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Pt Lots 4 & 7 Wellesley Rd Wellesley
Flora and Vegetation Survey

PREPARED FOR LUNDSTROM ENVIRONMENTAL CONSULTANTS

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Executive Summary

Plantecology Consulting was commissioned by Lundstrom Environmental Consultants Pty Ltd on behalf of B & J Catalano in October 2022 to undertake a detailed flora and vegetation survey of a part of Lots 4 & 7 Wellesley Rd, Wellesley, in the Shire of Harvey. The study site consisted of three blocks in the north, south and northwest of the property.

The chief purpose of the survey was to provide a detailed assessment of botanical values within the site, which could then be assessed for suitability as offsets for the clearing of native vegetation within the property. The objectives of the survey therefore were to:

- Sample the native vegetation within the study area in accordance with the Environmental Protection Authority's (EPA) *Technical Guidance: Flora and Vegetation Survey for Environmental Impact Assessment* (2016);
- Record the presence of any Threatened Flora and Priority Flora to identify additional conservation values;
- Assess the suitability of parkland cleared areas for restoration to native vegetation; and
- Identify the FCT/s present and compare to that previously recorded within the property.

The field survey was conducted by a botanist from Plantecology Consulting on the 22nd and 23rd November 2022. A detailed survey of the vegetation was undertaken at six 100 m2 sampling plots (10m x 10m quadrats) in the intact native vegetation, selected to adequately sample the flora within a stand. Another five recce (or EPA-defined relevés) were positioned in the parkland cleared areas of Blocks A and B. Plots were positioned to sample a representative and homogeneous (i.e. not located in transitional areas between communities) area of each community. The location of each corner of a plot was recorded with a hand-held GPS unit and a photograph of the plot taken looking inward to the quadrat. All vascular plant species were recorded and an estimate of the Foliage Projective Cover (FPC) percentage was made for each species.

A total of 85 native and 12 non-native (exotic) taxa were recorded within the site, representing 35 families and 79 genera. The dominant families containing mostly native taxa were Fabaceae (12 native taxa, 1 exotic taxon), Proteaceae (6 native taxa), and Asparagaceae (6 native taxa). For a complete species list and the individual site data refer to Appendix A and Appendix B, respectively.

The survey identified two plant communities within the site (Figure 2):

Eucalyptus marginata - Banksia attenuata woodland (Plates 1:6)

> Open Woodland of *Eucalyptus marginata* and *Banksia attenuata* with *Agonis flexuosa* over *Banksia grandis* and a shrubland of *Xanthorrhoea brunonis, Bossiaea eriocarpa* and *Hibbertia hypericoides* over a herbland of *Dasypogon obliquifolius, Patersonia occidentalis* and *Lepidosperma pubisquameum* on grey sands.

Parkland cleared pasture and other infrastructure (Plates 7:11)

> Open woodlands of *Agonis flexuosa* or *Corymbia calophylla* over grass or herblands of pasture species and **Ursinia anthemoides* in grey sands.

The native vegetation within Blocks A and C of the study area is contiguous with previously surveyed area within the property and area that are proposed to be cleared. The vegetation type is the same as the remainder of the upland vegetation i.e. FCT 21a 'Central *Banksia attenuata – Eucalyptus marginata* woodlands', which is part of the 'Banksia-dominated woodlands of the Swan Coastal Plain IBRA Region' TEC. Most of the vegetation stand is in 'Excellent' condition and is greater than 0.5 ha in extent. It thus meets the criteria to be included in the 'Banksia-dominated woodlands of the Swan Coastal

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Plain IBRA Region' TEC . The presence of the two priority flora that have already been recorded for the adjacent vegetation also adds to the suitability as a like-for-like offset for the vegetation to be cleared.

The parkland cleared areas in Blocks A and B do have potential to be restored with native vegetation but will require considerable resources.

The revegetation sites will need to be scalped to depth of 5-10 cm to remove existing exotic plants as well as their soil seed bank. This material should be disposed of, possibly within a disused pit and covered or at an appropriate facility to prevent reinfestation.

The site is likely to require ripping to enhance moisture penetration before the application of seed and/or seedlings. The most effective means to establish understorey species is often direct return of topsoil from a freshly cleared area. This will bring not only the native seed bank but also the myccorhizal cohort of the soil. Some seeding and planting of seedlings from tree and shrub species may also be required.

The adjacent farmland represents a source of reinfestation of grassy weeds to the site and an appropriate weed control program will be required until the restored vegetation has attained sufficient resilience.

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1 Introduction

Plantecology Consulting was commissioned by Lundstrom Environmental Consultants Pty Ltd on behalf of B & J Catalano in October 2022 to undertake a detailed flora and vegetation survey of a part of Lots 4 & 7 Wellesley Rd, Wellesley, in the Shire of Harvey (Figure 1). The study site consisted of three blocks in the north, south and northwest of the property (Figure 1).

Part of the broader site is currently used for resource extraction and an expansion to the operations has been proposed. The expansion of operations would require the clearing of native vegetation with any loss of ecological values offset by the reservation of a sufficient area of the same vegetation type. The current proposal is to use areas of intact native vegetation within the property and supplement this with restoration of parkland cleared areas to a state consistent with the vegetation type/s to be cleared.

1.1 Previous studies

Vegetation surveys of the site have been conducted in September 2018 (Lundstrom Environmental 2018a, 2018b) and in May 2022 (Plantecology 2022). These studies found that the upland vegetation consists of *Banksia attenuata – Eucalyptus marginata* open woodland, which is consistent with Floristic Community Type (FCT) 21a 'Central *Banksia attenuata – Eucalyptus marginata* woodlands' of the Swan Coastal Plain. FCT 21a is part of the 'Banksia dominated woodlands of the Swan Coastal Plain IBRA Region', which listed as a Threatened Ecological Community (TEC) pursuant to the Environment Biodiversity and Conservation Act 1999 (EPBC Act).

The previous studies have also identified four Priority Flora occurring within the property:

- *Millotia tenuifolia* var. *laevis* (P2);
- *Lasiopetalum membranaceum* (P3);
- *Caladenia speciosa* (P4); and
- *Acacia semitrullata* (P4).

The presence of the Commonwealth-listed TEC as well as the conservation-significant flora imparts significant conservation value to the vegetation within the property.

1.2 Existing Environment

The property is currently being used for resource extraction and has also previously supported stock grazing. As a result, the vegetation varies in condition and structure with some areas retaining intact native vegetation, while most of the site has lost much of the original native midstorey and ground layer.

1.3 Climate

The Wellesley area experiences a dry Mediterranean climate of hot dry summers and cool wet winters. Long-term climatic averages indicate the site is located in an area of moderate to high rainfall, receiving 726 mm on average annually (data for Bunbury, station number 9965, the nearest currently reporting station) (Bureau of Meteorology 2022) with the majority of rainfall received between May and August. The area experiences rainfall on an average of 122 days per year. Mean maximum temperatures range from 17.3 °C in July to 29.8 °C in January. Mean minimum temperatures range from 7.1 °C in July to 15.8 °C in February.

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1.4 Soils

The Atlas of Australian Soils maps the soils for the site as Map Unit Cb39, which is a subdued swale terrain. The chief soils are leached sands (Uc2.33) with smaller areas of other sands (Natural Resource Information Centre 1991).

1.5 Conservation Significant Flora

Under the Biodiversity Conservation Act 2016 ('BC Act'), the Minister for the Environment produces a gazetted list of Threatened Flora under three categories: Critically Endangered, Endangered and Vulnerable. The Parks and Wildlife Service (PWS) also produces a list of Priority Flora that have not been assigned statutory protection under the BC Act but may be under some degree of threat (PWS 2019a). The PWS recognises four Priority Flora levels. The definitions for each category of Threatened and Priority Flora are shown in Appendix E.

As well as protection under State legislation, selected flora are also afforded statutory protection at a Federal level pursuant to the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The EPBC Act provides for the protection of Threatened species, pursuant to Schedule 1 of the Act, and are defined as "Critically Endangered", "Endangered", "Vulnerable" or "Conservation Dependent" under Section 179. Definitions of these categories are shown in Appendix E. Any action likely to have a significant impact on a species listed under the EPBC Act requires approval from the Commonwealth Minister for Environment and Energy.

Searches of the State databases identified 26 taxa with the potential to occur within the site (Table 1). Of these taxa, six are listed as Threatened under the BC Act, five of which are orchids. *Diuris drummondii, Diuris micrantha* are orchids of winter-wet swamps and *Drakaea elastica* occurs in sands of low-lying areas adjacent to damp areas. These species are unlikely to occur within the site. As described above in Section 1.1, three of the taxa listed have already been recorded within the property, as well as *Millotia tenuifolia* var. *laevis* (P2).

1.6 Conservation Significant Communities

The PWS defines an ecological community as "a naturally occurring assemblage that occurs in a particular type of habitat" (PWS 2019b). A Threatened Ecological Community (TEC) is one that has declined in area or was originally limited in distribution. Uncommon ecological communities that do not strictly meet TEC defined criteria, or are inadequately defined, are listed by the PWS as a Priority Ecological Community (PEC). Definitions of the categories of Threatened and Priority Ecological Communities are given in Appendix E.

As well as protection under State legislation, selected ecological communities are also afforded statutory protection at a Federal level pursuant to the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The EPBC Act provides for the protection of TECs, which are listed under section 181 of the Act, and are defined as "Critically Endangered", "Endangered" or "Vulnerable" under Section 182. Similar to flora listed under the EPBC Act, any action likely to have a significant impact on a TEC listed under the EPBC Act requires Commonwealth approval.

Two terrestrial TECs endorsed under State legislation are recorded as occurring near the site:

- Floristic Community Type (FCT) 9 -'Dense shrublands on clay flats'; and
- 'Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain'.

Seven other terrestrial FCTs listed as PECs are recorded as occurring within or near the site:

- FCT 25 – 'Southern Eucalyptus gomphocephala – Agonis flexuosa woodlands' (Priority 3);
- FCT 21c – 'Low-lying Banksia attenuata woodlands or shrublands' (Priority 3);

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- FCT 24 – 'Northern Spearwood shrublands and woodlands' (Priority 3);
- FCT 30b – 'Quindalup Eucalyptus gomphocephala and/or Agonis flexuosa woodlands' (Priority 3);
- Subtropical and Temperate Coastal Saltmarsh' (Priority 3);
- 'Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain' (Priority 3); and
- 'Banksia dominated woodlands of the Swan Coastal Plain IBRA Region' (Priority 3).

