Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Section 1 – Eligibility for Listing		
1. Name of the ecological community		
'*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain' (also known as Swan Coastal Plain floristic community type 20b).		
2. Listing Category for which the ecological community is nominated		
	Western Australia	EPBC Act (wholly or as a component)
Current listing category TEC list under WA Minister ESA list in policy (Please check box)	☐ Critically endangered ☒ Endangered ☐ Vulnerable ☐ Priority 1-4 ☐ Data Deficient ☐ None – not listed	Name: ☐ Critically endangered ☐ Endangered ☐ Vulnerable ☒ None – not listed (however many locations meet description of umbrella TEC 'Banksia woodlands of the Swan Coastal Plain)'
Proposed listing category under the *Biodiversity Conservation Act 2016* (Please check box)	☐ Collapsed ☒ CR: Critically endangered ☐ EN: Endangered ☐ VU: Vulnerable ☐ Priority 1-4	
Select one or more of the following criteria under which the community is to be nominated for BC Act listing. (Please check box). For further details on these criteria please refer to the Attachment to this form. The information you provide in Section 3 should support the criteria you select here.	☐ Criterion A – Reduction in geographic distribution ☒ Criterion B – Restricted geographic distribution ☐ Criterion C – Environmental degradation based on change in an abiotic variable ☐ Criterion D – Disruption of biotic processes or interactions based on change in a biotic variable ☐ Criterion E – Quantitative analysis that estimates the probability of ecosystem collapse	

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Section 2 – Description, Condition, Threats & Recovery

Please answer all the questions, providing references where applicable. If no or insufficient information exists to answer a question, you must indicate this instead of leaving the question blank. The answers may be provided within this form or as attachments, ensuring that responses clearly indicate which question number they refer to.

Classification

3. What is the name of the ecological community?

Note any other names that have been used recently, including where different names apply within different jurisdictions. For example, is it known by separate names in different States or regions?

'Banksia attenuata and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain' (also known as Swan Coastal Plain community 20b - SCP20b; and floristic community type 20b - FCT20b).

4. What authorities/surveys/studies support or use the name?

The community was originally described by Gibson *et al.* (1994). The community type has been recognised since the publication of that report. It was endorsed for listing as an endangered TEC under policy by the WA Minister for Environment on the 6th of November 2001, but was ranked as endangered using ranking criteria developed in WA that do not match those used for the IUCN RLE. Some occurrences of the community will meet the description of the umbrella TEC listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – the 'Banksia woodlands of the Swan Coastal Plain'.

The ecological community is referred to as '*Banksia attenuata and/or Eucalyptus marginata woodlands of the eastern side of the Swan Coastal Plain',* as FCT20b, and as SCP20b. The community is referred to as above by the Department of Biodiversity, Conservation and Attractions, and data about the ecological community is stored in the departmental TEC database, including the name. Hereafter the community will be referred to as FCT20b.

5. How does the nominated ecological community relate to other ecological communities that occur nearby or that may be similar to it?

Does it intergrade with any other ecological communities and, if so, what are they and how wide are the intergradation zones?
Describe how you might distinguish the ecological community in areas where there is overlap (also see Description section below).

The community is a sub-type of the umbrella EPBC listed Banksia Woodlands of the Swan Coastal Plain ecological community. It is generally dominated by *Banksia attenuata* and/or *Eucalyptus marginata,* with *Mesomelaena pseudostygia*, *Tetraria octandra, Banksia dallanneyi, Desmocladus fasciculatus,* and *Chamaescilla corymbosa* being common in the understorey. It has similarities to other Banksia woodlands communities that are listed under the EPBC Act, in that it generally has a woodland structure with a prominent overstorey.

The community differs from the two most closely related communities described in Gibson *et al.* (1994). FCT20b differs from the *Banksia attenuata* woodlands over species rich dense shrublands (FCT20a) and the eastern shrublands and woodlands (FCT20c) in the presence of understorey species that can include *Grevillea pilulifera, Babingtonia camphorosmae, Hibbertia vaginata, Caladenia flava, Hakea stenocarpa and Conostylis setosa,* and the absence of *Alexgeorgea nitens* that is a common component of FCT20a.

Description

6. List the main features that distinguish this ecological community from all other ecological communities.

Characteristic (or diagnostic) features can be biological (e.g. taxa or taxonomic groups of plants and animals characteristic to the community; a type of vegetation or other biotic structure), or associated non-biological landscape characteristics (e.g. soil type or substrate, habitat feature, hydrological feature). Please limit your answer to those features that are specific to the ecological community and can be used to distinguish it from other ecological communities.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

The community is regionally rare, very restricted and is a relatively rich community (75 species/100m^2) that occurs on the eastern side of the Swan Coastal Plain. It is restricted to the sands at the base of the Scarp from Stratton in the north to Warawarrup in the south.

This community is differentiated from the other two subgroups of the 'type 20 woodlands' FCT20a and FCT20c) by the occurrence of species such as *Grevillea pilulifera, Babingtonia camphorosmae, Hibbertia vaginata, Caladenia flava, Hakea stenocarpa, Conostylis setosa,* and *Johnsonia* aff. *pubescens* as well as the absence of species restricted to the other subgroups, such as *Alexgeorgea nitens* which is a common component of FCT20a.

7. Give a description of the biological components of the ecological community.

For instance, what species of plants and animals commonly occur in the community; what is the typical vegetation structure (if relevant).

The community is very species rich (75 species/100m^2). Most sites in this community type were *Eucalyptus marginata – Banksia attenuata* woodlands but *Banksia* woodlands and heaths were also found (Gibson *et al.* 1994). It is generally dominated by *Banksia attenuata* and/or *Eucalyptus marginata* with *Mesomelaena pseudostygia*, *Tetraria octandra, Banksia dallanneyi, Desmocladus fasciculatus, and Chamaescilla corymbosa* being common in the understorey (Gibson *et al.* 1994). *Mesomelaena pseudostygia* was common in quadrats in this community and occurred in 67% of plots. An average of 1.4 weed species were recorded per quadrat in the Gibson *et al.* (1994) study. This is less than weed levels recorded in the closely related FCT20c, and is a low level of weed invasion. The most common weeds found in occurrences are *Gladiolus caryophyllaceus* and *Watsonia meriana* var. *bulbillifera* (Gibson *et al*. 1994).

A detailed list of threatened and priority flora and fauna that occur in the community can be found in section 11.

8. Give a description of the associated non-biological landscape characteristics or components of the ecological community.

For instance, what is the typical landscape in which the community occurs? Note if it is associated with a particular soil type or substrate; what major climatic variables drive the distribution of the ecological community (e.g. rainfall). Note particular altitudes, latitudes or geographic coordinates

The community is found on a range of soil and landform units at the base of the Darling Scarp that are described in Churchward and McArthur (1978). The community occurs largely on the Forrestfield unit (Ridge Hill Shelf - 20 occurrences), Guildford unit (11 occurrences), or at the confluence of Guildford with Forrestfield (6 occurrences). There are also 2 occurrences recorded from Southern River unit (total 0.63ha). Three occurrences are also mapped on the Darling Scarp Unit, but the soil and landform mapping is considered inaccurate in these areas and should be mapped as Forrestfield unit (Rush02 - occurrence 25, ConnellPlot2 – occurrence 48, and Nett01 - occurrence 36).

Churchward and McArthur (1978) describe the Forrestfield unit as laterised foothills of the Darling Scarp dominated by gravelly and sandy soils, the Guildford unit as flat plain with medium textured deposits; yellow duplex soils, and the Southern River unit as sandplain with low dunes and many intervening swamps; iron and hummus podzols; peats, and clays. The mapping of these soil and landform units correlates directly with the vegetation complexes that have the same names. The vegetation complexes were mapped to the soil and landform units.

9. Provide information on the ecological processes by which the biological and non-biological components interact (where known).

Figure 1 indicates that Banksia woodlands such as FCT20b, play an integral role in providing habitat or food for a diverse range of understorey flora and fauna. *Banksia attenuata* resprouts after fire through epicormic or lignotuberous buds. It is an obligate outcrosser, and pollinated by nectar-feeding birds (predominantly honeyeaters in the family Meliphagidae), small marsupials, and to a lesser extent bees and wasps. Seeds are stored on the plant for 5 years or more, and then predominantly gravity-dispersed post-fire, mostly landing near parents where they must germinate during the first winter, otherwise they expire (Ritchie and Krauss 2012). *Banksia attenuata* and *Eucalyptus marginata* also form the upper strata/structural layer that provides shade protection and helps

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

control humidity to assist survival of other species. Negative influences effecting Banksia and their diverse understory include; dieback disease caused by *Phytophthora* species, weed invasion, altered fire regimes, decline in available water, and land clearing.

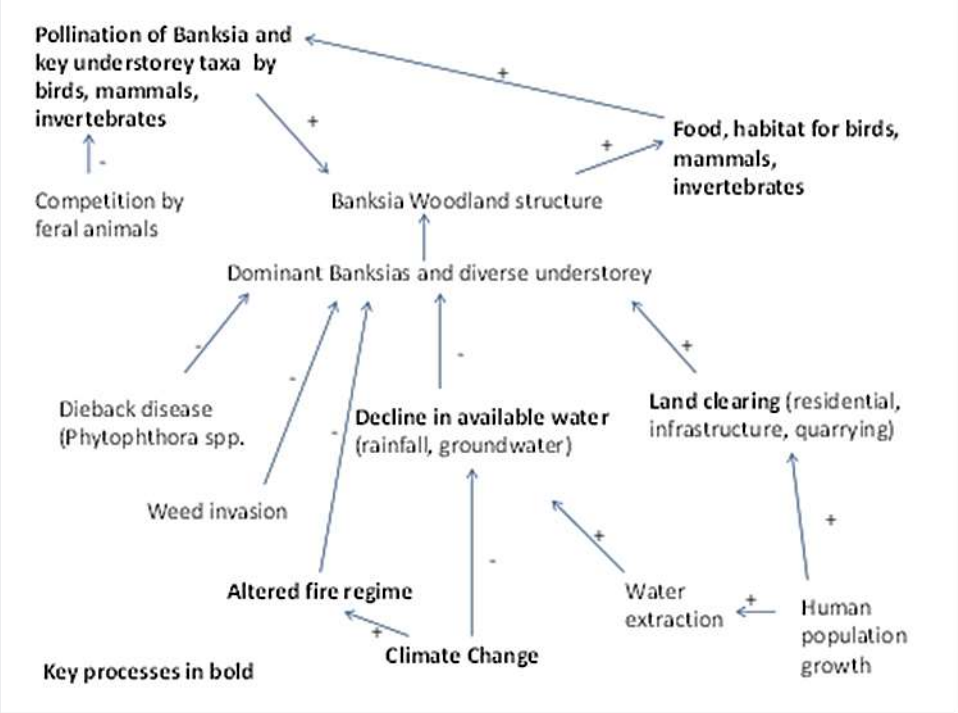


Figure 1. Cause-effect model of ecosystem dynamics for Banksia woodlands on the Swan Coastal Plain showing positive (+) and negative (-) environmental and anthropogenic influences on ecosystem processes and components.

10. Does the ecological community show any consistent regional or other variation across its extent, such as characteristic differences in species composition or structure?

If so, please describe these.

Gibson *et al* (1994) recorded low forest A, low woodland A and open woodland A in quadrats in the community.

11. Does the ecological community provide habitat for any listed threatened species and/or endemic species?

If so, please note the species and whether the species is listed on State and/or national lists and the nature of their dependence on the ecological community.

Eight other threatened ecological communities (TECs)(WA listed), two priority ecological communities (PECs), four threatened flora (TF), four priority flora and seven threatened fauna occur within or occur close to this community.

Threatened flora recorded in occurrences of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands include *Drakaea elastica*, *Darwinia apiculata, Synaphea sp.* Serpentine (G.R. Brand 103), *Conospermum undulatum* and *Tetraria australiensis. Acacia anomala* occurs in close proximity and is also threatened. Priority flora recorded in occurrences of this community include *Johnsonia pubescens* subsp. c*ygnorum* and *Synaphea odocoileops*. The priority flora *Acacia oncinophylla* subsp. *oncinophylla*, occurs in close proximity to the community.

Other threatened and priority ecological communities (PECs), most of which were originally described in Gibson *et*

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

al. (1994), that are found in bushland adjacent to occurrences of the '*Banksia attenuata* and/or *Eucalyptus marginata* woodlands' are as follows:

- *Eucalyptus calophylla – Kingia australis* woodlands on heavy soils, Swan Coastal Plain (critically endangered in WA, endangered under the EPBC Act)
- *Eucalyptus calophylla – Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain (critically endangered in WA, endangered under the EPBC Act);
- Shrublands on dry clay flats (endangered in WA, critically endangered under the EPBC Act);
- Southern wet shrublands, Swan Coastal Plain (endangered in WA)
- *Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils (vulnerable in WA)
- Herb rich shrublands in clay pans (vulnerable in WA, critically endangered under the EPBC Act)
- Herb rich saline shrublands in clay pans (vulnerable in WA, critically endangered under the EPBC Act)
- Dense shrublands on clay flats (endangered in WA, critically endangered under the EPBC Act)
- *Corymbia haematoxylon - Eucalyptus marginata* woodlands on Whicher foothills (priority 3)
- Central Granite Shrublands (community type 5 in Markey 1997) (priority 4).

12. Identify major studies on the ecological community (authors, dates, title and publishing details where relevant).

Groves, H. (2014). Predicted risk to Banksia woodlands in the Swan Coastal Plain in response to groundwater decline. Western Australian Department of Parks and Wildlife in accordance with the hydrogeological industry placement for the completion of a Master of Hydrogeology degree at the University of Western Australia.

