Interim Report (April 2018)

Biological Survey: Kojaneerup Project
South Coast Highway, 46.4 to 65.7 SLK

Report prepared for
Main Roads Western Australia
April 2018

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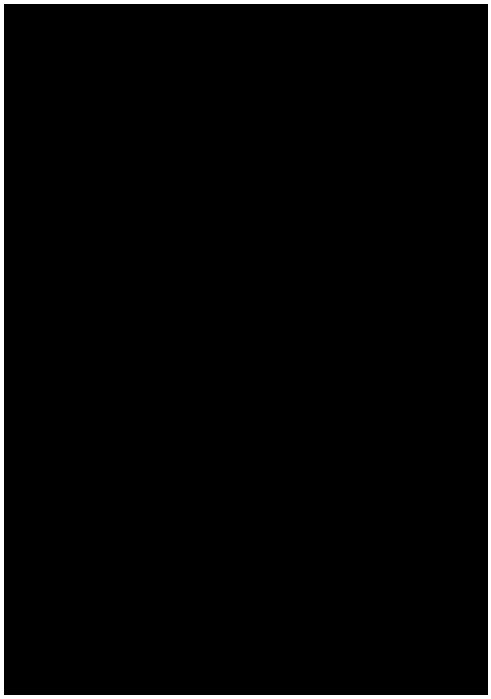

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REPORT CONTENTS

1 SUMMARY

Main Roads Great Southern Region are proposing to upgrade South Coast Highway between SLK 46.4 and 65.7 (Kojaneerup Project). A biological survey of 275 hectares (ha) was previously undertaken for the Project by GHD (2016). This report details a biological survey by Southern Ecology, of two small additional survey areas (2.4 ha) and infill targeted flora survey within the larger Project Survey Area.

Additional Survey Areas

- Two vegetation associations and 127 taxa from 29 families, including 9 weeds were recorded within and adjacent to four quadrats (Appendix C, D).
- A small area of vegetation (0.94 ha) was concordant with the Proteaceae Dominated Kwongkan Shrublands of the southeast coastal floristic province Threatened Ecological Community (Kwongkan TEC) (DotE 2014).
- Two Priority-listed (Appendix A) flora were recorded: - *Stylidium daphne* (P2) and *Centrolepis caespitosa* (P4).
- Two conservation-listed fauna (Appendix A) are highly likely to utilise habitats within the additional survey areas: - Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*, T-EN) and Southern Brown Bandicoot (*Isoodon obesulus* subsp. *fusciventer*, P5).
- Survey intensity is considered sufficient for Environmental Impact Assessment within the additional survey areas.

Infill Targeted Flora Survey

- Targeted infill survey was undertaken over approximately 145 ha (52%) of the Project Area.
- An additional 3,684 individuals of nine Priority flora were recorded, one previously not known from the Project Area: - *Gonocarpus trichostachyus* (P3), *Centrolepis caespitosa* (P4), *Stylidium daphne* (P2), *Stylidium gloeophyllum* (P4), *Stenanthemum sublineare* (P2), and *Synaphea incurva* (P1), *Drosera fimbriata* (P4) and *Leucopogon altissimus* (P3).
- Three additional annual flora were recorded: - *Microtis atrata, Microtis cupularis* and *Thelymitra antennifera. Microtis cupularis* occurs over a wide distribution, although has not been previously recorded within 150 km of the Survey Area.
- One additional introduced species was recorded, **Kunzea ambigua*, which is considered significant by local government authorities.
- Survey intensity is only considered to be partially sufficient for Environmental Impact Assessment within the Project Area. Southern Ecology has been engaged to undertake further targeted flora survey in Autumn and Spring 2018.

2 INTRODUCTION

Main Roads Great Southern Region are proposing to upgrade South Coast Highway between SLK 46.4 and 65.7. The proposed upgrade is referred to as the Kojaneerup Project. The Project Survey Area is a narrow corridor that includes the South Coast Highway road reserve of (approx. 40 m wide) and a small strip of Hassel National Park, which encompasses the entire length of the Project. A biological survey of 275 hectares (ha) was previously undertaken for the Project by GHD (2016). Southern Ecology was engaged in Spring 2017 to complete a biological survey of two small additional areas (total 2.4 ha) and to undertake further targeted flora survey within the Project Survey Area. Additional survey was warranted due to the high diversity, vegetation complexity and potential impacts within conservation estate.

The Survey Area is located approximately 50 km east of Albany and occurs within the Esperance Plains and Jarrah Forest Interim Biogeographic Regionalisation of Australia (IBRA) Regions (Department of the Environment [DotE] 2014). Broad scale pre-European vegetation mapping (Shepherd et al. 2002) indicates that the native vegetation of the area is composed of "Mallee-heath. Mixed heath with scattered mallee" (Vegetation Association: Riche_980) and "Low forest, woodland or low woodland with scattered trees of *Eucalyptus marginata*, *Banksia* spp., *Allocasuarina* spp." (Vegetation Association: East Kalgan_994). The soil-landscapes (Department of Agriculture and Food Western Australia [DAFWA] 2014) of the Survey Area are mapped as:

- *Chillinup System* described as "Level to gently undulating sandplain with scattered small lakes and depressions. Some lunettes and linear dunes. Lower slopes are often saline. Mallee-heath and yate and banksia woodlands".
- *Chillinup 5 Subsystem* described as "Gentle gravelly rises with some areas of deep sand sheet deposits".
- *Dempster crest Phase* described as "Sands and laterite on elongate crests; Jarrah-Albany Blackbutt-Marri forest".
- *Minor Valleys 6 Subsystem* described as "Narrow V-shaped valleys, in sedimentary rocks;<10 m relief. Sandy yellow duplex soils on slopes; Jarrah-Marri low forest. Deep sands on narrow swampy floor; sedges and reeds".
- *Minor Valleys S7 slope Phase* described as "Broad valleys in sedimentary rocks; 30 m relief; smooth slopes. Deep sands and iron podzols on slopes; Albany Blackbutt-jarrah-sheoak woodland. Podzols and yellow duplex soils on floors; paperbark woodland, teatree heath".
- *Takalarup Subsystem* described as "Broadly undulating plateau; lakes; depressions; hummocks; scattered siltstone. Gravelly yellow duplex soils on plains, yellow solonetzic soils in depressions, podzols in sands of hummocks.".

3 METHODS

The assessment was conducted by Damien Rathbone with field assistance by Fin Pope-Gilby. Field visits were conducted in October and November 2017. Location information for all features were identified using a handheld GPS (Garmin 64).

3.1 Desktop Assessment

A desktop assessment of known or potential conservation significant vegetation, flora and fauna within a 10km radius of the Survey Area was undertaken using the following sources:

- Priority flora records from previous assessment of Study Area (GHD 2016).
- Protected Matters Search Tool (PMST) (Department of the Environment and Energy [DotEE] 2017a).
- Threatened and Priority flora and fauna records from the Department of Biodiversity, Conservation and Attractions [DBCA] and/or the Western Australian Herbarium as supplied by Main Roads.
- Priority Ecological Community (PEC) and Threatened Ecological Community (TEC) mapping from the Species and Communities Branch, DBCA, as supplied by Main Roads.

