A Vegetation and flora survey of part of Lot 10591

Clearing application CPS 7775/1

Shire of Perenjori

25th April 2019

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1. Introduction

1.1 Background

The Shire of Perenjori has a waste facility on Lot 10591 south of the Carnamah – Perenjori Road, 8.7 km west of the Perenjori townsite. The Shire proposes to expand the waste facility and applied to the WA Department of Water and Environment Regulation (DWER) in September 2017 (CPS 7775/1). A preliminary assessment by DWER determined that the priority 1 species *Leptospermum exsertum* was previously recorded within the area (1994) however none were found during a survey by DWER in 2017. A search was also undertaken for *Grevillea asparagoides* P3 with no plants being found although suitable habitat was present. DWER determined that there was suitable habitat for *Persoonia pentasticha* P3 and *Acacia isoneura* subsp. *nimia* P3, with the nearest records of the species 1033 and 323 metres away respectively.

The Shire of Perenjori requested that a flora and vegetation survey be undertaken of the site targeting the above conservation flora in April 2019. The response to DWER to the clearing application assessment is required to be lodged before the end of June 2019 so the survey was undertaken in autumn 2019 which is not within the ideal timing for vegetation surveys in the northern wheatbelt. Due to the vegetation likely to be in senescent or vegetative condition with few reproductive structures present, care was taken to collect material where possible to assist with verification of identity.

The surveyor – Jenny Borger – visited the site briefly in August 2018 after a conversation with Ken Markham (Shire of Perenjori Manager of Infrastructure Services) regarding the application, during which a number of species were flowering and some photographs and GPS locations were taken. These have been used along with results from the current survey to determine/ verify species identifications.

An assessment against the clearing principals has been undertaken by DWER (2017), and results from this survey will be used to further define potential impacts.

1.2 Climate

The climate recorded at Perenjori can be described as Mediterranean with hot dry summers with occasional thunderstorms and cool moist winters. Rainfall recorded at Perenjori (Bureau of Meteorology (BOM) Station 8107) is presented in table 1 and Figure 1. The mean annual rainfall is 327.4 mm; with the wettest months being May to August with a mean of 193.6 mm. Rainfall recorded for 2017 and 2018 was below average, although above average falls were recorded in October and November. Rainfall received in 2019 prior to the survey has been well below average.

Table 1: Monthly rainfall recorded at Perenjori (BOM Station 8107)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	14.3	17.5	22.5	23.1	44.6	57.1	51.1	40.8	19.5	13	9.5	8.1	327.4
2017	16.2	61.5	2.6	4.4	9.8	4.6	17.3	56.7	17	4.8	0	4	198.9
2018	55	15	13	0	28.4	32.6	55.6	53.4	1.2	23	15.4	0.8	293.4
2019	0	14.2	6	5.2									

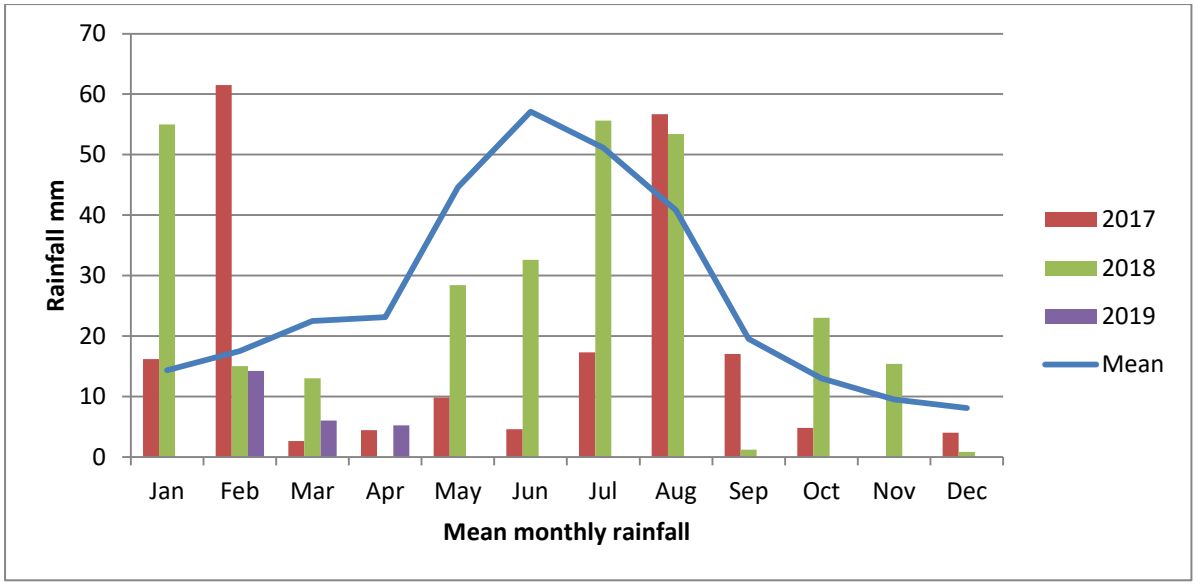

Figure 1: Mean monthly rainfall recorded at Perenjori BOM station 8107

Monthly maximum and minimum temperatures have been close to the mean (Morawa) although slightly above average maximum temperatures were recorded at the start of 2019, with slightly lower than average monthly mean minimum temperatures for January (Figure 2).