Ritchie, A.L., and Krauss, S.L. (2012). A Genetic Assessment of Ecological Restoration Success in *Banksia attenuata*. Restoration Ecology 20.4 441–449.

Department of Environment and Conservation (2012). Interim Recovery Plan 2012-2017 for *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (Swan Coastal Plain community type 20b – Gibson *et al*. 1994). Interim Recovery Plan No. 328. Department of Environment and Conservation, PerthAbbott, I. and

City of Armadale (2004). Forrestfield Complex Bushland Management Plan (2004-2009). City of Armadale.

City of Armadale (2010). Draft Bushland Management Plan for reserves in the City of Armadale. City of Armadale.

Env Australia Pty Ltd (2008). Flora and vegetation survey, weed and vegetation condition mapping of lots 9, 10, 11, 12 and 3 Rushton and Quarry Roads, Martin. Unpublished report prepared for City of Gosnells.

Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994) *A floristic survey of the Southern Swan Coastal Plain*. Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).

Shire of Serpentine-Jarrahdale (2007). Draft Management Plan for Serpentine Sports Reserve. Unpublished Report, Perth, Western Australia.

Shire of Serpentine-Jarrahdale (2009). Draft Brickwood Reserve and Briggs Park Management Plan. Unpublished Report, Perth, Western Australia.

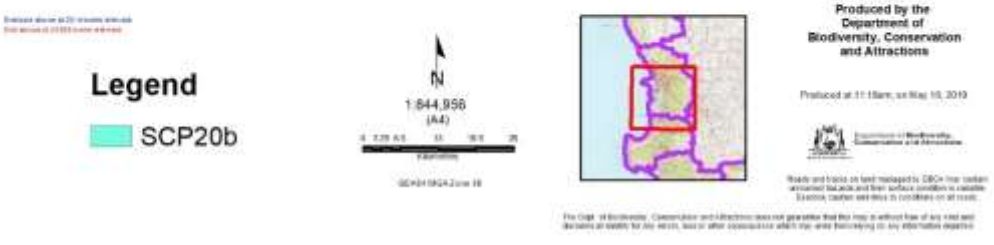
Distribution

13. Describe the distribution across WA and nationally.

State the appropriate bioregions where the ecological community occurs. Attach or provide any maps showing its distribution with details of the source of the maps, or explain how they were created and the datasets used.

GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**



The map above was created using ArcGIS version 10.6.1 and indicates the distribution of FCT20b. The community has a range of 138km, with the southernmost occurrence at Warawarrup and the northernmost at Stratton. The figure indicates the high level of fragmentation of occurrences.

The map was created from known mapped occurrences of the community contained on the Western Australian Threatened Ecological Community database (TECDB), as administered by the Department of Biodiversity and Conservation (DBCA).

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

14. What is the area of distribution of the ecological community?

For answers to parts a, b, c & d: please identify whether any values represent extent of occurrence or area of occupancy (as described in the Attachment); provide details of the source(s) for the estimates and explain how they were calculated and the datasets used.

14 a. What is the current known area (in ha)?

45 records of occurrences currently in TEC database. Two require further statistical analysis to verify identification and the location of an additional occurrence requires verification. There are 42 occurrences that are extant and have boundaries mapped. These occurrences total 296 hectares (TEC database data 21/06/2019).

14 b. What is the pre-industrialisation extent or its former known extent (in ha)? An ecological community is considered to be naturally restricted if it has a pre-industrialisation area of occupancy that is less than 10 000 ha or a pre-industrialisation extent of occurrence that is less than 100 000 ha (refer to the Attachment A)

Area calculations from digitised GIS mapping based on the Vegetation Survey of WA (Beard & Sprenger 1984) estimate that Banksia low woodland originally covered 4435.3 km2. In addition, Banksia woodland with scattered emergent eucalypts is estimated to have covered a further 2303.2km2. Therefore, the original extent of all Banksia woodlands (including Banskia woodland other than ecological community 20b) as defined in this context is estimated to be 6738.5km2 which equates to 673,850 ha.

From digitised GIS mapping of remnant vegetation in WA as at 2008 (WA Department of Agriculture and Food) it is estimated that about 325669ha (3256.69km2) of the entirety of the Banksia woodlands categorised as "Banksia Woodlands of the Swan Coastal Plain IBRA region remained" (Department of Parks and Wildlife (DPaW) 2016). The total loss of Banksia Woodlands on the Swan Coastal Plain is estimated to about 52%. The extent of loss of vegetation in a radius of 20 km around central Perth is much greater and is estimated to be greater than 90% with less than 10% remaining.

It is assumed that the reduction in extent of native vegetation on the soil and landform units that support the community is indicative of the level of clearing of the community. The community occurs on Forrestfield unit (Ridge Hill Shelf) or Guildford unit (Pinjarra plain), at the continuum of Guildford with Forrestfield units or on the Southern River unit. The distribution of soil and landform units are the equivalent of the vegetation complexes as the boundaries of the complexes relates directly to the mapping of the soil and landforms (Department of Conservation and Environment (DCE) 1980). The pre-European and current extant of these vegetation complexes are outlined in table 1 (DBCA 2019). These data provide some indication of the likely decline of FCT20b.

Table 1. Pre-European and current extent of vegetation complexes associated with FCT20b

Vegetation Complex	Pre-European extent (ha)	Current (2018) extent (ha)	Proportion remaining - %
Guilford complex	90513.13	4607.91	5.09
Forrestfield complex	22812.92	2803.36	12.29
Southern River complex	58,781.48	10,832.18	18.43

Clearing for agriculture and urbanisation has been extensive on the eastern side of the Swan Coastal Plain where the community occurs. Forrestfield complex, Guildford complex and Southern River complex support occurrences of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands. It is therefore assumed that a similarly large proportion of the original extent of FCT20b has probably been cleared. The extent of the Forrestfield complex in the Perth Metropolitan Region where the community occurs had been reduced by 91%,

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

the Guildford complex by 94% and the Southern River complex by 83% at the time of publication of Bush Forever (Government of Western Australia 2000).

14c. What is the estimated percentage decline of the ecological community?

Based on data in table 1 above the community is assumed to have declined by approximately 82-95% since pre-industrialisation (~1750) based on clearing levels of soil and land units with which FCT20b is most commonly associated. This is similar to the estimate in Table 23 in Gibson *et al*. (1994) that the community's range contraction is likely to have been >90%. The authors based their estimate of decline on vegetation clearing of the lands and geomorphic data for habitats that supported the floristic community types that they described.

14d. What data are there to indicate that future changes in distribution may occur?

Some Bush Forever sites as identified in Government of Western Australia (2000) in which the community occurs are likely to be proposed for development, such as clearing for infrastructure including high tension power lines and roads.

Many occurrences are not in secure tenure, and this is a particular consideration for occurrences that are also not Bush Forever sites and are not in reserves with conservation included in the purpose. Areas that may be associated with potential developments for road and railway works, housing and/or industry include occurrences 3 (BRICK02), 4 (YARL04), 7-9 (ByfordFire, BYFORD06, BYFORD07) 14-16 (norm01, PAUL01, PAUL06) ,19 (HALL01), part of 21 (WATKINS PLOT1), 23-25 (myperth03, Bancell01, Rush02), 27-33 (CREYK01, CAMMILLO01, DEPOT01, JOHN DUNN01, MOORE01, KENDAL01, CREYK02) 34 (MYYARL03), 35 (Austral Plot02) and 36 (NETT01). Occurrence 4 (YARL04) was previously a mineral sand mine but is now under rehabilitation. Areas adjacent to the mapped areas of occurrence 24 (Bancell01 and 02) have been physically disturbed. The landowners of occurrence 14 (Norm01, 03 and 07) have expressed intentions to develop the land at Whitby for residential purposes. Occurrence 36 (NETT01) has already been substantially cleared through property development.

Patch size

15. What is the typical size (in ha) for a patch of the ecological community (if known)?

Explain how it was calculated and the datasets that are used. Relevant data includes the average patch size, the proportion of patches that are certain sizes, particularly proportions below 10 ha and below 100 ha, (but also below 1 ha and above 100 ha, for example). This could be presented as the range of patch sizes that comprise 90% of the occurrences.

Statistics in Table 2 were taken from the DBCA corporate Threatened Ecological Community Database June 2019.

Table 2. Statistical summary of FCT20b occurrences

Count	42
Minimum	0.01
Maximum	60.6
Sum	295.6
Mean	7.0
Standard Deviation	13.2

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

16. Quantify, if possible, the smallest percentage or area required for a patch of the ecological community to be considered viable.

This refers to the minimum size of a remnant that can remain viable without active management. It may be determined through the requirements for dominant native species, level of species diversity, or the nature of invasive weeds.

The condition state thresholds specified for this community to be considered viable examples of the community is Good condition (Bush Forever 2000 scales). Vegetation that is in poorer condition than 'Good' is not considered an extant example of the TEC.

Good Condition refers to "Vegetation structure altered but retains basic vegetation structure or ability to regenerate it. Obvious signs of disturbance, e.g. from partial clearing, dieback, logging, grazing. Presence of very aggressive weeds." (Keighery 1994 Vegetation Condition Scale in Government of WA 2000)

Functionality

17. Is the present distribution of the ecological community severely fragmented?

If so, what are likely causes of fragmentation?
If fragmentation is a natural or positive characteristic of this ecological community, please explain this and state the reason.
Severely fragmented refers to the situation in which increased extinction risk to the ecological community results from most remnants being found in small and relatively isolated patches.

This community is severely fragmented, with most remaining occurrences being small and isolated and in an urban environment, separated by roads, buildings or other infrastructure.

18. Has there been a loss or decline of functionally important species?

This refers to native species that are critically important in the processes that sustain or play a major role in the ecological community and whose removal has the potential to precipitate change in community structure or function sufficient to undermine the overall viability of the community.

Disease caused by *Phytophthora* species

Banksia attenuata and *Eucalyptus marginata* are two functionally important species in the community. *Banksia attenuata* has an inferred high susceptibility to dieback disease caused by *Phytophthora* species and *Eucalyptus marginata* is moderately susceptible. Table 3 lists the dieback susceptibility for some flora taxa in this community.

A key biotic driver in Banksia woodlands in general that may be disrupted is loss of key Banksia taxa through dieback disease caused by *Phytophthora* spp. The main historical impact of *Phytophthora* spp. is likely to have been to change the structure and composition of Banksia woodlands towards dominance by taxa that are less susceptible to the disease.

The area of mapped Banksia woodlands that coincide with inferred disease areas and those in which the disease has been detected is 19,984ha (2010 GIS data Forest Management Branch DEC). This represents about 3% of the overall extent of the Banksia woodlands, as at 2008. This may represent an underestimate of the area of the Banksia woodlands that is dieback infested as much of the extent of the Banksia woodlands may not have been surveyed for the disease.

Occurrences of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands that are known to be infected with dieback are occurrences 2-3 (CARD01, BRICK02), 12, 14, 15 (BLACKBURN01, norm01, Paul01), 28 (CAMMILLO01), 32 (KENDAL01), 35, 27 and 33 (CREYK02 and CREYK02), 30 (JOHN DUNN01), and 31 (MOORE01). Not all occurrences have been surveyed for the disease.

Table 3. Known dieback susceptibility of species that commonly occur in SCP20b.

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

Taxon	Dieback response
Banksia attenuata	Inferred high susceptibility
Eucalyptus marginata	Good evidence of moderate susceptibility
Mesomelaena pseudostygia	Unknown
Hakea stenocarpa	Unknown
Conostylis setosa	Unknown
Johnsonia pubescens subsp. cygnorum	Unknown
Tetraria octandra	Unknown
Banksia dallanneyi	Inferred susceptibility
Desmocladus fasciculatus	Unknown
Chamaescilla corymbosa	Unknown

Potential loss through groundwater reduction;

Decline in available groundwater in Banksia woodlands near Perth has been clearly linked to a change of Banksia woodlands towards non-woody, shallow-rooted species not dependent on specific hydrological conditions as follows (from Sommer and Froend 2011) “However, since the drawdown event, the regional water table continued to decline, with the vegetation responding through progressive and uni-directional change in abundance and composition. The change in composition was primarily manifested as a shift towards non-woody, shallow-rooted species not dependent on specific hydrological conditions. This slow, progressive change in hydrology associated with reduced rainfall and land use changes has continued to force a transition in the floristics towards an alternative ecohydrological state.”

Department of Environment and Conservation (2012) and Groves (2014) note that increasing groundwater abstraction and reductions in rainfall in the region will likely continue to cause groundwater levels to continue to decline into the future. Groundwater decline also has the potential to change the composition and structure of the community towards shallow rooted plant species.

18a. If yes, which species are affected?

The dominant species in this community, *Banksia attenuata* and *Eucalyptus marginate,* are both affected by dieback disease. Other species that make up the community; *Mesomelaena pseudostygia*, *Tetraria octandra, Desmocladus fasciculatus* and *Chamaescilla corymbosa* have an unknown dieback susceptibility. *Banksia dallanneyi* has an inferred moderate susceptibility.

Deeper rooted species, particularly trees, are most susceptible to groundwater decline.

18b. How are the species functionally important and to what extent have they declined?

Banksia attenuata and *Eucalyptus marginata* form the upper strata/structural layer, that provides shade protection and helps control humidity to assist survival of a diverse range of understorey species. The integral role of the overstorey trees in the community is outlined in section 9.

Reduction in community integrity

19. Please describe any processes that have resulted in a reduction in integrity and the consequences of these processes, e.g. loss of understorey in a woodland. Include any available information on the rate of these changes.