3.2 Vegetation Assessment

A vegetation assessment was conducted using floristic quadrats of 100 m^2 in accordance with technical guidance (EPA 2016) where the following attributes were recorded:

- Location and site description – GPS coordinate of NW corner, other corners measured using a vertex (Nikon 36) and compass.
- Species inventory – all vascular plant species present, including weed species. Species that were not confidently identified during the field survey were collected for identification in the Albany Regional Herbarium or Western Australian Herbarium.
- Foliar cover – the estimated percentage cover for each stratum.
- Vegetation condition – according to the current vegetation condition classification (Table 1).
- Photographs – four photographs overlooking the quadrat were combined into a panorama.

Quadrat information was used to define the vegetation association according to the National Vegetation Information System (Executive Steering Committee for Australian Vegetation Information [ESCAVI] 2003) and then aligned with units described by GHD (2016). Floristic similarity was assessed using two-way tables and field observations, no cladistics analysis was conducted.

Table 1. Vegetation condition scale (EPA 2016).

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. 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 disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, 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. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, 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 areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

3.3 Targeted Flora Survey

A targeted search for potential Threatened and Priority flora identified from the desktop assessment was conducted across the Survey Area. The search was conducted in the appropriate season to detect most of the Threatened or Priority species considered possible or likely to occur. The assessment area was initially surveyed via a meandering traverse to identify vegetation types and condition. Where vegetation types were identified as potential habitat for Threatened or Priority flora, an intensive grid of suitably spaced transects was surveyed. Population census and site information of Threatened or Priority flora was recorded in accordance with the Threatened & Priority Flora (TPFL) Database Manual (Department of Environment and Conservation [DEC] 2010). Population size was determined by either direct counts, or by estimation of plant density using transects or suitably sized quadrats.

3.4 Fauna Habitat Assessment

A fauna habitat assessment was undertaken in accordance with technical guidance for fauna surveys in Western Australia (EPA and DEC 2010). The fauna assessment primarily focused on the identification of fauna habitat based on broad vegetation type, structure and condition, and the likelihood of occurrence determined from the desktop analysis. Opportunistic recording of evidence (sightings, bird calls, tracks, scats, bones and feeding signs) of conservation significant fauna was undertaken within the Study Area.

Breeding, foraging and roosting habitat of threatened Black Cockatoos was assessed in accordance with the EPBC Act Referral guidelines (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC 2012). This included recording the species, location, number and behaviour of any observed Black Cockatoos; recording the number, location and species of breeding trees above or equal to a diameter at breast height (DBH) of 500mm and notes on whether they contain hollows; the presence and extent of potential and known foraging habitat (identification of areas with known feeding species and observations of feeding evidence); and the presence and extent of potential roosting habitat.

3.5 Legislation and Conservation Significance

Flora, fauna and vegetation can be considered as conservation significant under Federal or State legislation or though listing by State Government Authorities. These are explained below with the definitions of conservation status relevant to the different Acts tabulated in Appendix A.

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Federal Government and provides protection to Threatened flora, fauna or vegetation communities that are recognised as Matters of National Environmental Significance (MNES). Impacts to MNES require approval from the Federal Minister for the Environment.

State Government legislation includes the *Wildlife Conservation Act 1950* (WC Act), which recognises flora, fauna and vegetation that is Threatened (state level only) or in need of special protection within Western Australia. The recently proclaimed *Biodiversity Conservation Act* 2016 (BC Act) will supersede the WC Act. The DBCA also maintains a list of Priority flora, fauna and ecological communities that warrant monitoring or protection.

The *Environmental Protection Act* 1986 (EP Act) provides regulations for clearing of vegetation or habitats through ten clearing principles (Schedule Five of the EP Act) relevant to the biological and environmental aspects of native vegetation. The EP Act also recognises Environmentally Sensitive Areas (ESA) that have specific values such as threatened species, certain conservation estate and wetlands.

Other State level measures of conservation significance other than statutory listing include association with restricted habitats, range extensions, relictual characteristics, potentially novel taxa and naturally occurring hybrids. Conservation targets also exist for the protection of certain vegetation above thresholds of pre-European extent (EPA 2016).

4 RESULTS - ADDITIONAL SURVEY AREAS

4.1 Vegetation

Four floristic quadrats were established within the additional Survey Areas (Appendix D). A total of 127 taxa from 29 families, including 9 weeds were recorded (including opportunistic observations; Appendix C). Two vegetation associations were recorded, which have previously been described and mapped in the Project Survey Area (GHD 2016). A small area of sedgeland swamps was mapped in the additional survey areas through extrapolation of the previous mapping (GHD 2016). Due to the very low extent of this association, no floristic description or quadrat assessment was undertaken.

Table 2. Extent (ha) and condition (EPA 2016) of vegetation associations in the Additional Survey Areas.

	Condition			
Vegetation Association	**Good**	**Very Good**	**Excellent**	**Total:**
Hakea spp. Complex - A	0.16	0.43	0.94*	1.53
Sedgelend Swamps			0.02	0.02

The majority of the additional survey areas were mapped as *Hakea* spp. Complex – A, which is contiguous with the adjacent areas mapped by GHD (2016). This association was described by GHD (2016) as the most common of four structurally and floristically diverse associations typically dominated by *Hakea* species. Complex type A is delineated based on the dominance of *H. cucullata* and *H. ferruginea* occurring on soils with impeded drainage. Due to the dominance of Proteaceae species, many areas of this association meet the requisite criteria of Kwongkan TEC.

Within the additional survey areas *Hakea* spp. Complex – A was mapped in condition grading from Good to Excellent. A total of 0.94 ha was mapped as Excellent condition and is concordant with the Kwongkan TEC, due to the cover of Proteaceae species > 30%. The floristics and condition within and adjacent to the four quadrats established are described below (Plate 1-5). Quadrats one to 20 were previously established by GHD (2016).

Plate 1. *Hakea* spp. Complex - A from quadrat 21 (621097mE, 6158531mN) occurring on a hill crest with grey sand. Condition excellent and Proteaceae >30% therefore concordant with Kwongkan TEC.