The 'Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community' is also categorised as 'Critically Endangered' by the Commonwealth and includes FCTs 25 and 30b. The 'Subtropical and Temperate Coastal Saltmarsh' community is listed as 'Vulnerable' by the Commonwealth and the 'Banksia-dominated woodlands of the Swan Coastal Plain IBRA Region', which is listed as an 'Endangered' TEC by the Commonwealth and includes FCT 21c, is mapped as occurring within the site.

The 'Banksia-dominated woodlands of the Swan Coastal Plain IBRA Region' is the only conservation significant community recorded within the site to date.

1.7 Vegetation Complexes

Vegetation complexes are a series of plant communities forming a regularly repeating pattern associated with a particular soil unit (Government of Western Australia 2000). Two vegetation complexes have been mapped as occurring within the site. The Bassendean Complex – Central and South occupies approximately half of the site on the eastern side and has 25% of its original 87 300 ha pre-European extent remaining and 1.8% of its current extent has some level of protection (Government of Western Australia 2017). The Karrakatta Complex – Central and South occupies the western side of the site. This complex has 23.6% of its original 53 000 ha extent remaining with 3.9% of its current extent having some level of protection (Government of Western Australia 2017).

1.8 Purpose

The chief purpose of the survey was to provide a detailed assessment of botanical values within the site, which could then be assessed for suitability as offsets for the clearing of native vegetation within the property. The objectives of the survey therefore were to:

- Sample the native vegetation within the study area in accordance with the Environmental Protection Authority's (EPA) *Technical Guidance: Flora and Vegetation Survey for Environmental Impact Assessment* (2016);
- Record the presence of any Threatened Flora and Priority Flora to identify additional conservation values;
- Assess the suitability of parkland cleared areas for restoration to native vegetation; and
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Table 1: Threatened and Priority Flora potentially occurring within the survey area based on database searches. (VU = Vulnerable; EN = Endangered; CR = Critically Endangered; T = Threatened; 1 – 4 = Priority Flora Category)

Taxon	PWS Ranking	EPBC Act Category	Flowering Period
Acacia flagelliformis	4		May-Sep
Acacia semitrullata	4		May - Oct
Acacia sp. Binningup (G. Cockerton et al. WB 37784)	1		
Austrostipa bronweniae	T	EN	
Boronia capitata subsp. *gracilis*	3		Jun - Nov
Boronia juncea subsp. *juncea*	1		Apr
Caladenia procera	T	CR	Sep-Oct
Caladenia speciosa	4		Sep-Oct
Cyathochaeta teretifolia	3		DEC
Dillwynia dillwynioides	3		Aug - Dec
Diuris drummondii	T	VU	Nov-Jan
Diuris micrantha	T	VU	Sep-Oct
Drakaea elastica	T	EN	Oct-Nov
Drakaea micrantha	T	EN	Sep-Oct
Lasiopetalum membranaceum	3		Sep-Dec
Myriophyllum echinatum	3		Nov
Pterostylis frenchii	2		
Puccinellia vassica	1		
Pultenaea skinneri	4		Jul-Sep
Schoenus sp. Waroona (G.J. Keighery 12235)	3		Oct - Nov
Styphelia filifolia	3		
Tripterococcus sp. Brachylobus (A.S. George 14234)	4		
Verticordia attenuata	3		Dec-May

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2 Methods

2.1 Field Survey

The field survey was conducted by a botanist from Plantecology Consulting on the 22nd and 23rd November 2022. A detailed survey of the vegetation was undertaken at six 100 m2 sampling plots (10m x 10m quadrats) in the intact native vegetation, selected to adequately sample the flora within a stand (Figure 2). Another five recce (or EPA-defined relevés) were positioned in the parkland cleared areas of Blocks A and B. Plots were positioned to sample a representative and homogeneous (i.e. not located in transitional areas between communities) area of each community. The location of each corner of a plot was recorded with a hand-held GPS unit and a photograph of the plot taken looking inward to the quadrat. All vascular plant species were recorded and an estimate of the Foliage Projective Cover (FPC) percentage was made for each species.

Environmental data recorded included topographic position, aspect, slope, soil colour and texture class, rock outcropping, litter cover as well as the degree of disturbance and an estimate of the time since the last fire event. The condition of the vegetation of the site was assessed to assist in determining the conservation values of the site. The vegetation condition was rated according to Keighery (1994), a vegetation condition scale commonly used in the metropolitan and southwest regions. The categories are listed and defined in Table 2. Data on the vegetation structure was also recorded and included the height of the three main strata and the dominant species within each stratum. The vegetation structural description follows that of the National Vegetation Information System (Thackway et al. 2006).

All plant specimens collected during the field survey were dried, pressed and then sorted in accordance with requirements of the Western Australian Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys. Taxonomic determinations were made using reference material at the Western Australian State Herbarium. Taxa names utilise the current terminologies from FloraBase (2022). Family names utilise the revised phylogeny of the Angiosperm Phylogeny Group - APGIII (FloraBase 2022).

2.1 Data Analysis

The remnant vegetation of the southern Swan Coastal Plain (SCP) was surveyed by Gibson et al. (1994) to provide an understanding of the major floristic gradients across the region. The major plant communities (or FCTs) were defined by classifying the data according to the similarities in species composition between plots. When determining the FCT of a new record, a floristic analysis of species composition provides the most robust method that is consistent with the original classification. Presently, a single consistent method for the determination of FCTs for vegetation data in the Swan Coastal Plain is not available. Therefore, it is preferable to use multiple methods and compare the output for the most likely result. All analyses described below were undertaken using R packages Cluster (Maechler et al 2019), Vegclust (De Cáceres et al. 2010), indicspecies (De Cáceres and Legendre 2009), optpart (Roberts 2020) and Vegan (Oksanen et al. 2020).

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Table 2: Vegetation Condition Scale (Keighery 1994)

Vegetation Condition	Definition
Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and 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 and 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 and 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 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 or shrubs.

2.1.1 Hierarchical Clustering

Hierarchical agglomerative clustering is the usual first stage in classifying vegetation data into community types. This involves calculating the similarity (or more often, the dissimilarity) between plots within the dataset and then sequentially fusing the plots into groups according to their similarity. This type of method was used in the analysis of the original Swan Coastal Plain dataset (Gibson et al. 1994) and to determine the conservation status of additional plots, data is often added to the original dataset and the analysis re-run (Environmental Protection Authority 2016). The direct use of the original dataset as the basis for assigning new plot data to the regional classification has some drawbacks, however. Firstly, a hierarchical clustering only applies to the relationships between plots, and the relative distances between them, within that particular dataset. The addition of new data often alters the relative cophenetic distances and disrupts the clustering output. Secondly, as an unsupervised method, hierarchical clustering does not define rules for the membership of the defined groups, and so the addition of new plots requires the rebuilding of the entire hierarchy (De Cáceres and Wiser 2012).

The data for the Swan Coastal Plain regional survey (Gibson et al. 1994) was downloaded from the NatureMap website. This is largely similar to the original survey except for one site (OATES-1), which has now been excluded, resulting in a dataset of 508 plots. The species nomenclature of the original dataset was updated to be consistent with current usage. Where original names could not be matched clearly to the updated usage, those taxa were removed from the analysis.

The new data from the survey was added to the Swan Coastal Plain dataset and the new dataset was then analysed calculating the Bray-Curtis distance coefficient (or resemblance measure) and the flexible beta linkage method (beta = -0.1). Assignment of the plots was to the nearest distinct group by inspection of the resulting dendrogram.

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In practice, there is often less similarity between new plots and the plots of the original group to which it is assigned than between the original plots themselves. That is, new plots are usually most similar to fringing members of the original group.

2.1.2 Non-hierarchical clustering

Non-hierarchical clustering methods often allow new plot data to be added to previous classifications because they are based on the concept that each group or cluster is represented by a prototype i.e. either a centroid or a medoid (a 'type' plot) (De Cáceres and Wiser 2012). Therefore, new observations can be assigned to an existing classification by calculating the distance to the nearest prototype (which may be considered a membership criterion). This approach is to be preferred to the hierarchical reconstruction approach because it defines numerical rules that can be consistently applied. However, it also means the original classification needs to be reanalysed using a different method, which can be problematic because not all sites from the original classification may be diagnostic for their respective clusters.

For the analysis of the plot data, the same updated SCP dataset was used as for the hierarchical clustering analysis. The dataset was then analysed using Fuzzy C-Means clustering in the R package 'Vegclust'. A fuzziness coefficient of 1.1 was chosen to minimise influence from noisy data points. FCTs with too few plots to reliably define or determine a prototype (e.g. FCT 14 with two plots) were removed from the analysis. Similarly, some plots that were regularly being misclassified (such as those from clusters with large internal heterogeneity) were also removed. The final dataset consisted of 344 plots with 1316 taxa representing 38 FCTs. Each plot was then assigned a FCT using function 'vegclass' in the Vegclust package.

It should be noted that this approach for FCT assignment is preliminary and will need to be refined further before it can be used consistently.

2.2 Study Limitations and Survey Effort

Various factors can limit the effectiveness of a vegetation survey. Pursuant to EPA Technical Guidance: Flora and Vegetation Survey for Environmental Impact Assessment (EPA 2016), these factors have been identified and their potential impact on the effectiveness of the survey has been assessed (Table 3).

The survey was undertaken November 2022. This timing is late in the spring season and would not be likely to have intercepted the flowering period of annuals of conservation concern with the potential to occur within the site. However, the property has been surveyed previously on multiple occasions and the primary purpose of the current survey was to determine the similarity of the subject vegetation with the remainder of the property.

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Table 3: Potential limitations affecting the vegetation survey

Potential limitations	Constraint	Comment
Availability of contextual information	No	Sufficient regional and local information was available to place the survey site in its environmental context.
Competency and experience of the botanists undertaking the survey	No	The survey was undertaken by botanists with a comprehensive knowledge of Swan Coastal Plain vegetation, with at least 20 years experience in vegetation surveys in Western Australia.
Seasonality	Minor	The survey was undertaken in spring 2022. The rainfall in the three months prior to the survey near average for the area. Maximum and minimum temperatures varied from average only in October, when it was cooler.
Adequate ground coverage and intensity of survey effort	No	The survey area was traversed on foot. It is considered the survey quadrats and mapping points provided adequate coverage given the degraded nature of most of the site.
Proportion of Flora identified	No	The survey recorded an estimated 79% of the plant taxa present (Chao2 estimator).
Disturbance	Minor	The area has previously been used for wood collection and harvesting and the area is traversed by access racks, many of which are regenerating if not being used. Weed infestation is largely restricted to the edges of the survey area.
Resources	No	Adequate resources were available to conduct the survey.
Access restrictions	No	All parts of the site were accessible

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3 Results

3.1 Flora

3.1.1 Floristic Summary

A total of 85 native and 12 non-native (exotic) taxa were recorded within the site, representing 35 families and 79 genera. The dominant families containing mostly native taxa were Fabaceae (12 native taxa, 1 exotic taxon), Proteaceae (6 native taxa), and Asparagaceae (6 native taxa). For a complete species list and the individual site data refer to Appendix A and Appendix B, respectively.