This recognises that an ecological community can be threatened with extinction through on-going modifications that do not necessarily lead to total destruction of all elements of the community. Changes in integrity can be measured by comparison with a benchmark state that reflects as closely as possible the natural condition of the community with respect to the composition and arrangement of its abiotic and biotic elements and the processes that sustain

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

them. Please provide a description of the benchmark state where available. For further information please refer to the Guidelines.

Many of the occurrences are surrounded by highly urbanised areas and in turn, the frequency of fires, disturbance by recreational users, and incidence of illegal rubbish dumping are generally increased. These factors can all lead to degradation of vegetation through increasing weed invasion and alteration of structure, species composition or loss of component taxa. Monitoring data for the community are not adequate to indicate specific levels of change associated with each of the threatening processes.

Survey and Monitoring

20. Has the ecological community been reasonably well surveyed?

Provide an overview of surveys to date, including coverage of different land tenure, and the likelihood of the ecological community's current known distribution and/or patch size being a true reflection of its actual distribution (consider area of occupancy and area of extent, including any data on number and size of patches).

Gibson *et al.* (1994) established 509 quadrats across the southern Swan Coastal Plain that included 8 quadrats in the community. Approximately 1000 additional quadrats were established for Bush Forever (Government of Western Australia 2000) that included another 8 quadrats in this community. A series of additional quadrats have been established by DBCA, consultants and other groups and individuals since 2000. The distribution of the community is considered to have been well surveyed.

Table 4. Survey data extracted from the DBCA TEC database (occurrences are not sequential as numbering is taken directly from the TEC database that may include destroyed occurrences).

Occurrence No.	Site ID	Area (Ha)	Year of latest survey	Land manager	Reserve No.
2	CARD01	60.6	2018	DBCA	2457
3	BRICK02	2.5	2012	Shire of Serpentine and Jarrahdale	17490
4	YARL04	6.4	2014	Shire of Harvey	31900
5	BURNRD01	7.5	1995	DBCA	6268
7	ByfordFire	3.0	2015	Brookfield Rail	-
8	MYBYFORD06	0.8	2011	Brookfield Rail	-
9	MYBYFORD07	6.3	2011	Brookfield Rail	-
10	BELLA01	2.0	2000	Shire of Serpentine and Jarrahdale	6168
11	CONNELL_PLOT01	17.0	2016	Department of Planning Lands and Heritage (DPLH)	-
12	BLACKBURN01	5.5	2007	City of Armadale	-
14	norm01	58.4	2002	Private	-
15	PAUL01	3.9	2002	Shire of Serpentine and Jarrahdale	-
16	PAUL06	1.2	2002	Shire of Serpentine and Jarrahdale/Brookfield Rail	-
17	xLamb02	0.0	2002	Shire of Serpentine and Jarrahdale	-
18	xLamb01	0.6	2002	DBCA	32352
19	HALL01	0.7	2002	Public road/Brookfield Rail	-
20	HALL03	0.4	2002	DBCA	46587

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

21	WATKINS PLOT1	5.1	2006	Shire of Serpentine and Jarrahdale/Private	14088/49122
22	WATKINS02	7.6	2006	DBCA	23012
23	myperth03	1.4	2002	Commonwealth/Perth Airport Pty Ltd	-
24	Bancell01	5.6	2002	Shire of Waroona/Western Power	11160/43703
25	Rush02	7.5	2002	City of Gosnells	-
27	CREYK01	0.8	2004	City of Armadale	39208
28	CAMMILLO01	0.2	2007	City of Armadale	44606
29	DEPOT01	0.1	2007	City of Armadale	-
30	JOHN DUNN01	0.2	2007	City of Armadale	9820
31	MOORE01	0.3	2007	City of Armadale	-
32	KENDAL01	2.4	2007	City of Armadale/Private	-
33	CREYK02	0.2	2004	City of Armadale	39208
34	MYYARL03	5.2	1995	Main Roads WA	31901
35	Austral Plot02	4.6	2007	Private	-
36	NETT01	4.3	2009	Shire of Serpentine and Jarrahdale/Private	-
41	AITKEN03	2.1	2011	Shire of Harvey	25823
42	TALB19	3.2	2016	DBCA	-
44	RoeHwy02	0.3	2012	Main Roads	-
45	AITKEN01	4.2	2011	Shire of Harvey	-
46	PETERSON01	3.5	2011	Shire of Harvey	16804
47	Austral Plot01	17.3	2007	Private	-
48	CONNELL_PLOT2	2.7	2011	DPLH	-
49	WATSONIA RD PLOT1	9.2	2018	Shire of Kalamunda / Private	14088/49122
50	Fairbridgeiron01	30.6	2013	Private	-
51	MaidaVale09	0.1	-	Private	-

21. Where possible, please indicate areas that haven't been surveyed but may add to the information required in determining the community's overall viability and quality.

Include commentary on issues to do with accessing different land tenures within the area of distribution, including private property, and the likelihood that these areas may include occurrences.

- For a number of sites, statistical analysis will not be possible due to unsuitable vegetation condition, size of patches (eg. occurrences 7 (Mybyford05), 8 (Mybyford06), 9 (Mybyford07), 28 (Camillo01), 29 (Depot01), 30 (John Dunn01), 31 (Moore01) and 33 (Creyk02). It should be possible to establish quadrats in occurrences 10 (Bella01) 15 (Paul01), 16 (Paul06), 17 (Xlamb02), 19 (Hall01), 20 (Hall03), 22 (Watkins02), 24 (Bancell01, 02), 32 (Kendal01) and 34 (Myyarl03) and compile data useful for statistical analysis

- Occurrences that are a priority for re-mapping include occurrences 7 (Mybyford05), 8 (Mybyforf06), 9 (Mybyford07), 17 (xLamb02), 18 (xLamb01), 23 (myperth03) and 34 (Myyarl03). The boundaries of

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

occurrences 2 (CARD01), 11 (CONNEL PLOT01), 14 (norm01), 15 (PAUL01), 16 (PAUL06), 19 (HALL01), 20 (HALL03), 21 (WATKINS PLOT1), 22 (WATKINS02), 24 (BANCELL01), 25 (Rush02), 31 (MOORE01), 33 (CREYK02) and 35 (Austral Plot02) may also need to be further refined (DEC 2012))

- Occurrence 29 (DEPOT01) and 30 (JOHN DUNN01) - dieback infestation has not been confirmed in occurrence 29, and occurrence 30 is under threat from disease introduction (DEC 2012)
- Occurrence 36 (NETT01) – has been partially cleared for development.
- Occurrence 39 (Rapid01), 40 (Rapid06) and 50 (Fairbridgeiron01) require further analysis regarding the floristic community type
- Occurrence 42 (TALB19) – (quadrats in surrounding bushland, but vegetation condition may not be adequate to support statistical analysis)
- Occurrence 44 (RoeHwy02) - boundary requires re-mapping as recent clearing has occurred for road widening (ArcGIS)

22. Is there an ongoing monitoring program? If so, please describe the extent and length of the program.

Specific monitoring plans and actions are provided for occurrences in section 38.

Condition Classes and Thresholds

23. Do you think condition classes/thresholds apply to this ecological community? If not, give reasons.

The Committee recognises that ecological communities can exist in various condition states. In reaching its decision the Committee uses condition classes and/or thresholds to determine the patches that are included or excluded from the listed ecological community (see the Guidelines for details of the process of determining condition classes). Relevant here is recognition of different states following disturbance and the natural recovery of the occurrence towards a higher condition class.

The condition state thresholds specified for this community to be considered extant examples of the community is Good condition (Bush Forever scales). Vegetation that is in poorer condition than 'Good' is not considered an extant example of the TEC.

The condition class/thresholds of Good condition also apply for recognition of patches under the EPBC Act (DotEE 2016).

24. If so, how much of the community would you describe as in relatively <u>good condition</u>,

i.e. likely to persist into the long-term with minimal management?

Good condition is specified as WA condition categories 'Very Good to Pristine' as below are considered to be in good condition, so therefore ~288 ha or ~98% of known occurrences are considered to be in good condition, and to contain high native plant species diversity, maintain integrity of vegetation structure, and have minimal weed/introduced species cover.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Table 5. Vegetation condition of occurrences of '*Banksia attenuata and/or Eucalyptus marginata woodlands of the eastern side of the Swan Coastal Plain'* for which condition is recorded.

Condition (as per rankings in Keighery 1994 in Government of Western Australia 2000)	**Hectares**
Pristine	0
Excellent	222.35
Very Good	66.13
Good	6.48
Degraded	0.26
Total	295.22

25. What features or variables do you consider to be most valuable for identifying a patch of the ecological community in relatively <u>good condition</u>?

Variables for establishing the highest condition class may include: patch size; connectivity; native plant species composition; diversity and cover (for example in overstorey; mid-shrub and/or understorey layers); recognised faunal values; and cover of weeds or other invasive species.

Moderate to high native plant species diversity, with minimal evidence of disturbance and weed cover are indicators of good condition in this community.

This includes vegetation ranging from 'Pristine' - with no obvious signs of disturbance and native plant species diversity fully retained or almost so, zero or almost so weed cover/abundance, to 'Excellent' - Vegetation structure intact, with disturbance only affecting individual species, weeds are non-aggressive species, and the area contains high native plant species diversity, with less than 10% weed cover, and 'Very Good' - Vegetation structure altered, obvious signs of disturbance eg: from repeated fires, dieback, logging, grazing, aggressive weeds are present, with moderate native plant species diversity, and typical weed cover is less than 20% (5 – 20%) (Government of Western Australia 2000; DotEE 2016).

26. How much of the community would you describe as in relatively <u>medium condition</u>, i.e. likely to persist into the long-term future with management?

Medium condition relates to WA condition category 'Good' condition. There is 6.48 ha or 2% of occurrences are considered to be in medium condition. They have moderate plant species diversity, obvious evidence of disturbance, reduced vegetation structure, and a medium level of weed cover.

This includes vegetation ranging from 'Very Good-Good' and 'Good' - Vegetation structure altered but retains basic vegetation structure or ability to regenerate it, obvious signs of disturbance are present, from activities including partial clearing, dieback, logging, grazing, and very aggressive weeds are present, with low native plant diversity (5 – 50%) (Government of Western Australia 2000; DotEE 2016).

27. Please describe how you would identify areas in <u>medium condition</u> using one or a combination of indicators such as species diversity, structure, remnant size, cover of weeds or other invasive species, etc.

See section 28.

28. How much of the community would you describe as in relatively <u>poor condition</u>, i.e. unlikely to be recoverable with active management?

Poor condition relates to WA condition categories 'Degraded' (and Completely Degraded, however vegetation in this condition is not recorded in the TEC database), so 0.26 ha or 0.1% of known occurrences are considered to be in poor condition, with vegetation containing minimal native flora, presence of aggressive weeds, and evidence

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

of high level disturbance.

This includes vegetation ranging from 'Degraded' - basic vegetation structure severely impacted by disturbance, the vegetation requires intensive management, and disturbance such as partial clearing, dieback, logging and grazing are present, very aggressive weeds are present at high density, and very low native plant species diversity is observed (20 – 70%) to 'Completely Degraded' where vegetation structure is no longer intact and the area is completely or almost completely without native flora. Also referred to also as 'parkland cleared', with very low to no native species diversity (weed species greater than 70%) (Government of Western Australia 2000; DotEE 2016).

29. Please describe how you would identify areas in poor condition using one or a combination of indicators such as species diversity, structure, remnant size, cover of weeds or other invasive species, etc.

See section 30.

Threats

Note: If you plan to identify climate change as a threat to the ecological community, please refer to the Guidelines for information on how this should be addressed.

30. Identify PAST threats to the ecological community indicating whether they are *actual* or *potential*.

The most significant historical threat to the community was clearing for residential areas and related infrastructure. Too frequent fire, dieback caused by *Phytophthora* species, hydrological change, grazing by native and introduced species, weed invasion and damage by recreational users were historically, and continue to be actual and potential future threats to the community.

31. Identify CURRENT threats to the ecological community indicating whether they are *actual* or *potential*.

See above

32. Identify FUTURE threats to the ecological community indicating whether they are *actual* or *potential*.

See above.

As residential areas and related infrastructure increase, the frequency of fires, impact of recreational users, and incidence of illegal rubbish dumping are generally increased. These factors can all lead to degradation of plant communities through increasing weed invasion and alteration of structure, species composition or loss of component taxa.

For each threat describe:

32 a. How the threat has impacted on this ecological community in the past.

- Vegetation clearing: The predominant soil and landform units that support the community are the Forrestfield and Guildford units. These units have been a focus for vegetation clearing in the past are very highly cleared (see section 15b).
  Several occurrences have already been partially cleared relatively recently (for example occurrence 4 – YARL04, an ex-mine site). Areas adjacent to the mapped areas of occurrence 24 (Bancell01 and 02) have been disturbed. Occurrence 36 (NETT01) has been substantially cleared through property development and occurrence 44 (RoeHwy02) further reduced due to road widening.
  Several occurrences are near rural/semi-rural areas and have been long used by recreational users (occurrences 3 (BRICK02), 15 (Paul01), 21 (WATKINS PLOT1), 25 (Rush02)). The use of these areas

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

of bushland for recreational activities can lead to the creation of new tracks or the widening of existing tracks, and the spread of weeds and diseases such as dieback. Many sites have also been used as unofficial BMX and off-road bike tracks and jumps that can also result in vegetation clearing and spread of disease and weeds.
There has been historic clearing around the communications tower at occurrence 16 (PAUL06), and surface drainage may have been altered due to road grading activities around occurrence 21 (WATKINS PLOT1). Depot and power pole dumping are the actual purposes of the reserve that contains occurrence 24 (Bancell01). Almost all occurrences are likely to be affected by firebreak construction and maintenance as they occur in small vegetation remnants. Occurrences 7-9 (ByfordFire, Byford06, Byford07) are railway reserves, therefore railway upgrades and maintenance are likely to disturb vegetation.