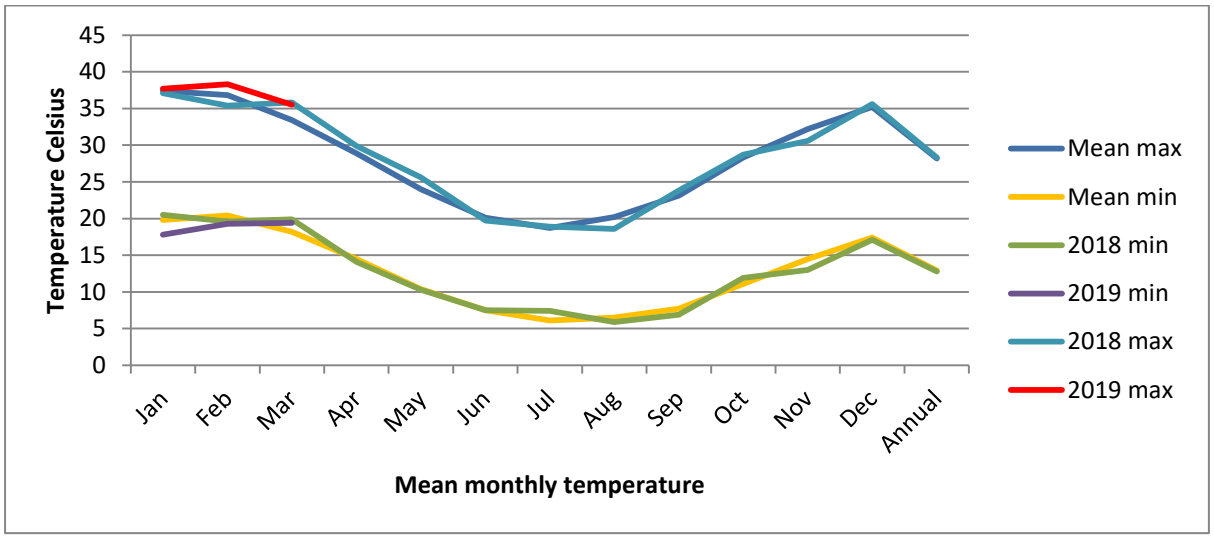

Figure 2: Mean temperature data recorded at Morawa BOM Station 8296

1.3 Biogeography

The site is located within the South-West Botanical Province of Western Australia within the Avon Wheatbelt P1 Interim Biogeographic Regionalisation for Australia (IBRA) sub-region. The site is located on a broad ridge within undulating sandplain with areas of heavier soil supporting *Eucalyptus* woodlands (*Eucalyptus salmonophloia* and *E. loxophleba* dominant) outside the disturbance footprint. The woodlands are listed as the Threated Ecological Community (TEC) Eucalypt woodlands of the Western Australian Wheatbelt. Regional vegetation association mapping of the area (Beard 1976) has two associations mapped as occurring within the disturbance proposal – 352.7 (Woodland other; wheatbelt – York gum, salmon gum etc.) and 551.7 – Thicket – *Acacia* –

Allocasuarina – *Melaleuca* alliance. No association 352 occurs within the proposal. The DWER assessment of the vegetation noted that the site was pre-dominantly *Allocasuarina* thicket over *Grevillea paradoxa* and *Melaleuca cordata* shrubs, with a small area of *Eucalyptus* sp. mallee woodland over mixed shrubs and grasses (DWER 2017). The results of this survey support this to some extent and will be further discussed in Section 3.

The proposal is mapped as occurring within the Land sub-System 271Pi – Gently undulating sandplain and long gentle slopes with acidic yellow and brown deep sands and sandy earths (Schocknecht et al. 2004). Drainage from the site is to the west.

Table 2: Conservation flora recorded within a 20 km radius (DBCA 2019). Taxa listed by DWER are highlighted

Family	**Scientific Name**	**Cons code**	**Habitat present**
Gyrostemonaceae	*Gyrostemon reticulatus*	T	Yes; requires disturbance (fire or mechanical); gravel; short lived perennial
Lamiaceae	*Dasymalla axillaris*	T	Yes; yellow sand, gravel
Scrophulariaceae	*Eremophila nivea*	T	No; York gum, Melaleuca and Acacia on sandy-clay, clay loam
Scrophulariaceae	*Eremophila rostrata* subsp. *trifida*	T	Unlikely; light brown loam; granite; under open Mallee and Acacia
Scrophulariaceae	*Eremophila viscida*	T	Unlikely; probably prefers heavier soils
Fabaceae	*Acacia nigripilosa* subsp. *latifolia*	P1	Yes; yellow sand
Myrtaceae	*Babingtonia minutifolia*	P1	No, rocky outcrops
Myrtaceae	*Leptospermum exsertum*	P1	Yes, sandplain
Myrtaceae	*Verticordia dasystylis* subsp. *oestopoia*	P1	No; gritty soils over granite, outcrops
Scrophulariaceae	*Eremophila sericea* (E. sp. Rothsay)	P1	Unlikely
Myrtaceae	*Baeckea* sp. Perenjori	P2	Unlikely; banded ironstone formation; gravel; granite
Fabaceae	*Acacia isoneura* subsp. *nimia*	P3	Yes; sandplains and sand ridges
Fabaceae	*Mirbelia ferricola*	P3	No; banded ironstone formation
Fabaceae	*Urodon capitatus*	P3	Potential; Sandy gravelly soils
Proteaceae	*Grevillea asparagoides*	P3	Yes; gravelly loam; sandy soils
Proteaceae	*Grevillea granulosa*	P3	Yes; gravelly sand; sandplains; several records in Perenjori area
Proteaceae	*Persoonia pentasticha*	P3	Unlikely; usually on heavier soils; often associated with York gum
Myrtaceae	*Enekbatus longistylus*	P3	Yes; sandplains
Myrtaceae	*Eucalyptus arachnaea* subsp. *arrecta*	P3	No; clay loam on granite; breakaways, gullies
Myrtaceae	*Melaleuca barlowii*	P3	Potential; gravelly soils
Myrtaceae	*Verticordia muelleriana* subsp. *muelleriana*	P3	Yes, sandplains
Myrtaceae	*Verticordia venusta*	P3	Yes; yellow sandplain
Proteaceae	*Banksia benthamiana*	P4	Yes; sandplain; gravelly soils

1.4 Conservation listed flora

Twenty two threatened and priority flora have been recorded within a 20 km radius of the proposal. DWER listed four species as occurring on the same soil type (highlighted in Table 2) which may occur within the site. *Persoonia pentasticha* P3 was included by DWER but this is not supported by the habitats in which it has been recorded, generally growing on heavier soils than what is present within the site.

1.5 Conservation Estate

The West Perenjori Nature Reserve is located on the eastern boundary of the proposal and has extensive areas of the Wheatbelt woodland TEC and sandplain. A 3.5 ha area of historical disturbance is located on the southern boundary of the refuse site.

1.6 Disturbance History

The site has a moderate to high level of disturbance due to the proximity of the current waste facility. Areas adjacent to the waste facility have been partly cleared with minor ground excavations; a moderate to high level of weed invasion; vehicle access tracks and minor areas of wind erosion. The northern section is less disturbed and supports vegetation mostly in very good condition. A section of this appears to be regrowth following fire likely to have occurred more than 15 years ago.

2. Methodology

The main purpose of the survey was to determine if there were any conservation listed flora within the proposal which might be impacted by the expansion of the waste facility and to describe the vegetation and condition. The survey area was 3.7 ha, of which 3 ha supported remnant vegetation. The design of the survey was based on requirements in the Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016). The vegetation was described from four quadrats and 5 relevés located within areas with good or better condition. The number of sites chosen was to describe the vegetation and to have enough data to run a statistical analysis.

2.1 Quadrats

Four quadrats of 10 m x 10 m were established (Keighery). Floristics and structure were recorded (Table 3) as well as condition (Table 4) and threats as well as land surface details – percentage cover of litter, fallen timber, surface rock and cryptogams (lichens and mosses).

Table 3: Vegetation data recorded at each site

Height class & habit	Species	% cover	No. plants
Trees, mallee 2 – 8 m	*	*	*
Shrubs > 2 m	*	*	*
Shrubs 1 – 2 m	*	*	*
Shrubs 0.5 – 1 m	*	*	*
Shrubs < 0.5 m	*	*	*
Grasses	*	*	
Herbs	*	*	
Sedges	*	*	

Table 4: Vegetation Condition (adapted from Keighery 1994 and Trudgen 1988; 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.

Vegetation structure was classified by the National Vegetation Information System (NVIS) Level V (ESCAVI 2003) which lists the three dominant taxa in the three dominant strata. A description listing all taxa present within each stratum has also been included.

