood to occur on the site |
|---|---|---|---|
| *Eleocharis keigheryi* | Keighery's Eleocharis | Keighery's Eleocharis occurs in clay, sandy loam and is emergent in freshwater: creeks, claypans. | Highly Unlikely – no damp habitat |
| *Eucalyptus argutifolia* | Yanchep Mallee, Wabling Hill Mallee | The Yanchep Mallee occurs in shallow soils over limestone on slopes or gullies of limestone ridges, outcrops. | Known to occur on the site |
| *Baeckea* sp. Limestone (N. Gibson & M.N. Lyons 1425) | | *Baeckea* sp. Limestone is recorded from limestone outcrop/ridge in yellow sand derived from Tamala Limestone - Spearwood Dune System in bushland burnt 5+ years (Western Australian Herbarium, 2012). | Possible |
| *Drosera patens* | | *Drosera patens* occurs in sandy soils on the margins of winter-wet depressions, swamps and lakes. | Highly Unlikely – no swamp habitat |
| *Drosera x sidjamesii* | | *Drosera x sidjamesii* grows in peaty sand along lake margins, close to winter high-water line. | Highly Unlikely – no lake habitat |
| *Grevillea* sp. Ocean Reef (D. Pike Joon 4) | | *Grevillea* sp. Ocean Reef (D. Pike Joon 4) occurs in dry brown/grey sand, yellow brown sand on sandy dune, gully in coastal scrub. | Highly Unlikely – Not coastal habitat |
| *Haloragis* sp. Parrot Ridge (G.J. Keighery 11563) | | *Haloragis* sp. Parrot Ridge (G.J. Keighery 11563) is recorded from a hill on margin of ridge in black sand over limestone (Western Australian Herbarium, 1989). | Possible but would be an extension of the range of this species |
| *Hydrocotyle striata* | | *Hydrocotyle striata* occurs in clay near springs. | Highly Unlikely – no spring habitat |
| *Leucopogon maritimus* | | *Leucopogon maritimus* occurs in Quindalup deep, calcareous sands, on the mid to upper slopes of dunes or in shallow sand over limestone, but avoiding the thicker vegetation of the swale (Hislop, 2011) | Highly Unlikely – no Quindalup habitat |
| *Acacia benthamii* | | *Acacia benthamii* grows on sand, typically on limestone breakaways | Possible |
| *Amanita wadulawitu* | Long-spored Lepidella | Long-spored Lepidella occurs in sandy soil with *Corymbia calophylla, Eucalyptus marginata*, *E. todtiana, E. camaldulensis*, *Jacksonia furcellata*, *Banksia attenuata* and *B. menziesii*. (McGurk et al., 2016). | Highly Unlikely – no suitable habitat |

| Scientific Name | Common Name | Habitat* | Likelihood to occur on the site |
|---|---|---|---|
| *Calectasia elegans* | Elegant Tinsel Lily | Elegant Tinsel Lily occurs in deep grey quartz soils on gentle slopes, above damplands. | Highly Unlikely – no suitable habitat |
| *Fabronia hampeana* | | *Fabronia hampeana* occurs on sheltered wet trunk of *Macrozamia dyeri* in shrub layer (Western Australian Herbarium, 2005). | Possible if *Macrozamia* is present |
| *Lecania sylvestris* | | *Lecania sylvestris* is recorded from a roadside (Western Australian Herbarium, 1988). | Possible |
| *Lecania turicensis* var. *turicensis* | | *Lecania turicensis* var. *turicensis* occurs on coastal rocks, limestone (Western Australian Herbarium, 1988). | Unlikely – not coastal habitat |
| *Leucopogon squarrosus* subsp. *trigynus* | | *Leucopogon squarrosus* subsp. *trigynus* occurs in Bassendean sands (Hislop, 2011). | Highly Unlikely – no Bassendean habitat |
| *Poranthera moorokatta* | | *Poranthera moorokatta* grows in white silica sand and has been recorded in Banksia woodland and in a shallow dampland (Barrett, 2012). | Highly Unlikely – no low-lying habitat |
| *Rinodina bischoffii* | | *Rinodina bischoffii* is recorded from grasslands with low shrubs (Western Australian Herbarium, 1994). | Highly Unlikely – no suitable habitat |
| *Stenanthemum sublineare* | | *Stenanthemum sublineare* grows in littered white sand on coastal plain. | Highly Unlikely – no suitable habitat |
| *Tetraria* sp. Chandala (G.J. Keighery 17055) | | *Tetraria* sp. Chandala is recorded from a mound spring in peaty sand (Western Australian Herbarium, 2005). | Highly Unlikely – no mound spring habitat |
| *Thelymitra variegata* | Queen of Sheba | The Queen of Sheba orchid grows on sandy clay, sand and laterite. | Highly Unlikely – no lateritic habitat |
| *Adenanthos cygnorum* subsp. *chamaephyton* | | *Adenanthos cygnorum* subsp. *chamaephyton* occurs in grey sand, lateritic gravel. | Highly Unlikely – no lateritic habitat |
| *Amanita carneiphylla* | Miller's Pink-Gilled Lepidella | Miller's Pink-Gilled Lepidella is a deeply rooting species and grows in sandy soil. | HighlyUnlikely – not deep sands |
| *Austrostipa mundula* | | *Austrostipa mundula* occurs on plains in grey sand (Western Australian Herbarium, 2001). | Highly Unlikely – no suitable habitat |

| Scientific Name | Common Name | Habitat* | Likelihood to occur on the site |
|---|---|---|---|
| *Beyeria cinerea* subsp. *cinerea* | | *Beyeria cinerea* subsp. *cinerea* grows in sand over limestone on road verges, gullies | Possible |
| *Chamaescilla gibsonii* | | *Chamaescilla gibsonii* grows in clay to sandy clay on winter-wet flats, shallow water-filled claypans. | Highly Unlikely – no winter-wet habitat |
| *Conostylis bracteata* | | *Conostylis bracteata* occurs in sand, limestone on consolidated sand dunes. | Unlikely – not dune habitat |
| *Cyathochaeta teretifolia* | | *Cyathochaeta teretifolia* occurs in grey sand, sandy clay on swamps, creek edges. | Highly Unlikely – no wetland habitat |
| *Dampiera triloba* | | *Dampiera triloba* grows in loamy sand (Australian National Herbarium, 2009) in lower lying areas. | |
| *Guichenotia tuberculata* | | *Guichenotia tuberculata* grows in sand clay over laterite, sand. | Highly Unlikely – no lateritic habitat |
| *Hibbertia leptotheca* | | *Hibbertia leptotheca* grows near-coastal limestone ridges, outcrops and cliffs in coastal heaths and thickets usually dominated by species of *Melaleuca* and *Acacia* (Thiele, 2019). | Highly Unlikely – not coastal habitat |
| *Jacksonia gracillima* | | *Jacksonia gracillima* occurs in grey and brown well-drained sand. | Possible |
| *Lasiopetalum membranaceum* | | *Lasiopetalum membranaceum* grows in sand over limestone. | Possible |
| *Leucopogon* sp. Yanchep (M. Hislop 1986) | | *Leucopogon* sp. Yanchep occurs in light grey-yellow sand, brown loam, limestone, laterite, granite on coastal plain, breakaways, valley slopes, low hills. | Possible |
| *Pimelea calcicola* | | *Pimelea calcicola* occurs in sand on coastal limestone ridges. | Possible |
| *Pithocarpa corymbulosa* | | *Pithocarpa corymbulosa* occurs in gravelly or sandy loam amongst granite outcrops. | Highly Unlikely – no granite outcrop habitat |
| *Placynthium nigrum* | Blackthread Lichen | Blackthread Lichen is recorded from karst limestone on lagoon shore among salt marsh (Allan Herbarium, 1997). | Highly Unlikely – no saltmarsh habitat |
| *Platysace ramosissima* | | *Platysace ramosissima* prefers sandy soils. | Possible |
| *Sarcozona bicarinata* | Ridged Noon-flower | Ridged Noon-flower is found in white sand. | Possible |

| Scientific Name | Common Name | Habitat* | Likelihood to occur on the site |
|---|---|---|---|
| *Sphaerolobium calcicola* | | *Sphaerolobium calcicola* grows in white-grey-brown sand, sandy clay over limestone, black peaty sandy clay on tall dunes, winter-wet flats, interdunal swamps, low-lying areas. | Highly Unlikely – no wetland habitat |
| *Stylidium maritimum* | | *Stylidium maritimum* occurs in sand over limestone on dune slopes and flats in coastal heath and shrubland, open Banksia woodland. | Unlikely – not coastal habitat |
| *Stylidium paludicola* | | *Stylidium paludicola* prefers peaty sand over clay in winter wet habitats in Marri and Melaleuca woodland, Melaleuca shrubland. | Highly Unlikely – no wetland habitat |
| *Verticordia serrata* var. *linearis* | | *Verticordia serrata* var. *linearis* grows in white sand, gravel in open woodland. | Highly Unlikely – no gravel habitat |
| *Anigozanthos humilis subsp. chrysanthus* | Golden Cats Paw | Golden Cats Paw grows in grey or yellow sand. | Possible |
| *Conostylis pauciflora* subsp. *euryrhipis* | | *Conostylis pauciflora* subsp. *euryrhipis* occurs in white, grey or yellow sand on consolidated dunes in coastal areas. | Unlikely – not coastal habitat |
| *Conostylis pauciflora* subsp. *pauciflora* | | *Conostylis pauciflora* subsp. *pauciflora* occurs in grey sand, limestone on hillslopes, consolidated dunes in coastal areas. | Unlikely – not coastal habitat |
| *Drosera occidentalis* | Western Sundew | The Western Sundew occurs in sandy and clayey soils in swamps and wet depressions. | Highly Unlikely – no wetland habitat |
| *Hibbertia helianthemoides* | | *Hibbertia helianthemoides* grows in clayey sand over sandstone or loam over quartzite on hills and scree slopes. | Highly Unlikely – no suitable habitat |
| *Hydrocotyle lemnoides* | Aquatic Pennywort | Aquatic Pennywort occurs in swamps | No – no swamp habitat |
| *Jacksonia sericea* | Waldjumi | Waldjumi grows in calcareous and sandy soils. | Possible |
| *Lepidium pseudotasmanicum* | | *Lepidium pseudotasmanicum* occurs in loam, sand associated with granite. | Highly Unlikely – no granite habitat |
| *Schoenus griffinianus* | | *Schoenus griffinianus* grows in white sand in low heath (Wilson, 1997). | Unlikely – not heath habitat |

| Scientific Name | Common Name | Habitat* | Likelihood to occur on the site |
|---|---|---|---|
| *Stylidium longitubum* | Jumping Jacks | Jumping Jacks prefer sandy clay, clay in seasonal wetlands. | Highly Unlikely – no wetland habitat |
| *Tripterococcus* sp. Brachylobus (A.S. George 14234) | | *Tripterococcus* sp. Brachylobus occurs in grey, black or peaty sand winter-wet flats | Highly Unlikely – no wetland habitat |

* sourced from Florabase (DBCA, 2017) and SPRAT Database (DoEE, 2016) as well as the DBCA database searches unless otherwise denoted

## 4.2 TEC and PEC Desktop Search

A search of DBCA's Threatened (TEC) and Priority Ecological Communities (PEC) database was conducted within a radius of 5km around the site (48-0820EC) (Appendix 5). Three TECs and four Priority 3 PECs at State level were identified in the database search. There was one State listed PEC are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as TEC as part of a larger ecological community. The communities identified in the database searches are outlined in Table 4. The SCP26a has the potential to occur on the site given the site soil conditions.

**Table 4: Threatened and Priority Ecological Communities likely to occur within 5km of the Site**

| Ecological Community | Description | Conservation Status WA | Status under the EPBC Act |
|---|---|---|---|
| SCP10a | Shrublands on dry clay flats (floristic community type 10a as originally described in Gibson *et al.* (1994)) | Endangered | Critically Endangered |
| SCP20a | *Banksia attenuata* woodlands over species rich dense shrublands (floristic community type 20a as originally described in Gibson *et al.* (1994)) | Endangered | Endangered (as part of Banksia WL SCP) |
| SCP26a | *Melaleuca huegelii - Melaleuca systena* shrublands on limestone ridges (floristic community type 26a as originally described in Gibson *et al*. (1994)) | Endangered | |
| SCP22 | *Banksia ilicifolia* woodlands | Priority 3 | Endangered (as part of Banksia WL SCP) |
| SCP24 | Northern Spearwood shrublands and woodlands | Priority 3 | |
| Banksia WL SCP | Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region | Priority 3 | Endangered |
| Tuart woodlands | Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain | Priority 3 | Critically Endangered |

## 4.3 Flora

A total of 155 plant species were recorded during the survey (Appendix 6). The total consisted of 116 native and 39 introduced species (25%). The number of native species is considered to be an accurate representation of the number of species expected on a site of this size with good quality vegetation on shallow sand over limestone soils.

The plant Families with the highest representation of species were the Asteraceae (Daisy family – 15 species, including 7 native and 8 introduced), Fabaceae (Pea and Wattle family – 14 species, all native), Proteaceae (Banksia family - 14 species, all native), Myrtaceae (myrtle family – 11 species, 9 native and two introduced) and Poaceae (Grass family – 10 species, including 1 native and 9 introduced).

Quadrat Data are provided in Appendix 7.

Species richness in the thirteen quadrats was varied with 8-41 species, with the lowest number (8) recorded in a rehabilitation area. The number of native species in the 12 quadrats sampled in native vegetation ranged from 17-41 (average 29.2). The average number of introduced species was 8.0 per quadrat (27.4%) which appears high but overall the percentage cover of introduced species was mostly very low.

One Threatened (Declared Rare) plant species has been recorded on the site.

A small number of *Eucalyptus argutifolia* (Threatened) mallee plants has been recorded to the north of the northern pit within a patch of the more common *E. petrensis*. A similar stand also occurs immediately north of the survey area (Figure 3).

One Priority 3 flora species, *Pimelea calcicola*, was recorded in the *Melaleuca systena/Acacia truncata* vegetation in the central north part of the site. Five plants were recorded in Quadrat WA 11.

## 4.4 Vegetation

### 4.4.1 Vegetation Complex

Vegetation Complexes are a broad level of vegetation description which is based on the underlying geomorphology and rainfall (Heddle *et al*., 1980). The areas of remnant native vegetation on the site is part of the Cottesloe Complex– Central and South vegetation complex which is described as:

> Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *E. gomphocephala – E. marginata* (Jarrah) – *Corymbia calophylla* (Marri), closed heath on the limestone outcrops' (Heddle *et al.,* 1980).

The general description of the vegetation complex matches the various types of native vegetation remaining in the survey area.

### 4.4.2 Vegetation Type

For small scale sites, such as the survey area, vegetation mapping can be further refined by using vegetation types which are described by the composition and structure of the dominant species rather than based on geomorphology.

Seven native vegetation types were described and mapped on the site. In addition, areas that have been actively rehabilitated after mining were also mapped. The vegetation types are described in Table 5 and mapped in Figure 3.

**Table 5: Vegetation Types on the Site**

| Vegetation Type | Description | Photograph |
|---|---|---|
| **BsXpCq** *Banksia sessilis/ Xanthorrhoea preissii/ Calothamnus quadrifidus* Closed Tall Scrub over *Hibbertia hypericoides/Melaleuca systena/ Jacksonia calcicola* Low Shrubland to Closed Low Heath | This is the main vegetation type on the site representing about 75% of the native vegetation. *Banksia sessilis* (Parrot Bush) is up to 2m high in unburnt vegetation and from 30-60% cover. Other common species include *Xanthorrhoea preissii, Calothamnus quadrifidus, Hibbertia hypericoides, Melaleuca systena, Jacksonia calcicola, Acacia pulchella, Desmocladus flexuosus, Conostylis aculeata* and *Trachymene pilosa.*<br><br>The soils were very shallow orange-brown sands with some surface limestone.<br><br>Quadrats WA 1,2,5 and 12 are representative of this vegetation type. |  |
| **MhBs** *Melaleuca huegelii/Banksia sessilis* Tall Open Scrub over *Melaleuca systena/Grevillea preissii* Open Low Heath | One very small area of this vegetation type occurred on the top of a small limestone outcrop near the south-east corner of the site. The main shrub species was *Melaleuca huegelii* to 1.5-2m high and 30% cover with *Banksia sessilis, Melaleuca systena* and *Grevillea preissii* also very common. *Desmocladus flexuosus* and **Galium murale* were common ground covers.<br><br>The soils were dark-brown sand with abundant surface limestone.<br><br>Quadrat WA 3 is representative of this vegetation type. |  |

| Vegetation Type | Description | Photograph |
|---|---|---|
| **SnMs** *Scaevola nitida/Melaleuca systena* Open Heath | This vegetation type occurred in the central northeastern part of the site and was similar to the MhBs vegetation type except for the total absence of any *Melaleuca huegelii* plants and prevalence of *Scaevola nitida*. Other common species included *Melaleuca systena, Grevillea preissii, Diplolaena angustifolia, Banksia dallanneyi, Acacia pulchella* and *Banksia sessilis*<br><br>The soils were orange-brown sand with abundant surface limestone.<br><br>Quadrat WA 9 is representative of this vegetation type. |  |
| **MsAst** *Melaleuca systena/Acacia stenoptera* Closed Heath | This vegetation type occurred in a narrow valley at the central northern part of the site. The vegetation was very dense with an abundance of the two main species *Melaleuca systena* and particularly *Acacia stenoptera* at around 1m high and 50% cover. Other common species included *Acacia pulchella, Diplopeltis huegelii, Banksia sessilis* and *Melaleuca huegelii.*<br><br>The soils were orange-brown sand with abundant surface limestone.<br><br>Quadrat WA 10 is representative of this vegetation type. |  |

| Vegetation Type | Description | Photograph |
|---|---|---|
| **MsAt** *Melaleuca systena/Acacia truncata* Closed Heath | This vegetation type occurred in the central northwestern part of the site and was also similar to the MhBs unit but with *Melaleuca huegelii* sparse to absent. *Acacia truncata* and *Melaleuca systena* were up to 1m high and over 50% cover with other common shrubs including *Acacia pulchella, Xanthorrhoea preissii, Banksia sessilis, Grevillea preissii* and *Pimelea ferruginea.*<br><br>The soils were orange-brown sand with abundant surface limestone.<br><br>Quadrat WA 11 is representative of this vegetation type. |  |
| **Ed** *Eucalyptus decipiens* Low Open Woodland over *Xanthorrhoea preissii/Banksia sessilis* Open Shrubland to Tall Open Scrub | This vegetation type occurred in one small patch between the two quarries and a larger patch at the eastern side of the site. Both areas contained *Eucalyptus decipiens* 3-10m high over *Banksia sessilis* and *Xanthorrhoea preissii* 1.5-2m high. Typical understorey species included *Melaleuca systena, Hibbertia hypericoides, Hibbertia racemosa, Conostylis aculeata, Homalosciadium homalocarpum* and *Hardenbergia comptoniana.*<br><br>The soils were orange-brown sand with some surface limestone.<br><br>Quadrats WA 4 and 6 are representative of this vegetation type. |  |

| Vegetation Type | Description | Photograph |
|---|---|---|
| **BaAf** *Banksia attenuata/ Allocasuarina fraseriana* Low Open Woodland over *Jacksonia sternbergiana* Tall Shrubland over *Xanthorrhoea preissii/ Hibbertia hypericoides* Open Low Heath | This vegetation type occurred on the eastern lower part of the site on deeper sandy soils. *Banksia attenuata* and *Allocasuarina fraseriana* trees, and occasional *Nuytsia floribunda* were up to 4m high and reasonably sparse at 5-10% total tree cover. *Jacksonia sternbergiana* was a common mid-canopy shrub to 2m in some areas, depending on the age since fire. Common understorey species included *Xanthorrhoea preissii, Hibbertia hypericoides, Acacia pulchella, Mesomelaena pseudostygia, Podotheca angustifolia, Hardenbergia comptoniana, Burchardia congesta* and *Homalosciadium homalocarpum.*<br><br>The soils were light orange-brown sand with no surface limestone.<br><br>Quadrats WA 7 and 8 are representative of this vegetation type. |  |
| **Rehabilitation Area** *Olearia axillaris/Cenchrus setaceus* Low Shrubland | Many parts of the quarry sides have been actively regenerated and contain a low shrubland with a moderate cover of native species such as *Olearia axillaris* and *Acacia pulchella*. Introduced species are common such as Fountain Grass (*Cenchrus setaceus*) and Rose Pelargonium (*Pelargonium capitatum*).<br><br>The soils were crushed limestone at the surface.<br><br>Quadrat WA 13 is representative of this vegetation type. |  |

### 4.4.3 Vegetation Condition

The condition of the vegetation was assessed according to the system of Keighery as described in Bush Forever (Government of Western Australia, 2000) (Table 6).

**Table 6: Vegetation Condition Rating Scale**

| Condition | Description |
|---|---|
| Pristine | Pristine or nearly so, no obvious signs of disturbance. |
| Excellent | Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. |
| Very Good | Vegetation structure altered, obvious signs of disturbance.<br>For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing. |
| Good | Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate to it.<br>For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing. |
| Degraded | Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.<br>For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing. |
| Completely Degraded | The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs. |

The condition of the vegetation is shown in Figure 4. All of the areas of native vegetation were rated as being in Very Good to Excellent condition. While the percentage of introduced plant species overall and in the quadrats was relatively high (around 25%) the percentage cover was low, thereby not affecting the condition significantly.

Some areas in the northwestern sector had been cleared previously presumably for limestone drilling or excavation testing. These areas were rated as Degraded due to lack of regeneration of native species and some dense cover of weed species such as Victorian Teatree (*Leptospermum laevigatum*) (Plate 4).

**Plate 4: Victorian Teatree regrowing on cleared test pit**



## 4.5 Conservation Significance of Flora and Vegetation

### 4.5.1 Flora

Two or three plants of the Threatened flora species *Eucalyptus argutifolia* have been recorded on the site immediately north of the northern pit. The number of plants among the stand of mallee shrubs has been confirmed by genetic testing undertaken by DBCA (Lindsay Stephens, pers comm, February 2021).

One small population of five plants of the Priority 3 flora species, *Pimelea calcicola* was recorded in the *Melaleuca systena/Acacia truncata* vegetation in the central north part of the site. *Pimelea calcicola* grows on coastal limestone ridges from the Yalgorup National Park northwards to the Shire of Gingin coastline.

### 4.5.2 Vegetation

*Vegetation Complex*

The vegetation on the site is part of the Cottesloe Complex - Central and South (Heddle *et al.*, 1980). Approximately 32% of the pre-European vegetation extent of this complex remains, of which 14% is currently managed by DBCA (DBCA, 2018).

The percentage retention is above EPA's target for minimum 30% retention of vegetation complexes State-wide in the Perth and Peel Region Constrained Areas and the area in protection is above the 10% minimum criteria for vegetation complexes.

*Floristic Community Type*

Analysis of the quadrat data using the spreadsheet method resulted in all the vegetation types, including the limestone heath as well as the Banksia/Sheoak woodland on the site being most similar to Floristic Community Type (FCT) 28 'Spearwood *Banksia attenuata* or *Banksia attenuata* – *Eucalyptus marginata* woodlands' with some similarity to FCT 24 'Northern Spearwood Shrublands and woodlands'.

At the State level FCT 28 is not a Threatened or Priority Ecological Community.

The small area of *Melaleuca huegelii/Banksia sessilis* Tall Open Scrub over *Melaleuca systena/Grevillea preissii* Open Low Heath (MhBs) has potential to be FCT 26a '' *Melaleuca huegelii – M. acerosa* (now M. *systena*) shrublands of limestone ridges' which is a TEC at State level. However the area lacked a well-defined herb layer which is characteristic of the FCT. In addition, the small area of this vegetation type did not occur on a limestone ridge, more a small limestone outcrop.

*Banksia Woodland TEC*

The Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (Banksia Woodland TEC) is listed as an Endangered TEC under the Commonwealth EPBC Act. The Banksia Woodland community is a conglomerate of a number of Banksia-dominated FCTs recognised at State level. FCT 28 is one of the FCTs that form part of the Banksia Woodland TEC. However, the identification of one of the relevant FCTs on a site is not of itself sufficient to assign the vegetation to the Banksia Woodland TEC. The vegetation needs to meet specific criteria to be considered the TEC as follows.

The *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community* (Conservation Advice) describes the Banksia Woodland TEC as follows:

> *The ecological community is a woodland associated with the Swan Coastal Plain of southwest Western Australia. A key diagnostic feature is a prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among or emerging above the Banksia canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range*.

In summary, *Banksia attenuata* trees only occur in the BaAf vegetation type on the eastern side of the survey area. the vegetation types that do not have *Banksia attenuata* trees by definition cannot be the Banksia Woodland TEC.

The BaAf vegetation type meets the definition of the Banksia Woodland TEC as it contains *Banksia attenuata* as a dominant tree layer, is in Very Good condition, and is large enough (when considering the off-site Banksia woodland as well) to meet the minimum 1ha criteria for the TEC.

# 5 SUMMARY AND CONCLUSIONS

The Flora and Vegetation survey of the site resulted in the following findings:

- A total of 155 plant species were recorded during the 2020 flora survey. This total consisted of 116 native species and 39 (25%) introduced species;
- Two or three plants of the Threatened (Declared Rare) flora species *Eucalyptus argutifolia* (Threatened) have been recorded on the site mixed with *E. decipiens* immediately north of the northern pit. Another similar stand occurs just north of the survey area;
- One Priority plant species (*Pimelea calcicola*) was recorded in low numbers in the northern part of the site;
- Seven native vegetation types were described on the site plus areas being actively revegetated. The main vegetation types were heaths dominated by *Banksia sessilis* and *Melaleuca systena* occurring shallow sand with surface limestone. The lower eastern part of the site on deeper sandy soils contained some *Banksia attenuata/Allocasuarina fraseriana* (Sheoak) Low Open Woodland;
- The vegetation was all rated in Very Good to Excellent condition;
- All vegetation types were most closely related to FCT 28 'Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus marginata* woodlands' with some similarity to FCT 24 'Northern Spearwood Shrublands and woodlands'. The small area of *Melaleuca huegelii/Banksia sessilis* vegetation on outcropping limestone has potential to be FCT 26a which is a TEC at State level.
- FCT28 is not a TEC or PEC at State level; and
- The area of *Banksia attenuata/Allocasuarina fraseriana* (Sheoak) Low Open Woodland at the eastern end of the site is considered to be the Banksia Woodlands of the Swan Coastal Plain ecological community which is a PEC at State level and a TEC under the Commonwealth EPBC Act.

# 6 REFERENCES


Allan Herbarium (1997) Atlas of Living Australia; Australia's Virtual Herbarium Record *Placynthium nigrum* http://biocache.ala.org.au/occurrences/ab98eab4-f136-4c0d-b79e-78326a027802 Accessed May 2017 Perth, Western Australia

Australian National Herbarium (2009) Atlas of Living Australia; Australia's Virtual Herbarium Record for *Dampiera triloba* http://biocache.ala.org.au/occurrences/d94999ab-255f-49c4-b567-b35c4a5f3860 Accessed March 2017 Perth, Western Australia

Barrett, R.L. (2012) Poranthera moorokatta (Phyllanthaceae), a rare new species from Perth, Western Australia Nuytsia 22(6): 399-407 Perth, Western Australia

Bolland, M. (1998) *Soils of the Swan Coastal Plain.* Department of Agriculture. Bunbury, Western Australia.

Davidson, W.A. (1995) 'Hydrogeology and groundwater resources of the Perth region, Western Australia', *Western Australia Geological Survey*, Bulletin 142 Perth Western Australia

Department of Biodiversity, Conservation and Attractions (DBCA) (2020) Naturemap Accessed November 2020 https://naturemap.dpaw.wa.gov.au/ Perth Western Australia

Department of Biodiversity, Conservation and Attractions (DBCA) (2018) *Remnant Vegetation Extent Stats 2018* Perth western Australia

Department of Environment and Conservation (DEC) (2009) *Marianthus paralius Interim Recovery Plan 2009-2014. Interim Recovery Plan No. 291*. Perth, Western Australia.

Department of Parks and Wildlife (DPaW) (2017) *Serpentine Synaphea (Synaphea sp. Serpentine (G.R. Brand 103)) Interim Recovery Plan 2017–2022. Interim Recovery Plan No. 380*. Perth, Western Australia.

Department of Primary Industries and Regional Development (DPIRD) (2020) Natural Resource Information. Accessed November 2020 http://maps.agric.wa.gov.au/nrm-info/ Government of Western Australia, Perth.

Department of the Environment and Energy (DoEE) (2020) Protected Matters Search Tool http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf Accessed November 2020 Canberra, Australia

Department of the Environment and Energy (DotEE) (2016) Species Profile and Threats (SPRAT) Database. http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl Commonwealth of Australia.

Department of Water and Environmental Regulation (DWER) (2020) *Perth Groundwater Map.* Accessed November 2020 https://maps.water.wa.gov.au/#/webmap/gwm Government of Western Australia, Perth.

Environmental Protection Authority (EPA) (2016) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* Perth Western Australia

Government of Western Australia (2000) Bush Forever - *Keeping the Bush in the City. Volume 2: Directory of Bush Forever Sites*. Perth, Western Australia.

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

Hislop, M. (2011) New, locally endemic taxa in *Leucopogon* (Ericaceae: Styphelioideae: Styphelieae) from the Perth and midwest regions of Western Australia *Nuytsia* 21(2): 75-89 Perth, Western Australia

Landgate (2020) Historical Aerial Photography Accessed November 2020 https://www.landgate.wa.gov.au/bmvf/app/mapviewer/ Government of Western Australia, Perth.

McGurk, L.E., Giustiniano, D., Davision, E.M. and Watkin, E.L.J. (2016) Amanita wadulawitu (Basidiomycota), a new species from Western Australia, and an expanded description of A. kalamundae Nuytsia 27: 21-30 Perth, Western Australia

National Map (2020) Map-Based Access to Spatial Data from Australian Government Agencies http://nationalmap.gov.au/#wa Accessed October 2020 Government of Australia

Phillimore, R. and English, V. (2000) *Narrow curved-leaf Grevillea Grevillea curviloba subsp. incurva Interim Recovery Plan 2000-2003* Department of Conservation and Land Management Perth, Western Australia

Thiele, K.R. (2019) The Hibbertia polystachya–H. spicata (Dilleniaceae) species group in Western Australia Nuytsia 30: 291-308 Perth, Western Australia

Western Australian Herbarium (1988) Atlas of Living Australia; Australia's Virtual Herbarium Record *Lecania sylvestris* http://biocache.ala.org.au/occurrences/dc9d69ab-0b3f-4fe4-b4aa-a2dd98a3a5e1 Accessed April 2017 Perth, Western Australia

Western Australian Herbarium (1988) Atlas of Living Australia; Australia's Virtual Herbarium Record *Lecania turicensis* var. *turicensis* http://biocache.ala.org.au/occurrences/3b84f801-3ec8-4f6e-bf0d-6f1ab749c6cf Accessed April 2017 Perth, Western Australia

Western Australian Herbarium (1989) Atlas of Living Australia; Australia's Virtual Herbarium Record for *Haloragis* sp. Parrot Ridge (G.J. Keighery 11563) Accessed March 2016 http://biocache.ala.org.au/occurrences/6d199a28-59d7-4e68-8714-537f66481a9a Perth, Perth, Western Australia

Western Australian Herbarium (1994) Atlas of Living Australia; Australia's Virtual Herbarium Record *Rinodina bischoffii* http://biocache.ala.org.au/occurrences/0fb24d74-d598-4649-9a04-ccaf73478709 Accessed May 2017 Perth, Western Australia

Western Australian Herbarium (2001) Atlas of Living Australia; Australia's Virtual Herbarium Record for *Austrostipa mundula* http://biocache.ala.org.au/occurrences/5d377bf5-98ec-4fbe-8723-4cfc8f8f534f Accessed March 2017 Perth, Western Australia

Western Australian Herbarium (2005) Atlas of Living Australia Record *Tetraria* sp. Chandala http://biocache.ala.org.au/occurrences/a9c665cf-9f13-4d82-8bd5-d53cfd2f5c19 Accessed March 2016 Perth, Western Australia

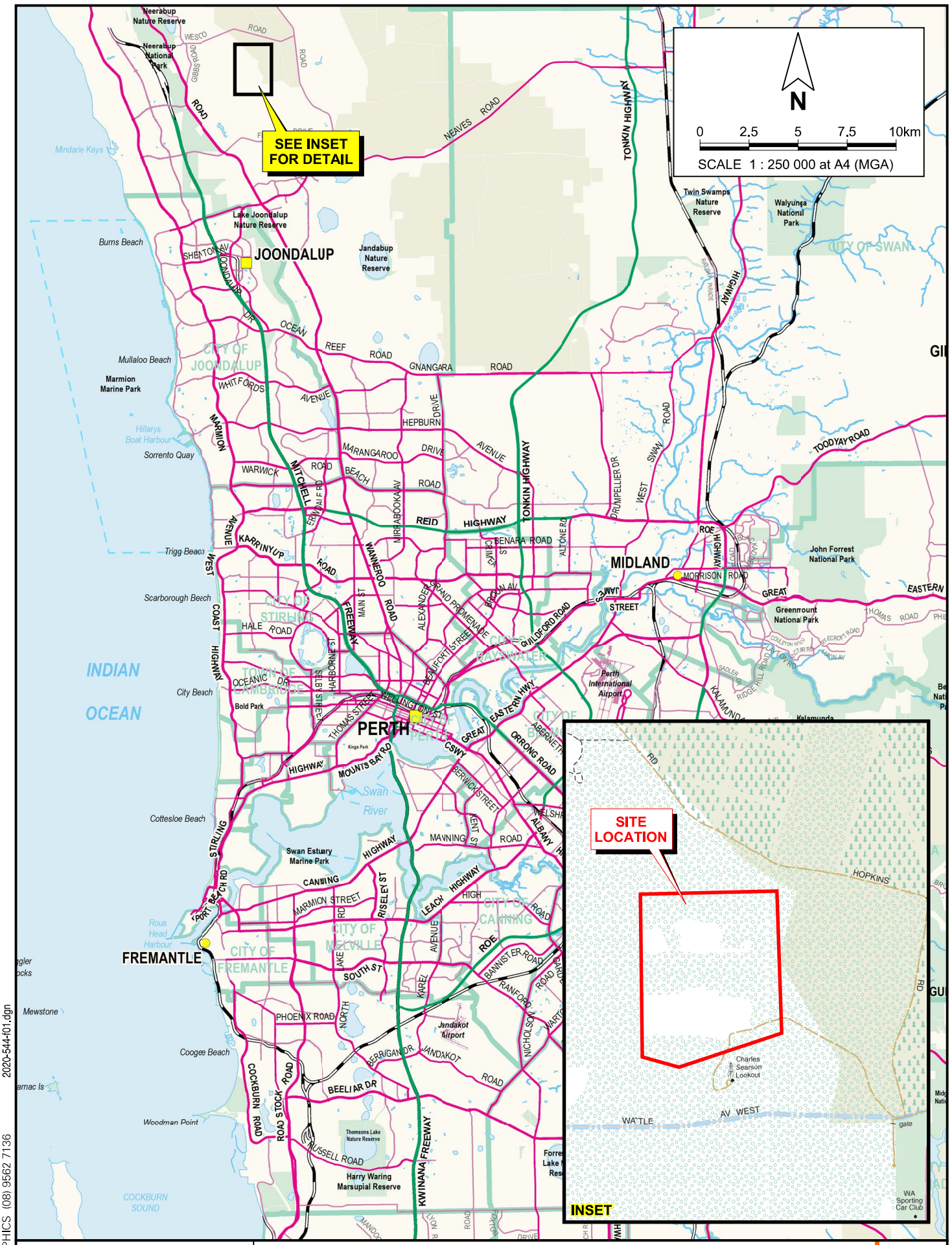
Western Australian Herbarium (2005) Atlas of Living Australia; Australia's Virtual Herbarium Record *Fabronia hampeana* http://biocache.ala.org.au/occurrences/a6597c55-520f-4cbd-b048-5614581df41f Accessed March 2017 Perth, Western Australia

Western Australian Herbarium (2008) Atlas of Living Australia; Australia's Virtual Herbarium Record http://avh.ala.org.au/occurrences/c5c5512a-6415-4041-ade9-0a5a71c9670a Accessed March 2016 Perth

Western Australian Herbarium (2012) Atlas of Living Australia; Australia's Virtual Herbarium Record for *Baeckea* sp. Limestone http://biocache.ala.org.au/occurrences/7c4abf9b-8c70-41d2-ab52-20afe6570b20 Accessed November 2016 Perth, Western Australia

Williams, K., Horan, A., Wood, S. and Webb, A (2001) *Declared rare and poorly known flora in the Central Forest Region, Western Australian Wildlife Management Program No. 33*, Western Australian Department of Conservation and Land Management. Perth, Western Australia