- Dieback disease: *Banksia attenuata* has an inferred high susceptibility and there is good evidence of moderate susceptibility to dieback disease caused by *Phytophthora* species in *Eucalyptus marginata.* It is likely that there is a change of structure and composition of Banksia woodlands towards dominance by taxa that are less susceptible to the disease where the disease has had a significant historical impact. The main causes of disease spread that may occur in future are likely to be associated with human activity. The area of mapped Banksia woodlands that coincide with inferred disease areas and those in which the disease has been detected is 19,984ha (2010 GIS data Forest Management Branch DEC). This represents about 3% of the overall extent of the Banksia woodlands as at 2008. This may represent an underestimate as much of the extent of the Banksia woodlands may not have been surveyed for the disease. Occurrences of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands that are known to be infested with dieback disease caused by *Phytophthora* spp. are occurrences 2-3 (CARD01, BRICK02), 12, 14, 15 (BLACKBURN01, norm01, Paul01), 28 (CAMMILLO01), 32 (KENDAL01), 35, 27 and 33 (CREYK02 and CREYK02), 30 (JOHN DUNN01), and 31 (MOORE01). Not all occurrences have been surveyed.

  Phytophthora assessments have been undertaken for several occurrences. In 2018, a full *Phytophthora* dieback interpretation was completed for Cardup Nature Reserve (Figure 2) (DBCA 2018). Approximately 50% of occurrence CARDD01 is infected with dieback. As outlined in the Forrestfield Complex Bushland Management plan (City of Armadale, 2011), approximately 10% of occurrence 12 (BLACKBURN01) (Figure 3), approximately 1% of occurrence 2 (CAMMILLO01) (Figure 4), approximately 50% of occurrence 33 (CREYK02) (Figure 5), 100% of occurrence 30 (JOHN DUNN01) (Figure 6), approximately 10% of occurrence 32 (KENDAL01) (Figure 7), and 100% of occurrence 32 (MOORE01) (Figure 7), are infected with dieback. Other occurrences that are suspected to be dieback infected are; approximately 5% of occurrence 14 (norm01), 5% of occurrence 15 (Paul01) and 10% of occurrence 3 (BRICK02).

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

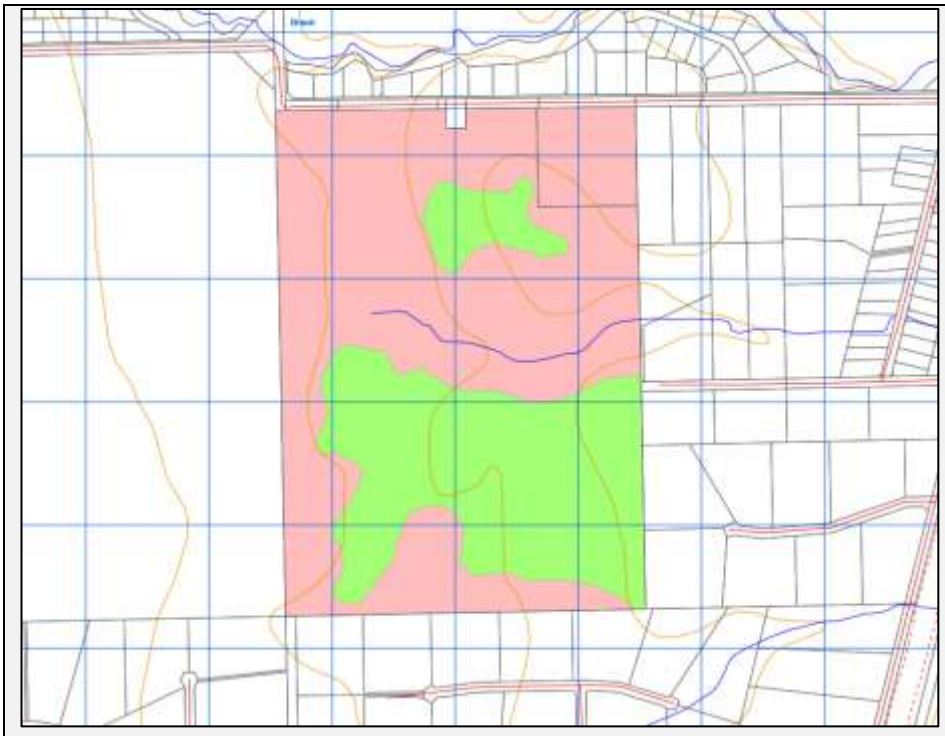


Figure 2. Dieback infection coverage of the Cardup Nature Reserve that contains occurrence CARD01. Pink represents those areas infested, green represents those areas where there was no infestation, and no colour within the perimeter of reserve represents areas not able to be mapped at the time (DBCA 2018).

GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

Figure 3. Dieback infection coverage of the Bob Blackburn Flora Reserve where occurrence 12 (BLACKBURN01) is located. Pink shaded region represents those areas infected (City of Armadale 2011).

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

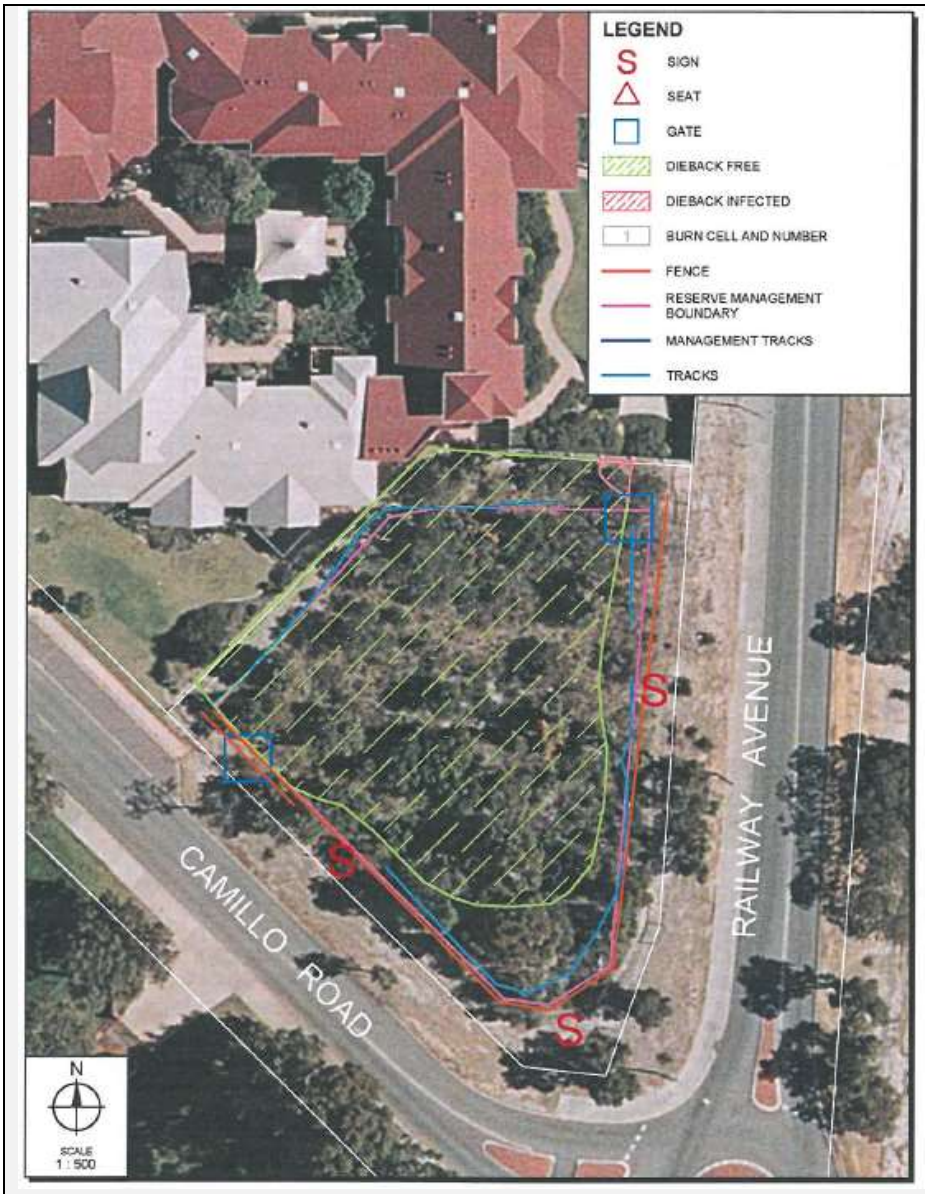


Figure 4. Dieback infection coverage of the Cammillo Road Reserve where occurrence 28 (CAMMILLO1) is located. Pink shaded region represents those areas infected (City of Armadale 2011).

GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

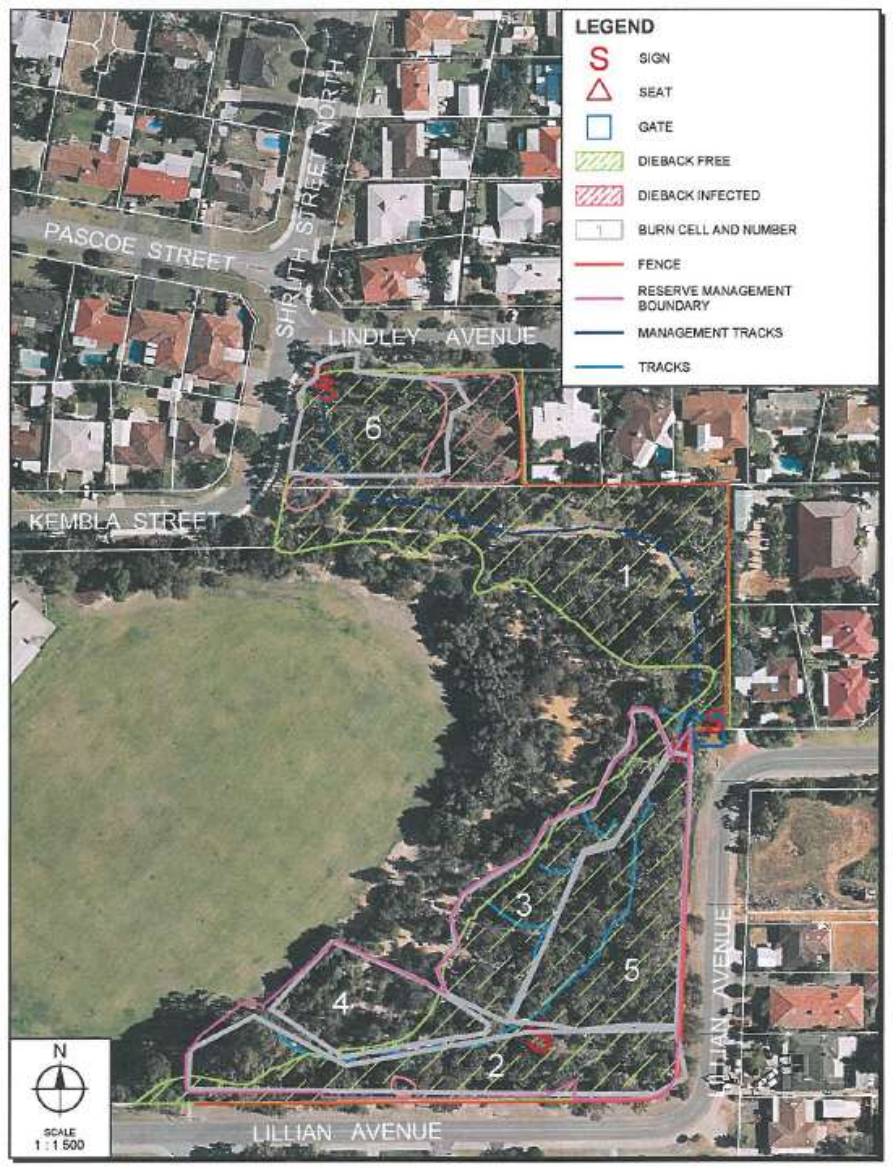


Figure 4. Dieback infection coverage of the Creyk Park Bushland Reserve where occurrence 27 (CREYK01) and 33 (CREYK02) are located. Pink shaded region represents those areas infected (City of Armadale 2011).

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Figure 5. Dieback infection coverage of the John Dunn Bushland Reserve where occurrence 30 (JOHN DUNN01) is located. Pink shaded region represents those areas infected (City of Armadale 2011).