Species present: *Acacia varia* var. *varia, Agonis theiformis, Allocasuarina humilis, Amphipogon amphipogonoides, Anarthria gracilis, Anarthria prolifera, Astroloma prostratum, Banksia mucronulata, Banksia obtusa, Beaufortia anisandra, Boronia crenulata, Boronia spathulata, Bossiaea praetermissa, Cassytha racemosa, Chordifex isomorphus, Chordifex laxus, Chorizema glycinifolium, Dampiera juncea, Desmocladus fasciculatus, *Disa bracteata, Drosera erythrorhiza, Drosera menziesii, Eucalyptus decurva, Eucalyptus marginata, Eucalyptus staeri, Gastrolobium retusum, Gompholobium venustum, Haemodorum laxum, Hakea ceratophylla, Hakea cucullata, Hakea ferruginea, Hakea lasiantha, Hakea trifurcata, Hibbertia gracilipes, Hibbertia recurvifolia, Hovea trisperma, Isopogon longifolius, Kingia australis, Lepidosperma squamatum, Leucopogon flavescens* var. *brevifolius, Leucopogon gibbosus, Melaleuca striata, Patersonia limbata, Petrophile divaricata, Petrophile squamata, Pultenaea verruculosa, Schoenus obtusifolius, Stylidium daphne (P2), Taxandria spathulata, Tetraria octandra, Thelymitra sp., Tricostularia compressa, Tricostularia compressa, Tricostularia neesii, Xanthorrhoea platyphylla.*

Plate 2. *Hakea* spp. Complex - A from quadrat 22 (621122mE 6158694mN) occurring on a very gentle hill-slope with light grey sand and laterite gravel. Condition Excellent and Proteaceae >30% therefore concordant with Kwongkan TEC.

Species present: *Acacia drummondii, Adenanthos apiculatus, Agonis theiformis, Amphipogon amphipogonoides, Anarthria gracilis, Anarthria prolifera, Andersonia depressa, Banksia mucronulata, Beaufortia anisandra, Boronia spathulata, Cassytha melantha, Chordifex isomorphus, Chordifex laxus, Comesperma calymega, Comesperma virgatum, Conostylis setigera, Dampiera juncea, Desmocladus fasciculatus, Drosera pulchella, Eucalyptus marginata, Gompholobium venustum, Goodenia incana, Goodenia pterigosperma, Hakea ceratophylla, Hakea ferruginea, Hakea lasiantha, Hakea trifurcata, Hibbertia gracilipes, Hibbertia recurvifolia, Hovea trisperma, Johnsonia acaulis, Laxmannia sessiliflora, Lepidosperma squamatum, Lepidosperma squamatum, Lepyrodia hermaphrodita, Levenhookia stipitata, Melaleuca striata, Mesomelaena stygia* subsp. *stygia, Mesomelaena tetragona, Neurachne alopecuroidea, Nuytsia floribunda, Patersonia limbata, Rinzia schollerifolia, Rytidosperma setaceum, Schoenus caespititius, Schoenus obtusifolius, Schoenus* sp., *Schoenus subfascicularis, Stylidium scandens, Synaphea petiolaris* subsp. *petiolaris, Taxandria spathulata, Tetraria octandra, Tetraria* sp. Jarrah Forest (R. Davis 7391*), Thelymitra crinita, Tricostularia compressa, Tricostularia neesii, Xanthorrhoea platyphylla, Xanthosia huegellii.*

Plate 3. *Hakea* spp. Complex - A from quadrat 23 (620660mE 6156732mN) occurring on gentle hill-slope with brown loam with laterite boulders. Condition Very Good to north and Excellent to South. Patch cover of Proteaceae is below 30%, due to long unburnt structure. Considered concordant with Kwongkan TEC due to likely recovery of Proteaceae after fire and in context of contiguous Kwongkan TEC south of quadrat.

Species present: *Agonis theiformis, Allocasuarina humilis, Anarthria gracilis, Anarthria prolifera, Billardiera heterophylla, *Briza maxima, Chordifex isomorphus, Chordifex laxus, Cyathochaeta avenacea, Desmocladus fasciculatus, *Disa bracteata, Drosera menziesii, *Ehrharta calycina, *Eucalyptus globulus, Eucalyptus staeri, Haemodorum spicatum, Hakea cucullata, Hakea ferruginea, Hakea lasiantha, Hibbertia recurvifolia, *Holcus lanatus, Hovea trisperma, Lepidosperma drummondii, Lepidosperma squamatum, Lomandra purpurea, Mesomelaena stygia subsp. stygia, Mesomelaena tetragona, Microtis atrata, *Pinus radiata, Sphaerolobium grandiflorum, Stirlingia latifolia, Tetraria octandra, Tricostularia compressa, Tricostularia neesii, Xanthorrhoea platyphylla.*

Plate 4. *Hakea* spp. Complex - A from quadrat 24 (620751mE 6157098mN) occurring on sandy road batter. Condition Very Good although highly modified by previous road works. Not considered concordant with Kwongkan due to cover of Proteaceae below 30% and disturbance history.

Species present: *Acacia cyclops, Agonis theiformis, Anarthria prolifera, Anarthria prolifera, Billardiera heterophylla, Boronia albiflora, Boronia spathulata, *Briza maxima, Cassytha melantha, Cassytha racemosa, Caustis dioica, Dasypogon bromeliifolius, *Eragrostis curvula, Eucalyptus staeri, *Gladiolus undulatus, Hakea ceratophylla, Hakea cucullata, Hakea ruscifolia, Hovea trisperma, Lambertia echinata* subsp. *citrina, Lepidosperma squamatum, Melaleuca striata, Stirlingia latifolia, Taxandria spathulata, Tricostularia neesii, Xanthorrhoea platyphylla.*

Plate 5. Hakea spp. Complex – A mapped in Good or Very Good condition consisted of remnant clusters of *Eucalyptus staeri* and occasional *Hakea cucullata* with a depauperate understory, interspersed with sedgeland. These areas were not concordant with the Kwongkan TEC.

4.2 Conservation Significant Flora

Two Priority flora were recorded and mapped in the additional survey area adjacent to the Drawbin Rd/ South Coast Highway Intersection (Appendix B). A total of 16 individuals of *Stylidium daphne* (P2) (Plate 6) were found scattered within intact Kwongkan TEC and on the edge of a fire break. A total of 37 individuals of *Centrolepis caespitosa* (P4) (Plate 7) were found in subtle depressions along the edge of a fire break. No conservation significant flora was recorded in the second additional survey area.

Plate 6. *Stylidium daphne* (P2).

Plate 7. *Centrolepis caespitosa* (P4).

4.3 Conservation Significant Fauna

Carnaby's Cockatoo (Calyptorhynchus latirostris) (T)

Woodlands or forests of Marri, Jarrah or Karri (*Eucalyptus diversicolor*) and shrublands of *Hakea, Banksia* and *Grevillea* are considered habitat for Carnaby's Cockatoo (DSEWPaC 2012). On the south coast this species feeds on Jarrah and Marri seeds and a wide variety of mainly proteaceous species. Breeding occurs in large Jarrah and Marri in hollows with an entrance diameter >200mm. (Pittman *et. al*. 2007, Whitford 2002, DPaW 2013). Night roosting habitat usually consists of tall trees, close to a water source and within an area of quality foraging habitat. On the south coast, potential roost trees include Marri, Karri, Blackbutt, *Taxandria juniperina* or introduced eucalypts and pines (DSEWPaC 2012).

The Survey Area occurs within the known distribution and predicted breeding range of Carnaby's Cockatoo. Areas of Kwongkan TEC in excellent condition are considered high quality foraging habitat. The additional survey areas are contiguous with high quality foraging habitat within the Hassell National Park. No individuals were directly observed during the field survey and no trees suitable for breeding or night roosting were recorded. Several small flocks (<10 birds) were observed within the Hassell National Park during the targeted flora survey.