# FIGURES




PINPOINT CARTOGRAPHICS (08) 9562 7136 2020-544-f01.dgn

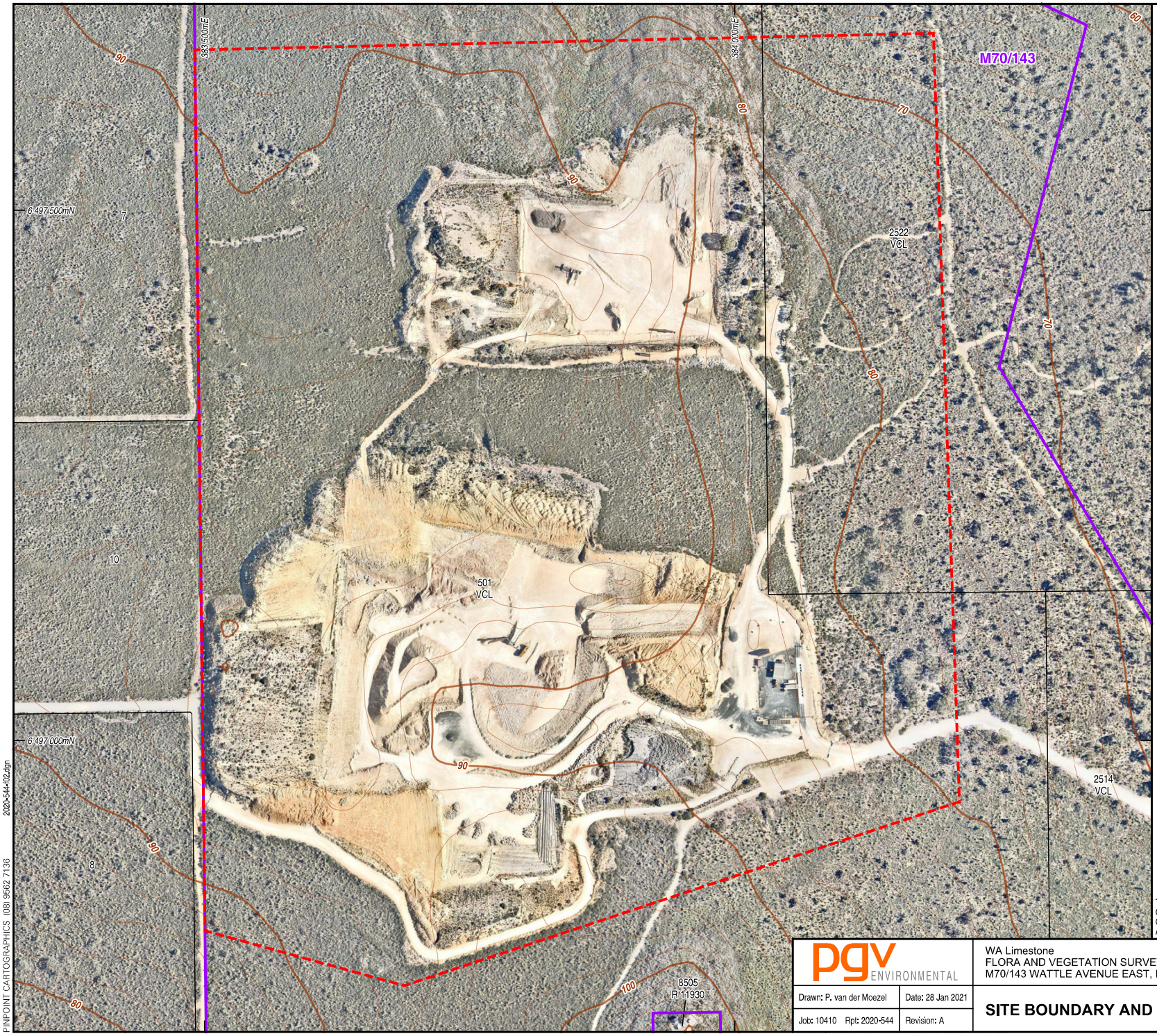
pgv ENVIRONMENTAL

WA Limestone
FLORA AND VEGETATION SURVEY
M70/143 WATTLE AVENUE EAST, NOWERGUP

| | |
|---|---|
| Drawn: P. van der Moezel | Date: 28 Jan 2021 |
| Job: 10410 Rpt: 2020-544 | Revision: A |

**SITE LOCATION**

Figure 1




N

0 50 100 150 200m

SCALE 1 : 3 500 at A3 (MGA)

**Legend**

- Site Boundary
- Cadastral Boundary
- Topographic Contour
- Tenement Boundary

TENEMENT SOURCE: DMIRS, March 2020.
CONTOUR SOURCE: Dept. of Agriculture, 2000.
CADASTRAL SOURCE: Landgate, January 2021.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2021.

pgv ENVIRONMENTAL

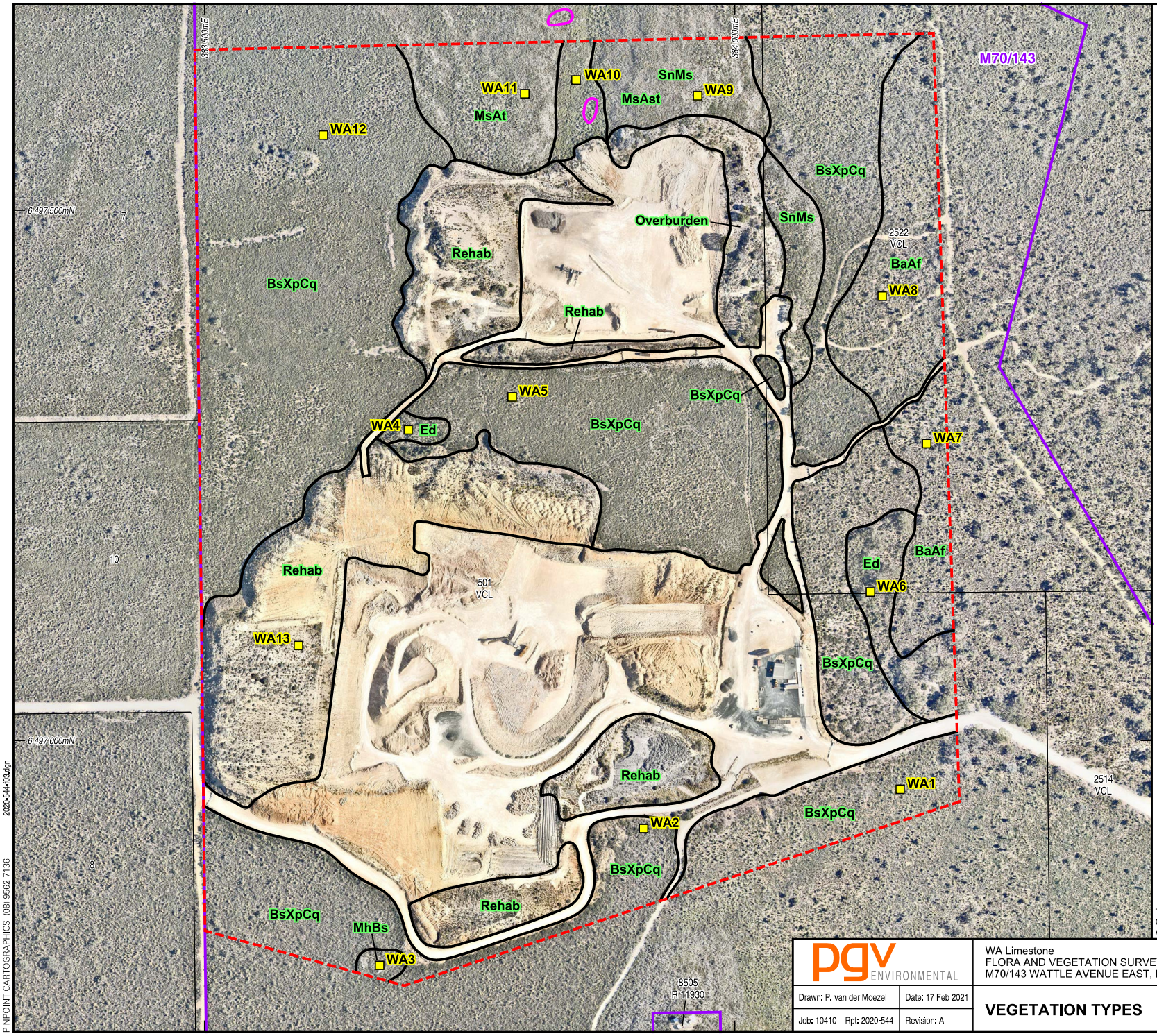
WA Limestone
FLORA AND VEGETATION SURVEY
M70/143 WATTLE AVENUE EAST, NOWERGUP

| | |
|---|---|
| Drawn: P. van der Moezel | Date: 28 Jan 2021 |
| Job: 10410 Rpt: 2020-544 | Revision: A |

**SITE BOUNDARY AND TOPOGRAPHY**

Figure 2

PINPOINT CARTOGRAPHICS (08) 9562 7136 2020-544-f02.dgn




N

0 50 100 150 200m

SCALE 1 : 3 500 at A3 (MGA)

**Legend**

- Site Boundary
- Cadastral Boundary
- Tenement Boundary
- Quadrat Location
- Vegetation Type Boundary
- BaAf Vegetation Type
- *Eucalyptus petrensis* and *E. argutifolia* (T)

**Vegetation Types**

**BsXpCq**
*Banksia sessilis/Xanthorrhoea preissii/Calothamnus quadrifidus* Closed Tall Scrub over *Hibbertia hypericoides/Melaleuca systena/Jacksonia calcicola* Low Shrubland to Closed Low Heath

**MhBs**
*Melaleuca huegelii/Banksia sessilis* Tall Open Scrub over *Melaleuca systena/Grevillea preissii* Open Low Heath

**SnMs**
*Scaevola nitida/Melaleuca systena* Open Heath

**MsAst**
*Melaleuca systena/Acacia stenoptera* Closed Heath

**MsAt**
*Melaleuca systena/Acacia truncata* Closed Heath

**Ed**
*Eucalyptus decipiens* Low Open Woodland over *Xanthorrhoea preissii/Banksia sessilis* Open Shrubland to Tall Open Scrub

**BaAf**
*Banksia attenuata/Allocasuarina fraseriana* Low Open Woodland over *Jacksonia sternbergiana* Tall Shrubland over *Xanthorrhoea preissii/Hibbertia hypericoides* Open Low Heath

**Rehabilitation Area**
*Olearia axillaris/Cenchrus setaceus* Low Shrubland

TENEMENT SOURCE: DMIRS, March 2020.
CADASTRAL SOURCE: Landgate, January 2021.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2021.

pgv ENVIRONMENTAL

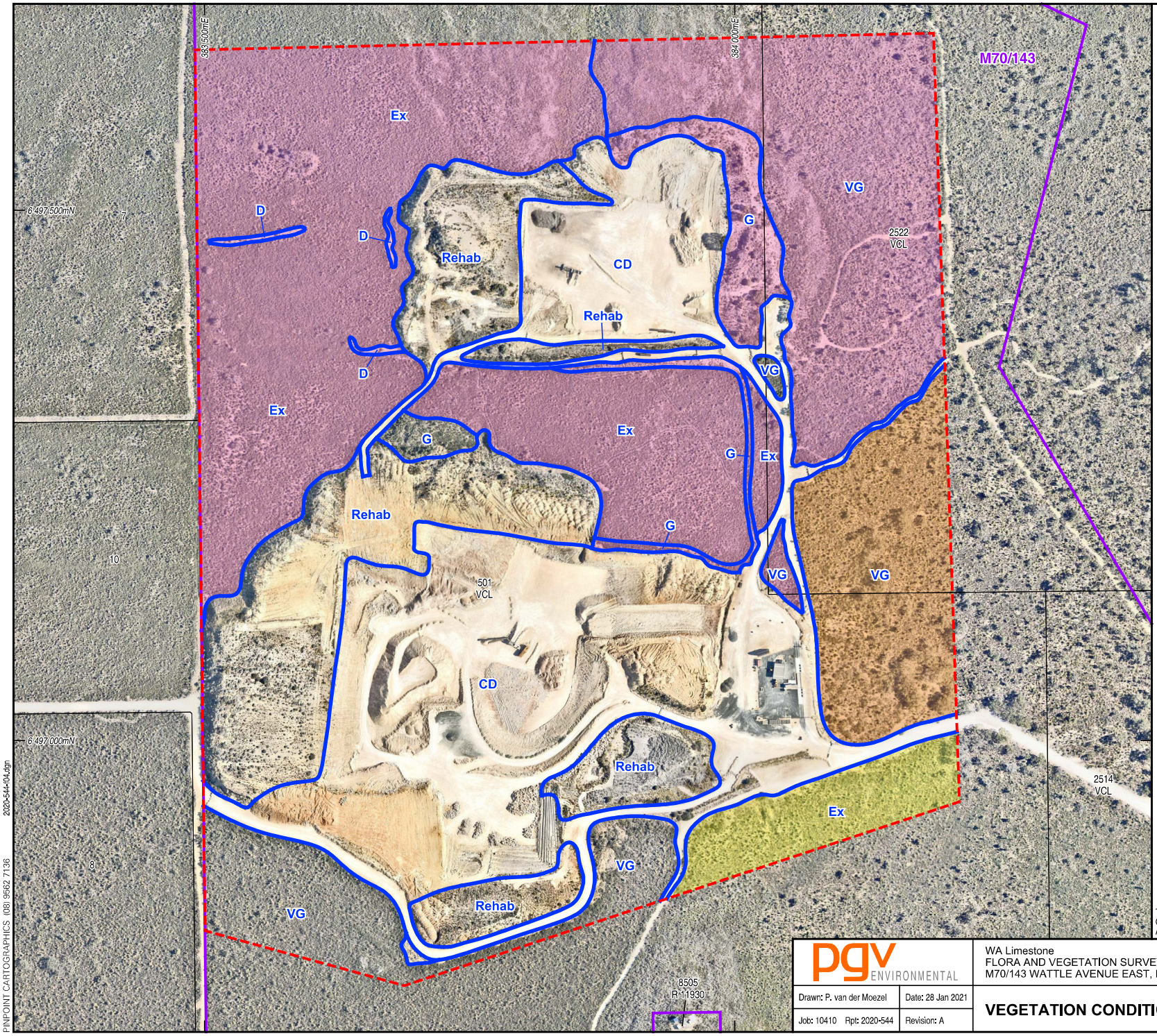
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Drawn: P. van der Moezel | Date: 17 Feb 2021
Job: 10410 Rpt: 2020-544 | Revision: A

**VEGETATION TYPES**

Figure 3

PINPOINT CARTOGRAPHICS (08) 9562 7136 2020-544-f03.dgn




N

0 50 100 150 200m

SCALE 1 : 3 500 at A3 (MGA)

**Legend**

- Site Boundary
- Cadastral Boundary
- Tenement Boundary
- Vegetation Condition Boundary
- BaAf Vegetation Condition
- Area Burnt 2015
- Area Burnt 2017
- Area Burnt 2019

**Vegetation Condition**
(SOURCE: Bush Forever, Govt. of W.A., 2000)

**P - Pristine**
Pristine or nearly so, no obvious signs of disturbance.

**Ex - Excellent**
Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species.

**VG - Very Good**
Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

**G - Good**
Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

**D - Degraded**
Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

**CD - Completely Degraded**
The structure of the vegetation is no longer intact and the areas is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.

**Cl - Cleared**
No native vegetation remaining.

TENEMENT SOURCE: DMIRS, March 2020.
CADASTRAL SOURCE: Landgate, January 2021.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2021.

pgv ENVIRONMENTAL

WA Limestone
FLORA AND VEGETATION SURVEY
M70/143 WATTLE AVENUE EAST, NOWERGUP

Drawn: P. van der Moezel | Date: 28 Jan 2021
Job: 10410 Rpt: 2020-544 | Revision: A

**VEGETATION CONDITION**

Figure 4

2020-544-f04.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

# Appendix D WEPL (2024) Targeted Searches for Conservation Significant Flora Species

WESTERN ENVIRONMENTAL

(08) 6162 8980
PO Box 437, Leederville, WA 6903
enquiries@westenv.com.au

Wednesday, 20 March 2024

*Our Ref: P23.068-PRO-FVSR_0_FINAL*

P.M.R Quarries (T/A WA Limestone)
401 Spearwood Avenue
Bibra Lake WA 6163

ATTENTION: Roger

**SUBJECT: WATTLE AVENUE EAST QUARRY TARGETED FLORA SEARCHES (EPBC 2023/09326)**

## Introduction

P.M.R Quarries Pty Ltd (T/A WA Limestone) proposes to expand the Wattle Ave East Quarry to facilitate limestone extraction (the 'proposed action) within M 70/143 on Wattle Avenue East, Neerabup, approximately 40 km north of Perth within the City of Wanneroo. The proposed action has a total footprint of 15.49 ha as shown on Figure 1. The proposed action was referred under the *Environment Protection and Biodiversity Act 1999* (EPBC Act) (EPBC 2023/09326) and was deemed a controlled action requiring assessment and approval under the EPBC Act on 28 February 2023.

The clock was stopped on the decision of assessment approach, as the referral requested assessment under the accredited process (see Appendix A). To proceed, an application to clear native vegetation will be submitted to the WA Department of Mining, Industry Regulation and Safety (DMIRS), with the Commonwealth's assessment to follow.

The Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) advised that key issues relating to the proposed action requiring assessment are:

- Carnaby's Black Cockatoo (*Zanda latirostris*).
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*).
- Chuditch (*Dasyurus geoffroii*).
- *Melaleuca* sp. Wanneroo.
- Yanchep Mallee (*Eucalyptus argutifolia*).
- Banksia Woodlands of the Swan Coastal Plain ecological community.

PGV (2021) undertook a flora and vegetation survey within M70/143 over two days on 14th and 15th September 2020. The survey covered a broader area than that proposed to be disturbed by the proposed action. The survey area as walked as thoroughly as possible by PGV, covering all vegetation types present. PGV (2021) noted that the survey area could not be surveyed efficiently using parallel transects given the

dense limestone heath vegetation present. PGV (2021) considered the survey effort to be adequate given the relatively low variation in the main vegetation types present.

To ensure the area of the proposed action was surveyed adequately to capture any threatened flora with the potential to occur, WEPL undertook a targeted flora search within suitable habitat for both species.

As such, this letter report should be read in conjunction with PGV (2021) which is provided as Appendix B.

## Scope of Work

To supplement the flora and vegetation survey undertaken by PGV (2021), a targeted search for threatened flora species with the potential to occur within the proposed action area was undertaken, specifically:

- *Eucalyptus argutifolia* (Vulnerable).
- *Melaleuca* sp. Wanneroo (Endangered).

The Survey Area was defined based on the extent of potentially suitable habitat for both species, given their strong habitat associations. The Survey area was delineated based on a desktop review of threatened flora records available via the Department of Biodiversity, Conservation and Attractions (DBCA), the flora and vegetation survey undertaken by PGV (2021), scientific literature, and conservation (and/or listing advice) for each flora species. Further information is provided in the 'Methods' section (and subsections therein).

## Methods

### Desktop Review

Background information on the Survey Area and surrounds was provided by WA Limestone and reviewed prior to the field survey. This letter report should be read in conjunction with the flora and vegetation survey report prepared by PGV (2021) which is provided as Appendix B.

A search of the Protected Matters Search Tool (PMST) and databases managed by DBCA was undertaken as part of PGV (2021) and the results indicated that the only threatened flora with the potential to occur within the proposed action area were:

- *Melaleuca* sp. Wanneroo (Endangered).
- *Eucalyptus argutifolia* (Vulnerable).

WEPL undertook a detailed likelihood of occurrence assessment to inform the targeted searches based on the vegetation units described by PGV (2021) as summarised in Table 1. This confirmed that potentially suitable habitat is present within the proposed action area for *Eucalyptus argutifolia* (Vulnerable) and *Melaleuca* sp. Wanneroo (Endangered).

Given there are no other threatened flora with the potential to occur within the proposed action area, the Survey Area was delineated to capture all potentially suitable habitat for both species. Further detail is provided in the following subsection titled Delineation of Survey Area.

**Table 1. Vegetation Units within the Site (Data from PGV [2021])**

| Vegetation Unit | Photo | Description | Soil |
|---|---|---|---|
| **BsXpCq**<br>***Banksia sessilis/ Xanthorrhoea preissii/ Calothamnus quadrifidus* Closed Tall Scrub over *Hibbertia hypericoides/Melaleuca systena/ Jacksonia calcicola* Low Shrubland to Closed Low Heath** |  | This is the main vegetation type on the site representing about 75% of the native vegetation. *Banksia sessilis* (Parrot Bush) is up to 2m high in unburnt vegetation and from 30-60% cover. Other common species include *Xanthorrhoea preissii*, *Calothamnus quadrifidus*, *Hibbertia hypericoides*, *Melaleuca systena*, *Jacksonia calcicola*, *Acacia pulchella*, *Desmocladus flexuosus*, *Conostylis aculeata* and *Trachymene pilosa*. | The soils were very shallow orange-brown sands with some surface limestone. |
| **Ed**<br>***Eucalyptus decipiens* Low Open Woodland over *Xanthorrhoea preissii/Banksia sessilis* Open Shrubland to Tall Open Scrub** |  | This vegetation type occurred in one small patch between the two quarries and a larger patch at the eastern side of the site. Both areas contained *Eucalyptus decipiens* 3-10m high over *Banksia sessilis* and *Xanthorrhoea preissii* 1.5-2m high. Typical understorey species included *Melaleuca systena*, *Hibbertia hypericoides*, *Hibbertia racemosa*, *Conostylis aculeata*, *Homalosciadium homalocarpum* and *Hardenbergia comptoniana*. | The soils were orange-brown sand with some surface limestone. |

| Vegetation Unit | Photo | Description | Soil |
|---|---|---|---|
| **MsAst** ***Melaleuca systena/Acacia stenoptera*** **Closed Heath** |  | This vegetation type occurred in a narrow valley at the central northern part of the site. The vegetation was very dense with an abundance of the two main species *Melaleuca systena* and particularly *Acacia stenoptera* at around 1m high and 50% cover. Other common species included *Acacia pulchella*, *Diplopeltis huegelii*, *Banksia sessilis* and *Melaleuca huegelii.* | The soils were orange-brown sand with abundant surface limestone. |
| **MsAt** ***Melaleuca systena/Acacia truncata*** **Closed Heath** |  | This vegetation type occurred in the central northwestern part of the site and was also similar to the MhBs unit but with *Melaleuca huegelii* sparse to absent. *Acacia truncata* and *Melaleuca systena* were up to 1m high and over 50% cover with other common shrubs including *Acacia pulchella*, *Xanthorrhoea preissii*, *Banksia sessilis*, *Grevillea preissii* and *Pimelea ferruginea.* | The soils were orange-brown sand with abundant surface limestone. |

## Delineation of Survey Area

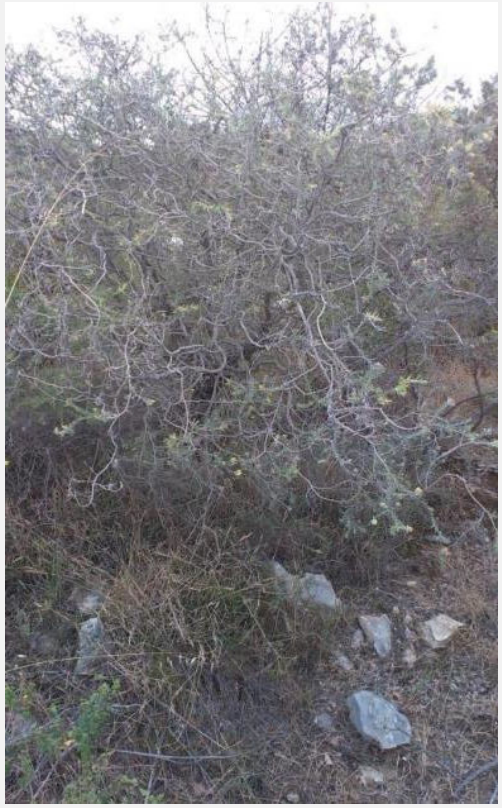
The survey area was delineated based on a detailed likelihood of occurrence assessment for threatened flora. PGV (2021) undertook a flora and vegetation survey within M70/143 over two days on the 14th and 15th September 2020, which resulted in the identification and mapping of four native vegetation units (Table 1). There are two threatened species with the potential to occur within the proposed action area based on those known to occur in the surrounding area (derived from the PMST and DBCA database searches) and the vegetation units described (Table 2). These species are:

- *Melaleuca* sp. Wanneroo (Endangered).
- *Eucalyptus argutifolia* (Vulnerable).

The habitat requirements of each species are detailed in Table 2, together with the number of records within a 10 km radius, the location of the nearest known record, and the habitat of the nearest known record. Both species display a very strong habitat association with limestone ridges (in the case of *Melaleuca* sp. Wanneroo) (TSSC, 2019) and gullies close to the summits of limestone ridges (in the case of *Eualyptus argutifolia*) (DEWHA, 2008).

Potentially suitable habitat was identified to occur within the vegetation units MsAt and MsAst mapped by PGV (2021) which was described as *Melaleuca systena / Acacia stenoptera* Closed Heath. As such, the Survey Area was defined as the maximum extent of both the MsAt and MsAst vegetation units (see Table 1 for full description). Potentially suitable habitat is absent from the remainder of the proposed action area and was therefore excluded from the Survey Area. However, a drone survey was undertaken as part of the field surveys to ensure any additional areas of suitable habitat could be identified and searched as required to capture the full extent of suitable habitat. This is detailed in the Field Survey sub-section.

**Table 2. Threatened Flora Species Potentially Occurring within the Site**

| Species | Photo | DBCA Database Search | Habit and Habitat | Likelihood of Presence with Justification |
|---|---|---|---|---|
| ***Melaleuca*** **sp. Wanneroo** |  | 20 records within 10 km (2004 – 2019)<br>Nearest record is just over 500 m south west of the Site.<br>Nearest record is on a limestone hill with skeletal white loam over limestone.<br><br>Of the records within 10 km of the Site, all are situated farther west. | *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) is known to co-occur often as a dominant, in dense patches with other Melaleuca species, predominantly *M. systena*, when growing on very shallow soils over limestone 'caprock' on ridges (TSSC, 2019). | **May Occur**<br>Suitable habitat is present within the Site and is limited to vegetation units MsAst and MsAt described in Table 1. |

| Species | Photo | DBCA Database Search | Habit and Habitat | Likelihood of Presence with Justification |
|---|---|---|---|---|
| |  | | | |
| ***Eucalyptus argutifolia*** |  | 18 records within 10 km (1990 – 2021)<br>Nearest records are 40 m to the east and north of the Site.<br>Nearest record is on a limestone ridge with brown sand. | Yanchep Mallee grows on slopes or gullies close to the summits of limestone ridges, where soils are shallow, well drained and grey with outcrops of limestone. Vegetation in association includes heath of Parrotbush (*Banksia sessilis*) and Chenille Honey-myrtle (*Melaleuca huegelii*) (Grayling & Brooker, 1992; Brown et al., 1998; DEC, 2008). | **Known to Occur**<br>The species is known to occur within M70/143, approximately 40 m to the east of the Site.<br>Suitable habitat is limited to vegetation units MsAst and MsAt described in Table 1. |

## Field Survey

The targeted field survey was conducted on 7th December 2023 by WEPL Senior Environmental Scientist Andrew Fry, who has over ten years of relevant experience (DBCA Licence No. FB62000002-2). The survey was conducted in accordance with the WA Environmental Protection Authority's (EPA) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (targeted survey).

### *Contextual Targeted Search*

A contextual targeted search was undertaken at the site of a known population of *Melaleuca* sp. Wanneroo approximately 500 m southeast of the survey area on the same day. As detailed in Table 2, *Melaleuca* sp. Wanneroo has a very strong habitat association with very shallow soils over limestone 'caprock' on ridges (TSSC, 2019). The species appears similar to the common *Melaleuca systena*, however can be differentiated in the field based on its flowering period and leaf dimensions. *Melaleuca* sp. Wanneroo flowers during later November to late December, following the completion of the flowering period of *M. systena* (TSSC, 2019). The species was readily identifiable and in flower during the contextual targeted search, providing confirmation that the species could be identified within the survey area if present.

Drone detectability was also tested for *Melaleuca* sp. Wanneroo during the contextual targeted search at the known population 500 m southeast of the Survey Area. The species and suitable habitat were detectable via drone, as shown in Plate 1. This provided sufficient confidence that any additional areas of suitable habitat could identified via drone within the proposed action area that were outside of the designated Survey Area.



**Plate 1. Observation of *Melaleuca* sp. Wanneroo and Suitable Habitat via Drone at a Known Population 500 m South of the Survey Area**

### *Targeted Searches within the Survey Area*

Searches were undertaken across the Survey Area in systematic transects 20-25 m apart (Figure 2).

The locations of any species of conservation significance or unknown taxa were to be recorded using a handheld GPS, together with the following data:

- Observer, date, and time.
- Local abundance/population size and/or population boundary.
- Representative photos of each species and habitat.
- Collection of representative specimens.
- Notes on habitat and vegetation type.

*Drone Flyover*

A drone was flown over in north south running regular transects over the remainder of the proposed action area to identify any other areas of potentially suitable habitat. If potential habitat was identified elsewhere within the proposed action area, the Survey Area would be expanded and targeted searches would be undertaken within.

## Limitations

An assessment against potential limitations and constraints relevant to targeted searches (as outlined in the *Flora and Vegetation Technical Guidance*) is provided in Table 1.

**Table 1. Assessment Against Potential Limitations and Constraints**

| Possible Limitation | Degree of Limitation (Significant, Moderate or Negligible) | Potential Constraints on Survey Outcomes |
|---|---|---|
| **Survey Level/ Scope** | Not a constraint. | Targeted pre-clearance searches following a detailed flora and vegetation survey was undertaken at a sufficient level of detail and in accordance with the *EPA Flora and Vegetation Technical Guidance.* |
| **Availability of contextual information at a regional and local scale** | Not a constraint. | All data required to complete the scope of works including regional and local contextual information was available. Previous survey data was provided by WA Limestone.<br><br>Available literature was reviewed, and publicly available databases were also searched. Contextual information is therefore not a limiting factor for this study. |
| **Site Access** | Not a constraint. | The Survey Area was readily accessible by foot, and the entire Survey Area was traversed. |

| Possible Limitation | Degree of Limitation (Significant, Moderate or Negligible) | Potential Constraints on Survey Outcomes |
|---|---|---|
| **Survey Intensity and Extent** | Not a constraint. | The entire Survey Area was traversed by foot to search for conservation significant flora. Survey effort is demonstrated by the tracks shown on Figure 2.<br><br>Sufficient time was allocated to survey, given the size and complexity of the Survey Area. The survey effort was considered adequate to assess values of the Survey Area and provide information required to support approvals applications. |
| **Experience** | Not a constraint. | The survey was undertaken by suitably qualified Senior Environmental Scientist Andrew Fry who has over ten years' experience in conducting flora and vegetation surveys in the southwest. All flora collections of potential conservation significant species were submitted to the Western Australian Herbarium for identification. |
| **Timing, weather, season** | Not a constraint. | The recommended primary survey period for flora and vegetation surveys for the region as per the EPA Technical Guidance occurs during Spring (September through November). However, given the survey was targeting *Melaleuca* sp. Wanneroo which flowers from late November to late December, the survey was undertaken in early December to ensure the species could be identified in the field. |
| **Mapping Reliability** | Not a constraint. | The entire of the Survey Area was traversed by foot and mapping reliability is considered high. |
| **Disturbances (fire, flood etc.)** | Not a constraint. | The Survey Area shows minimal signs of disturbance (some weed species present) and the vegetation structure remains intact. This was not a constraint for the survey. |

## Results and Discussion

The survey covered the entirety of the survey area in 20-25 m transects, as shown on Figure 3.

A drone was flown over the remainder of the proposed action area in north to south transects to identify any other areas of potentially suitable habitat. Through the drone flyover, a second area of potentially suitable habitat was identified, which presented as a limestone ridge with significant surface limestone. This area was visited on foot (as shown on Figure 3), however was actually a man-made limestone stockpile rather than a limestone ridge. As such, no suitable habitat was present, and no individuals were identified.

Plate 2 shows the typical flat plateau habitat that is present throughout the majority of the proposed action area outside of the Survey Area where no suitable habitat (i.e. limestone ridges and the gullies associated with limestone ridges) is present.



**Plate 2. Typical Flat Plateau Habitat throughout the Proposed Action Area**

No threatened flora species at Commonwealth level were recorded within the Survey Area, and none are expected to occur.

## References


Department of Environment, Water, Heritage and the Arts. (2008). Approved Conservation Advice for *Eucalyptus argutifolia* (Yanchep Mallee). Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/24263-conservation-advice.pdf

Environmental Protection Authority (EPA). (2016). *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment*.

Threatened Species Scientific Committee (TSSC). (2019). *Conservation Advice* Melaleuca *sp. Wanneroo (G.J. Keighery 16705*. Canberra: Department of the Environment and Energy. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/89456-conservation-advice-04072019.pdf


This report should be read in conjunction with the Schedule - Statement of Limitations. Should you have any queries regarding the above, please contact the undersigned on (08) 6162 8980.

Yours sincerely,
Western Environmental Approvals Pty Ltd



Andrew Fry
Senior Environmental Scientist

Schedule

- Statement of Limitation

Appendices

- Appendix A: Decision on referral for Wattle Avenue East Quarry
- Appendix B: PGV (2021) M70/143 Wattle Avenue East, Nowergup Flora and Vegetation Survey




# Figure 1: Proposed Action Area

0 20 40 60 80 m

N

| | |
|---|---|
| SCALE: 1:2,500 | SHEET SIZE: A3 COLOUR |
| PROJECT/REPORT NAME: Targeted Flora Searches (EPBC 2023/09326) Wattle Avenue East Quarry | CLIENT: WA Limestone |
| COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50 | PROJECT NUMBER: A23.068 / VERSION: 0 |
| DATA SOURCE: LANDGATE AERIAL IMAGERY Summer 2023 | DRAWN BY / REVIEWED BY: HS / DN / DATE: 19/3/2024 |

**Legend**

Proposed Action Area

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original Issue | HS | DN | 19/03/2024 |
| B | Revision | | | 19/3/2024 |

NOTES:

Cadastral boundary (LGATE-002). Label corresponds to the vegetation association number.

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# Figure 2: Survey Area

N

0 20 40 60 80 m

| | |
|---|---|
| PROJECT/REPORT NAME | Targeted Flora Searches (EPBC 2023/09326) Wattle Avenue East Quarry |
| SCALE | 1:2,500 |
| SHEET SIZE | A3 COLOUR |
| CLIENT | WA Limestone |
| COORDINATE REFERENCE SYSTEM | GDA2020 / MGA zone 50 |
| PROJECT NUMBER | A23.068 |
| VERSION | 0 |
| DATA SOURCE | LANDGATE AERIAL IMAGERY Summer 2023 |
| DRAWN BY / REVIEWED BY | HS / DN |
| DATE | 19/3/2024 |

**Legend**

- Proposed Action Area
- Survey Area (Targeted Searches)
- Drone Flyover

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original Issue | HS | DN | 19/03/2024 |
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# Figure 3: Survey Effort

N

0 20 40 60 80 m

| | |
|---|---|
| PROJECT/REPORT NAME | Targeted Flora Searches (EPBC 2023/09326) Wattle Avenue East Quarry |
| SCALE | 1:2,500 |
| SHEET SIZE | A3 COLOUR |
| CLIENT | WA Limestone |
| COORDINATE REFERENCE SYSTEM | GDA2020 / MGA zone 50 |
| PROJECT NUMBER | A23.068 |
| VERSION | 0 |
| DATA SOURCE | LANDGATE AERIAL IMAGERY Summer 2023 |
| DRAWN BY / REVIEWED BY | HS / DN |
| DATE | 19/3/2024 |

**Legend**

- Proposed Action Area
- Survey Area (Targeted Searches)
- Tracks

| No | Description | Drawn | Approved | Date |
|---|---|---|---|---|
| A | Original Issue | HS | DN | 19/03/2024 |
| B | Revision | | | 19/3/2024 |

NOTES:

Cadastral boundary (LGATE-002). Label corresponds to the vegetation association number.

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# Statement of Limitations

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In preparing this report, WEPL has relied on data, surveys, analyses, designs, plans and other information provided by the Client (or its agents), other individuals and organisations ("the data").

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The conclusions must also be considered in light of the agreed scope of services (including any constraints or limitation therein) and the methods used to carry out those services, both of which are as stated or referred to in this report.

### Environmental Conclusions

In accordance with the scope of services, WEPL has conducted environmental field monitoring and/or testing in the preparation of this report. The nature and extent of monitoring and/or testing conducted is described in this report.

On all sites, varying degrees of non-uniformity of vertical and horizontal conditions in media (soil, water, air, waste or other media as described in the report) are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of media conditions encountered. The conclusions are based on the data and the environmental field monitoring and/or testing actually undertaken, and are therefore merely indicative of the environmental condition of the site at the time of preparing this report, including the presence or otherwise of contaminants or emissions. It should be recognised that site conditions, including the extent and concentration of contaminants, can change.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. To the maximum extent permitted by law, no other warranty, express or implied, is made.

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This report is intended to be read in its entirety, and sections or parts of this report should therefore not be read and relied on out of context.

WEPL will not be liable to update or revise this report to take into account any events or circumstances or facts becoming apparent after the date of this report.

