Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

Nomination *(to be completed by nominator)*

Current conservation status	
Name of ecological community:	*Corymbia calophylla — Xanthorrhoea preissii woodlands and shrublands, Swan Coastal Plain (floristic community type 3c as originally described in Gibson et al. (1994))*
Other names:	Swan Coastal Plain community 3c (SCP3c), floristic community type 3c(FCT3c) as described by Gibson *et al.* (1994). The community is hereafter termed 'SCP3c'.
Description:	The community occurs on heavy soils of the eastern side of the southern Swan Coastal Plain, generally between Bullsbrook and Stratham. The community is dominated by *Corymbia calophylla* (marri) and *Xanthorrhoea preissii* (balga). It also occasionally includes *Eucalyptus wandoo* (wandoo). The more common shrubs include *Gompholobium marginatum*, *Hypocalymma angustifolium* (white myrtle) and *Banksia dallanney*i (couch honeypot). The herbs, grasses and sedges including *Burchardia congesta*, *Cyathochaeta avenacea*, *Neurachne alopecuroidea* (foxtail mulga grass), *Caesia micrantha* (pale grass-lily), *Mesomelaena tetragona* (semaphore sedge), *Morelotia octandra*, *Desmocladus flexuosus, Opercularia vaginata* (dog weed), *Sowerbaea laxiflora* (purple tassels), *Lepidosperma* spp. and *Drosera menziesii* (pink rainbow) are also common. The community is also known as "floristic community type 3c" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia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.)).
Nomination for:	Listing ☒ Under BC Act Change of status ☐ Delisting ☐

1. *Is the ecological community currently on any conservation list, either in a State or Territory, Australia or Internationally?* 2. *Is it present in an Australian jurisdiction, but not listed?*	*Provide details of the occurrence and listing status for each jurisdiction in the following table*

Jurisdiction	**List or Act name**	**Date listed or assessed (or N/A)**	**Listing category eg. critically endangered (or none)**	**Listing criteria eg. B1ab(iii)+2ab(iii) (or none)**
National	EPBC Act	16/07/2000	Endangered	
Western Australia	Current ranking under WA Minister ESA list in policy	6/11/2001	Critically Endangered	B ii) under previous ranking criteria developed in WA
	Priority list		1 ☐ 2 ☐ 3 ☐ 4 ☐	
Other State/Territory				

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Nominated conservation status: category and criteria (include recommended status for deleted ecological communities)				
Critically endangered (CR) ☐	Endangered (EN) ☒	Vulnerable (VU) ☐	Collapsed (CO) ☐	
Priority 1 ☐	Priority 2 ☐	Priority 3 ☐	Priority 4 ☐	None ☐
What criteria support the conservation status category for listing as a threatened ecological community or collapsed ecological community? *Refer to Section 32 of the Biodiversity Act 2016 for definition of 'Collapsed', and Appendix 3 table 'IUCN Red List Criteria for ecosystems version 2.2'.*	EN A3; B1a(ii),b; B2a(ii),b			
Eligibility against the criteria				
*Provide justification for the nominated conservation status; is the ecological community eligible or ineligible for listing against the five criteria. For **delisting**, provide details for why the ecological community no longer meets the requirements of the current conservation status.*				
A.	Reduction in geographic distribution *(evidence of decline)*	☐ **A1** ☐ **A2a** ☐ **A2b** ☒ **A3 EN/CR**		
	Justification of assessment under Criterion A.	For criterion A the ecosystem is assumed to collapse when the mapped distribution declines to zero. • Community SCP3c occurs predominantly on the Guilford and Forrestfield vegetation complexes. The remaining proportion of the pre-European extent of these complexes is 5% and 12% (Government of Western Australia, 2019). The community is also recorded from the Beermullah and Southern River complexes. The remaining proportion of the pre-European extent of these complexes is 7% and 18% (Government of Western Australia, 2019). The reduction in extent of native vegetation on the land units is assumed to be indicative of the level of clearing of the community. The extent of decline of these vegetation complexes since 1750, ranges from 72% to 95%. • The timing of the vegetation clearing is not known so is conservatively inferred to be since 1750. • Gibson *et al*. (1994) estimated a ≥90% reduction of SCP3c since 1750 based on their analysis of the level of clearing of vegetation on the geomorphologies and landforms that support the community. • Based on available evidence, the community plausibly meets criterion A3 as the distribution decline ranges from		

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		72%-95%. This range is partly within the ≥90% threshold required to meet CR under A3. It is also plausibly meets endangered under criterion A3, for which the threshold of decline since 1750 is ≥70%. • The vegetation clearing data associated with a plausible rank of CR under A3 do not cover the full known range of the community. • **Plausible rank critically endangered or endangered under criterion A3.**
B.	Restricted geographic distribution *(EOO and AOO, number of locations and evidence of decline)*	☒ **B1** (specify at least one of the following): ☐ **a)(i)** ☒**a)(ii)** ☐**a)(iii)** ☒**b)** ☐**c); EN** ☒ **B2** (specify at least one of the following): ☐ **a)(i)** ☒**a)(ii)** ☐**a)(iii)** ☒**b)** ☐**c); EN** ☐ **B3 (only for Vulnerable Listing)**
	Justification of assessment under Criterion B.	For criterion B the ecosystem is assumed to collapse when the mapped distribution declines to zero. • B1: EOO is 2407km^2 (≤20,000km^2-threshold for EN, and ≥2,000km^2-threshold for CR). • Community meets threshold for rank EN under criterion part B1. • B1aii: There is an observed and inferred continuing decline in a measure of environmental quality (groundwater levels) in some occurrences for which data are available (see explanation for criterion C below, and Appendix 1). Meets criterion EN under B1aii. • B1 b): Continuing decline observed from the impacts of land clearing, hydrological change, weed invasion, trampling, altered fire regimes, disease, grazing by introduced fauna, and a drying and warming climate (see Appendix 1 for details of threats). • B1 c) Community is considered to occur at 15 threat-defined locations, based on the identification of 15 areas of the community that may be subject to similar threats such as fires or dieback disease infections that affect a particular bushland location. The community does not meet VU under B1c) Does not meet as B1c as threshold for VU is ≤10 threat-defined locations. • B2: AOO. Community covers 13 grid cells. The community meets EN under criterion B2 for which the threshold is ≤20 grid cells (threshold for CR ≤2 grid cells) (b and c of B1 are the same for B2) • B2aii: There is an observed and inferred continuing decline in a measure of environmental quality (groundwater levels) in some occurrences for which data are available. Meets criterion for EN under B2aii.