Southern Brown Bandicoot/Quenda (Isoodon obesulus* subsp*. fusciventer) (P4)

Quenda occur in wet or dry sclerophyll forest through to open woodland and scrubby, dense vegetation (Paull 2008). Characteristic runnels made by Quenda were observed in dense shrublands in the area adjacent to the Drawbin Rd/ South Coast Highway Intersection, although they are likely to utilise habitats throughout both survey areas and the contiguous surrounding vegetation.

Other potential Conservation Significant Fauna

Several other conservation significant fauna were considered to possibly utilise habitat within the Project Survey Area (GHD 2016): - Forest Red-tailed and Baudin's Black Cockatoo, Western Whipbird, Rainbow Bee-eater and Western Brush Wallaby. Potential habitats for these species are contiguous throughout Project and additional survey areas. No evidence was observed of Western Ring-tailed Possum (previously recorded at Cheynes Beach Rd intersection), therefore the additional Survey Areas are potentially outside its distribution.

5 RESULTS - INFILL TARGETED FLORA SURVEY

Infill targeted flora survey was undertaken over approximately 145 ha (52%) of the Project Area. The targeted survey areas were chosen due to high quality vegetation condition or for representing generally uncommon landforms. Three additional annual flora and one weed species were observed that were not previously recorded from the Survey Area. *Microtis cupularis* occurs over a wide distribution, although has not been previously recorded within 150 km of the Survey Area. *Kunzea ambigua*, was found from one isolated location and is considered a significant weed by local government authorities.

An additional 3,684 individuals of eight Priority flora were recorded, including one species previously not recorded from the Project Area (*Leucopogon altissimus* (P3)). The survey effort and general location of the additional priority flora is mapped in Appendix B and tabulated below (Table 3). Survey intensity within the Project Area is considered to be only partially sufficient for Environmental Impact, therefore Southern Ecology has been engaged to undertake further targeted flora survey in Autumn and Spring 2018 (final results will be appended and fully mapped within final report).

Table 3. Additional results of Priority-listed flora (Appendix A) from infill targeted flora survey of the Kojaneerup Project Survey Area (Spring 2017).

Taxon (Status)	Number of additional individuals recorded	Comments
Leucopogon sp. Manypeaks (A.S. George 6488) (P1)	24	13 previously recorded (GHD 2016). Survey by DBCA increased the total known plants in Survey Area to 37 individuals
Synaphea incurva (P1)	265	Previously only known from one individual (GHD 2016). Several new sub-populations recorded, including some that extend out of Survey area along Bluff Creek Rd
Stylidium daphne (P2)	28	Several new sub-populations and isolated plant recorded
Stenanthemum sublineare (P2)	4	Population count increase to existing population
Gonocarpus trichostachyus (P3)	91	Several new sub-populations recorded
Leucopogon altissimus (P3)	7	Several plants observed on road verge. Requires further survey
Centrolepis caespitosa (P4)	2,088	Plants highly abundant in localised patches, associated with *Taxandria spathulata* on spongolite
Stylidium gloeophyllum (P4)	1,127	Locally abundant within the western section of the Survey Area
Drosera fimbriata (P4)	50	Population count increases to several existing populations

Four other Priority flora are known from the Survey Area, including *Latrobea recurva* (P3), *Synaphea preissii* (P3), *Tetraria* sp. Blackwood (A.R. Annels 3043) (P3) and *Xanthosia eichleri* (P4). No additional individuals were recorded, although suitable habitats for these taxa were only partially surveyed.

6 SURVEY LIMITATIONS

Seasonal conditions preceding the field assessment have the potential to affect the emergence of annual species and the flowering of perennial species. The Survey Area occurs within a high rainfall zone and the assessment was conducted after close to average rainfall (Figure 1). Consequently, dry soil conditions were not considered a major limitation for the emergence and flowering of Threatened or Priority flora species. Heavy spring rainfall preceding the field assessment caused considerable flooding in the Survey Area; it is unknown how this may have affected early flowering annual taxa.

The information provided within this report is accurate and correct to the best of the author's knowledge. However, no liability is accepted for loss, damage or injury arising from its use. Plant populations can fluctuate over time, particularly after disturbance events such as fire and drought. Consequently, all mapping, vegetation descriptions and population estimates within this report should not be considered accurate indefinitely.

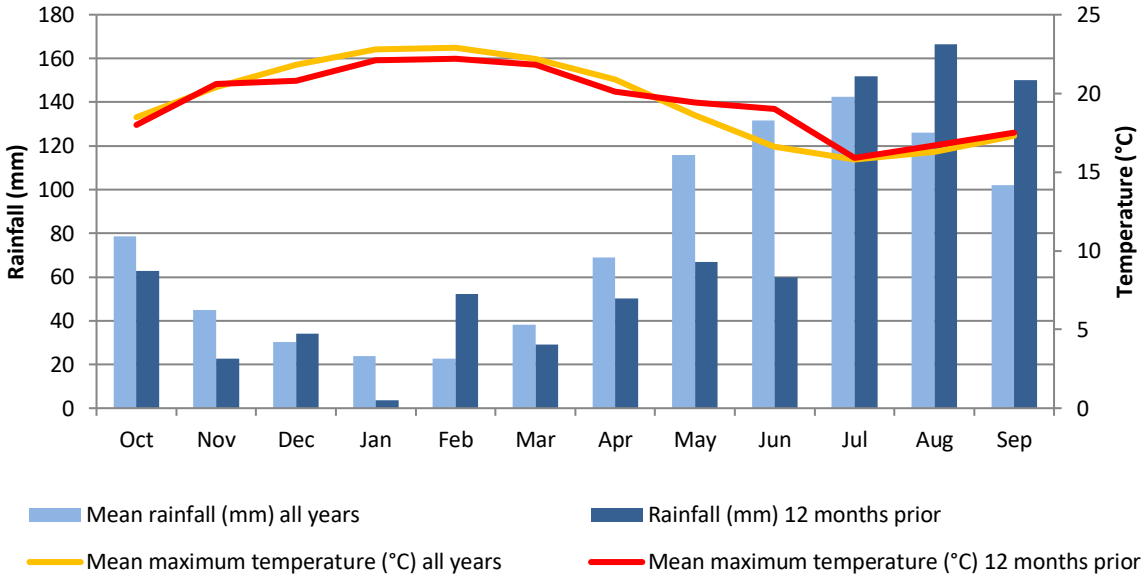

Figure 1. Climate statistics for 12 months prior to the assessment compared with historical averages (all years available) from the nearest weather station (Albany 9500) (BOM 2017). Total rainfall for 12-month period prior to the survey was 850 mm compared to the historic average of 925 mm.

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8 APPENDIX A - Conservation Status Definitions

Table A1. Acts used in environmental impact assessment.