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

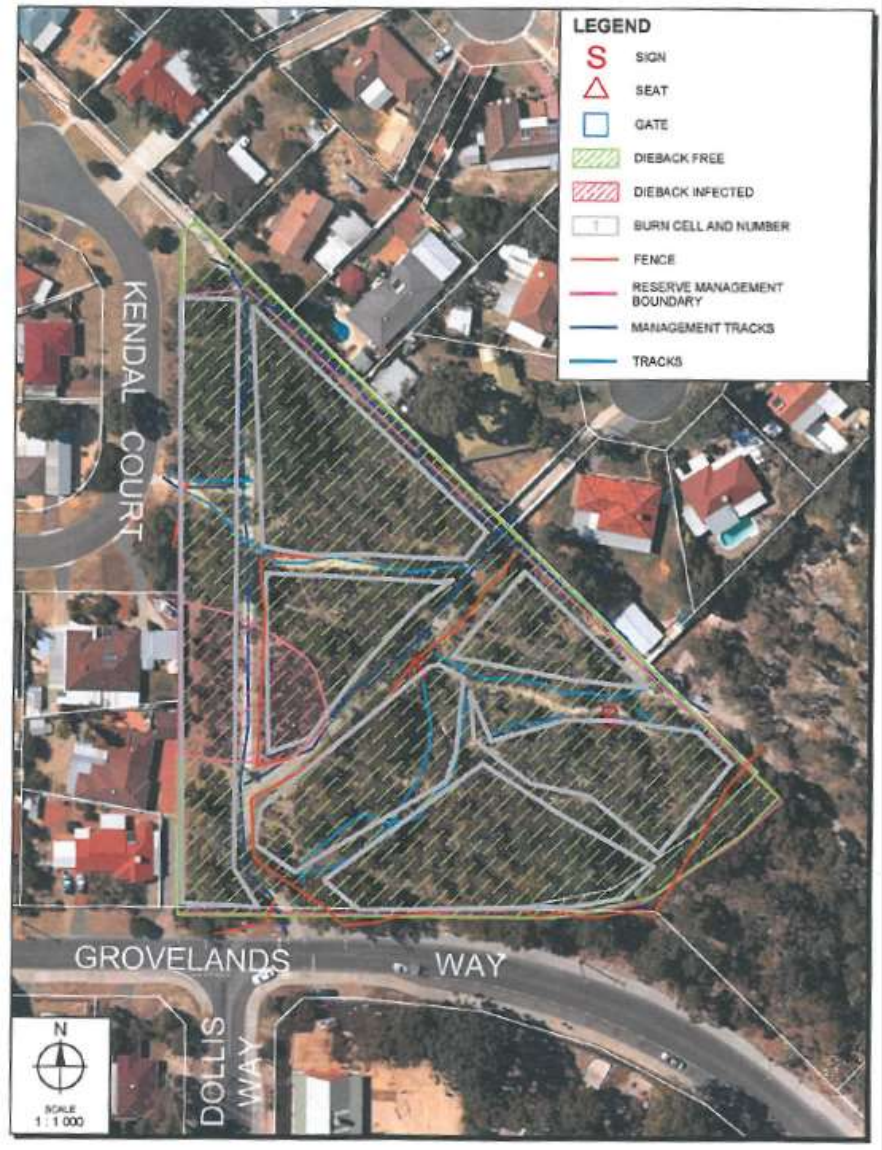


Figure 6. Dieback infection coverage of the Kendal Court Bushland Reserve where occurrence 32 (KENDAL01) is located. Pink shaded region represents those areas infected (City of Armadale 2011).

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Figure 7. Dieback infestation coverage of the Eva and Bill Moore Reserve where occurrence 32 (MOORE01) is located. Pink shaded region represents those areas infected (City of Armadale 2011).

(NB: dieback mapping is only available as PDF documents from original reports).

- Weed invasion: There are tracks throughout most occurrences of the community and weeds have invaded to varying extents along these tracks and from the outer edges of the vegetation. The most common weeds found in occurrences are *Gladiolus caryophyllaceus* and *Watsonia meriana* var. *bulbillifera*.

- Hydrological change and quality: There are no monitoring bores located within occurrences of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands, but there are a series of bores located very close to the community, including some within about 100m. The depth to groundwater in these bores when drilled was between 0.49m to 4m, with a number being within 0-3m. There are three bores

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

located within 100m of occurrences of the community that have monitored groundwater levels over time, however, these measurements were inconsistent over months and were only recorded until 1998. Developments that impact on hydrology – in particular on groundwater levels, may have potential to impact this community through impacts to some key deeper-rooted species such as *Banksia and Eucalyptus.* There are insufficient data for quantitative analysis of the level of this threat however.

Monitoring bore data were available near occurrence 15 (PAUL01). The data indicate groundwater levels are relatively stable but declining at a low rate (Figure 8). The hydrographs (figure 8 and 9) indicate this occurrence does not currently face an immediate threat of total collapse associated with groundwater decline.

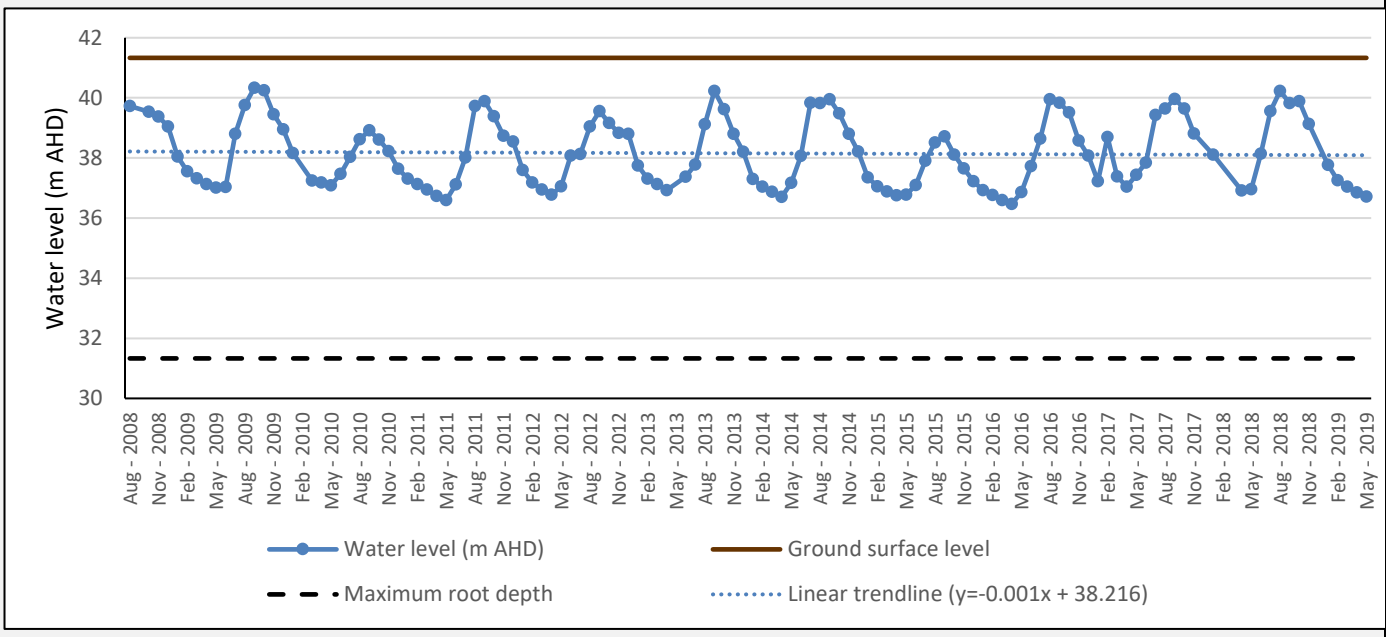


Figure 8. Hydrograph of monitoring bore located 600m south-east of occurrence PAUL01 (15) (site ref: 61410655), sampling the superficial swan aquifer.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

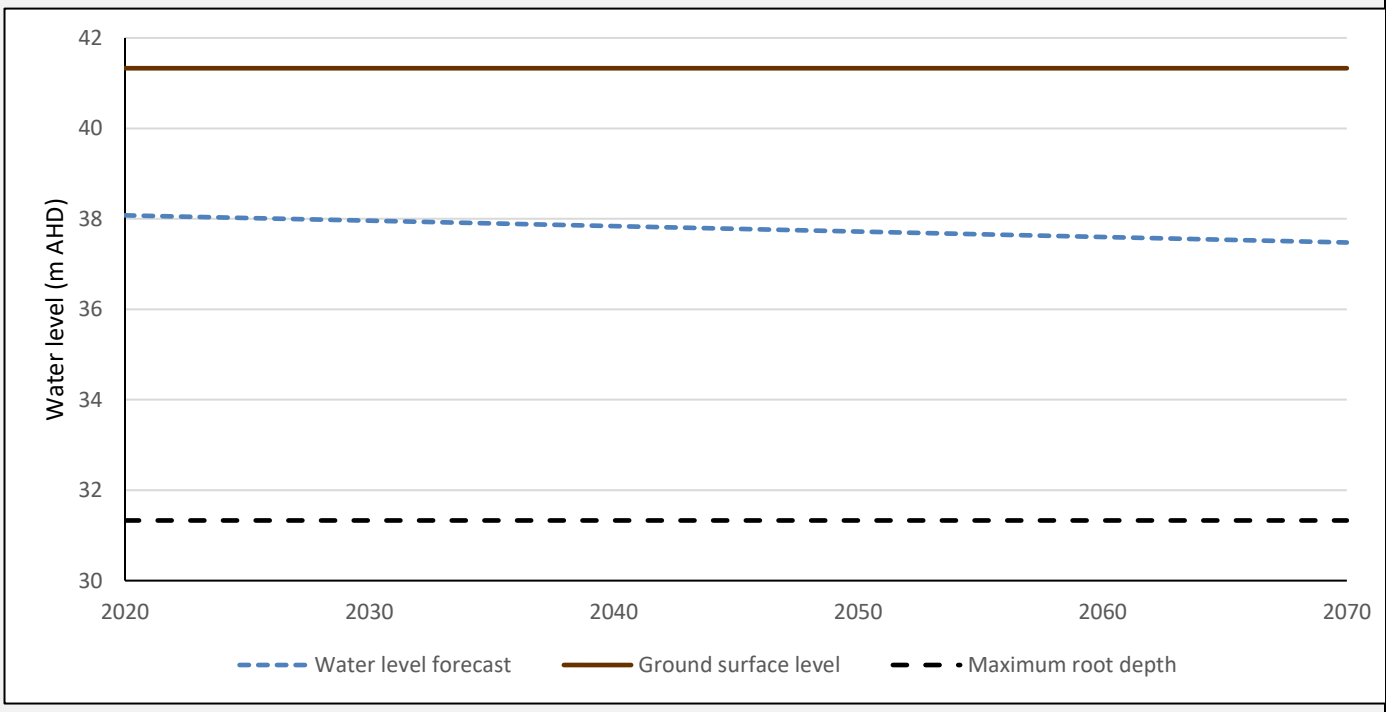


Figure 9. A 50-year forecast of groundwater level decline at occurrences PAUL01 (15) (site ref: 61410655) calculated using the trendline (y=-0.001x + 38.216).

32b. What its expected effects are in the future. Include or reference supporting research or information.

- Clearing: As mentioned in Section 15d, some occurrences are likely to be proposed for development and infrastructure. Further clearing and urbanisation will result in direct impacts to the community and has the potential to spread of weeds and dieback as well as increase recreational impact and fire frequency.
- Weed invasion: Piles of soil scraped from track widening and disused sand pits generally contain high densities of weeds and will continue to act as a weed source.
- Too frequent fire: The risk of fire is generally increased by the presence of grassy weeds in the understorey, as they are likely to be more flammable than many of the original native species in the herb layer. There is evidence of weed invasion as a consequence of historical fire regimes in similar woodlands that have been subject to more frequently burning in recent decades ([redacted] personal observation 2010). In addition, fire frequency is expected to increase with urbanisation and drying and warming climate in the south west of the state.
- Hydrological change: Developments that impact on hydrology, in particular on groundwater levels, have potential to impact this community in future, in particular through impacts to some key deeper-rooted species such as *Banksia and Eucalyptus*.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

32c. Identify whether the threat only affects certain portions or occurrences. Give Details.

Occurrences near urbanised areas are more likely to be affected by a series of threats. Aside from direct land clearing, edge effects along with rubbish dumping and recreational activity increases the risk and frequency of weed invasion and disease. Fire frequency also generally increases with encroachment of urban areas.

33. Identify any natural catastrophic event/s

Explain its likely impact and indicate the likelihood of it occurring (e.g. a drought/fire in the area every 100 years). Catastrophic events are those with a low predictability that are likely to severely affect the ecological community.

Climate models indicate there is high confidence that climate change will result in a harsher fire-weather climate in the future (CSIRO and Australian Government Department of the Environment 2015).
The incidence of damaging bush fires that are more frequent and more intense is likely to increase with increased temperatures and reduced rainfall over the south west of the state. Very hot fires can cause death of Banksias. The levels of stress, and ultimately deaths of the dominant Banksias and other sensitive species in the Banksia woodlands caused by reduced rainfall and availability of groundwater, in combination with increased temperatures and incidence of damaging fires is expected to increase, with impacts being site specific across the range of the Banksia woodlands.

34. Additional biological characteristics

Identify and explain any additional biological characteristics particular to the community or species within it that are threatening to its survival (e.g. low genetic diversity). Identify and explain any models addressing survival or particular features.

Seed production by both Banksias and Eucalypts relies on pollinators (insects, mammals and especially highly mobile birds), and in their absence seed set can be rare or even non-existent.

If the community is further cleared and disturbed, this may increase fragmentation and affect the presence of pollinator species that inhabit the community. Populations of outcrossing plants with a reduced facility for outcrossing due to a failure in delivery of pollinator services will result in decreased seed set, increased inbreeding, and reduced population fitness. It is therefore important that pollinator services are retained.

34a. How does it respond to disturbance?

It is likely that fire regimes such as long periods of fire exclusion, sustained frequent burns, and post-fire grazing (eg by rabbits) will be detrimental to the community. There is evidence of weed invasion as a consequence of historical fire regimes in similar woodlands that have been subject to more frequently burning.

Within occurrence 11 (CONNELL PLOT01), DBCA has established five transects and three quadrats as 'control' and 'test areas' to monitor the effects of fire on species composition in the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands (DEC 2012).

34b. How long does it take to regenerate and/or recover?