3.1.2 Threatened and Priority Flora

No Threatened Flora pursuant to the Biodiversity Conservation Act (2016) nor the EPBC Act (1999) were recorded during the survey. One species listed as Priority Flora by the PWS was recorded during the survey. *Lasiopetalum membranaceum* (P3) is a low multi-stemmed shrub growing up to 1 m in height (Table 4). *Acacia semitrullata* (P4) is a slender shrub with pungent phyllodes to 0.7 m in height and occurs in white to grey sands of sandplains and damp areas.

Table 4: Locations of priority flora within the surveyed area.

Taxon Name	Abundance	Latitude	Longitude
Lasiopetalum membranaceum	10	-33.13986	115.757026
Lasiopetalum membranaceum	10	-33.13977	115.75880
Lasiopetalum membranaceum	5	-33.14754	115.75898
Acacia semitrullata	3	-33.14735	115.75346
Acacia semitrullata	2	-33.14752	115.75702

3.2 Vegetation

3.2.1 Plant Associations

The survey identified two plant communities within the site (Figure 2):

Eucalyptus marginata - Banksia attenuata woodland (Plates 1:6)

> Open Woodland of *Eucalyptus marginata* and *Banksia attenuata* with *Agonis flexuosa* over *Banksia grandis* and a shrubland of *Xanthorrhoea brunonis, Bossiaea eriocarpa* and *Hibbertia hypericoides* over a herbland of *Dasypogon obliquifolius, Patersonia occidentalis* and *Lepidosperma pubisquameum* on grey sands.

Parkland cleared pasture and other infrastructure (Plates 7:11)

> Open woodlands of *Agonis flexuosa* or *Corymbia calophylla* over grass or herblands of pasture species and **Ursinia anthemoides* in grey sands.

3.2.2 Conservation Significance

The results of the FCT assignment were inconsistent between the hierarchical clustering and non-hierarchical clustering. This inconsistency is likely partially due to the due to the survey timing, but was also seen in the previous surveys (Lundstrom Environmental 2018a, 2018b). Consistent results from the non-hierarchical clustering assignments are best seen with vegetation in a near undisturbed state.

The hierarchical clustering assignments indicated that Plots 1 - 6 are part of FCT 21. The new plot data fused with the SCP dataset high in the dendrogram and the assignments could not discriminate between the subgroups of FCT 21. However, the landscape position indicates that FCT 21a 'Central *Banksia attenuata – Eucalyptus marginata* woodlands' is the best fit for the majority of the vegetation

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(Appendix D). This result would be consistent with the locality and position on the Swan Coastal Plain. Plot 4 was assigned to FCT 21c and this is not unreasonable as this plot is positioned on a lower slope. The vegetation in this location was not distinguishable from that of the remainder of the property, however. Plot 2 showed a similarity to FCT 25 'Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands', but tuarts have not been recorded from the site.

The non-hierarchical clustering produced different results to the hierarchical clustering and no assignment could be made with confidence (Table 5). For all plots there was little range in strengths of memberships for the first three nearest groups, indicating an equivocal result. The most common assignment was to FCT 21c, but strengths of membership are too low for a definitive result.

Table 5: Results of non - hierarchical analysis for plots from the Runnymede Rd survey (Strength of membership shown in brackets).

Plot	FCT of nearest group	FCT of 2nd nearest group	FCT of 3rd nearest group	Possible FCT
Plot 1	21c (21.2%)	6 (13.3%)	5 (10.2%)	undetermined
Plot 2	6 (18.3%)	13,15,16,17 (16.6%)	29a/30a (16.0%)	undetermined
Plot 3	21c (23.8%)	6 (12.5%)	13,15,16,17 (11.6%)	undetermined
Plot 4	6 (17.2%)	21c (16.0%)	5 (14.7%)	undetermined
Plot 5	21c (15.5%)	6 (12%)	5 (9.8%)	undetermined
Plot 6	6 (22.8%)	13,15,16,17 (16.5%)	21c (14.8%)	undetermined

The *Eucalyptus marginata - Banksia attenuata* woodland has an open overstorey with *Banksia attenuata* as a co-dominant, which is a key diagnostic characteristic for the Commonwealth-listed TEC 'Banksia-dominated woodlands of the Swan Coastal Plain IBRA Region'. For this TEC to be present, the condition of the vegetation needs to be 'Good' or better, which is the case for the *Eucalyptus marginata - Banksia attenuata* woodland (see below) as the extent of the community within the site exceeds 2 ha, it is likely that this community meets the criteria for inclusion in the 'Banksia-dominated woodlands of the Swan Coastal Plain IBRA Region' TEC.

3.2.3 Vegetation Condition

The *Eucalyptus marginata - Banksia attenuata* woodland is rated mostly as 'Excellent' with much of the original vertical structure intact. The original shrub and tree density has been affected to some degree by past logging and wood collection activity, but areas of bare ground or sparse understorey are small (Figure 3). The native stands appear resilient to invasion with few weeds were observed within the core of the native vegetation stand, none of which are aggressive.

The parkland cleared areas are rated as 'Completely Degraded' with only a low density of tree cover over pasture grasses. These areas retain little of their original botanical value.

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3.2.4 Weeds

Twelve of the taxa recorded during the survey within the *Eucalyptus marginata - Banksia attenuata* woodland are exotics (weeds). None is a Declared Pest under the Biosecurity and Agriculture Management Act 2007.

Within the parkland cleared areas, most of the ground layer was dominated by common pasture grasses and invasive species of disturbed ground such as, **Avena barbata, *Ehrharta calycina, *Bromus diandrus* and **Trachyandra divaricata.*

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4 Discussion

The native vegetation within Blocks A and C of the study area is contiguous with previously surveyed area within the property and area that are proposed to be cleared. The vegetation type is the same as the remainder of the upland vegetation i.e. FCT 21a 'Central *Banksia attenuata – Eucalyptus marginata* woodlands', which is part of the 'Banksia-dominated woodlands of the Swan Coastal Plain IBRA Region' TEC. Most of the vegetation stand is in 'Excellent' condition and is greater than 0.5 ha in extent. It thus meets the criteria to be included in the 'Banksia-dominated woodlands of the Swan Coastal Plain IBRA Region' TEC . The presence of the two priority flora that have already been recorded for the adjacent vegetation also adds to the suitability as a like-for-like offset for the vegetation to be cleared.

The parkland cleared areas in Blocks A and B do have potential to be restored with native vegetation but will require considerable resources. That within Block A is adjacent to the existing native vegetation and is likely to also have originally been *Eucalyptus marginata - Banksia attenuata* woodland. Block B is lower in the landscape and closer to the water table, but the substrate is similar and is likely to have been another variant of the banksia woodlands TEC before clearing. The vegetation on lower slopes at the eastern end of the property forms part of the banksia woodlands TEC, with FCT 5 in the adjacent damplands (Plantecology Consulting 2022). The presence of *Corymbia calophylla* in Block B indicates that this was a dryland environment.

These areas have been cleared for a long period and will have accumulated a significant seed bank of non-native grasses with the potential to outcompete any re-establishing native species. To successfully re-establish native vegetation, a number of factors need to be considered (White & Mullan 2006). These include:

- Weed control;
- Control or exclusion of grazing animals;
- Matching species with soil type;
- Providing adequate levels of soil moisture;
- Preparation of the seed bed;
- Seed and seedling quality;
- Correct timing of site works.

The revegetation sites will need to be scalped to depth of 5-10 cm to remove existing exotic plants as well as their soil seed bank. This material should be disposed of, possibly within a disused pit and covered or at an appropriate facility to prevent reinfestation.

The site is likely to require ripping to enhance moisture penetration before the application of seed and/or seedlings. The most effective means to establish understorey species is often direct return of topsoil from a freshly cleared area. This will bring not only the native seed bank but also the myccorhizal cohort of the soil. Some seeding and planting of seedlings from tree and shrub species may also be required.

The adjacent farmland represents a source of reinfestation of grassy weeds to the site and an appropriate weed control program will be required until the restored vegetation has attained sufficient resilience.

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5 Summary

The native vegetation of the surveyed areas in Blocks A and C are part of the 'Banksia-dominated woodlands of the Swan Coastal Plain IBRA Region' TEC and represent an appropriate offset on a like-for-like basis for the adjacent vegetation that is proposed to be cleared.

The parkland cleared areas in Blocks A and B have potential for restoration to native vegetation but will require considerable resources.