Relevant codes used in the NVIS description are presented in Tables 5 – 7.

Table 5: NVIS foliage cover codes

Cover Characteristics					
Foliage cover	70 – 100	30 – 70	10 – 30	< 10	~ 0 (<2)
Crown cover	>80	50 – 80	20 – 50	0.25 – 20	<0.25
% cover	>80	50 – 80	20 – 50	0.25 - <20	<0.25
Cover code	d	c	i	r	bi

Table 6: Height classes defined for the NVIS

Height		Growth Form				
Height Class	Height Range (m)	Tree	Shrub, chenopod shrub	Tree mallee, mallee shrub	Tussock grass	Bryophyte, lichen
8	>30	Tall	N/A	N/A	N/A	N/A
7	10 – 30	Mid	N/A	Tall	N/A	N/A
6	< 10	Low	N/A	Mid	N/A	N/A
5	<3	N/A	N/A	Low	N/A	N/A
4	>2	N/A	Tall	N/A	Tall	N/A
3	1 – 2	N/A	Mid	N/A	Tall	N/A
2	0.5 – 1	N/A	Low	N/A	Mid	Tall
1	< 0.5	N/A	Low	N/A	Low	Low

Table 7: Summary of NVIS strata codes
More information can be sourced from the NVIS manual. Height classes and growth forms in brackets are currently allowed but not recommended. The code U1 has been used for mallee shrubs in the description as it is often the dominant upper stratum form and falls in height class 6.

NVIS stratum code	NVIS sub-stratum	Description	Growth forms	Height classes
U	U1	Tallest stratum	Tree, tree mallees (mallee shrubs)	8, 7, 6, (5)
	U2	Sub-canopy layer, second tree layer		
	U3	Sub-canopy layer, third tree layer		
M	M1	Tallest shrub layer	Shrubs, low trees, mallee shrubs, low shrubs, vines	(6), 5, 4, 3
	M2	Next shrub layer		
	M3	Third shrub layer		
G	G1	Tallest ground species	Grasses, forbs, sedges, rushes, vines, lichens, low shrubs	(4, 3), 2, 1
	G2	Ground		

2.2 Survey Limitations

The proposal was surveyed at the end of April 2019 following below average rainfall over the summer period and below average rainfall in 2018 and well below average rainfall in 2017 which meant that the vegetation was not likely to be in the best condition for identification. The potential limitations and extents are described in Table 8.

Table 8: Survey limitations

Potential Limitation	Extent
Contextual information at a regional and local scale	Maybe partly limiting Several surveys have been undertaken over the region and there are many records of conservation flora. Limited surveys appear to have been undertaken within the West Perenjori NR although there are some records of flora and fauna. Several surveys have been undertaken on unique landforms such as the Billeranga Hills, Koolanooka Hills and Perenjori Hills, and some of the granite outcrop areas.
Competency/ experience	Not limiting The botanist has surveyed in the northern agricultural region since 2002, including several years with WWF Australia on Woodland Watch and Healthy Bushland projects and extensive surveys under the DEC Hidden Treasures and Last Stands projects. Surveys undertaken in the Perenjori – Carnamah area include North Road Survey & Lot 3635 (Perenjori – Rothsay Road; Environmental offset area); Bunjil BioBlitz 2017; Innering Hills TEC surveys (Carnamah); Carnamah – Bunjil Rd flora surveys for road upgrade (Carnamah Shire)
Proportion of flora recorded and/ or collected, any identification issues	Partly limiting All flora present within the proposed impact areas were recorded. Many perennial species were flowering or had fruit present. A few grasses and forbs were present. Most grasses had fruiting structures present. Most forbs had dried off but some still had flowering/ fruiting structures present (e.g. everlastings). Annual weeds were mostly absent but likely to occur in winter/ spring.
Was the appropriate area fully surveyed	Not limiting The area of potential impact is about 3.7 ha and the whole area was walked over.
Access restrictions within the survey area	Not limiting The site was accessed by an existing vehicle track which services the present waste facility. There are also other old tracks through the area. The site is mostly level with no landforms restricting access.
Survey timing, rainfall, season	Partly limiting The survey was undertaken in autumn following a fairly dry summer. There is a high probability that most annual herbs and grasses would not be present as live plants. Some species were identifiable from dried reproductive structures.
Disturbance that may have affected the results such as fire, flood or clearing	Limiting There are varying levels of disturbance within the proposed clearing area. The areas closer to the present tip have the highest levels of disturbance including minor excavation; weeds; clearing (historic); vehicle tracks and rubbish. A section of the vegetation in better condition is regrowth following fire ~ 15 years +.

3. Results

3.1 Summary

The site was surveyed on the 25th April at the beginning of autumn. The vegetation was in a reasonable condition, although some plants appeared slightly water stressed. Reproductive structures (mostly fruit) were present on most perennial taxa, particularly within the Myrtaceae, Cyperaceae and Poaceae families. Herbs, excepting *Borya sphaerocephala*, had died off but most were still recognisable (*Waitzia, Podolepis, Actinobole* and *Angianthus*). The *Acacia* species were identified based on phyllode and habit characteristics. Three *Grevillea* species were present and were able to be identified by fruit and leaf characteristics. A total of fifty two taxa were recorded from 21 families and 38 genera, including 3 identifiable weeds. Other weeds are likely to be present in the winter and spring. The most diverse families were Myrtaceae (11 species, 7 genera); Fabaceae (8 species, 1 genus); Poaceae (5 species, 5 genera including 2 weeds) and Asteraceae (5 genera, 5 species). One priority species – *Grevillea asparagoides* P3 was recorded. The list of species is presented in Appendix 1.

The site had various levels of disturbance from minor to high. Four quadrats were established in the vegetation in better condition, and five relevés were described – three within the more disturbed areas and two in vegetation similar to quadrats 3 and 4. Two likely vegetation types were identified from the field interpretation and these were supported by the statistical analysis.

3.2 Conservation listed flora

One species – *Grevillea asparagoides* – was recorded (3 plants) in the south east of the survey area near the change in soil type from sandplain to sand over laterite. Two other species of *Grevillea* with pinnately divided leaves (*G. paradoxa* and *G. levis*) were also present. Leaf characteristics (such as width and length of lobes) and fruit characteristics were used to distinguish the plants.

Flower image taken in August 2018.

Dehisced fruit – April 2019.

Figure 3: *Grevillea asparagoides* flowering shrub (August) and dehisced fruit (April).

The GPS locations of *G. asparagoides* are presented in Appendix 2.