Burrows *et al.* (2008) recommend a minimum period between fires that are lethal to fire-sensitive plants (obligate seeders with long juvenile periods) of at least twice the juvenile period of the slowest maturing

Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

species. That is, the juvenile period of plant taxa that are killed by fire and only reproduce from seed can be used as a guide to determine minimum inter-fire intervals. In the case of this community*, Petrophile macrostachya is a* serotinous species that is killed by fire and only reproduces from seed. The juvenile period is 60 months, therefore a minimum inter-fire interval of ten years, and up to 20 years would be recommended for occurrences that contain this species. The juvenile period for other taxa in the community is also quite long. For example, *Lysinema ciliatum* has a juvenile period of 48 months. Other species that are likely to survive fire also have long juvenile periods. These include *Banksia attenuata, Corymbia calophylla* and *Eucalyptus marginata* (all 48 months).

The community's specific responses to other disturbances such as declining groundwater levels is unknown.

Threat Abatement and Recovery

35. Identify key management documentation available for the ecological community, e.g. recovery plans, biodiversity management programmes, or site-specific management plans (e.g. for a reserve).

- Department of Environment and Conservation (2012). Interim Recovery Plan 2012-2017 for *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (Swan Coastal Plain community type 20b – Gibson et al. 1994). Interim Recovery Plan No. 328. Department of Environment and Conservation, Perth City of Armadale (2004).
- City of Armadale (2004). Forrestfield Complex Bushland Management Plan (2004-2009). City of Armadale.
- City of Armadale (2010). Draft Bushland Management Plan for reserves in the City of Armadale. City of Armadale.
- Shire of Serpentine-Jarrahdale (2007). Draft Management Plan for Serpentine Sports Reserve. Unpublished Report, Perth, Western Australia.
- Shire of Serpentine-Jarrahdale (2009). Draft Brickwood Reserve and Briggs Park Management Plan. Unpublished Report, Perth, Western Australia.
- Serpentine Jarrahdale Shire (2016). Brickwood Reserve and Briggs Park Management Plan. Shire of Serpentine Jarrahdale, Western Australia.

36. Give an overview of how threats are being/potentially abated and other recovery actions underway and/or proposed. Identify who is undertaking these activities and how successful the activities have been to date.

- Occurrence 2 (CARD01) - Managed for conservation with fence repairs and weed control.
- Occurrence 3 (BRICK02) - Management plan in place (Shire of Serpentine-Jarrahdale, 2016). Includes: fencing, TEC signage, weed control, fire management plan and dieback assessment and mapping.
- Occurrences 4 and 34 (YARL04 and MYYARL03) – Historical rubbish dumping sites, however, Reserve 31900 is currently being rehabilitated by the Shire of Harvey and the shire plans to continue rehabilitation of the tip site, including fencing and weed management (Western Australian Local Government Authority (WALGA) 2011).
- Occurrence 5 (BURNRD01) – Annual weed monitoring and management by DBCA.
- Occurrence 7 (ByfordFire) – Fire response monitoring quadrat established by Shire of Serpentine-Jarrahdale.
- Occurrence 10 (BELLA01) - is within Bella Cumming Reserve that has been fenced.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

- Occurrence 11 (CONNELL_PLOT01) - DBCA has established five transects and three quadrats as 'control' and 'test areas' to monitor the effects of fire on species composition in the community.
- Occurrence 12 (BLACKBURN01) - The local friends group have organised fencing for part of the reserve, sign installation and walk trails. A management plan has been drafted for a suite of bushland areas on the Ridge Hill Shelf, including this one (City of Armadale 2004) and the bushland has been inspected and mapped for *Phytophthora* species. The City of Armadale monitors weeds every five years and annually prepares a weed control contract for the site. Over the past five years, weed control has been focussed on *Ehrharta calycina* (veldt grass), *Eragrostis curvula* (African love grass) and woody eastern states species. The City of Armadale recently changed the purposes of the bushland portion of this reserve from "C Class Reserves for Recreation" to "C Class Reserves for Passive Recreation and Conservation" to reflect its current purpose.
- Occurrence 14 (norm01) – bushland has been fenced.
- Occurrence 15 and 16 (PAUL01 and PAUL06) - occurrence 15 occurs on the western side of the bushland area in Paul Robinson Park for which a draft management plan exists (Shire of Serpentine Jarrahdale 2007). The reserve occurs adjacent to a horse and pony club and a golf course. The bushland is fenced however horse riders do utilise the site.
- Occurrences 17 and 18 (xLamb02 and xLamb01) - weed mapping and control of *Watsonia* were conducted in 2009 by DBCA's Swan Coastal District.
- Occurrence 20 (HALL03) – occurrence is fenced.
- Occurrences 21 and 22 (WATKINS PLOT1 and WATKINS02) - *Watsonia* control and monitoring were undertaken in 2009 and 2010 by DBCA's Urban Nature group. Fenced off.
- Occurrence 23 (myperth03) – dieback surveys supervised by DBCA. Current conservation management actions undertaken by Perth Airport in these occurrences are pest control, namely for rabbits and weeds, and revegetation. Revegetation has been through planting of locally provenance stock, but direct seeding was the method used in the past ([redacted][1] personal communication 2011).
- Occurrence 25 (Rush02) - a large area of the bushland has been mapped as being infested with dieback ([redacted][2] personal communication 2010). The bushland is fenced, weed mapping has been undertaken, dieback management plans are in place.
- Occurrences 27 and 33 (CREYK01 and CREYK02) - the City of Armadale mapped dieback in the area and the bushland is treated on a four-year rotation phosphite program. The City of Armadale monitors weeds every five years, and annually prepares a weed control contract for the site. Recent mapping located a number of new weed species and these are now targeted for weed control ([redacted] personal communication).
- Occurrence 28 CAMMILLO01) - the City of Armadale monitors weeds with GPS mapping every five years and annually prepares a weed control contract for this bushland areas They recently changed the reserve purposes from "C Class Reserves for Recreation" to "C Class Reserves for Passive Recreation and Conservation".
- Occurrence 29 (DEPOT01) - the City of Armadale monitors weeds with GPS mapping every five years and annually prepares a weed control contract for this bushland area.
- Occurrence 30 (JOHN DUNN01) – the City of Armadale monitors weeds with GPS mapping every five years and annually prepares a weed control contract for this bushland area.
- Occurrence 31 (MOORE01) – heavily impacted by fire and dieback and is now dominated by grass weeds. The control of grass weeds in the reserve is a priority due to their invasive nature and contribution to fire hazard. The draft management plan (City of Armadale 2010) recommends that "Due to the extent of weed proliferation and the impact of dieback on the *Banksia* canopy, it is recommended that grass weed control efforts are coupled with a revegetation program using seed sourced from the same vegetation type". The City of Armadale has mapped Cammillo Rd Bushland Reserve for dieback

[1] Ms Kobi Bradshaw: Previously Perth Airport Pty Ltd
[2] Mr Wayne van Lieven: Previously City of Gosnells

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

and inferred infestation in the other reserves. Phosphite treatment is undertaken in reserves to help reduce the impact of dieback.

- Occurrence 32 (KENDAL01) - the City of Armadale monitors weeds with GPS mapping every five years and annually prepares a weed control contract for the area. *Euphorbia terracina*, which is a Declared Plant under the *Agricultural and Related Resources Protection Act 1976* has been located in the reserve and control of this weed is a priority ([redacted] personal communication 2010). According to the draft management plan (City of Armadale 2010) The City of Armadale recently altered the reserve purposes from "C Class Reserves for Recreation" to "C Class Reserves for Passive Recreation and Conservation" to ensure that the conservation values were reflected in the purpose. Approximately 10% of the occurrence is infested with *Phytophthora*. The City of Armadale has mapped the reserve for dieback and treats the area on a four-year rotation phosphite program. Groveland's Primary School occurs adjacent to the occurrence and the school carries out injection of phosphite to help combat dieback disease.
- Occurrence 41 (AITKEN03) - good condition fence along east border to private property
- Occurrence 45 (AITKEN01) – good condition fence along eastern border to private property
- Occurrence 46 (PETERSON01) - farm fencing on northern side with fire access tracks slashed, sprayed and ploughed Has soil, concrete, limestone and mulched pathways.

37. What portion of the current extent of the ecological community is protected in a reserve set aside for conservation purposes, and what proportions are private land, or other tenure? Give details including the name of the reserves, and the extent the ecological community is protected within these reserves.

The community is currently known from a total of 296 hectares. Many occurrences are within sites that are recommended for conservation and are included in Bush Forever, but many recommendations held in Bush Forever have not yet been implemented. Occurrences 2-3, 7-23, 35, 47 & 49 making up approximately 70% (208ha) of the total area of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands and are within Bush Forever sites. Currently, there are approximately 185 hectares (62%) of the community found on public lands. Of this, about 80 hectares are managed by DBCA (27%), and of those 70 hectares (23%) are in nature reserves. About 105 hectares (35%) are on lands under the care, control and management of other authorities. Another 113 hectares (38%) of the community occur on private land.

Occurrences of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands are found within the local government authorities of the City of Swan, Shire of Serpentine-Jarrahdale, Shire of Harvey, City of Armadale, City of Gosnells and the Shire of Waroona. Other land managers include Department of Planning Heritage and Lands (DPHL), Main Roads WA, the Commonwealth government, Western Power, the Perth Transport Authority and private companies. Some lands held by DPHL are intended to be transferred to DBCA management.

- Occurrence 2 (Card01) is in Cardup Nature Reserve vested with the Conservation and Parks Commission.
- Occurrence 3 (Brick02) is in the Brickwood reserve (Bush Forever).
- Occurrences 4 and 34 (Yarl04 and Myyarl03) occur on two Crown reserves.
- Occurrence 5 (Burnrd01) occurs on an unnamed reserve proposed as an A class nature reserve.
- Occurrences 7, 8 and 9 (Mybyford05, 06 and 07) are located on Soldiers Road Reserve and adjacent rail reserve. Occurrences 8 and 9 occur within Bush Forever site 'Byford to Serpentine Rail/Road Reserves and Adjacent Bushland'. Approximately half of occurrence 7 occurs in the Bush Forever site.
- Occurrence 10 (Bella01) is within Bella Cumming Reserve.
- Occurrence 11 (Connell) covers most of Bush Forever site Connell Avenue Bushland, Kelmscott.

Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

- Occurrence 12 (Blackburn01 and 02) occurs within the Bush Forever site Bob Blackburn Reserve Bushland, Armadale and is managed by the City of Armadale for conservation.
- Occurrence 14 (Norm01, 03 and 07) occur on freehold land in Whitby. Bush Forever recommends the site be set aside as a conservation park or nature reserve.
- Occurrence 15 and 16 (Paul01 and 06) occur in the Bush Forever site Lambkin Reserve and bushland in Paul Robinson Park/ Serpentine Golf Course. Occurrence 15 occurs on the western side of the bushland area in Paul Robinson Park and occurrence 16 occurs mostly on rail reserve but also extends into some Unallocated Crown Land (UCL) and road reserves.
- Occurrence 17 and 18 (xLamb02 and xLamb01) occur within Lambkin Nature Reserve and Road Reserves.
- Occurrences 19 and 20 (Hall01 and 03) occupy a portion of nature reserve 46587 and the neighbouring road reserve. The occurrence falls within Bush Forever site Byford to Serpentine Rail/Road Reserves and Adjacent Bushland.
- Occurrences 21 and 22 (Watkins01 and 02) occur within Bush Forever site Mundijong and Watkins Road Bushland, Mundijong/Peel Estate. The occurrences are almost all within reserves managed for conservation of flora and fauna, with small areas on private land and road reserves.
- Occurrence 23 (Perth03 and Myperth03) occurs within the Bush Forever site Perth Airport and Adjacent Bushland which is Commonwealth land leased by Perth Airport Pty Ltd.
- Occurrence 24 (Bancell01, 02) is adjacent to the Wagerup refinery and occurs over two Crown reserves.
- Occurrences 27 and 33 (Creyk01 and 02) are within Creyk Park Reserve which is adjacent to a sports oval and housing.
- Occurrence 28 (CAMMILLO01) occurs in Cammillo reserve in Kelmscott is adjacent to Kelmscott farm school.
- Occurrence 29 (DEPOT01) occurs on a depot site surrounded by industrial land.
- Occurrence 30 (JOHN DUNN01) occurs in John Dunn Memorial Park reserve.
- Occurrence 31 (MOORE 01) occurs in Eva and Bill Moore Reserve.
- Occurrence 32 (Kendal01) occurs partly on freehold land owned by a private company who manage the adjacent retirement village. The rest of the occurrence is on freehold or Crown reserve managed by the City of Armadale for conservation
- Occurrence 35 (Austral02) occurs on privately owned freehold land in the Bush Forever site Cardup Brook Bushland, Cardup/Peel Estate.
- Occurrence 41 (AITKEN03) occurs on a reserve utilised by local residents on the Corner of Aitken St & South West Hwy, Yarloop, NW block of vegetation.
- Occurrence 42 (TALB19) occurs on DBCA land, near the intersection of Farrall Road and Talbot Road, Stratton
- Occurrence 45 (AITKEN01) occurs on a reserve utilised by local residents on the corner of Aitken St & South West Hwy, Yarloop, NE block of vegetation on a reserve utilised by residents. Adjacent lands are small rural holdings.
- Occurrence 46 (PETERSON01) occurs within Crown Reserve 16804, Peterson Road, Warrawarrup, Shire of Harvey.
- Occurrence 47 (Austral Plot01) occurs on privately owned freehold land in a Bush Forever site - Cardup Brook Bushland, Cardup/Peel Estate.
- Occurrence 48 (CONNELL_PLOT2) occurs on DPHL land in Kelmscott.
- Occurrence 49 (WATSONIA RD PLOT1) occurs in eastern part of Maida Vale Reserve.

