Newman Rd/Hannan Way, Narrikup

Plantagenet Shire proposed road realignment

Vegetation and flora survey

July 2023

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Contents

Disclaimer

Every effort has been made to ensure the accuracy of the information provided, however the author does not accept responsibility for any omissions or errors or in how this information is used subsequently by others.

Executive summary

The Shire of Plantagenet proposes to straighten the road in the vicinity of the Newman Rd and Hannan Way intersection, affecting approximately 140 m length of existing road verge, and approximately 0.15 ha of land. The road widening requires excision of approximately 0.15 ha from unallocated crown land (Land ID Pin 3091247), managed by Department of Planning, Lands and Heritage. Just under half of the proposed excision area of approximately 0.06 ha has been historically cleared or partially cleared for power poles.North of the proposed straightening area, on the west of Newman Rd, Narrkiup between Spencer Rd and Hannan Way, it is proposed to clear only to the top of the back slope.

A detailed vegetation and flora survey was conducted in intact native vegetation within the proposed clearing area including two 5 m x 20 m quadrats and two 10 m x 10 m relevés. In addition, reconnaissance survey including an additional 4 relevés was conducted in a total of approximately 0.24 ha of the remaining stretch of road on the west side of Newman Rd, south of the Spencer Rd intersection.

The vegetation unit occurring throughout the intact vegetation in the survey area is *Hakea ferruginea* Closed Heath. This vegetation unit meets the criteria to be a Proteaceae Dominated Kwongkan Shrublands of the South East Floristic Province Threatened Ecological Community. One priority flora species *Tricostularia davisii* P3 was recorded in all survey sites on Newman Rd, but not in the site on Hannan Way.

The vegetation at two sites in the proposed clearing area is in pristine or nearly so condition. The remaining two sites are in very good and excellent condition. Scattered occurrence of two potentially invasive weeds (Victorian tea tree and *Watsonia* sp) were recorded in reasonably low numbers mostly on the edges of the cleared to partially cleared area as well as the site on Hannan Way which is the most disturbed site in very good condition. An isolated mature plant of African love grass was noted on edge of Newman Rd near the Hannan Way intersection.

The proposed clearing area is small in relation to the overall area of bush in the surrounding area and located in an area that is already dissected by roads and a track, plus a cleared and partially cleared area for power poles and power lines. It is recommended that ongoing management of the potentially invasive weeds be undertaken with the aim of eradication while the numbers are relatively low and to prevent their further spread. It is also recommended that that all machinery should be cleaned prior to use on the site, to limit the introduction of weeds and plant pathogens.

1 Introduction

The Shire of Plantagenet proposes to straighten the road in the vicinity of the Newman Rd and Hannan Way intersection, affecting approximately 140 m length of existing road verge. The road widening requires excision from unallocated crown land (Land ID Pin 3091247), managed by Department of Planning, Lands and Heritage (pers. comm. D. Lynch, Works Manager, Shire of Plantagenet, November, 2022). North of the proposed straightening area, on the west of Newman Rd, Narrkiup between Spencer Rd and Hannan Way, it is proposed to clear only to the top of the back slope on the west side of Newman Rd (pers. comm. K. Hemmings, Works Manager, Shire of Plantagenet, July 2023).

A vegetation and flora survey was undertaken in and adjacent to the target area covering approximately 0.65 ha in total for the purpose of applying to the Department of Water and Environmental Regulation (DWER) for permission to clear the relevant area to enable proposed road works. The survey and report follows guidelines as set out in the Environmental Protection Act (EP Act) guidance statement number 51.

The scope of works undertaken for this survey include a desktop survey that included previous flora and vegetation studies in the vicinity of the study site and conservation flora searches; field survey, vegetation unit and condition mapping, genera and species names of all species recorded (Appendix 3); detailed descriptions of vegetation unit (Appendix 4); vegetation association descriptions from site data (Appendix 5) and floristics summary (two-way table) (Appendix 6).

This report details methods, limitations, results, discussion, conclusions and recommendations. Also included is the vegetation survey recording sheet template used in this survey (Appendix 1), the condition and structural classification systems used and the Native Vegetation Information System (NVIS) Hierarchy (Appendix 2).

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1.1 Size and location

The proposed road works on near the Newman Rd/Hannan Way intersection is within the Shire of Plantagenet, located approximately 200 m north of the Narrikup town site (Figure 2), 32 km north west of Albany and 17 km south east of Mount Barker (Figure 1). Narrikup is located in the catchment of the Wilson Inlet Catchment Council (WICC) – the area of which is defined by the catchment of rivers flowing into the Wilson Inlet. WICC is the most westerly catchment of the South Coast Natural Resource Management (South Coast NRM). The total survey area is shown in Figure 3.

The proposed area to be excised for road straightening is approximately 1514 m^2 or 0.15 ha. Of this area, approximately 600 m^2 is already cleared and partially cleared for power poles. The clearing of the back slope along the west side of Newman Rd, past the proposed road straightening area is not included in the proposed clearing area because clearing the back slope is part of normal road maintenance.

Figure 1: Context map of the location of the study site (marked with red pin) in relation to nearby towns and South Western Australia

Figure 2: Aerial photo showing the survey site and location of Newman Rd and Hannan Way proposed roadworks (marked in red) in relation to the Narrikup townsite.

Figure 3: Location of survey area on west side of Newman Rd and Hannan Way south west of Newman Rd intersection. The area north of the proposed road straightening area (shown in Figure 2) on the west side of Newman Rd will only involve clearing to the top of the back slope.

1.2 Geology

The context area is underlain by the Albany-Fraser Oregon composed of Proterozoic age (1200 to 1800 million years ago) gneissic and granitic rocks. Slumping of the south coast after Antarctica began to separate from Australia about 100 million years ago, caused the sea to cover the low-lying parts of the area, when the Stirling Range and Porongurup Range were islands. Silt and spongolite (Pallinup Siltstone) was deposited under the sea and swampy sediments (Werrilup Formation) were deposited in low lying areas in the Eocene (RAP & SCRIPT, 1996). Uplift and warping associated with the down-warps of the southern edge raised the land and caused faulting and shearing of the basement rocks, the rejuvenation of drainage lines and the formation of new surfaces along the ancient river systems (Mulcahy, 1960). Lateritisation occurred in the Tertiary (about 30 million years ago) (RAP & SCRIPT, 1996, p. 10).

The land surface of the context area is now a plain composed of sand and laterite that slopes gently south to the coast from the base of the Stirling Range, formed from the weathering of sediments and wind-blown sands over time. The lower parts of the plain are “broad, flat valleys containing lakes, sand dunes and erosional remnants of lateritised continental sandstone, Eocene spongolite and fossil wood”, drained at the southern edge by the headwaters of the Kalgan and Hay River (Muhling *et al.* 1985, p. 2).

The Sleeman Creek watercourse drains the catchment in the Narrikup area, where the soil type is clay, sand, silt and gravel. Soils in the broader landscape of this area consist of white, grey or brown sand, commonly containing iron pisoliths (2-10 mm diameter sedimentary rocks) and often overly laterite (Muhling, Brakel and Moncrieff, 1978).

1.3 Climate

The climate is Mediterranean, with generally cool and wet winters and warm, dry summers. The closest weather station with long-term climate records is Mount Barker (BOM, 2022). Mean annual rainfall is 726 mls. The wettest months are May to October. Monthly temperature and rainfall statistics for Mount Barker are shown in Table 1.

Table 1: Long term monthly rainfall and temperature statistics for Mount Barker (BOM As at 17 November, 2022)

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Mean maximum temperature (°C)	26.3	26.2	24.3	21.3	17.9	15.4	14.4	15.1	16.8	18.9	21.9	24.2	20.2	103	1905 2022
Mean minimum temperature (°C)	12.8	13.1	12.4	10.7	8.8	7.2	6.1	6.2	7.0	8.1	9.9	11.4	9.5	103	1905 2022
Rainfall															
Mean rainfall (mm)	23.4	24.0	36.9	54.1	81.8	92.5	102.4	90.1	79.0	67.8	42.4	29.4	726.0	129	1886 2022
Decile 5 (median) rainfall (mm)	15.3	16.2	28.8	44.8	73.9	86.6	98.2	85.1	76.6	62.6	35.0	24.9	720.9	114	1886 2022
Mean number of days of rain ≥ 1 mm	3.9	3.8	5.3	7.3	10.5	11.9	13.3	12.3	10.8	9.6	6.7	4.8	100.2	110	1907 2022

1.4 Rivers and wetlands

The headwaters of the Sleeman River watercourse commence in the Narrikup area. The catchment of the Sleeman River is a heavily cleared fresh water system that drains into the Wilson Inlet. The Sleeman River has also been straightened and channelled in sections that are periodically cleaned out and is a source of nutrient enrichment in the Wilson Inlet. The Eyrie wetland group is a group of permanent and seasonal lakes and swamps at the north-eastern branch of the Hay River Catchment, just to the north-west of Narrikup. All lie within a cleared catchment with some remnant bush blocks which border upon one or two wetlands. The wetlands include Lakes Mowilyilip, Eyrie and Barnes (South Coast Regional Asssessment Team (RAP) and South Coast Regional Initiative Planning Team (SCRIPT), (1996).

1.5 Biogeography and vegetation

The study area falls within the Darling Botanical District where the vegetation is classified as the Narrikup System. Jarrah and Marri forest covered most of the area prior to clearing for agriculture. Small patches of Banksia occur on sand with Swamp Yate occurring along creeklines (Beard, 1979).

The extent, type and status of the native vegetation in Western Australia, recorded that 38.8% of the catchment of the Hay River Land Conservation District (LCD) was recorded as being vegetated at the time of the study in 2002 (Shepherd, Beeston & Hopkins, 2002). The Narrikup area was included in the Hay River LCD at this time (pers. comm. K. Collins, 29 June, 2023).

1.6 Previous studies and database search

Sandiford & Barrett (2010) undertook the Albany Regional Vegetation Survey: Extent, Type and Status in the area south of Narrikup. The survey was undertaken around the Albany area, finishing approximately 10 km south of the Newman Rd site. A total of 67 native vegetation units on wetland, dampland and drainage line edge and upland landscapes were recorded in this study.

A database search was done of the Priority and Threatened Flora species and Ecological Communities by DBCA which identified 44 Priority and Threatened Flora and 2 Threatened Ecological Communities occurring within a 20 km radius of the survey site. A search of the Department of Climate Change, Energy, the Environment and Water (DCCEEW) database within a 20 km radius of the Newman Rd site showed two threatened ecological communities occurring in the area (see Results section). The DCCEEW site also showed that the Porongurup National Park is the closest National Heritage place.