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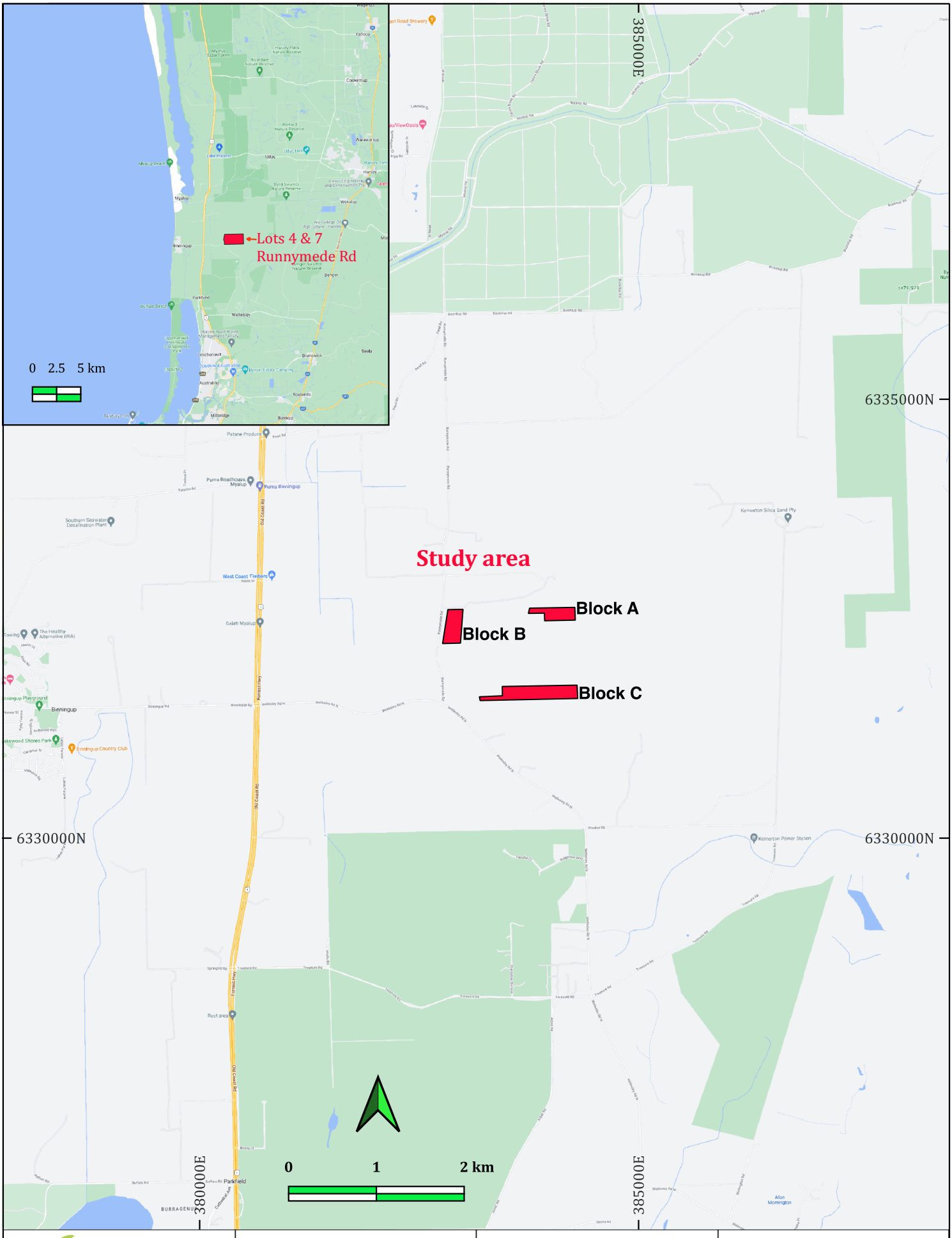
Figures



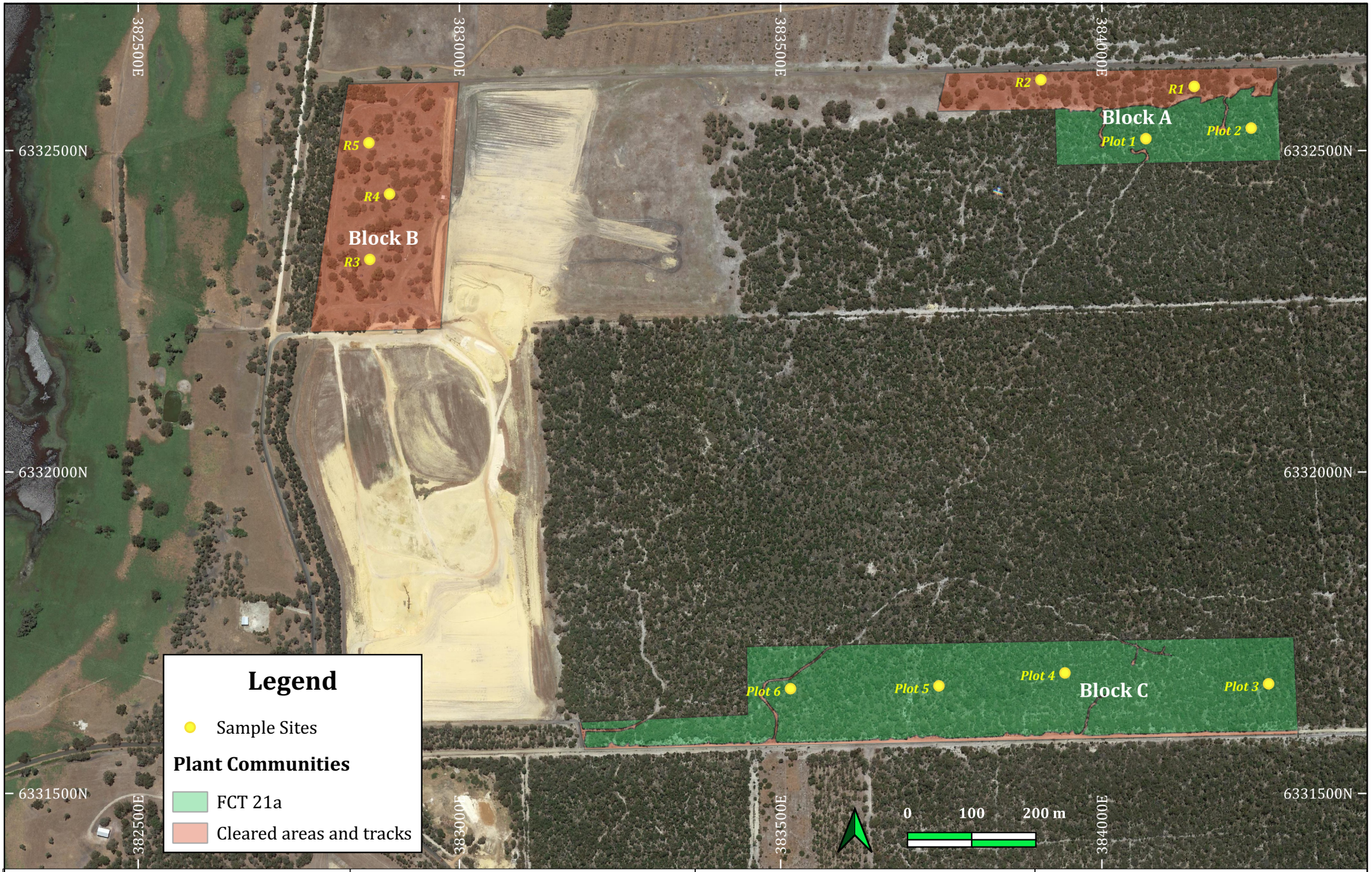
Plantecology CONSULTING

50 New Cross Rd Kingsley WA 6026

Scale: 1:55 000
Basemap Source: Google Road
Datum: GDA94
Projection: MGA 50

Client: B & J Catalano
Project: Lot 4 Flora Survey
Location: Lot 4 Runnymede Rd, Wellesley
Author: S.T.S. Chalwell
Drawn: S.T.S. Chalwell

Figure 1: Locality Plan



Plantecology CONSULTING

50 New Cross Rd
Kingsley WA 6026

Scale: 1:7 500
Original Size: A4
Basemap Source: Google Satellite
Datum: GDA94
Projection: MGA94 (50)

Client: B&J Catalano
Project: Lot 4 Runnymede Rd Flora Survey
Location: Lot 4 Runnymede Rd, Wellesley
Author: S.T.S. Chalwell
Drawn: S.T.S. Chalwell

Figure 2: Plant Communities

Plantecology CONSULTING

50 New Cross Rd
Kingsley WA 6026

Scale: 1:7 500
Original Size: A4
Basemap Source: Google Satellite
Datum: GDA94
Projection: MGA94 (50)

Client: B&J Catalano
Project: Lot 4 Runnymede Rd Flora Survey
Location: Lot 4 Runnymede Rd, Wellesley
Author: S.T.S. Chalwell
Drawn: S.T.S. Chalwell

Figure 3: Vegetation Condition

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Plates

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Plate 1: View of sampling Plot 1: Eucalyptus marginata – Banksia attenuata woodland

Plate 2: View of sampling Plot 2: Eucalyptus marginata – Banksia attenuata woodland

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Plate 3: View of sampling Plot 3: *Eucalyptus marginata – Banksia attenuata* woodland

Plate 4: View of sampling Plot 4: *Eucalyptus marginata – Banksia attenuata* woodland

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Plate 5: View of sampling Plot 5: *Eucalyptus marginata – Banksia attenuata* woodland

Plate 6: View of sampling Plot 6: *Eucalyptus marginata – Banksia attenuata* woodland

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Plate 7: View of sampling plot R1: Parkland cleared pasture and other infrastructure

Plate 8: View of sampling plot R2: Parkland cleared pasture and other infrastructure

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Plate 9: View of sampling plot R3: Parkland cleared pasture and other infrastructure

Plate 10: View of sampling plot R4: Parkland cleared pasture and other infrastructure

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Plate 11: View of sampling plot R5: Parkland cleared pasture and other infrastructure

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Appendix A

List of flora recorded within the survey area

NB: * indicates introduced flora

Family		Taxon
Zamiaceae		*Macrozamia riedlei*
Colchicacee		*Burchardia congesta*
Orchidaceae	*	*Disa bracteata*
		Microtis media
		Pterostylis recurva
		Pyrorchis nigricans
		Thelymitra crinita
Iridaceae		*Patersonia occidentalis*
Xanthorrhoeaceae		*Xanthorrhoea brunonis*
Asparagaceae		*Lomandra caespitosa*
		Lomandra hermaphrodita
		Lomandra sericea
		Thysanotus arenarius
		Thysanotus manglesianus
		Thysanotus multiflorus
Asphodelaceae	*	*Trachyandra divaricata*
Hemerocallidaceae		*Corynotheca micrantha*
		Tricoryne elatior
Haemodoraceae		*Conostylis aculeata*
		Conostylis aculeata subsp. *gracilis*
		Conostylis juncea
		Haemodorum spicatum
		Phlebocarya ciliata
Dasypogonaceae		*Dasypogon obliquifolius*
Cyperaceae		*Isolepis marginata*
		Lepidosperma pubisquameum
		Lepidosperma squamatum
		Morelotia octandra
Restionaceae		*Desmocladus fasciculatus*
		Hypolaena exsulca
		Loxocarya cinerea
		Lyginia barbata
		Lyginia imberbis
Poaceae		*Austrostipa compressa*
		Austrostipa flavescens
	*	*Avena barbata*
	*	*Briza maxima*

Family	Taxon
Poaceae	* *Bromus diandrus*
	* *Cynodon dactylon*
	* *Ehrharta calycina*
	* *Pentaschistis airoides*
	Tetrarrhena laevis
Proteaceae	*Banksia attenuata*
	Banksia dallaneyi
	Banksia grandis
	Hakea amplexicaulis
	Petrophile linearis
	Stirlingia latifolia
Dilleniaceae	*Hibbertia hypericoides*
	Hibbertia racemosa
Crassulaceae	*Crassula colorata* var. *acuminata*
Fabaceae	*Acacia extensa*
	Acacia huegelii
	Acacia pulchella
	Acacia semitrullata
	Bossiaea eriocarpa
	Daviesia physodes
	Daviesia preissii
	Gompholobium knightianum
	Hardenbergia comptoniana
	Hovea trisperma
	Isotropis cuneifolia
	Jacksonia furcellata
	* *Trifolium repens*
Polygalaceae	*Comesperma confertum*
Celastraceae	*Stackhousia huegelii*
Elaeocarpaceae	*Tetratheca hirsuta*
Phyllanthaceae	*Phyllanthus calycinus*
Myrtaceae	*Agonis flexuosa*
	Corymbia calophylla
	Eucalyptus marginata
	Kunzea glabrescens
	Melaleuca thymoides
Rutaceae	*Boronia fastigiata*
	Philotheca spicata