Some local government reserves are used for purposes other than conservation or passive recreation, such as occurrence 4 (old rubbish disposal site and sandpit) and occurrence 24 (timber, gravel and pole dumping).

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

37a. Which of the reserves are actively managed?
Note which, if any, reserves have management plans and if they are being implemented.

- In 2007, the Yarloop occurrence (occurrence 4 - YARL04) under the management of the Shire of Harvey was fenced and gated to restrict access. This is expected to help prevent the spread of dieback disease caused by *Phytophthora* spp. It is intended that the location and extent of weeds will be mapped, and the reserve will then be included in the weed control program.

- A management plan that details recovery actions for all of reserves managed by the City of Armadale is in place. The current plan - City of Armadale (2004), is being updated (City of Armadale 2010). The City of Armadale currently undertakes weed mapping and control as well as dieback mapping and treatment in all reserves containing *Banksia attenuata* and/or *Eucalyptus marginata* woodlands. Fire management objectives and approaches are in place for all reserves managed by the City of Armadale and the Fire and Emergency Services Authority of WA (FESA) is responsible for fire-fighting response.

- Currently, the City of Gosnells manages weeds and dieback in lots 9, 10, 11, 12 and 3 Rushton and Quarry Roads, Martin. There is a weed spray program in place for *Echium plantagineum* and grass weeds such as *Ehrharta calycina*. Regular dieback mapping is carried out, and phosphite foliar spraying and stem injection are planned. The City of Gosnells is also completing a detailed management plan which will make recommendations on access, weed control, fire management, revegetation and dieback ([redacted][3] personal communication 2011).

37b. Give details of any other forms of protection, such as conservation covenants, and whether the protection mechanisms are permanent.

See section 38 above

38. Indigenous interests
Is the nominated ecological community or parts thereof known to occur on any culturally significant sites? If so comment on any issues with respect to aboriginal interests, in particular with regard to management of the ecological community.

- Occurrence 4 (YARL04) is an Aboriginal site with artefact scatters nearby.
- Occurrence 11 (CONNELL_PLOT01) is an Aboriginal Site with artefact scatters and a camp
- Occurrence 15 and 16 (PAU01 and PAUL06) are an Aboriginal site (ceremonial and mythological)
- Occurrence 17 and 18 (xLamb02 and xLamb01) are an Aboriginal site (ceremonial and mythological)
- Occurrence 19 and 20 (Hall01 and Hall03) are an Aboriginal site (ceremonial and mythological)
- Occurrence 23 (DEPOT01) is an Aboriginal site (Bridge camp)
- Occurrence 34 (MYYARL03) has an Aboriginal site within approx. 20m with artefact scatters
- Occurrence 35 (Austral plot02) is an Aboriginal site with artefact scatters

38 a. Native Title

[3] Mr Toby Rees: City of Gosnells

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Do Native Title or Indigenous Protected Areas apply to any parts of the community? If so comment on any issues with respect to exclusive possession and rights to plants and animals, in particular with regard to management of the ecological community.

FCT20b occurs within the following Native Titles;

- GNAALA KARLA BOOJA - GNAALA KARLA BOOJA INDIGENOUS LAND USE AGREEMENT
- WHADJUK PEOPLE - WHADJUK PEOPLE INDIGENOUS LAND USE AGREEMENT

39. Give details of recovery actions that are or could be carried out at the local and regional level, e.g. develop and implement management plan for the control of specific weed species (regional), undertake weeding of known sites (local).

- Occurrences should be monitored at least every five years. Boundaries can be determined from current aerial photographs and ground-truthing.
- Careful use of herbicides is the preferred method of maintenance of firebreaks to minimise soil movement and risk of dieback spread or intensification in the community.
- Weed control plans should be developed and implemented. The highest priority will be to control weeds in the early stages of invasion that pose the greatest threat to the community, for example some perennial grass weeds and *Gladiolus caryophyllaceus*.
- Tracks excess to requirements should be closed and left to revegetate naturally, or revegetation facilitated through seeding or brushing as necessary.
- Occurrences will require baseline and ongoing monitoring of the extent, impact and boundaries of dieback to determine if there are priority areas for treatment. Priority areas for dieback treatment in the community should be determined from the Dieback Protocol (Dieback Working Group 2000). Once dieback disease is detected, the dieback front should be monitored at least every five years in summer and flagging marking the front replaced regularly. Additional quadrat or transect data would provide useful monitoring data.
- Appropriate fencing for all occurrences should be designed to permit authorised vehicle access for operational purposes, allow foot access, and protect rehabilitation areas in high usage zones where necessary.
- To reduce the likelihood of accidental destruction appropriate authorities should mark occurrences the community on roadsides, tracks and firebreaks, with the same pegs as used to mark threatened flora. These should be placed about 50 m either side of the boundaries of the community to provide a protective buffer.

40. Is there an existing support network for the ecological community that facilitates recovery? e.g. an active Landcare group, Conservation Management Network.

- **City of Armadale** undertake weed, dieback and fire management in all their reserves.
- **City of Gosnells** undertake weed and dieback management in occurrences on Rushton and Quarry Roads, Martin
- **DBCAs Swan Coastal District and DBCA's Urban Nature group** have completed weed management work at Watkins Rd Nature Reserve (WATKINS PLOT1 and WATKINS02)
- **The Shire of Harvey** fenced and gated the Yarloop occurrence (YARL04) to restrict access.
- **The Shire of Serpentine-Jarrahadale** has a management plan in place for Brickwood Reserve and Briggs Park
- **City of Kalamunda** undertakes weed control in the community.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

41. Describe methods for identifying the ecological community including when to conduct surveys.

For example, season, time of day, weather conditions; length, intensity and pattern of search effort; and limitations and expert acceptance; recommended methods; survey-effort guide. Include references.

Sampling protocols and timelines best used for identifying and conducting surveys in this ecological community are identified in the EPBC Banksia Woodland Conservation Advice (2016) and include: "At least one hour per plot in early to mid-spring and a second survey in late spring may be required to detect the majority of species. Sampling should be based upon plot sizes of at least 100 m² (= 0.01 ha, 10m x 10m, or an appropriate shape of equivalent size). However, larger and more variable areas of vegetation will need more samples or plots to assess a site accurately…consideration must be given to the role that season and disturbance history may play in an assessment. For example, flowering may be necessary to identify some shrub species and active growth will indicate population sizes of annual weeds. Immediately after a fire one or more vegetation layers, or groups of species (e.g. obligate seeders), may not be evident for a time. The cover of native plants also varies between seasons and between years in response to variability in environmental conditions, and also with respect to cycles of recurring disturbance such as fire. Timing of surveys should therefore allow for a reasonable interval after a disturbance (natural or human-induced) to allow for regeneration, and be timed to enable component species to be detected and identified. For instance, surveys at least one-year post fire may be required to assess a site against the key diagnostic characteristics and minimum condition thresholds."

Taxonomy should be reconciled between datasets to current or historic species names. The species data from quadrats established should then be compared and analysed against quadrat data held in Gibson *et al*. (1994) or Keighery *et al*. (2012) using appropriate statistical techniques and parameters (eg PATN, Primer or PC-ORD). The reporting should note the closest matches for FCTs present at the new site.

42. Are there other any aspects relating to the survival of this ecological community that you would like to address?

No.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Section 3 - Justification for this nomination

In order for the nomination to be considered further, one or preferably more of the following criteria need to be fulfilled and substantiated. A clear case for why the ecological community is eligible for listing under the criteria is required, including evidence as to how it meets the requirements for listing under a particular listing category, e.g. 'David *et al*. (1999) finding of 95% decline in geographic distribution suggests it should be listed as critically endangered'. The type of data available will determine which criteria will be used to justify the application of a listing category.
At least one criterion must trigger the thresholds of a listing category as indicated in the Attachment. Criteria may be of different levels of listing category e.g. Criterion 1 = CR and Criterion 3 = VU.

43. Provide data that demonstrates why the ecological community meets at least one of the following criteria for the nominated listing category.

Please use data provided in previous sections to demonstrate how it specifically meets at least one of the following criteria. Advice on how to interpret the listing criteria is in Attachment A. Provide a response for every sub-criterion.

Criterion A: Reduction in geographic distribution.

Criterion A	
☐ CR ☒ EN ☐ VU ☐ not eligible	☐ **A1** ☐ **A2a** ☐ **A2b** ☒ **A3**

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Justification for assessment under Criterion A:

- For criteria A and B, the ecosystem was assumed to collapse when the mapped distribution declines to zero.
- As stated in question 15, area calculations from digitised GIS mapping based on the Vegetation Survey of WA (Beard and Sprenger 1984) estimate the total loss of Banksia Woodlands on the Swan Coastal Plain is approximately 52%. As the timing of clearing of the Banksia woodlands is not known, it is conservatively estimated to have occurred since 1750. The estimate meets the criterion for ≥50% loss since 1750 to meet VU under A3.
- The extent of loss in a radius of 20 km around central Perth is much greater and is estimated to be greater than 90% with less than 10% remaining as intact vegetation.
- The reduction in extent through clearing of native vegetation on the soil and landform units that support FCT20b is assumed to be indicative of the level of clearing of FCT20b. The community occurs on Forrestfield unit, Guildford unit, at the continuum of Guildford with Forrestfield, and on the Southern River unit. The extent to which the vegetation of these soil and landform units has declined since pre-industrialisation ranges from 82% to 95% (DBCA 2019). This estimate is consistent with the >90% range contraction estimated for FCT20b in Gibson *et al*. (1994). Their estimate was based on the clearing of land and geomorphic units that support the community.
- As the timing of clearing of vegetation in the soil and landform units is not known, it is conservatively estimated to have occurred since 1750.
- Based on clearing of the soil and landform units that support the community, the distribution decline is estimated to be 82%-95% (Southern River - 82%, Forrestfield complex - 88%, Guildford unit -95%). This is partly above the ≥90% threshold to meet CR under A3 and is above the threshold of ≥70% reduction in geographic distribution since 1750 to meet EN.
- The community plausibly meets criteria for CR or EN based on decline in soil and landform units. It also plausibly meets VU under A3 based on decline of Swan Coastal Plain Banksia woodlands overall**.**
- Based on clearing of the relevant soil and landform units, the community is conservatively considered to best meet EN under A3.
- **Endangered is considered the most plausible rank under criterion A3.**

Criterion B: Restricted geographic distribution.

Criterion B	
☒ CR ☒ EN ☐ VU ☐ not eligible	☒ **B1** (specify at least one of the following) ☐ **a)(i)** ☐ **a)(ii)** ☒ **a)(iii)** ☐ **b)** ☐ **c); CR** ☒ **B2** (specify at least one of the following) ☐ **a)(i)** ☐ **a)(ii)** ☒ **a)(iii)** ☐ **b)** ☐ **c); EN** ☐ **B3** (only for Vulnerable Listing)

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Justification for assessment under Criterion B:

- B1: EOO is 537km^2 (≤ 2,000km – threshold for CR). The community's EEO is less that the 2,000km^2 threshold for rank CR. Community meets threshold for rank CR under criterion part B1.
- B1a(iii), B2a(iii): A measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem is from dieback surveys of the community (see figures 2-7).
- B1 b): Main threatening processes are land clearing, weed invasion, too frequent fire, disease, grazing by introduced herbivores and hydrological change, however, there is inadequate evidence of these threats being non-trivial.
- B1 c) Community is considered to occur at 35 threat defined locations, based on the identification of 35 clusters of the community that may be subject to similar threats such as fires that affect a particular bushland location. The community does not meet VU (≤10 threat-defined locations).
- B2: AOO. Community covers 11 grid cells. The community meets EN under criterion B2 for which the AOO threshold is ≤20 grid cells (threshold for CR ≤2 grid cells) (b and c of B1 are the same for B2)
- B3: community is considered to consist of 35 threat defined locations, based on the identification of 35 clusters of the community that may be subject to similar threats such as fires that may affect a particular bushland location. Does not meet VU under criterion B3, as community occurs at more than 5 threat defined locations.

Meets criteria for Critically Endangered B1a(iii). Meets Endangered under B2a(iii).

Criterion C: Environmental degradation based on change in an abiotic variable.

Criterion C	
☐ CR ☐ EN ☐ VU ☒ not eligible	☐ **C1** ☐ **C2** ☐ **C3**

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

Justification for assessment under Criterion C:

- Hydrological change in the form of groundwater decline is an abiotic variable that is potentially a significant threat to the community.
- For criterion C, the assessment of decline in abiotic processes focussed on hydrological change using data on the depth of the water tables. It was assumed conservatively that the community would collapse if the water table depth fell to about 10m below ground surface based on the maximum water depth accessed by deep rooted phreatophytic taxa in nearby areas (Froend and Loomes 2006), and observations that the vigour of canopies declined in groundwater dependent trees in association with declining water table levels (Froend et al. 2004).
- The relatively stable groundwater level at occurrence PAUL01 (representative of 1.3% of the community), is projected to decline less than 1m groundwater over the next 50 years, calculated from the previous trendline in Figures 8 and 9. Based on current and future forecasted groundwater levels at this location, it is predicted that within the next 50 years there will be a 7% severity in relation to total collapse assuming groundwater levels decline at the current calculated rate (y=-0.001x + 38.216).
- Based on the limited data available regarding current and future predictions of groundwater levels in the community, the community does not meet the minimum thresholds of ≥30% of the extent with severity ≥30% to meet VU under C2.