1.7 Disturbance history within survey area

The northern end of Hannan Way below the Newman Rd intersection, as well as the southern portion of Newman Rd has had the overstorey removed in the vicinity of power lines. There were no signs of recent fire observed throughout the target area. Approximately 0.1 ha at the southern end of Newman Rd has been cleared for the erection of power poles

1.8 Habitat and connectivity

Approximately 20% (or 300 m^2) of the proposed excision and clearing area of approximately 0.15 ha – which occurs to the northern end of the proposed excision area – is valuable habitat because the bushland is intact, and much of it has dense understorey. The remainder varies in condition, being dissected by roads and tracks and cleared and partially cleared for power poles and lines. The remnant is connected to bushland that surrounds the Narrikup town site to the west, east and south of the survey site and ultimately linking with the Chorkerup Nature Reserve further south.

2 Method

Initial field work was carried out on 16th and 22 November, 2022. The survey area was determined based on initial communication with the Plantagenet Shire Works Manager at the time that they planned to widen Newman Rd five metres to the west. An area approximately 10 m wide by 410 m long on the west side of Newman Rd was targeted for the initial survey. However, an additional field survey was undertaken on 10 July, 2023 because the planned road works communicated were changed to road straightening of the bend in the area of the Hannan Way/Newman Rd intersection, including land that had not been surveyed previously. The original plan to widen Newman Rd to the west (south of the Spencer Rd intersection) and to the north of the proposed road straightening area was reduced to only clearing of the back slope of the road verge to enable normal road maintenance.

Prior to undertaking the spring 2022 field work, a desktop study was carried out. A search of the Department of Biodiversity, Conservation and Attractions (DBCA) database produced a list of priority and threatened species for the western South Coast Region which was downloaded and listed prior to undertaking the initial survey work. Contact was also made with Sarah Barrett, the Threatened Flora Officer with DBCA Albany District to request feedback on any particular species she wanted me to watch out for from a local perspective.

Prior to undertaking the July 2023 field work, the following additional desktop studies were undertaken within a 20 km radius of the Newman Rd site:

- A search undertaken by DBCA of DBCA and WA Herbarium databases of the Priority and Threatened Flora species and Ecological Communities;
- A search was undertaken of the Department of Climate Change, Energy, the Environment and Water (DCCEEW) database (website) of threatened ecological communities and National Heritage places; and
- Vegetation survey work undertaken by Sandiford & Barrett (2010) around the Albany area, finishing approximately 10 km south of the Newman Rd site was reviewed.

Sites were selected for the spring 2022 survey to represent variation of vegetation structure, landscape position and hydrology. Due to the long narrow nature of the overall survey area as understood at that time, variation in vegetation within the target area was identified by reconnaissance by driving along Newman Rd with the aim of ensuring variations in vegetation structure and diversity were represented at survey sites.

The relevé survey type used follows the method used by Sandiford & Barrett (2010) and following the definition in the EPA Technical Guidance for Flora and Vegetation surveys (Section 4), is a Reconnaissance survey type. In the spring 2022 survey, each site (relevé) consisted of an unmarked 10 m x 10 m area, and the tree, mallee and >2m shrub strata were taken over an 20 m x 20 m area. However, these strata were redone in July 2023 when it was understood that this should have been done in a 10 m x 10 m area for the tree and >2m shrub strata in the Jarrah Forest Interim Biogeographic Regional Area.

Rules governing inclusion of species in site data are that they are required to either project at least 5% canopy cover or be represented by at least three individuals in the relevé area to be included. If

not, they are listed at the bottom as 'other species' and are included in the overall summary of species (Appendix 3) but not used in site data.

The relevé survey method used has been shown to be an effective rapid survey method rather than marked quadrats where every species is recorded. Although marked quadrats contain more data, they are a lot more time consuming and compromise the coverage of the targeted survey area. The relevé method was used for the Ravensthorpe Range (Craig et al. 2008), the Albany Regional Vegetation Survey (Sandiford & Barrett, 2010), Proteaceous Rich Vegetation Survey in the Forest to Stirlings section of the Gondwana Link (Sandiford, 2012), and for the Ranges Link Surveys (Bradshaw, 2013, 2014, 2015).

Sites were selected for the July 2023 survey based on intact vegetation and to ensure detailed representation of the vegetation present in the revised area targeted for roadworks. The narrow nature of the target clearing area was undertaken using marked 5 m x 20 m quadrats following Keighery (1994) bushland plant survey method. The main difference in contrast to the relevé method apart from being marked is that all species are included the quadrat data. Detailed surveying was undertaken because the desktop survey indicated the likelihood of the presence of a threatened ecological community and threatened flora. The cleared to partially cleared area associated with power poles was surveyed by reconnaissance only and included in the overall species list but not included in any data. Sites were marked by using a compass to determine right angles and a tape measure to measure the sides, and marked with a string.

Site data records (Appendix 5) include vegetation association, stratum composition, percent cover and species dominance for each relevé and quadrat area. Photographs and Global Position System (GPS) locations shown with site data were taken from the north-west corner for relevé sites 1, 4 and 6; the south-west corner for sites 2, 3 and 5; the north east corner for quadrat 7 and the south east corner for quadrat 8. Relevé sites and quadrats were located approximately 5 m in from the disturbed edge of the road verge. GPS unit used was a Garmin 76, using WGS 84 datum.

Vegetation structure for all sites was determined using Keighery (1994), adapted from Muir (1979) and Aplin (1979). Condition was determined using Keighery (1994) modified from Trudgen (1991) (Appendix 2). The quadrat site numbers are listed as Site 7 and 8 to continue on from the numbering of 1 to 6 for relevé sites.

Site attributes including visual assessment of soil colour and type to a depth of 10cm, geology, percentage surface rock, land form, hydrology and drainage status were recorded, as per relevé template (Appendix 1) and also includes subsurface soil type and colour in quadrat data.

Samples of species that could not be identified in the field were collected, given a unique identifying name, and pressed for identification. Where possible, all species that could not be identified in the field were identified through cross referencing between Department of Biodiversity, Conservation and Attractions website *Florabase*, relevant plant identification keys/reference books, and the at Albany Herbarium and with the DBCA Threatened Flora Officer where potential threatened/priority species were identified.

Following all field work, all relevés were reviewed. Results of all relevés were clustered by common dominant upper, mid and lower storey dominants, landform and soil units. Site data was entered

into a two-way table (Appendix 6) to show the transition of species presence/absence between survey sites, linked to soil types and landscape positions. Vegetation associations are named by site in species data (Appendix 5) and unit name developed based on species composition, with species dominance linked to landform and best fit the description of NVIS level 5 associations (level V as defined in the National Vegetation Inventory System (NVIS) Information Hierarchy (ESCAVI, 2003, Appendix 2d) (follows Sandiford & Barrett, 2010).

2.1 Limitations

Limitations of the survey are listed in Table 2 and below under plant identification. It should also be noted that soil and hydrology data was assessed briefly and subjectively and thus any conclusions regarding these attributes need to be treated with caution.

Table 2: Limitations and issues of the survey

Limitation	Description
Availability of contextual information at regional and local scale	Priority, threatened flora and ecological communities recorded within 20 km of the survey area were accessed. Beard (1979) mapping is available for the regional scale at 1:250,000. Sandiford & Barrett (2010) surveyed an area in the Albany region, to approximately 10 km south of Narrikup, and provides a close reference for the local context.
Competency/experience of survey work undertaken including experience in the bioregion surveyed	20 plus years' experience working in biodiversity restoration in the western South Coast Natural Resource Management Region including working for Greening Australia 1998-2008; Have an ecological agriculture degree(completed 2008) which included study of the biological environment including taxonomy, as well as units covering landscape ecology, restoration ecology, habitat management, applied ecology and wildlife management. Was mentored by experienced botanist Libby Sandiford in undertaking flora surveys including how to use the relevé survey method and do a two-way table in 2013. Since then have undertaken a number of vegetation surveys for local sub-regional groups in the western South Coast NRM region.
Effort and extent of area surveyed	A total of 200 m^2 was surveyed using the quadrat method and 200m^2 surveyed by relevé method within the overall approximately 1514 m^2 area targeted for clearing of which approximately 600 m^2 is already cleared or partially cleared for power poles and lines. An additional 400 m^2 of relevés were undertaken along the remaining approximately 300m length of Newman Rd where it is now understood will only be cleared to the back slope.
Survey timing, rainfall , season	Survey was undertaken in mid-November, after the winter – dominant rainfall, and again in July during the wet season.
Disturbance factors affecting results	A small area to the south of the site has had the trees removed due to power lines. The relevant vegetation unit area was then checked in an area immediately adjacent to the tree clearing line to clarify what is the likely pre-clearing tree and mallee strata height, species and canopy cover in the affected area to assist in determining application of relevant vegetation unit name to the affected area.

2.2.1 Proportion of flora recorded and/or collected, identification issues

The proportion of area surveyed (400 m^2) is 44% of the total intact native vegetation area (900 m^2) in the area proposed land excision area of approximately 1514 m^2 (the remainder is cleared or partially cleared). Plants that could not be identified in the field were collected and pressed. All species were identified by cross referencing with Albany Herbarium specimens, relevant plant keys/identification literature and Florabase. The Albany Herbarium also does not have a complete collection of flora from the area and some specimens in the herbarium are likely to be incorrectly named (pers. comm. E. Sandiford). Plants that were not able to be identified to species level were identified to genus level where possible. Identification of the following species were resolved as follows:

- A specimen of what was provisionally named *Drosera gibsonii (P2)* was given to Sarah Barrett, the local Threatened Flora Officer (DBCA) who had the specimen further checked with botanist Libby Sandiford and was taken to the Perth Herbarium for checking by her staff member and was determined to be *Drosera verrucata.*
- Photos were taken of a stand of possible *Lambertia orbifolia* (T) and sent to Sarah Barrett for checking as unable to collect specimens of threatened species that were seen growing on the other side of the road. She confirmed was not the threatened species
- The genus of *Lepidosperma* is currently being revised with a large number of new species being named (Barrett & Wilson, 2020). Specimens identified as belonging to the genus *Lepidosperma* were named sp. aff. followed by the species name that appears closest to current Albany herbarium specimen identification.
- *Eucalyptus marginata* (jarrah) and *E. staeri* both occur in the Narrikup area. The species was named as jarrah because of discolorous leaves that are glossy green on top and dull pale green below, the intramarginal vein, presence of oil glands and less deeply furrowed bark. This has been given the name *Eucalyptus marginata* subsp. *marginata* as recorded by French & Nicole (2019, p. 274), can occur as a “shrubby mallee” which this form was.