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		• B3: community is considered to consist of 15 threat-defined locations, based on the identification of 15 clusters of the community that may be subject to similar threats such as fires or dieback disease infections that affect a particular bushland location. Does not meet VU under criterion B3, as community occurs at more than the threshold 5 threat-defined locations. • **Plausibly meets criteria for Endangered under B1a(ii),b; B2a(ii),b.**
C.	Environmental degradation of abiotic variable *(Evidence of decline over 50-year period)*	☐ **C1** ☐ **C2** ☐ **C3**
	Justification of assessment under Criterion C.	• Hydrological change in the form of groundwater decline is a significant variable affecting the community. • For criterion C, the assessment of decline in abiotic processes focussed on hydrological change using data on the depth to groundwater. It was assumed conservatively that the community would collapse if the groundwater fell to about 10m below ground surface. This is 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). • Almost all of the monitoring bores for which data were available are located some distance from occurrences (Appendix 1). Most of the data are therefore assumed to provide only an indication of the regional groundwater trends in the vicinity of occurrences. • Bore data is available at a site within 20m of Water03 (Figures 6a, 6b in Appendix 1) and indicate a gradual decline in groundwater since 1977. • Regional groundwater levels for bores located near occurrences are indicative of a 0.5 to 2.5m decline over 40 years. If it assumed that projections of groundwater levels in Figures 3 - 7 in Appendix 1 are indicative of the risk of collapse from groundwater decline, the level of risk appears relatively low. • The water table data for occurrences WATER03 (25) and WATER06_Webb (40) (representative of 8.9% of the extent of the community), indicates an approximate 1m groundwater decline from 1977 to 2019 (figure 6a). Figure 6b projects an approximated 1.5m groundwater decline at

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		this occurrence over the next 50 years, as calculated from the previous trendline in figure 6a. Based on current and future forecasted groundwater levels at this one location, it is predicted that within the next 50 years there will be a 23.8% severity in relation to total collapse assuming groundwater levels decline at the current calculated rate (y=-0.0027x + 13.904). • Based on current and future predictions that are largely based on trends in regional groundwater levels across the community, 18% of the extent of the community has a quantified severity ranging from 23.8% over a 50-year period. • Data are not available for the remainder of the occurrences, and not available for sites sufficiently close to occurrences to reliably predict risk of collapse from groundwater decline with a high level of certainty. • The minimum thresholds to meet VU are environmental degradation of ³50% extent of the community with ³50% severity over the next 50 years to meet C2a. • Available data do not indicate the community meets minimum thresholds for criteria for VU based on regional ground water data available for specific occurrences. • **Insufficient evidence to indicate the community meets criterion C.**
D.	Disruption of biotic processes or interactions *(Evidence of decline over 50-year period)*	☐ **D1** ☐ **D2** ☐ **D3**
	Justification of assessment under Criterion D.	• Dieback disease caused by *Phytophthora* species is a significant biotic threat to the community. • For criterion D, collapse 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 5 occurrences, 2 within Talbot Road Nature Reserve (TALB01 & TALB12), and three within Ellenbrook Nature Reserve (ELLEN06, ellen07 and ELLEN08), a minimum of 28.37ha (23.8%) of the community is infected with the disease. To meet the criteria for VU, ≥80%, of the dieback sensitive flora would be required to be lost by the disease over ≥30% of the extent of the community (or ≥30%, of the dieback sensitive flora would be required to be lost to the disease over ≥80% of the extent of the community) over the specified time periods.

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		• Although there are dieback maps that encompass the community, currently there are inadequate systematic collected quantitative data about the impacts of dieback on individual sensitive species to support a reliable 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 that 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 the community meets criterion D.**
E.	Quantitative analysis *(statistical probability of ecosystem collapse)*	• No quantitative estimates of the risk of ecosystem collapse have been completed • **Not evaluated under criterion E**

Reasons for change of status

Genuine change ☐ New knowledge ☐ Previous mistake ☐ Review/Other ☒

Provide details: The community was initially ranked critically endangered using ranking criteria developed in WA that differ from those in the IUCN Red List Criteria for Ecosystems (version 2.2).

Summary of assessment information *(provide detailed information in the relevant sections of the nomination form)*

EOO	2407km^2	AOO	13 (10x10km grid method).
No. locations	15	Severely fragmented	Yes ☒ No ☐ Unknown ☐ The community was likely to have historically been much more extensive. Land clearing has resulted in the community becoming severely fragmented, with only small occurrences remaining in isolated patches.
Current known area			119.2 ha
Pre-industrialisation extent or its former known extent (if known)			Based on an estimated level of loss between 72 and 95% of the vegetation complexes that support the community (Government of Western Australia, 2019) the estimated original area of the community between 2384ha and 662ha

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	(100/5%x119.19 and 100/18%x119.19 respectively)
Estimated percentage decline	The estimated level of decline of the vegetation complexes with which SCP3c is associated, ranges from 72% to 95% (Government of Western Australia 2019)

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	CR-EN	• Based on available evidence, the community plausibly meets EN - CR under criterion A3
B1a	EN	• EOO is ≤20,000km^2 • Observed and inferred continuing decline in a measure of environmental quality (groundwater levels) • Meets criteria for EN under B1aii
B1b	EN	• EOO is ≤20,000km^2 • Observed and inferred continuing decline from land clearing, hydrological change, weed invasion, trampling, altered fire regimes, disease, grazing by introduced fauna, and a drying climate • Meets criterion for EN under B1b
B1c	-	• EOO is ≤20,000km^2 • Ecosystem exists at 15 threat defined locations • Does not meet criterion
B2a	EN	• AOO is ≤20 grid cells • Observed and inferred continuing decline in a measure of environmental quality (groundwater levels) • Meets criteria for EN under B2aii
B2b	EN	• AOO is ≤20 grid cells • Observed and inferred continuing decline from land clearing, hydrological change, weed invasion, trampling, altered fire regimes, disease, grazing by introduced fauna, and a drying climate • Meets criterion for EN
B2c	-	• AOO is ≤20 grid cells • Ecosystem exists at 15 threat defined locations • Does not meet criterion
B3	-	• Known from 15 threat-defined locations • Does not meet criterion
C1	-	• Available data indicate community does not meet minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over the past 50 years to meet VU.
C2	-	• Inadequate data to indicate that 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	-	• Inadequate data to indicate if community meets minimum thresholds for proportion of the extent (≥50%) or proportional severity of degradation (≥50%) since 1750 to meet VU.