# Appendix E Conservation Significant Flora - Likelihood of Occurrence

| Scientific Name | Common Name | Conservation Status (WA) | Conservation Status (EPBC Act) | Habitat | Likelihood of Occurrence within the Site |
|---|---|---|---|---|---|
| ***Caladenia huegelii*** | King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid | Schedule 1 | Endangered | The Grand Spider-orchid prefers sand or clay loam. This species generally does not survive in disturbed areas. | Highly Unlikely – habitat not typical to the species |
| ***Calectasia cyanea*** | Blue Tinsel Lily | Schedule 1 | Critically Endangered | The Blue Tinsel Lily prefers white, grey or yellow sand or gravel and is known from the Albany region. | No – this species is restricted to the Albany region |
| ***Drakaea elastica*** | Glossy-leafed Hammer Orchid | Schedule 1 | Endangered | The Glossy-leafed Hammer Orchid prefers low-lying situations adjoining winter-wet swamps. This species does not survive in disturbed areas. | Highly Unlikely – no low-lying habitat |
| ***Grevillea curviloba*** | Curved-leaf Grevillea | Schedule 1 | Endangered (as subsp. Curviloba and incurva) | Narrow curved-leaf Grevillea occurs in grey sand in winter-wet heath. There are 17 known populations in an area between Muchea and Badgingarra (Phillimore and English, 2000). | Highly Unlikely – not winter wet heath habitat |
| ***Darwinia foetida*** | Muchea Bell | Schedule 2 | Critically Endangered | The Muchea Bell is found in grey-white sand on swampy, seasonally wet sites. | Highly Unlikely – no swamp habitat |
| ***Diuris purdiei*** | Purdie's Donkey-orchid | Schedule 2 | Endangered | Purdie's Donkey Orchid occurs in grey-black sand in moist winter-wet swamps. | Highly Unlikely – no swamp habitat |
| ***Drakaea micrantha*** | Dwarf Hammer-orchid | Schedule 2 | Vulnerable | Dwarf Hammer-orchid occurs in grey sands over dark, grey to blackish, sandy clay-loam substrates in winter wet depressions or swamps. | Highly Unlikely – no swamp habitat |
| ***Marianthus paralius*** | | Schedule 2 | Endangered | *Marianthus paralius* occurs in white sand and brown loam amongst heath on coastal limestone cliffs (DEC, 2009). | Highly Unlikely – no coastal habitat |
| ***Melaleuca* sp. Wanneroo (G.J. Keighery 16705)** | | Schedule 2 | Endangered | *Melaleuca* sp. Wanneroo occurs in very shallow soils over limestone 'caprock' on ridges. | Possible |

| Scientific Name | Common Name | Conservation Status (WA) | Conservation Status (EPBC Act) | Habitat | Likelihood of Occurrence within the Site |
|---|---|---|---|---|---|
| ***Acacia anomala*** | Grass Wattle, Chittering Grass Wattle | Schedule 3 | Vulnerable | The Grass Wattle prefers lateritic soils and slopes. | Highly Unlikely – no lateritic habitat |
| ***Andersonia gracilis*** | Slender Andersonia | Schedule 3 | Endangered | Slender Andersonia occurs in white/grey sand, sandy clay, gravelly loam in winter-wet areas, near swamps. | Highly Unlikely – no swamp habitat |
| ***Anigozanthos viridis* subsp. *terraspectans*** | Dwarf Green Kangaroo Paw | Schedule 3 | Vulnerable | The Dwarf Green Kangaroo Paw occurs on grey sand, clay loam in winter-wet depressions. | Highly Unlikely – no wetland habitat |
| ***Diuris micrantha*** | Dwarf Bee-orchid | Schedule 3 | Vulnerable | The Dwarf Bee-orchid is usually found on cleared firebreaks or open sandy patches that have been disturbed with in Jarrah Banksia woodland or thickets of Spearwood (*Kunzea ericifolia/ glabrescens*) (Williams et al., 2001). | Highly Unlikely – no suitable habitat |
| ***Eleocharis keigheryi*** | Keighery's Eleocharis | Schedule 3 | Vulnerable | Keighery's Eleocharis occurs in clay, sandy loam and is emergent in freshwater: creeks, claypans. | Highly Unlikely – no damp habitat |
| ***Eucalyptus argutifolia*** | Yanchep Mallee, Wabling Hill Mallee | Schedule 3 | Vulnerable | The Yanchep Mallee occurs in shallow soils over limestone on slopes or gullies of limestone ridges, outcrops. | Known to occur on the site |
| ***Baeckea* sp. Limestone (N. Gibson & M.N. Lyons 1425)** | | Priority 1 | N/A | *Baeckea* sp. Limestone is recorded from limestone outcrop/ridge in yellow sand derived from Tamala Limestone -Spearwood Dune System in bushland burnt 5+ years (Western Australian Herbarium, 2012). | Possible |
| ***Drosera patens*** | | Priority 1 | N/A | *Drosera patens* occurs in sandy soils on the margins of winter-wet depressions, swamps and lakes. | Highly Unlikely – no swamp habitat |
| ***Drosera* x *sidjamesii*** | | Priority 1 | N/A | *Drosera* x *sidjamesii* grows in peaty sand along lake margins, close to winter high-water line. | Highly Unlikely – no lake habitat |

| Scientific Name | Common Name | Conservation Status (WA) | Conservation Status (EPBC Act) | Habitat | Likelihood of Occurrence within the Site |
|---|---|---|---|---|---|
| ***Grevillea* sp. Ocean Reef (D. Pike Joon 4)** | | Priority 1 | N/A | *Grevillea* sp. Ocean Reef (D. Pike Joon 4) occurs in dry brown/grey sand, yellow brown sand on sandy dune, gully in coastal scrub. | Highly Unlikely – Not coastal habitat |
| ***Haloragis* sp. Parrot Ridge (G.J. Keighery 11563)** | | Priority 1 | N/A | *Haloragis* sp. Parrot Ridge (G.J. Keighery 11563) is recorded from a hill on margin of ridge in black sand over limestone (Western Australian Herbarium, 1989). | Possible but would be an extension of the range of this species |
| ***Hydrocotyle striata*** | | Priority 1 | N/A | *Hydrocotyle striata* occurs in clay near springs. | Highly Unlikely – no spring habitat |
| ***Leucopogon maritimus*** | | Priority 1 | N/A | *Leucopogon maritimus* occurs in Quindalup deep, calcareous sands, on the mid to upper slopes of dunes or in shallow sand over limestone, but avoiding the thicker vegetation of the swale (Hislop, 2011) | Highly Unlikely – no Quindalup habitat |
| ***Acacia benthamii*** | | Priority 2 | N/A | *Acacia benthamii* grows on sand, typically on limestone breakaways | Possible |
| ***Amanita wadulawitu*** | Long-spored Lepidella | Priority 2 | N/A | Long-spored Lepidella occurs in sandy soil with *Corymbia calophylla*, *Eucalyptus marginata*, *E. todtiana*, *E. camaldulensis, Jacksonia furcellata*, *Banksia attenuata and B. menziesii*. (McGurk et al., 2016). | Highly Unlikely – no suitable habitat |
| ***Calectasia elegans*** | Elegant Tinsel Lily | Priority 2 | N/A | Elegant Tinsel Lily occurs in deep grey quartz soils on gentle slopes, above damplands. | Highly Unlikely – no suitable habitat |
| ***Fabronia hampeana*** | | Priority 2 | N/A | *Fabronia hampeana* occurs on sheltered wet trunk of *Macrozamia dyeri* in shrub layer (Western Australian Herbarium, 2005). | Possible if Macrozamia is present |
| ***Lecania sylvestris*** | | Priority 2 | N/A | *Lecania sylvestris* is recorded from a roadside (Western Australian Herbarium, 1988). | Possible |

| Scientific Name | Common Name | Conservation Status (WA) | Conservation Status (EPBC Act) | Habitat | Likelihood of Occurrence within the Site |
|---|---|---|---|---|---|
| ***Lecania turicensis* var. *turicensis*** | | Priority 2 | N/A | *Lecania turicensis* var. *turicensis* occurs on coastal rocks, limestone (Western Australian Herbarium, 1988). | Unlikely – not coastal habitat |
| ***Leucopogon squarrosus* subsp. *trigynus*** | | Priority 2 | N/A | *Leucopogon squarrosus* subsp. *Trigynus* occurs in Bassendean sands (Hislop, 2011). | Highly Unlikely – no Bassendean habitat |
| ***Poranthera moorokatta*** | | Priority 2 | N/A | *Poranthera moorokatta* grows in white silica sand and has been recorded in Banksia woodland and in a shallow dampland (Barrett, 2012). | Highly Unlikely – no low-lying habitat |
| ***Rinodina bischoffii*** | | Priority 2 | N/A | *Rinodina bischoffii* is recorded from grasslands with low shrubs (Western Australian Herbarium, 1994). | Highly Unlikely – no suitable habitat |
| ***Stenanthemum sublineare*** | | Priority 2 | N/A | *Stenanthemum sublineare* grows in littered white sand on coastal plain. | Highly Unlikely – no suitable habitat |
| ***Tetraria* sp. Chandala (G.J. Keighery 17055)** | | Priority 2 | N/A | *Tetraria* sp. Chandala is recorded from a mound spring in peaty sand (Western Australian Herbarium, 2005). | Highly Unlikely – no mound spring habitat |
| ***Thelymitra variegata*** | Queen of Sheba | Priority 2 | N/A | The Queen of Sheba orchid grows on sandy clay, sand and laterite. | Highly Unlikely – no lateritic habitat |
| ***Adenanthos cygnorum* subsp. *chamaephyton*** | | Priority 3 | N/A | *Adenanthos cygnorum* subsp. *chamaephyton* occurs in grey sand, lateritic gravel. | Highly Unlikely – no lateritic habitat |
| ***Amanita carneiphylla*** | Miller's Pink-Gilled Lepidella | Priority 3 | N/A | Miller's Pink-Gilled Lepidella is a deeply rooting species and grows in sandy soil. | HighlyUnlikely – not deep sands |
| ***Austrostipa mundula*** | | Priority 3 | N/A | *Austrostipa mundula* occurs on plains in grey sand (Western Australian Herbarium, 2001). | Highly Unlikely – no suitable habitat |

| Scientific Name | Common Name | Conservation Status (WA) | Conservation Status (EPBC Act) | Habitat | Likelihood of Occurrence within the Site |
|---|---|---|---|---|---|
| ***Beyeria cinerea* subsp. *cinerea*** | | Priority 3 | N/A | *Beyeria cinerea* subsp. *cinerea* grows in sand over limestone on road verges, gullies | Possible |
| ***Chamaescilla gibsonii*** | | Priority 3 | N/A | *Chamaescilla gibsonii* grows in clay to sandy clay on winter-wet flats, shallow water-filled claypans. | Highly Unlikely – no winter-wet habitat |
| ***Conostylis bracteata*** | | Priority 3 | N/A | *Conostylis bracteata* occurs in sand, limestone on consolidated sand dunes. | Unlikely – not dune habitat |
| ***Cyathochaeta teretifolia*** | | Priority 3 | N/A | *Cyathochaeta teretifolia* occurs in grey sand, sandy clay on swamps, creek edges. | Highly Unlikely – no wetland habitat |
| ***Dampiera triloba*** | | Priority 3 | N/A | *Dampiera triloba* grows in loamy sand (Australian National Herbarium, 2009) in lower lying areas. | |
| ***Guichenotia tuberculata*** | | Priority 3 | N/A | *Guichenotia tuberculata* grows in sand clay over laterite, sand. | Highly Unlikely – no lateritic habitat |
| ***Hibbertia leptotheca*** | | Priority 3 | N/A | *Hibbertia leptotheca* grows near-coastal limestone ridges, outcrops and cliffs in coastal heaths and thickets usually dominated by species of Melaleuca and Acacia (Thiele, 2019). | Highly Unlikely – not coastal habitat |
| ***Jacksonia gracillima*** | | Priority 3 | N/A | *Jacksonia gracillima* occurs in grey and brown well-drained sand. | Possible |
| ***Lasiopetalum membranaceum*** | | Priority 3 | N/A | *Lasiopetalum membranaceum* grows in sand over limestone. | Possible |
| ***Leucopogon* sp. Yanchep (M. Hislop 1986)** | | Priority 3 | N/A | *Leucopogon* sp. Yanchep occurs in light grey-yellow sand, brown loam, limestone, laterite, granite on coastal plain, breakaways, valley slopes, low hills. | Possible |
| ***Pimelea calcicola*** | | Priority 3 | N/A | *Pimelea calcicola* occurs in sand on coastal limestone ridges. | Possible |

| Scientific Name | Common Name | Conservation Status (WA) | Conservation Status (EPBC Act) | Habitat | Likelihood of Occurrence within the Site |
|---|---|---|---|---|---|
| ***Pithocarpa corymbulosa*** | | Priority 3 | N/A | *Pithocarpa corymbulosa* occurs in gravelly or sandy loam amongst granite outcrops. | Highly Unlikely – no granite outcrop habitat |
| ***Placynthium nigrum*** | Blackthread Lichen | Priority 3 | N/A | Blackthread Lichen is recorded from karst limestone on lagoon shore among salt marsh (Allan Herbarium, 1997). | Highly Unlikely – no saltmarsh habitat |
| ***Platysace ramosissima*** | | Priority 3 | N/A | *Platysace ramosissima* prefers sandy soils. | Possible |
| ***Sarcozona bicarinata*** | Ridged Noon-flower | Priority 3 | N/A | Ridged Noon-flower is found in white sand. | Possible |
| ***Sphaerolobium calcicola*** | | Priority 3 | N/A | *Sphaerolobium calcicola* grows in white-grey-brown sand, sandy clay over limestone, black peaty sandy clay on tall dunes, winter-wet flats, interdunal swamps, low-lying areas. | Highly Unlikely – no wetland habitat |
| ***Stylidium maritimum*** | | Priority 3 | N/A | *Stylidium maritimum* occurs in sand over limestone on dune slopes and flats in coastal heath and shrubland, open Banksia woodland. | Unlikely – not coastal habitat |
| ***Stylidium paludicola*** | | Priority 3 | N/A | *Stylidium paludicola* prefers peaty sand over clay in winter wet habitats in Marri and Melaleuca woodland, Melaleuca shrubland. | Highly Unlikely – no wetland habitat |
| ***Verticordia serrata* var. *linearis*** | | Priority 3 | N/A | *Verticordia serrata* var. *linearis* grows in white sand, gravel in open woodland. | Highly Unlikely – no gravel habitat |
| ***Anigozanthos humilis* subsp. *chrysanthus*** | Golden Cats Paw | Priority 4 | N/A | Golden Cats Paw grows in grey or yellow sand. | Possible |
| ***Conostylis pauciflora* subsp. *euryrhipis*** | | Priority 4 | N/A | *Conostylis pauciflora* subsp. *Euryrhipis* occurs in white, grey or yellow sand on consolidated dunes in coastal areas. | Unlikely – not coastal habitat |

| Scientific Name | Common Name | Conservation Status (WA) | Conservation Status (EPBC Act) | Habitat | Likelihood of Occurrence within the Site |
|---|---|---|---|---|---|
| ***Conostylis pauciflora* subsp. *pauciflora*** | | Priority 4 | N/A | Conostylis pauciflora subsp. Pauciflora occurs in grey sand, limestone on hillslopes, consolidated dunes in coastal areas. | Unlikely – not coastal habitat |
| ***Drosera occidentalis*** | Western Sundew | Priority 4 | N/A | The Western Sundew occurs in sandy and clayey soils in swamps and wet depressions. | Highly Unlikely – no wetland habitat |
| ***Hibbertia helianthemoides*** | | Priority 4 | N/A | Hibbertia helianthemoides grows in clayey sand over sandstone or loam over quartzite on hills and scree slopes. | Highly Unlikely – no suitable habitat |
| ***Hydrocotyle lemnoides*** | Aquatic Pennywort | Priority 4 | N/A | Aquatic Pennywort occurs in swamps | No – no swamp habitat |
| ***Jacksonia sericea*** | Waldjumi | Priority 4 | N/A | Waldjumi grows in calcareous and sandy soils. | Possible |
| ***Lepidium pseudotasmanicum*** | | Priority 4 | N/A | Lepidium pseudotasmanicum occurs in loam, sand associated with granite. | Highly Unlikely – no granite habitat |
| ***Schoenus griffinianus*** | | Priority 4 | N/A | Schoenus griffinianus grows in white sand in low heath (Wilson, 1997). | Unlikely – not heath habitat |
| ***Stylidium longitubum*** | Jumping Jacks | Priority 4 | N/A | Jumping Jacks prefer sandy clay, clay in seasonal wetlands. | Highly Unlikely – no wetland habitat |
| ***Tripterococcus* sp. Brachylobus (A.S. George 14234)** | | Priority 4 | N/A | Tripterococcus sp. Brachylobus occurs in grey, black or peaty sand winter-wet flats | Highly Unlikely – no wetland habitat |

# Appendix F Bamford (2022) Fauna Assessment

# WA Limestone
# Wattle Avenue East Project
# Fauna Assessment



View over the Wattle Avenue East site. Photo: Wes Bancroft.

Prepared for: WA Limestone
401 Spearwood Avenue
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27th January 2022

# Executive Summary

Bamford Consulting Ecologists (BCE) was commissioned by WA Limestone to conduct a Basic (*sensu* EPA 2020) fauna assessment (desktop review and site inspection) of their proposed Wattle Avenue East quarry expansion in Nowergup. The purposes of this report are to provide information on the fauna values of the project area, an overview of the ecological function of the site within the local and regional context, and to provide discussion on the interaction of proposed development on the site with these fauna values and functions.

BCE uses a 'values and impacts' assessment process with the following components:

- The identification of **fauna values**:
  - Assemblage characteristics: uniqueness, completeness and richness;
  - Species of conservation significance;
  - Recognition of ecotypes or vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
  - Patterns of biodiversity across the landscape; and
  - Ecological processes upon which the fauna depend.
- The review of **impacting processes** such as:
  - Habitat loss leading to population decline;
  - Habitat loss leading to population fragmentation;
  - Degradation of habitat due to weed invasion leading to population decline;
  - Ongoing mortality from operations;
  - Species interactions including feral and overabundant native species;
  - Hydrological change;
  - Altered fire regimes; and
  - Disturbance (dust, light, noise).
- The **recommendation** of actions to mitigate impacts (if requested).

**Description of project area**

The proposed location ('project area') for the 'Wattle Avenue East' quarry expansion surrounds existing quarries within Mining Tenement M70/143, in the suburb of Nowergup, approximately 34 km north of the Perth CBD. The project area is c. c. 23.4 ha, of which at c. 8.3 ha has previously been cleared. The 'development footprint' of the expansion is not expected to take up the entire 15.1 ha of undeveloped lands within the project area.

The project area is within the Swan Coastal Plain 2 (SWA02) subregion of the Swan Coastal Plain bioregion and falls within the 'Cottesloe Complex – Central and South' of Heddle *et al.* (1980) and Webb *et al.* (2016). The eastern edge of the project area intersects Bush Forever Site number 293 (Shire View Hill and adjacent bushland, Nowergup, Neerabup) with at least one additional Environmentally Sensitive Area extending over the southern portion of the project area. The project area also sits within the 'Northern Swan Coastal Plain' Key Biodiversity Area. There are no known Ramsar Sites or Important Wetlands within the project area.

**Key fauna values**

Vegetation and Substrate Associations (VSAs) that provide habitat for fauna. Five major Vegetation and Substrate Associations were identified in the project area: Proteaceous heath (VSA 1), Myrtaceous/fabaceous heath (VSA 2), Limestone Marlock woodland (VSA 3), Rehabilitation (VSA 4), and Cleared (VSA 5).

Fauna assemblage. The desktop study identified 173 vertebrate fauna species as potentially occurring in the project area: no fish, eight frogs, 46 reptiles, 100 birds and 19 mammals. The presence of at least 23 species (20 birds and three mammals) was confirmed during the 2021 site inspection. The fauna assemblage is probably typical of the near-coastal shrublands of the coastal plain north of Perth. The assemblage is likely to be substantially complete except for the mammal component, which is depauperate in both medium-sized and small species. The assemblage is likely to be only moderately rich in a regional context as the environment consists largely of shrublands and lacks the banksia and eucalypt woodlands of the coastal plain slightly further east.

Species of conservation significance. Three broad levels of conservation significance are used in this report:

- Conservation Significance 1 (CS1) – species listed under State or Commonwealth Acts.
- Conservation Significance 2 (CS2) – species listed as Priority by DBCA but not listed under State or Commonwealth Acts.
- Conservation Significance 3 (CS3) – species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

The majority of the 46 conservation significant species (including two reptiles, 35 birds, five mammals and four invertebrates) expected in the project area are likely to be residents or regular visitors/migrants visitors. Only five of the expected conservation species are listed under WA State and/or Commonwealth legislation (category CS1; four bird and one mammal), with seven listed as Priority by DBCA (category CS2; one reptile, two mammals and four invertebrates) and the remaining 34 considered locally significant (category CS3; one reptile, 31 birds and two mammals). Of most concern are Carnaby's Black-Cockatoo (CS1, known to be a regular migrant to the area and to use the project area for foraging), and Quenda (CS2, known to occur within the project area and expected to be resident).

Patterns of biodiversity. The three intact native VSAs can be expected to be richer in species than the rehabilitation and cleared areas. Differences in the fauna assemblage between these three VSAs might be slight, as they contain many of the same plant species and have broadly similar substrates. VSA 1 (proteaceous heath) is notable for high nectar production important for a range of nectarivores (*B. sessilis*) and supply of food for Carnaby's Black-Cockatoo. VSA 2 (myrtaceous/fabaceous heath) and VSA3 (Limestone Marlock woodland) may be less productive in this respect. VSA 3 is notable as having the only eucalypts in the project area and thus may support some birds and invertebrates that are eucalypt specialists.

Key ecological processes. The ecological processes that currently have major effects upon the fauna assemblage include landscape permeability, hydrology, fire, and the presence of feral species.

**Potential impacts upon fauna**

Threatening processes reviewed in relation to the proposed development included: habitat loss, habitat fragmentation, degradation due to weed invasion, direct mortality during construction, ongoing mortality, impacts of feral and overabundant native species, hydrological change, fire and disturbance (dust, noise and light). Potential impacts are considered to be negligible to minor because of the small areas involved, the low number of conservation significant species expected to be regularly present within, and wholly reliant on, the project area (and the low likelihood of their disruption), and the general fauna assemblage being well-represented in the general region. The cumulative impact of habitat loss due to the proposed Wattle Avenue East quarry expansion project is not expected to be significant (clearing is expected to contribute less than a further 0.03% to the c. 53.7% of the cleared lands in the region).

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# 1 Introduction

WA Limestone is proposing to expand operations at its 'Wattle Avenue East' quarry within Mining Tenement M70/143, in the suburb of Nowergup on the outskirts of the Perth Metropolitan area (see Figure 1).

Bamford Consulting Ecologists (BCE) was commissioned by WA Limestone to conduct a Basic (*sensu* EPA 2020) fauna assessment (desktop review and site inspection) of the proposed Wattle Avenue East quarry expansion. This report presents the results of that fauna desktop review and site inspection.

## 1.1 General approach to fauna impact assessment

The purpose of impact assessment is to provide government agencies with the information they need to decide upon the significance of impacts of a proposed development, and to provide information to proponents to help them to develop appropriate strategies for avoiding and minimising impacts of their activities. This relies on information on the fauna assemblage and its environment, and BCE uses an approach with the following components:

- The identification of **fauna values**:
  - Assemblage characteristics: uniqueness, completeness and richness;
  - Species of conservation significance;
  - Recognition of ecotypes or vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
  - Patterns of biodiversity across the landscape; and
  - Ecological processes upon which the fauna depend.
- The review of **impacting processes** such as:
  - Habitat loss leading to population decline;
  - Habitat loss leading to population fragmentation;
  - Degradation of habitat due to weed invasion leading to population decline;
  - Ongoing mortality from operations;
  - Species interactions including feral and overabundant native species;
  - Hydrological change;
  - Altered fire regimes; and
  - Disturbance (dust, light, noise).
- The **recommendation** of actions to mitigate impacts (if requested).

Based on the impact assessment process above, the objectives of the study are therefore to:

1. Conduct a literature review and searches of Commonwealth and State fauna databases;
2. Review the list of fauna expected to occur on the site in the light of fauna habitats present, with a focus on investigating the likelihood of significant species being present;
3. Identify significant or fragile fauna habitats within the project area;
4. Identify any ecological processes in the project area upon which fauna may depend;
5. Identify general patterns of biodiversity within or adjacent to the project area, and
6. Identify potential impacts upon fauna and propose recommendations to minimise impacts.

Descriptions and background information on these values and processes can be found in Appendices 1 to 4. Based on this impact assessment process, the objectives of investigations are to: identify fauna values; review impacting processes with respect to these values and the proposed development; and provide recommendations to mitigate these impacts.

## 1.2 Description of project area and background environmental information

### *1.2.1 Project area*

For spatial terminology (i.e. definitions of project, survey and study areas) see Section 2.1.1 below.

The proposed location ('project area') for the 'Wattle Avenue East' quarry expansion surrounds existing quarries within Mining Tenement M70/143, in the suburb of Nowergup, approximately 34 km north of the Perth CBD. The project area is c. c. 23.4 ha, of which at c. 8.3 ha has previously been cleared. The 'development footprint' of the expansion is not expected to take up the entire 15.1 ha of undeveloped lands within the project area.

The field investigations in this environmental impact assessment were conducted within the project area only and, therefore, the 'survey area' and project area are treated as synonymous from hereon.

### *1.2.2 Interim Biogeographic Regionalisation of Australia (IBRA) and landscape characteristics*

The Interim Biogeographic Regionalisation of Australia (IBRA) has identified 26 bioregions in Western Australia which are further divided into subregions (DAWE 2021b). Bioregions are classified on the basis of climate, geology, landforms, vegetation and fauna (Thackway and Cresswell 1995). IBRA Bioregions are affected by a range of different threatening processes and have varying levels of sensitivity to impact (EPA 2016c). The project area is within the Swan Coastal Plain 2 (SWA02) subregion of the Swan Coastal Plain bioregion, as mapped in Figure 2. This bioregion falls within the Bioregion Group 1 (South-West Botanical Province) classification of EPA (2016c) where native vegetation is "extensively cleared for agriculture".

The Swan Coastal Plain 2 subregion was described by Mitchell *et al.* (2003) and a summary of their work follows here. The Swan Coastal Plain is a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The climate is Warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *C. obesa*-Marri woodlands and Melaleuca shrublands, are extensive only in the south. The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats, coastal limestone. Heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvials. Includes a complex series of seasonal wetlands and also includes Rottnest, Carnac and Garden Islands etc. Rainfall ranges between 600 and 1000 mm annually and the climate is Mediterranean.

### *1.2.3 Land systems and vegetation complexes*

Heddle *et al.* (1980) and Webb *et al.* (2016) have defined and described broad vegetation complexes for the Swan Coastal Plain and the mapping of these is provided by DBCA (2021j). The project area is located wholly within one of these:

- Cottesloe Complex – Central and South: Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops.

Heddle vegetation complexes in the vicinity of the project area are mapped in Figure 3 (data provided by DBCA 2021j).

### *1.2.4 Land use and tenure*

The dominant land uses within the Swan Coastal Plain 2 (SWA02) subregion are cultivation – dry land agriculture, conservation, UCL and Crown reserves, urban, rural residential, cultivation – irrigated horticulture, agriculture and plantations, forestry-plantations, roads and other easements and infrastructure, and grazing – Improved pastures, with smaller areas of mining, and defence lands (Mitchell *et al.* 2003). The project area lies in the central sector of the subregion. At the local scale, the project area is surrounded by areas of agriculture, plantations and mining.

### *1.2.5 Recognised sensitive sites*

The eastern edge of the project area intersects Bush Forever Site number 293: Shire View Hill and adjacent bushland, Nowergup, Neerabup (Dell and Banyard 2000), as shown in Figure 4 (data provided by DPLH 2021). This Bush Forever listing is also captured in the database of Environmentally Sensitive Areas (DWER 2021a, b), with other sensitive areas extending over the southern portion of the project area as shown in Figure 5. The project area also sits within the 'Northern Swan Coastal Plain' Key Biodiversity Area (KBA 2021), listed because "supports a considerable portion of the non-breeding population of the endangered Carnaby's Black-Cockatoo and a small number of breeding pairs" (KBAP 2020). There are no known Ramsar Sites (DBCA 2021f) or Important Wetlands (DBCA 2021c), within the project area.

### *1.2.6 Climate information*

The project areas falls within the Köppen climate classification of 'Hot-summer Mediterranean climate (*Csa*)', which is characterised by s characterized by dry summers and mild, wet winters. They usually occur on the western sides of continents between the latitudes of 30° and 45°. Hot-summer Mediterranean climates are in the polar front region in winter, and thus have moderate temperatures and changeable, rainy weather. Summers are hot and dry, due to the domination of the subtropical high pressure systems, except in the immediate coastal areas, where summers are milder due to the nearby presence of cold ocean currents that may bring fog but prevent rain (Anon. 2021; BOM 2021a).

For the Swan Coastal Plain 2 (SWA02) subregion, climate is "Warm Mediterranean" (Mitchell *et al.* 2003).

Climate averages (temperate, rainfall, sunshine) for the project area, as provided by BOM (2021b), are presented in Table 1.

## Table 1. Climate averages for the project area.

Data from BOM (2021b) for:
*Site name* = GINGIN AERO
*Site number* = 009178

| Statistics | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual | Years | | Plot | Map |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature | | | | | | | | | | | | | | | | | |
| Mean maximum temperature (°C) | 33.1 | 33.0 | 30.8 | 26.8 | 22.8 | 19.7 | 18.4 | 19.1 | 20.8 | 24.4 | 28.1 | 30.9 | 25.7 | 25 | 1996 2021 | | |
| Mean minimum temperature (°C) | 16.4 | 17.0 | 15.4 | 12.0 | 8.9 | 7.2 | 6.4 | 6.6 | 7.4 | 9.3 | 12.0 | 14.4 | 11.1 | 25 | 1996 2021 | | |
| Rainfall | | | | | | | | | | | | | | | | | |
| Mean rainfall (mm) | 15.7 | 15.5 | 19.1 | 27.1 | 73.1 | 109.3 | 129.1 | 108.6 | 77.3 | 33.9 | 19.4 | 10.1 | 620.7 | 20 | 1996 2021 | | |
| Decile 5 (median) rainfall (mm) | 1.6 | 3.0 | 11.4 | 23.6 | 70.0 | 113.0 | 123.2 | 116.8 | 82.4 | 29.6 | 12.2 | 4.2 | 605.5 | 25 | 1996 2021 | | |
| Mean number of days of rain ≥ 1 mm | 1.2 | 1.4 | 2.5 | 4.2 | 8.6 | 10.3 | 13.9 | 12.1 | 10.1 | 5.4 | 3.3 | 1.9 | 74.9 | 24 | 1996 2021 | | |