Family		Taxon
Malvaceae		*Lasiopetalum membranaceum*
Droseraceae		*Drosera stolonifera*
Caryophyllaceae	*	*Petrorhagia dubia*
Ericaceae		*Brachyloma preissii*
		Leucopogon cordatus
Ericaceae		*Styphelia racemulosa*
		Styphelia tenuiflora
Rubiaceae		*Opercularia echinocephala*
Lamiaceae		*Hemiandra pungens*
Campanulaceae		*Isotoma hypocrateriformis*
		Lobelia ?rhytidosperma
Stylidiaceae		*Levenhookia stipitata*
		Stylidium brunonianum
		Stylidium piliferum
Goodeniaceae		*Dampiera linearis*
Asteraceae	*	*Hypochaeris glabra*
		Lagenophora huegelii
		Podolepis lessonii
	*	*Ursinia anthemoides*
Pittosporaceae		*Billardiera variifolia*
Araliaceae		*Trachymene pilosa*
Apiaceae		*Platysace filiformis*

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Appendix B

Site x species matrix of flora recorded within plots in the survey area.

Taxon	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
Acacia extensa	0	0	0.1	0	0.2	0
Acacia huegelii	0	0	0	0	0	0.1
Acacia pulchella	0	0	0	0.1	0	0.3
Acacia semitrullata	0	0	0	0	0.1	0.1
Agonis flexuosa	10	7	5	12	20	0
Austrostipa compressa	0.1	0	0	0	0	0
Austrostipa flavescens	0	0.1	0	0	0	0
Banksia attenuata	3	4	10	5	10	6
Banksia dallaneyi	0.1	0	0	0	0	0
Banksia grandis	0	4	0	0	0	0
Billardiera variifolia	0	0	0.1	0	0	0
Boronia fastigiata	0	0	0	0	0	0.1
Bossiaea eriocarpa	0.2	0.1	0.3	4	2	0
Brachyloma preissii	1	0.5	0.4	0	0	0
**Briza maxima*	0.1	0	0	0.1	0.1	0.1
Burchardia congesta	0.1	0	0	0	0	0.1
Comesperma confertum	0.1	0	0	0.1	0	0
Conostylis aculeata	0	0	0.1	0.1	0.2	0
Conostylis aculeata subsp. *gracilis*	0	0.1	0	0.1	0	0
Conostylis juncea	0	0	0.1	0	0.1	0.2
Corymbia calophylla	0	0	2	0	1	0
Corynotheca micrantha	0.1	0	0	0	0	0
Crassula colorata var. *acuminata*	0	0	0	0.1	0	0
Dampiera linearis	0	0	0	0	0	0.1
Dasypogon obliquifolius	0.3	0	2	1	2	5
Daviesia physodes	0	0	0	0	0.2	0.1
Daviesia preissii	0	0	0	0	0	2
Desmocladus fasciculatus	0.2	0	0.2	0	0	0
Drosera stolonifera	0.1	0	0.1	0.1	0.1	0.2
Eucalyptus marginata	7	2	10	8	5	5
Gompholobium knightianum	0.1	0	0	0.1	0.2	0
Hardenbergia comptoniana	0	0.2	0	0.1	0.1	0
Hemiandra pungens	0	0	0	0	0	0.3
Hibbertia hypericoides	2	5	5	5	0.3	2
Hibbertia racemosa	0.1	0.1	0.2	0	0.1	0
Hovea trisperma	0	0	0	0	0.1	0
**Hypochaeris glabra*	0	0.1	0	0.1	0	0
Hypolaena exsulca	0	0	0.3	0.1	0.2	0
Isolepis marginata	0	0	0	0	0.1	0
Isotoma hypocrateriformis	0.1	0.1	0	0	0	0
Isotropis cuneifolia	0.1	0.1	0.1	0.1	0.1	0
Jacksonia furcellata	0	0	0.1	0	0	0
Lagenophora huegelii	0.1	0.1	0.1	0.1	0.1	0
Lasiopetalum membranaceum	0.5	0.5	0.1	0	0	0
Lepidosperma pubisquameum	0.2	0	0	0.1	0.3	0.5
Lepidosperma squamatum	0	0	0.5	0	0	0
Leucopogon cordatus	0	0	0.1	0	0	0
Levenhookia stipitata	0.1	0	0	0.1	0	0
Lobelia ?rhytidosperma	0	0.1	0	0.1	0.1	0.1
Lomandra caespitosa	0.2	0.1	0.1	0.1	0	0.1
Lomandra hermaphrodita	0.1	0.1	0.1	0.1	0.1	0.1

Taxon	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
Lomandra sericea	0.1	0	0.1	0.1	0.1	0
Loxocarya cinerea	0.1	0.1	0.1	0.1	0	0
Lyginia barbata	0	0	0	0	0.4	0
Lyginia imberbis	0	0	0.1	0.1	0	0.3
Macrozamia riedlei	1	1	0	0.1	0	0
Melaleuca thymoides	0	0	0	0	0.3	10
Microtis media	0	0	0	0	0.1	0
Morelotia octandra	0.3	0	0	0	0	0
Opercularia echinocephala	0.2	0	0.1	0.1	0	0.1
Patersonia occidentalis	2	0	2	0	0	0
**Pentaschistis airoides*	0	0.1	0	0.1	0.1	0
Petrophile linearis	0.1	0	0.1	0	0	0
Philotheca spicata	0	0	0	0	0	0.3
Phlebocarya ciliata	0	0	0	0	0.1	0
Phyllanthus calycinus	0.1	0.2	0	0	0	0
Platysace filiformis	0	0	0	0	0	0.1
Podolepis lessonii	0.2	0.2	0	0.1	0	0
Pterostylis recurva	0	0	0	0.1	0	0.1
Pyrorchis nigricans	0	0	0	0	0.1	0
Stackhousia huegelii	0.1	0	0	0	0	0
Stirlingia latifolia	0	0	0.3	0	0	0
Stylidium brunonianum	0	0	0	0	0.1	0.1
Stylidium piliferum	0	0.1	0	0.1	0	0
Styphelia racemulosa	0	0.3	0	0	0.1	0
Styphelia tenuiflora	0	0	0	0	0.1	0
Tetrarrhena laevis	0	0	0	0.1	0	0
Tetratheca hirsuta	0	0	0	0	0	0.1
Thelymitra crinita	0	0.1	0	0.1	0.1	0.1
Thysanotus arenarius	0	0	0	0	0.1	0
Thysanotus manglesianus	0.1	0	0	0.1	0.1	0
Thysanotus multiflorus	0	0	0	0	0.1	0.1
Trachymene pilosa	0.1	0.1	0.1	0.1	0.1	0
Tricoryne elatior	0	0	0.1	0	0.1	0.1
**Trifolium repens*	0.1	0	0	0	0	0
**Ursinia anthemoides*	0.1	0.5	0	0.1	0.1	0.1
Xanthorrhoea brunonis	3	5	3	0	1	7

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Appendix C

Sampling plot environmental data

Site Name	Latitude	Longitude	SiteType	Date	Plot Shape	Plot size ($m^{2)}$
Plot 1	6332518	384068.524	Quadrat	22/11/2022	Square	100
Plot 2	6332535	384232.476	Quadrat	22/11/2022	Square	100
Plot 3	6331670	384259.638	Quadrat	23/11/2023	Square	100
Plot 4	6331687	383942.516	Quadrat	23/11/2023	Square	100
Plot 5	6331667	383746.303	Quadrat	23/11/2023	Square	100
Plot 6	6331663	383515.282	Quadrat	23/11/2023	Square	100
R1	6332600	384143.758	Relevé	22/11/2022	N/A	0
R2	6332610	383905.024	Relevé	22/11/2022	N/A	0
R3	6332331	382860.243	Relevé	22/11/2022	N/A	0
R4	6332432	382890.999	Relevé	22/11/2022	N/A	0
R5	6332512	382858.888	Relevé	22/11/2022	N/A	0

Site Name	Topography	Relief	Slope (^{o})	Aspect	Soil Colour	Soil Depth (cm)
Plot 1	Upper Slope	UP	0-5	N	Yellow	>50
Plot 2	Upper Slope	UP	0-5	N	Yellow	>50
Plot 3	Lower Slope	UP	0-5	ENE	Cream	>50
Plot 4	Upper Slope	UP	5-15	N	Cream	>50
Plot 5	Mid-slope	UP	5-15	W	Cream	>50
Plot 6	Lower Slope	UP	5-15	S	Cream	>50
R1	Upper Slope	UP	0-5	N	Yellow	>50
R2	Upper Slope	UP	0-5	N	Yellow	>50
R3	Simple slope	UP	0-5	N	Cream	>50
R4	Simple slope	UP	0-5	N	Cream	>50
R5	Simple slope	UP	0-5	N	Cream	>50

Site Name	Texture	Bare Ground (%)	Litter (%)	Fire Interval	Disturbance Level	Vegetation Condition
Plot 1	Loamy Sand	20	45	>3	Low	E
Plot 2	Loamy Sand	15	75	>3	Low	E
Plot 3	Clayey Sand	5	75	>3	Low	E
Plot 4	Clayey Sand	15	80	>3	Low	E
Plot 5	Clayey Sand	10	75	>3	Low	E
Plot 6	Clayey Sand	5	50	>3	Low	E
R1	Loamy Sand	15	85	>3	High	CD
R2	Loamy Sand	25	50	>3	High	CD
R3	Clay Loam Sandy	N/A	N/A	>3	High	CD
R4	Clay Loam Sandy	N/A	N/A	>3	High	CD
R5	Clay Loam Sandy	N/A	N/A	>3	High	CD