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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.
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.
		Plausibly meets EN-CR under A3. Meets EN B1aii, B1b, B2aii, B2b. Plausible range of rank: EN to CR. The vegetation clearing data associated with a plausible rank of CR under A3 do not cover the full known range of the community however. *'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). Conservatively, meets EN under A3; B1a(ii),b; B2a(ii),b.

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Summary of location (occurrence) information *(provide detailed information in the relevant sections of the nomination form)*						
Occurrence ID (Occurrence No.)	Land manager	Survey information: date of surveys	Condition*	Area of occurrence (ha)	Threats *(note if past, present or future)*	Specific management actions
PEARCE02 (1)	Commonwealth of Australia	1995, 2002, 2010, 2012, 2017	Good 50% Very good 50%	12.12	Weed invasion, disease, too frequent fire (and fire fighting foam), recreational activities and trampling (horses and walkers)	
YARL01 (2)	Shire of Waroona – Crown Reserve 22215	1995, 2010	Very good 60% Good 30% Degraded 10%	0.52	Disease, weed invasion, too frequent fire, hydrological change and trampling	Weed management.
TALB01 (4)	DBCA – Talbot Road Bushland Crown Reserve 23953	1995, 2008, 2010, 2012, 2013, 2016	Excellent 100%	32.34	Weed invasion, too frequent fire and clearing	Weed management and implementing appropriate fire regime.
TALB12 (5)	DBCA – Talbot Road Bushland Crown Reserve 23953 Metropolitan Cemeteries Board – Crown Reserve 6955	1995, 2008	Excellent 80% Very good 20% (1995 survey)	4.11	Clearing, weed invasion, too frequent fire and recreational activities	Weed management and implementing appropriate fire regime.
DUCK01 (6)	PTA – Crown Reserve 23793	1994, 2008, 2010, 2014	Excellent 50% Very good 50%	2.70	Clearing, weed invasion, too frequent fire and recreational activities	Weed management.

ELLEN06 (7)	DBCA – Ellen Brooke Nature Reserve 27620	2005, 2010, 2012	Excellent 50% Very good 50%	0.70	Weed invasion, disease, too frequent fire and grazing by native or introduced animals	Weed management and implementing appropriate fire regime.
MYROMAN02 (8)	DBCA – Crown Reserve 46818	2000, 2010	Excellent 60% Very good 20% Good 20%	3.04	Weed invasion, disease, too frequent fire, disease and grazing by native or introduced animals	Weed management.
MYTOODY01 (9)	DPLH	2000, 2010, 2013	Excellent 70% Very good 30%	3.35	Weed invasion, too frequent fire and grazing by native or introduced animals	Weed management.
MYGOOSE01 (11)	DBCA	2000, 2010	Excellent 80% Good 20%	4.52	Weed invasion, too frequent fire and grazing by native or introduced animals	Weed management.
MYGOOSE02 (12)	DBCA	2000, 2010	Excellent 90% Degraded 10%	3.84	Clearing, weed invasion, too frequent fire and recreational activities	Weed management.
MYPEARCE02 (14)	Commonwealth of Australia	2000, 2010	Excellent 90% Very good 10%	4.98	Clearing and weed invasion	Weed management
MYPEARCE03 (15)	Commonwealth of Australia	2000, 2002	Excellent 85% Very good 15%	3.76	Clearing and weed invasion	Weed management

MYPEARCE04 (16)	Commonwealth of Australia	2000, 2002	Excellent 90% Very good 10%	3.78	Clearing and weed invasion	Weed management
MYPEARCE05 (17)	Commonwealth of Australia	2000 & 2002	Excellent 90% Very good 10%	2.29	Clearing and weed invasion	Weed management
MYBYFORD01 (18)	Public land/Railway	2000, 2010	Very good 30% Good 60% Degraded 10%	3.06	Clearing, too frequent fire and weed invasion	Weed management.
MYPEARCE09 (23)	Commonwealth of Australia	2004, 2010	Excellent 100%	2.94	Clearing, too frequent fire (and fire fighting foam) and weed invasion	Weed management.
MYPEARCE10 (24)	Commonwealth of Australia	2004	Excellent 25% Very good 25% Good 50%	3.96	Clearing, too frequent fire (and fire fighting foam) and weed invasion	Weed management.
WATER03 (25)	Public road/Railway DBCA – Crown Reserve 46108	1995, 2010	Very good 100%	8.27	Too frequent fire, hydrological change and weed invasion	Weed management and implementing appropriate fire regime.
ellen07 (26)	DBCA – Ellen Brooke Nature Reserve 27620	2005	Very good 100%	0.27	Weed invasion, too frequent fire and grazing by native or introduced species	Weed management and implementing appropriate fire regime.

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ELLEN08 (27)	DBCA – Ellen Brooke Nature Reserve 27620	2005, 2014	Very good 100%	0.32	Weed invasion, too frequent fire and grazing by native or introduced species	Weed management and implementing appropriate fire regime.
ROSE01 (29)	DBCA	2006, 2009, 2010	Excellent 80% Very good 20%	0.90	Weed invasion, hydrological change and too frequent fire	Weed management and implementing appropriate fire regime.
ROSE04 (30)	DBCA	2006, 2009	Very good 90% Degraded 10%	1.16	Weed invasion, hydrological change and too frequent fire	Weed management and implementing appropriate fire regime.
ROSE05 (31)	DBCA	2006, 2009	Very good 90% Degraded 10%	1.15	Weed invasion, hydrological change and too frequent fire	Weed management and implementing appropriate fire regime.
NthDand01 (39)	Department of Education	2011	Excellent 50% Very good 50%	0.55	Weed invasion, too frequent fire and grazing by native or introduced species	Weed management and implementing appropriate fire regime.
WATER06_Webb (40)	Public land/Railway DPLH	2003, 2010, 2011	Excellent 50% Good 50%	2.34	Clearing, weed invasion, disease and too frequent fire	Weed management and implementing appropriate fire regime.
BYFrail02 (41)	Public land/Railway UCL	2011, 2013	Excellent 40% Very good 30% Good 30%	2.45	Clearing, weed invasion, disease and too frequent fire	Weed management and implementing appropriate fire regime.