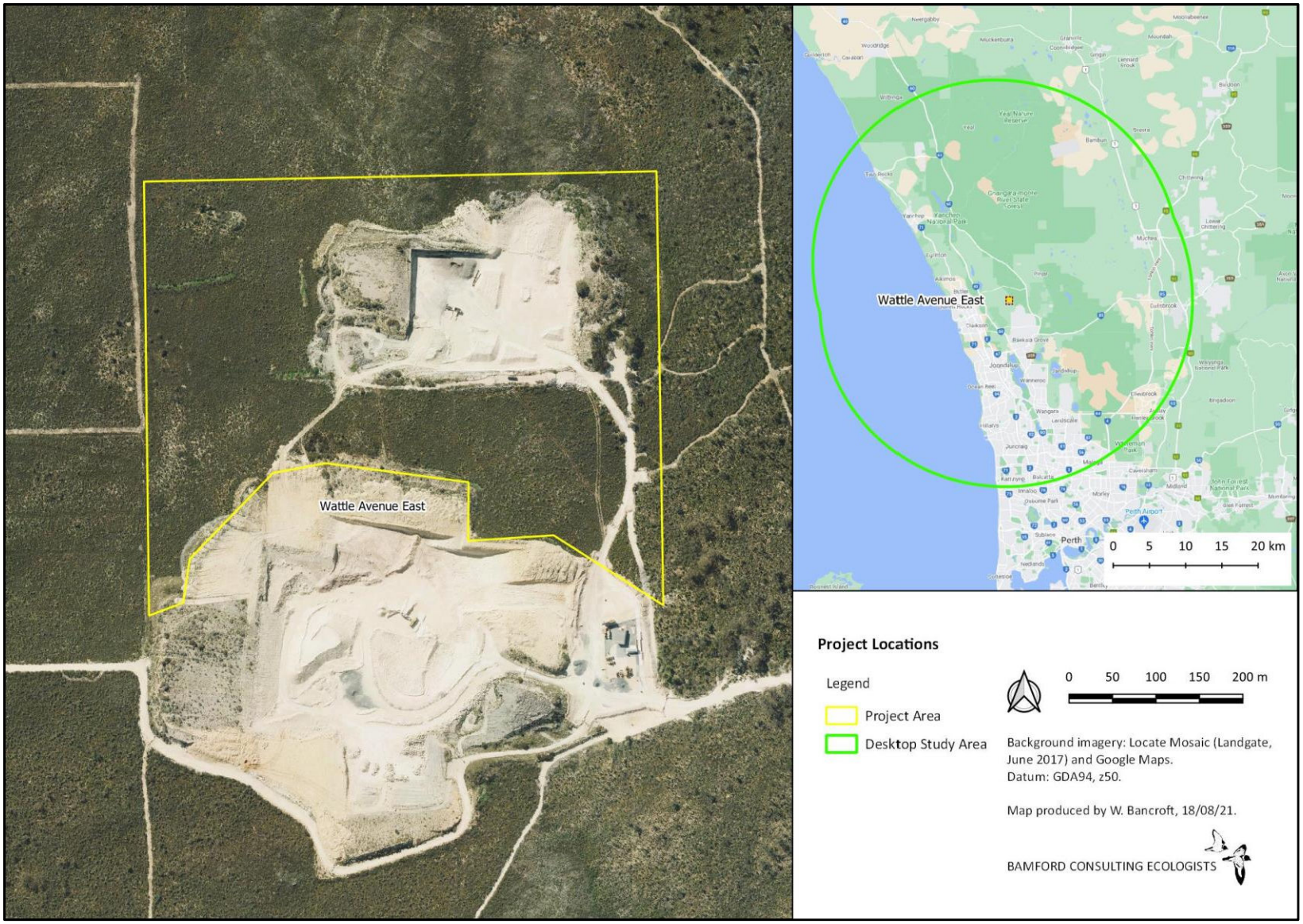



**Figure 1. Location of the Wattle Avenue East Project.**

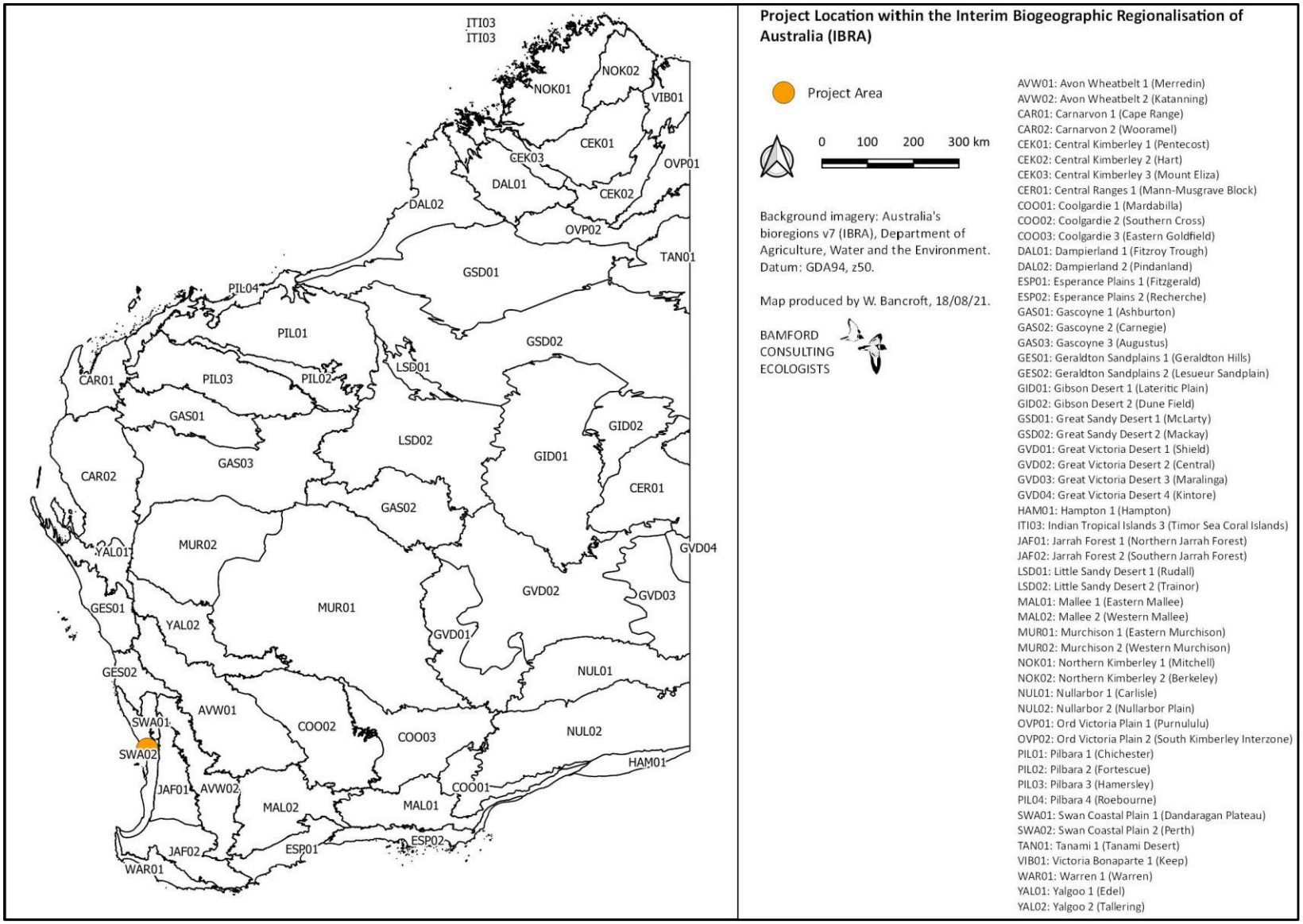



**Figure 2. Project location within the Interim Biogeographic Regionalisation of Australia (IBRA).**

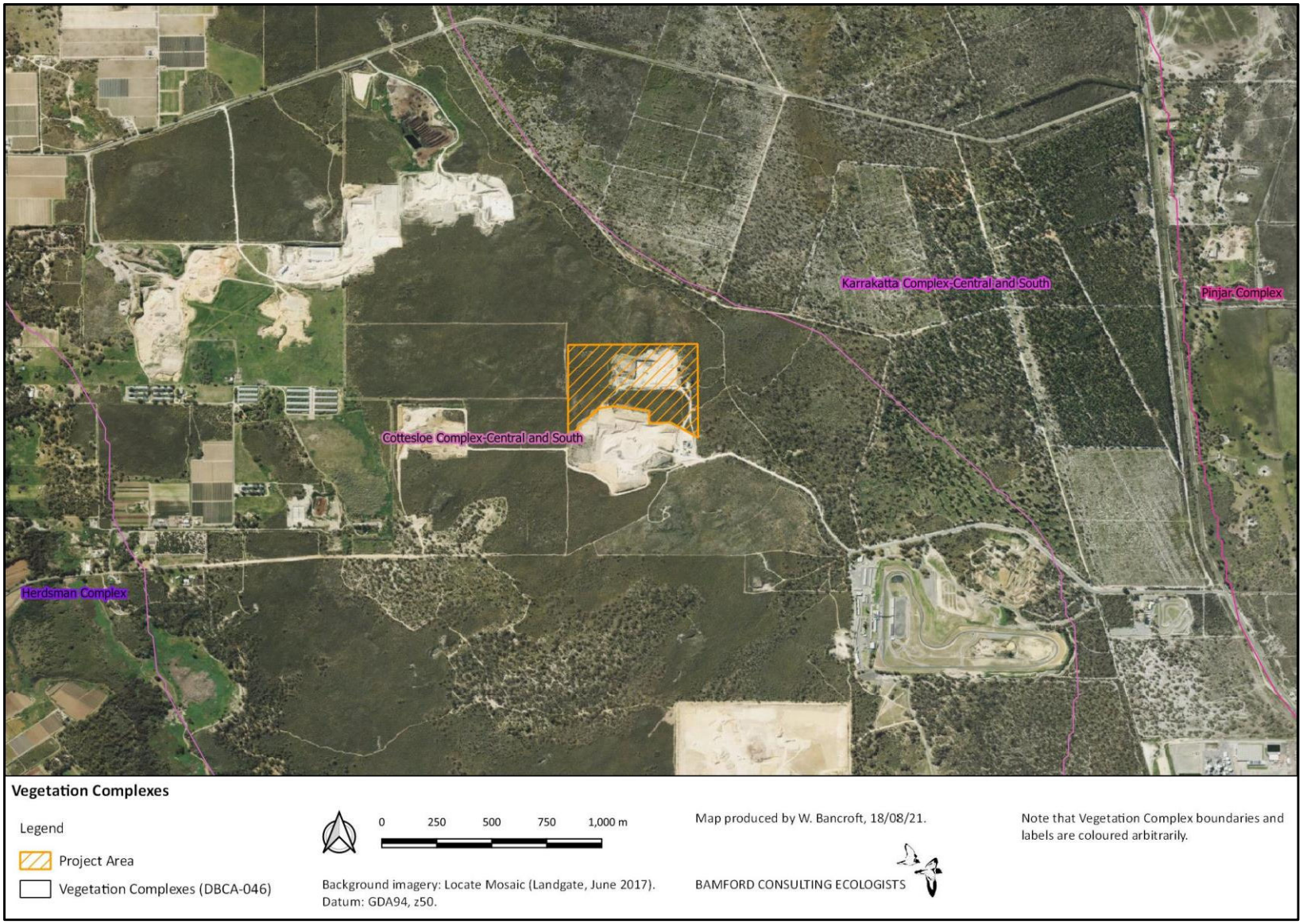



**Figure 3. Vegetation Complexes (Heddle *et al*. 1980) in the vicinity of the Wattle Avenue East Project.**

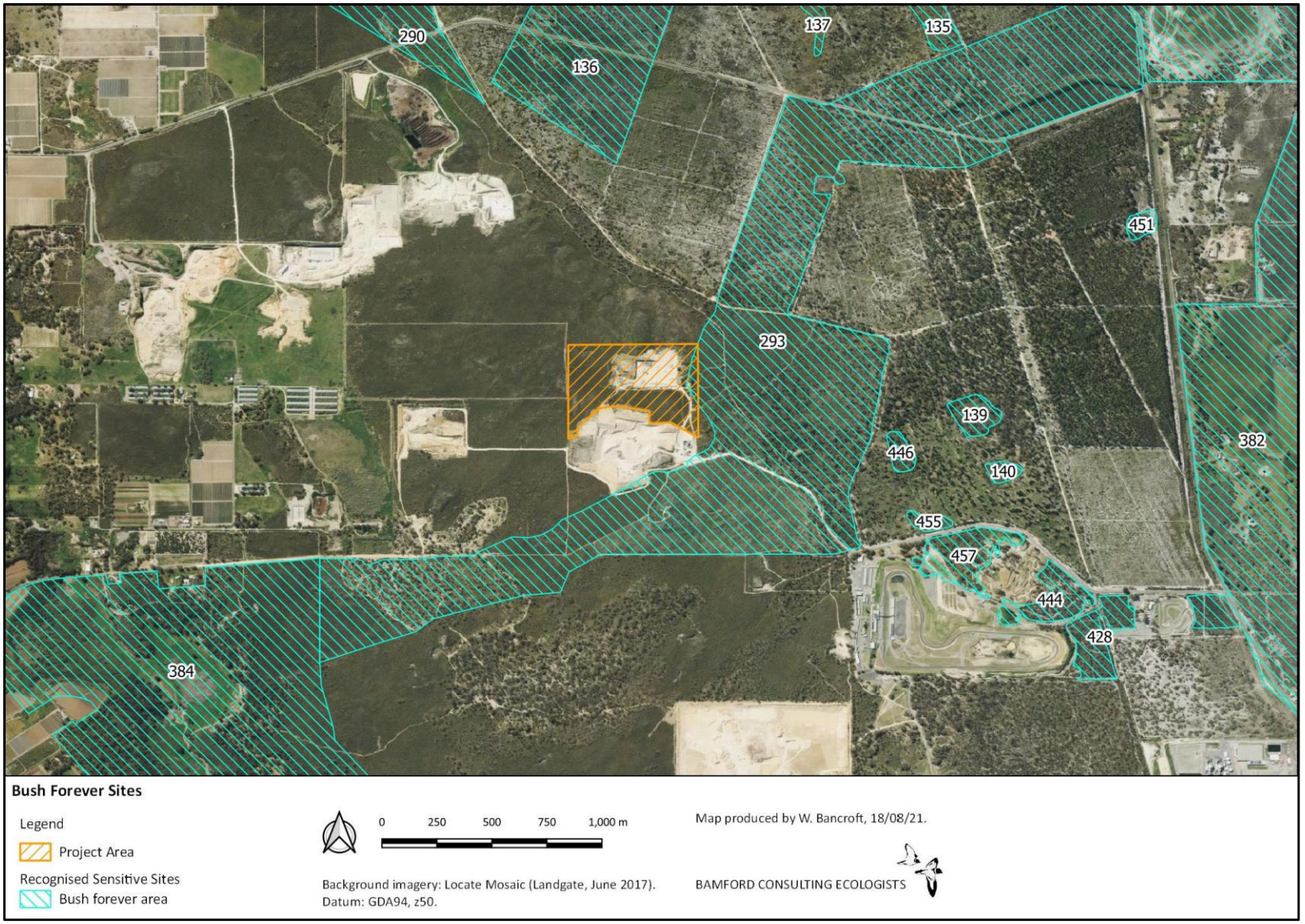



**Figure 4. Bush Forever Sites (Dell and Banyard 2000) in the vicinity of the Wattle Avenue East Project.**

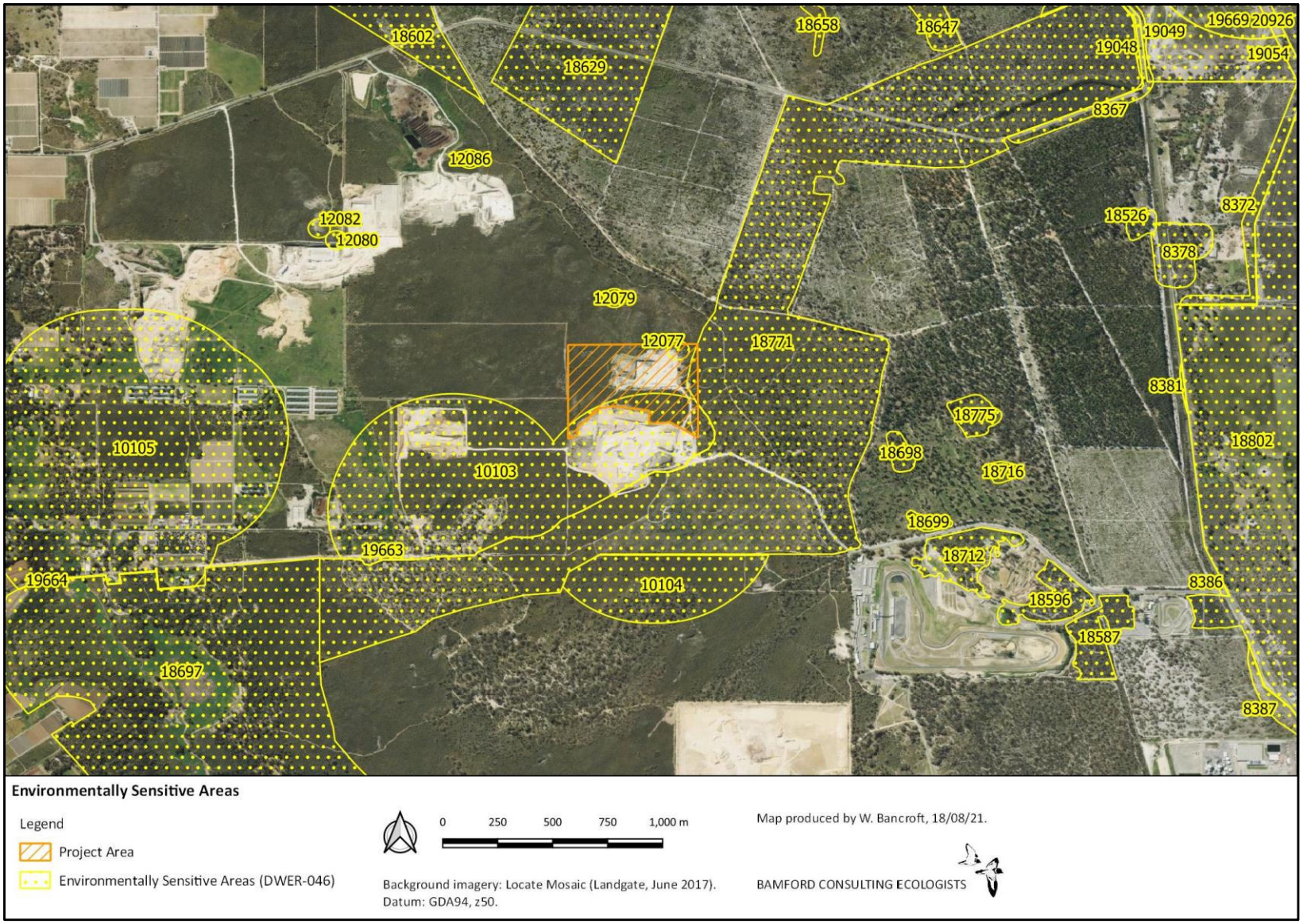



**Figure 5. Environmentally Sensitive Areas (DWER 2021a, b) in the vicinity of the Wattle Avenue East Project.**

# 2 Methods

## 2.1 Overview

This approach to fauna impact assessment has been developed with reference to guidelines and recommendations set out by the Western Australian Environmental Protection Authority (EPA) on fauna surveys and environmental protection (EPA 2002, 2016c, b, 2020), and Commonwealth biodiversity legislation (DotE 2013; DSEWPaC 2013a). The EPA (2020) recommends three levels of investigation that differ in their approach for field investigations:

- Basic – a low-intensity survey, conducted at the local scale to gather broad fauna and habitat information (formerly referred to as 'Level 1'). The primary objectives are to verify the overall adequacy of the desktop study, and to map and describe habitats. A basic survey can also be used to identify future survey site locations and determine site logistics and access. The results from the basic survey are used to determine whether a detailed and/or targeted survey is required. During a basic survey, opportunistic fauna observations should be made and low-intensity sampling can be used to gather data on the general faunal assemblages present. While referred to as 'basic', this level of survey is involved and powerful, and should be considered the primary level of assessment. Other levels of assessment (where deemed necessary) add information to inform this primary level.
- Detailed – a detailed survey to gather quantitative data on species, assemblages and habitats in an area (formerly referred to as 'Level 2'). A detailed survey requires comprehensive survey design and should include at least two survey phases appropriate to the biogeographic region (bioregion). Surveys should be undertaken during the seasons of maximum activity of the relevant fauna and techniques should be selected to maximise the likelihood that the survey will detect most of the species that occur, and to provide data to enable some community analyses to be carried out.
- Targeted – to gather information on significant fauna and/or habitats, or to collect data where a desktop study or field survey has identified knowledge gaps. Because impacts must be placed into context, targeted surveys are not necessarily confined to potential impact areas. A targeted survey usually requires one or more site visits to detect and record significant fauna and habitats. For areas with multiple significant species there may not be a single time of year suitable to detect all species. In these cases, multiple visits, each targeting different species or groups, should be conducted.

The level of assessment recommended by the EPA (2020) is determined by geographic position, with a generic statement that detailed surveys are expected across all of the state except the south-west, but also recommending that site and project characteristics be considered, such as the survey objectives, existing available data, information required, the scale and nature of the potential impacts of the proposal and the sensitivity of the surrounding environment in which the disturbance is planned. These aspects should be considered in the context of the information acquired by the desktop study. When determining the type of survey required, the EPA (2020) suggested that the following be considered:

- level of existing regional knowledge
- type and comprehensiveness of recent local surveys
- degree of existing disturbance or fragmentation at the regional scale
- extent, distribution and significance of habitats

- significance of species likely to be present
- sensitivity of the environment to the proposed activities
- scale and nature of impact.

Guidance for field investigations methods is provided by the EPA (2016c, 2020) and by Bamford *et al.* (2013).

A 'basic' level survey (desktop review, fauna habitat identification and a site inspection) is considered appropriate for the current project. This is based upon the level of existing knowledge (see Section 2.3 below), the extent, distribution and significance of habitats (widespread) and the significance of species likely to be present (generally a limited assemblage of significant species).

The approach and methods utilised in this report are divided into three groupings that relate to the stages and the objectives of impact assessment:

- **Desktop assessment.** The purpose of the desktop review is to produce a species list that can be considered to represent the vertebrate fauna assemblage of the project area based on unpublished and published data using a precautionary approach.
- **Field investigations.** The purpose of the field investigations carried out for a Basic assessment is to gather information on the vegetation and soil associations ('habitats') that support the fauna assemblage and place the list generated by the desktop review into the context of the environment of the project area. The brief field investigations that form part of a Basic assessment also allow for some fauna observations to be made and assist the consultant to develop an understanding of the ecological processes that may be operating in the project area.
- **Impact assessment.** Determine how the fauna assemblage may be affected by the proposed development based on the interaction of the project with a suite of ecological and threatening processes.

### *2.1.1 Spatial terminology*

A range of terms are used through the report to refer to the spatial environment around the proposed project, and these are defined below:

- Study area – the outermost boundary of the desktop assessment that is almost always a specified buffer distance (see Section 2.3.1 below) around the *survey area*. The study area thus encompasses the *survey area* but includes the area from which databases are sourced.
- Survey area – the *survey area* is the area to which the results of the desktop analysis are directed and/or the area within which field investigations are conducted. Note that while the term '*survey area*' is used throughout the guidance provided by EPA (2020), it does not appear to be explicitly defined and, therefore, the above definition has been developed with interpretation of both the guidance and BCE report structure.
- Project area – this may be equivalent to the *survey area* but is strictly the land over which the proponent has tenure or some control and within which on-site impacts may occur.
- Development footprint – the expected extent of land clearing and/or development.

Where available, these spatial boundaries are mapped in Figure 1.

## 2.2 Identification of vegetation and substrate associations (VSAs)

Vegetation and substrate associations (VSAs) combine vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna.

BCE deliberately makes the distinction between 'habitat' (a species-specific term that may encompass the whole or part of one or more VSAs and is the physical subset of an ecosystem that a given species, or species group, utilises) and 'VSA' (a general, discrete and mutually exclusive spatial division of a target area, based on soil, vegetation and topography). It is recognised, however, that, within the broader EIA literature/guidance, the former term is used more or less synonymously to indicate the latter (e.g.' habitat assessment' used by EPA 2020). Further discussion is provided in Appendix 1.

For the current assessment, VSAs were identified based on the consultant's previous experience in the area, a vegetation assessment of the site (by RPS), and on observations made during the field investigations.

## 2.3 Desktop assessment of expected species

### *2.3.1 Sources of information*

As per the recommendations of EPA (2020), information on the fauna assemblage of the project area was drawn from a range of sources including databases (as listed in Table 2) and reports from other fauna surveys in the region (as listed in Table 3). Information from these sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns are listed in Table 4.

### *2.3.2 Previous fauna surveys*

Bamford Consulting Ecologists has undertaken multiple previous fauna investigations in the region of the current study area (Table 3). These indicate the local experience of the Bamford Consulting team in the region. Fauna records from almost all these investigations would have been added to naturemap, and naturmap will also contain records from other consultants who have worked in the region.

**Table 2. Databases searched for the desktop review; accessed August 2021.**

| Database | Type of records held in database | Area searched |
|---|---|---|
| BCE Database | Fauna recorded by BCE in the vicinity of the project area. | 25 km buffer around the centroid of the project area (383796E, 6497393N; or 31.653° S, 115.774° E). |
| Atlas of Living Australia (ALA 2021) | Fauna records from Australian museums and conservation/research bodies, including records from BirdLife Australia's Atlas (Birdata) Database. | 25 km buffer around the centroid of the project area (383796E, 6497393N; or 31.653° S, 115.774° E). |
| NatureMap (DBCA 2021e) | Records from the Western Australian Museum (WAM) and Department of Biodiversity, Conservation and Attractions (DBCA) databases, including historical data and Threatened and Priority species in WA. | 25 km buffer around the centroid of the project area (383796E, 6497393N; or 31.653° S, 115.774° E). |
| EPBC Protected Matters Search Tool (DAWE 2021g) | Records on MNES protected under the EPBC Act. | 25 km buffer around the centroid of the project area (383796E, 6497393N; or 31.653° S, 115.774° E). |
| Index of Biodiversity Surveys for Assessment (IBSA) (DWER 2021c) | Flora and fauna data contained in EIA biodiversity survey reports. | 25 km buffer around the centroid of the project area (383796E, 6497393N; or 31.653° S, 115.774° E). |

**Table 3. Literature sources for the desktop review.**

| Author | Title |
|---|---|
| Syrinx Environmental and Bamford Consulting Ecologists (2011) | Yellagonga Regional Park Fauna Baseline Survey. Level 2 (Detailed) fauna survey. Unpubl. report to City of Joondalup. |
| Basnett, G. and Bamford, M. (2013). | Fauna Survey of the Hepburn Heights Conservation Area, Padbury. Unpubl. report to Syrinx Environmental and City of Joondalup. Level 2 (Detailed) fauna survey. |
| Bamford, M. (2006). | Jindee Fauna Assessment. Unpubl. report to RPS Bowman Bishaw Gorham. Level 2 (Detailed) fauna survey. |
| Bamford, M. and Everard, C. (2017) | Capricorn Coastal Reserve Fauna Assessment. Level 1 and targeted survey. Unpubl. report to strategen environmental (jbs&g). |
| Bamford, M (2020) | Neerabup Industrial Estate pre-clearing fauna survey and translocation. Unpubl. notes to EcoLogical Australia. Level 2 (Detailed) fauna survey. |
| McKenzie *et al.* (2009) | Neerabup Road Fauna Underpass Monitoring Project. Unpubl. report to Main Roads WA. Targeted survey. |
| Bamford, M., Gamblin, T., McCreery, A. and Huang, N. (2019). | Fauna Assessment for VRX Silica Muchea Silica Sands Project. Unpubl. report to VRX Silica. Level 2 (Detailed) fauna survey. |
| Valentine, L., Wilson, B., Johnson, B., Huang, N and Reaveley, A. (2008). | Gnangara Sustainability Strategy. Comprehensive survey of fauna and other environmental factors, including chapters on vertebrate fauna and black-cockatoos. |
| Wadey, J., Huang, N. and Bamford, M. (2022). | Fauna Assessment for Lots 5324 and 8037 Duringen Road, Cowalla. Unpubl. report to Focussed Vision Consulting Pty Ltd. Level 1 ('Basic') fauna investigation and targeted assessment for black-cockatoos. |

**Table 4. Sources of information used for general patterns of fauna distribution.**

| Taxa | Sources |
|---|---|
| Fish | Morgan *et al.* (1998), Allen *et al.* (2003), Morgan *et al.* (2014), DoF (2020). |
| Frogs | Tyler and Doughty (2009), Anstis (2017). |
| Reptiles | Storr *et al*. (1983, 1990, 1999, 2002), Bush and Maryan (2011), Wilson and Swan (2021). |
| Birds | Johnstone and Storr (1998, 2005), Menkhorst *et al*. (2017). |
| Mammals | Van Dyck and Strahan (2008), Churchill (2009), Menkhorst and Knight (2011). |

### *2.3.3 Nomenclature and taxonomy*

As per the recommendations of the EPA (2020), the nomenclature and taxonomic order presented in this report are generally based on the Western Australian Museum's (WAM) Checklist of the Fauna of Western Australia 2020. The authorities used for each vertebrate group were: fish (Morgan *et al.* 2014), frogs (Doughty 2021a), reptiles (Doughty 2021b), birds (BirdLife Australia 2019; Gill *et al.* 2021), and mammals (Travouillon 2021). In some cases, more widely-recognised names and naming conventions have been followed, particularly for birds where there are national and international naming conventions in place (e.g. the BirdLife Australia working list of names for Australian Birds, and the International Ornithological Congress' 'World Bird List'). Similarly, the group name 'black-cockatoo' is consistently used for all three taxa in the South-West. English common names of species, where available, are used throughout the text; Latin names are presented with corresponding English names in tables in the appendices. The use of subspecies is limited to situations where there is an important (and relevant) geographically distinct population, or where the taxonomic distinction has direct relevance to the conservation status or listing of a taxon.

### *2.3.4 Interpretation of species lists*

#### *2.3.4.1 Expected occurrence*

Species lists generated from the review of sources of information are generous as they include records drawn from a large region (the study area, see Figure 1) and possibly from environments not represented in the project area. Therefore, some species that were returned by one or more of the database and literature searches have been excluded because their ecology, or the environment within the project area, determine that it is highly unlikely that these species will be present. Such species can include, for example, seabirds that might occur as extremely rare vagrants at a terrestrial, inland site, but for which the site is of no importance. Species returned from the databases and not excluded on the basis of ecology or environment are therefore considered potentially present or expected to be present in the project area at least occasionally, whether or not they were recorded during field surveys, and whether or not the project area is likely to be important for them. This list

of expected species is therefore subject to interpretation by assigning each a predicted status, the expected occurrence, in the project area. The status categories used are:

- **Resident:** species with a population permanently present in the project area;
- **Regular migrant or visitor:** species that occur within the project area regularly in at least moderate numbers, such as part of an annual cycle;
- **Irregular Visitor:** species that occur within the project area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the project area in at least moderate numbers and for some time;
- **Vagrant:** species that occur within the project area unpredictably, in small numbers and/or for very brief periods. Therefore, the project area is unlikely to be of importance for the species; and
- **Locally extinct:** species that would have been present but has not been recently recorded in the local area and therefore is almost certainly no longer present in the project area.

These status categories make it possible to distinguish between vagrant species, which may be recorded at any time but for which the site is not important in a conservation sense, and species which use the site in other ways but for which the site is important at least occasionally. This is particularly useful for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive, and further recognises that even the most detailed field survey can fail to record species which will be present at times. The status categories are assigned conservatively based on the precautionary principle. For example, a lizard known from the general area is assumed to be a resident unless there is very good evidence the site will not support it, and even then it may be classed as a vagrant rather than assumed to be absent if the site might support dispersing individuals. It must be stressed that these status categories are predictions only and that often very intensive sampling would be required to confirm a species' status.

The results of the database searches were reviewed and interpreted, and obvious errors and out of date taxonomic names were deleted.

#### *2.3.4.2 Conservation significance*

All expected species were assessed for conservation significance as detailed in Appendix 1. Three broad levels of conservation significance are used in this report:

- Conservation Significance 1 (CS1) – species listed under State or Commonwealth Acts such as the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Biodiversity Conservation Act 2016* (BC Act);
- Conservation Significance 2 (CS2) – species listed as Priority by DBCA but not listed under State or Commonwealth Acts; and
- Conservation Significance 3 (CS3) – species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

See Appendix 1 for an expanded discussion of these categories and Appendix 2 for a description of the categories used in the legislation (EPBC and BC Acts) and by the DBCA.

## 2.4 Field investigations

### *2.4.1 Overview*

A site inspection was conducted to familiarise the consultants with the project area. This involved looking around as much of the project area as possible; including walking through areas that did not have direct vehicle access. This enabled:

- identification of VSAs (that provide fauna habitats);
- targeted searches for significant fauna and an assessment of their likelihood of occurrence based on VSAs present;
- continuous recording of bird species encountered; and
- opportunistic fauna observations.

### *2.4.2 Dates*

The project area was visited on the 15th June 2021.

### *2.4.3 Black-cockatoo habitat analysis*

#### *2.4.3.1 Guidelines*

The Commonwealth Department of Agriculture, Water and the Environment (DAWE) provides guidelines for the referral of actions that may result in impact to black-cockatoos (for assessment under the EPBC Act). The survey and analysis reported here have been conducted with strong reference to both the existing guidelines (DSEWPaC 2012) as well as the recently revised draft guidelines (DEE 2017). This includes application of the foraging habitat scoring tool in DEE (2017). In addition, survey methodology followed the recommendations listed on the DAWE's Species Profile and Threats Database (DAWE 2021c, d, e). Ecological values for black-cockatoos within the site were based on the definitions of breeding, foraging and roosting habitat as per the EPBC Act referral guidelines for black-cockatoos (DSEWPaC 2012).

The DBCA has also indicated that the methodology developed and applied previously by BCE (e.g. Bancroft and Bamford 2021), and as described below, to score nesting value and foraging habitat is an acceptable approach.

#### *2.4.3.2 Breeding*

The aim of the breeding surveys was to record all potential hollow-bearing trees (suitable for black-cockatoo nesting) within the project area. The entire project area (see Figure 1), was examined for the presence of these trees. The following information was recorded for every suitable tree[1] with a diameter at breast height (DBH) equal to or greater than 500 mm:

- tree location;
- tree species;
- life status;
- DBH; and

[1] the draft revised EPBC Act study guidelines (DEE 2017) stress that any tree species may provide suitable hollows. Note that trees where the DBH criterion is >300mm do not occur at Lowlands.

- nest-tree rank: trees were assessed (from the ground) for the potential presence/quality of nest-hollows and allocated a nesting rank (developed by BCE) as described in Table 5.

The BirdLife Australia database of black-cockatoo breeding surveys was also searched for relevant local records (see Peck 2019).

**Table 5. Ranking system for the assessment of potential nest-trees for black-cockatoos (revised 08/01/2021).**

As per DAWE (2021c, d, e) guidance, a potential nest-tree is any tree with a diameter at breast height >500 mm (or >300 mm for *Eucalyptus salmonophloia* and *E. wandoo*). Note that black-cockatoos favour vertical hollows for the nest chamber, but the hollow entrance may be vertical (a chimney hollow), have a side entrance or have a horizontal spout entrance.

| Rank | Description of tree and hollows/activity |
|---|---|
| 1 | Activity at hollow observed; adult (or immature) bird seen entering or emerging from hollow. Can also be used for a known nest tree active in the previous 12 months (although this should be noted in the description). Note that activity at a hollow does not absolutely mean that breeding is occurring unless a young bird in hollow is observed. |
| 2 | Hollow of suitable size visible with chew marks around entrance. Record if chew-marks are recent or old. |
| 3 | Potentially suitable hollow visible but no chew marks present at entrance; or potentially suitable hollow suspected to be present - as suggested by structure of tree, such as large, vertical trunk broken off at a height of >8m; but note that hollow height is contextual. Carnaby's Black-Cockatoo will nest in hollows <5m so in a Wheatbelt breeding site a lower criterion may be more appropriate. |
| 4 | Tree with large hollows or broken branches that might contain large hollows, but hollows or potential hollows (nest chamber) are not vertical or near-vertical; thus a tree with or likely to have hollows of sufficient size but not to have hollows of the angle preferred by Black-Cockatoos. Trees with low but otherwise suitable hollows can also be assigned a rank or 4, depending on the species of black-cockatoo likely to be present. |
| 5 | Tree lacking large hollows or broken branches that might have large hollows; a tree with more or less intact branches and a spreading crown. |

#### *2.4.3.3 Foraging*

The foraging value of the study area was assessed by calculating a foraging score for areas of similar vegetation type/condition (see Appendix 5). The foraging score provides a numerical value that reflects the significance of vegetation as foraging habitat for black-cockatoos, and this numerical value is designed to provide the sort of information needed by DAWE, Department of Water and Environmental Regulation (DWER) and the Environmental Protection Authority (EPA) to assess impact significance and offset requirements. The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area, and can be influenced by the context such as the availability of foraging habitat nearby. The BCE scoring system for value of foraging habitat has three

components as detailed in Appendix 5. These three components are drawn from the DAWE offset calculator but with the scoring approach developed by BCE:

- A score out of six for the vegetation composition, condition and structure.
- A score out of three for the context of the site.
- A score out of one for species density.

Foraging value can thus be assigned a score out of six, based upon site vegetation characteristics, or a score out of 10 if context and species density are also considered. A higher score represents better foraging value. A score out of 10 is presented for the purposes of aiding offset calculations. The approach to assigning scores for vegetation, context and species density are outlined in Appendix 5. Foraging value scores are calculated differently for the three black-cockatoo species (Appendix 5) depending upon the vegetation present; thus a separated score is given for each VSA for each species.

Black-cockatoo foraging signs were also recorded in conjunction with the breeding tree surveys (see Section 2.4.3.2) and general site inspections. When observed, the location, tree species and approximate age of the foraging evidence were recorded. Black-cockatoo foraging evidence may persist for some months or years after the foraging event. There is currently no published evidence documenting the deterioration process of forage. Factors that help to establish the time since foraging include: the colour of nuts/foliage, the degree of weathering or decay of debris, the presence of small fragments of nut debris, the position/compression of the foraging debris relative to surrounding vegetation and leaf litter, and the strength of the eucalypt smell emitted. Despite the absence of empirical data, four categories of foraging activity were recognised, based on the time since foraging:

(i) Active – where birds were observed in the act of foraging;
(ii) Recent – foraging signs (e.g. chewed nuts or vegetation) were 'fresh' (i.e. foraging was likely to have occurred within days to weeks). Recent foraging signs were typically green and/or with very little sign of weathering. Approximately less than four weeks old;
(iii) Intermediate – foraging was likely to have occurred within weeks to months previously. Approximately one to six months old; and
(iv) Old – foraging was likely to have occurred months to years previously. Approximately more than six months old.

As an indication, Appendix 6 shows examples of Forest Red-tailed Black-Cockatoo foraging signs across the range of these categories (note that it is uncertain as to the exact time frame for each stage).

#### *2.4.3.4 Roosting*

As the breeding and foraging surveys were conducted, areas likely to be used as roosting sites (e.g. sites adjacent to watercourses with large trees) or areas that had cockatoo activity in the late-afternoon were noted.

The BirdLife Australia Great Cocky Count (GCC) database of roost sites was also searched for relevant local records (see Peck *et al.* 2019).

## 2.5 Personnel

Personnel involved in the field investigations and report preparation (including desktop review) are listed in Table 6.

**Table 6. Personnel involved in the field investigations and report preparation.**

| Personnel | EIA Experience | Field Investigations | Report Preparation |
|---|---|---|---|
| Dr Wes Bancroft *BSc (Zoology/Microbiology), Hons (Zoology), PhD (Zoology)* | 24 years | + | + |
| Dr Mike Bamford *BSc (Biology), Hons (Biology), PhD (Biology)* | 40 years | | + |

## 2.6 Survey limitations

The EPA Guidance Statement 56 (EPA 2004) and the EPA (2020) outline a number of limitations that may arise during field investigations for Environmental Impact Assessment. These survey limitations are discussed in the context of the BCE investigation of the project area in Table 7. No limitations were identified.

The lack of detailed survey (i.e. intensive sampling of the fauna assemblage) is not considered a limitation as this assemblage is well-understood in the area due to multiple previous field investigations. Furthermore, EPA guidance does not consider limitations related to the effectiveness of field sampling for fauna but appears to make an assumption that the purpose of such sampling is to confirm the fauna assemblage. This is implicit in the EPA (2020) technical guidance that does provide suggestions for sampling techniques, but the level of field investigations suggested cannot confirm the presence of an entire assemblage, or confirm the absence of a species. This requires far more work than is possible (or recommended) for studies contributing to the EIA process because fauna assemblages vary seasonally and annually, and often have high levels of variation even over short distances (Beta diversity). For example, in an intensive trapping study, How and Dell (1990) recorded in any one year only about 70% of the vertebrate species found over three years. In a study spanning over two decades, Bamford *et al.* (2010) found that the vertebrate assemblage varies over time and space, meaning that even complete sampling at a set of sites only defines the assemblage of those sites at the time of sampling. The limited effectiveness of short periods of fauna sampling is not a limitation for impact assessment *per se*, as long as database information is interpreted effectively and field investigations are targeted appropriately. That is the approach taken by BCE.

**Table 7. Survey limitations as outlined by EPA (2020).**

| EPA Survey Limitations | BCE Comment |
|---|---|
| Availability of data and information | Sufficient information from databases and previous studies (see Section 2.3.1). Not a limitation. |
| Competency/experience of the survey team, including experience in the bioregion surveyed | The ecologists have had extensive experience in conducting desktop reviews and reconnaissance surveys for environmental impact assessment fauna studies, and have undertaken a number of studies within the region. See also Table 6 for further details. Not a limitation. |
| Scope of the survey (e.g. were faunal groups were excluded from the survey) | The survey focused on terrestrial vertebrate fauna and fauna values. Some information on threatened invertebrates was available from databases. Not a limitation. |
| Timing, weather and season | Timing is not of great importance for Basic level field investigations in this region. Not a limitation. |
| Disturbance that may have affected results | None. Not a limitation. |
| The proportion of fauna identified, recorded or collected | All fauna observed were identified. Not a limitation. |
| Adequacy of the survey intensity and proportion of survey achieved (e.g. the extent to which the area was surveyed) | The site was adequately surveyed to the level appropriate for a Basic level assessment. Fauna database searches covered a 25 km radius beyond the centroid of the project area. The Basic level assessment was completed. Not a limitation. |
| Access problems | There were no access problems encountered. Not a limitation. |
| Problems with data and analysis, including sampling biases | There were no data problems. Not a limitation. |

## 2.7 Presentation of results for Impact Assessment

While some impacts are unavoidable during a development, of concern are long-term, deleterious impacts upon biodiversity. This is reflected in documents such as the Significant Impact Guidelines provided by DSEWPaC (2012), as summarised in Appendix 4. Significant impacts may occur if:

- There is direct impact upon a VSA and the VSA is rare, a large proportion of the VSA is affected and/or the VSA supports significant fauna.
- There is direct impact upon conservation significant fauna.
- Ecological processes are altered and this affects large numbers of species or large proportions of populations, including significant species.

The impact assessment process therefore involves reviewing the fauna values identified through the desktop assessment and field investigations with respect to the project and impacting processes. The severity of impacts on the fauna assemblage and conservation significant fauna can then be quantified on the basis of predicted population change.

The presentation of this assessment follows the general approach to impact assessment as given in Section 1.1, but modified to suit the characteristics of the site. Key components to the general approach to impact assessment are addressed as follows:

Fauna values

This section presents the results of the desktop and field investigations in terms of key fauna values (described in detail in Appendix 1) and includes:

- Recognition of ecotypes or vegetation/substrate associations (VSAs);
- Assemblage characteristics (uniqueness, completeness and richness);
- Species of conservation significance;
- Patterns of biodiversity across the landscape; and
- Ecological processes upon which the fauna depend.

Impact assessment

This section reviews impacting processes (as described in detail in Appendix 3) with respect to the proposed development and examines the potential effect these impacts may have on the faunal biodiversity of the project area. It thus expands upon Section 1.1 and discusses the contribution of the project to impacting processes, and the consequences of this with respect to biodiversity. A major component of impact assessment is consideration of threats to species of conservation significance as these are a major and sensitive element of biodiversity. Therefore, the impact assessment section includes the following:

- Review of impacting processes; will the proposal result in:
    - Habitat loss leading to population decline, especially for significant species;
    - Habitat loss leading to population fragmentation, especially for significant species;
    - Weed invasion that leads to habitat degradation;
    - Ongoing mortality;
    - Species interactions that adversely affect native fauna, particularly significant species;
    - Hydrological change;
    - Altered fire regimes; or
    - Disturbance (dust, light, noise)?
- Summary of impacts upon significant species, and other fauna values.

The impact assessment concludes with recommendations for impact mitigation, based upon predicted impacts. Note that the terms direct and indirect impacts are not used in this report; for further explanation see Appendix 3.

### *2.7.1 Criteria for impact assessment*

Impact assessment criteria are based on the severity of impacts on the fauna assemblage and conservation significant fauna, and quantified on the basis of predicted population change (Table 8). Population change can be the result of direct habitat loss and/or impacts upon ecological processes.