Environment Protection and Biodiversity Conservation [EPBC] *Act 1999*	https://www.legislation.gov.au/Details/C2016C00777
Wildlife Conservation [WC] *Act 1950*	https://www.slp.wa.gov.au/legislation/statutes.nsf/law_a908.html
Environmental Protection [EP] *Act 1986*	https://www.slp.wa.gov.au/legislation/statutes.nsf/law_a252.html
Biodiversity Conservation [BC] *Act 2016*	https://www.slp.wa.gov.au/legislation/statutes.nsf/law_a147120.html

Table A2. The categories for flora and fauna listed as Threatened or specially protected. Taxa can be recognised as Threatened (T) or Conservation Dependent under Federal (EPBC) and / or State (WC / BC) Acts.

Threat category	Definition
Threatened - Critically Endangered (T-CR)	Considered to be facing an extremely high risk of extinction in the wild
Threatened – Endangered (T-EN)	Considered to be facing a very high risk of extinction in the wild
Threatened – Vulnerable (T-VN)	Considered to be facing a high risk of extinction in the wild
Threatened - Presumed extinct (T-EX)	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died.
Conservation dependant (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened
Migratory birds protected under international agreement (IA)	Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation

Table A3. Flora or fauna that are potentially threatened but do not meet the survey criteria or are otherwise data deficient are listed under Priority categories.

Category	Description
Priority One (P1)	Known from few locations (generally <5), small populations and/or occurring on land with insecure tenure
Priority Two (P2)	Known from few locations (generally <5), small populations with some occurring on land with secure tenure
Priority Three (P3)	Known from several locations with habitat not under imminent threat
Priority Four (P4)	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy

Table A4. Categories for ecological communities listed as Threatened (TEC). Communities can be recognised as Threatened under Federal (EPBC) and / or State (WC / BC) Acts.

Category	Description
Presumed totally destroyed (PU)	Adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.
Critically Endangered (CR)	Adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
Endangered (EN)	Adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future.
Vulnerable (VU)	Adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium (within approximately 50 years) to long-term future.

Table A5. The categories for ecological communities listed as Priority (PEC).

Category	Brief description
Priority One (P1)	Known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha) and are currently under threat
Priority Two (P2)	Known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years)
Priority Three (P3)	Known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or; (iii) made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc
Priority Four (P4)	Adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring
Priority Five (P5)	Conservation dependant ecological communities. Not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years

9 APPENDIX B - Maps

Map 1: Project Overview, Additional Survey Areas and Targeted Flora Survey Infill, Kojaneerup Project

Map produced by Damien Rathbone on 19/04/2018.
Report Reference: Biological Survey: Kojaneerup Project South Coast Highway, 46.4 to 65.7 SLK (SE1714).

Map Projection: Transverse Mercator Horizontal Datum GDA 1994 Grid: MGA Zone 50 Map Size: A3 at 1:55,000

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Total Survey Area (GHD - Spring 2016)

Additional Survey Features (Southern Ecology - Spring 2017)