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Koongamia (42)	City of Swan – Crown Reserve 31321	2008, 2009, 2013	Excellent 90% Good 10%	0.64	Clearing, weed invasion, too frequent fire and recreational activities	Weed management.
PearceSth01 (45)	City of Swan	2012, 2013, 2017	Very good 80% Good 20%	1.83	Clearing, weed invasion, too frequent fire and recreational activities	Weed management.
CoolupBushland01 (46)	Public road DPLH	2017	Excellent 100%	3.73	Weed invasion	Weed management
CoolupBushland03 (47)	Public road DPLH	2017	Excellent 100%	2.79	Weed invasion	Weed management
Cambridge01 (48)	Shire of Kalamunda – Crown Reserve 34364	2019	Excellent 100%	0.79	Clearing, weed invasion and recreational activities	Weed management

*For the purposes of relating condition to the criteria, categories from Keighery (1994) vegetation condition scales from Government of WA (2000) are defined below:

Good ('Pristine', 'Excellent', 'Very Good' using Bush Forever (2000) scale): This includes vegetation ranging from 'Pristine' - with no obvious signs of disturbance, to 'Excellent' - Vegetation structure intact, with disturbance only affecting individual species, weeds are non-aggressive species and 'Very Good' - Vegetation structure altered, obvious signs of disturbance eg: from repeated fires, dieback, logging, grazing.

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Medium ('Good' using Bush Forever (2000) scale): This includes vegetation categorised as '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 and grazing.

Poor ('Degraded' using Bush Forever (2000) scale): Basic vegetation structure severely impacted by disturbance such as partial clearing, dieback, logging and grazing. Scope for regeneration but not to a state approaching good condition without intensive management.

Beyond recovery ('Completely degraded' using Bush Forever (2000) scale): Vegetation structure is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native shrubs and trees.

Table 1. Known vegetation condition of occurrences of the *Corymbia calophylla — Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain

Condition Ranking (Keighery 1994) from Government of Western Australia 2000)	**Hectares**	**IUCN Criteria condition ranking**	**Hectares**
Pristine	0		
Excellent	76.68		
Very Good	27.67		
Good	13.88	**Good**	104.35
Degraded	0.97	**Medium**	13.88
Completely degraded	0	**Poor**	0.97
Total	119.19	**Total**	119.19

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APPENDIX 1 THREATS

Clearing

Clearing for agriculture has been extensive on the heavy soils on the eastern side of the Swan Coastal Plain - with some 97% of all vegetation in the area cleared historically (Keighery and Trudgen 1992). The marri dominated communities on these heavy soils were probably some of the most common on this portion of the plain but are now very rare and are likely to be at least 90% cleared (Gibson *et al.* 1994). An occurrence in Middle Swan (Occurrence 5 – TALB12) was partially cleared in the past and gravel extracted from the site. Other areas of the community were probably cleared historically for gravel extraction or other uses, and have been grazed or otherwise disturbed since and have not regenerated. Most occurrences are surrounded by cleared land.

Future proposals to clear vegetation in the community are planned and are associated with developments for housing, roads, or industry.

Altered fire regimes

It is likely that the fire regime in the remnants containing the occurrences has been modified since 1750 to more frequent fires, especially hot burns. Mediterranean ecosystems are usually fire responsive and may require a particular fire regime to assist regeneration (Abbot and Burrows 2003). Bush fires or prescribed burns must occur at appropriate intervals, and possibly at the appropriate season and intensity, to sustain the integrity of plant communities. Too frequent fire can increase the risk of invasive weeds establishing within small bushland remnants such as this community (Abbot and Burrows 2003).

It is likely that the fire regime in the remnants containing the occurrences has been modified since 1750 to more frequent fires, especially hot burns. Talbot Road bushland, that contains occurrences 4 (TALB01) and 5 (TALB12), is frequently burnt by vandals, and occurrence 25 (WATER03) was burnt in a bushfire in November 1997. Occurrence 42 (Koongamia) was burnt in a hot bushfire in March 2019. Disturbance events such as fire increase weed invasion, especially in small remnants. The risk of fire is also 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. The application of fire-fighting foam is also a threat to occurrences within Pearce Airbase.

Weed invasion

Weed invasion is usually enhanced by disturbances such as fires and grazing if weed propagules are present. All of the occurrences of this community are close to weed sources such as urban or agricultural areas and would be vulnerable to weed invasion following any disturbance. Small remnants often exhibit surprising resistance to weed invasion particularly if left undisturbed (Keighery 1996). There are tracks through most occurrences of the community, and weed invasion is generally concentrated in disturbed areas including tracks.

Grazing

Grazing of plant communities causes alteration to the species composition, both in the selective grazing of edible species, and in the introduction of weeds as a result of trampling, general disturbance, and weed seeds in droppings. Weed invasion in some of the remnants containing the type indicates they may have been grazed (Occurrences 1 (PEARCE02), 14, 15, 16, 17, 23, 24 (MYPEARCE02, 03, 04, 05, 09, 10) 7, 26, 27 (ELLEN06, 07, 08) 6 (DUCK01) and 2 (YARL01).

Introduction of Disease

Dieback disease caused by *Phytophthora* species has the potential to impact the community. Plant communities on heavy soils such as those associated with this community, especially in relatively flat areas, are generally not highly susceptible to dieback disease (Helyar 1994). *Phytophthora* assessments have been undertaken for several occurrences. In 2011, a full *Phytophthora* dieback interpretation was completed for Talbot Road Nature Reserve (Figure 1) (DBCA 2011a). Approximately 75% of occurrence TALB01, and 100% of TALB12, is infected with dieback. In 2011, a full *Phytophthora* dieback interpretation was completed for Ellenbrook Nature Reserve (Figure 2) (DBCA 2011b). Areas of the reserve where occurrences ELLEN06 (7), ellen07 (26) and ELLEN08 (27) are located, were uninterpretable for dieback. In 2006, Roman Road Reserve was assessed for dieback and none of the occurrence MYROMAN02 (8) was infected with the disease.