The significance of population change is contextual. The EPA (2016c) suggested that the availability of fauna habitats within a radius of 15 km can be used as a basis to predict low, moderate or high impacts. In this case, a high impact is where the impacted environment and its component fauna are

rare (less than 5% of the landscape within a 15 km radius or within the Bioregion), whereas a low impact is where the environment is widespread (e.g. >10% of the local landscape). Under the Ramsar Convention, a wetland that regularly supports 1% of a population of a waterbird species is considered to be significant. These provide some guidance for impact assessment criteria. In the following criteria (Table 8), the significance of impacts is based upon percentage population decline within a 15 km radius (effectively local impact) and upon the effect of the decline upon the conservation status of a recognised taxon (recognisably discrete genetic population, sub-species or species). Note that percentage declines can usually only be estimated on the basis of the distribution of a species derived from the extent of available habitat while for a few species, such as the Black-Cockatoos, there is guidance for the assessment of impact significance.

The impact assessment concludes with recommendations based upon predicted impacts and designed to mitigate these.

**Table 8. Assessment criteria for impacts upon fauna.**

| Impact Category | Observed Impact |
|---|---|
| **Negligible** | Effectively no population decline; at most few individuals impacted and any decline in population size within the normal range of annual variability. |
| **Minor** | Population decline temporary (recovery after end of project such as through rehabilitation) or permanent, but < 1% within 15 km radius of centre-point of impact area (or within bioregion if this is smaller). No change in viability or conservation status of taxon. |
| **Moderate** | Permanent population decline 1-10% within 15 km radius. No change in viability or conservation status of taxon. |
| **Major** | Permanent population decline 10-50% within 15 km radius. No change in viability or conservation status of taxon. |
| **Critical** | Taxon decline > 50% (including local extinction) within 15 km and/or change in viability or conservation status of taxon. |

## 2.8 Mapping

Low resolution maps have been provided within the body this report. Higher resolution maps and GIS files can be supplied if required. As per the recommendation of EPA (2020), maps use the GDA94 datum and are projected into the appropriate Map Grid of Australia (MGA94) zone.

# 3 Fauna values

## 3.1 Vegetation and substrate associations (VSAs) ['Habitat assessment']

Vegetation and substrate associations within the project area are a complex mosaic, largely reflecting soil types. A full vegetation assessment of the site was conducted by PGV (2021). From this, and observations made during the field investigations here, five major vegetation and substrate associations (VSAs) were identified in relation to fauna in the project area:

**VSA 1. Proteaceous heath.** Heath dominated by proteaceous species, particularly *Banksia sessilis*, on orange-brown sands with some limestone outcropping. VSA 1 corresponds to the PGV (2021) vegetation category 'BsXpCq': *Banksia sessilis*/*Xanthorrhoea preissii*/*Calothamnus quadrifidus* Closed Tall Scrub over *Hibbertia hypericoides*/*Melaleuca systena*/*Jacksonia calcicola* Low Shrubland to Closed Low Heath. See Plate 1.

**VSA 2. Myrtaceous/fabaceous heath.** Heath dominated by myrtaceous or fabaceous species, particularly *Melaleuca systena*, on orange-brown sands with limestone outcropping. VSA 2 corresponds to the PGV (2021) vegetation categories 'MsAst', 'MsAt' and 'SnMs': *Melaleuca systena*/*Acacia stenoptera* Closed Heath; *Melaleuca systena*/*Acacia truncata* Closed Heath; and *Scaevola nitida*/*Melaleuca systena* Open Heath. See Plate 2 and Plate 3.

**VSA 3. Limestone Marlock woodland.** Woodland dominated by Limestone Marlock (*Eucalyptus decipiens*) on orange-brown sands with some limestone outcropping. VSA 3 corresponds to the PGV (2021) vegetation category 'Ed': *Eucalyptus decipiens* Low Open Woodland over *Xanthorrhoea preissii*/*Banksia sessilis* Open Shrubland to Tall Open Scrub. This occupies only a small area near the exiting quarry (Figure 6).

**VSA 4. Rehabilitation.** Disturbed areas, with limestone substrate, that have undergone some rehabilitation of vegetation. VSA 4 corresponds to the PGV (2021) vegetation category 'Rehabilitation area': *Olearia axillaris*/*Cenchrus setaceus* Low Shrubland. See Plate 4.

**VSA 5. Cleared.** Cleared or largely disturbed areas (e.g. roads, or where quarrying is being undertaken, or has taken place), or roads, tracks or drains. VSA 5 corresponds to the PGV (2021) vegetation category 'Cleared': cleared. See Plate 5.

The extent of the VSAs in the project area is mapped in Figure 6.

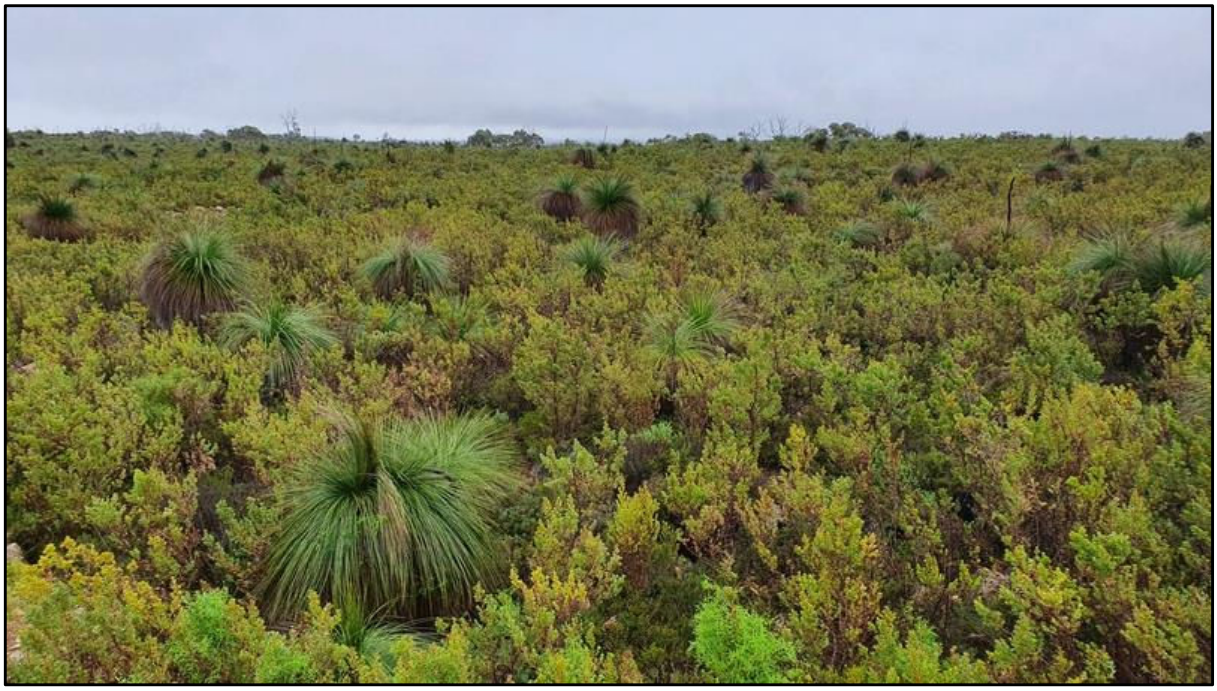


**Plate 1. VSA 1: Proteaceous heath.**



**Plate 2. VSA 2: Myrtaceous/fabaceous heath.**

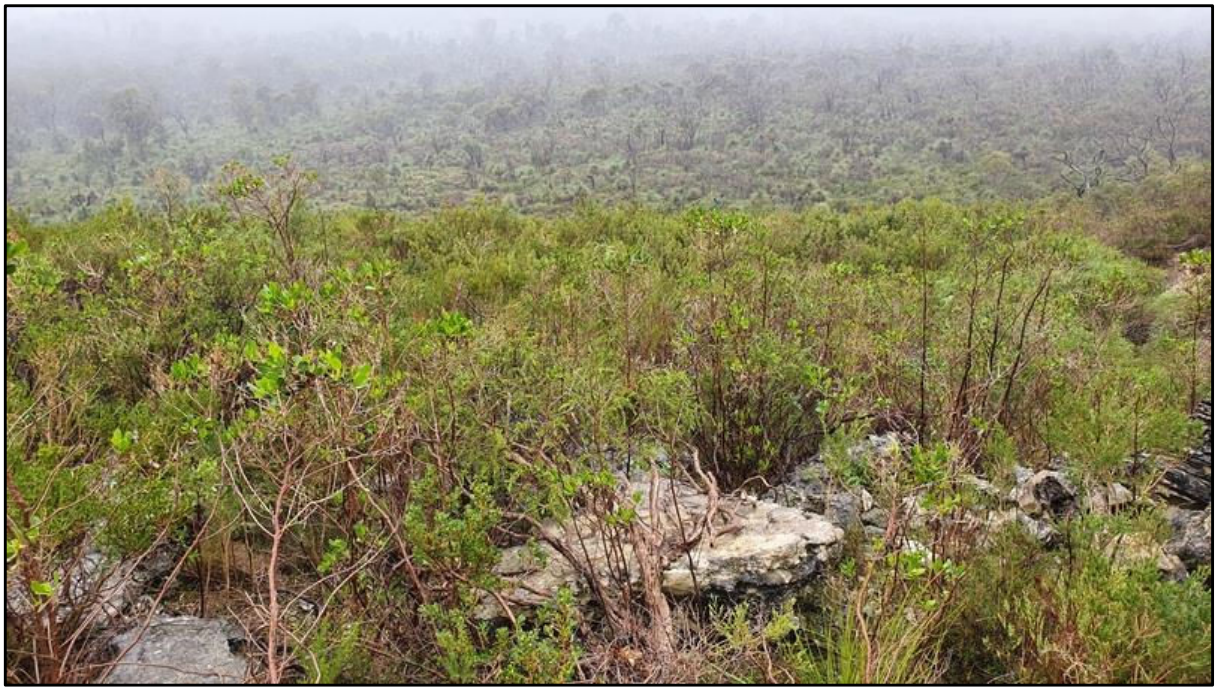


**Plate 3. VSA 2: Myrtaceous/fabaceous heath.**



**Plate 4. VSA 4: Rehabilitation.**



**Plate 5. VSA 5: Cleared.**

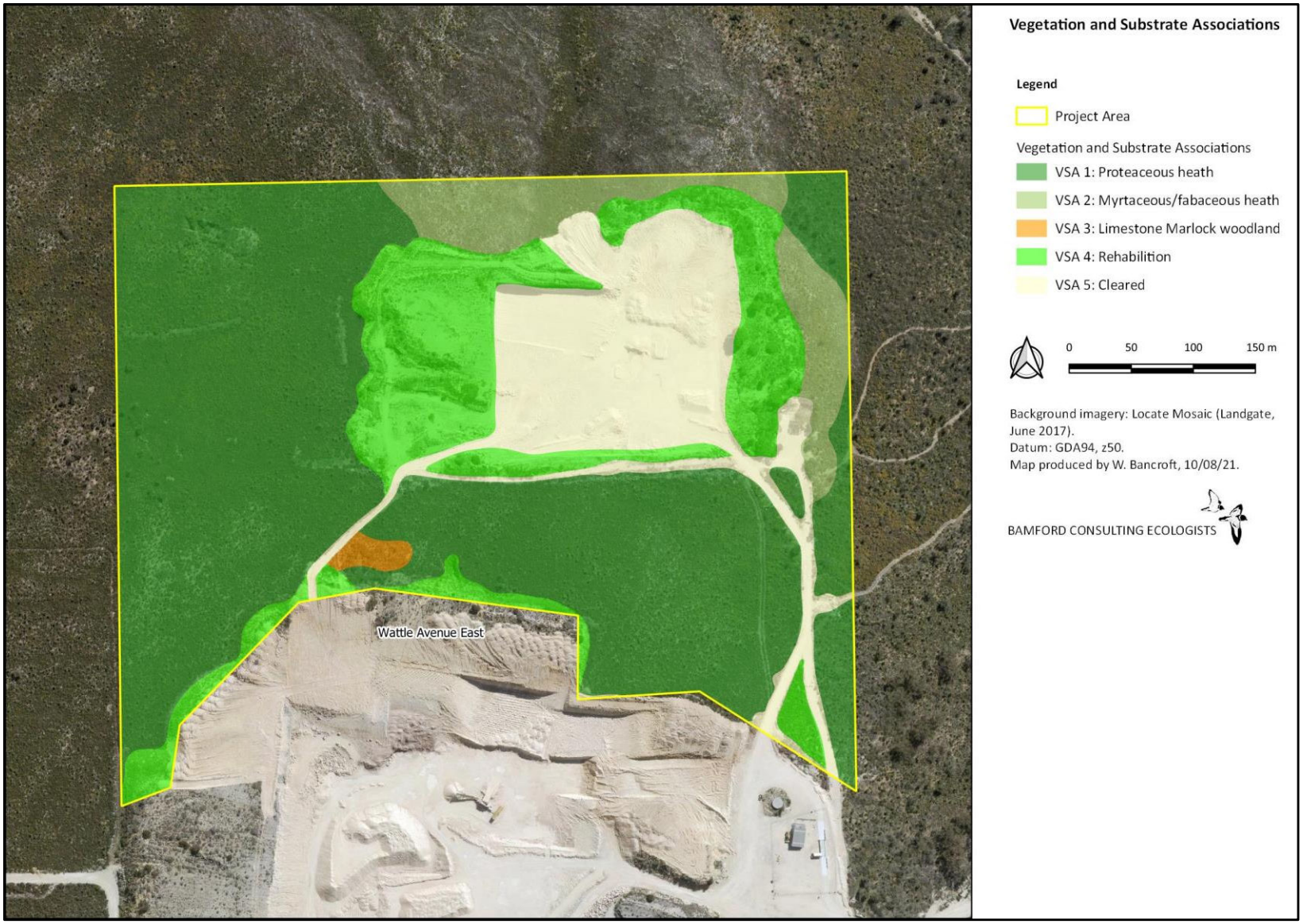



**Figure 6. The distribution of VSAs in the project area.**

### *3.1.1 Regional development*

The project area is located within a highly fragmented natural landscape that has been largely cleared for housing, agriculture or plantations. Figure 7 illustrates the existing extent of development in a 15 km buffer around the project area. Existing developments (c. 31,684 ha) impact c. 53.7% of the total land area within this buffer (c. 58,982 ha). The proposed Wattle Avenue East site has a total area of c. 23.4 ha, of which at c. 8.3 ha has been cleared. Therefore, up to an additional 15.1 ha may be impacted and this would, at most, contribute 0.03% to the land clearing within the region, taking the total developments in the region to c. 53.74% of the area. It should be noted that the development footprint (see Section 2.1.1) of the Wattle Avenue East quarry within the project area may be less than this figure.

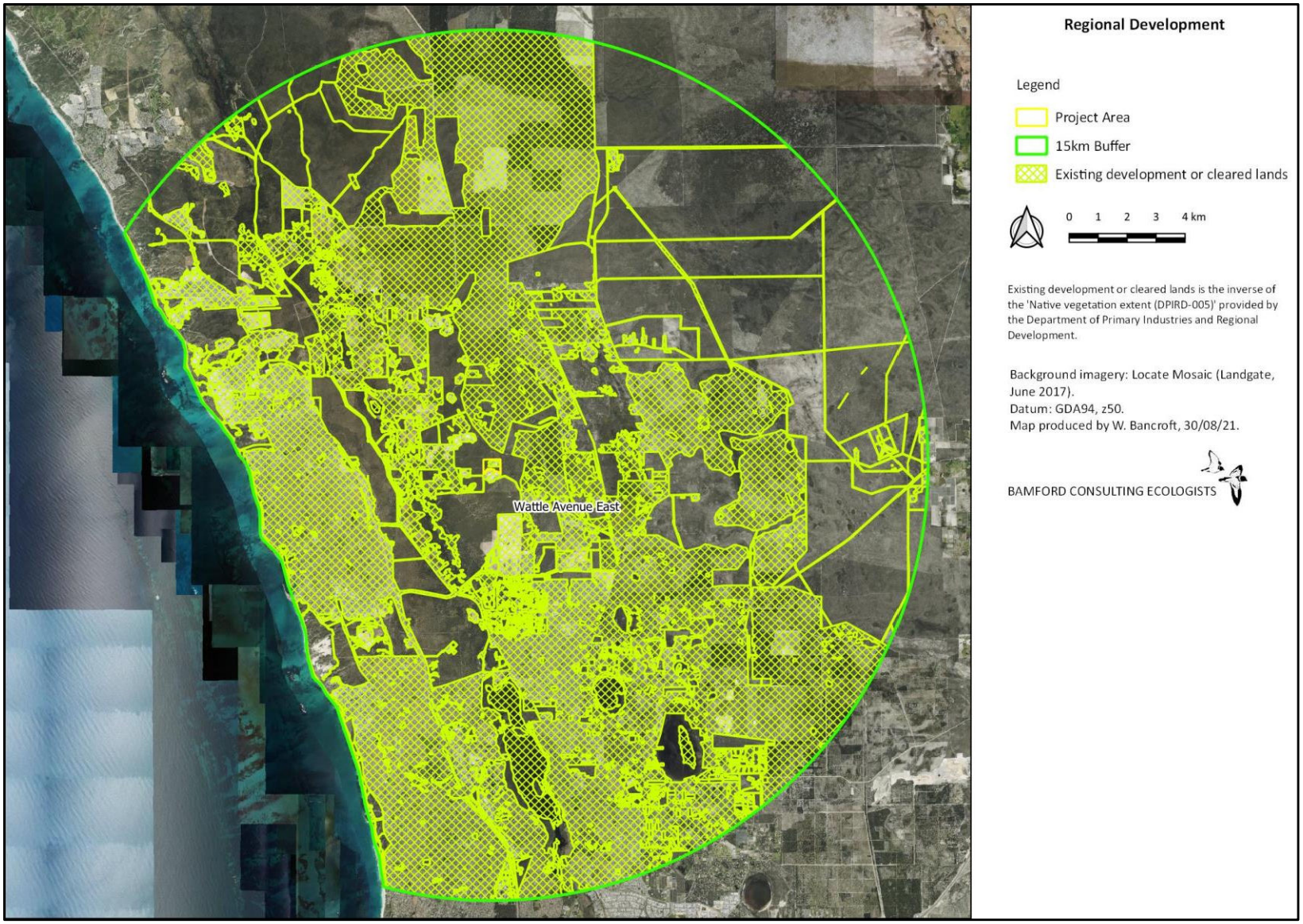



**Figure 7. Estimated existing development within the region (15 km).**

## 3.2 Fauna assemblage

### *3.2.1 Overview of vertebrate fauna assemblage*

The desktop study identified 173 vertebrate fauna species as potentially occurring in the project area: no fish, eight frogs, 46 reptiles, 100 birds and 19 mammals. These species are listed in Appendix 7. The presence of at least 23 species (20 birds and three mammals) was confirmed during the 2021 site inspection (as presented in Appendix 8, but also indicated in Appendix 7).

Two hundred and forty-seven species (six fish, nine frogs, 30 reptiles, 174 birds and 28 mammals) that were returned by the database searches and/or literature review have been omitted from the expected species list because of habitat or range limitations, or because they are considered to be locally extinct in the project area. These species are listed in Appendix 9.

The composition of the vertebrate fauna is summarised in Table 9.

**Table 9. Composition of vertebrate fauna assemblage of the project area.**

The number of non-native species is shown in parentheses.

| Taxon | Expected Species | Recorded Species | Number of species in each status category | | | | |
|---|---|---|---|---|---|---|---|
| | | | Resident | Migrant or regular visitor | Irregular visitor | Vagrant | Locally extinct |
| Fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Frogs | 8 | 0 | 4 | 0 | 4 | 0 | 0 |
| Reptiles | 46 | 0 | 44 | 1 | 1 | 0 | 0 |
| Birds | 100 (6) | 23 | 39 | 36 | 20 | 5 | 4 |
| Mammals | 19 (5) | 3 | 11 | 7 | 0 | 1 | 9 |
| **Total** | 173 (11) | **23** | **98** | **42** | **27** | **6** | **13** |

There is limited information on invertebrate fauna in the area; this fauna is discussed in Section 3.2.3.

### *3.2.2 Expected vertebrate fauna*

While freshwater fish are known from the region, there was no suitable habitat for this group within the project area.

The eight frog species include four that are considered to be residents within the project area. These species spend much, or all, of their life cycle away from wetlands/damplands and may be wide-ranging through woodlands and heathlands. The remaining four species are more dependent on regular seasonal or permanent standing fresh water and are expected to be irregular visitors to the site; passing through when suitable conditions prevail and/or in very low numbers. There are no introduced species of frog expected.

The 46 reptile species are all considered to be residents with the exception of *Lerista lineopunctulata* and the Carpet Python which may occur as irregular or regular visitors. There are no introduced species of reptiles expected.

The bird assemblage of 100 species is much smaller than would be expected in the broader region. This is due to a limited range of VSAs present and, notably, the absence, or all-but-absence, of eucalypt woodlands, Banksia woodlands and wetlands. Thirty-nine of the bird species are considered to be resident in the project area, with a further 36 that are regular visitors or migrants. A further 20 are expected to be irregular visitors and there are five vagrant species. There are six introduced species of birds expected to occur within the project area (three pigeons/doves, the Laughing Kookaburra, the Long-billed Corella and the Rainbow Lorikeet).

Most of the 19 mammal species are considered to be residents (11) or regular visitors (7), with the Chuditch considered to be a vagrant to the area. A large proportion of the original indigenous local mammal fauna has become extinct (9 species), as listed in Appendix 9, although several of these (e.g. dunnarts, pygmy-possum, Ash Grey Mouse) persist in less developed/impacted areas of the Swan Coastal Plain (e.g. well to the north of the project area). There are five introduced species of mammal expected to occur within the project area including two feral predators, two rodents and the Rabbit.

The key features of the fauna assemblage expected in the project area are:

- **Uniqueness:** The fauna assemblage is probably typical of the near-coastal shrublands of the coastal plain north of Perth. This assemblage is only moderately well-represented due to extensive clearing.
- **Completeness:** The assemblage is likely to be substantially complete except for the mammal component, which is depauperate in both medium-sized and small species.
- **Richness:** The assemblage is likely to be only moderately rich in a regional context as the environment consists largely of shrublands and lacks the banksia and eucalypt woodlands of the coastal plain slightly further east.

### *3.2.3 Invertebrate fauna of conservation significance*

The project area sits within DBCA's Swan management region (DBCA 2021b). DBCA (2021g) listed 21 threatened or priority invertebrate fauna in this region, as outlined in Appendix 10. At least nine of these species can be immediately ruled out from occurring within the project area and the reasons for exclusion are presented in Appendix 10 (e.g. wholly or locally extinct, absence of suitable habitat in the project area, distance from known populations). To help ascertain the status of the remaining 12 species, all location records from ALA (2021) and WAM (2021) were compiled, collated and mapped in relation to the project area. A map of these DBCA-listed threatened and priority species is provided in Figure 8. Note that no records for *Australotomurus morbidus* (Cemetery Springtail) were available.

There are no records of threatened invertebrate fauna within the project area. Six species have been recorded from within the regional (15 km) buffer:

(i) *Austrosaga spinifer* (Spiny Katydid [Swan Coastal Plain]) – known from only a few records in 'heath habitats' (Rentz 1993) from Cervantes to Boya (ALA 2021). Habitat that is potentially suited to this species exists within the project area, therefore this species may be present.

(ii) *Hesperocolletes douglasi* (Douglas's Broad-headed Bee) – known only from one or two records in the Pinjar/Muchea area (Arnold *et al.* 2019). A single female specimen was collected with a sweep net by Arnold *et al.* (2019) in a Banksia woodland remnant, c. 15km west of Muchea. While this record is only c. 7 km from the project area there is a low prevalence of this habitat type within the project area. Therefore, it is difficult to ascertain the likelihood of this species' occurrence. It is probably not present.

(iii) *Hylaeus globuliferus* (Woollybush Bee) – there have been a number of records of this species within 15 km of the project area, all of which are to the south. The Woollybush Bee occurs across a fairly broad region of south-western Australia, north to about Eneabba, east to the eastern edge of the wheatbelt and along the southern coast to Fitzgerald National Park near Hopetoun (ALA 2021). Houston (2018) notes that this species is known to forage on the flowers of Woollybush (*Adenanthos cygnorum*) and Candlestick Banksia (*Banksia attenuata*) which are very limited, if not absent, in occurrence within the project area. Therefore, it is unlikely that the project area would support the Woollybush Bee and that it is probably absent.

(iv) *Idiosoma sigillatum* (Swan Coastal Plain Shield-backed Trapdoor Spider) – there are several records of this species within 15 km of the project area, and tens of records to the south. Rix *et al.* (2017) noted that this species has a "relatively widespread although strictly … substrate-specific distribution along the Swan Coastal Plain of south-western Western Australia, from Dalyellup north to at least Ledge Point (including Rottnest Island and Garden Island)". While much of its previous range has been developed (as part of the greater Perth Metropolitan area) it still persists in areas of remnant bushland with "Banksia woodland and heathland on sandy soils". These habitats are present within the project area and, therefore, it is likely that Swan Coastal Plain Shield-backed Trapdoor Spider is present.

(v) *Leioproctus contrarius* (a short-tongued bee) – several historical records of this species occur within 15 km of the project area, to the east. Moulds (2019) suggested *L. contrarius* that prefers areas where the plant species *Scaevola repens* var. *repens* and *Lechenaultia* spp. are present. While *Scaevola* is present in the project area it is a different species and it is uncertain

as to whether this will be used by *L. contrarius*. Therefore, the occurrence of this species is uncertain but it may be present.

(vi) *Synemon gratiosa* (Graceful Sun-Moth) – a number of records of this species are known from within 15 km of the project area, to the south. The Graceful Sun-Moth was previously listed as specially protected fauna under the WA Wildlife Conservation Act 1950 (rare or likely to become extinct) and also as Endangered under the EPBC Act (Bishop *et al.* 2010a; Bishop *et al.* 2010b) but extensive surveys between 2009 and 2018 dramatically increased the known range of this species and it has been subsequently re-evaluated as a priority-listed species (DBCA 2021g; Williams *et al.* 2021). The moth is now known from a series of disjunct subpopulations between Binningup and Kalbarri, a range of 625 km, where it is mainly restricted to coastal and near-coastal sand dunes but extends into Banksia woodlands near Perth (Williams *et al.* 2021). Larvae feed on two host plants, *Lomandra maritima* (on coastal dunes) and *L. hermaphrodita* (in Banksia woodlands), the former of which is known from the project area (PGV 2021). It is therefore likely that this species is present.

Therefore, four known invertebrate species of conservation significance are most likely to occur in the vicinity of the project area:

- Spiny Katydid [Swan Coastal Plain] – CS2 (P2)
- Swan Coastal Plain Shield-backed Trapdoor Spider – CS2 (P3)
- *Leioproctus contrarius* (a short-tongued bee) – CS2 (P3)
- Graceful Sun-Moth – CS2 (P4)

It should be noted that the ecology and distribution of short-range endemic invertebrates is often poorly understood or documented, and the project area occurs in a region that is remote and likely to be poorly-surveyed for these groups. Thus there may be undetected SRE species present.

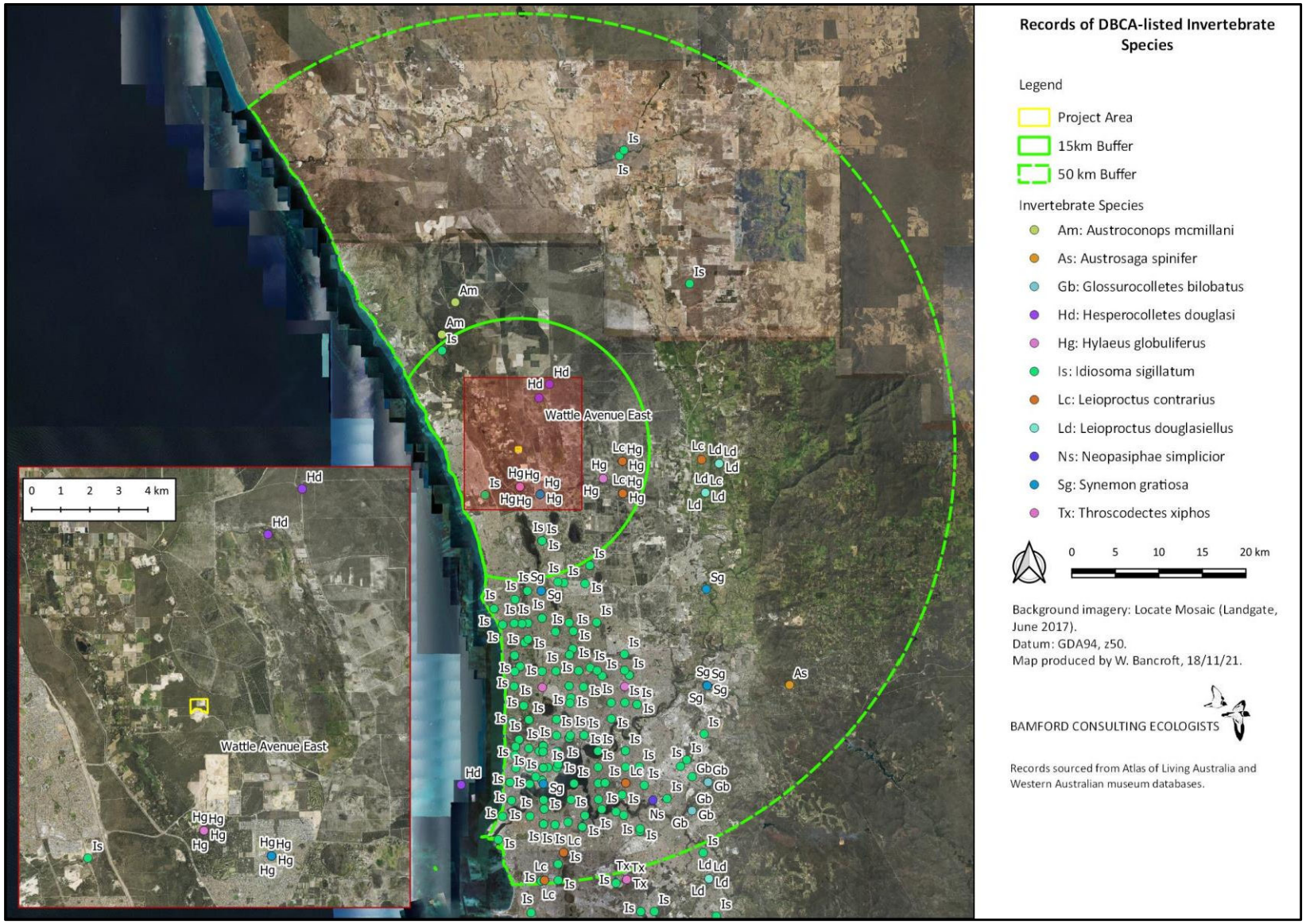



**Figure 8. Records of DBCA-listed (threatened or priority) invertebrate species within 50 km of the project area.**

### *3.2.4 Vertebrate fauna of conservation significance*

Of the 173 species of vertebrate fauna that are expected to occur in the project area (Section 3.2.1 above), 42 are considered to be of conservation significance (five CS1, three CS2 and 34 CS3; see Appendix 1 for descriptions of these CS (conservation significance) levels). A summary of the numbers in each vertebrate class is presented in Table 10. These species of conservation significance are indicated in the complete species list (Appendix 7) but are also listed with details of their conservation significance in Table 11. The majority of conservation significant species are expected as residents or regular visitors/migrants visitors (30 species), with some irregular visitors (9 species) or vagrants (3 species).

**Table 10. The number of conservation significant species in each vertebrate class.**

See Appendix 1 for full explanation of Conservation Significance (CS) levels: CS1 = listed under WA State and/or Commonwealth legislation; CS2 = listed as Priority by DBCA; CS3 = considered locally significant.

| CLASS | CONSERVATION SIGNIFICANCE | | | |
|---|---|---|---|---|
| | CS1 | CS2 | CS3 | Total |
| Fish | 0 | 0 | 0 | **0** |
| Frogs | 0 | 0 | 0 | **0** |
| Reptiles | 0 | 1 | 1 | **2** |
| Birds | 4 | 0 | 31 | **35** |
| Mammals | 1 | 2 | 2 | **5** |
| **Total** | **5** | **3** | **34** | **42** |

**Table 11. Conservation significant fauna species expected to occur within the project area.**

Species are listed in taxonomic order.
CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.
EPBC Act listings: C = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory (see Appendix 2).
WA *Biodiversity Conservation Act 2016* (BC Act) listings: S1 to S7 = Schedules 1 to 7 (see Appendix 2).
DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).
Bush Forever (Dell and Banyard 2000) status: HS = habitat specialists with a reduced distribution on the Swan Coastal Plain, WR = wide ranging species with reduced populations on the Swan Coastal Plain.
LS = considered by BCE to be of local significance (see Appendix 1).

| SPECIES | COMMON NAME | STATUS | EXPECTED OCCURRENCE |
|---|---|---|---|
| *Morelia spilota imbricata* | Carpet Python (southwest) | CS3 (LS) | Regular visitor |
| *Neelaps calonotos* | Black-striped Snake | CS2 (P3) | Resident (if present) |
| *Dromaius novaehollandiae* | Emu | CS3 (WR) | Regular visitor |
| *Phaps chalcoptera* | Common Bronzewing | CS3 (HS) | Resident |
| *Phaps elegans* | Brush Bronzewing | CS3 (HS) | Irregular visitor |
| *Apus pacificus* | Fork-tailed Swift | CS1 (M,Mar,S5) | Vagrant |
| *Turnix varius* | Painted Button-quail | CS3 (WR) | Resident |
| *Lophoictinia isura* | Square-tailed Kite | CS3 (WR) | Regular visitor |
| *Aquila audax* | Wedge-tailed Eagle | CS3 (WR) | Regular visitor |
| *Hieraaetus morphnoides* | Little Eagle | CS3 (WR) | Regular visitor |
| *Accipiter fasciatus* | Brown Goshawk | CS3 (WR) | Regular visitor |
| *Accipiter cirrocephalus* | Collared Sparrowhawk | CS3 (WR) | Regular visitor |
| *Haliastur sphenurus* | Whistling Kite | CS3 (WR) | Regular visitor |
| *Falco peregrinus* | Peregrine Falcon | CS1 (S7) | Regular visitor |
| *Calyptorhynchus banksii naso* | Forest Red-tailed Black-Cockatoo | CS1 (V,S3) | Irregular visitor |
| *Calyptorhynchus latirostris* | Carnaby's Black-Cockatoo | CS1 (E,S2) | Regular migrant |
| *Malurus assimilis* | Purple-backed Fairy-wren | CS3 (HS) | Resident |
| *Malurus splendens* | Splendid Fairy-wren | CS3 (HS) | Resident |
| *Malurus leucopterus* | White-winged Fairy-wren | CS3 (HS) | Regular visitor |
| *Stipiturus malachurus* | Southern Emu-wren | CS3 (HS) | Regular visitor |
| *Phylidonyris novaehollandiae* | New Holland Honeyeater | CS3 (WR) | Resident |
| *Phylidonyris niger* | White-cheeked Honeyeater | CS3 (WR) | Resident |
| *Glyciphila melanops* | Tawny-crowned Honeyeater | CS3 (WR) | Regular visitor |
| *Anthochaera lunulata* | Western Wattlebird | CS3 (WR) | Regular visitor |
| *Manorina flavigula* | Yellow-throated Miner | CS3 (WR) | Irregular visitor |
| *Smicrornis brevirostris* | Weebill | CS3 (HS) | Resident |
| *Sericornis frontalis* | White-browed Scrubwren | CS3 (HS) | Resident |
| *Acanthiza chrysorrhoa* | Yellow-rumped Thornbill | CS3 (HS) | Resident |

| SPECIES | COMMON NAME | STATUS | EXPECTED OCCURRENCE |
|---|---|---|---|
| *Acanthiza apicalis* | Inland Thornbill | CS3 (HS) | Resident |
| *Acanthiza inornata* | Western Thornbill | CS3 (HS) | Irregular visitor |
| *Daphoenositta chrysoptera* | Varied Sittella | CS3 (HS) | Irregular visitor |
| *Colluricincla harmonica* | Grey Shrike-thrush | CS3 (HS) | Resident |
| *Strepera versicolor* | Grey Currawong | CS3 (WR) | Irregular visitor |
| *Artamus personatus* | Masked Woodswallow | CS3 (WR) | Vagrant |
| *Artamus cyanopterus* | Dusky Woodswallow | CS3 (WR) | Regular visitor |
| *Petroica boodang* | Scarlet Robin | CS3 (HS) | Regular visitor |
| *Quoyornis georgianus* | White-breasted Robin | CS3 (HS) | Irregular visitor |
| *Dasyurus geoffroii fortis* | Chuditch | CS1 (V,S3) | Vagrant |
| *Isoodon fusciventer* | Quenda | CS2 (P4) | Resident |
| *Tarsipes rostratus* | Honey Possum, Noolbenger | CS3 (LS) | Resident |
| *Notamacropus irma* | Brush Wallaby | CS2 (P4) | Regular visitor |
| *Rattus fuscipes fuscipes* | Western Bush Rat, Moodit | CS3 (LS) | Resident |
| *Austrosaga spinifer* | Spiny Katydid [Swan Coastal Plain] | CS2 (P2) | Resident (if present) |
| *Idiosoma sigillatum* | Swan Coastal Plain Shield-backed Trapdoor Spider | CS2 (P3) | Resident |
| *Leioproctus contrarius* | a short-tongued bee | CS2 (P3) | Resident (if present) |
| *Synemon gratiosa* | Graceful Sun-Moth | CS2 (P4) | Resident |

### *3.2.5 Conservation significant species accounts*

A list of all conservation significant species expected within the project area is provided in Table 11; these comprise four invertebrates (see also Section 3.2.3) and 42 vertebrates (see also Section 3.2.4). Information on the conservation status, distribution and habitat, salient ecology and expected occurrence within the project area if provided for each of these species is below (and, for invertebrates, in Section 3.2.3).

#### *3.2.5.1 Conservation Significance 1*

Fork-tailed Swift (*Apus pacificus*) CS1 (M,S5)

Conservation status: Migratory under the EPBC Act and Schedule 5 under the BC Act.