3 Results

A total of six relevé sites and two quadrat sites were surveyed (see Figure 4 for overall survey area map and Figure 5 for sites within proposed land excision area). A total of 97 native species from 29 genera were recorded overall, of which 86 species from 28 genera met relevé rules to be included in the data which in turn was used to describe one vegetation unit overall. The average number of species recorded per relevé was 34. The family that contained the highest number of species (that were included in the data) was the Proteaceae (14 species), followed by Myrtaceae (12 species), Fabaceae (nine species), Cyperaceae (eight species) and Ericaceae (seven species). All remaining families were represented by five or less species.

3.1 Vegetation units and associations

One unit *Hakea ferruginea* Closed Heath was developed from the floristics table (Appendix 6), represented in the entire intact survey area of 0.65 ha (Figure 6). This unit occurs on flat, low lying ground. The variation in altitude within the entire (reconnaissance) survey area varies between 133 m ASL and 135 m ASL. Vegetation associations and condition for each survey site are shown in Table 3. Vegetation condition for each site is mapped in Figure 7. Sites 1, 6, 7 and 8 all fall within the proposed clearing area. The remaining sites are located on the western side of Newman Rd, south of Spencer Rd.

Table 3: Vegetation associations and condition status for all survey sites

Site no.	Vegetation association	Condition
1	*Hakea ferruginea* closed heath with emergent *Allocasuarina fraseriana* and Jarrah mallee	Pristine
2	*Allocasuarina fraseriana* low open woodland/Jarrah mallee over *Hakea ferruginea* tall shrubland	Pristine
3	Jarrah mallee over *Hakea ferruginea* closed tall scrub with emergent *Allocasuarina fraseriana*	Pristine
4	Jarrah mallee over *Hakea ferruginea* tall shrubland with emergent *Allocasuarina fraseriana*	Pristine
5	Jarrah mallee over *Hakea ferruginea* tall shrubland with emergent *Allocasuarina fraseriana*	Pristine
6	*Hakea ferruginea* closed heath with emergent *Allocasuarina fraseriana* and Jarrah mallee	Pristine
7	*Hakea ferruginea* open heath with emergent jarrah	Very good
8	*Hakea ferruginea* closed tall scrub	Excellent

3.2 Species diversity and condition status

The species diversity ranges from 24 species in the lowest number (Site 6) and 43 in the highest number (Site 5). The vegetation in Sites 1 to 6 was described in the category of pristine or nearly so with no weeds recorded and bushland appearing healthy. Quadrat 7 was described as very good because of disturbance such as an adjacent track, some deaths of *Hakea ferruginea* and presence of two potentially invasive weeds (*Leptospermum laevigatum* and *Watsonia* sp. – currently in low numbers). Quadrat 8 was described in the category of excellent because the bush appeared healthy but lacking in tree and mallee cover due to removal for power lines.

An area to the south of Newman Rd of approximately 0.06 ha has been cleared or partially cleared for power poles. One mature plant of African love grass was recorded on the edge of Newman Rd near the Hannan Way intersection. One record of recently dumped garden waste (possibly *Coryline* sp.) on the verge of Newman Rd was recorded.

3.3 Conservation species

3.3.1 Results of data search

Species identified by the local Threatened Flora Officer with DBCA that are particularly known to occur in the Narrikup area were as follows: *Isopogon buxifolius* ssp *buxifollius* P1 (nominated as Threatened) and *Melaleuca spathulata / Melaleuca viminea* Priority Ecological Community, and Threatened Flora – *Lambertia orbifolia* CR, *Isopogon uncinatus* CR and *Conostylis misera* (pers. comm S. Barrett email 10 October, 2022).

Results of the Threatened and Priority Flora search was received from the Department of Biodiversity, Conservation and Attractions (2018) Threatened and Priority Flora Database Search for a 20 km area around Newman Rd, Narrikup from DBCA records and the WA Herbarium, accessed on the 29 June, 2023 are listed in Tables 4 and 5 respectively. A total of 44 Priority and Threatened Flora are listed.

Results of a search by DBCA of the Priority and Threatened Ecological Communities database within 20 km radius of Newman Rd was received on 4 July, 2023 and are shown with TEC data results from Department of Climate Change, Energy, the Environment and Water (DCCEEW) database are in Table 6. The DBCA search found 3 TECs and DCCEEW found 2 TECs in the search area.

3.3.2 Survey results of conservation species

One priority flora species: *Tricostularia davisii* P3 was recorded in all sites except Site 7.

One threatened ecological community (TEC) was recorded. The TEC recorded is Proteaceae Dominated Kwongkan Shrublands of the South Eastern Floristic Province. This TEC is in the category of Endangered (Department of Environment, 2014) (Figure 6).

Table 4: Threatened and Priority Flora Database Search results for a 20 km area around Newman Rd, Narrikup (DBCA, 2018)

Taxon	Conservation Status	WARank
Acacia heteroclita subsp. valida	2	
Andersonia auriculata	3	
Andersonia setifolia	3	
Andersonia sp. Jamesii (J. Liddelow 84)	4	
Andersonia sp. Mitchell River (B.G. Hammersley 925)	3	
Apium prostratum subsp. phillipii	T	EN
Banksia brownii	T	CR
Banksia goodii	T	VU
Caladenia christineae	T	EN
Caladenia harringtoniae	T	VU
Caladenia startiorum	2	
Caladenia ultima	2	
Carex tereticaulis	3	
Chordifex abortivus	T	VU
Conostylis misera	T	VU
Degelia flabellata	2	
Gonocarpus trichostachyus	3	
Goodenia sp. South Coast (A.R. Annels ARA1846)	3	
Hibbertia porongurupensis	4	
Isopogon uncinatus	T	CR
Juncus meianthus	3	
Lambertia orbifolia subsp. orbifolia	T	CR
Lysinema lasianthum	4	
Ornduffia calthifolia	T	EN
Pleurophascum occidentale	4	
Rorippa cygnorum	2	
Sphenotoma drummondii	T	EN
Styphelia cymbiformis	2	
Synaphea incurva	3	
Synaphea preissii	3	
Verticordia apecta	T	CR
Verticordia endlicheriana var. angustifolia	3	

Table 5: WA Herbarium Threatened and Priority Flora Database Search results for a 20 km area around Newman Rd, Narrikup (DBCA, 2018)

Taxon	Conservation Code
Acacia drummondii subsp. elegans Porongurup variant (R.J. Cumming 938)	4
Acacia heteroclita subsp. valida	2
Andersonia auriculata	3
Andersonia sp. Jamesii (J. Liddelow 84)	4
Andersonia sp. Mitchell River (B.G. Hammersley 925)	3
Apium prostratum subsp. phillipii	T
Astartea transversa	2
Banksia brownii	T
Banksia densa	2
Banksia goodii	T
Banksia parva	4
Banksia porrecta	4
Banksia seneciifolia	4
Banksia serra	4
Banksia sphaerocarpa var. latifolia	2
Banksia verticillata	T
Boronia crassipes	3
Bossiaea lalagoides	3
Caladenia christineae	T
Caladenia startiorum	2
Caladenia ultima	2
Cardamine paucijuga	2
Carex tereticaulis	3
Chordifex abortivus	T
Chorizema carinatum	3
Conostylis misera	T
Darwinia leiostyla	4
Darwinia macrostegia	4
Degelia flabellate	2
Drosera lasiantha	2
Eucalyptus buprestium x staeri	4
Gastrolobium ferrugineum	2
Gastrolobium subcordatum	4
Gonocarpus trichostachyus	3
Goodenia quadrilocularis	2
Goodenia sp. South Coast (A.R. Annels ARA 1846)	3
Hakea lasiocarpha	3
Hibbertia porongurupensis	4
Hibbertia sandifordiae	1
Isopogon uncinatus	T

Table 5 (cont.)

Taxon	Conservation Code
Juncus meianthus	3
Lambertia orbifolia subsp. orbifolia	T
Lepidium pseudotasmanicum	4
Lysinema lasianthum	4
Marianthus granulatus	4
Meionectes tenuifolia	3
Ornduffia calthifolia	T
Ornduffia marchantii	4
Pimelea rosea subsp. annelsii	3
Pleurophascum occidentale	4
Pterostylis heberlei	2
Rorippa cygnorum	2
Schoenus sp. Mt Barker (G.J. Keighery 9679)	1
Sphenotoma drummondii	T
Spyridium spadiceum	4
Stylidium corymbosum var. proliferum	2
Stylidium marradongense	3
Styphelia cymbiformis	2
Synaphea incurva	3
Synaphea intricata	3
Synaphea preissii	3
Tecticornia uniflora	4
Thelymitra jacksonii	3
Thomasia solanacea	4
Tricostularia davisii	3
Tricostularia sandifordiana	3
Tricostularia sp. Porongurup (I. Abbott 18)	1
Verticordia apecta	T
Verticordia endlicheriana var. angustifolia	3
Verticordia fimbrilepis subsp. australis	T
Xanthoparmelia sargentii	1
Xanthoparmelia subalpina	2

Table 6: Threatened Ecological Communities recorded by DBCA within 20 km radius of Newman Rd

Threatened Ecological Community	State Category (DBCA database only)	Commonwealth Category (DBCA database only)	Database source
Proteaceae Dominated Kwongkan Shrublands of the southeast coastal floristic province of Western Australia	Priority 3	Endangered	DBCA, DCCEEW
South Coast Porongurup Range Karri Forest	Priority 1	Endangered	DBCA
Banksia coccinea Shrubland/*Eucalyptus staeri/Sheoak* Open Woodland	Priority 1	Endangered	DBCA
Eucalypt Woodlands of the Western Australian Wheatbelt			DCCEEW

Figure 4: Location overall survey areas and survey sites (relevés and quadrats) (white outline) and main area of proposed roadworks (red outline)

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Figure 5: Location of survey sites within the proposed area of focus for roadworks involving straightening of road in the vicinity of the Newman Rd and Hannan Way intersection (red outline)