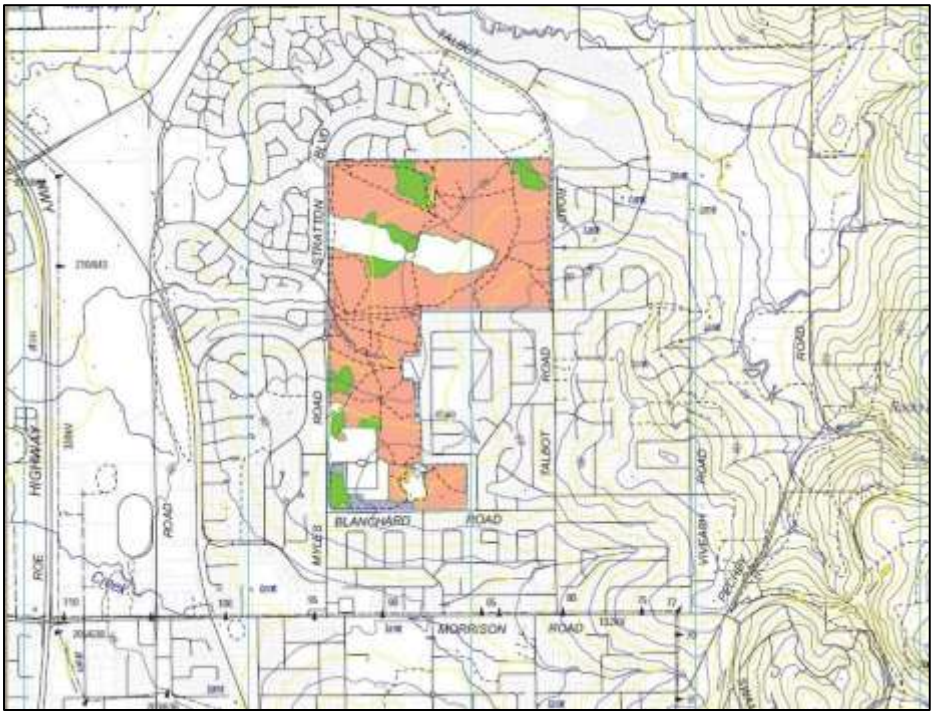

Figure 1. Dieback infection coverage of the Talbot Road Nature Reserve, that includes occurrences TALB01 (4) and TALB12 (5). Pink represents infested areas, green represents those areas where there was no infestation, purple represents areas that are uninterpretable, and no colour within the perimeter of reserve represents areas not able to be mapped at the time (DBCA 2012).

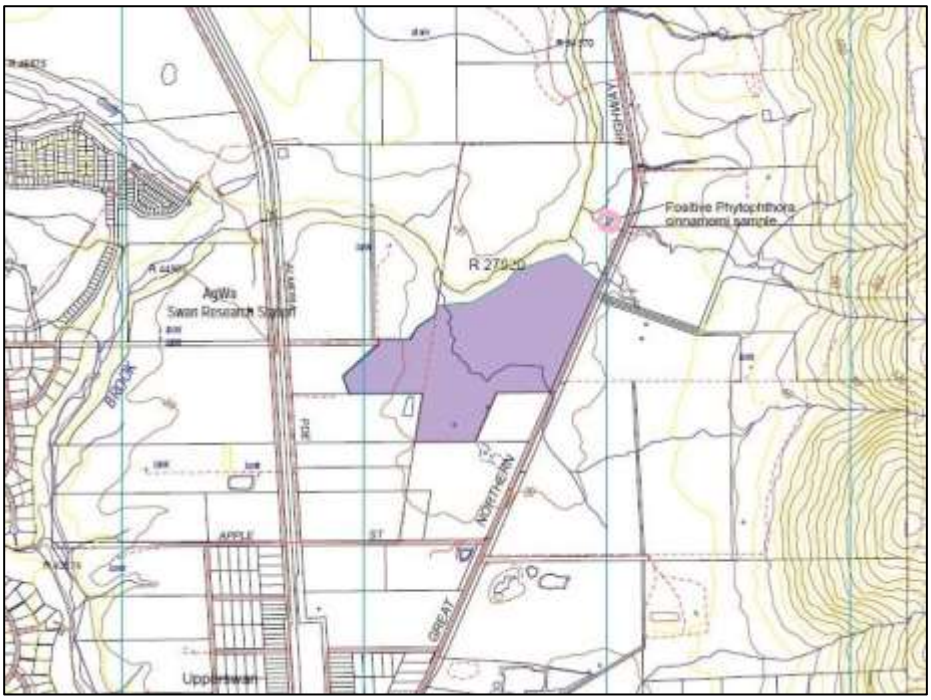

Figure 2. Dieback infection coverage of the Ellenbrook Nature Reserve where occurrences ELLEN06 (7), ellen07 (26) and ELLEN08 (27) are located. Pink represents areas infested (small point north of the reserve) and purple represents those areas uninterpretable, and no colour within the perimeter of reserve represents areas not able to be mapped at the time (DBCA 2013).

Marri canker, caused by a native fungus, *Quambalaria coyrecup*, that appears to attack the stem, is also a threat to the survival of the marri. The disease incidence is greater in disturbed areas such as along roads, in parks, in remnant bushland on farms and on small rural blocks. The impacts appear to be non-recoverable with attempts to contain the pathogen by callus production ultimately circumvented by the pathogen (Lamond 2009; Paap *et al*. 2017).

Hydrological changes

Vegetation clearing generally results in increased runoff and a temporary increase in recharge to the groundwater table. Uncontrolled extraction from irrigation bores may lower groundwater levels, especially in summer. Altered periods or depths of ponding may affect the timing of growth of herbs in the understorey, and may also effect the species composition by favoring different plant species. Data in Davidson (1995) suggests this community may be at risk from hydrological changes. Occurrences 1 (PEARCE02), 14, 15, 16, 17, 23, 24 (MYPEARCE02, 03, 04, 05, 09, 10), 26, 27 (ELLEN06, 07, 08), 2 (YARL01), 6 (DUCK01) and 25 (WATER03) occur on very low-lying land and this may predispose the sites to the impacts of hydrological changes such as increasing inundation and salinisation as a consequence of clearing or urbanisation of the catchment.