Distribution and habitat: The swift is a largely aerial species of unpredictable occurrence in Western Australia. There are scattered records from the south coast, widespread in coastal and subcoastal areas between Augusta and Carnarvon, scattered along the coast from south-west Pilbara to the north and east Kimberley region. Sparsely scattered inland records, especially in the Wheatbelt, but more common in the north and north-west Gascoyne Region, north through much of the Pilbara Region, and the south and east Kimberley (Higgins 1999; DAWE 2021a). Aerial, usually flying from as low as one metre to in excess of 300 m above the ground.

Ecology: A diurnal, aerial insectivore, this species often forages along the edge of low pressure systems in flocks of ten to 1000 birds (Higgins 1999; DAWE 2021a). Breeds in Siberia (April to July) and spends the non-breeding season (October to mid-April) in Australia. Being aerial, it is effectively independent of terrestrial ecosystems when in Australia.

Expected occurrence: Vagrant. Likely to be regularly present, unpredictably, within the region and to pass over the project area on an occasional basis.

Peregrine Falcon (*Falco peregrinus*) CS1 (S7)

Conservation status: Schedule 7 under the BC Act.

Distribution and habitat: More or less cosmopolitan throughout Australia (Menkhorst *et al.* 2017). This species occurs in a variety of habitats but is usually reliant on cliff faces or tall trees for nesting (Debus 2019).

Ecology: A highly adept aerial predator that predominantly forages on birds, although will also occasionally take invertebrates, fish, reptiles and mammals (Debus 2019). Mostly diurnal or crepuscular.

Expected occurrence: Regular visitor. Wide-ranging and likely to pass over the project area on a regular basis.

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) CS1 (V,S3)

Conservation status: Vulnerable under the EBPC Act and Schedule 3 under the BC Act.

Distribution and habitat: Endemic to the deeper south-west of Western Australia, from around Gingin in the north, east to Mount Helena, North Bannister and Mount Saddleback, and south to around Albany (Johnstone and Storr 1998). In recent years there appears to have been a distinct expansion of the range of this species on to the Swan Coastal Plain, including many suburbs within the Perth metropolitan area. Generally restricted to areas of Jarrah-Marri forest, farmlands with remnant trees and urban landscapes. Forest Red-tailed Black-Cockatoos are currently considered not to undergo regular migration (DAWE 2021c). Two other sub-species occur in Western Australia: *C. b. escondidus* in the western mid-west and Pilbara, and *C. b. macrorhynchus* in the Kimberley (Johnstone and Storr 1998). Neither of these is a conservation significant taxon.

Ecology: Diurnal granivore, feeding predominantly on the seeds of Jarrah and Marri (Johnstone and Kirkby 1999; Johnstone *et al.* 2013b) but is also adapting to foraging on urban (introduced) plant species. Reliant on large tree-hollows in eucalypts (especially Marri) for breeding (Johnstone *et al.* 2013a; DAWE 2021c). Threatened by habitat loss, habitat degradation, nest hollow shortage, and competition for available nest hollows from other parrots and feral Honeybees (DAWE 2021c).

Expected occurrence: Irregular visitor. The project area is at the limit of this species' range and supports very little suitable foraging or breeding habitat but, given the expansion of this species' distribution on the Swan Coastal Plain, irregular occurrence cannot be ruled out.

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) CS1 (E,S2)

Conservation status: Endangered under the EPBC Act and Schedule 2 under the BC Act.

Distribution and habitat: Endemic to south-western Western Australia, from Kalbarri in the north, east to Merredin and Ravensthorpe, and then further east along the south coast to the Esperance area (Johnstone and Storr 1998; DAWE 2021e). Breeds (July to December) predominantly in the east of its range with a migration to coastal areas in the non-breeding period. In recent years, however, the species has expanded its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain (DAWE 2021e). Heavily reliant on areas of Banksia woodland and proteaceous shrubland/heath for foraging (Johnstone and Storr 1998; DAWE 2021e).

Ecology: Diurnal granivore, feeding predominantly on the seeds of the Proteaceae (especially banksias) but also known to feed on a very wide variety of plants, including non-native ornamentals and plantation species such as pine (Valentine and Stock 2008; Groom 2011; DPaW 2013; Johnston *et al.* 2016; DAWE 2021e). Reliant on large tree-hollows in eucalypts (especially smooth-barked species such as Wandoo and Salmon Gum) for breeding (Saunders 1974; Johnstone and Storr 1998; DAWE 2021e). Threatened by habitat loss, habitat degradation, nest hollow shortage, and competition for available nest hollows from other parrots and feral Honeybees, illegal shooting and illegal trade (Burbidge 2004; DAWE 2021e).

Expected occurrence: Regular migrant. Known to occur within the project area with some foraging plants available (in particular *Banksia sessilis*). Foraging and nesting values of the project area for the species are assessed in section 3.3.

Chuditch (*Dasyurus geoffroii fortis*) CS1 (V,S3)

Conservation status: Vulnerable under the EBPC Act and Schedule 3 under the BC Act.

Distribution and habitat: The Chuditch is a wide-ranging resident in Marri-Jarrah forest of the south-west of Western Australia and also in heaths and eucalypt woodlands of the eastern wheatbelt and goldfields (Van Dyck and Strahan 2008). This species was formerly distributed throughout much of western and inland Australia but its range has contracted to the region approximately south-west of a line between Shark Bay and Esperance (Burbidge 2004; Van Dyck and Strahan 2008; DAWE 2021f).

Ecology: The Chuditch is a nocturnal, terrestrial carnivore, feeding mainly on smaller vertebrates (e.g. reptiles, birds and mammals) and large invertebrates (Burbidge 2004; Van Dyck and Strahan 2008). During the day Chuditch shelter in dens; predominantly hollow logs and earth burrows (Van Dyck and Strahan 2008). Chuditch have a large home range, with females in the deeper south-west occupying 55-120 ha and males ranging over 400 ha or more (Van Dyck and Strahan 2008). Further east, Rayner *et al.* (2012) found that Chuditch in the Forrestania area occurred at an average density of 0.039 individuals/km$^2$, with home ranges as small as 189 ha (a female) and as large as 2,125 ha (a male).

Expected occurrence: Vagrant. Wide-ranging and likely to be present in the project area only as a vagrant. A juvenile male was caught about 10km to the east in 2004, in dense riparian vegetation in the Gnangara pine plantation (M. Bamford pers obs.).

#### *3.2.5.2 Conservation Significance 2*

Black-striped Snake (*Neelaps calonotos*) CS2 (P3)

Conservation status: Listed as Priority 3 by DBCA.

Distribution and habitat: Restricted to coastal sandplains from near Dongara to Mandurah (Bush *et al.* 2010). Appears to be absent from the eastern coastal plain (M. Bamford pers. obs.). Within the Perth Metropolitan area this species may be restricted to large reserves (How and Shine 1999).

Ecology: A fossorial species that preys upon small, fossorial skinks in the upper layers of loose sand (Bush *et al.* 2010).

Expected occurrence: Resident (if present). Some suitable habitat is present within the project area.

Quenda (*Isoodon fusciventer*) CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: The Quenda formerly occurred across the south-west of Western Australia from Geraldton to east of Esperance, including the wheatbelt, but it now has a much-reduced range, with few records north of Yanchep/Muchea on the coastal plain, and it is more or less extinct across the Wheatbelt (Van Dyck and Strahan 2008; Travouillon and Phillips 2018). It persists around Perth, particularly in areas of dense vegetation around wetlands, and it remains locally common in suitable environments (Howard *et al.* 2014).

Ecology: Omnivorous and cathemeral (active throughout the day and night) Quenda feed on invertebrates, plant material and fungi (Van Dyck and Strahan 2008). It is one of the few native, terrestrial mammals to persist in semi-urban landscapes in the south-west. Populations of this species have declined due to ongoing threats from feral predators and land-clearing (Van Dyck and Strahan 2008; Howard *et al.* 2014).

Expected occurrence: Resident. Known to occur within the project area and suitable habitat present.

#### *3.2.5.3 Conservation Significance 3*

Carpet Python (southwest) (*Morelia spilota imbricata*) CS3 (LS)

Conservation status: This subspecies was formerly listed under the Western Australian *Wildlife Conservation Act 1950* as 'other specially protected fauna' but that status has, more recently, been removed in the WA *Biodiversity Conservation Act 2016* (DBCA 2021g). It is likely to remain uncommon or at risk in the proximity of development.

Distribution and habitat: Patchily distributed through south-west Western Australia in a wide range of habitats including woodlands, heaths and rock outcrops (Bush *et al.* 2010; Wilson and Swan 2021). It is particularly common in areas of exposed limestone, including offshore islands (Bush *et al.* 2010).

Ecology: Predominantly a nocturnal carnivore, the Carpet Python preys mainly on birds and mammals, although reptiles are occasionally taken (Bush *et al.* 2010).

Expected occurrence: Regular visitor. Parts of the project area are well suited to this species and it is known to occur in nearby Neerabup National Park, so individuals can at least be expected as regular visitors.

Habitat specialist or wide-ranging bird species with reduced populations on the Swan Coastal Plain (31 species; see Table 11) CS3 (LS)

Conservation status: These species have all been noted by Dell and Banyard (2000) as either habitat specialists or wide ranging species with a reduced population on the Swan Coastal Plain and are, therefore, considered locally significant.

Distribution and habitat: Generally species that require larger areas of intact native remnants to persist.

Ecology: There is a wide range of foraging strategies in this group but the majority of the species are small insectivores or honeyeaters. Also includes ground-foraging granivores (e.g. Emu, bronzewings, button-quail) and nectarivores (honeyeaters).

Expected occurrence: Most species are expected to be residents or regular visitors, although a number are expected as irregular visitors or vagrants (see Table 11).

Honey Possum (*Tarsipes rostratus*) CS3 (LS)

Conservation status: While locally abundant in good seasons in suitable habitat, this species is struggling to persist on the Swan Coastal Plain in the vicinity of development (e.g. urban areas, agriculture, plantations etc.).

Distribution and habitat: Occurs in sandplain heaths and woodlands of south-western Australia (south-west from Kalbarri area to Esperance) and along the south-eastern coast (Van Dyck and Strahan 2008; ALA 2021).

Ecology: A nocturnal nectarivore, the Honey Possum is dependent on a high diversity of nectar-producing plants that can provide year-around food resources (Van Dyck and Strahan 2008).

Expected occurrence: Resident. Suitable habitat, with good nectar supply, exists within the project area. The Honey Possum persists in moderate numbers in suitable habitat on the northern margins of Perth, with records within a few kilometres of the Wanneroo City Centre (M. Bamford pers. obs.).

Moodit or Western Bush Rat (*Rattus fuscipes fuscipes*) CS3 (LS)

| | |
|---|---|
| Conservation status: | While locally common in suitable habitat, this species is struggling to persist on the Swan Coastal Plain in the vicinity of development (e.g. urban areas, agriculture, plantations etc.). |
| Distribution and habitat: | The Bush Rat (*R. fuscipes*) occurs along the south-west, southern and eastern coastlines of Australia in coastal scrubs, heaths, eucalypt forests and rainforests that provide dense cover (Van Dyck and Strahan 2008). The western subspecies, the Western Bush Rat, occurs generally within 100 km of the coast between Geraldton and Israelite Bay, east of Esperance, in Western Australia (ALA 2021). |
| Ecology: | The Western Bush Rat is nocturnal and secretive omnivore, feeding on fungi, seeds, fruits and invertebrates (Van Dyck and Strahan 2008). The availability of food through the winter appears to limit populations of this species (Van Dyck and Strahan 2008). |
| Expected occurrence: | Resident. Suitable habitat exists within the project area. The species was recorded in Neerabup in 2020 during fauna translocation prior to clearing in the nearby Neerabup industrial area (M. Bamford pers obs). |

## 3.3 Black-cockatoo habitat analysis

### *3.3.1 Black-cockatoo presence*

Only one of the three species of black-cockatoo known to occur in the south-west of Western Australia was directly recorded on the site during the site inspection: Carnaby's Black-Cockatoo. This was outside of the project area; two birds were seen perched in trees to the west of the project area. Anecdotal evidence suggested a number of Carnaby's Black-Cockatoos had been seen in the project in the previous weeks and this is supported by the indirect (foraging) evidence presented in Section 3.3.3 below.

Given these direct observations, indirect (foraging) records (see Section 3.3.3 below), roosting data (see Section 3.3.4 below) and the literature review (including current species distributions), it is considered that, currently:

- Carnaby's Black-Cockatoo is likely to be a regular non-breeding migrant to the site in moderate numbers.
- Forest Red-tailed Black-Cockatoo is likely to be an irregular visitor to the site. The project area is at the limit of this species' range and supports very little suitable foraging or breeding habitat but, given the expansion of this species' distribution on the Swan Coastal Plain, irregular occurrence cannot be ruled out.
- Baudin's Black-Cockatoo is unlikely to use the site as it is outside its normal/expected range.

### *3.3.2 Black-cockatoo breeding habitat*

No trees that met the potential nest-tree criteria of DAWE (2021c, d, e) and DEE (2017) were recorded within the project area.

### *3.3.3 Black-cockatoo foraging habitat*

#### *3.3.3.1 Carnaby's Black-Cockatoo*

Foraging habitat for the Carnaby's Black-Cockatoo was present throughout the Wattle Avenue East site. This is predominantly due to the presence of one shrub species known to be a mainstay of the Carnaby's Black-Cockatoo diet: *Banksia sessilis* (Groom 2011). Where it occurred, *B. sessilis* was generally in high to very high density. There were also some areas of low to no *B. sessilis* density. Based upon guidance on the assessment of foraging values of vegetation (Appendix 5), the areas of high density *B. sessilis* are assigned a vegetation score of 5 out of 6. The areas (and percentages) of each vegetation score for each VSA are shown for the Carnaby's Black-Cockatoo in Table 12. A map of vegetation scores for Carnaby's Black-Cockatoo foraging within the project area is presented in Figure 9.

There are approximately 27,298 ha of remnant native vegetation (as assessed by DPIRD 2021) within 15 km of the project area, which itself has c. 15.1 ha of native vegetation. Therefore, the site comprises c. 0.06% of the native vegetation in the 'local area' (as per the methods outlined in Appendix 5). It is likely that the Carnaby's Black-Cockatoo breeds within the local area, given the proximity to Tuart forests in the region. Thus, a 'context' score of 1 (out of 3) has been assigned to the project area for this species (see Appendix 5). This low context score is assigned because despite the high quality of foraging habitat and the presence of breeding nearby, the area of habitat is small and foraging habitat is widespread nearby.

There was extensive evidence of foraging by the Carnaby's Black-Cockatoo throughout the project area. This was entirely foraging on *B. sessilis* (with recent and intermediate-aged signs noted); wherever this plant species occurred there was evidence of foraging by Carnaby's Black-Cockatoo. The locations of these records is shown in Figure 10. It is expected that Carnaby's Black-Cockatoo will occur regularly (including foraging) within the project area. Therefore the project area was assigned a species 'density' score for Carnaby's Black-Cockatoo of 1 (out of 1; see Appendix 5).

The context and density values have been added on to the vegetation scores to yield the overall foraging value scores (with areas and percentages) that are also presented in Table 12.

The project area is, generally, of moderate to high value for foraging by the Carnaby's Black-Cockatoo and there was evidence to show that this species has previously used the site for feeding.

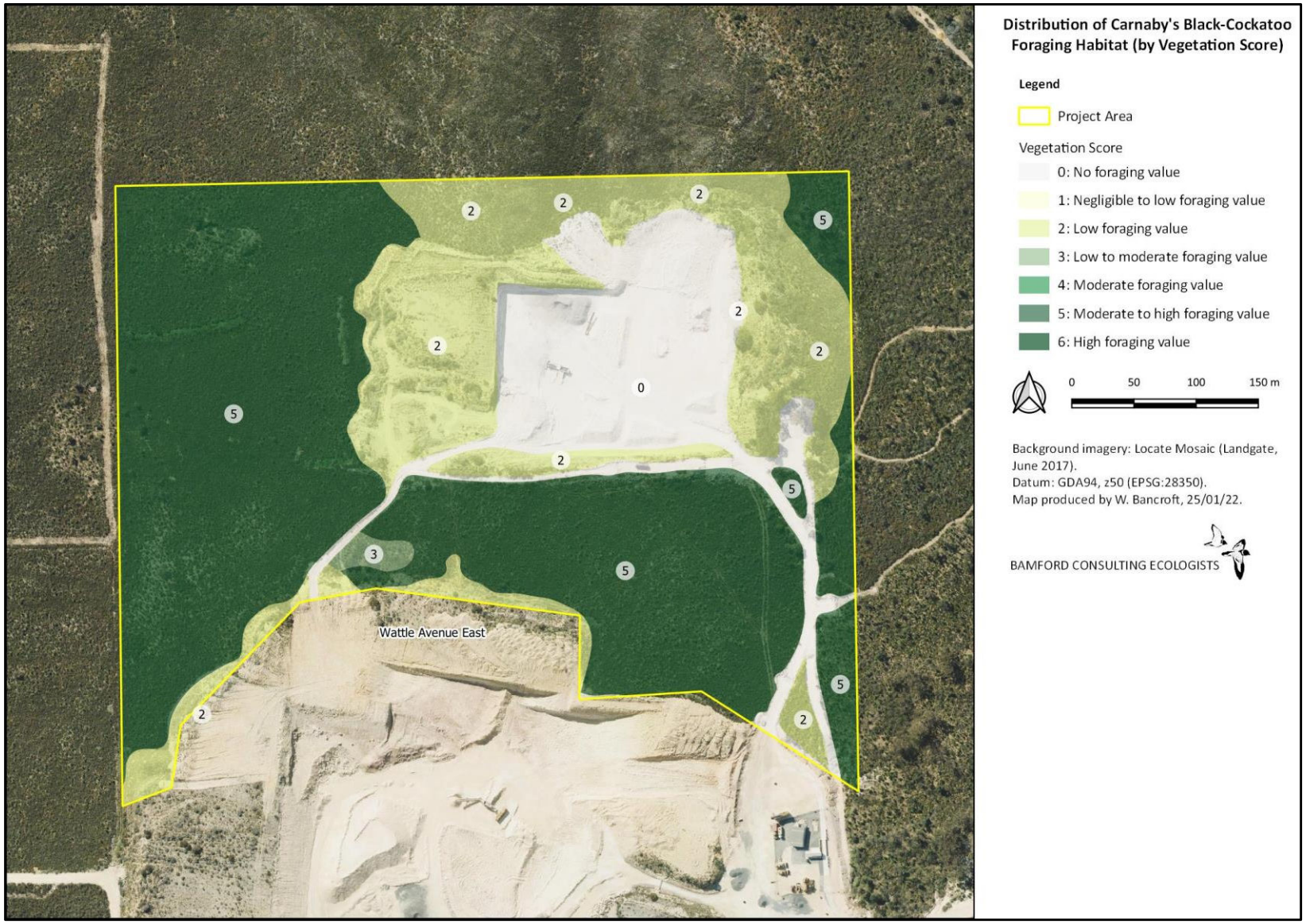



**Figure 9. Distribution of Carnaby's Black-Cockatoo vegetation scores within the project area.**

**Table 12. Areas (ha) and proportions (%) of each category (vegetation score, combined foraging score) of foraging habitat at the survey area for Carnaby's Black-Cockatoo and Forest Red-tailed Black-Cockatoo.**

See Section 2.4.3.3 and Appendix 8 for explanation of vegetation, context, species density and (combined) foraging scores.

| | Carnaby's Black-Cockatoo | | Forest Red-tailed Black-Cockatoo | |
|---|---|---|---|---|
| **Vegetation Score/Value** | **Area (ha)** | **%** | **Area (ha)** | **%** |
| 6: High | 0.0 | 0.0 | 0.0 | 0.0 |
| 5: Moderate to High | 13.0 | 55.7 | 0.0 | 0.0 |
| 4: Moderate | 0.0 | 0.0 | 0.0 | 0.0 |
| 3: Low to Moderate | 0.1 | 0.6 | 0.0 | 0.0 |
| 2: Low | 6.0 | 25.8 | 0.0 | 0.0 |
| 1: Negligible | 0.0 | 0.0 | 0.0 | 0.0 |
| 0: Nil | 4.2 | 17.9 | 23.4 | 100.0 |
| TOTAL | 23.4 | 100.0 | 23.4 | 100.0 |
| **Context Score** | 1 | | 0 | |
| **Species Density Score** | 1 | | 0 | |
| **Foraging Score** | | | | |
| 10 | - | - | - | - |
| 9 | - | - | - | - |
| 8 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | 13.0 | 55.7 | 0.0 | 0.0 |
| 6 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 | 0.1 | 0.6 | 0.0 | 0.0 |
| NA (Vegetation Score < 3) | 10.2 | 43.7 | 23.4 | 100.0 |
| TOTAL | 23.4 | 100.0 | 23.4 | 100.0 |

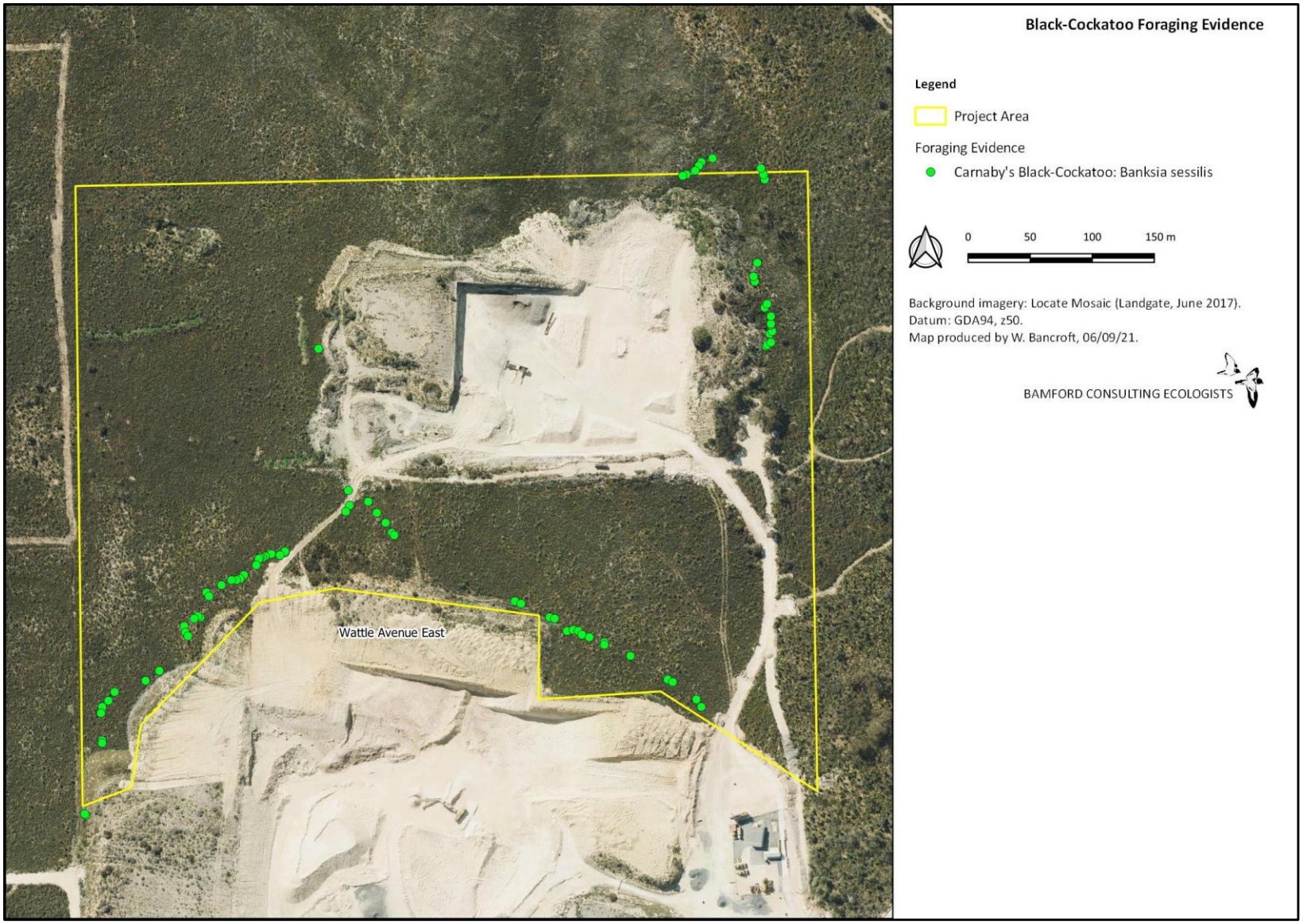



**Figure 10. Location of black-cockatoo foraging records (from the June 2021 inspection) within the project area.**

#### *3.3.3.2 Forest Red-tailed Black-Cockatoo*

Foraging habitat for the Forest Red-tailed Black-Cockatoo was all but absent within the Wattle Avenue East site. This is due to the absence of plant species known to be a mainstays of the Forest Red-tailed Black-Cockatoo diet, such as Marri, Jarrah and She-oak (Groom 2011). Some of these species are present in areas near to the project area (e.g. to the south-east of the project area) but these were not investigated as part of this assessment. The areas (and percentages) of each vegetation score for each VSA are shown for the Forest Red-tailed Black-Cockatoo in Table 12. No map of the vegetation scores for Forest Red-tailed Black-Cockatoo foraging within the project area is provided, as the entire project area was assessed as 'no value'.

There are approximately 27,298 ha of remnant native vegetation (as assessed by DPIRD 2021) within 15 km of the project area, which itself has c. 15.1 ha of native vegetation. Therefore, the site comprises c. 0.06% of the native vegetation in the 'local area' (as per the methods outlined in Appendix 5). It is unlikely that the Forest Red-tailed Black-Cockatoo breeds within the local area. Thus, a 'context' score of 0 (out of 3) has been assigned to the project area for this species (see Appendix 5).

There was no evidence of foraging by Forest Red-tailed Black-Cockatoo within the project area. Therefore the project area was assigned a species density score for Forest Red-tailed Black-Cockatoo of 0 (out of 1; see Appendix 5).

The context and density values have been combined with the vegetation scores to yield the overall foraging value scores (with areas and percentages) that are also presented in Table 12.

The project area is, generally, of no value for foraging by the Forest Red-tailed Black-Cockatoo and there was no evidence to suggest that this species has previously used the site for feeding.

### *3.3.4 Black-cockatoo roosting habitat*

The area around the project area is known to support black-cockatoo roosting, however there are no records of roost sites within the project area itself. Previously known roost locations (provided by DBCA (2021a) and that reflect data collected in BirdLife Australia's Great Cocky Counts) and are within 12 km of the project area are mapped in Figure 11. The nearest of these known roosts are within c. 1 km of the project area boundary.

The absence of roosts within the project area is reasonable; there is little, if any, suitable roosting habitat. There is an almost complete absence of taller trees (e.g. eucalypts, pines) preferred by black-cockatoos as roost locations. It is highly unlikely that either of the black-cockatoo species expected in the region (Carnaby's and Forest Red-tailed Black-Cockatoos) are dependent on the project area for roosting habitat.

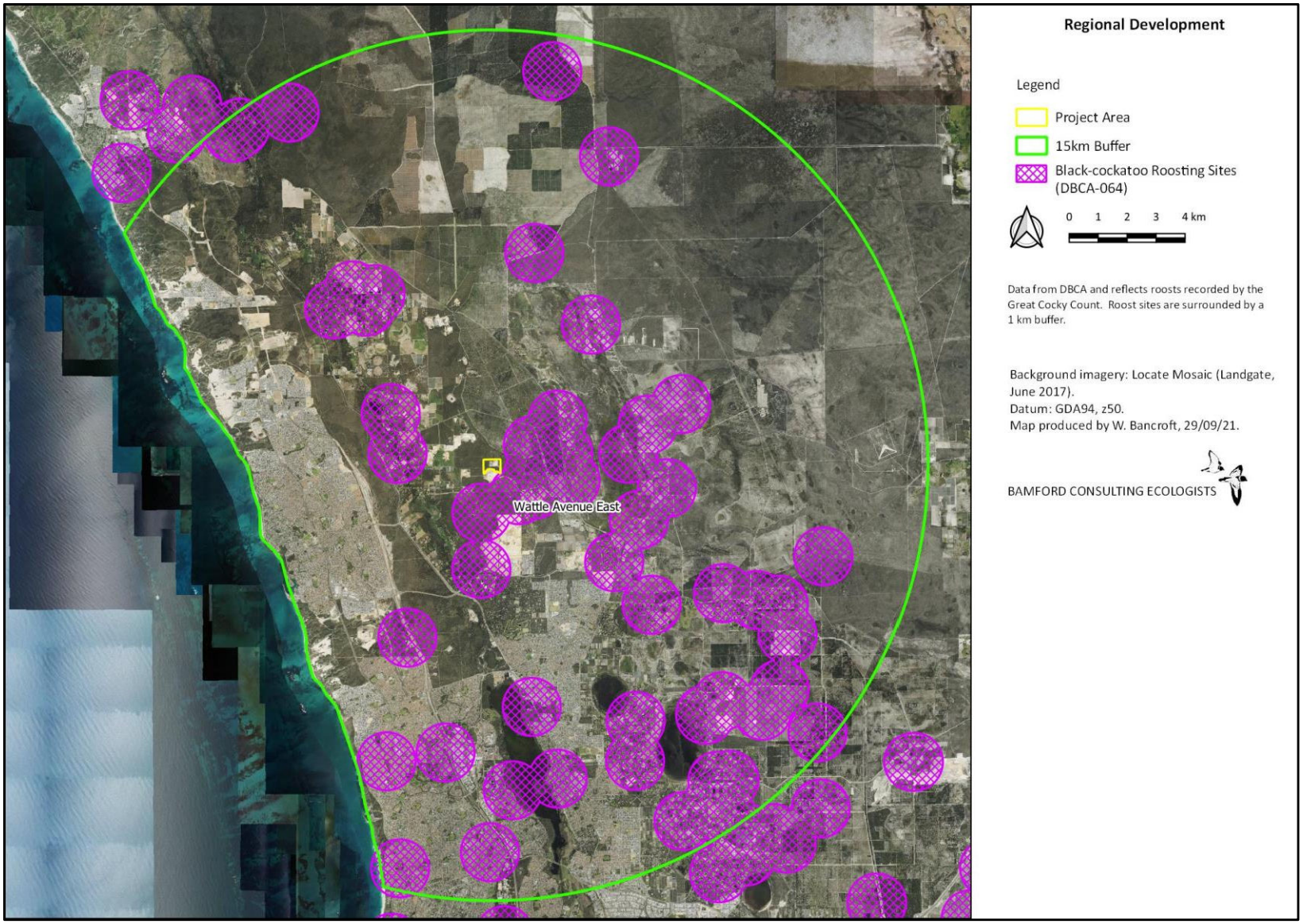



**Figure 11. Known black-cockatoo roost locations within 12 km of the project area.**

## 3.4 Patterns of biodiversity

Investigating patterns of biodiversity can be complex and are often beyond the scope even of detailed or targeted investigations (see Section 2.1 above), but it is possible to draw some general conclusions based upon the different landscapes in the project area. The three intact native VSAs (VSA 1 – proteaceous heath; VSA 2 – myrtaceous/fabaceous heath; and VSA 3 – Limestone Marlock woodland) can be expected to be richer in species than the rehabilitation and cleared areas. Differences in the fauna assemblage between these three VSAs might be slight, as they contain many of the same plant species and have broadly similar substrates. VSA 1 is notable for high nectar production important for a range of nectarivores (*B. sessilis*) and supply of food for Carnaby's Black-Cockatoo. VSAs 2 and 3 may be less productive in this respect. VSA 3 is notable as having the only eucalypts in the project area and thus may support some birds and invertebrates that are eucalypt specialists.

## 3.5 Ecological processes

The nature of the landscape and the fauna assemblage indicate some of the ecological processes that may be important for ecosystem function (see Appendix 1 for descriptions and other ecological processes). These include the aspects discussed below.

Connectivity and landscape permeability. The project area is part of a larger area of native vegetation that is itself surrounded by development. This makes it likely that the fauna assemblage is already affected by fragmentation and loss of connectivity. This is likely to have resulted in the loss of some mammal species. It also makes the larger area vulnerable to further fragmentation (see Section 4 below).

Local hydrology. The project area contains no wetlands, but elements of the native vegetation are likely to have some reliance on groundwater. The limestone topography suggests that a subterranean fauna assemblage is present, and this may include species that occur in the groundwater (Stygofauna).

Fire. Native vegetation throughout the project area is subject to fire and is likely to be burnt on a regular basis. While appropriate fire regimes can benefit biodiversity, inappropriate regimes can lead to a loss of biodiversity. Most of the project area was burnt in 2015, with the south-eastern corner burnt in 2017 (PGV 2021). The project area (and surrounds) is part of a DBCA-managed fire regime, and a prescribed burn appears to be planned (SWC_081) but no timing is available (DBCA 2021d).

Feral species and interactions with over-abundant native species. Feral species occur throughout Western Australia and are a considerable component of the current mammal fauna of the project area (see Section 3.2.1). They have contributed to local extinctions (see Appendix 9) and may be affecting populations of extant species. Feral Cats, Foxes and Rabbits, and to a lesser extent the Rainbow Lorikeet, are likely to be placing considerable pressure on the native fauna in the region. Feral Bees may be competing with native nectarivores.

## 3.6 Summary of fauna values

The desktop study identified 173 vertebrate fauna species as potentially occurring in the project area: no fish, eight frogs, 46 reptiles, 100 birds and 19 mammals. The presence of at least 23 species (20 birds and three mammals) was confirmed during the 2021 site inspection.

Fauna assemblage. The fauna assemblage is probably typical of the near-coastal shrublands of the coastal plain north of Perth. The assemblage is likely to be substantially complete except for the mammal component, which is depauperate in both medium-sized and small species. The assemblage is likely to be only moderately rich in a regional context as the environment consists largely of shrublands and lacks the banksia and eucalypt woodlands of the coastal plain slightly further east.

Species of conservation significance. The majority of the 46 conservation significant species (including two reptiles, 35 birds, five mammals and four invertebrates) expected in the project area are likely to be residents or regular visitors/migrants. Only five of the expected conservation species are listed under WA State and/or Commonwealth legislation (category CS1; four bird and one mammal), with seven listed as Priority by DBCA (category CS2; one reptile, two mammals and four invertebrates) and the remaining 34 considered locally significant (category CS3; one reptile, 31 birds and two mammals). Of most concern are Carnaby's Black-Cockatoo (CS1, known to be a regular migrant to the area and to use the project area for foraging), and Quenda (CS2, known to occur within the project area and expected to be resident).

Vegetation and Substrate Associations (VSAs). The project area encompasses five VSAs which reflect landscape position and soil type: Proteaceous heath (VSA 1), Myrtaceous/fabaceous heath (VSA 2), Limestone Marlock woodland (VSA 3), Rehabilitation (VSA 4), and Cleared (VSA 5). The three intact (i.e. not-disturbed) native VSAs are regionally widespread.

Patterns of biodiversity. The three intact native VSAs can be expected to be richer in species than the rehabilitation and cleared areas. Differences in the fauna assemblage between these three VSAs might be slight, as they contain many of the same plant species and have broadly similar substrates. VSA 1 (proteaceous heath) is notable for high nectar production important for a range of nectarivores (*B. sessilis*) and supply of food for Carnaby's Black-Cockatoo. VSA 2 (myrtaceous/fabaceous heath) and VSA3 (Limestone Marlock woodland) may be less productive in this respect. VSA 3 is notable as having the only eucalypts in the project area and thus may support some birds and invertebrates that are eucalypt specialists.

Key ecological processes. The ecological processes that currently have major effects upon the fauna assemblage include landscape permeability, hydrology, fire, and the presence of feral species.

# 4 Impact assessment

Threatening processes have to be considered in the context of fauna values, the surrounding landscape and the nature of the proposed action, and are examined below. Landscape context is important, as the project area contains areas of previously cleared or disturbed lands and is in a local, and regional, landscape that is relatively continuous and intact. Impact categories are defined in Table 8.

Habitat loss leading to population decline. *Negligible to Minor*

The area to be cleared is small and is already partly disturbed. The 15.1 ha of native vegetation to be cleared represents 0.03% of native vegetation within the region (12 km radius) and brings the total regional clearing to 53.74%. Population decline due to habitat loss is therefore very small.

Habitat loss leading to population fragmentation. *Minor*

The development footprint is expected to be compact and expands on existing developed areas, with native vegetation surrounding. However, the project area is within a region with multiple other small developments (see Figure 5), so the potential exists for these multiple areas to coalesce over time with further approvals, which could result in the fragmentation of the large area of native vegetation that aligns north-south, and within which the current project area and nearby developments lie.

Degradation of habitat due to weed invasion. *Minor*

The level of weed invasion is low in the native vegetation, but weeds are present in degraded areas. There is potential for development to increase the spread of weeds (particularly during clearing), but standard hygiene measures are likely to be in place to reduce this risk.

Mortality during construction. *Negligible to Minor*

This is a concern mostly on animal welfare grounds, as the development footprint is small in the context of the overall landscape. Animals will inevitably be killed during clearing but there are standard practices for reducing fauna mortality during such activities. Removal trapping and relocation of species such as Quenda and large reptiles, while avoiding clearing during spring reduces impact on breeding birds.

Ongoing mortality. *Negligible*

This results mainly from roadkill due to vehicle movements close to native vegetation, fauna striking infrastructure and effects of lighting. The numbers of animals affected are likely to be very small although the long-term impacts of lighting close to native vegetation is poorly understood.

Species interactions. *Negligible to Minor*

Feral species are already present on the site, but feral species may be attracted to work-sites and increase in abundance. Impacts to native fauna can be kept to Negligible/Minor through standard practices such as not feeding wildlife, managing waste and even implementing some feral species control.