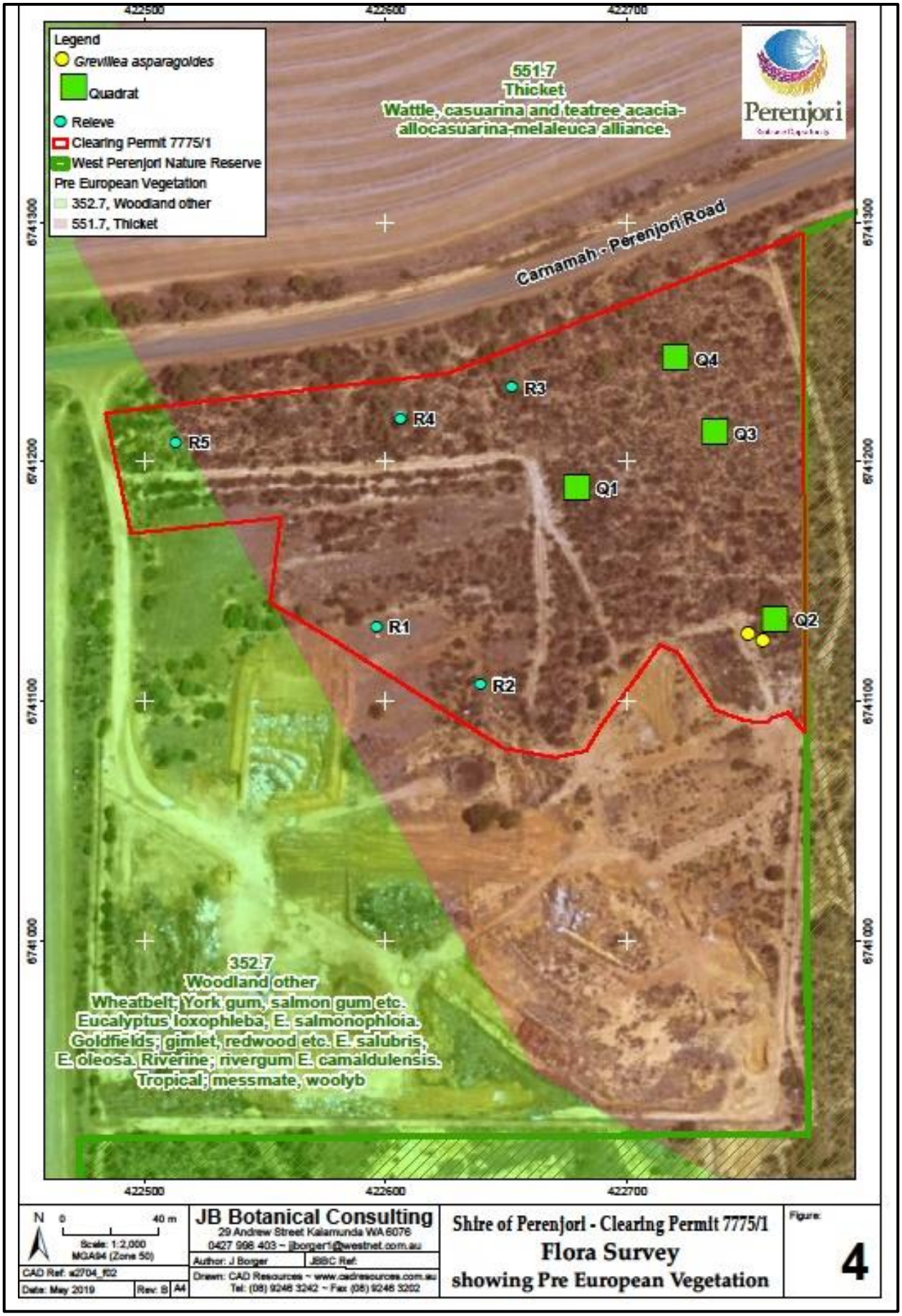

Figure 4: Locations of description sites and of the priority species – *Grevillea asparagoides*. Pre-European vegetation is also mapped and will be discussed in section 3.3.

3.3 Vegetation

Two vegetation communities were mapped from the survey results in the proposal (2.98 ha) as well as 0.7 ha of degraded vegetation. The description of the quadrats and relevés is presented in Appendix 2. (Google Earth Pro 2019)

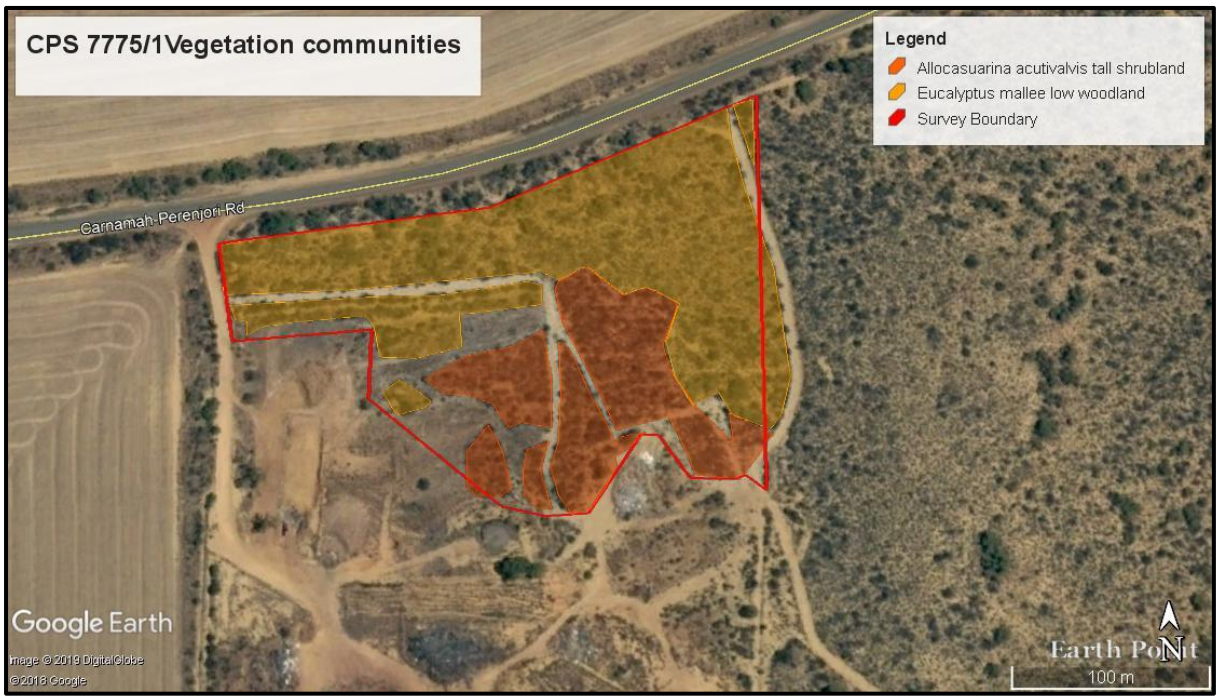

Figure 5: Vegetation communities occurring within the proposal

Vegetation 1 (0.98 ha): *Allocasuarina acutivalvis* subsp. *acutivalvis* tall shrubland over *Melaleuca cordata, Grevillea paradoxa, Cyathostemon heteranthus, Acacia longiphyllodinea* and *Micromyrtus racemosa* shrubland to open shrubland on lateritic gravel

Vegetation 2 (2 ha): *Eucalyptus leptopoda* and *E. eudesmioides* low mallee woodland to low open mallee woodland over *Ecdeiocolea monostachya, Rhagodia drummondii* and *Melaleuca fabri* sedgeland to open sedgeland with sparse shrubs on brownish yellow sandy loam

Disturbed areas – degraded (0.7 ha): Isolated shrubs and mallee over *Avena fatua*, Ptilotus polystachyus, Maireana brevifolia* mixed ground cover

The dendrogram produced from the statistical analysis (Figure 6) shows that Q1 and R2 are quite similar, and the remaining sites are similar, with the exception of R1 which is located in a more disturbed area, but has more affinities with the second group. Q1 and R2 are located within the *Allocasuarina acutivalvis* tall shrubland on laterite, while Q2 – Q4 and R3 – R5 are located within *Eucalyptus* low mallee woodland.