Site Name	Strata 1 Cover (%)	Strata 2 Cover (%)	Strata 3 Cover (%)	Strata 1 Height (m)	Strata 2 Height (m)	Strata 3 Height (m)	Strata 1 Dominants	Strata 2 Dominants	Strata 3 Dominants
Plot 1	25	10	20	10	1.5	0.5	*Agonis flexuosa, Eucalyptus marginata, Banksia attenuata*	*Xanthorrhea brunonis, Hibbertia hypericoides, Macrozamia reidlei*	*Patersonia occidentalis, Lasiopetalum occidentalis, Morelotia octandra*
Plot 2	10	10	20	8	1.4	0.5	*Agonis flexuosa, Eucalyptus marginata, Banksia attenuata*	*Xanthorrhea brunonis, Hibbertia hypericoides, Macrozamia reidlei*	*Hardenbergia comptoniana, Podolepis lessonii, Ursinia anthemoides*
Plot 3	25	10	20	10	1.2	0.4	*Agonis flexuosa, Eucalyptus marginata, Banksia attenuata*	*Xanthorrhea brunonis, Hibbertia hypericoides, Bossiaea eriocarpa*	*Patersonia occidentalis, Dasypogon obliquifolius, Hypolaena exsulca*
Plot 4	25	5	15	8	1.5	0.5	*Agonis flexuosa, Eucalyptus marginata, Banksia attenuata*	*Acacia pulchella, Hibbertia hypericoides, Bossiaea eriocarpa*	*Dasypogon obliquifolius*
Plot 5	30	10	15	8	1	0.3	*Agonis flexuosa, Eucalyptus marginata, Banksia attenuata*	*Xanthorrhea brunonis, Melaleuca thymoides, Bossiaea eriocarpa*	
Plot 6	10	40	25	7	1.5	0.3	*Banksia attenuata, Eucalyptus marginata*	*Daviesia preissii, Melaleuca thymoides, Xanthorrhoea brunonis*	*Dasypogon obliquifolius, Lepidosperma pubisquameum, Lyginia imberbis*
R1							*Agonis flexuosa*	*Acacia longifolia, Xanthorrhoea brunonis*	*Ursinia anthemoides*
R2							*Agonis flexuosa*	*Xanthorrhea brunonis*	*Trachyandra divaricata, Ursinia anthemoides*
R3							*Agonis flexuosa, Corymbia calophylla*	*Xanthorrhea brunonis*	*Trachyandra divaricata*
R4							*Agonis flexuosa, Corymbia calophylla, Eucalyptus marginata*	*Xanthorrhea brunonis*	*Trachyandra divaricata, Ehrharta calycina*
R5							*Agonis flexuosa, Corymbia calophylla*	*Xanthorrhea brunonis*	*Bromus diandrus, Avena barbata*

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Appendix D

Partial dendrograms from hierarchical clustering assignment of plot floristics to the Swan Coastal Plain classification (Gibson et al. 1994)

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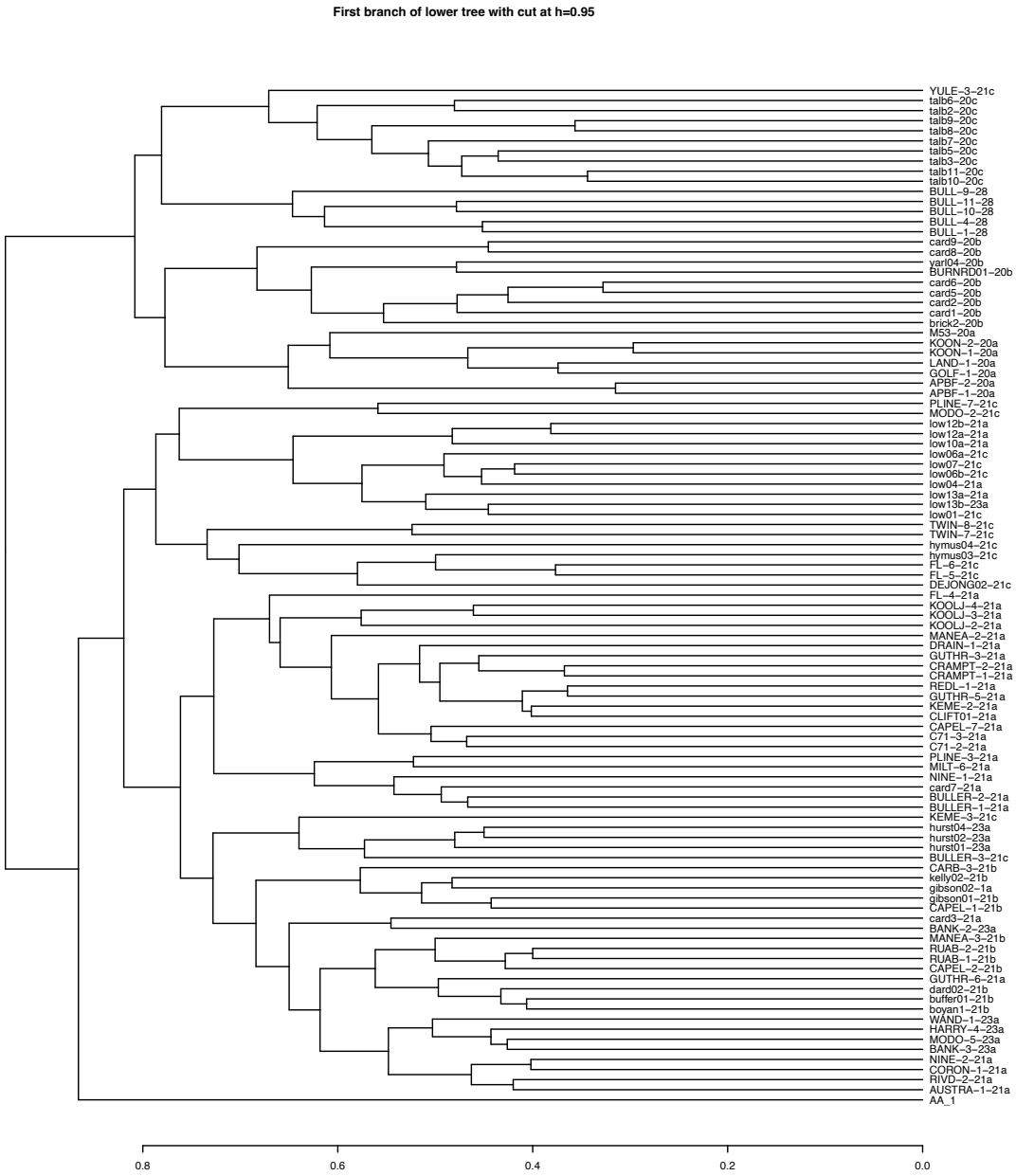

Partial Dendrogram for Plot 1

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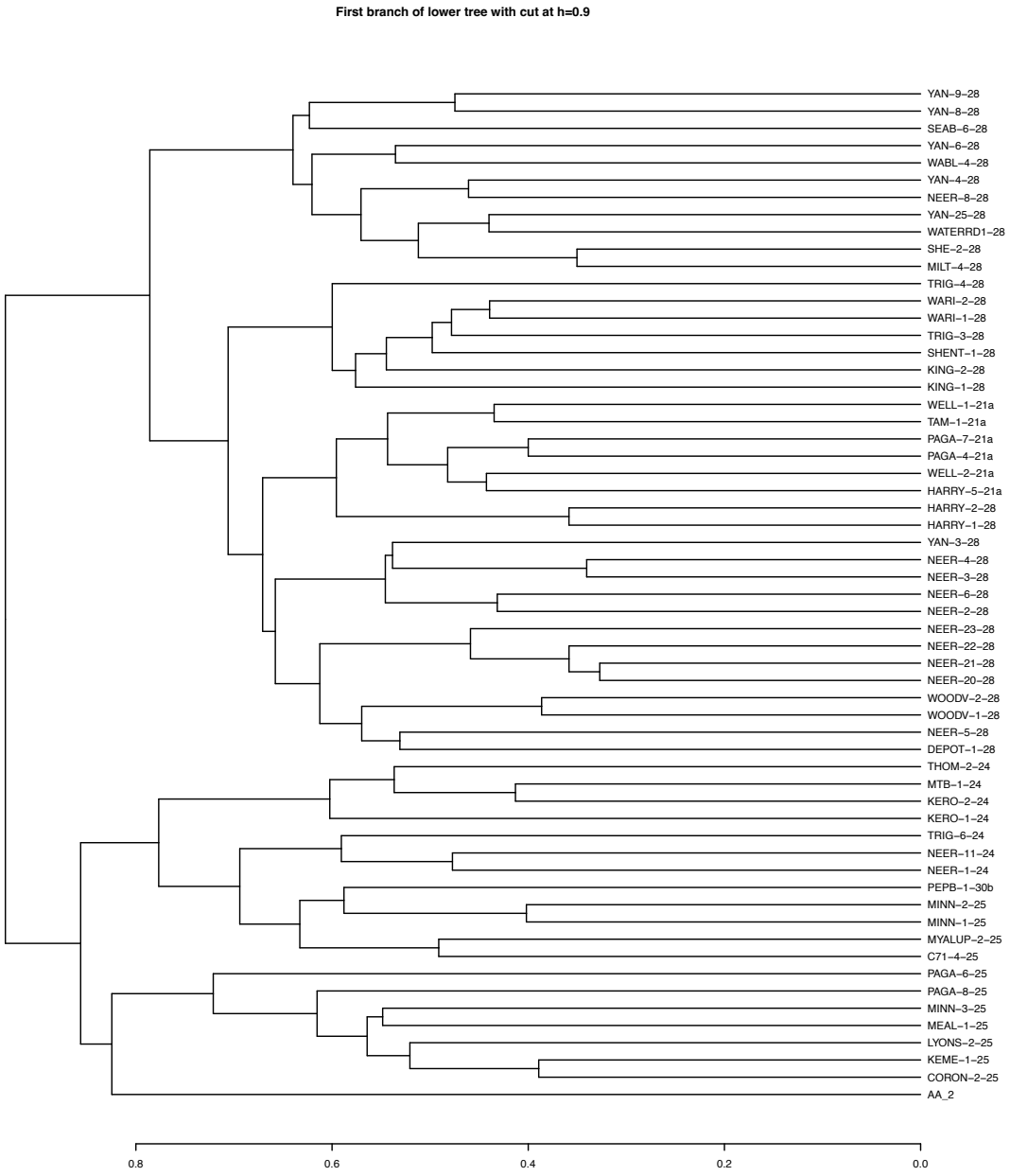
ABN 18 849 210 133