Hydrological change. *Negligible*

There is no surface water and activities will not interact with groundwater, so hydrological change should be minimal. If drainage and runoff management of work areas is required, this should not be diverted into native vegetation but should be infiltrated into groundwater.

Altered fire regimes. *Negligible*

The vegetation of the project area is tolerant of and to some extent dependent on fire, but the fire regime is important. There have been recent fires that are likely to have affected the fauna, and any increase in fire frequency is likely to have adverse impacts. The proposed development has the potential to lead to increased fire frequency, but given the small areas involved this risk should be readily managed.

Disturbance (dust, noise, light). *Minor*

The level of dust, noise and light during development and operation has the potential to result in some impacts, but there are standard management procedures to minimise these. There is also existing activity so these forms of disturbance will not be new to the location. As noted above, impacts of additional lighting upon invertebrates is largely unknown.

# 5 References


ALA. (2021). Atlas of Living Australia. http://www.ala.org.au

Allen, G. R., Midgley, S. H. and Allen, M. (2003). *Field Guide to the Freshwater Fishes of Australia*. Western Australian Museum, Perth, Western Australia.

Anon. (2021). Köppen climate classification. https://en.wikipedia.org/wiki/K%C3%B6ppen_climate_classification

Anstis, M. (2017). *Tadpoles and Frogs of Australia*. New Holland Publishers, Chatswood, New South Wales.

Arnold, J. P., Murphy, M. V., Didham, R. K. and Houston, T. F. (2019). Rediscovery of the 'extinct' bee *Hesperocolletes douglasi* Michener, 1965 (Colletidae: Colletinae: Paracolletini) in Western Australia and first description of the female. *Journal of Threatened Taxa* **11**: 13310-13319.

Bamford, M. J., Bancroft, W. J. and Sibbel, N. (2010). Twenty years and two transects; spatial and temporal variation in local patterns of biodiversity. *Ecological Society of Australia Conference*, Canberra, Australian Capital Territory.

Bancroft, W. J. and Bamford, M. J. (2021). Perth Airport Pty Ltd: Fauna Impact Assessment for the Airport North Project. Unpublished report to Perth Airport Pty Ltd by M. J. and A. R. Bamford Consulting Ecologists, Kingsley, Western Australia.

BirdLife Australia. (2019). The BirdLife Australia Working List of Australian Birds; Version 3.0. www.birdlife.org.au/documents/BWL-BirdLife_Australia_Working_List_v3.xlsx

Bishop, C., Williams, M., Mitchell, D. and Gamblin, T. (2010a). Survey guidelines for the Graceful sun-moth (*Synemon gratiosa*) & site habitat assessments. Department of Environment and Conservation. http://www.dec.wa.gov.au/content/view/5695/1813/

Bishop, C., Williams, M., Mitchell, D., Williams, A., Fissioli, J. and Gamblin, T. (2010b). Conservation of the Graceful Sun-moth: Findings from the 2010 Graceful Sun-moth surveys and habitat assessments across the Swan, South West and southern Midwest Regions. Interim report. Department of Environment and Conservation, Kensington, Western Australia.

BOM. (2021a). Climate classification maps. Commonwealth of Australia, Bureau of Meteorology. http://www.bom.gov.au/jsp/ncc/climate_averages/climate-classifications/index.jsp?maptype=kpn#maps

BOM. (2021b). Climate Data Online. Commonwealth of Australia, Bureau of Meteorology. http://www.bom.gov.au/climate/data/index.shtml?bookmark=200&view=map

Borkent, A. and Craig, D. A. (2004). *Austroconops* Wirth and Lee, a Lower Cretaceous genus of biting midges yet living in Western Australia: a new species, first description of the immatures and discussion of their biology and phylogeny (Diptera: Ceratopogonidae). *American Museum Novitates* **2004**: 1-67.

Burbidge, A. A. (2004). *Threatened Animals of Western Australia*. Department of Conservation and Land Management, Kensington, Western Australia.

Burbidge, A. A. and McKenzie, N. L. (1989). Patterns in the modern decline of Western Australia's vertebrate fauna: causes and conservation implications. *Biological Conservation* **50**: 143-198.

Bush, B. and Maryan, B. (2011). Field Guide to Snakes of the Pilbara. Western Australian Museum, Welshpool, Western Australia.

Bush, B., Maryan, B., Browne-Cooper, R. and Robinson, D. (2010). *Field Guide to Reptiles and Frogs of the Perth Region*. Western Australian Museum, Welshpool, Western Australia.

Calver, M. C., Lymbery, A. J., McComb, J. and Bamford, M. J. (2009). *Environmental Biology*. Cambridge University Press, Melbourne, Australia.

Churchill, S. (2009). *Australian Bats*. Allen & Unwin, St Leonards, New South Wales.

Clevenger, A. P. and Waltho, N. (2000). Factors influencing the effectiveness of wildlife underpasses in Banff National Park, Alberta, Canada. *Conservation Biology* **14**: 1-11.

CoA. (2017). National Recovery Plan for the Clay Pans of the Swan Coastal Plain ecological community. Commonwealth of Australia, Canberra, Australia.

DAWE. (2020a). List of marine species. Department of Agriculture, Water and the Environment. https://www.environment.gov.au/marine/marine-species/marine-species-list

DAWE. (2020b). Protected marine species - Identification guide. Department of Agriculture, Water and the Environment. https://www.environment.gov.au/marine/publications/protected-marine-species-identification-guide

DAWE. (2021a). *Apus pacificus* - Fork-tailed Swift in Species Profile and Threats Database. Department of Agriculture, Water and the Environment. Available from: http://www.environment.gov.au/sprat

DAWE. (2021b). Australia's bioregions (IBRA) Department of Agriculture, Water and the Environment. http://www.environment.gov.au/land/nrs/science/ibra#ibra

DAWE. (2021c). *Calyptorhynchus banksii naso* in Species Profile and Threats Database. Department of Agriculture, Water and the Environment. Available from: http://www.environment.gov.au/sprat

DAWE. (2021d). *Calyptorhynchus baudinii* in Species Profile and Threats Database. Department of Agriculture, Water and the Environment. Available from: http://www.environment.gov.au/sprat

DAWE. (2021e). *Calyptorhynchus latirostris* in Species Profile and Threats Database. Department of Agriculture, Water and the Environment. Available from: http://www.environment.gov.au/sprat

DAWE. (2021f). *Dasyurus geoffroii* in Species Profile and Threats Database. Department of Agriculture, Water and the Environment. Available from: http://www.environment.gov.au/sprat

DAWE. (2021g). Protected Matters Search Tool. Department of Agriculture, Water and the Environment. https://www.environment.gov.au/epbc/protected-matters-search-tool

DBCA. (2021a). Black Cockatoo Roosting Sites - Buffered (DBCA-064). Department of Biodiversity, Conservation and Attractions. https://catalogue.data.wa.gov.au/dataset/black-cockatoo-roosting-sites-buffered

DBCA. (2021b). DBCA Region Boundaries (DBCA-022). Department of Biodiversity, Conservation and Attractions. https://catalogue.data.wa.gov.au/dataset/dpaw-region-boundaries

DBCA. (2021c). Directory of Important Wetlands in Australia - Western Australia (DBCA-045). Department of Biodiversity, Conservation and Attractions. https://catalogue.data.wa.gov.au/tr/dataset/directory-of-important-wetlands-in-western-australia

DBCA. (2021d). Indicative burn plans. Department of Biodiversity, Conservation and Attractions. https://www.dpaw.wa.gov.au/management/fire/prescribed-burning/burns/indicative

DBCA. (2021e). NatureMap. Department of Biodiversity, Conservation and Attractions. https://naturemap.dbca.wa.gov.au/

DBCA. (2021f). Ramsar Sites (DBCA-010). Department of Biodiversity, Conservation and Attractions. https://catalogue.data.wa.gov.au/tr/dataset/ramsar-sites

DBCA. (2021g). Threatened and Priority Fauna List. Department of Biodiversity, Conservation and Attractions, Kensington, Western Australia.

DBCA. (2021h). Threatened ecological communities. Department of Biodiversity, Conservation and Attractions. https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities

DBCA. (2021i). Threatened Ecological Communities (DBCA-038). Department of Biodiversity, Conservation and Attractions. https://catalogue.data.wa.gov.au/tr/dataset/threatened-ecological-communities

DBCA. (2021j). Vegetation Complexes - Swan Coastal Plain (DBCA-046). Department of Biodiversity, Conservation and Attractions. https://catalogue.data.wa.gov.au/dataset/vegetation-complexes-swan-coastal-plain

Debus, S. (2019). *Birds of Prey of Australia: A Field Guide*. CSIRO Publishing, Australia.

DEE. (2017). Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo. Department of the Environment and Energy, Commonwealth of Australia, 2017, Canberra, Australian Capital Territory.

Dell, J. and Banyard, J. (Eds). (2000). *Bush Forever*. Department of Environmental Protection, Perth, Western Australia.

DEWHA. (2008). Approved Conservation Advice for *Neopasiphae simplicior* (a short-tongued bee). Department of the Environment, Water, Heritage and the Arts, Canberra, Australia.

DoF. (2020). Freshwater Fish Distribution in Western Australia. Department of Fisheries. http://freshwater.fish.wa.gov.au/

DotE. (2013). Matters of National Environmental Significance. Significant impact guidelines 1.1. *Environment Protection and Biodiversity Conservation Act 1999* Department of the Environment, Canberra, Australia.

Doughty, P. (2021a). Checklist of the Frogs of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.

Doughty, P. (2021b). Checklist of the Reptiles of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.

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

DPIRD. (2021). Native Vegetation Extent (DPIRD-005) Department of Primary Industries and Regional Development. https://catalogue.data.wa.gov.au/dataset/native-vegetation-extent

DPLH. (2021). Region Scheme - Special Areas (DPLH-022). Department of Planning, Lands and Heritage. https://catalogue.data.wa.gov.au/dataset/region-scheme-special-areas-dop-073

DSEWPaC. (2012). *EPBC Act referral* guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*. Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australian Capital Territory.

DSEWPaC. (2013a). Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies. Significant impact guidelines 1.2. *Environment Protection and Biodiversity Conservation Act 1999* Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australia.

DSEWPaC. (2013b). Approved Conservation Advice for *Leioproctus douglasiellus* (a short-tongued bee). Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australia.

DSEWPaC. (2013c). Matters of National Environmental Significance. Significant impact guidelines 1.1. *Environment Protection and Biodiversity Conservation Act 1999* Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australia.

Dufty, A. C. (1989). Some population characteristics of *Perameles gunnii* in Victoria. *Wildlife Research* **18**: 355-365.

DWER. (2021a). Clearing Regulations - Environmentally Sensitive Areas (DWER-046). Department of Water and Environmental Regulation. https://catalogue.data.wa.gov.au/tr/dataset/clearing-regulations-environmentally-sensitive-areas-dwer-046

DWER. (2021b). Environmentally Sensitive Areas. Department of Water and Environmental Regulation. https://www.der.wa.gov.au/your-environment/environmentally-sensitive-areas

DWER. (2021c). Index of Biodiversity Surveys for Assessments (IBSA). Department of Water and Environmental Regulation. https://biocollect.ala.org.au/ibsa#max%3D20%26sort%3DdateCreatedSort

English, V., Jasinska, E. and Blyth, J. (2003). Aquatic Root Mat Community of Caves of the Swan Coastal Plain, and the Crystal Cave Crangonyctoid interim recovery plan 2003-2008. *Western Australian Department of Conservation and Land Management, Perth*.

EPA. (2002). Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3. Environmental Protection Authority, Perth, Western Australia.

EPA. (2004). Guidance for the assessment of environmental factors: Terrestrial fauna surveys for environmental impact assessment in Western Australia. No. 56. Environmental Protection Authority, Perth, Western Australia.

EPA. (2016a). Environmental Factor Guideline - Terrestrial Fauna. Environmental Protection Authority, Perth, Western Australia.

EPA. (2016b). Technical Guidance: Sampling of short range endemic invertebrate fauna. Environmental Protection Authority, Perth, Western Australia.

EPA. (2016c). Technical Guidance: Terrestrial Fauna Surveys. Environmental Protection Authority, Perth, Western Australia.

EPA. (2020). Technical Guidance - Terrestrial vertebrate fauna surveys for environmental impact assessment. Environmental Protection Authority, Perth, Western Australia.

Fox, B. J. (1982). Fire and mammalian secondary succession in an Australian coastal heath. *Ecology* **63**: 1332-1341.

Gill, A. M., Groves, R. H. and Noble, I. R. (Eds). (1981). *Fire and the Australian Biota*. Australian Academy of Science, Canberra, Australian Capital Territory.

Gill, F., Donsker, D. and Rasmussen, P. (2021). IOC World Bird List (v 11.1). Available at www.worldbirdnames.org/

Gleeson, J. and Gleeson, D. (2012). *Reducing the Impacts of Development on Wildlife*. CSIRO Publishing, Collingwood, Victoria, Australia.

Greenslade, P. J. M. and Jordana, R. (2014). Description and conservation status of a new species of *Australotomurus* (Collembola: Entomobryidae: Orchesellinae) from urban Perth remnant bushland. *Zootaxa* **3872**: 561-76.

Groom, C. (2011). Plants Used by Carnaby's Black Cockatoo. Department of Environment and Conservation, Perth, Western Australia.

Harewood, G. (2017). Fauna Assessment: Lots 4, 5, 7, 8, 9, 10 & 11 Doyle Place, Margaret River. Greg Harewood, Bunbury, Western Australia.

Harrington, R. (2002). The effects of artificial watering points on the distribution and abundance of avifauna in an arid and semi-arid mallee environment. PhD thesis. Department of Zoology, Univesity of Melbourne, Melbourne, Victoria.

Harvey, M. S. (2002). Short-range endemism among the Australian fauna: some examples from non-marine environments. *Invertebrate Systematics* **16**: 555-570.

Heddle, E., Loneragan, O. and Havel, J. (1980). Vegetation complexes of the Darling system, Western Australia. *Department of Conservation and Environment, Atlas of Natural Resources, Darling System, Western Australia*.

Higgins, P. J. (Ed.) (1999). *Handbook of Australian, New Zealand and Antarctic Birds. Volume 4: Parrots to Dollarbird*. Oxford University Press, Melbourne, Australia.

Horwitz, P., Rogan, R., Halse, S., Davis, J. and Sommer, B. (2009). Wetland invertebrate richness and endemism on the Swan Coastal Plain, Western Australia. *Marine and Freshwater Research* **60**: 1006-1020.

Houston, T. (2018). *A Guide to Native Bees of Australia*. CSIRO Publishing, Clayton South, Victoria, Australia.

Houston, T. F. (2000). *Native bees on wildflowers in Western Australia*. Western Australian Insect Study Society.

How, R. A. and Dell, J. (1990). Vertebrate fauna of Bold Park, Perth. *Western Australian Naturalist* **18**: 122-131.

How, R. A. and Shine, R. (1999). Ecological traits and conservation biology of five fossorial "sand-swimming" snake species (Simoselaps: Elapidae) in south-western Australia. *Journal of Zoology* **249**: 269-282.

Howard, K. H., Barrett, G., Ramalho, C. E., Friend, J. A., Boyland, R. J. I., Hudson, J. and Wilson, B. (2014). Community Quenda Survey 2012. Report prepared by WWF Australia and the Department of Parks and Wildlife, Perth, Western Australia.

IUCN. (2012). *IUCN Red List Categories and Criteria, Version 3.1. Second edition*. International Union for the Conservation of Nature, Gland, Switzerland and Cambridge, UK.

Jackson, S. D. and Griffin, C. R. (2000). A Strategy for Mitigating Highway Impacts on Wildlife. In: Messmer, T. A. and West, B. (Eds), *Wildlife and Highways: Seeking Solutions to an Ecological and Socio – economic Dilemma,* pp. 143-159. The Wildlife Society,

Johnston, T. R., Stock, W. D. and Mawson, P. R. (2016). Foraging by Carnaby's Black-Cockatoo in Banksia woodland on the Swan Coastal Plain, Western Australia. *Emu* **116**: 284-293.

Johnstone, R. E. and Kirkby, T. (1999). Food of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* in south-west Western Australia. *The Western Australian Naturalist* **22**: 167-177.

Johnstone, R. E., Kirkby, T. and Sarti, K. (2013a). The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. I. Characteristics of nest trees and nest hollows. *Pacific Conservation Biology* **19**: 121-142.

Johnstone, R. E., Kirkby, T. and Sarti, K. (2013b). The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. II. Breeding behaviour and diet. *Pacific Conservation Biology* **19**: 143-155.

Johnstone, R. E. and Storr, G. M. (1998). *Handbook of Western Australian birds. Volume 1: Non-passerines (Emu to Dollarbird)*. Western Australian Museum, Perth, Western Australia.

Johnstone, R. E. and Storr, G. M. (2005). *Handbook of Western Australian birds. Volume 2: Passerines (Blue-winged Pitta to Goldfinch)*. Western Australian Museum, Perth, Western Australia.

Jones, M. E. (2000). Road upgrade, road mortality and remedial measures: impacts on a population of Eastern Quolls and Tasmanian Devils. *Wildlife Research* **27**: 289-296.

KBA. (2021). Key Biodiversity Areas. Key Biodiversity Areas. http://www.keybiodiversityareas.org/kba-data

KBAP. (2020). Key Biodiversity Areas factsheet: Northern Swan Coastal Plain. Developed by the Key Biodiversity Areas Partnership: BirdLife International, IUCN, American Bird Conservancy, Amphibian Survival Alliance, Conservation International, Critical Ecosystem Partnership Fund, Global Environment Facility, Global Wildlife Conservation, NatureServe, Rainforest Trust, Royal Society for the Protection of Birds, World Wildlife Fund and Wildlife Conservation Society. Downloaded from http://www.keybiodiversityareas.org/

Keighery, B. J. (1994). *Bushland Plant Survey: A guide to plant community survey for the community*. Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia.

Kofoed, P. (1998). A wizard with wavelengths. *Ecos* **96**: 32-35.

Letnic, M., Dickman, C. R., Tischler, M. K., Tamayo, B. and Beh, C. L. (2004). The responses of small mammals and lizards to post-fire succession and rainfall in arid Australia. *Journal of Arid Environments* **59**: 85-114.

McKenzie, N., Start, A., Burbidge, A., Kenneally, K. and Burrows, N. (2009). Protecting the Kimberley: a synthesis of scientific knowledge to support conservation management in the Kimberley region of Western Australia. *Department of Environment and Conservation: Perth*.

Menkhorst, P. and Knight, F. (2011). *A Field Guide to the Mammals of Australia*. Oxford University Press, Melbourne, Victoria.

Menkhorst, P., Rogers, D., Clarke, R., Davies, J., Marsack, P. and Franklin, K. (2017). *The Australian Bird Guide*. CSIRO Publishing, Clayton South, Victoria, Australia.

Mitchell, D. S., Williams, K. and Desmond, A. (2003). Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion). In: CALM (Ed.) *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002,* pp. 606-623. Department of Conservation and Land Management, Perth, Western Australia.

Morgan, D. L., Gill, H. S. and Potter, I. C. (1998). Distribution, identification and biology of freshwater fish in south-western Australia. *Records of the Western Australian Museum* **Suppl. No. 56**.

Morgan, D. L., Unmack, P. J., Beatty, S. J., Ebner, B. C., Allen, M. G., Keleher, J. J., Donaldson, J. A. and Murphy, J. (2014). An overview of the 'freshwater fishes' of Western Australia. *Journal of the Royal Society of Western Australia* **97**: 263-278.

Moulds, T. (2019). Conservation Significant and Short Range Endemic invertebrate desktop habitat assessment for Thornlie-Cockburn Link Proposal, Perth, Western Australia. Unpublished report for the Public Transport Authority by Invertebrate Solutions, Victoria Park, Western Australia.

Pacfic Hydro. (2021). Request for Quotation: Ord Hydrogen Project - Ecological Surveys March 2021. Pacific Hydro Australia Developments Pty Ltd, Docklands, Victoria.

Payne, A. L. and Schoknecht, N. R. (2011). Technical Bulletin 98: Land systems of the Kimberley region, Western Australia. Department of Agriculture and Food, South Perth, Western Australia.

Peck, A. (2019). BirdLife Australia 2019 Black-Cockatoo breeding survey report. BirdLife Australia, Perth, Western Australia.

Peck, A., Barrett, G. and Williams, M. (2019). The 2019 Great Cocky Count: a community-based survey for Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*), Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) and Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*). BirdLife Australia, Perth, Western Australia.

PGV. (2021). M70/143 Wattle Avenue East, Nowergup: Flora and Vegetation Survey. Unpublished report prepared for WA Limestone by PGV Environmental, Osborne Park, Western Australia.

Rayner, K., Chambers, B., Johnson, B., Morris, K. D. and Mills, H. R. (2012). Spatial and dietary requirements of the chuditch (*Dasyurus geoffroii*) in a semiarid climatic zone. *Australian Mammalogy* **34**: 59-67.

Read, J. L., Parkhurst, B. and Delean, S. (2015). Can Australian bush birds be used as canaries? Detection of pervasive environmental impacts at an arid Australian mine site. *Emu-Austral Ornithology* **115**: 117-125.

Rentz, D. C. F. (1993). *Tettigoniidae of Australia Volume 2: Austrosaginae, Zaprochilinae and Phasmodinae*. CSIRO Publishing, Australia.

Rich, C. and Longcore, T. (Eds). (2006). *Ecological Consequences of Artificial Night Lighting*. Island Press, Washington D.C., USA.

Rix, M. G., Huey, J. A., Cooper, S. J. B., Austin, A. D. and Harvey, M. S. (2018). Conservation systematics of the shield-backed trapdoor spiders of the nigrum-group (Mygalomorphae, Idiopidae, Idiosoma): integrative taxonomy reveals a diverse and threatened fauna from south-western Australia. *ZooKeys* **756**: 1-121.

Rix, M. G., Raven, R. J., Main, B. Y., Harrison, S. E., Austin, A. D., Cooper, S. J. B. and Harvey, M. S. (2017). The Australasian spiny trapdoor spiders of the family Idiopidae (Mygalomorphae: Arbanitinae): a relimitation and revision at the generic level. *Invertebrate Systematics* **31**: 566-634.

Saunders, D. A. (1974). Breeding biology of the Short-billed form of the White-tailed Black Cockatoo *Calyptorhynchus baudinii latirostris* (Carnaby). *Emu* **74**: 292-293.

Scheick, B. K. and Jones, M. D. (1999). Locating wildlife underpasses prior to expansion on Highway 64 in North Carolina. In: Evink, G. L., Garrett, P. and Ziegler, D. (Eds), *Proceedings of the Third International Conference on Wildlife Ecology and Transportation,* pp. 247-252. Florida Department of Transportation, Tallahassee, Florida, USA.

Soule, M. E., Mackey, B. G., Recher, H. F., Williams, J. E., Woinarski, J. C. Z., Driscoll, D., Dennison, W. C. and Jones, M. E. (2004). The role of connectivity in Australian conservation *Pacific Conservation Biology* **10**: 266-279.

Stock, W. D., Finn, H. C., Parker, J. and Dods, K. (2013). Pine as Fast Food. Foraging Ecology of an Endangered Cockatoo in a Forestry Landscape. *PlosOne* **8**.

Storr, G. M., Smith, L. A. and Johnstone, R. E. (1983). *Lizards of Western Australia. II. Dragons and Monitors*. Western Australian Museum, Perth, Western Australia.

Storr, G. M., Smith, L. A. and Johnstone, R. E. (1990). *Lizards of Western Australia. III. Geckos and Pygopods*. Western Australian Museum, Perth, Western Australia.

Storr, G. M., Smith, L. A. and Johnstone, R. E. (1999). *Lizards of Western Australia. I. Skinks*. Western Australian Museum, Perth, Western Australia.

Storr, G. M., Smith, L. A. and Johnstone, R. E. (2002). *Snakes of Western Australia*. Western Australian Museum, Perth, Western Australia.

Thackway, R. and Cresswell, I. D. (1995). An Interim Biogeographic Regionalisation for Australia: A framework for establishing the national system of reserves, Version 4.0. Australian Nature Conservation Agency, Canberra, Australia.

Travouillon, K. (2021). Checklist of the Mammals of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.

Travouillon, K. J. and Phillips, M. J. (2018). Total evidence analysis of the phylogenetic relationships of bandicoots and bilbies (Marsupialia: Peramelemorphia): reassessment of two species and description of a new species. *Zootaxa* **4378**: 224-256.

Tyler, M. J. and Doughty, P. (2009). *Field Guide to Frogs of Western Australia*. Western Australian Museum, Welshpool, Western Australia.

Valentine, L. and Stock, W. (2008). Food Resources of Carnaby's Black-Cockatoo (Calyptorhynchus latirostris) in the Gnangara Sustainability Strategy study area. Unpublished report to Forest Products Commission by the Centre for Ecosystem Management, Edith Cowan University, and the Department of Environment and Conservation, Perth, Western Australia.

Van Dyck, S. and Strahan, R. (Eds). (2008). *Mammals of Australia*. New Holland Publishers, Sydney, New South Wales.

WAM. (2021). Terrestrial Zoology Datasets. Department of Terrestrial Zoology, Western Australian Museum. http://data.museum.wa.gov.au/dataset/terrestrial-zoology

Webb, A., Kinloch, J., Keighery, G. and Pitt, G. (2016). The extension of vegetation complex mapping to landform boundaries within the Swan Coastal Plain landform and forested region of south-west Western Australia. *Department of Parks and Wildlife (now Department of Biodiversity, Conservation and Attractions), Bunbury, WA*.

Williams, A. A., Williams, M. R., Bishop, C. L., Gamblin, T., Fissioli, J. and Coppen, R. A. (2021). Notes on the biology, ecology, life history and conservation of the graceful sun-moth'Synemon gratiosa'westwood, 1877 (Lepidoptera: Castniidae). *Australian Entomologist, The* **48**: 17-32.

Wilson, S. and Swan, G. (2021). *A Complete Guide to Reptiles of Australia* New Holland, Australia.

# Appendix G Conservation Significant Fauna - Likelihood of Occurrence

## Appendix 7. Vertebrate fauna expected to occur in the project area.

Status codes:

CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.

EPBC Act listings: E = Endangered, V = Vulnerable, M = Migratory, Mar = Marine (see Appendix 2).

Biodiversity Conservation Act 2016 listings: S1 to S7 = Schedules 1 to 7 (see Appendix 2).

DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).

Bush Forever (Dell and Banyard 2000) status: HS = habitat specialists with a reduced distribution on the Swan Coastal Plain, LE = locally extinct, WR = wide ranging species with reduced populations on the Swan Coastal Plain.

LS = considered to be of local significance by Bamford Consulting Ecologists (see Appendix 1).

Int = introduced species.

Expected Occurrence categories:

See Section 2.3.4 for explanation of expected occurrence categories.

Source:

1 = Atlas of Living Australia (ALA 2021), 2 = NatureMap (DBCA 2021e), 3 = Protected Matters Search Tool (DAWE 2021g), 4 = general literature (see Table 4).

Recorded:

'+' = recorded directly, D = diggings, F = foraging signs, S = scats, T = tracks.

Wetland dependence:

~ = species is dependent on wetland environments for the entirety its lifecycle.

w = species is dependent on wetland environments for the majority of its lifecycle.

w† = species is dependent on wetland environments for some its lifecycle (often breeding) but can spend a substantial portion of time in dryland environments.

o = species is dependent on oceanic environments (including coastlines and islands).

| Species | Status | Expected Occurrence | Source | Recorded |
|---|---|---|---|---|
| **Hylidae (Tree frogs)** | | | | |
| *Litoria adelaidensis* w | Slender Tree Frog | Irregular visitor | 1, 2 | |
| *Litoria moorei* w | Motorbike Frog | Irregular visitor | 1, 2 | |
| **Limnodynastidae (Burrowing frogs)** | | | | |
| *Heleioporus eyrei* w† | Moaning Frog | Resident | 1, 2 | |
| *Limnodynastes dorsalis* w† | Western Banjo Frog | Resident | 1, 2 | |
| **Myobatrachidae (Ground frogs)** | | | | |

| Species | | Status | Expected Occurrence | Source | Recorded |
|---|---|---|---|---|---|
| *Crinia glauerti* [w†] | Clicking Frog | | Irregular visitor | 1, 2 | |
| *Crinia insignifera* [w†] | Squelching Froglet | | Irregular visitor | 1, 2 | |
| *Myobatrachus gouldii* | Turtle Frog | | Resident | 1, 2 | |
| *Pseudophryne guentheri* [w†] | Crawling Toadlet | | Resident | 1, 2 | |
| **Carphodactylidae (Carphodactylid geckos)** | | | | | |
| *Underwoodisaurus milii* | Southern Barking Gecko | | Resident | 1, 2 | |
| **Diplodactylidae (Diplodactylid geckos)** | | | | | |
| *Crenadactylus ocellatus* | South-western Clawless Gecko | | Resident | 1, 2 | |
| *Diplodactylus polyophthalmus* | Spotted Sandplain Gecko | | Resident | 1, 2 | |
| *Lucasium alboguttatum* | | | Resident | 2 | |
| *Strophurus spinigerus spinigerus* | | | Resident | 1, 2 | |
| **Gekkonidae (Gekkonid geckos)** | | | | | |
| *Christinus marmoratus* | Marbled Gecko | | Resident | 1, 2 | |
| **Pygopodidae (Legless lizards)** | | | | | |
| *Aprasia repens* | | | Resident | 1, 2 | |
| *Delma concinna concinna* | | | Resident | 2 | |
| *Delma fraseri* | | | Resident | 1, 2 | |
| *Delma grayii* | | | Resident | 1, 2 | |
| *Lialis burtonis* | Burton's Legless-Lizard | | Resident | 1, 2 | |
| *Pletholax gracilis gracilis* | | | Resident | 1, 2 | |
| *Pygopus lepidopodus* | Common Scaly Foot | | Resident | 1, 2 | |
| **Agamidae (Dragons)** | | | | | |
| *Ctenophorus adelaidensis* | Western Heath Dragon | | Resident | 1, 2 | |

| Species | | Status | Expected Occurrence | Source | Recorded |
|---|---|---|---|---|---|
| *Pogona minor minor* | Western Bearded Dragon | | Resident | 1, 2 | |
| **Scincidae (Skinks)** | | | | | |
| *Acritoscincus trilineatus* | | | Resident | 1, 2 | |
| *Cryptoblepharus buchananii* | Fence Skink | | Resident | 1, 2 | |
| *Ctenotus australis* | | | Resident | 1, 2 | |
| *Ctenotus fallens* | | | Resident | 2 | |
| *Ctenotus impar* | | | Resident | 1, 2 | |
| *Cyclodomorphus celatus* | | | Resident | 1, 2 | |
| *Egernia kingii* | King's Skink | | Resident | 1, 2 | |
| *Egernia napoleonis* | | | Resident | 1, 2 | |
| *Hemiergis quadrilineata* | | | Resident | 1, 2 | |
| *Lerista elegans* | | | Resident | 1, 2 | |
| *Lerista lineopunctulata* | | | Irregular visitor | 1, 2 | |
| *Lerista praepedita* | | | Resident | 1, 2 | |
| *Menetia greyii* | | | Resident | 1, 2 | |
| *Morethia lineoocellata* | | | Resident | 1, 2 | |
| *Morethia obscura* | | | Resident | 1, 2 | |
| *Tiliqua occipitalis* | Western Bluetongue | | Resident | 1, 2 | |
| *Tiliqua rugosa rugosa* | Bobtail | | Resident | 1, 2 | |
| **Varanidae (Monitors and goannas)** | | | | | |
| *Varanus gouldii* | Bungarra or Sand Goanna | | Resident | 1, 2 | |
| *Varanus tristis tristis* | Tree Goanna | | Resident | 1, 2 | |
| **Typhlopidae (Blind snakes)** | | | | | |

| Species | | Status | Expected Occurrence | Source | Recorded |
|---|---|---|---|---|---|
| *Anilios australis* | | | Resident | 1, 2 | |
| **Pythonidae (Pythons)** | | | | | |
| *Morelia spilota imbricata* | Carpet Python (southwest) | CS3 (LS) | Regular visitor | 1, 2 | |
| **Elapidae (Venomous land snakes)** | | | | | |
| *Brachyurophis fasciolatus fasciolatus* | | | Resident (if present) | 1, 2 | |
| *Brachyurophis semifasciatus* | | | Resident | 1, 2 | |
| *Demansia psammophis psammophis* | Yellow-faced Whipsnake | | Resident | 1, 2 | |
| *Echiopsis curta* | Bardick | | Resident | 1, 2 | |
| *Neelaps bimaculatus* | Black-naped Snake | | Resident | 1, 2 | |
| *Neelaps calonotos* | Black-striped Snake | CS2 (P3) | Resident (if present) | 1, 2 | |
| *Pseudonaja affinis affinis* | Dugite | | Resident | 1, 2 | |
| *Simoselaps bertholdi* | Jan's Banded Snake | | Resident | 1, 2 | |
| *Suta gouldii* | Gould's Hooded Snake | | Resident | 1, 2 | |
| *Suta nigriceps* | | | Resident | 2 | |
| **Casuariidae (Emus and Cassowaries)** | | | | | |
| *Dromaius novaehollandiae* | Emu | CS3 (WR) | Regular visitor | 1, 2 | |
| **Anatidae (Ducks, Geese and Swans)** | | | | | |
| *Tadorna tadornoides* [w] | Australian Shelduck | | Irregular visitor | 1, 2 | |
| *Anas superciliosa* [w] | Pacific Black Duck | | Irregular visitor | 1, 2 | |
| *Chenonetta jubata* [w] | Australian Wood Duck | | Irregular visitor | 1, 2 | |
| **Phasianidae (Pheasants and Quail)** | | | | | |
| *Coturnix pectoralis* | Stubble Quail | | Vagrant | 1, 2 | |

| Species | | Status | Expected Occurrence | Source | Recorded |
|---|---|---|---|---|---|
| *Synoicus ypsilophorus* | Brown Quail | | Resident | 1, 2 | |
| **Columbidae (Pigeons and Doves)** | | | | | |
| *Columba livia* | Rock Dove/Feral Pigeon | Int | Irregular visitor | 1, 2 | |
| *Streptopelia chinensis* | Spotted Dove | Int | Resident | 1, 2 | |
| *Spilopelia senegalensis* | Laughing Dove | Int | Resident | 1, 2 | |
| *Phaps chalcoptera* | Common Bronzewing | CS3 (HS) | Resident | 1, 2 | |
| *Phaps elegans* | Brush Bronzewing | CS3 (HS) | Irregular visitor | 1, 2 | |
| *Ocyphaps lophotes* | Crested Pigeon | | Resident | 1, 2 | |
| **Cuculidae (Cuckoos)** | | | | | |
| *Chalcites basalis* | Horsfield's Bronze-Cuckoo | | Regular migrant | 1, 2 | |
| *Chalcites lucidus* | Shining Bronze-Cuckoo | | Regular migrant | 1, 2 | |
| *Cacomantis flabelliformis* | Fan-tailed Cuckoo | | Regular migrant | 1, 2 | + |
| *Heteroscenes pallidus* | Pallid Cuckoo | | Regular migrant | 1, 2 | |
| **Podargidae (Frogmouths)** | | | | | |
| *Podargus strigoides* | Tawny Frogmouth | | Resident | 1, 2 | |
| **Eurostopodidae (Eared Nightjars)** | | | | | |
| *Eurostopodus argus* | Spotted Nightjar | | Vagrant | 1, 2 | |
| **Aegothelidae (Owlet-nightjars)** | | | | | |
| *Aegotheles cristatus* | Australian Owlet-nightjar | | Regular visitor | 1, 2 | |
| **Apodidae (Swifts and Swiftlets)** | | | | | |
| *Apus pacificus* | Fork-tailed Swift | CS1 (M,Mar,S5) | Vagrant | 1, 2, 3 | |
| **Turnicidae (Button-quail)** | | | | | |
| *Turnix varius* | Painted Button-quail | CS3 (WR) | Resident | 1, 2 | |

| Species | | Status | Expected Occurrence | Source | Recorded |
|---|---|---|---|---|---|
| *Turnix velox* | Little Button-quail | | Irregular visitor | 1, 2 | |
| **Accipitridae (Eagles, Kites, Goshawks)** | | | | | |
| *Elanus axillaris* | Black-shouldered Kite | | Regular visitor | 1, 2 | |
| *Lophoictinia isura* | Square-tailed Kite | CS3 (WR) | Regular visitor | 1, 2 | |
| *Aquila audax* | Wedge-tailed Eagle | CS3 (WR) | Regular visitor | 1, 2 | |
| *Hieraaetus morphnoides* | Little Eagle | CS3 (WR) | Regular visitor | 1, 2 | |
| *Circus assimilis* | Spotted Harrier | | Irregular visitor | 1, 2 | |
| *Accipiter fasciatus* | Brown Goshawk | CS3 (WR) | Regular visitor | 1, 2 | |
| *Accipiter cirrocephalus* | Collared Sparrowhawk | CS3 (WR) | Regular visitor | 1, 2 | |
| *Haliastur sphenurus* | Whistling Kite | CS3 (WR) | Regular visitor | 1, 2 | |
| **Tytonidae (Masked Owls)** | | | | | |
| *Tyto alba* | Barn Owl | | Regular visitor | 1, 2 | |
| **Strigidae (Hawk-Owls)** | | | | | |
| *Ninox novaeseelandiae* | Southern Boobook | | Regular visitor | 1 | |
| **Meropidae (Bee-eaters)** | | | | | |
| *Merops ornatus* | Rainbow Bee-eater | | Regular migrant | 1, 2, 3 | |
| **Alcedinidae (Kingfishers)** | | | | | |
| *Todiramphus sanctus* | Sacred Kingfisher | | Regular migrant | 1, 2 | |
| *Dacelo novaeguineae* | Laughing Kookaburra | Int | Resident | 1, 2 | |
| **Falconidae (Falcons)** | | | | | |
| *Falco cenchroides* | Nankeen Kestrel | | Resident | 1, 2 | |
| *Falco longipennis* | Australian Hobby | | Regular visitor | 1, 2 | |
| *Falco berigora* | Brown Falcon | | Irregular visitor | 1, 2 | |