Most of the monitoring bores for which data were available are not within the occurrences, and are located some distance away. The substrates and groundwater can vary significantly over short distances on the Swan Coastal Plain. Most of the available monitoring data can therefore only provide an indication of the regional groundwater trends in the vicinity of occurrences. The exceptions are bores that are located either within or very close to occurrences of the community. Bores occur within 20m of Water03 (Figures 8a, 8b) and indicate groundwater very close to the surface, and in gradual decline since 1977. This occurrence is distant from the majority of areas of the community that are closer to Perth.

Monitoring data for bores that are up to 1.2km from occurrences are generally indicative of groundwater levels that are declining but at a relatively slow rate. Groundwater levels range from a 0.5 to 2.5m decline over a historical period of 40 years. If it is assumed that Figures 3 through to 9 are indicative of the risk of collapse of the community from groundwater decline based on trends in regional groundwater tables, the level of risk appears relatively low. Declining water levels can also pose the threat of increasing terrestrialisation on the community by favouring deeper rooted species, and this is a more likely scenario than collapse in the next 50 years, based on available data.

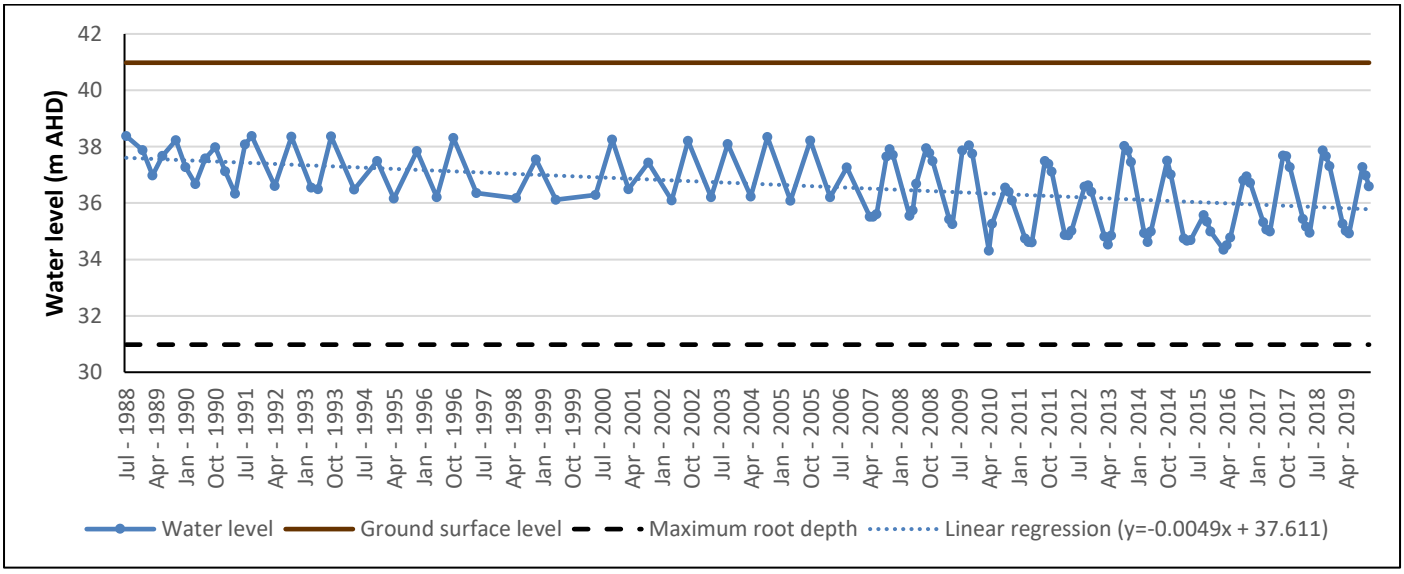

Figure 3a. Hydrograph of monitoring bore located 773m north of occurrence YARL01 (2) (site ref: 61330032), sampling the superficial Swan aquifer (DoW 2020).

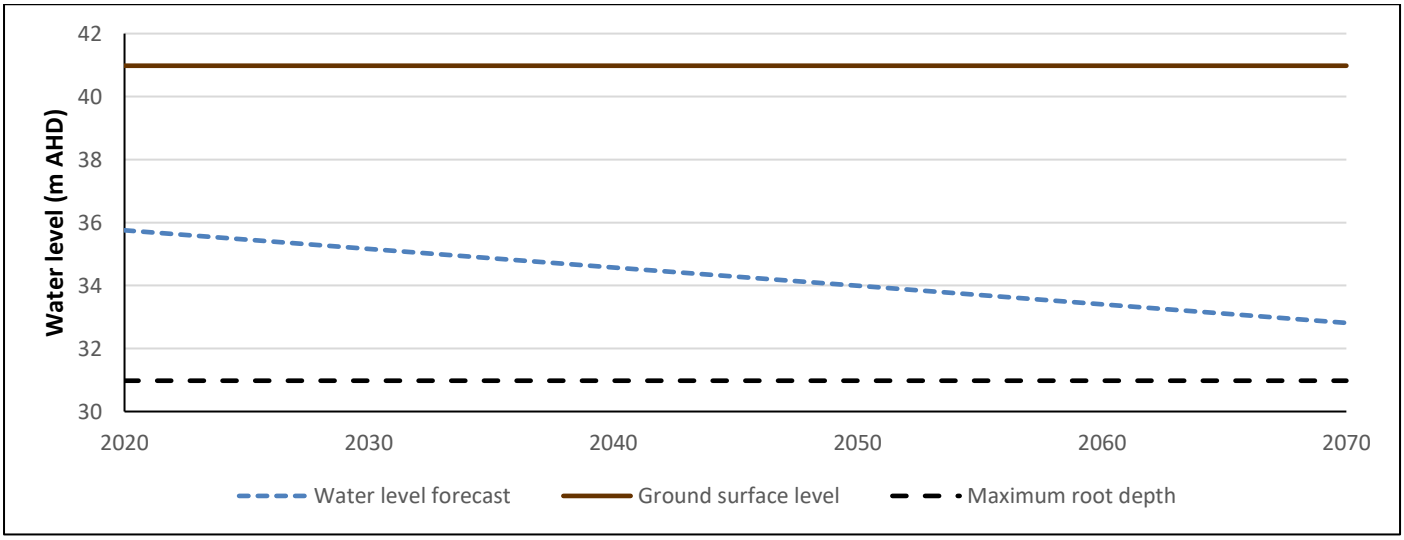

Figure 3b. A 50-year forecast of groundwater level decline at occurrence YARL01 (2) (site ref: 61330032), calculated using the trendline (y=-0.0049x + 37.611).