Partial Dendrogram for Plot 2

Kingsley, WA 6026
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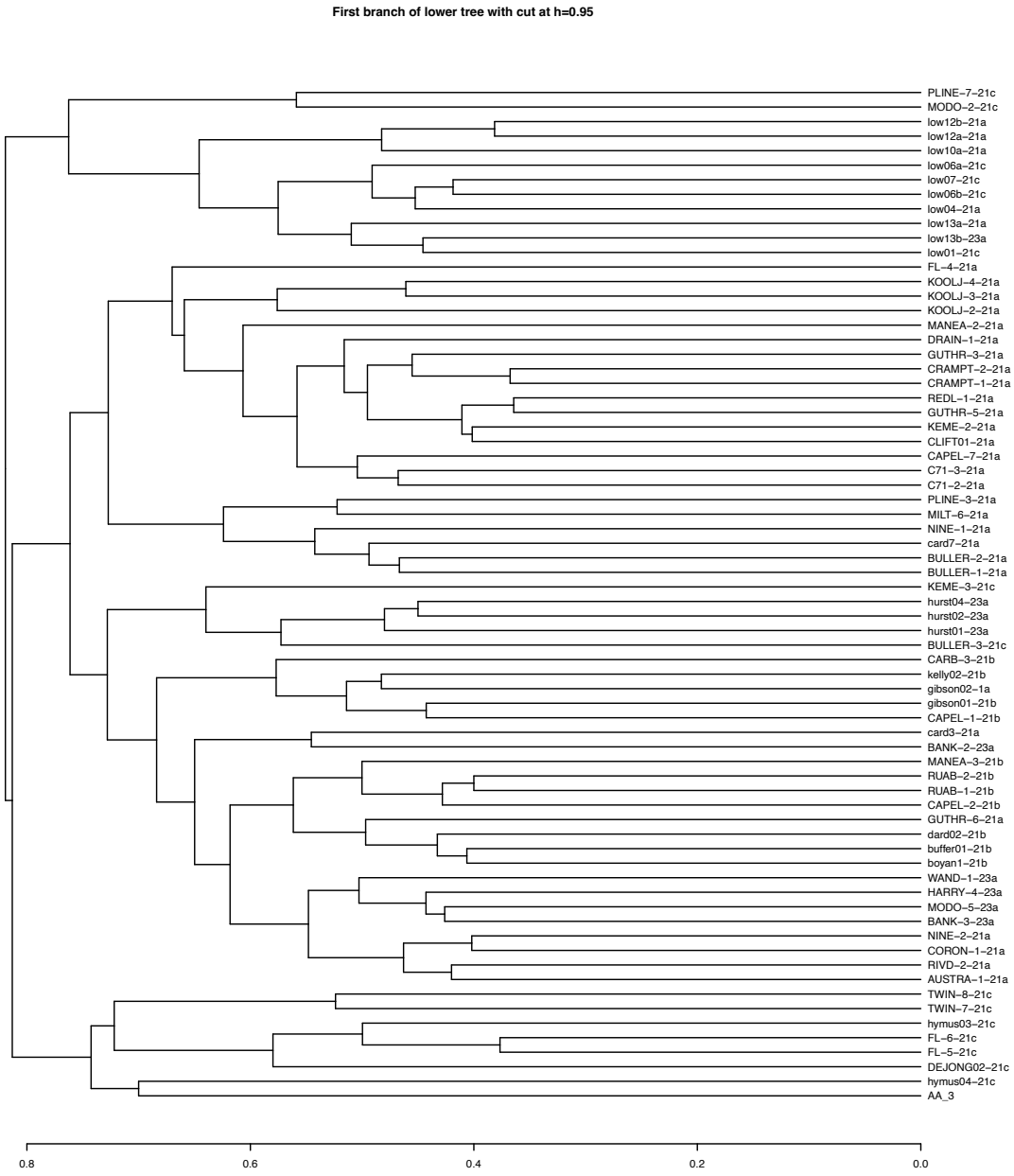
ABN 18 849 210 133



Partial Dendrogram for Plot 3

Kingsley, WA 6026
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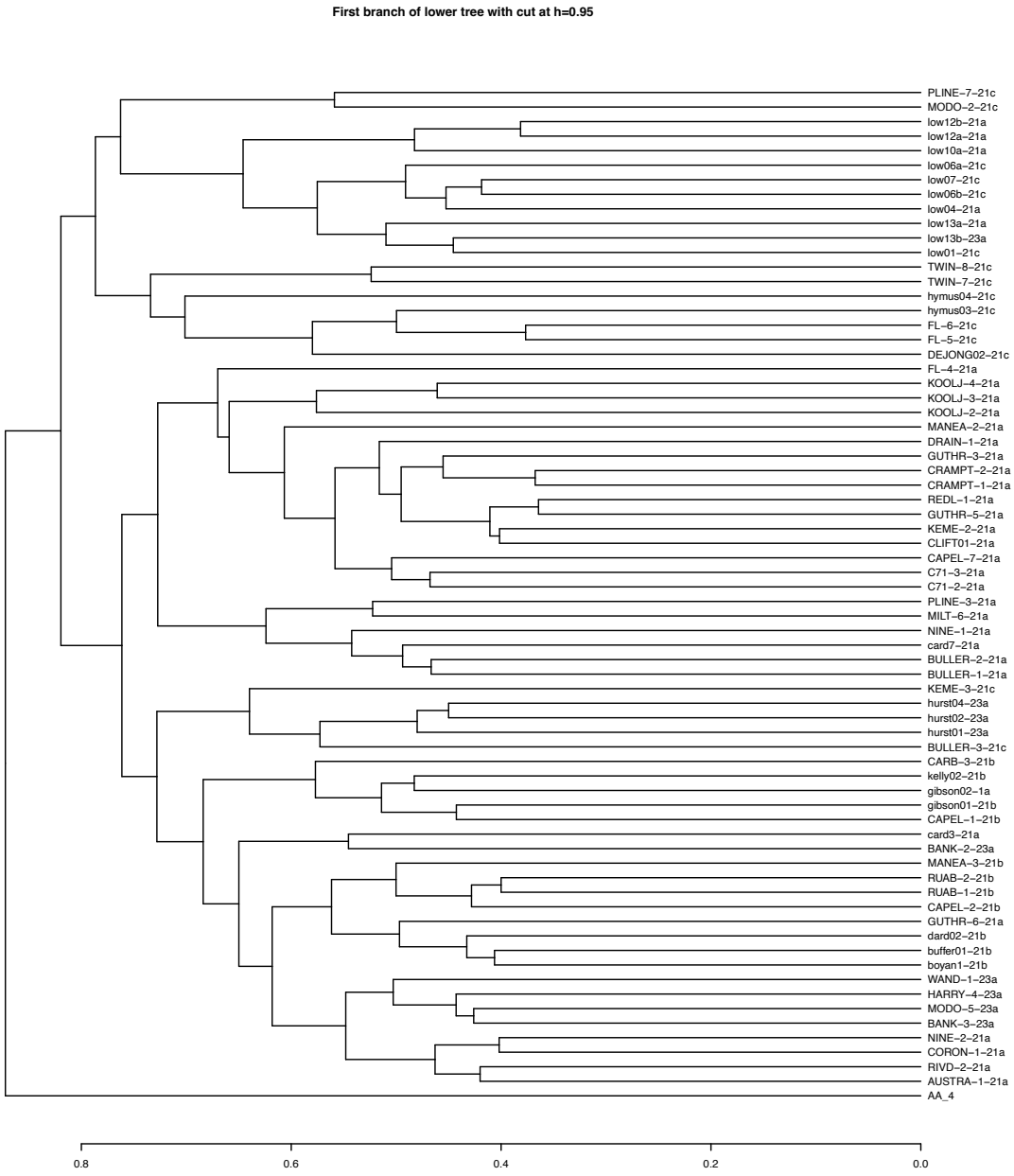
ABN 18 849 210 133



Partial Dendrogram for Plot 4

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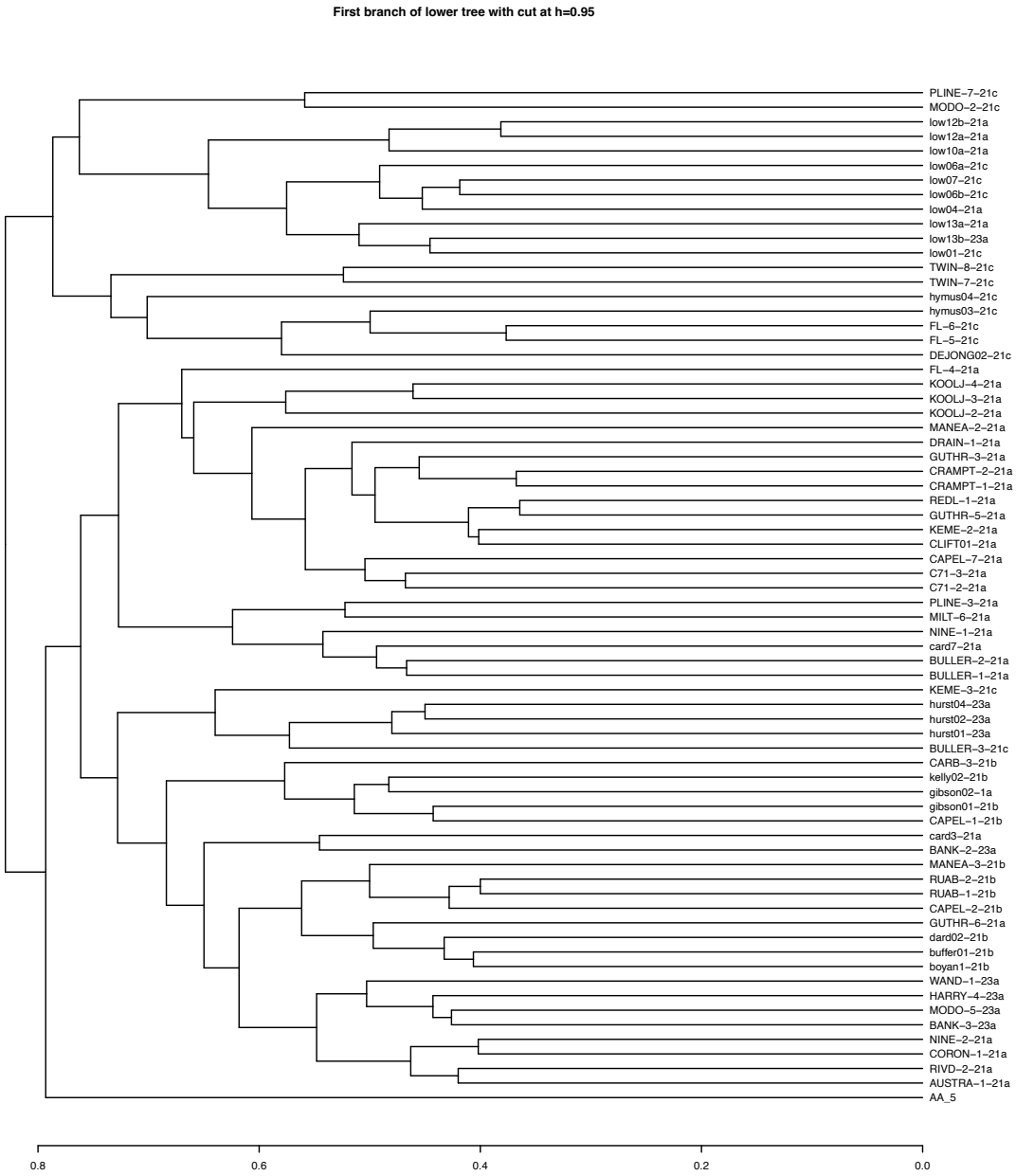
ABN 18 849 210 133