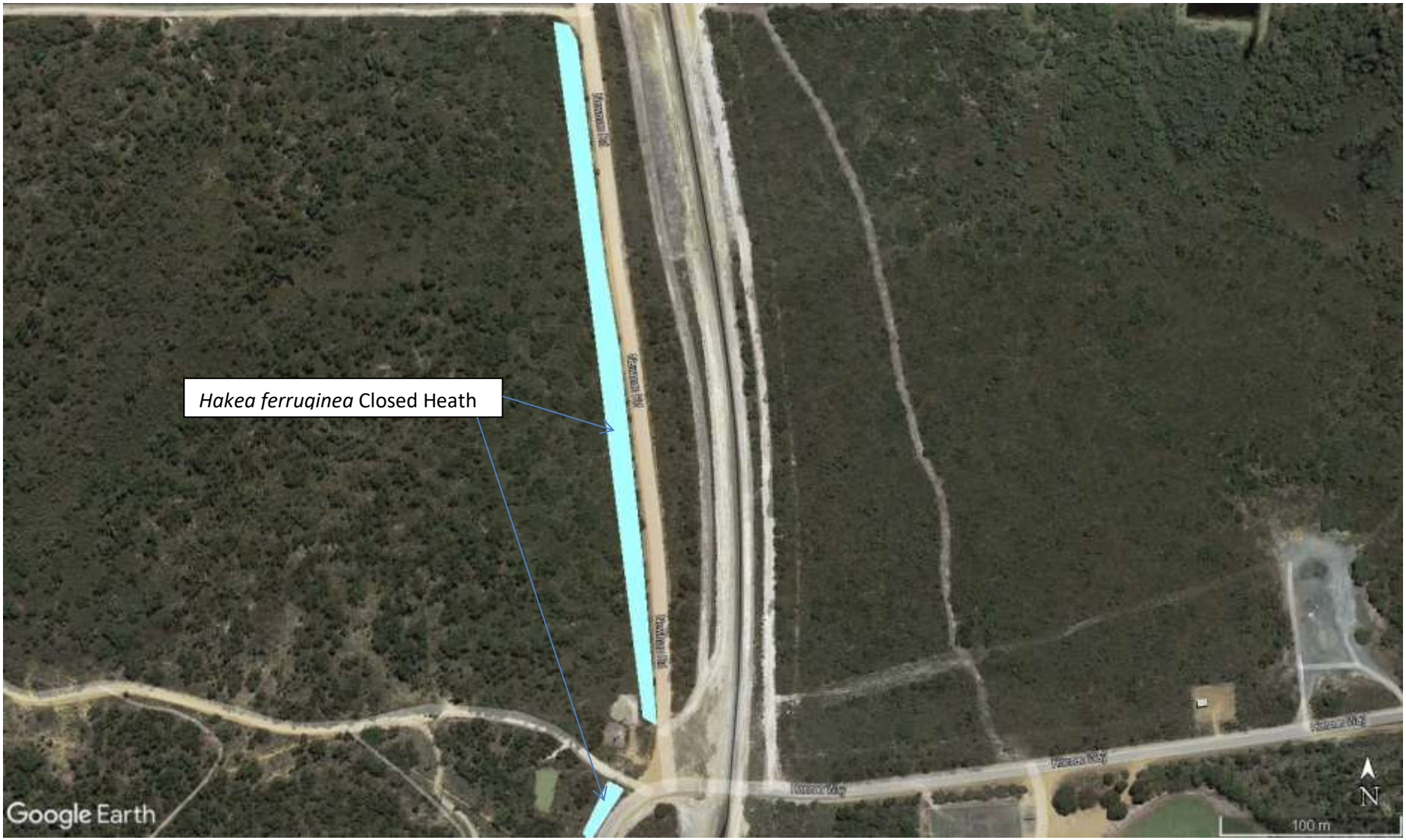

Figure 6: Vegetation map showing the location of the vegetation *Hakea ferruginea* Closed Heath

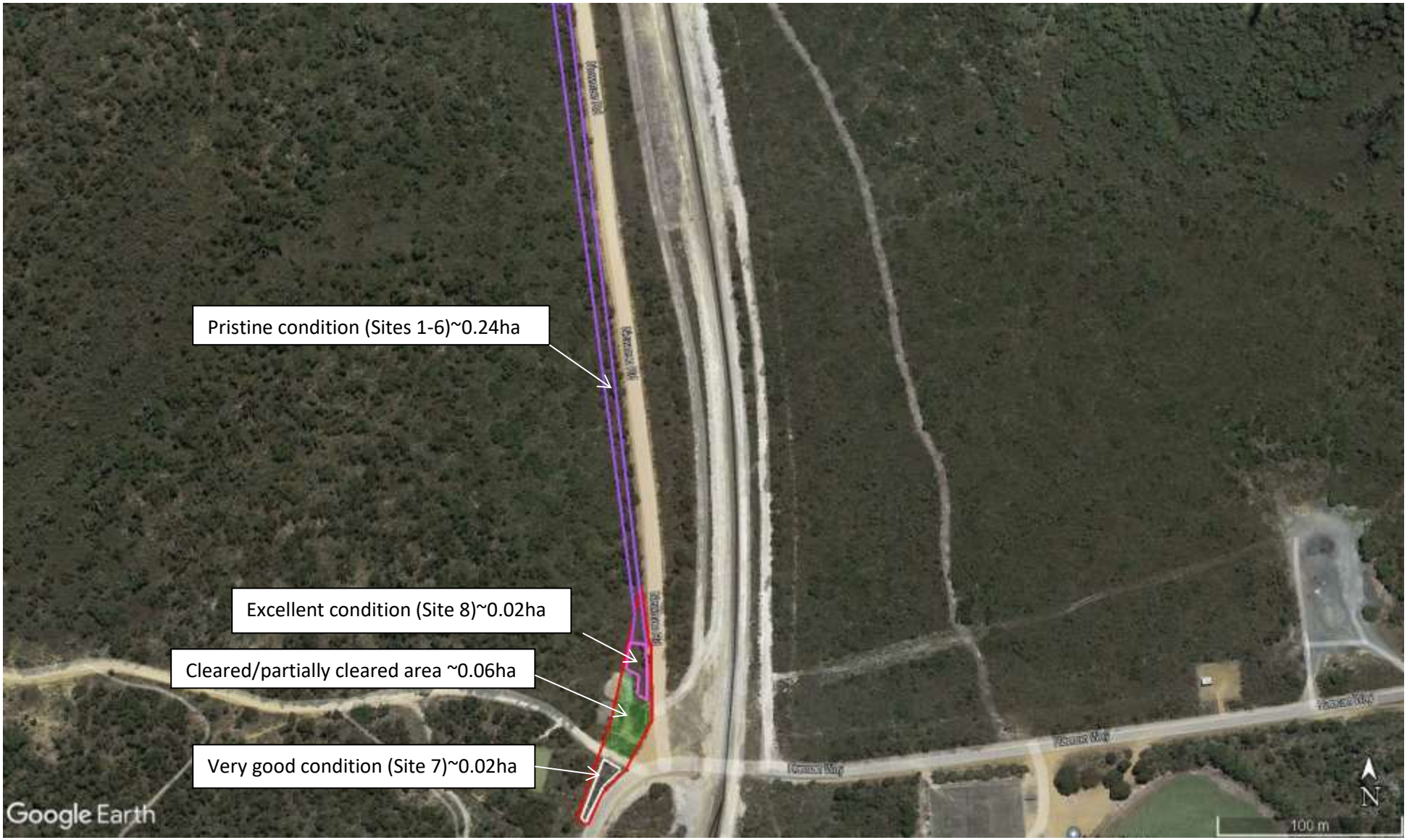

Figure 7: Vegetation condition map. Target area for proposed excision outlined in red (~0.15ha). Cleared/partially cleared area shaded in green

4 Discussion

The intact structural and compositional diversity with mostly dense understorey at the survey sites is indicative of the high habitat value of this bushland. Prevalent diggings of what appear to be both echidna (*Tachyglossus* sp.*)* and quenda (*Isoodon obesulus)* were observed within the first few steps taken into the bush (Figure 8). However, the approximately 0.15 ha (1514 m^2) that is targeted for proposed clearing for road works includes the degraded cleared and partially cleared area of approximately 600 m^2 which is nearly half of the total proposed clearing area (Figure 7).

It is not possible to pinpoint why there is a variation in numbers of species between sites except to say there tends to be more species in the sandier and possibly deeper sand than sites with more clay. For example, Sites 3 and 5 have the highest number of species (42 and 43 respectively) and occur on sands while Site 6 has the lowest number (24 species) and occurs on sandy clay loam. However, Site 1 is also on sandy clay loam and has 37 species.

Figure 8: Examples of diggings observed in intact bushland indicating presence of small native mammals

4.1 Conservation species

The presence of the Proteaceae Dominated Kwongkan Shrublands of the South Eastern Floristic Province TEC at the survey site is confirmed for the *Hakea ferruginea* Closed Heath vegetation unit because the following criteria are met:

- the area lies within the South Eastern Floristic Province,
- has the presence of a minimum of 30% Proteaceae species, and

- the absence of a >10% projected foliage cover tree stratum in all except one site (a patch of the TEC may contain localised patches of trees that may be at a higher density than 10% projected foliage cover) (Department of Environment (DOE), 2014, p. 8).

The key Proteaceae species that is widespread and dominant throughout the unit (*Hakea ferruginea)* is recorded in the Conservation Advice (DOE, 2014) as being one of a number of widespread Proteaceae species within the TEC. *Hakea corymbosa* is also recorded at the site and listed as a widespread species within the TEC. A number of other Proteaceae species were also recorded (listed in the species list, Appendix 3).

Jarrah also qualifies for the Eucalypt Woodlands of the Western Australian Wheatbelt TEC. However, as Narrikup is located on the Fraser Oregon and not on the Yilgarn Craton, this disqualifies this unit as being a TEC under this category (See Department of Environment, 2015, Section 2.2, p. 6).

4.1.2 Comment on threatened and priority flora and threatened ecological communities

The following comment discusses the relationship between time of survey and flowering time, soils and landscapes for each species(accessed from Florabase July 2023) relevant to threatened and priority flora and TECs that are known to occur close to the survey area (pers. comm. S. Barrett, DBCA October, 2022; DBCA & WA Herbarium (2018).