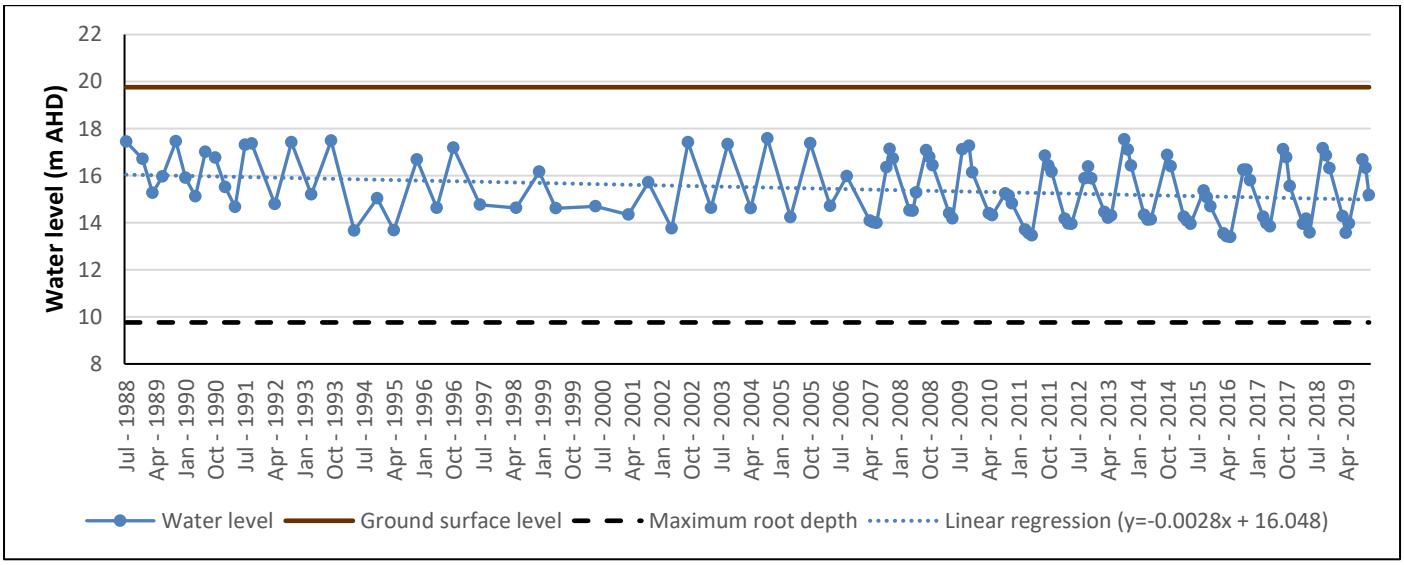

Figure 4a. Hydrograph of monitoring bore located 576m south west of occurrence coolupbushland01 (46) and 849m south west of coolupbushland03 (47) (site ref: 61330068), sampling the superficial Swan aquifer (DoW 2020).

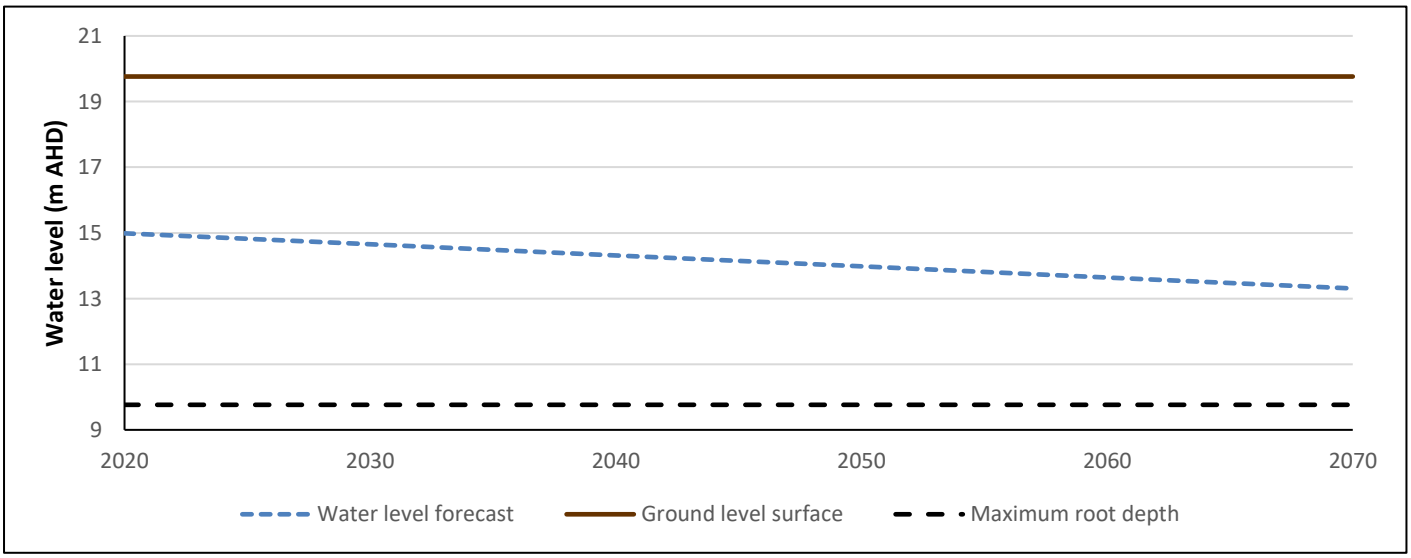

Figure 4b. A 50-year forecast of groundwater level decline at occurrences coolupbushland01 (46) and coolupbushland03 (47) (site ref: 61330068), calculated using the trendline (y=-0.0028x + 16.048).