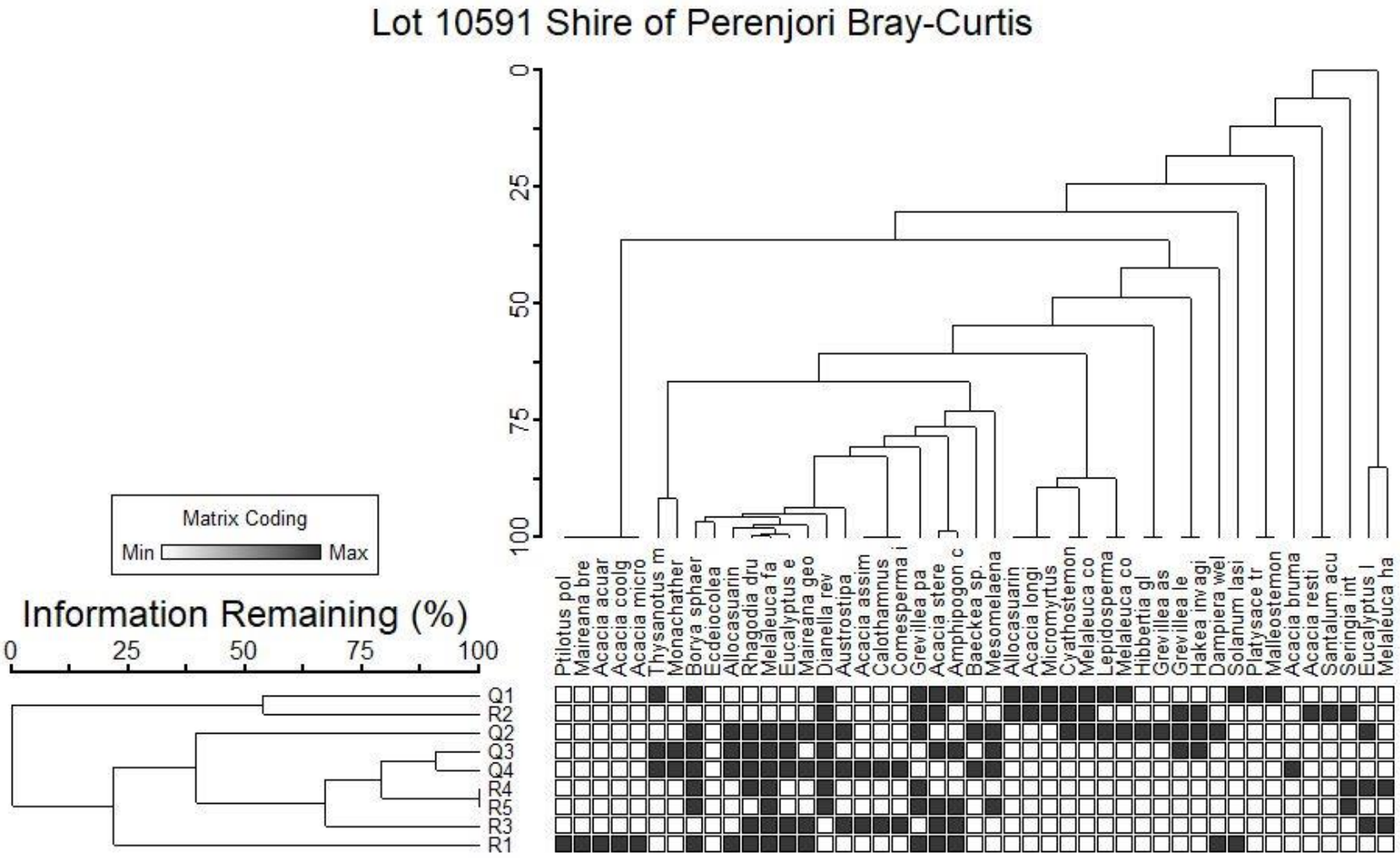

Figure 6: Bray Curtis Analysis using the presence/ absence of perennial species. The dendrogram (bottom left) shows the similarities between the sites. Quadrats 3 and 4, and R4 and 5 are very similar, as are Q1 and R2 (laterite). Q2 was located on sandplain near the change from sandplain to laterite.

4. Discussion

The vegetation within the proposal is representative of the sandplain vegetation within the adjacent reserve, and tall shrubland on laterite which also occurs in the reserve. No areas of the Wheatbelt woodlands TEC were present, although it is present within the reserve, 300 m to the east, and 550 m south of the waste facility. The *Eucalyptus* species present in the proposal are not listed as key dominant species in the description of the TEC. No species which would be considered range extensions were recorded.

The structure of the vegetation was mostly intact in the northern and eastern areas, with well-established mallees, shrubs and sedges. *Melaleuca cordata* and *M. fabri* were present as well as a number of shrubs which were hybrids of the 2 species. Due to the timing of the survey the diversity of annuals was low. It is highly unlikely that any conservation listed annual flora would occur at the site.

The statistical analysis supported two remnant vegetation associations (VA) – 1) *Allocasuarina acutivalvis* subsp. *acutivalvis* tall shrubland over *Melaleuca cordata, Grevillea paradoxa, Cyathostemon heteranthus, Acacia longiphyllodinea* and *Micromyrtus racemosa* shrubland to open shrubland on lateritic gravel and 2) *Eucalyptus leptopoda* and *E. eudesmioides* low mallee woodland to low open mallee woodland over *Ecdeiocolea monostachya, Rhagodia drummondii* and *Melaleuca fabri* sedgeland to open sedgeland with sparse shrubs on brownish yellow sandy loam. Description sites Q1 (low disturbance) and R2 (moderate disturbances) were placed in VA 1 with a similarity of 53%. Sites Q3, Q4, (~90 % similarity), R4 and R5 (~ 80 %) and R3 (68 % with Q3 & 4; R4 & 5) were included in VA2. Q2 was included in VA2, but had a much lower similarity at 38 %. Q2 was located on sandplain near the change in soil type to shallower sand on laterite. R1 was a highly disturbed area and would have been within VA 1 pre-disturbance. R4 and R5 were both located in the north western area and had a moderate level of disturbance – mostly with the removal of mallee and some taller shrubs.