Conostylis misera (T) flowers in October to November and does occur in similar habitats to those surveyed – on white or grey sand, sandy loam on winter wet flats. Six sites were surveyed in mid-November within the flowering window but no individuals of this species were found. Similarly, *Isopogon uncinatus* (T) flowers in October and November and can occur on swampy depressions and on similar soil types but was not found. Comment was made under the limitations section regarding the possible sighting of *Lambertia orbifolia* subsp. *orbifolia* (T) nearby to the survey area but was confirmed as not being this species. *Isopogon buxifolius* var. *buxifolius* (P1, nominated as T) flowers from July to December and also is recorded in similar habitat on grey sand and swampy areas. However, this species was not found in either the July or November surveys. *Melaleuca spathulata / Melaleuca viminea* PEC occurs in similar habitats but neither of these species were sighted individually or as a community. *Pimelea rosea* ssp. *annalsii* P3 is also known to occur in the Narrikup area and flowers between September and November, within the time of survey but does not occur in similar habitats to those surveyed as occurs on upper slopes. No individuals of the species were found.

4.2 Commonality with Albany Regional Vegetation Survey

The northern boundary closest to the Narrikup area of the Albany Regional Vegetation Survey: Extent, Type and Status (ARVS) (Sandiford & Barrett, 2010) was undertaken approximately 10 km south of the survey area. The authors described and mapped 67 native vegetation units within a survey area of 125,415 ha surrounding Albany. *Hakea ferruginea* Closed Heath has commonalities with two sub-units identified in the ARVS. These include: 31f *Hakea ferruginea* and/or *H. trifurcata/Xanthorrhoea platyphylla* Shrubland, and *Pericalymma spongiocaule* Low Heath.

Hakea ferruginea and/or *H. trifurcata/Xanthorrhoea platyphylla* Shrubland was recorded in the central and north-western areas of the ARVS and occurs on soils overlying laterite or spongelite, in areas of impeded drainage. Similarly to *Hakea ferruginea* Closed Heath which commonly occurs on areas prone to water-logging due to increasing clay content in the topsoil and/or shallow topsoil. This sub-unit has a number of common species with *Hakea ferruginea* Closed Heath including jarrah, *Allocasuarina fraseriana, Taxandria parviceps, Agonis theiformis, Hakea ceratophylla, Isopogon formosus, Allocasuarina humilis, Xanthorrhoea platyphylla, Beaufortia anisandra, Acacia browniana, Grevillea fasciculata, Leucopogon gibbosus, Pericalymma spongiocaule, Mesomelaena tetragona, Anarthria gracilis* and *Anarthria prolifera* .

Pericalymma spongiocaule Low Heath is found on sandy soils with impeded drainage by an impervious subsurface layer. *Hakea ferruginea* Closed Heath has common species with this sub-unit including jarrah, *Allocasuarina fraseriana, Hakea ceratophylla, Taxandria parviceps, Melaleuca thymoides* and *Lyginia barbata.*

4.3 Condition

Approximately 0.06 ha or 650 m^2 area to the south of sites 1 and 6 has been partially to completely cleared in the area of power poles on the southern end of Newman Rd near the intersection with Hannan Way. Part of this area is affected by increased surface water and the presence of wetland species *Machaerina articulata* which appears to have colonised the area in its current wetland condition (Figure 9). A few potentially invasive weeds were recorded on the edge of the disturbed area near the junction with Hannan Way, including *Leptopsermum laevigatum* (Victorian tea tree) and *Watsonia* sp. These weeds were also recorded in Site 7. One plant of African love grass (*Eragrostis curvula)* was recorded on the very edge of the road verge on the southern end of Newman Rd. One instance of dumping of garden waste – possibly a *Cordyline* species – was observed on the Newman Rd verge (Figure 10).

The list of weeds of national significance (Parliament of Australia, viewed 20 July, 2023) was checked and none of the weeds recorded were on it. However, it is important to remove/control these weeds while they are in relatively small numbers and to avoid them being spread with road works. The majority of the western side road verge of Newman Rd is weed free and vigilance to prevent the spreading of these weeds further down the road is important to maintain the pristine state of the majority of the road verge and neighbouring bushland (Figure 11). There were also no signs of patterns of death indicating the presence of *Phythophthora* Dieback in the study area.

Figure 9: Disturbed area associated with power poles and lines and road verge showing the introduced Victorian Tea Tree (*Leptopsermum laevigatum)* (left foreground) and wetland cleared area to the right that has been colonised by jointed rush (*Machaerina articulata)*

Figure 10: Dumped garden waste (?*Cordyline* sp.) on west edge of Newman Rd verge (left).
Figure 11 (right): A small section showing an example of the mostly pristine or nearly so state Newman Rd verge.

5 Conclusion

The Shire of Plantagenet proposes to straighten the bend in the vicinity of the Hannan Way/Newman Rd intersection, involving approximately 0.15 ha of clearing to the west of these roads. Approximately 600 m^2 – nearly half of the total proposed clearing area – is already cleared or partially cleared for power poles and power lines.

A vegetation and flora survey was undertaken in November 2022 and July 2023 in, and adjacent to, the proposed clearing area, covering approximately 0.65 ha in total. The vegetation to the north of the proposed clearing area was in pristine or nearly so condition and the two sites closest to the intersection north and south of the intersection were in excellent and very good condition respectively.

Three potentially invasive weeds (Victorian tea tree, *Watsonia* sp. and African love grass were recorded in the disturbed southern area of the site and need to be managed to prevent their spread into more pristine areas.

The intact vegetation of the proposed road works to the west of Newman Rd between Spencer Road and Hannan Way was given the vegetation unit name of *Hakea ferruginea* Closed Heath. This unit meets criteria of being included in the Proteaceae Dominated Shrublands of the South Eastern Floristic Province Threatened Ecological Community. One priority species (*Tricostularia davisii* P3) was identified at all survey sites except the most southerly site on Hannan Way.

The amount of proposed clearing of intact vegetation is located on an edge (adjacent to roads) is small relative to the size of a number of connected remnants – some of which are dissected by roads. A weed control program and vigilant hygiene to prevent the introduction of weeds and pathogens such as *Phytophthorra* Dieback is important to maintain the mostly pristine condition of the bushland in the broader area. These efforts will also help to minimise the possible negative impacts of the proposed clearing for road straightening should it go ahead.

6 Recommendations

It is recommended that:

- Ongoing control measures be put in place for Victorian tea tree (*Leptopsermum laevigatum), Watsonia* sp. and African love grass (*Eragrostis curvula)* that were recorded in the proposed road works area;
- Strict hygiene protocols are followed for all road works carried out in the area. The Proteaceae species that characterise the threatened ecological community that occurs throughout the intact survey area are highly susceptible to *Phytophthorra* Dieback.

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Appendix 1: Relevé recording sheet

		SITE_ID:
Date:	**Wp:**	**mE**
Recorder:	**VegCode:**	**mN**
Location and Site Notes:		

Condition: *Pristine Excellent Very Good Good Degraded --- RESIDUAL MODIFIED TRANFORMED*	
Aspect: *N NE E SE S SW W NW*	**Slope:** *Flat Gentle Mod Steep*
Geology: *Gnei Gran Lat Lime Silt*	**Rock:** *0 <2 2-10 10-20 20-50 >50*
Soil Colour: *Brown Grey Dark Brown Dark Grey Light Grey Light Brown Orange/Brown White Yellow Yellow/Grey*	**Soil Type:** *C CL CLS CS L LS S SCL SL SP ZCL ZL ZS P GL GS*
Hydrology: *Good drain Poor drain Perm wet Seasonal wet*	**Landform:** *Breakaway Cliff Consolidated Dune Drainage Depression Dune Gully Hill Crest Riparian Bank Rock Outcrop Slope Lower Slope Middle Slope Upper Swale Swamp Tidal Flat Tor Valley Flat Berm Flat Plain Ridge*

Growth form	Ht	Cvr	NVIS/dominant	Others
T_1	>30			
T_2	10-30			
T_3	<10			
M_1	>8			
M_2	<8			
S_1	>2			
S_2	1-2			
S_3	0.5-1			
S_4	<0.5			
V	NA			
H	NA			
G	NA			

Cover Codes: **D** >70% **M** 30-70% **S** 10-30% **V** 2-10% **E** <5% Emergent

Other Species:

Appendix 2

2.1 Growth Form Layer definitions, 2b Condition Scale and 2c Structural Classification; 2d The NVIS Information Hierarchy

1a. Growth Form Layers (Perth Biodiversity Project Natural Area Initial Assessment Templates)

Adapted from Keighery 1994, McDonald et al. 1990 and Executive Steering Committee for Australian Vegetation Information 2003)

Tree: woody plant with a single trunk and canopy, the canopy is less than or equal to ⅔ of the height of the trunk, no lignotuber apparent

Mallee: woody plant with many woody stems, canopy well above the base, lignotuber usually apparent, commonly of the genus *Eucalyptus*

Shrub: woody plant with one or many woody stems, foliage all or part of the total height of the plant, includes grass trees (*Xanthorrhoea spp*.) and cycads (*Macrozamia spp*.)

Herb: non-woody plant with stems, generally under 0.5 m tall and not a grass, sedge or rush

Grass: non-woody plant that comes from the plant family Poaceae; all have inconspicuous individual flowers that are pollinated by wind; leaf sheath always split, ligule present, leaf usually flat, stem cross-section circular, evenly spaced internodes

Sedge: non-woody, tufted or spreading plant that comes from the plant family Cyperaceae; most have inconspicuous flowers that are pollinated by wind; leaf sheath never split, usually no ligule, leaf not always flat, extended internode below inflorescence

Rush: same as sedge but comes from the plant families Juncaceae, Restionaceae, Typhaceae or Xyridaceae; leaf sheath may be split in Restionaceae

Climbers: plants that climb or scramble over other plants for support

2.2 Classification System Used to Describe Vegetation Structure (Keighery 1994), as adapted from Muir (1977) and Aplin (1979)

Growth Form/ Height Class	Canopy Cover			
	100% to 70 %	**70% to 30 %**	**30% to 10 %**	**10% to 2 %**
Trees over 30 m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland
Trees 10-30 m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees under 10 m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Mallee over 8 m (Tree Mallee)	Closed Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Mallee under 8 m (Shrub Mallee)	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub
Shrubs over 2 m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrubs 1-2 m	Closed Heath	Open Heath	Shrubland	Open Shrubland
Shrubs under 1 m	Closed Low Heath	Open Low Heath	Low Shrubland	Very Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