| Species | | Status | Expected Occurrence | Source | Recorded |
|---|---|---|---|---|---|
| *Falco peregrinus* | Peregrine Falcon | CS1 (S7) | Regular visitor | 1, 2 | |
| **Cacatuidae (Cockatoos and Corellas)** | | | | | |
| *Calyptorhynchus banksii naso* | Forest Red-tailed Black-Cockatoo | CS1 (V,S3) | Irregular visitor | 1, 2, 3 | |
| *Calyptorhynchus latirostris* | Carnaby's Black-Cockatoo | CS1 (E,S2) | Regular migrant | 1, 2, 3 | F |
| *Eolophus roseicapilla* | Galah | | Resident | 1, 2 | + |
| *Cacatua tenuirostris* | Long-billed Corella | Int | Regular visitor | 1, 2 | |
| *Cacatua sanguinea* | Little Corella | | Regular visitor | 1, 2 | |
| **Psittaculidae (Parrots, Lorikeets and Rosellas)** | | | | | |
| *Purpureicephalus spurius* | Red-capped Parrot | | Regular visitor | 1, 2 | + |
| *Barnardius zonarius* | Australian Ringneck | | Resident | 1, 2 | + |
| *Neophema elegans* | Elegant Parrot | | Resident | 1, 2 | |
| *Trichoglossus haematodus* | Rainbow Lorikeet | Int | Resident | 1, 2 | |
| **Maluridae (Fairy-wrens, Emu-wrens and Grasswrens)** | | | | | |
| *Malurus assimilis* | Purple-backed Fairy-wren | CS3 (HS) | Resident | 1, 2 | |
| *Malurus splendens* | Splendid Fairy-wren | CS3 (HS) | Resident | 1, 2 | + |
| *Malurus leucopterus* | White-winged Fairy-wren | CS3 (HS) | Irregular visitor | 1, 2 | + |
| *Stipiturus malachurus* | Southern Emu-wren | CS3 (HS) | Irregular visitor | 4 | |
| **Meliphagidae (Honeyeaters and Chats)** | | | | | |
| *Lichmera indistincta* | Brown Honeyeater | | Resident | 1, 2 | |
| *Phylidonyris novaehollandiae* | New Holland Honeyeater | CS3 (WR) | Resident | 1, 2 | + |
| *Phylidonyris niger* | White-cheeked Honeyeater | CS3 (WR) | Resident | 1, 2 | + |
| *Glyciphila melanops* | Tawny-crowned Honeyeater | CS3 (WR) | Regular visitor | 1, 2 | |
| *Acanthorhynchus superciliosus* | Western Spinebill | | Resident | 1, 2 | |

| Species | | Status | Expected Occurrence | Source | Recorded |
|---|---|---|---|---|---|
| *Epthianura albifrons* | White-fronted Chat | | Irregular visitor | 1, 2 | |
| *Anthochaera lunulata* | Western Wattlebird | CS3 (WR) | Regular visitor | 1, 2 | |
| *Anthochaera carunculata* | Red Wattlebird | | Regular visitor | 1, 2 | |
| *Gavicalis virescens* | Singing Honeyeater | | Resident | 1, 2 | |
| *Manorina flavigula* | Yellow-throated Miner | CS3 (WR) | Irregular visitor | 1, 2 | |
| **Pardalotidae (Pardalotes)** | | | | | |
| *Pardalotus punctatus* | Spotted Pardalote | | Irregular visitor | 1, 2 | |
| *Pardalotus striatus* | Striated Pardalote | | Resident | 1, 2 | |
| **Acanthizidae (Thornbills and Gerygones)** | | | | | |
| *Gerygone fusca* | Western Gerygone | | Resident | 1, 2 | |
| *Smicrornis brevirostris* | Weebill | CS3 (HS) | Resident | 1, 2 | |
| *Calamanthus campestris* | Rufous Fieldwren | | Irregular visitor | 1 | + |
| *Sericornis frontalis* | White-browed Scrubwren | CS3 (HS) | Resident | 1, 2 | + |
| *Acanthiza chrysorrhoa* | Yellow-rumped Thornbill | CS3 (HS) | Resident | 1, 2 | |
| *Acanthiza apicalis* | Inland Thornbill | CS3 (HS) | Resident | 1, 2 | |
| *Acanthiza inornata* | Western Thornbill | CS3 (HS) | Irregular visitor | 1, 2 | |
| **Neosittidae (Sittellas)** | | | | | |
| *Daphoenositta chrysoptera* | Varied Sittella | CS3 (HS) | Irregular visitor | 1, 2 | |
| **Campephagidae (Cuckoo-shrikes and Trillers)** | | | | | |
| *Coracina novaehollandiae* | Black-faced Cuckoo-shrike | | Regular visitor | 1, 2 | + |
| *Lalage tricolor* | White-winged Triller | | Regular visitor | 1, 2 | |
| **Pachycephalidae (Whistlers, Shrike-thrushes and allies)** | | | | | |
| *Pachycephala rufiventris* | Rufous Whistler | | Resident | 1, 2 | |

| Species | | Status | Expected Occurrence | Source | Recorded |
|---|---|---|---|---|---|
| *Colluricincla harmonica* | Grey Shrike-thrush | CS3 (HS) | Resident | 1, 2 | + |
| **Oreoicidae (Australo-Papuan Bellbirds)** | | | | | |
| *Oreoica gutturalis* | Crested Bellbird | | Vagrant | 1 | |
| **Artamidae (Woodswallows, Currawongs, Butcherbirds and Magpie)** | | | | | |
| *Strepera versicolor* | Grey Currawong | CS3 (WR) | Irregular visitor | 1, 2 | |
| *Gymnorhina tibicen* | Australian Magpie | | Resident | 1, 2 | + |
| *Cracticus torquatus* | Grey Butcherbird | | Resident | 1, 2 | |
| *Artamus personatus* | Masked Woodswallow | CS3 (WR) | Vagrant | 1, 2 | |
| *Artamus cyanopterus* | Dusky Woodswallow | CS3 (WR) | Regular visitor | 1, 2 | |
| *Artamus cinereus* | Black-faced Woodswallow | | Resident | 1, 2 | + |
| **Rhipiduridae (Fantails)** | | | | | |
| *Rhipidura leucophrys* | Willie Wagtail | | Resident | 1, 2 | |
| *Rhipidura albiscapa* | Grey Fantail | | Resident | 1, 2 | + |
| **Corvidae (Crows and Ravens)** | | | | | |
| *Corvus coronoides* | Australian Raven | | Resident | 1, 2 | + |
| **Monarchidae (Monarch and Flycatchers)** | | | | | |
| *Grallina cyanoleuca* | Magpie-lark | | Resident | 1, 2 | + |
| **Petroicidae (Australian Robins)** | | | | | |
| *Petroica boodang* | Scarlet Robin | CS3 (HS) | Regular visitor | 1, 2 | |
| *Petroica goodenovii* | Red-capped Robin | | Irregular visitor | 1, 2 | |
| *Quoyornis georgianus* | White-breasted Robin | CS3 (HS) | Irregular visitor | 1, 2 | |
| *Melanodryas cucullata* | Hooded Robin | | Irregular visitor | 1 | |
| **Dicaeidae (Flowerpeckers)** | | | | | |

| Species | | Status | Expected Occurrence | Source | Recorded |
|---|---|---|---|---|---|
| *Dicaeum hirundinaceum* | Mistletoebird | | Regular visitor | 1, 2 | |
| **Motacillidae (Pipits and Wagtails)** | | | | | |
| *Anthus novaeseelandiae* | Australasian Pipit | | Resident | 1, 2 | |
| **Locustellidae (Grassbirds)** | | | | | |
| *Cincloramphus cruralis* | Brown Songlark | | Regular visitor | 1 | |
| *Cincloramphus mathewsi* | Rufous Songlark | | Regular visitor | 1 | |
| **Hirundinidae (Swallows and Martins)** | | | | | |
| *Cheramoeca leucosterna* | White-backed Swallow | | Regular visitor | 1, 2 | |
| *Petrochelidon ariel* | Fairy Martin | | Irregular visitor | 1, 2 | |
| *Petrochelidon nigricans* | Tree Martin | | Resident | 1, 2 | |
| *Hirundo neoxena* | Welcome Swallow | | Resident | 1, 2 | + |
| **Zosteropidae (White-eyes)** | | | | | |
| *Zosterops lateralis* | Silvereye | | Resident | 1, 2 | + |
| **Tachyglossidae (Echidnas)** | | | | | |
| *Tachyglossus aculeatus acanthion* | Short-beaked Echidna | | Resident | 1, 2 | |
| **Dasyuridae (Dasyurids)** | | | | | |
| *Dasyurus geoffroii fortis* | Chuditch | CS1 (V,S3) | Vagrant | 1, 2, 3 | |
| **Peramelidae (Bandicoots)** | | | | | |
| *Isoodon fusciventer* | Quenda | CS2 (P4) | Resident | 1, 2 | D |
| **Tarsipedidae (Honey Possum)** | | | | | |
| *Tarsipes rostratus* | Honey Possum, Noolbenger | CS3 (LS) | Resident | 1, 2 | |
| **Phalangeridae (Brushtail possums)** | | | | | |
| *Trichosurus vulpecula hypoleucus* | Brushtail Possum | | Resident | 1, 2 | |

| Species | | Status | Expected Occurrence | Source | Recorded |
|---|---|---|---|---|---|
| **Macropodidae (Kangaroos)** | | | | | |
| *Macropus fuliginosus melanops* | Western Grey Kangaroo | | Resident | 1, 2 | S,T |
| *Notamacropus irma* | Brush Wallaby | CS2 (P4) | Regular visitor | 1, 2 | |
| **Muridae (Rats and mice)** | | | | | |
| *Mus musculus* | House Mouse | Int | Resident | 1, 2 | |
| *Rattus fuscipes fuscipes* | Western Bush Rat, Moodit | CS3 (LS) | Resident | 1, 2 | |
| *Rattus rattus* | Black Rat | Int | Resident | 1, 2 | |
| **Leporidae (Rabbits and hares)** | | | | | |
| *Oryctolagus cuniculus* | Rabbit | Int | Resident | 1, 2 | D,S |
| **Molossidae (Freetail bats)** | | | | | |
| *Austronomus australis* | White-striped Free-tailed Bat | | Regular migrant | 1 | |
| **Vespertilionidae (Vespertillionid bats)** | | | | | |
| *Chalinolobus gouldii* | Gould's Wattled Bat | | Regular visitor | 1, 2 | |
| *Chalinolobus morio* | Chocolate Wattled Bat | | Regular visitor | 1, 2 | |
| *Nyctophilus geoffroyi geoffroyi* | Lesser Long-eared Bat | | Regular visitor | 1, 2 | |
| *Nyctophilus holtorum (formerly gouldi)* | Holt's Long-eared Bat | | Regular visitor | 1, 2 | |
| *Vespadelus regulus* | Southern Forest Bat | | Regular visitor | 1, 2 | |
| **Canidae (Dogs)** | | | | | |
| *Vulpes vulpes* | Red Fox | Int | Resident | 1, 2 | |
| **Felidae (Cats)** | | | | | |
| *Felis catus* | Cat | Int | Resident | 1, 2 | |

# Appendix H Carnaby's Cockatoo Habitat Assessment - DCCEEW Scoring Tool

This habitat scoring system describes elements indicative of suitable foraging habitat[1] for the three WA black cockatoo species (Carnaby's Black Cockatoo, Baudin's Black Cockatoo and the Forest Red-tailed Black Cockatoo) in WA. Its use must be supported by survey information and reporting, undertaken by suitably qualified and experienced ecologists.

Appropriate scores will best fit a description. Where all components of the 'detail' column description are not met, this must be specified, and justification provided for that score to be accepted by the Department.

For an offset site to be considered by the Department, the offset site must have a start score of 1 for each indicator (e.g., there must be a species stocking rate score of at least 1).

## Assessment of Habitat Quality

| Indicator | Score | Detail | | Impact site |
|---|---|---|---|---|
| **Site Condition** | | | | |
| | | **Foraging value** | **Details** | |
| **Vegetation Condition and structure**<br><br>**Habitat features** | 7 | Very High | Carnaby's Black Cockatoo | |
| | | | Native kwongan heath and shrubland (>30% projected foliage cover), banksia and eucalypt woodlands with >50% projected foliage cover. Low percentage (< 5%) of tree deaths[2]. | N/A |
| | | | Baudin's Black Cockatoo | |
| | | | Marri-Jarrah Forest and woodlands with >50% projected foliage cover. Low percentage (< 5%) of tree deaths. | N/A |
| | | | Forest Red-tailed Black Cockatoo | |

[1] In some cases, an impact or offset site may contain or require both foraging and breeding habitat for one or more black cockatoos. Breeding habitat is species of trees known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to develop a nest hollow. For most species of trees, suitable DBH is 500 mm. For salmon gum and wandoo, suitable DBH is 300 mm.

[2] No tree deaths indicate robustness of habitat, unlikely for the habitat to decline in the medium-term. Tree deaths may be owing to disease, water stress, fire, etc.

| Indicator | Score | | Detail | Impact site |
|---|---|---|---|---|
| | | | Marri-Jarrah-Karri Forest, other eucalypt woodlands, or allocasuarina woodlands, with >50% projected foliage cover. Low percentage (< 5%) of tree deaths. | N/A |
| | 6 | High | Carnaby's Black Cockatoo | |
| | | | Native kwongan heath and shrubland (>25% projected foliage cover), banksia and eucalypt woodlands with >40% projected foliage cover. Low percentage (< 10%) of tree deaths. | 13.27 ha of Proteaceous shrubland with *Banksia sessilis* occurring at moderate to high density (ranges from 30-60%). |
| | | | Baudin's Black Cockatoo | |
| | | | Marri-Jarrah Forest and woodlands with >40% projected foliage cover. Low percentage (< 10%) of tree deaths. | N/A |
| | | | Forest Red-tailed Black Cockatoo | |
| | | | Marri-Jarrah-Karri Forest, other eucalypt woodlands, or allocasuarina woodlands, with >40% projected foliage cover. Low percentage (< 10%) of tree deaths. | N/A |
| | 5 | Moderate to High | Carnaby's Black Cockatoo | |
| | | | Native kwongan heath and shrubland (>20% projected foliage cover), banksia and eucalypt woodlands with 30-40% projected foliage cover; OR > 60% projected foliage cover but veg. condition reduced due to tree deaths (up to 20%). | N/A |
| | | | Baudin's Black Cockatoo | |
| **Vegetation Condition and structure** | | | Marri-Jarrah Forest or woodlands with 30-40% projected foliage cover; OR > 60% projected foliage cover but veg. condition reduced due to tree deaths (up to 20%). | N/A |
| **Habitat features** | | | Forest Red-tailed Black Cockatoo | |
| | | | Marri-Jarrah-Karri Forest, other eucalypt woodlands, or allocasuarina woodlands, with 30-40% projected foliage cover; OR > 60% projected | N/A |

| Indicator | Score | | Detail | Impact site |
|---|---|---|---|---|
| | | | foliage cover but veg. condition reduced due to tree deaths (up to 20%). | |
| | 4 | Moderate | Carnaby's Black Cockatoo | |
| | | | Native kwongan heath and shrubland, banksia or eucalypt woodlands with 20-30% projected foliage cover. Moderate percentage of tree deaths (30-40%). | N/A |
| | | | Baudin's Black Cockatoo | |
| | | | Marri-Jarrah Forest or woodlands with 20-30% projected foliage cover; OR Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to tree deaths (up to 30-40%). | N/A |
| | | | Forest Red-tailed Black Cockatoo | |
| | | | Marri-Jarrah-Karri Forest, other eucalypt woodlands, or allocasuarina woodlands with: 20-30% projected foliage cover; OR 40-60% projected foliage cover but veg. condition reduced due to tree deaths (up to 30-40%). | N/A |
| | 3 | Low to Moderate | Carnaby's Black Cockatoo | |
| | | | Native kwongan heath and shrubland, banksia or eucalypt woodlands with 10-20% projected foliage cover. | N/A |
| | | | Baudin's Black Cockatoo | |
| | | | Marri-Jarrah Forest or woodlands with 5-20% projected foliage cover. | N/A |
| | | | Forest Red-tailed Black Cockatoo | |
| | | | Marri-Jarrah-Karri Forest, other eucalypt woodlands, or allocasuarina woodlands with 5-20% projected foliage cover. | N/A |
| | 2 | Low[3] | Carnaby's Black Cockatoo | |

[3] If the site scores between 0-2 (low to no value) for site condition, 0 for the site context score, or is No for species stocking rate, it is extremely unlikely to be considered as suitable habitat. This would not be appropriate to use as an offset site.

| Indicator | Score | | Detail | Impact site |
|---|---|---|---|---|
| **Vegetation Condition and structure**<br><br>**Habitat features** | | | Native kwongan heath and shrubland, banksia and eucalypt woodlands with <10% projected foliage cover; OR Paddocks and/or urban areas with scattered foraging trees such as banksias, marri. | 0.14 ha of Limestone marlock woodland comprised of *Xanthorrhoea preissii* and *Banksia sessilis* at low density (~5%).<br>Unlikely to constitute suitable habitat due to low projected foliage cover of foraging species. |
| | | | Baudin's Black Cockatoo | |
| | | | Marri-Jarrah Forest or woodlands with 1-5% projected foliage cover; OR Paddocks and/or urban areas with scattered foraging trees such as banksia, hakea, dryandra. | N/A |
| | | | Forest Red-tailed Black Cockatoo | |
| | | | Marri-Jarrah-Karri Forest, other eucalypt woodlands, or allocasuarina woodlands with 1-5% projected foliage cover; OR Paddocks and/or urban areas with scattered food plants such as Cape Lilac, *Eucalyptus caesia* and *E. erythrocorys*. | N/A |
| | 1 | Negligible to Low | All species | |
| | | | Scattered specimens of known food plants but projected foliage cover of these is <2%. May include: paddocks or urban areas with scattered foraging trees. | 1.65 ha of Myrtaceous/fabaceous heath and rehabilitated vegetation with limited foraging species.<br>Unlikely to constitute suitable habitat due to low projected foliage cover of foraging species. |
| | 0 | None | All species | |
| | | | No Proteaceae, eucalypts or other potential sources of food. May include bare ground or developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits). | N/A |

## Regional Context of the Site

| Site Context | | | | | |
|---|---|---|---|---|---|
| **Proximity of the site in relation to other habitat** | 3 | Site is within 6 km of known breeding site. | or | Site is within 12 km of other foraging resources with site condition of at least 3. | Site is adjacent to other high quality foraging resources. |
| | 2 | Site is within 12 km of known breeding site. | | Site is within 15 km of other foraging resources with site condition of at least 4. | N/A |
| | 1 | Site is within 15 km of known breeding site. | | Site is between 15 km and 20 km of other foraging resources with site condition of at least 5. | N/A |
| | 0 | Site is further than 15 km from known breeding site. | | Site is further than 20 km from other foraging resources. | N/A |
| | | | | **Totals** | 3 |

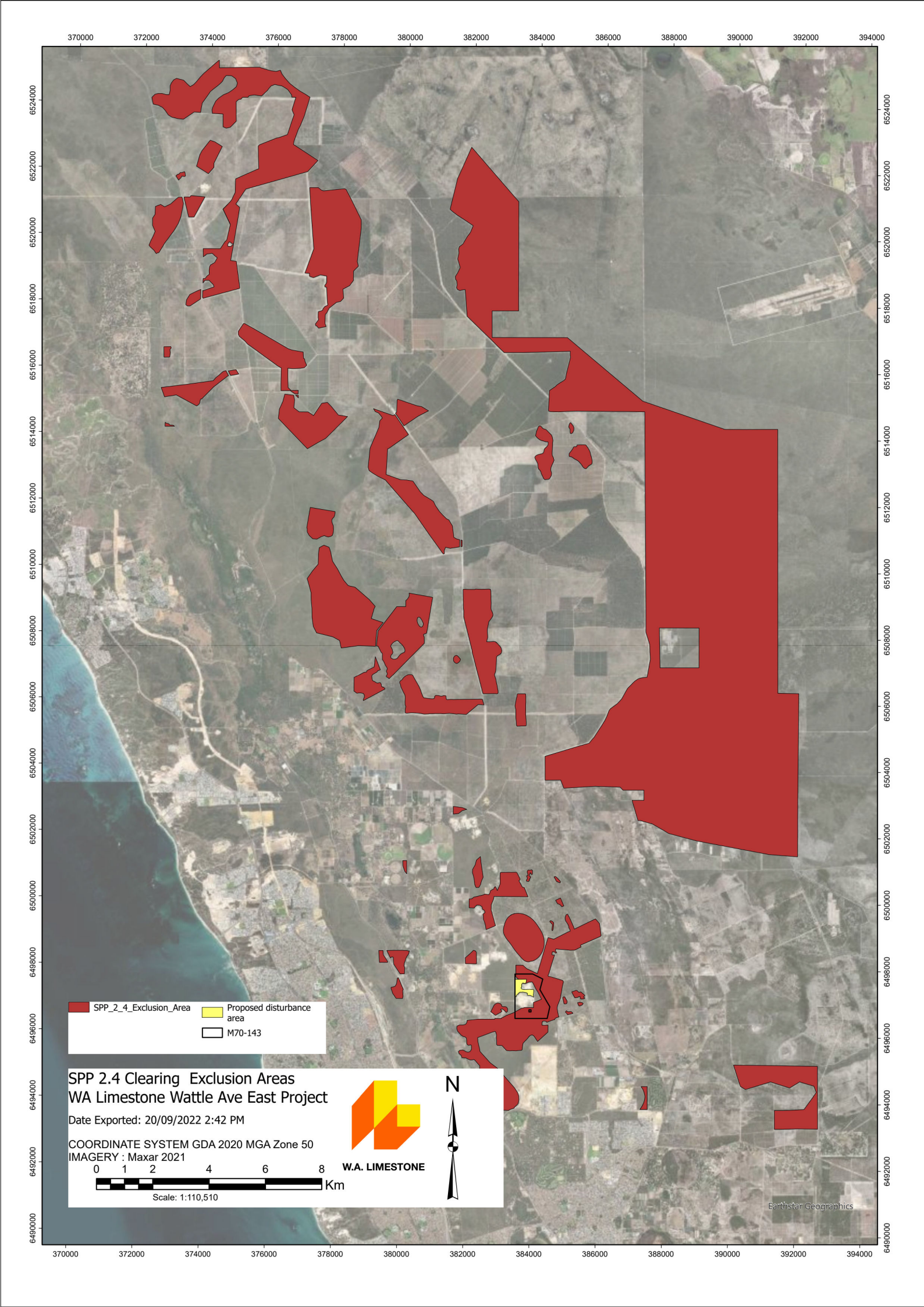
| | |
|---|---|
| **Final Totals** | 13.27 ha with quality of 9 |

## Presence of Black Cockatoo Within the Site

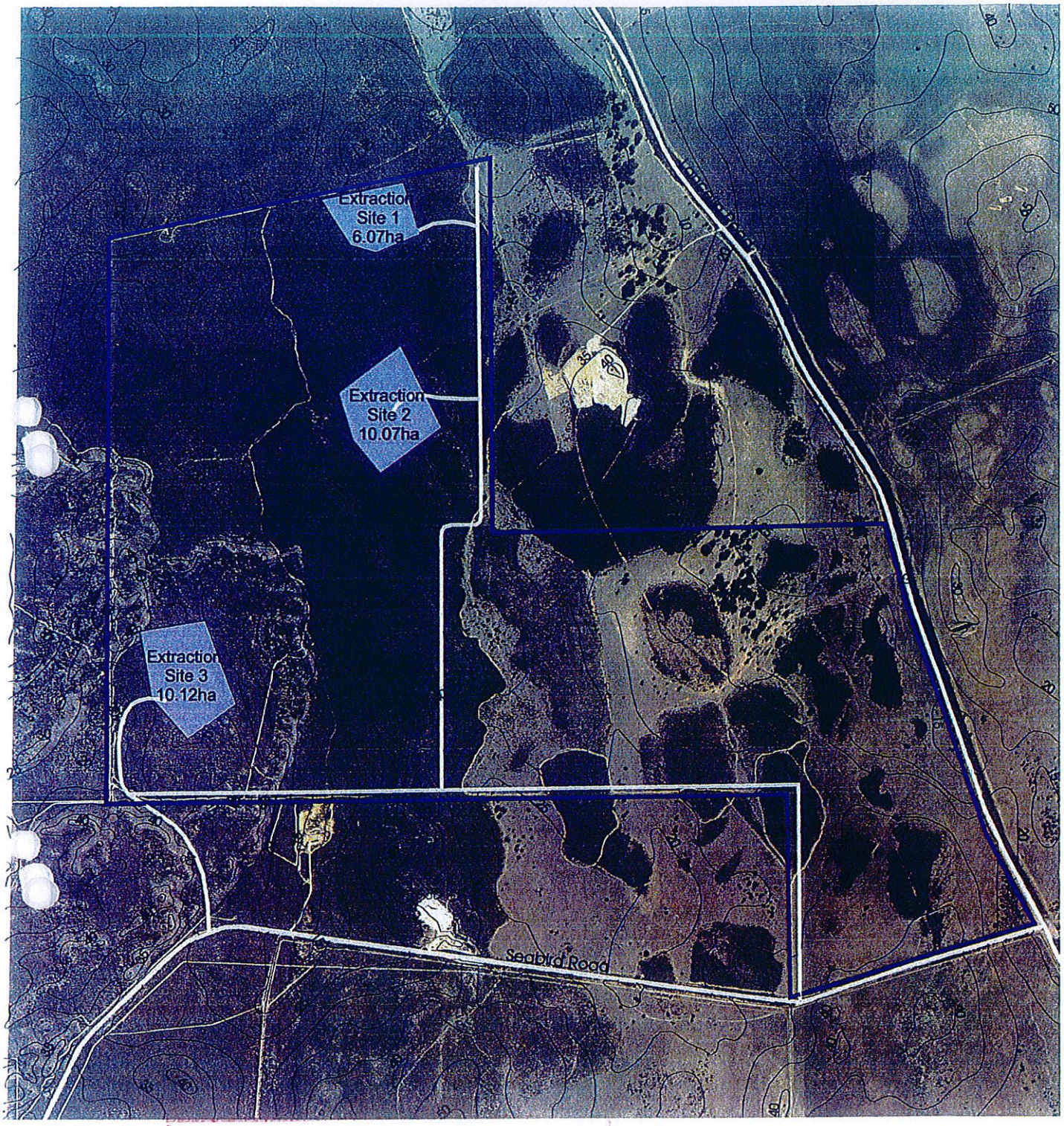
| Indicator | | Species Stocking Rate[4] | Impact Site | | |
|---|---|---|---|---|---|
| | | | **CBC** | **BBC** | **FRT** |
| **Confirm presence/ absence of species** | Yes | Species is seen or reported regularly and/or there is abundant foraging evidence, e.g. chewed nuts can be identified as this species. Regularly is when the species is seen at intervals of every few days or weeks for at least several months of the year. | Yes | - | - |
| | No | Species is recorded or reported very infrequently and there is little or no foraging evidence. | - | No | No |

[4] Species stocking rate is indicated by yes or no to confirm if any of the species is frequently present or not. If yes, the presence must be for the species being impacted by the proposal, not for a species that will not be impacted.

# Appendix I State Planning Policy 2.4: Clearing Exclusion Areas


370000
372000
374000
376000
378000
380000
382000
384000
386000
388000
390000
392000
394000
6524000
6522000
6520000
6518000
6516000
6514000
6512000
6510000
6508000
6506000
6504000
6502000
6500000
6498000
6496000
6494000
6492000
6490000
SPP_2_4_Exclusion_Area
Proposed disturbance area
M70-143
SPP 2.4 Clearing Exclusion Areas
WA Limestone Wattle Ave East Project
Date Exported: 20/09/2022 2:42 PM
COORDINATE SYSTEM GDA 2020 MGA Zone 50
IMAGERY : Maxar 2021
0 1 2 4 6 8
Km
Scale: 1:110,510
W.A. LIMESTONE
N
Earthstar Geographics

# Appendix J Lot 100 Seabird Road, Breton Bay, Approved Limestone Extraction Sites




Lot boundary

SHIRE OF GINGIN
APPROVAL OF PLANNING CONSENT GRANTED
Date: 10/9/02

Aerial Photograph and Extraction Sites

**G & M Fazio as Trustee for the Quarry Trust**

200 0 200 400 m
1:20,000

NORTH

Lot 89 Lancelin Road, Gingin

JOHN CLEARY PLANNING

Map 2 Apr 2002

# Appendix K DWER Environmental Offsets Metric - Carnaby's Black Cockatoo

# Step 1: Determining conservation significance

Key:
- Data to be entered
- Drop-down selection
- Automatically-generated scores (Or, if appropriate, manual data entry permitted)

***Area / feature*** **(Impact site)**

| Conservation significance determination for the environmental value impacted | | |
|---|---|---|
| Conservation significance | **Description** | CBC/BBC Foraging |
| | **Type of environmental value** | Species (flora/fauna) |
| | **Conservation significance of environmental value** | Rare/threatened species - endangered |
| | **Conservation significance score** | **1.2%** |

| | |
|---|---|
| **Please select *area* or *feature* for the calculations** | **Area** |

WA Environmental Offsets Calculator

# Step 2: Calculating significant residual impact

Key:
- Data to be entered
- Drop-down selection
- Automatically-generated scores

| Environmental value (step 1) | CBC/BBC Foraging |
|---|---|

***Area* (impact site)**

**Part A: Significant impact calculation *Area***

| | Description | Quantum of impact | |
|---|---|---|---|
| Significant impact | Significant foraging habitat for Carnaby's cockatoo | Significant impact (hectares) | 13.27 |
| | | Quality (scale) | 9.00 |
| | | Total quantum of impact | 11.94 |

**Part B: Rehabilitation credit calculation *Area* (onsite)**

| | Description | | | | |
|---|---|---|---|---|---|
| Rehabilitation Credit | | Proposed rehabilitation (area in hectares) | 0.00 | Time until ecological benefit (years) | 0.00 |
| | | Current quality of rehabilitation site (scale) | 0.00 | Confidence in rehabilitation result (%) | 0.0% |
| | | Future quality WITHOUT rehabilitation (scale) | 0.00 | Rehabilitation credit | 0.00 |
| | | Future quality WITH rehabilitation (scale) | 0.00 | | |

**Part C: Significant residual impact calculation *Area***

| | | |
|---|---|---|
| Significant residual impact | Total quantum of impact | 11.94 |
| | Rehabilitation credit | 0.00 |
| | Significant residual impact | 11.94 |

WA Environmental Offsets Calculator

# Step 3: Calculating offsets

Key:
- Data to be entered
- Drop-down selection
- Automatically-generated scores

| | | | |
|---|---|---|---|
| Environmental value (step 1) | CBC/BBC Foraging | Significant impact (step 2, part A) | 13.27 |
| | | Rehabilitation credit (step 2, part B) | 0.00 |
| | | Significant residual impact (step 2, part C) | 11.94 |

***Area*** **(offset site)**

**Offset calculation**
***Area***

| Offsets calculation | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Description** | **Proposed offset (area in hectares)** | 88.75 | **Duration of offset implementation (maximum 20 years)** | 20.00 | **Offset value** | **23.70** |
| | Portion of Lot 100 Seabird Road, Breton Bay | **Current quality of offset site (scale)** | 10.00 | **Time until offset site secured (years)** | 2.00 | | **198.5%** |
| | | **Future quality WITHOUT offset (scale)** | 8.00 | **Risk of future loss WITHOUT offset (%)** | 20.0% | | |
| | | **Future quality WITH offset (scale)** | 10.00 | **Risk of future loss WITH offset (%)** | 5.0% | | |
| | | **Time until ecological benefit (years)** | 5.00 | | | | |
| | | **Confidence in offset result (%)** | 80.0% | | | **OFFSET ADEQUATE?** | **YES** |

# Appendix L EPBC Act Environmental Offsets Calculator - Carnaby's Black Cockatoo

# Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

| Matter of National Environmental Significance | |
|---|---|
| **Name** | CBC |
| **EPBC Act status** | Endangered |
| **Annual probability of extinction**<br>Based on IUCN category definitions | **1.2%** |

| Key to Cell Colours |
|---|
| User input required |
| Drop-down list |
| Calculated output |
| Not applicable to attribute |

## Impact calculator

| Protected matter attributes | Attribute relevant to case? | Description | Quantum of impact | | Units | Information source |
|---|---|---|---|---|---|---|
| ***Ecological communities*** | | | | | | |
| **Area of community** | No | | **Area** | | | |
| | | | **Quality** | | | |
| | | | **Total quantum of impact** | 0.00 | | |
| ***Threatened species habitat*** | | | | | | |
| **Area of habitat** | Yes | | **Area** | 13.27 | Hectares | |
| | | | **Quality** | **9** | Scale 0-10 | |
| | | | **Total quantum of impact** | 11.94 | Adjusted hectares | |
| **Protected matter attributes** | **Attribute relevant to case?** | **Description** | **Quantum of impact** | | **Units** | **Information source** |
| **Number of features**<br>e.g. Nest hollows, habitat trees | No | | | | | |
| **Condition of habitat**<br>Change in habitat condition, but no change in extent | No | | | | | |
| ***Threatened species*** | | | | | | |
| **Birth rate**<br>e.g. Change in nest success | No | | | | | |
| **Mortality rate**<br>e.g Change in number of road kills per year | No | | | | | |
| **Number of individuals**<br>e.g. Individual plants/animals | No | | | | | |

## Offset calculator

| Protected matter attributes | Attribute relevant to case? | Total quantum of impact | Units | Proposed offset | Time horizon (years) | | Start area and quality | | Future area and quality without offset | | Future area and quality with offset | | Raw gain | Confidence in result (%) | Adjusted gain | Net present value (adjusted hectares) | % of impact offset | Minimum (90%) direct offset requirement met? | Cost ($ total) | Information source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Ecological Communities*** | | | | | | | | | | | | | | | | | | | | |
| **Area of community** | Yes | | Adjusted hectares | | **Risk-related time horizon (max. 20 years)** | | **Start area (hectares)** | | **Risk of loss (%) without offset** | | **Risk of loss (%) with offset** | | 0.00 | | 0.00 | 0.00 | #DIV/0! | #DIV/0! | | |
| | | | | | | | | | **Future area without offset (adjusted hectares)** | 0.0 | **Future area with offset (adjusted hectares)** | 0.0 | | | | | | | | |
| | | | | | **Time until ecological benefit** | | **Start quality (scale of 0-10)** | | **Future quality without offset (scale of 0-10)** | | **Future quality with offset (scale of 0-10)** | | 0.00 | | 0.00 | 0.00 | | | | |
| ***Threatened species habitat*** | | | | | | | | | | | | | | | | | | | | |
| **Area of habitat** | Yes | 11.94 | Adjusted hectares | | **Time over which loss is averted (max. 20 years)** | 20 | **Start area (hectares)** | 88.75 | **Risk of loss (%) without offset** | 0% | **Risk of loss (%) with offset** | 0% | 0.00 | 80% | 0.00 | 0.00 | 112.01% | Yes | | |
| | | | | | | | | | **Future area without offset (adjusted hectares)** | 88.8 | **Future area with offset (adjusted hectares)** | 88.8 | | | | 13.38 | | | | |
| | | | | | **Time until ecological benefit** | 5 | **Start quality (scale of 0-10)** | **10** | **Future quality without offset (scale of 0-10)** | **8** | **Future quality with offset (scale of 0-10)** | **10** | 2.00 | 80% | 1.60 | 1.51 | | | | |
| **Protected matter attributes** | **Attribute relevant to case?** | **Total quantum of impact** | **Units** | **Proposed offset** | **Time horizon (years)** | | **Start value** | | **Future value without offset** | | **Future value with offset** | | **Raw gain** | **Confidence in result (%)** | **Adjusted gain** | **Net present value** | **% of impact offset** | **Minimum (90%) direct offset requirement met?** | **Cost ($ total)** | **Information source** |
| **Number of features**<br>e.g. Nest hollows, habitat trees | No | | | | | | | | | | | | | | | | | | | |
| **Condition of habitat**<br>Change in habitat condition, but no change in extent | No | | | | | | | | | | | | | | | | | | | |
| ***Threatened species*** | | | | | | | | | | | | | | | | | | | | |
| **Birth rate**<br>e.g. Change in nest success | No | | | | | | | | | | | | | | | | | | | |
| **Mortality rate**<br>e.g Change in number of road kills per year | No | | | | | | | | | | | | | | | | | | | |
| **Number of individuals**<br>e.g. Individual plants/animals | No | | | | | | | | | | | | | | | | | | | |

## Summary

| Protected matter attributes | Quantum of impact | Net present value of offset | % of impact offset | Direct offset adequate? | Cost ($) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Direct offset ($) | Other compensatory measures ($) | Total ($) |
| **Birth rate** | 0 | | | | $0.00 | | $0.00 |
| **Mortality rate** | 0 | | | | $0.00 | | $0.00 |
| **Number of individuals** | 0 | | | | $0.00 | | $0.00 |
| **Number of features** | 0 | | | | $0.00 | | $0.00 |
| **Condition of habitat** | 0 | | | | $0.00 | | $0.00 |
| **Area of habitat** | 11.943 | 13.38 | 112.01% | **Yes** | $0.00 | N/A | $0.00 |
| **Area of community** | 0 | 0.00 | #DIV/0! | **#DIV/0!** | $0.00 | #DIV/0! | #DIV/0! |
| | | | | | **$0.00** | **#DIV/0!** | **#DIV/0!** |