Partial Dendrogram for Plot 5

Kingsley, WA 6026
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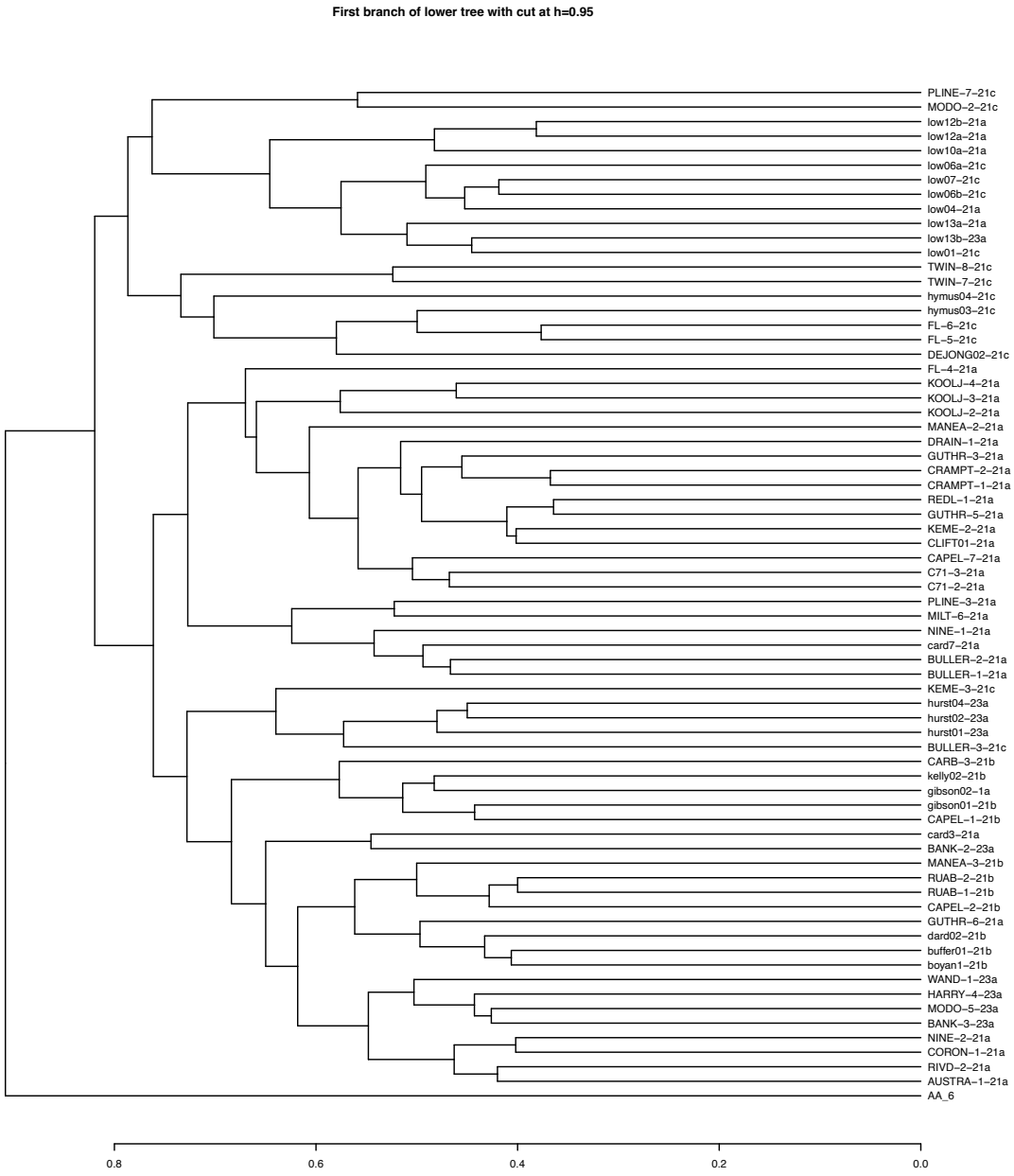
ABN 18 849 210 133



Partial Dendrogram for Plot 5

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Appendix E

Definitions of Threatened and Priority Flora and Communities

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

CONSERVATION CODES

For Western Australian Flora and Fauna

Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016.*

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T **Threatened species**

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR **Critically endangered species**

Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.

EN **Endangered species**

Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.

VU **Vulnerable species**

Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.

EX Extinct species

Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).

Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.

EW Extinct in the wild species

Species that *"is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).

Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

MI Migratory species

Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).

Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.

Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

CD Species of special conservation interest (conservation dependent fauna)

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).

Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

OS Other specially protected species

Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.
(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.
(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

[1] The definition of flora includes algae, fungi and lichens
[2]Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Categories of Threatened Species pursuant to the Environment Protection and Biodiversity Conservation Act 1999

EPBC Act Category	Department of Environment and Energy Definition
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically endangered	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Categories of Threatened Communities pursuant to the Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Critically Endangered	(1) An ecological community is eligible to be included in the ***critically endangered*** category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	(2) An ecological community is eligible to be included in the ***endangered*** category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	(3) An ecological community is eligible to be included in the ***vulnerable*** category at a particular time if, at that time: (a) it is not critically endangered nor endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Department of Environment and Conservation
January 2013

DEFINITIONS, CATEGORIES AND CRITERIA FOR THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

1. GENERAL DEFINITIONS

Ecological Community
A naturally occurring biological assemblage that occurs in a particular type of habitat.

Note: The scale at which ecological communities are defined will often depend on the level of detail in the information source, therefore no particular scale is specified.

A **threatened ecological community** (TEC) is one which is found to fit into one of the following categories; "presumed totally destroyed", "critically endangered", "endangered" or "vulnerable".

Possible threatened ecological communities that do not meet survey criteria are added to DEC's Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

An **assemblage** is a defined group of biological entities.

Habitat is defined as the areas in which an organism and/or assemblage of organisms lives. It includes the abiotic factors (eg. substrate and topography), and the biotic factors.

Occurrence: a discrete example of an ecological community, separated from other examples of the same community by more than 20 metres of a different ecological community, an artificial surface or a totally destroyed community.

By ensuring that every discrete occurrence is recognised and recorded future changes in status can be readily monitored.

Adequately Surveyed is defined as follows:
"An ecological community that has been searched for thoroughly in most likely habitats, by relevant experts."

Community structure is defined as follows:
"The spatial organisation, construction and arrangement of the biological elements comprising a biological assemblage" (eg. *Eucalyptus salmonophloia* woodland over scattered small shrubs over dense herbs; structure in a faunal assemblage could refer to trophic structure, eg. dominance by feeders on detritus as distinct from feeders on live plants).

Definitions of Modification and Destruction of an ecological community:

Modification: "changes to some or all of ecological processes (including abiotic processes such as hydrology), species composition and community structure as a

direct or indirect result of human activities. The level of damage involved could be ameliorated naturally or by human intervention."

Destruction: "modification such that reestablishment of ecological processes, species composition and community structure within the range of variability exhibited by the original community is unlikely within the foreseeable future even with positive human intervention."

Note: Modification and destruction are difficult concepts to quantify, and their application will be determined by scientific judgement. Examples of modification and total destruction are cited below:

Modification of ecological processes: The hydrology of Toolibin Lake has been altered by clearing of the catchment such that death of some of the original flora has occurred due to dependence on fresh water. The system may be bought back to a semblance of the original state by redirecting saline runoff and pumping waters of the rising watertable away to restore the hydrological balance. Total destruction of downstream lakes has occurred due to hydrology being altered to the point that few of the original flora or fauna species are able to tolerate the level of salinity and/or water logging.

Modification of structure: The understorey of a plant community may be altered by weed invasion due to nutrient enrichment by addition of fertiliser. Should the additional nutrients be removed from the system the balance may be restored, and the original plant species better able to compete. Total destruction may occur if additional nutrients continue to be added to the system causing the understorey to be completely replaced by weed species, and death of overstorey species due to inability to tolerate high nutrient levels.

Modification of species composition: Pollution may cause alteration of the invertebrate species present in a freshwater lake. Removal of pollutants may allow the return of the original inhabitant species. Addition of residual highly toxic substances may cause permanent changes to water quality, and total destruction of the community.

Threatening processes are defined as follows:
"Any process or activity that threatens to destroy or significantly modify the ecological community and/or affect the continuing evolutionary processes within any ecological community."

Examples of some of the continuing threatening processes in Western Australia include: general pollution; competition, predation and change induced in ecological communities as a result of introduced animals; competition and displacement of native plants by introduced species; hydrological changes; inappropriate fire regimes; diseases resulting from introduced microorganisms; direct human exploitation and disturbance of ecological communities.

Restoration is defined as returning an ecological community to its pre-disturbance or natural state in terms of abiotic conditions, community structure and species composition.

Rehabilitation is defined as the re-establishment of ecological attributes in a damaged ecological community although the community will remain modified.

2. DEFINITIONS AND CRITERIA FOR PRESUMED TOTALLY DESTROYED, CRITICALLY ENDANGERED, ENDANGERED AND VULNERABLE ECOLOGICAL COMMUNITIES

Presumed Totally Destroyed (PD)
An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant **and either** of the following applies (A or B):

A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats **or**

B) All occurrences recorded within the last 50 years have since been destroyed

Critically Endangered (CR)
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more of** the following criteria (A, B or C):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii):

i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);

ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.

C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B, or C):

A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement **and either or both** of the following apply (i or ii):

i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);

ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);

ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;

iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)
An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium (within approximately 50 years) to long-term future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long-term future because of existing or impending threatening processes.

3. DEFINITIONS AND CRITERIA FOR PRIORITY ECOLOGICAL COMMUNITIES

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities

Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities

Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:

(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or;

(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

(i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.

(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category.

(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.