2.3 Condition Scale (Keighery, 1994)

Pristine Pristine or nearly so, no obvious signs of disturbance
Excellent Vegetation structure intact; disturbance affecting individual species; weeds are non-aggressive species
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; grazing*
Good Vegetation structure significantly altered by very obvious signs of multiple disturbances. 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; grazing.*
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; 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 or shrubs.*

2.4 NVIS Information Hierarchy

The NVIS (Native Vegetation Information System) Hierarchy. (Source: ESCAVI 2003)

Hiearchical Level	Description	NVIS structural/floristic components required
I	Class*	Dominant growth form for the ecologically or structurally dominant stratum.
II	Structural Formation*	Dominant growth form, cover and height for the ecologically or structurally dominant stratum.
III	Broad Floristic Formation**	Dominant growth form, cover, height and dominant land cover genus for the upper most or the ecologically or structurally dominant stratum.
IV	Sub-Formation**	Dominant growth form, cover, height and dominant genus for each of the three traditional strata (i.e. Upper, Mid and Ground).
V	Association**	Dominant growth form, height, cover and species (3 species) for the three traditional strata (i.e. Upper, Mid and Ground).
VI	Sub-Association**	Dominant growth form, height, cover and species (5 species) for all layers/sub-strata

*Walker & Hopkins 1990 **NVIS (defined for the NVIS Information Hierarchy)

Appendix 3 – Species names

Anarthriaceae
Anarthria dioica
Anarthria prolifera
Apiaceae
Xanthosia singuliflora
Asparagaceae
Laxmannia sessiliflora
Lomandra nigricans
Lomandra nutans
Lomandra pauciflora
Lomandra rupestris
Casuarinaceae
Allocasuarina humilis
Allocasuarina fraseriana
Colchicaceae
Burchardia congesta
Cyperaceae
Lepidosperma sp. aff. *squamatum*
Cyathochaeta avenacea
Machaerina articulata
Machaerina juncea
Mesomelaena tetragona
Morelotia octandra
Netrostylis sp. Jarrah Forest
Tricostularia davisii P3
Dasypogonaceae
Dasypogon bromeliifolilus
Kingia australis
Dilleniaceae
Hibbertia gracilipes
Droseraceae
Drosera fimbriata
Drosera huegelii
Drosera menziesii
Drosera verrucata
Ericaceae
Andersonia caerulea
Leucopogon gibbosus
Leucopogon glabellus
Leucopogon verticilliatus
Lysinema ciliatum
Styphellia concinna
?Styphellia compacta
Fabaceae
Acacia myrtifolia
Acacia brownii
Bossiaea rufa
Daviesia flexuosa
Daviesia preissii
Hovea trisperma
Pultenaea radiata
Gompholobium polymorphum
Gompholobium venustum
Sphaerolobium vimineum
Goodeniaceae
Dampiera leptoclada
Scaevola striata
Haemodoraceae
Conostylis aculeata
Hemerocallidaceae
Agrostocrinum hirsutum
Iridaceae
?*Patersonia* sp.
Patersonia umbrosa
**Watsonia* sp.
Loranthaceae
Nuytsia floribunda
Myrtaceae
Agonis theifomis
Astartea glomerulosa
Beaufortia anisandra
Darwinia diosmoides
Eucalyptus marginata
Kunzea recurva
**Leptospermum laevigatum*
Melaleuca densa
Melaleuca thymoides
Pericalymma spongiocaule
Taxandria linerifolia
Taxandria parviceps
Verticordia habrantha
Orchidaceae
Prasophyllum gracile
Pterostylis vittata
Thelymitra crinita

Species list (cont.)

Pittosporaceae
Billardiera variifolia
Poaceae
Austrostipa variabilis
**Eragrostis curvula*
Neurachne alopecuroidea
Rytidosperma caespitosum
Polygalaceae
Comesperma confertum
Proteaceae
Banksia arctotidis
Banksia armata
Banksia dryandroides
Banksia gardneri
Banksia sphaerocarpa var. *sphaerocarpa*
Grevillea fasciculata
Hakea ceratophylla
Hakea corymbosa
Hakea ferruginea
Hakea ruscifolia
Isopogon formosus
Isopogon sphaerocephalus
Synaphea favosa
Synaphea polymopha
Restionaceae
Desmocladus fasciculatus
Hypolaena exsculca
Loxocarya cinerea
Platychorda applanata
Rhamnaceae
Cryptandra nutans
Rutaceae
Boronia spathulata
Santalaceae
Choretrum lateriflorum
Stylidiaceae
Stylidium accuminatum subsp. *meridionale*
Stylidium hirsutum
Stylidium menziesii
Thymelaeaceae
Pimelea angustifolia
Pimelea sulphurea
Xanthorrhoeaceae
Xanthorrhoea platyphylla

Appendix 4: Vegetation description

Vegetation unit: *Hakea ferruginea* Closed Heath
No. of relevés: 6 Sites 1 to 6, No. of quadrats: 2 Sites 7 and 8

Description

Hakea ferruginea Closed Heath occurs on low, flat ground, commonly prone to waterlogging in winter, particularly where there is more clay in the topsoil or closer to the surface in the subsoil. Commonly has an emergent sheoak (*Allocasuarina fraseriana)* or very open low woodland and open jarrah (*Eucalyptus marginata* subsp. *marginata)* mallee overstorey.

Hakea ferruginea is the dominant tall shrub at all sites commonly occurring as a closed heath, tall open scrub or open heath stratum. The other species that is common to all sites is the sedge *Platychorda applanata.* Species recorded on all except one site and commonly dominant include the shrub *Hibbertia gracilepes,* the sedge *Tricostularia davisii P3* and the herb *Dampiera leptoclada. Mesomylaena tetragona* is commonly dominant sedge in wetter sites.

Other commonly dominant recorded in the open heath to shrubland stratum include *Agonis theiformis* and *Allocasuarina humilis;* and commonly dominant species in the open low heath to low shrubland stratum is *Pericalymma spongiocaule.*

Remaining understorey strata are highly diverse and variable in dominance and composition between sites. Other common shrubs include *Astartea glomerulosa, Xanthorrhoea platyphylla* and *Synaphea polymorpha.* The very open grassland is commonly dominated by *Austrostipa variabilis.*

Comment

Sites 1 to 6 in this unit were recorded in pristine or nearly so condition, with no signs of disease or weeds recorded. Site 7 (located on west side of Hannan Way was recorded in very good condition because of disturbance factors including a track on its boundary, presence of two invasive weeds including Victorian tea tree (*Leptospermum laevigatum)* and *Watsonia* sp., some deaths of *Hakea ferruginea,* and (assumed) historic clearing of jarrah and sheoak for power lines. Site 8 was recorded in excellent condition because of the lack of jarrah and sheoak due to (assumed) historic clearing for power lines.

Key distinguishing features:

- *Hakea ferruginea* is present as a dominant shrub in the open heath to closed tall scrub strata. Otherwise highly diverse shrub strata.
- Occurs on low flat ground with high variation of soil types from sand to clay loam within very short distances. Often associated with seasonal waterlogging particularly where soils have higher clay content
- Sheoak (*Allocasuarina fraseriana)* commonly present as an emergent or low open woodland stratum
- A very open to open jarrah mallee stratum commonly present.

Floristic Summary (e=emergent)

Lifeform	%cover	Species
Trees <10-	e-30	*Allocasuarina fraseriana*
Mallees <8m	e-70	*Eucalyptus marginata* subsp. *marginata*
Shrubs >2m	30-100	*Hakea ferruginea, Agonis theiformis*
Shrubs 1-2m	30-100	*Hakea ferruginea, Taxandria parviceps, Isopogon formosus, Taxandria linearifolia, Agonis theiformis, Taxandria parviceps, Isopogon formosus, Choretrum lateriflorum, Hakea ruscifolia*
Shrubs <0.5-1m	10-70	*Allocasuarina humilis, Agonis theiformis, Xanthorrhoea platyphylla, Astartea glomerulosa, Lysinema cilliatum, Comesperma confertum, Sphaerolobium vimineum, Hakea ceratophylla, Banksia sphaerocarpa* var. *sphaerocarpa, Daviesia flexuosa, Xanthorrhoea platyphylla, Astartea glomerulosa, Pimelea sulphurea, Pimelea anguistfolia, Hakea corymbosa, Cryptandra lateriflorum, Leucopogon glabellus, Styphelia concinna, Verticordia habrantha, Gompholobium venustum, Gompholobium polymorphum, Boronia spathulata, Isopogon sphaerocephalus*
Shrubs <0.5 m	10-30	*Pericalymma ellipticum, Hovea trisperma, Hibbertia gracilipes, Synaphea polymorpha, Synaphea favosa, Grevillea fasciculata, Banksia arctotidis, Leucopogon gibbosus, Andersonia caerulea, Melaleuca thymoides, Beaufortia anisandra, Darwinia diosmoides, Billardiera variifolia, Cryptandra nutans, Bossiaea rufa, Banksia gardneri, Burchardia congesta, Drosera fibriata, Acacia browniana, Daviesia preissii*
Sedges	30-100	*Mesomylaena tetragona, Tricostularia davisii P3, Platychorda applanata, Machaerina juncea, Loxocarya cinerea, Desmocladus fasciculatus, Cyathochaeta avenacea, Lepidosperma* sp. aff. *squamatum, Morelotia octandra, Netrostylis* sp. Jarrah Forest
Herbs	2-30	*Scaevola striata, Lomandra nutans, Dampiera leptoclada, Stylidium hirsutum, Conostylis aculeata, Drosera verrucata, Drosera menziesii, Xanthosia singuliflora, Dasypogon bromeliifolius, Thelymitra crinita, Agrostocrinum hirsutum, Stylidium repens, Stylidium acuminatum* subsp. *meridionale, Dampiera alata*
Grasses	2-10	*Austrostipa variabilis, Rytidosperma caespitosum*


A few examples of *Hakea ferruginea* Closed Heath

Appendix 5: Site data (from relevés)

SITE 1 DATE 16/11/2022 RECORDER W. Bradshaw

LATITUDE: S 34.76963 LONGITUDE: E 117.70365

LOCATION West side of Newman Rd, Narrikup

VEGETATION TYPE *Hakea ferruginea* closed heath with emergent *Allocasuarina fraseriana* and Jarrah mallee

LANDFORM Flat SLOPE Flat GEOLOGY Laterite
ROCKS 0% SOIL TYPE Sandy clay loam SOIL COLOUR Grey-brown
HYDROLOGY Poor drainage CONDITION Pristine