5. Conclusions

The condition of the site ranged from degraded to very good, with most of the remnant vegetation (3 ha) in the good to very good category. One priority species was recorded, *Grevillea asparagoides* P3 (3 plants), located near Quadrat 2 (Figure 4) near the eastern boundary. These were healthy and had dehisced fruit, so the seeds will be present in the soil below the shrubs. Due to the location near the eastern boundary it may be possible to avoid clearing these plants and include the area within the proposed buffer zone. No plants were observed which could be *Leptospermum exsertum* P1 which was recorded in the area in 1994. Under clearing principle (c) Vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora – the proposed clearing may be at variance.

Topsoil should be stockpiled during the initial clearing of the area. The viability of the seed will remain good for up to two years, but it would be preferable if it can be spread within a shorter time frame (~ 6 months) for best outcomes. The expected life of the current refuse site is anticipated to be 20 years, so there will be limited use for the topsoil in this area. A portion of the topsoil could be used for the rehabilitation of the 3.5 ha area of historical disturbance on the south side of the refuse site within the West Perenjori NR which will need to be discussed with the DBCA. Rehabilitating this

area would offset a potential increase in recharge to the groundwater from the proposal as well as improving the buffer area between farmland on the western side of the reserve and the refuse site to the north.

The surface soil (sand/ sandy loam) will be at risk of wind erosion once the surface vegetation has been removed; however much of the site has laterite and clay at depth which will be exposed during the excavation for the new refuse site and is at lower risk of wind and water erosion. The gradient of the site is almost level which reduces the risk of water erosion. The Shire of Perenjori has advised that a vegetation buffer will remain on the eastern side, and also along the northern side within the road reserve which will reduce the risk of rubbish being blown into the adjacent reserve. DWER (2017) outlined the risk of dieback impacting on the reserve. The risk of dieback is minimal due to the location of the proposal at the top of the catchment, as well as being located in the eastern area of the northern wheatbelt for which there are no records of dieback occurrence.

Further survey of the West Perenjori Nature Reserve could be undertaken by the Department of Biodiversity, Conservation and Attractions to determine the existence, size and condition of populations of rare flora which could be used at a later date in the rehabilitation of the refuse site. If it is decided to clear the *Grevillea asparagoides* shrubs within the proposal, collection of seed later in the year (~ October/ November – depending on climatic conditions) should be considered for long term storage which would need to be discussed with DBCA and the Botanic Gardens and Parks Authority.

Overall, the size of the proposed clearing is small. However; being located within a highly cleared and fragmented landscape the loss of 3 ha (minus vegetation buffer area) could be significant although no species except *Grevillea asparagoides* are of particular importance. If the existing cleared areas to the south can be rehabilitated and plans are in place for future rehabilitation of the proposal, the impact will be minimal in the long term.

6. References

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Appendix 1: Species list

Family	Scientific Name	Cons code
Amaranthaceae	*Ptilotus polystachyus*	
Apiaceae	*Platysace trachymenioides*	
Asparagaceae	*Thysanotus manglesianus*	
Asteraceae	*Actinobole uliginosum*	
Asteraceae	*Angianthus tomentosus*	
Asteraceae	*Gilberta tenuifolia*	
Asteraceae	*Podolepis aristata*	
Asteraceae	*Waitzia acuminata*	
Boryaceae	*Borya sphaerocephala*	
Brassicaceae	*Brassica tournefortii**	Weed
Casuarinaceae	*Allocasuarina acutivalvis* subsp. *acutivalvis*	
Casuarinaceae	*Allocasuarina campestris*	
Chenopodiaceae	*Maireana brevifolia*	
Chenopodiaceae	*Maireana georgei*	
Chenopodiaceae	*Rhagodia drummondii*	
Cyperaceae	*Lepidosperma costale*	
Cyperaceae	*Mesomelaena preissii*	
Dilleniaceae	*Hibbertia glomerosa* var. *glomerosa*	
Ecdeiocoleaceae	*Ecdeiocolea monostachya*	
Fabaceae	*Acacia acuaria*	
Fabaceae	*Acacia assimilis* subsp. *assimilis*	
Fabaceae	*Acacia brumalis*	
Fabaceae	*Acacia coolgardiensis*	
Fabaceae	*Acacia longiphyllodinea*	
Fabaceae	*Acacia microbotrya*	
Fabaceae	*Acacia restiacea*	
Fabaceae	*Acacia stereophylla*	
Goodeniaceae	*Dampiera wellsiana*	
Hemerocallidaceae	*Dianella revoluta* var. *divaricata*	
Malvaceae	*Seringia integrifolia*	
Myrtaceae	*Baeckea sp. Dudawa*	
Myrtaceae	*Calothamnus gilesii*	
Myrtaceae	*Cyathostemon heteranthus*	
Myrtaceae	*Eucalyptus eudesmioides*	
Myrtaceae	*Eucalyptus leptopoda* subsp. *arctata*	
Myrtaceae	*Malleostemon hursthousei*	
Myrtaceae	*Melaleuca cordata*	
Myrtaceae	*Melaleuca cordata x fabri*	
Myrtaceae	*Melaleuca fabri*	
Myrtaceae	*Melaleuca hamata*	
Myrtaceae	*Micromyrtus racemosa*	

Family	Scientific Name	Cons code
Poaceae	*Amphipogon caricinus* var. *caricinus*	
Poaceae	*Austrostipa elegantissima*	
Poaceae	*Avena fatua**	Weed
Poaceae	*Monachather paradoxus*	
Poaceae	*Pentameris airoides **	Weed
Polygalaceae	*Comesperma integerrimum*	
Proteaceae	*Grevillea asparagoides*	P3
Proteaceae	*Grevillea levis*	
Proteaceae	*Grevillea paradoxa*	
Proteaceae	*Hakea invaginata*	
Santalaceae	*Santalum acuminatum*	
Solanaceae	*Solanum lasiophyllum*	

Appendix 2: GPS locations of *Grevillea asparagoides* P3

Scientific Name	Code	Date	Easting	Northing	No.
Grevillea asparagoides	P3	25/04/2019	422756	6741125	2
Grevillea asparagoides	P3	25/04/2019	422750	6741128	1

Appendix 3: Site data

3.1 Quadrat 1

GPS	E: 422674 N: 6741194	Date 25th April 2019
Land Surface	Yellowish brown loam sand; surface rock: lateritic gravel 10 – 15 %; litter 30 – 40 %; fallen timber < 2 %; cryptogams < 10 %; bare ground 15 – 20 %	
Landform	Broad ridge on undulating plain; almost level	
Condition	Very good; old disturbance and rubbish in area; clearing adjacent to west – old vehicle track	
Threats	Weeds (none present at time of survey); clearing, rubbish, climatic conditions – below average rainfall	
NVIS V Description	*U+^ Allocasuarina acutivalvis subsp. acutivalvis, Acacia stereophylla, Melaleuca cordata\Allocasuarina acutivalvis\^tree, shrub\4\r; M1 Cyathostemon heteranthus, Allocasuarina acutivalvis subsp. acutivalvis, Acacia stereophylla\^shrub\3\r; M2 ^Malleostemon hursthousei, Platysace trachymenioides, Grevillea paradoxa\^shrub\2\r*	