Additional Survey Area Map Index

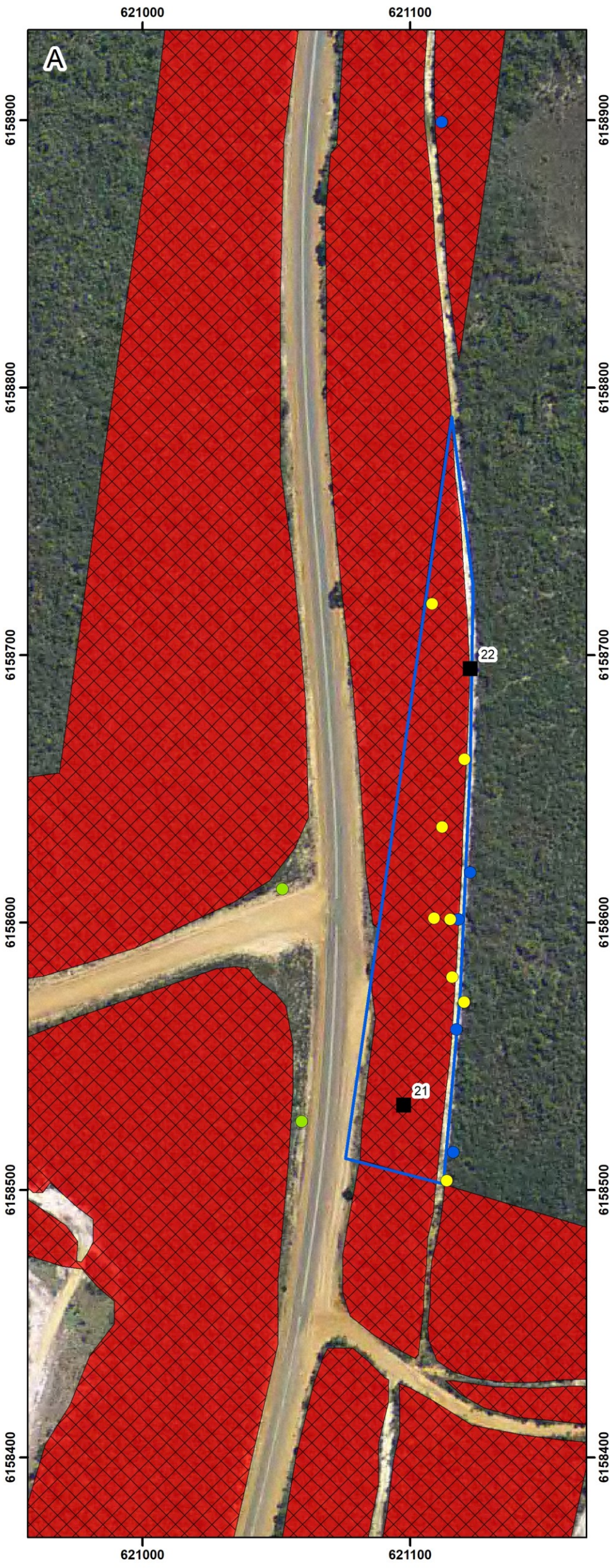
Infill Targeted Flora Survey Undertaken

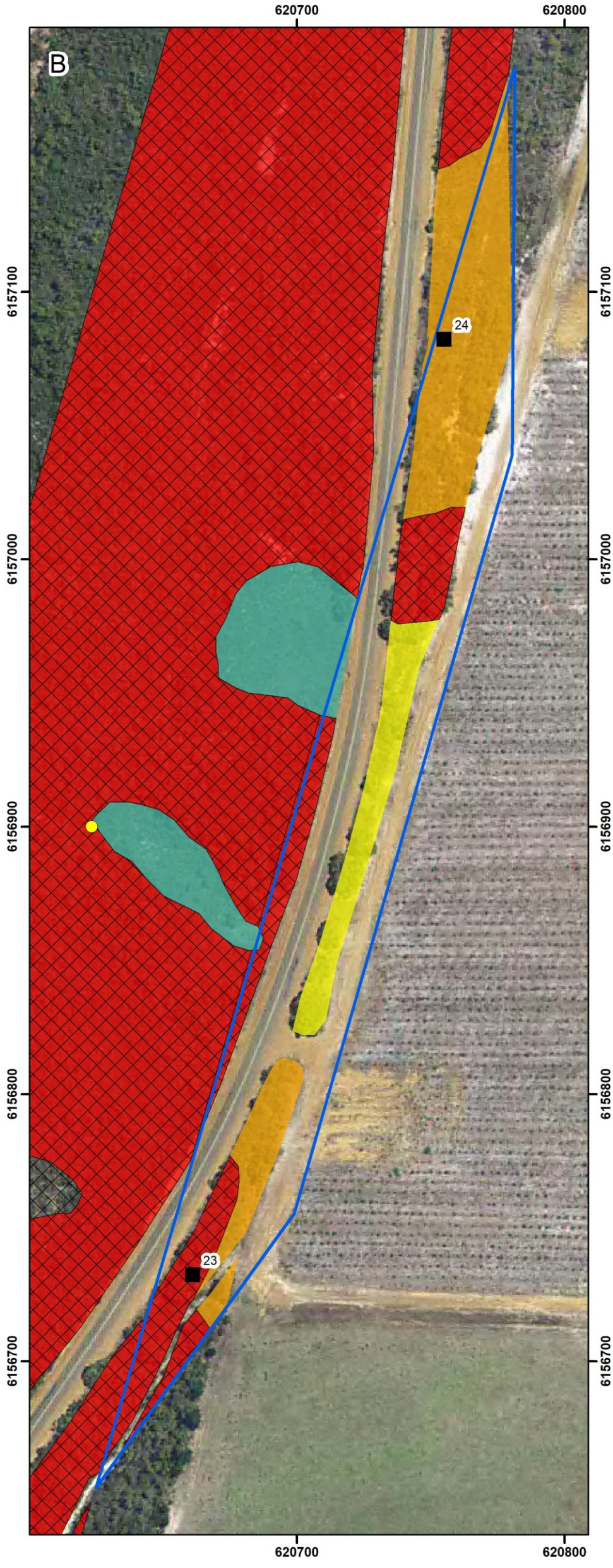
Additional Cons. Significant Flora Locations

N

0 1

Kilometers





Map 2A&B: Vegetation Association/Condition & Conservation Sigificant Flora, Kojaneerup Project

Map produced by Damien Rathbone on 19/04/2018.
Report Reference: Biological Survey: Kojaneerup Project South Coast Highway, 46.4 to 65.7 SLK (SE1714).

Map Projection: Transverse Mercator Horizontal Datum GDA 1994 Grid: MGA Zone 50 Map Size: A3

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Vegetation Association, Condition

- Hakea spp Complex - A, Excellent
- Hakea spp Complex - A, Very Good
- Hakea spp Complex - A, Good
- Sedgeland Swamps, Excellent
- Kwongkan TEC

Conservation Significant Flora

- *Centrolepis caespitosa (P4)*
- *Stylidium daphne (P2)*
- *Xanthosia eichleri (P4)*
- Quadrat Locations
- Additional Survey Area (Southern Ecology)

N

0 50

Metres

10 APPENDIX C - Plant Taxa Inventory

Table C1: Vascular plant taxa recorded opportunistically in the Survey Areas. Nomenclature and status according WAH (1998-) and DotEE (2017b). *denotes weed taxon.

FAMILY	TAXON
Anarthriaceae	*Anarthria gracilis*
	Anarthria prolifera
Apiaceae	*Xanthosia singuliflora*
	Xanthosia huegelii
Asparagaceae	*Laxmannia sessiliflora*
	Lomandra hastilis
	Thysanotus pseudojunceus
	Thysanotus thyrsoideus
Casuarinaceae	*Allocasuarina humilis*
Centrolepidaceae	*Centrolepis caespitosa* (P4)
	Centrolepis drummondiana
Cyperaceae	*Caustis dioica*
	Cyathochaeta avenacea
	Lepidosperma drummondii
	Lepidosperma squamatum
	Mesomelaena stygia subsp. *stygia*
	Mesomelaena tetragona
	Schoenus caespititius
	Schoenus obtusifolius
	Schoenus sp.
	Schoenus subfascicularis
	Tetraria octandra
	Tetraria sp. Jarrah Forest (R. Davis 7391)
	Tricostularia compressa
	Tricostularia neesii
	Tricostularia sp. south coast (R.T. Wills 1423)
Dasypogonaceae	*Dasypogon bromeliifolius*
	Kingia australis
Dilleniaceae	*Hibbertia gracilipes*
	Hibbertia recurvifolia
Droseraceae	*Drosera erythrorhiza*
	Drosera menziesii
	Drosera pulchella
Ericaceae	*Andersonia depressa*
	Andersonia simplex
	Astroloma prostratum
	Leucopogon altissimus (P3)
	Leucopogon flavescens var. *brevifolius*
	Leucopogon gibbosus
Fabaceae	*Acacia cyclops*
	Acacia drummondii
	Acacia varia var. *varia*
	Bossiaea praetermissa
	Chorizema glycinifolium
	Chorizema reticulatum
	Gastrolobium retusum
	Gompholobium venustum
	Hovea trisperma
	Pultenaea verruculosa
	Sphaerolobium grandiflorum
Goodeniaceae	*Dampiera juncea*
	Goodenia filiformis
	Goodenia incana
	Goodenia pterigosperma
Haemodoraceae	*Conostylis serrulata*
	Conostylis setigera
	Conostylis vaginata
	Haemodorum laxum
	Haemodorum spicatum
Hemerocallidaceae	*Johnsonia acaulis*
Iridaceae	**Gladiolus undulatus*
	Patersonia limbata
Lamiaceae	*Hemigenia humilis*
Lauraceae	*Cassytha melantha*
	Cassytha racemosa
Loranthaceae	*Nuytsia floribunda*
Myrtaceae	**Eucalyptus globulus*
	**Kunzea ambigua*
	Agonis flexuosa
	Agonis theiformis
	Astartea glomerulosa
	Beaufortia anisandra
	Eucalyptus decurva
	Eucalyptus marginata
	Eucalyptus staeri
	Melaleuca striata
	Rinzia schollerifolia
	Taxandria spathulata
Orchidaceae	**Disa bracteata*
	Caladenia flava
	Microtis atrata
	Microtis cupularis
	Thelymitra antennifera
	Thelymitra crinita
	Thelymitra sp.
Pinaceae	**Pinus radiata*
Pittosporaceae	*Billardiera heterophylla*
Poaceae	**Briza maxima*
	**Ehrharta calycina*
	**Eragrostis curvula*
	**Holcus lanatus*
	Amphipogon amphipogonoides
	Neurachne alopecuroidea
	Rytidosperma setaceum
Polygalaceae	*Comesperma calymega*
	Comesperma virgatum
Proteaceae	*Adenanthos apiculatus*
	Banksia dryandroides
	Banksia mucronulata
	Banksia obovata
	Hakea ceratophylla
	Hakea cucullata
	Hakea elliptica
	Hakea ferruginea
	Hakea lasiantha
	Hakea ruscifolia
	Hakea trifurcata
	Isopogon longifolius
	Lambertia echinata subsp. *citrina*
	Petrophile divaricata
	Petrophile squamata
	Stirlingia latifolia
	Synaphea petiolaris subsp. *petiolaris*
	Synaphea reticulata
Restionaceae	*Chordifex isomorphus*
	Chordifex laxus
	Desmocladus fasciculatus
	Lepyrodia hermaphrodita
Rutaceae	*Boronia albiflora*
	Boronia crenulata
	Boronia denticulata
	Boronia spathulata
Stylidiaceae	*Levenhookia dubia*
	Levenhookia stipitata
	Stylidium daphne (P2)
	Stylidium scandens
Xanthorrhoeaceae	*Xanthorrhoea platyphylla*

11 APPENDIX D - Likelihood of Occurrence Analysis

A likelihood of occurrence of all conservation significant species (flora only) was assessed based on the presence of suitable habitat and other factors as outlined in Table E1. Suitable habitat was determined from information in herbarium voucher labels, published descriptions, distribution records and knowledge from the authors.