VEG LAYER	**% COVER**	**SPECIES (Bold = dominant)**
Trees <10m	<5	***Alocasuarina fraseriana***
Mallees <8m	<5	***Eucalyptus marginata* subsp. *marginata***
Shrubs 1-2m	70-100	***Hakea ferruginea*** *Isopogon formosus* *Taxandria parviceps* *Taxandria linearifolia*
Shrubs 0.5-1m	30-70	***Allocasuarina humilis*** *Sphaerolobium vimineum* *Lysinema ciliatum* *Astartea glomerulosa* *Comesperma confertum*
Shrubs <0.5m	10-30	***Hibbertia gracilipes*** *Daviesia flexuosa* *Pericalymma spongiocaule* *Synaphea favosa* *Leucopogon glabellus* *Grevillea fasciculata* *Hovea trisperma* *Banskia arctotidis* *Synaphea polymorpha*
Sedges	70-100	***Tricostularia davisii* P3** *Lepidosperma* sp. aff. *squamatum* *Loxocarya cinerea* *Platychorda applanata* *Desmocladus fasciculatus* *Machaerina juncea* *Mesomylaena tetragona* *Cyathochaeta avenacea*
Herbs	2-10	***Lomandra nutans*** *Conostylis aculeata* *Dampiera leptoclada* *Drosera verrrucata* *Drosera menziesii* *Xanthosia singuliflora*

		Stylidium hirsutum
Grasses	e	***Austrostipa variabilis***
		Rytidosperma caespitosum

Site 1

SITE 2 DATE 16/11/2022 RECORDER W. Bradshaw

LATITUDE: S 34.76925 LONGITUDE: E 117.70356

LOCATION West side of Newman Rd, Narrikup

VEGETATION TYPE *Allocasuarina fraseriana* low open woodland/Jarrah mallee over *Hakea ferruginea* tall shrubland

LANDFORM Flat SLOPE Gentle GEOLOGY Laterite
ROCKS 0% SOIL TYPE Sand SOIL COLOUR Grey
HYDROLOGY Good drainage CONDITION Pristine

VEG LAYER	**% COVER**	**SPECIES (Bold = dominant)**
Trees <10 m	10-30	***Allocasuarina fraseriana***
Mallees <8m	30-70	***Eucalyptus marginata* subsp. *marginata***
Shrubs >2m	10-30	***Hakea ferruginea***
Shrubs 1-2m	10-30	***Agonis theiformis*** *Allocasuarina humilis* *Choretrum lateriflorum*
Shrubs 0.5-1	10-30	***Hakea corymbosa*** *Xanthorrhoea platyphylla* *Leucopogon glabellus* *Comesperma conferta* *Isopogon formosus* *Boronia spathulata* *Beaufortia anisandra*
Shrubs <0.5m	10-30	***Hakea ceratophylla*** ***Hibbertia gracilipes*** *Lysinema ciliatum* *Comesperma confertum* *Hovea trisperma* *Sphaerolobium vimineum* *Andersonia caerulea* *Banksia arctotidis* *Darwinia diosmoides* *Billardiera variifolia* *Acacia browniana* *Periclaymma spongiocaule* *Grevillea fasciculata*
Sedges	30-70	***Loxocarya cinerea*** ***Tricostularia davisii* P3** *Lepidosperma* sp. aff. *squamatum* *Desmocladus fasciculatus* *Cyathochaeta avenacea* *Platychorda applanata*
Herbs	2-10	***Lomandra nutans*** *Conostylis aculeata* *Thelymitra crinita* *Dampiera leptoclada*

		Agrostocrinum hirsutum *Stylidium repens* *Stylidium menziesii* *Stylidium hirsutum*
Grasses	<5	***Austrostipa variabilis*** *Rytidosperma caespitosum*

Site 2

SITE 3 DATE 16/11/2022 RECORDER W. Bradshaw

LATITUDE: S 34.76722 LONGITUDE: E 117.70322

LOCATION West side of Newman Rd, Narrikup

VEGETATION TYPE Jarrah mallee over *Hakea ferruginea* closed tall scrub with emergent *Allocasuarina fraseriana*

LANDFORM Valley flat SLOPE Flat GEOLOGY Laterite
ROCKS 0% SOIL TYPE Sand SOIL COLOUR Grey
HYDROLOGY Good drainage CONDITION Pristine

VEG LAYER	**% COVER**	**SPECIES (Bold = dominant)**
Trees <10m	<5	***Allocasuarina fraseriana***
Mallees <8m	10-30	***Eucalyptus marginata* subsp. *marginata***
Shrubs >2m	70-100	***Hakea ferruginea*** *Agonis theiformis*
Shrubs 1-2m	10-30	***Allocasuarina humilis*** *Pericalymma spongiocaule* *Melaleuca thymoides*
Shrubs 0.5-1m	10-30	***Hakea ceratophylla*** *Leucopogon glabellus* *Lysinema ciliatum* *Daviesia preissii* *Xanthorrhoea platyphylla* *Styphelia concinna*
Shrubs <0.5m	10-30	***Astartea glomerulosa*** *Banksia arctotidis* *Verticordia habrantha* *Gompholobium venustum* *Gompholobium polymorphum*
Sedges	70-100	***Loxocarya cinerea*** *Desmocladus fasciculatus* *Lepidosperma* sp. aff. *squamatum* *Morelotia octandra* *Tricostularia davisii* P3 *Platychorda applanata*
Herbs	<5	***Lomandra nutans*** *Dasypogon bromeliifolius* *Xanthosia singuliflora* *Dampiera leptoclada*
Grasses	2-10	***Austrostipa variabilis***

Site 3

SITE 4 DATE 22/11/2022 RECORDER W. Bradshaw

LATITUDE: S 34.76714 LONGITUDE: E 117.70324

LOCATION West side of Newman Rd, Narrikup

VEGETATION TYPE Jarrah mallee over *Hakea ferruginea* tall shrubland with emergent *Allocasuarina fraseriana*

LANDFORM Flat SLOPE Flat GEOLOGY Laterite
ROCKS 0% SOIL TYPE Sand SOIL COLOUR Light grey
HYDROLOGY Good drainage CONDITION Pristine

VEG LAYER	**% COVER**	**SPECIES (Bold = dominant)**
Trees <10m	<5	***Allocasuarina fraseriana***
Mallees <8m	30-70	***Eucalyptus marginata* subsp. *marginata***
Shrubs >2m	30-70	***Hakea ferruginea***
Shrubs 1-2m	30-70	***Agonis theiformis***
Shrubs 0.5-1m	10-30	***Hakea ceratophylla*** *Banksia sphaerocarpa* var *sphaerocarpa* *Astartea glomerulosa* *Daviesia flexuosa* *Comesperma confertum* *Pimelea sulphurea* *Pimelea angustifolia* *Hakea corymbosa* *Cryptandra lateriflorum*
Shrubs <0.5m	10-30	***Leucopogon gibbosus*** *Hibbertia gracilipes* *Dampiera leptoclada* *Synaphea favosa* *Synaphea polymorpha* *Banksia arctotidis* *Andersonia caerulea* *Melaleuca thymoides* *Beaufortia anisandra*
Sedges	70-100	***Tricostularia davisii* P3** *Loxocarya cinerea* *Platychorda applanata* *Mesomylaena tetragona* *Netrostylis* sp. Jarrah Forest *Morelotia octandra* *Desmocladus fasciculatus* *Cyathochaeta avenacea*
Herbs	10-30	***Lomandra nutans*** *Dampiera leptoclada* *Conostylis aculeata* *Stylidium accuminatum* subsp. *meridionale* *Dampiera alata*

		Scaevola striata
Grasses	2-10	***Austrostipa variabilis***
		Rytidosperma caespitosum

Site 4 (Top and bottom) Banksia gardneri (bottom)

SITE 5 DATE 22/11/2022 RECORDER W. Bradshaw

LATITUDE: S 34.76812 LONGITUDE: E 117.70335

LOCATION West side of Newman Rd, Narrikup

VEGETATION TYPE Jarrah mallee over *Hakea ferruginea* tall shrubland with emergent *Allocasuarina fraseriana*

LANDFORM Flat SLOPE Flat GEOLOGY Laterite
ROCKS 0% SOIL TYPE Loamy sand SOIL COLOUR Light grey/brown
HYDROLOGY Good drainage CONDITION Pristine

VEG LAYER	**% COVER**	**SPECIES (Bold = dominant)**
Trees <10m	<5	***Allocasuarina fraseriana***
Mallees <8m	30-70	***Eucalyptus marginata* subsp. *marginata***
Shrubs >2m	30-70	***Hakea ferruginea***
Shrubs 1-2m	30-70	***Agonis theiformis*** *Daviesia flexuosa* *Allocasuarina humlis* *Cryptandra nutans* *Hakea ruscifolia* *Taxandria parviceps*
Shrubs 0.5-1	30-70	***Melaleuca thymoides*** *Sphaerolobium vimineum* *Xanthorrhoea platyphylla* *Isopogon sphaerocephalus* *Isopogon formosus* *Bossiaea rufa* *Grevillea fasciculata* *Beaufortia anisandra* *Andersonia caerulea* *Hakea ceratophylla*
Shrubs <0.5m	10-30	***Banksia sphaerocarpa* var. *sphaerocarpa*** *Banksia gardneri* *Leucopogon gibbosus* *Synaphea polymorpha* *Gompholobium venustum* *Hibbertia gracilipes*
Sedges	30-70	***Tricostularia davisii* P3** ***Netrosylis* sp. Jarrah Forest** *Morelotia octandra* *Platychorda applanata* *Loxocarya cinerea* *Mesomylaena tetragona* *Desmocladus fasciculatus* *Lepidosperma* sp. aff. *squamatum*
Herbs	2-10	***Lomandra nutans*** *Xanthosia singuliflora* *Drosera menziesii*

		Stylidium accuminatum var. *meridionale* *Burchardia congesta* *Stylidium repens* *Dampiera leptoclada* *Drosera fimbriata*
Grasses	2-10	***Austrostipa variabilis*** ***Rytidosperma caespitosum***

Site 5

SITE 6 DATE 22/11/2022 RECORDER W. Bradshaw

LATITUDE: S 34.76955 LONGITUDE: E 117.70358

LOCATION West side of Newman Rd, Narrikup

VEGETATION TYPE *Hakea ferruginea* closed heath with emergent *Allocasuarina fraseriana* and Jarrah mallee

LANDFORM Flat SLOPE Flat GEOLOGY Laterite ROCKS 0% SOIL TYPE Sandy clay loam SOIL COLOUR Grey brown HYDROLOGY Poor drainage CONDITION Pristine