Quadrat 1 Description

Height class (m)	Habit	*Dominant species*	No.	% cover
3 – 4	Tree, shrub	*Allocasuarina acutivalvis subsp. acutivalvis, Acacia stereophylla, Melaleuca cordata*	8	7 – 10
1 – 2	Shrub	*Cyathostemon heteranthus, Allocasuarina acutivalvis subsp. acutivalvis, Acacia stereophylla, Melaleuca cordata*	21	6 – 8
0.5 – 1	Shrub	*Malleostemon hursthousei, Platysace trachymenioides, Grevillea paradoxa, Acacia stereophylla, Dianella revoluta var. divaricata, Thysanotus manglesianus*	50	3 – 4
< 0.5	Shrub	*Malleostemon hursthousei, Grevillea paradoxa, Platysace trachymenioides*	7	1 – 2
< 1	Sedge	*Lepidosperma costale, Ecdeiocolea monostachya*		1 – 2
<0.5	Grass	*Amphipogon caricinus var. caricinus*		<1
<0.5	Herb	*Borya sphaerocephala (live); (Podolepis aristata, Gilberta tenuifolia, Angianthus tomentosus – dried off 5 – 10 %)*		Live <1

Other species outside: *Acacia longiphyllodinea, Solanum lasiophyllum, Melaleuca cordata x fabri, Micromyrtus racemosa*

3.2 Quadrat 2

GPS	E: 422756 N: 6741139	Date	25th April 2019
Land Surface	Yellowish brown sandy loam; surface rock <1%; litter 50 – 60 %; fallen timber 8 – 10 %; bare ground 8 – 10 %		
Landform	Broad ridge on undulating plain		
Condition	Very good; some fallen shrubs; no weeds present (live); potential edge effects		
Threats	Clearing, fire, rubbish, drought, weeds		
NVIS V Description	*U+ ^Eucalyptus leptopoda subsp. arctata\^mallee shrub\6\c; M^ Grevillea paradoxa, Melaleuca cordata\shrub\2\r; G^ Ecdeiocolea monostachya, Mesomelaena preissii, Austrostipa elegantissima\^sedge, grass\2\r*		

Quadrat 2 Description

Height class (m)	Habit	Dominant species	No.	% cover
4 – 6	Mallee	*Eucalyptus leptopoda subsp. arctata*	2	30 – 40
> 2	Shrub	*Allocasuarina campestris*	1	3 – 4
1 – 2	Shrub	*Grevillea paradoxa, Melaleuca cordata*	5	3 – 4
0.5 – 1	Shrub	*Baeckea sp. Dudawa, Dianella revoluta var. divaricata, Grevillea paradoxa, Maireana georgei*	12	2 – 3
< 0.5	Shrub	*Baeckea sp. Dudawa, Melaleuca fabri*	3	< 1
< 1	Sedge	*Ecdeiocolea monostachya, Mesomelaena preissii, Lepidosperma costale*		3 – 4
< 1	Grass	*Austrostipa elegantissima, Pentameris airoides* (dead)*		5 – 6
< 0.5	Herb	*Borya sphaerocephala* (live), *(Waitzia acuminata, Podolepis aristata* – dead)		1 (live)

Other species outside: *Eucalyptus eudesmioides, Grevillea asparagoides P3, G. levis, Cyathostemon heteranthus, Hibbertia glomerosa* var. *glomerosa, Hakea invaginata, Rhagodia drummondii, Dampiera wellsiana, Melaleuca cordata x fabri*

3.3 Quadrat 3

GPS	E: 422731 N: 6741217	Date: 25th April 2019
Land Surface	Brownish yellow sandy loam; surface rock <1 %; litter 10 – 15 %; fallen timber 7 – 8 %; cryptogams 40 – 50 %; bare ground <10 %	
Landform	Broad ridge on undulating plain	
Condition	Very good; regrowth following fire (> 20 years); some evidence of grazing by kangaroos & ground disturbance; no live weeds present	
Threats	Clearing, fire regime, weeds, grazing (rabbits – no evidence of any in the area presently), changes in climate patterns	
NVIS V Description	M *^Melaleuca fabri, Dianella revoluta* var. *divaricata, Hakea invaginata \^shrub\ 2\r; G+ ^Ecdeiocolea monostachya, Mesomelaena preissii, Monachather paradoxus \^sedge, grass\2\i*	

Quadrat 3 Description

Height class (m)	Habit	Dominant species	No.	% cover
1 – 1.2	Shrub	*Hakea invaginata (2), Grevillea levis (1)*	3	1 – 2
0.5 – 1	Shrub	*Melaleuca fabri (6), Dianella revoluta* var. *divaricata (4), Acacia stereophylla (1)*	11	6 – 10
0.5 – 1	Sedge	*Ecdeiocolea monostachya, Mesomelaena preissii*		15 – 20
<0.5	Grass	*Monachather paradoxus*		1 – 2
<0.5	Herb	*Borya sphaerocephala* (live); *Podolepis aristata, Waitzia acuminata, Actinobole uliginosum* – dried off		2 – 3 (live)

Other species: *Allocasuarina campestris, Eucalyptus eudesmioides, Amphipogon caricinus var. caricinus*

3.4 Quadrat 4

GPS	E: 422715/ N: 6741248	Date	25th April 2019
Land Surface	Brownish yellow sandy loam; surface rock 0%; litter 30 – 40 %; fallen timber 3 – 5 %; cryptogam 20 – 30 %; bare ground 5 – 10 %		
Landform	Broad ridge on undulating plain		
Condition	Very good; some edge effects (near road and adjacent to old burn scar); ground disturbance – fauna; rubbish in area; slight wind erosion; epicormic growth present on mallee – indicative of drought recovery or similar; Allocasuarina campestris stressed; dried off weeds present (1 – 2 %)		
Threats	Clearing, edge effects (near road); wind erosion, weeds, inappropriate fire regime; climate changes		
NVIS V Description	U+ ^ *Eucalyptus eudesmioides*\ ^mallee shrub\6\i; M ^ *Rhagodia drummondii, Allocasuarina campestris, Melaleuca fabri*\^*shrub**2**r; G ^ Rhagodia drummondii, Baeckea sp. Dudawa, Austrostipa elegantissima*\^*shrub, grass**1**r*		