A comprehensive desktop analysis of potential fauna within the Project Survey Area was undertaken by GHD (2016). This previous assessment is considered sufficient to inform the likelihood of occurrence of conservation significant fauna in the small additional survey areas, as the vegetation and habitats are contiguous.

Table E1: Criteria for assessing the likelihood of occurrence of conservation significant flora and fauna that could potentially occur within the Survey Area.

Present	Species is recorded within the Survey Area.
Likely	Species is relatively wide spread, has been previously recorded a number of times recently within 10 km of the Survey Area and suitable habitat occurs within the Survey Area.
Possible	Species previously recorded within 10 km and suitable habitat occurs in the Survey Area.
Unlikely	Suitable habitat may occur but the species has a highly restricted distribution, is very rare and only known from a limited number of populations.
Highly Unlikely	Suitable habitat for the species does not occur at the Survey Area OR Suitable habitat does occur but the species has a highly restricted distribution, is very rare and only known from a limited number of populations OR The Survey Area is outside the species' natural distribution.

Table E2. Likelihood of occurrence of conservation significant flora recorded in the vicinity of the Survey Area (<10 km). Twelve Threatened taxa are not recorded within the vicinity (records = 0) but have the potential to occur according to the Protected Matters Search Tool (PMST) (Department of the Environment and Energy [DotEE] 2017a).

Status, Taxon [FAMILY]	Records in vicinity (<10km)	Description, Habitat & Distribution	Likelihood of Occurrence
T *Andersonia pinaster* [Ericaceae]	1	Erect, slender shrub, 0.2-0.6 m high. Flowers blue, Jul to Nov. Grey/white sand, sandy clay, granite. Winter-wet slopes, outcrops, hills.	Highly unlikely
T *Banksia anatona* [Proteaceae]	1	Upright, non-lignotuberous shrub, to 5 m high. Flowers yellow, Jan to Mar. Grey sand over gravelly shale, rocky silty clay loam. Lower slopes of ranges.	Record in proximity is a translocation site outside of species natural range
T *Banksia brownii* [Proteaceae]	7	Bushy, non-lignotuberous shrub or tree (small), 1-6 m high. Flowers cream & brown/orange-red, Mar to Jul. Sand over laterite, gravel, loam over granite. In gullies.	Possible. One record is a translocation site
T *Banksia pseudoplumosa* [Proteaceae]	0	Non-lignotuberous shrub, to 1.8 m high. Flowers Nov to Dec. Gravelly soils.	Unlikely

T *Banksia verticillata* [Proteaceae]	0	Non-lignotuberous shrub or tree (rarely), 1.3-6 m high. Flowers yellow-orange, Jan to Apr. Sandy loam. On or beside granite outcrops.	Highly unlikely
T *Chordifex abortivus* [Restionaceae]	7	Rhizomatous, erect perennial, herb, to 0.5 m high. Flowers brown, Sep to Oct. Sand. Low rises & undulating areas.	Highly likely. Recorded in Australian Bluegum Plantations property near the Survey Area in similar vegetation.
T *Conostylis misera* [Haemodoraceae]	2	Rhizomatous, tufted perennial, grass-like or herb, 0.05-0.18 m high. Flowers yellow, Oct to Nov. White or grey sand, sandy loam. Winter-wet flats.	Possible. Suitable habitat in wetland areas.
T *Darwinia collina* [Myrtaceae]	0	Erect shrub, 0.3-1.2 m high. Flowers yellow, Sep to Nov. Peaty sand. Rocky quartzite slopes.	Highly unlikely. Montane species
T *Darwinia oxylepis* [Myrtaceae]	0	Upright, dense shrub, 0.6-1.5 m high. Flowers red, Aug to Nov. Stony, peaty sand. Rocky gullies.	Highly unlikely. Montane species
T *Darwinia wittwerorum* [Myrtaceae]	0	Erect, single-stemmed shrub, 0.3-1 m high. Flowers green/white & pink, Sep to Dec. Clay loam, sandy clay. Roadsides, slopes.	Highly unlikely. Montane species
T *Daviesia obovata* [Fabaceae]	0	Erect, slender shrub, 0.7-1.5 m high. Flowers yellow & black, Sep to Oct. Stony loam, sandy loam. Hillslopes, outcrops.	Highly unlikely
T *Drakaea micrantha* [Orchidaceae]	0	Tuberous, perennial, herb, 0.15-0.3 m high. Flowers red & yellow, Sep to Oct. White-grey sand.	Highly unlikely
T *Isopogon uncinatus* [Proteaceae]	0	Tufted spreading or prostrate, non-lignotuberous shrub, 0.05-0.4 m high. Flowers yellow/cream, Oct to Nov. Loam or sand on granite, peaty sand. Swampy depressions, hillslopes.	Possible. Extensive suitable habitat, although never recorded from Hassell National Park
T *Kennedia glabrata* [Fabaceae]	0	Prostrate shrub, 0.05-0.5 m high, to 5 m wide. Flowers red, Aug to Nov. Soil pockets, sandy soils. Granite oucrops.	Highly unlikely. No habitat present
T *Leucopogon gnaphalioides* [Ericaceae]	0	Slender or sprawling shrub, 0.25-1 m high. Flowers white, Jul or Oct to Dec. Shallow rocky soils. Rocky slopes & plateaus.	Highly unlikely. Montane species
T *Persoonia micranthera* [Proteaceae]	0	Decumbent to prostrate shrub, 0.1-0.4 m high. Flowers yellow, Aug. Sandy, stony soils. Summit of plateau.	Highly unlikely. Montane species
T *Sphenotoma drummondii* [Ericaceae]	0	Tufted shrub, 0.15-0.5 m high. Flowers white, Sep to Dec. Stony or shallow soils over granite or quartzite. Steep rocky slopes, crevices of rocks.	Highly unlikely. Montane species
P1 *Leucopogon* sp. Manypeaks (A.S. George 6488) [Ericaceae]	2	Low shrub to 0.15 m. White flowers. Yellow sand over laterite.	Present
P1 *Synaphea incurva* [Proteaceae]	2	Clumped, spreading shrub. Flowers yellow, Sep to Nov. Gravelly loam, sandy soils. Slopes.	Present