- **Insufficient evidence to indicate that the community meets criterion C.**

Criterion D: Disruption of biotic processes or interactions based on change in a biotic variable.

Criterion D	
☐ CR ☐ EN ☐ VU ☒ not eligible	☐ **D1** ☐ **D2** ☐ **D3**

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

Justification for assessment under Criterion D:

- Dieback disease caused by *Phytophthora* species is a significant biotic threat to the community.
- For criterion D, collapse of this community is defined as 100% loss of dieback sensitive species in the community. It is assumed that this would result from very severe infestation and impacts of disease caused by *Phytophthora* species.
- Based on dieback surveys completed for 10 occurrences, a minimum of approximately 35ha (12%) of the community is infected with the disease (Section 34).
- The impacts of the disease in southwestern Australia have been observed since 1921 (Dell *et al*. (2005).
- It is assumed that the impacts of the disease have occurred since 1750, as there are no data to indicate the timing of the impact in this community. A minimum severity of ≥30%, with an extent of ≥80% would be required to be affected by the disease to meet the minimum thresholds for VU under D3.
- Although there are dieback maps that encompass the community, there are inadequate systematic collected quantitative data about the impacts of dieback on individual sensitive species and insufficient evidence to determine the total loss of susceptible native species lost through dieback infection in this community to support assessment of the community against criterion D.
- There are inadequate quantitative data to indicate the community meets the minimum proportion of the extent (≥30%) or proportional severity of disruption of abiotic processes (≥30%) over any 50-year period to meet criteria D1 or D2.
- D3: There are inadequate quantitative data to indicate if the community meets the minimum proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since 1750.
- **Insufficient evidence to indicate if the community meets criterion D.**

Criterion E: Quantitative analysis that estimates the probability of ecosystem collapse.

Criterion E	
☐ CR ☐ EN ☐ VU ☒ not eligible	

Justification for assessment under Criterion E:

No quantitative analysis of probability of collapse has been completed, so the community is not known to meet criterion E.

Section 4 – References/Standard of Scientific Evidence/Critical habitat

Note: The opinion of appropriate scientific experts may be cited (with their approval) in support of a nomination. If this is done the names of the experts, their qualifications and full contact details must also be provided in the reference list below. Harvard style of referencing is preferred.

44. Please provide copies of key documentation/references used in the nomination.

Abbott, I. and Burrows, N. (eds) (2003). *Fire in ecosystems of south-west Western Australia: impacts and management.* Bachhuys Publishers, Leiden, Netherlands.

Beard, J.S.; Sprenger, B.S. (1984). Geographical Data from the Vegetation Survey of Western Australia. Vegetation Survey of Western Australia. Occasional Paper No 2. Vegmap Publications, Applecross.

Burrows N.D. (2008). Linking fire ecology and fire management in south-west Australian forest landscapes. *Forest Ecology and Management*. 255: 2394–2406.

Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

Burrows N.D., Wardell-Johnston, G. and Ward, G. (2008). Post fire juvenile periods of plants in south-west Australian forests and implications for fire management. *Journal of the Royal Society of Western Australia*. 91: 163-174.

Churchward H.M and McArthur, W.M. (1978) Darling System Landform and Soils. Department of Conservation and Environment. Perth, Western Australia.

Churchward, H.M. and McArthur, W.M. (1980). Landforms and Soils of the Darling System. In: Atlas of Natural Resources, Darling System, Western Australia. Department of Conservation and Environment, Western Australia.

City of Armadale (2004). Forrestfield Complex Bushland Management Plan (2004-2009). City of Armadale.

City of Armadale (2011). Draft Bushland Management Plan for reserves in the City of Armadale. City of Armadale.

CSIRO and Australian Government Department of the Environment Southern and south-western flatlands cluster report (2015) available at url: https://www.climatechangeinaustralia.gov.au/media/ccia/2.1.6/cms_page_media/172/SSWFLATLANDS_CLUSTER_REPORT.pdf

DEC (1992) Policy Statement No. 44 *Wildlife Management Programs*. Perth, Western Australia.

DEC (1994) Policy Statement No. 50 Setting Priorities for the Conservation of Western Australia's Threatened Flora and Fauna. Perth, Western Australia.

Dell, B., Harding, G. and Vear, K. (2005). History of *Phytophthora cinnamomi* management in Western Australia. In: Proceedings 6th National Conference of the Australian Forest History Society Inc, Michael Calver *et al*. (eds) Millpress, Rotterdam.

Department of Biodiversity, Conservation and Attractions (2018). *Phytophthora dieback report of: Cardup Nature Reserve*. Forest Management Branch, DBCA, Perth, Western Australia.

Department of Biodiversity, Conservation and Attractions (2019). 2018 South West Vegetation Complex Statistics. Available from url: https://catalogue.data.wa.gov.au/dataset/dbca/resource/3d067960-2896-42fd-ba52-1aa46b2edf13

Department of Conservation and Environment (1980). Atlas of Natural Resources, Darling System, Western Australia. DCE, Perth. Department of Environmental Protection (1996). *System 6 update program unpublished site and area records and analysis*. Environmental Protection Authority, Perth, Western Australia.

Department of Environment and Conservation (2012). Interim Recovery Plan 2012-2017 for *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (Swan Coastal Plain community type 20b – Gibson *et al*. 1994). Interim Recovery Plan No. 328. Department of Environment and Conservation, Perth.

Department of Parks and Wildlife (2016). *Banksia attenuata* woodlands over species rich dense shrublands (Swan Coastal Plain community type 20a – Gibson *et al.* 1994). Interim Recovery Plan No. 359. Parks and Wildlife, Kensington, Western Australia.

Dieback Working Group (2000). Managing Phytophthora dieback. Guidelines for Local Government. Dieback Working Group. Perth.

Froend, R., Loomes, R. Horwitz, P., Bertuch, M., Storey, A. and Bamford, M. (2004). Study of Ecological Water Requirements on the Gnangara and Jandakot Mounds under Section 46 of the Environmental Protection Act. Task 2: Determination of Ecological Water Requirements. Report prepared for the Water and Rivers Commission by Centre for Ecosystem Management, ECU, Joondalup.

Froend, R. and Loomes, R. (2006). Determination of Ecological Water Requirements for wetland and terrestrial vegetation – Southern Blackwood and eastern Scott Coastal Plain. Report to the Department of Water. CEM report no. 200507. Centre for Ecosystem Management, Edith Cowan University, Joondalup, Western Australia

Heddle, E.M., Loneragan, O.W., and Havel, J.J. (1980) 'Vegetation of the Darling System' in *Atlas of Natural Resources, Darling System, Western Australia.* Department of Conservation and Environment, Perth, Western Australia.

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994) *A floristic survey of the Southern Swan Coastal Plain*. Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).

Government of Western Australia (2000). Bush Forever Volume 2: Directory of Bush Forever Sites. Department of Environmental Protection, Perth.

Groves, H. (2014). Predicted risk to Banksia woodlands in the Swan Coastal Plain in response to groundwater decline. Western Australian Department of Parks and Wildlife in accordance with the hydrogeological industry placement for the completion of a Master of Hydrogeology degree at the University of Western Australia.

Keighery, B.J. and Trudgen, M.E. (1992). *The Remnant Vegetation of the Eastern Side of the Swan Coastal Plain*. Unpublished report to the Department of Conservation and Land Management for the National Estate Grants Program.

Markey, A. (1997). A floristic survey of the northern Darling Scarp. Department of Conservation and Land Management, Perth.

Ritchie, A.L., and Krauss, Siegfried L.A (2012). Genetic Assessment of Ecological Restoration Success in *Banksia attenuata*. Restoration Ecology 20: 4 441–449.

Shire of Serpentine-Jarrahdale (2007). Draft Management Plan for Serpentine Sports Reserve. Unpublished Report, Perth, Western Australia.

Shire of Serpentine-Jarrahdale (2009). Draft Brickwood Reserve and Briggs Park Management Plan. Unpublished Report, Perth, Western Australia.

Urban Pacific Limited (2009). *Our Projects, Whitby WA, Vision/Overview*. Accessed 01/02/2010 from http://www.urbanpacific.com.au/our-projects/australia/Whitby.aspx

Western Australian Local Government Authority Natural Area Initial Assessment Database (2011). http://www.walga.asn.au/about/policy/pbp/tools/na_database. Accessed Feb 2011.

45. Statement on the Standard of Scientific Evidence

Published studies have appeared in peer reviews journals and when combined with unpublished information and survey data, were sufficient to apply some of the Red List of Ecosystem criteria. There is uncertainty in various aspects of the assessment. For the criteria applied, the outcomes of the assessment are considered robust.

Uncertainties exist in aspects of the hydrological status, and current status of disease and weed invasion within the occurrences. A well designed, systematic, long term monitoring program with spatially and temporally linked data for parameters including floristics, hydrology, fires, and invasive species is required to better understand the relationships between changes in the ecosystem and the most significant threatening process. Such a program would be resource intensive but could provide the necessary data to help guide future management of this unique and highly threatened ecosystem.

46. Has this document been reviewed and/or have relevant experts been consulted?
If so, indicate by whom and provide their contact details.

Ecologist DBCA Bunbury

Principal Ecologist, DBCA Kensington.

Senior Ecologist DBCA Kensington

Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

47. Do you wish to propose any areas of habitat for consideration as Critical Habitat for the nominated community? If so, refer to Ministerial Guideline No 5 and attached a separate nomination proposal addressing the matters required under that guideline. Indicate location/s including a map, and attached shapefiles.
No

Section 5 - Nominator Details & Declaration

48. Contact Details Note: Nominator details are subject to the provision of the *Privacy Act 1988*	
Title/Full Name	[redacted]
Organisation or Company name	Department of Biodiversity, Conservation and Attractions
Postal address	17 Dick Perry Avenue, Kensington Post: Locked Bag 104, Bentley Delivery Centre, WA 6983.
Email	[redacted]@dbca.wa.gov.au
Phone	N/A
Fax	
49. Declaration	
Signature (Or insert electronic signature)	***I declare that the information in this nomination form and any attachments is true and correct to the best of my knowledge.***
Date signed	

Section 6 – Completed nomination form checklist

Please check all items on this list have been completed or are included with your nomination.

- ☐ I have read and applied the further information and guidelines for completing this nomination form in Attachment A
- ☐ Nominator details including name, address contact phone number included
- ☐ Name of the EC
- ☐ Any other names it is known by
- ☐ Map included or attached
- ☐ References cited
- ☐ If questions are left unanswered, a statement indicating that insufficient information is available

A description of:

- ☐ Biological components of the ecological community
- ☐ Non biological components of the ecological community
- ☐ Key interactions and functional processes

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

- ☐ Characters distinguishing it from other ecological communities
- ☐ Key species (dominant, characteristic or diagnostic, threatened etc)
- ☐ Known or estimated current extent of the ecological community
- ☐ Past/current/future threats including actual/potential, how/ where, how being/how could be abated
- ☐ Which listing category/categories it should be listed under and why

How to lodge your nomination
Completed nominations may be lodged either: 1. by email to: **communities.data@dbca.wa.gov.au** ***If submitting by email, please also mail hard copies of attachments that cannot be emailed.*** OR 2. by mail to: Species and Communities Branch Department of Biodiversity, Conservation and Attractions, WA Government Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 ***If submitting by mail, please include an electronic copy on memory stick or CD.***

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

Summary assessment against IUCN RLE Criteria

Criterion	Rank indicated	Overall conclusion
A1	-	• Available data do not indicate if community meets criterion
A2a	-	• Available data do not indicate if community meets criterion
A2b	-	• Available data do not indicate if community meets criterion
A3	EN	• Based on available evidence, the community plausibly meets criterion A3 under VU, EN or CR. EN is considered most plausible under A3
B1a	CR	• EOO is ≤2,000km^2 • Available data shows measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem from dieback surveys of the community Meets criterion for CR B1a(iii)
B1b		• EOO is ≤2,000km^2 • No evidence to indicate current threats are non-trivial • Does not meet criterion
B1c		• AOO is 11 grid cells • Ecosystem exists at 35 threat defined locations • Does not meet criterion
B2a	EN	• AOO is 11 grid cells • Available data shows measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem from dieback surveys of the community Meets criterion for EN B2a(iii)
B2b	EN	• AOO is 11 grid cells • Observed and inferred continuing decline from land clearing, weed invasion, altered fire regimes, disease, grazing by introduced fauna, and hydrological change • Meets criterion for EN
B2c	-	• AOO is 11 grid cells • Ecosystem exists at 35 threat defined locations • Does not meet criterion
B3	-	• Known from 35 threat-defined locations • Does not meet criterion
C1	-	• Insufficient evidence to indicate community meets minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over the past 50 years to meet VU.
C2	-	• Insufficient evidence to indicate community meets minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU.
C3	-	• Insufficient evidence to indicate that community meets minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since 1750 to meet VU.
D1	-	• Inadequate quantitative data to indicate if the community meets the minimum proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over the past 50 years to meet VU.
D2	-	• Inadequate quantitative data to indicate if the community meets the minimum proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over any 50-year period to meet VU.

Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

D3	-	• Inadequate quantitative data to indicate if the community meets the minimum proportion of the extent (≥50%) or proportional severity of disruption of biotic processes (≥50%) since 1750 to meet VU.
E	NA	• No quantitative estimates of the risk of ecosystem collapse.
		Meets CR under B1a(iii). Meets EN under B2a(iii). Plausibly meets VU to CR under criterion A3 (EN most plausible). Plausible rank VU to CR. *'The highest risk category obtained by any of the assessed criteria will be the overall risk status of the ecosystem'* (IUCN RLE Guidelines V1.1 page 42). **Meets CR under criterion B1a(iii).**