Quadrat 4 Description

Height class (m)	Habit	*Dominant species*	No.	% cover
2.5 – 4	Mallee	*Eucalyptus eudesmioides*	1	25 – 30
1 – 2	Shrub	*Acacia brumalis*	1	1 – 2
0.5 – 1	Shrub	*Rhagodia drummondii (2), Allocasuarina campestris (1), Melaleuca fabri (1), Dianella revoluta* var. *divaricata (3), Thysanotus manglesianus (1)*	8	5 – 6
< 0.5	Shrub	*Rhagodia drummondii (1), Baeckea sp. Dudawa (2), Maireana georgei (2)*	5	2 – 3
< 1	Grass	*Austrostipa elegantissima, Monachather paradoxus, Avena fatua**		2 – 3
< 1	Sedge	*Mesomelaena preissii, Ecdeiocolea monostachya*		2 – 3
<0.5	Herb	*No live herbs; Podolepis aristata, Waitzia acuminata, Angianthus tomentosus – dried off 5 – 10 %*		0

Other species: *Acacia assimilis* subsp*. assimilis, Calothamnus gilesii, Comesperma integerrimum*

3.5 Relevé 1

GPS	E: 422596/ N: 6741131	Date	25th April 2019
Land Surface	Brownish yellow sandy loam; surface rock 5 – 10 % lateritic gravel; litter 10 – 20 %; fallen timber < 5 %; cryptogam < 2 %; bare ground 20 – 30 %		
Landform	Broad ridge on undulating plain		
Condition	Good; medium to high level of disturbance; ground disturbance, rubbish, vehicle tracks, weeds (20 – 30 %)		
Threats	Clearing, weeds, rubbish, vehicles		

Relevé 1 Description

Height class (m)	Habit	Dominant species	% cover
3 – 4	Mallee, shrub	*Eucalyptus eudesmioides, Acacia coolgardiensis*	2 – 10
1 – 3	Shrub	*Melaleuca cordata, Acacia stereophylla, Acacia coolgardiensis, Grevillea paradoxa, Allocasuarina campestris, Acacia acuaria*	2 – 10
0.5 – 1	Shrub, sedge	*Melaleuca fabri, Grevillea paradoxa, Ecdeiocolea monostachya, Maireana brevifolia, Rhagodia drummondii, Acacia coolgardiensis, Acacia assimilis subsp. assimilis, A. microbotrya*	2 – 10
<0.5	Shrub, herb, grass	*Solanum lasiophyllum, Ptilotus polystachyus (D), Avena fatua* (D), Brassica tournefortii (D), Amphipogon caricinus var. caricinus, Waitzia acuminata (D)*	20 – 30 (incl. dead plants)

3.6 Relevé 2

GPS	E: 422639/ N: 6741107	Date	25th April 2019
Land Surface	Yellowish red sandy loam; surface rock 60 – 70 % lateritic gravel (some exposed through removal of topsoil); litter 10 – 20 %; fallen timber 30 – 40 %; cryptogams < 2 %; bare ground < 10 %		
Condition	Good; high level of fallen shrubs; ground disturbance; rubbish present; weeds present; grazing, drought affected		
Threats	Clearing, vehicle access, rubbish, weeds, drought, grazing		

Relevé 2 Description

Height class (m)	Habit	Dominant species	% cover
2 – 4	Shrub, tree	*Allocasuarina acutivalvis subsp. acutivalvis, Hakea invaginata, Melaleuca cordata, Acacia stereophylla*	10 – 15
1 – 2	Shrub	*Acacia longiphyllodinea. Melaleuca cordata*	2 – 10
0.5 – 1	Shrub	*Grevillea paradoxa, Melaleuca cordata, Ecdeiocolea monostachya, Grevillea levis, Acacia longiphyllodinea, Santalum acuminatum, Micromyrtus racemosa, Cyathostemon heteranthus*	2 – 10
< 0.5	Shrub	*Micromyrtus racemosa, Acacia restiacea, Seringia integrifolia, Dianella revoluta var. divaricata, Allocasuarina acutivalvis subsp. acutivalvis*	< 2

3.7 Relevé 3

GPS	E: 422652/ N: 6741231	Date	25th April 2019
Land Surface	Brownish yellow sandy loam		
Condition	Very good		
Threats	Clearing, inappropriate fire regime, drought, weeds		
NVIS	U+ ^ *Eucalyptus leptopoda subsp. arctata, E. eudesmioides, Acacia assimilis subsp. assimilis\^mallee shrub, shrub\6\c; M ^ Calothamnus gilesii, Rhagodia drummondii, Conospermum integerrimum\^shrub, vine\2\r; G ^ Austrostipa elegantissima, Maireana georgei, Ecdeiocolea monostachya\^Grass, shrub, sedge\2\ i*		

Relevé 3 Description

Height class (m)	Habit	*Dominant species*	% cover
3 – 6	Mallee, shrub	*Eucalyptus leptopoda subsp. arctata, E. eudesmioides, Acacia assimilis subsp. assimilis, Melaleuca hamata, Acacia stereophylla*	30 – 40
1 – 2	Shrub	*Calothamnus gilesii, Rhagodia drummondii, Conospermum integerrimum, Melaleuca fabri*	2 – 10
< 1	Grass, shrub, sedge	*Austrostipa elegantissima, Maireana georgei, Ecdeiocolea monostachya, Melaleuca fabri*	10 – 20
<0.5	Grass	*Amphipogon caricinus var. caricinus*	2 – 10

3.8 Relevé 4

GPS	E: 422606/ N: 6741218	Date	25th April 2019
Land Surface	Brownish yellow sandy loam		
Condition	Very good to excellent; lot of diggings (?echidna); structure intact, possible edge effects with road just to north and clearing to south; slight wind erosion		
Threats	Clearing, inappropriate fire regime, drought, weeds		
NVIS V Description	U+ ^ *Eucalyptus leptopoda subsp. arctata, Melaleuca hamata\^mallee shrub, shrub\6\c; G ^ Ecdeiocolea monostachya, Dianella revoluta var. divaricata, Melaleuca fabri\^sedge, shrub\2\c*		

Relevé 4 Description

Height class (m)	Habit	*Dominant species*	% cover
4 – 6	Mallee, shrub	*Eucalyptus leptopoda subsp. arctata, Melaleuca hamata*	30 – 40
1 – 1.5	Shrub	*Rhagodia drummondii*	< 2
<1	Sedge, shrub	*Ecdeiocolea monostachya, Dianella revoluta var. divaricata, Melaleuca fabri, Grevillea paradoxa, Seringia integrifolia*	30 – 40
<0.5	Herb	*Borya sphaerocephala*	2 – 3

3.9 Relevé 5

GPS	E: 422513/ N: 6741208	Date	25th April 2019
Land Surface	Brownish yellow sandy loam		
Condition	Good; high level of disturbance		
Threats	Clearing, inappropriate fire regime, drought, weeds		

Relevé 5 Description

Height class (m)	Habit	*Dominant species*	% cover
> 2	Shrub	*Acacia stereophylla*	<2
1 – 2	Shrub	*Melaleuca fabri, Grevillea paradoxa, Dianella revoluta var. divaricata, Seringia integrifolia*	< 2
< 1	Sedge, shrub	*Ecdeiocolea monostachya, Melaleuca fabri, Seringia integrifolia, Mesomelaena preissii*	10 – 20
< 0.5	Herb, grass	*Borya sphaerocephala, Amphipogon caricinus var. caricinus*	< 2