P2 *Chamelaucium* sp. Waychinicup (D. Davidson s.n. PERTH 01486527) [Myrtaceae]	6	Weeping shrub to 1.5 m tall with fine linear foliage. White flowers. Sandy loam over granite.	Unlikely. No granite present.
P2 *Chordifex leucoblepharus* [Restionaceae]	3	Rhizomatous, perennial, herb, ca 0.4 m high. Flowers brown, Nov to Dec. Sand. Dry heath.	Likely. Suitable habitat present
P2 *Leucopogon bracteolaris* [Ericaceae]	1	Shrub, 0.25-1 m high. Flowers white, Feb or May or Jul or Oct. Stony sand, gravelly loam.	Likely. Suitable habitat present
P2 *Petrophile carduacea* [Proteaceae]	1	Non-lignotuberous shrub, 1-1.5 m high. Flowers yellow, Sep to Oct. Gravelly soils.	Likely. Suitable habitat present
P2 *Spyridium riparium* [Rhamnaceae]	1	Erect shrub, 0.8-1.5 m high. Flowers white/cream, Jul to Oct. Sandy or gravelly soils over laterite. River banks, slopes.	Possible.
P2 *Stenanthemum sublineare* [Rhamnaceae]	1	Erect shrub, to 0.1 m high. Flowers green, Oct to Dec. Littered white sand. Coastal plain.	Present
P2 *Stylidium daphne* [Stylidiaceae]	6	Rosetted perennial, herb, 0.15-0.45 m high, Leaves tufted, linear to narrowly oblanceolate, 1-4.5 cm long, 0.5-2 (-3) mm wide, apex subacute, margin entire, hoary. Scape mostly glabrous, inflorescence axis sparingly glandular. Inflorescence racemose. Flowers yellow, Dec. Grey to white sand or brown sandy clay loam over laterite. Gentle slopes or winter wet depressions. Mallee or *Melaleuca* shrubland.	Present
P3 *Andersonia setifolia* [Ericaceae]	1	Decumbent to erect, cushion-forming shrub, 0.05-0.15 m high. Flowers red/white, Jun to Oct. Sandy & gravelly soils. Hillslopes & breakaways.	Possible
P3 *Calothamnus robustus* [Myrtaceae]	11	Erect, compact shrub, 0.5-1.5 m high. Flowers red, Feb or Jul or Sep to Nov. Rocky quartzite or granitic soils. Low hills.	Unlikely. Known from different geological formations closer to the coast
P3 *Gonocarpus trichostachyus* [Haloragaceae]	2	Erect to spreading perennial, herb, 0.05-0.17 m high. Flowers red-purple, Sep to Oct. Sandy soils.	Present
P3 *Hakea lasiocarpha* [Proteaceae]	8	Erect shrub, to 6 m high. Flowers white, May to Jul. Sandy loam soils, organic litter over sand, clay or gravel. Hill tops, valleys.	Possible
P3 *Latrobea recurva* [Fabaceae]	1	Erect or procumbent, spreading shrub, 0.3-1 m high. Grey or white sand over laterite.	Present
P3 *Laxmannia grandiflora* subsp. *stirlingensis* [Asparagaceae]	1	Tall, slender, rambling, stilt-rooted perennial, herb, to 0.22 m high. Flowers white, Sep to Nov. White sand, sandy clay. Winter-wet locations.	Present/adjacent
P3 *Leucopogon altissimus* [Ericaceae]	1	Erect shrub to 2 m high. Inflorescence pendulous, flowers creamy - white. Grey or brown sandy loam over granite.	Present

P3 *Pultenaea calycina* subsp. *calycina* [Fabaceae]	1	Bushy shrub to 1 m. Sandy clay loam, laterite pebbles.	Possible
P3 *Tetraria* sp. Blackwood River (A.R. Annels 3043) [Cyperaceae]	1	Tall lax sedge. Drainage lines.	Present
P4 *Acacia declinata* [Fabaceae]	1	Dense, intricately branched, prostrate, pungent shrub, 0.2-0.4 m high. Flowers yellow, Aug to Sep. Loamy or sandy clay.	Possible
P4 *Banksia serra* [Proteaceae]	1	Erect, slender, non-lignotuberous shrub, 1-4(-7) m high. Flowers yellow/cream-green, Jul to Sep. Gravel, sand or clay loam over laterite. Hillslopes.	Possible
P4 *Centrolepis caespitosa* [Centrolepidaceae]	11	Tufted annual, herb (forming a rounded cushion up to 25 mm across). Flowers Oct to Dec. White sand, clay. Salt flats, wet areas.	Present
P4 *Drosera fimbriata* [Droseraceae]	14	Erect tuberous, perennial, herb, 0.05-0.15 m high. Flowers white, Sep to Oct. White sand, granite.	Present
P4 *Eucalyptus buprestium x staeri* [Myrtaceae]	4	Mallee or tree, 1.5-4 m high. Flowers Apr. Sand or loam with lateritic gravel, sandy loam. Steep slopes.	Likely
P4 *Jacksonia calycina* [Fabaceae]	3	Erect or straggling shrub, (0.2-)0.4-1.4 m high. Flowers orange/yellow & red, Sep to Nov. Gravelly sandy or clayey soils. Sandplains, low rises, hillslopes.	Likely
P4 *Lysinema lasianthum* [Ericaceae]	1	Spindly shrub, 0.25-0.7 m high. Flowers white-cream, Jul to Nov. Swamps, seasonally wet areas.	Possible
P4 *Microtis pulchella* [Orchidaceae]	1	Tuberous, perennial, herb, 0.12-0.25 m high. Flowers white, Nov to Dec or Jan. Peaty sand. Winter-wet swamps.	Possible
P4 *Rumex drummondii* [Polygonaceae]	2	Erect perennial, herb, 0.6-0.9 m high. Winter-wet disturbed areas.	Possible
P4 *Sphenotoma* sp. Stirling Range (P.G. Wilson 4235) [Ericaceae]	1	Shrub, 0.3-2 m high. Flowers white, Aug to Dec. Skeletal soils over granite or quartzite. Rocky slopes & plateaus, gullies.	Highly unlikely. Montane species
P4 *Stylidium gloeophyllum* [Stylidiaceae]	9	Rosetted perennial, herb, 0.13-0.47 m high, Leaves tufted, oblanceolate, 1.5-7 cm long, 2-12 mm wide, apex subacute, margin entire, glandular. Scape glandular on lower portion. Inflorescence racemose. Flowers orange/yellow, Oct to Dec. Sandy clay loam, granite. Winter wet depressions, or fringing outcrops. *Agonis*, mallee, or *Hakea* shrubland with sedges.	Present
P4 *Xanthosia eichleri* [Apiaceae]	1	Erect, procumbent or decumbent shrub (subshrub), 0.05-0.25 m high, leaves simple, cuneate; umbels simple; petals shorter than sepals. Flowers white-cream, Oct to Nov. Grey sand over granite, sandy loam. Granite outcrops, jarrah/marri woodland.	Present