VEG LAYER	**% COVER**	**SPECIES (Bold = dominant)**
Trees <10m	<5	***Allocasuarina fraseriana***
Mallees <8m	<5	***Eucalyptus marginata* subsp. *marginata***
Shrubs 1>2m	70-100	***Hakea ferruginea*** *Taxandria parviceps*
Shrubs 0.5-1	10-30	***Agonis theiformis*** *Xanthorrhoea platyphylla* *Astartea glomerulosa* *Comesperma confertum* *Lysinema ciliatum*
Shrubs <0.5m	10-30	***Pericalymma spongiocaule*** *Hovea trisperma* *Hibbertia gracilipes* *Synaphea polymorpha*
Sedges	70-100	***Mesomylaena tetragona*** ***Tricostularia davisii* P3** *Platychorda applanata* *Machaerina juncea* *Loxocarya cinerea*
Herbs	2-10	***Scaevola stiata*** ***Dampiera leptoclada*** *Lomandra nutans* *Stylidium hirsutum*
Grasses	<5	***Austrostipa variabilis***

Site 6

Site 7

SITE 7 DATE 10/07/2023 RECORDER W. Bradshaw

LATITUDE: S 34.77028 LONGITUDE: E 117.70343

LOCATION West side of Hannan Way, Narrikup, just south of Newman Rd intersection

VEGETATION TYPE *Hakea ferruginea* open heath with emergent jarrah

LANDFORM Flat	SLOPE Flat	GEOLOGY Laterite
ROCKS <2%	SOIL TYPE Gravelly loamy clay	SOIL COLOUR Grey brown
SUB-SURFACE SOIL Gravelly clay	COLOUR Orange	LITTER COVER ~20%
BARE GROUND ~25%	COVER ~75%	
HYDROLOGY Poor drainage	CONDITION Very good	

VEG LAYER	**% COVER**	**SPECIES (Bold = dominant)**
Mallees <8m	<5	***Eucalyptus marginata* subsp. *marginata***
Shrubs 1.5->2m	30-70	***Hakea ferruginea***
		Taxandria parviceps
Shrubs 1-1.5 m	10-30	***Taxandria linearifolia***
		Agonis theiformis
		Xanthorrhoea platyphylla
		Sphaerolobium vimineum
Shrubs 0.5-1 m	2-10	***Acacia browniana***
		Pericalymma spongiocaule
		Astartea glomerulosa
		Melaleuca thymoides
		Lysinema ciliatum
		Andersonia caerulea
		Hovea trisperma
		Daviesia preissii
		Synaphea polymorpha
		Leucopogon gibbosus
		Melaleuca densa
Shrubs <0.5 m	2-10	***Synaphea favosa***
		Hibbertia gracilipes
		Grevillea fasciculata
		?*Styphelia compacta*
Sedges	30-70	***Mesomylaena tetragona***
		Platychorda applanata
		Cyathochaeta avenacea
Herbs	2-10	***Dampiera leptoclada***
		Lomandra rupestris
		Drosera huegelii
		Lomandra pauciflora
		Billardiera variifolia
Grasses	e	***Neurachne alopecuroidea***

SITE 8 DATE 10/07/2023 RECORDER W. Bradshaw

LATITUDE: S 34.76974 LONGITUDE: E 117.70364 RECORDER W. Bradshaw

LOCATION West side of S end of Newman Rd, Narrikup

VEGETATION TYPE *Hakea ferruginea* closed tall scrub

LANDFORM Flat SLOPE Flat GEOLOGY Laterite
ROCKS 0% SOIL TYPE Loamy sand SOIL COLOUR Yellow grey
SUB-SURFACE SOIL Sandy clay COLOUR Orange-yellow LITTER COVER ~70%
BARE GROUND ~5% COVER ~95%
HYDROLOGY Poor drainage CONDITION Excellent

VEG LAYER	**% COVER**	**SPECIES (Bold = dominant)**
Shrubs 1.5->2m	70-100	***Hakea ferruginea***
Shrubs 1-1.5 m	30-70	***Allocasuarina humilis***
		Agonis theiformis
		Xanthorrhoea platyphylla
		Taxandria parviceps
Shrubs 0.5-1 m	10-30	***Pericalymma spongiocaule***
		Beaufortia anisandra
		Boronia spathulata
		Isopogon formosus
		Andersonia caerulea
		Hovea trisperma
		Daviesia preissii
		Synaphea polymorpha
		Leucopogon gibbosus
		Leucopogon glabellus
Shrubs <0.5 m	2-10	***Hibbertia gracilipes***
		?*Styphelia compacta*
		Banksia gardneri
		Pultenaea radiata
Sedges	70-100	***Mesomylaena tetragona***
		Platychorda applanata
		Cyathochaeta avenacea
		Desmocladus fasciculatus
		Anathria prolifera
		Tricostularia davisii P3
		Schoenus caespititius
		Anarthria dioica
Herbs	2-10 mix	*Laxmannia sessiliflora*
		Lomandra pauciflora
		Dampiera alata
		Drosera verrucata
Grasses	e	***?Amphipogon* sp.**

Site 8

Appendix 6: Floristics summary two-way table of site and species data

(**bold = dominant, P=pristine, LS = loamy sand)**

Landform	**Flat**							
Site (Releve) No.	**8**	**7**	**1**	**6**	**2**	**3**	**4**	**5**
Vegetation associations	**Hfer**	**Emar**	**Hfer**	**Hfer**	**Afra**	**Emar**	**Emar**	**Emar**
Condition	**E**	**VG**	**P**	**P**	**P**	**P**	**P**	**P**
Soil type	**LS**	**GCL**	**SCL**	**SCL**	**S**	**S**	**S**	**LS**
Hovea trisperma	1	1	1	1	1			
Pericalymma spongiocaule	**1**	**1**	1	1	1	1		
Platychorda applanata	1	1	1	1	1	1	1	1
Hakea ferruginea	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Tricosularia davisii P3	1		**1**	**1**	**1**	1	**1**	**1**
Synaphea polymorpha	1	1	1	1			1	1
Allocasuarina humilis	**1**		**1**		1	**1**		1
Hibbertia gracilipes	**1**	**1**	**1**	1	**1**		1	1
Agonis theiformis	1	1		**1**	**1**	1	**1**	**1**
Taxandria parviceps	1	1	1	1				1
Eucalyptus marginata		**1**	**1**	**1**	**1**	**1**	**1**	**1**
Astartea glomerulosa		**1**	1	1		**1**	1	
Lysinema ciliatum		1	1	1	1	1		
Isopogon formosus	1		1		1			1
Mesomylaena tetragona	**1**	**1**	1	**1**			1	1
Leucopogon glabellus	1		1		1	1		
Desmocladus fasciculatus	1		1		1		1	1
Cyathochaeta avenacea	1	1	1		1		1	
Xanthorrhoea platyphylla	1	1		1	**1**	1		1
Beaufortia anisandra	**1**				1		1	1
Andersonia caerulea	1	1			1		1	1
Leucopogon gibbosus	1	1					**1**	1
Acacia browniana	1				1			
Boronia spathulata	1				1			
Daviesia preissii	1	1				1		
Banksia gardneri	1							1
Schoenus ?caespititius	1				1			
?Stypehila compacta	1	1						
?Patersonia sp.	1	1						
Drosera verrucata	1		1					
Taxandria linearifolia		**1**	1					
Synaphea favosa		**1**	1				1	
Melaleuca thymoides		1				1	1	**1**
Dampiera leptoclada		**1**	1	**1**	1	1	1	1
Sphaerolobium vimineum		1	1		1			1
Grevillea fasciculata		1	1		1			1
Billardiera variifolia		1			1			
Machaerina juncea			1	1				
Stylidium hirsutum			1	1	1			
Loxocarya cinerea			1	1	**1**	**1**	1	1
Allocasuarina fraseriana			**1**	**1**	**1**	**1**	**1**	**1**
Austrostipa variabilis			**1**	**1**	**1**	**1**	**1**	**1**

Landform	**Flat**							
Site (Releve) No.	**8**	**7**	**1**	**6**	**2**	**3**	**4**	**5**
Vegetation associations	**Hfer**	**Emar**	**Hfer**	**Hfer**	**Afra**	**Emar**	**Emar**	**Emar**
Condition	**E**	**VG**	**P**	**P**	**P**	**P**	**P**	**P**
Soil type	**LS**	**GCL**	**SCL**	**SCL**	**S**	**S**	**S**	**LS**
Lomandra nutans			**1**	1	**1**	**1**	**1**	**1**
Comesperma confertum			1	1	1		1	
Banksia arctotidis			1		1	1	1	
Lepidospermum sp. aff squamatum			1		1	1		1
Conostylis aculeata			1		1		1	
Drosera menziesii			1					1
Rytidosperma caespitosum			1		1		**1**	**1**
Xanthosia singuliflora			1			1		1
Daviesia flexuosa			1				1	1
Scaevola striata				**1**			1	
Hakea ceratophylla					**1**	**1**	**1**	1
Hakea corymbosa					**1**		1	
Stylidium repens					1			1
Morelotia octandra						1	1	1
Banksia sphaerocarpa var. sphaerocarpa						1		**1**
Gompholobium venustum						1		1
Cryptandra nutans							1	1
Netrostylis sp. Jarrah Forest							1	**1**
Stylidium acuminata subsp. meridionale							1	1
Amphipogon sp.	**1**							
Pultenaea radiata	1							
Anarthria prolifera	1							
Anarthria dioica	1							
Melaleuca densa		1						
Lomandra rupestris		1						
Lomandra pauciflora		1						
Neurachne alopecuroidea		**1**						
Choretrum lateriflorum					1			
Darwinia diosmoides					1			
Thelymitra crinita					1			
Agrostocrinum hirsutum					1			
Stylidium menziesii					1			
Gompholobium polymorphum						1		
Verticordia habrantha						1		
Styphelia concinna						1		
Verticordia habrantha						1		
Gompholobium polymorphum						1		
Dasypogon bromeliifolius						1		
Dampiera alata							1	
Pimelia angustifolia							1	
Pimelia sulphurea							1	
Hakea ruscifolia								1
Isopogon sphaerocephalus								1
Bossiaea rufa								1
Burcharida congesta								1
Drosera fimbriata								1
Total no. native species/relevé	**31**	**30**	**37**	**24**	**42**	**31**	**37**	**43**