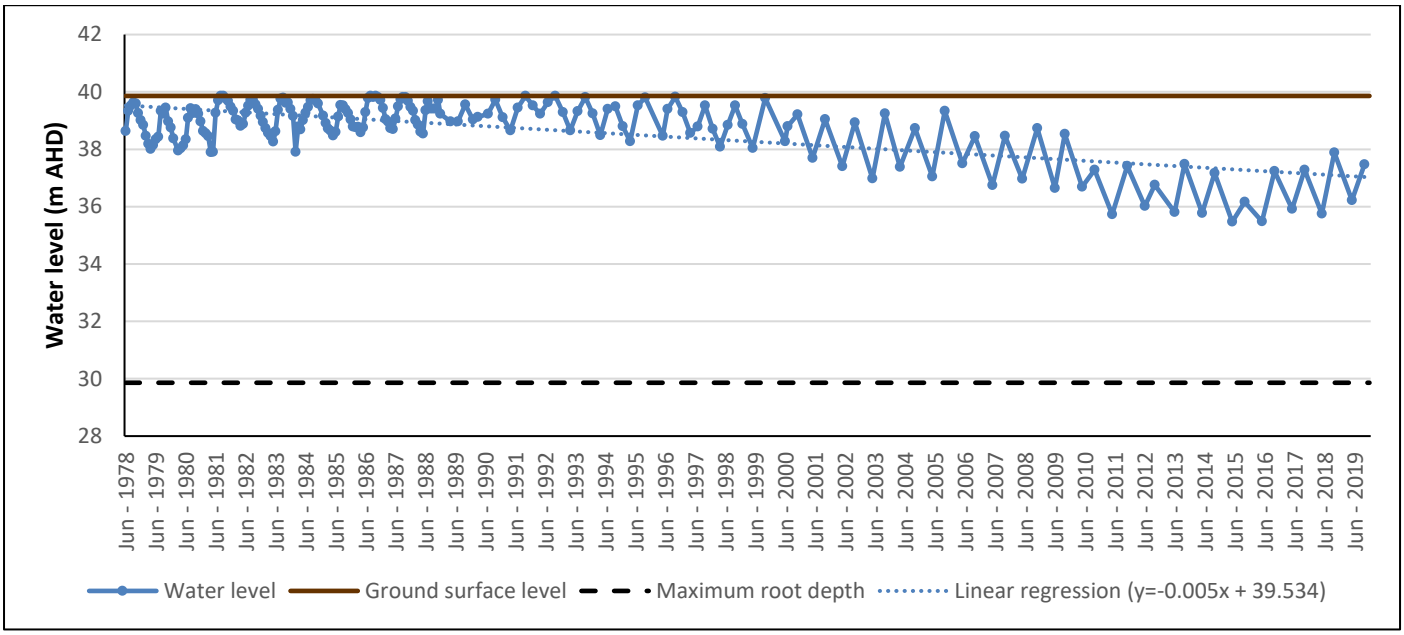

Figure 5a. Hydrograph of monitoring bore located 880m north of occurrence MYPEARCE10 (24) (site ref: 61611083), sampling the superficial Swan aquifer (DoW 2020).

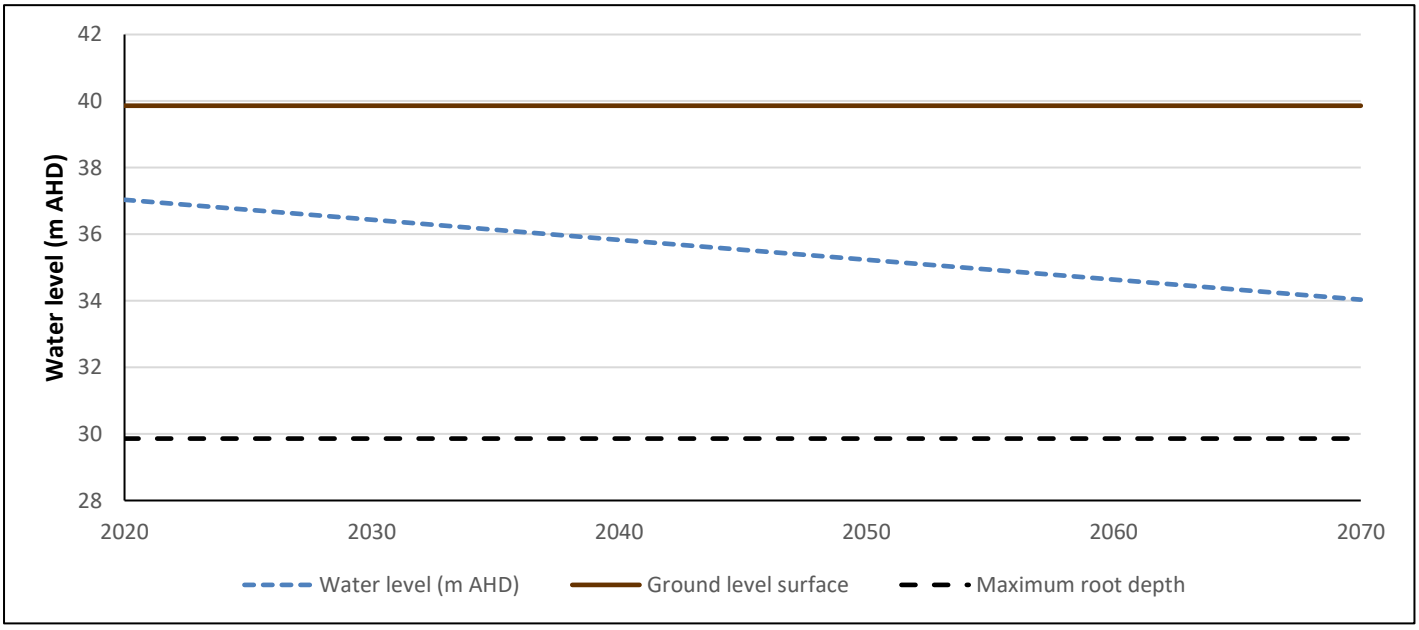

Figure 5b. A 50-year forecast of groundwater level decline at occurrence MYPEARCE10 (24) (site ref: 61611083) calculated using the trendline (y=-0.005x + 39.534).

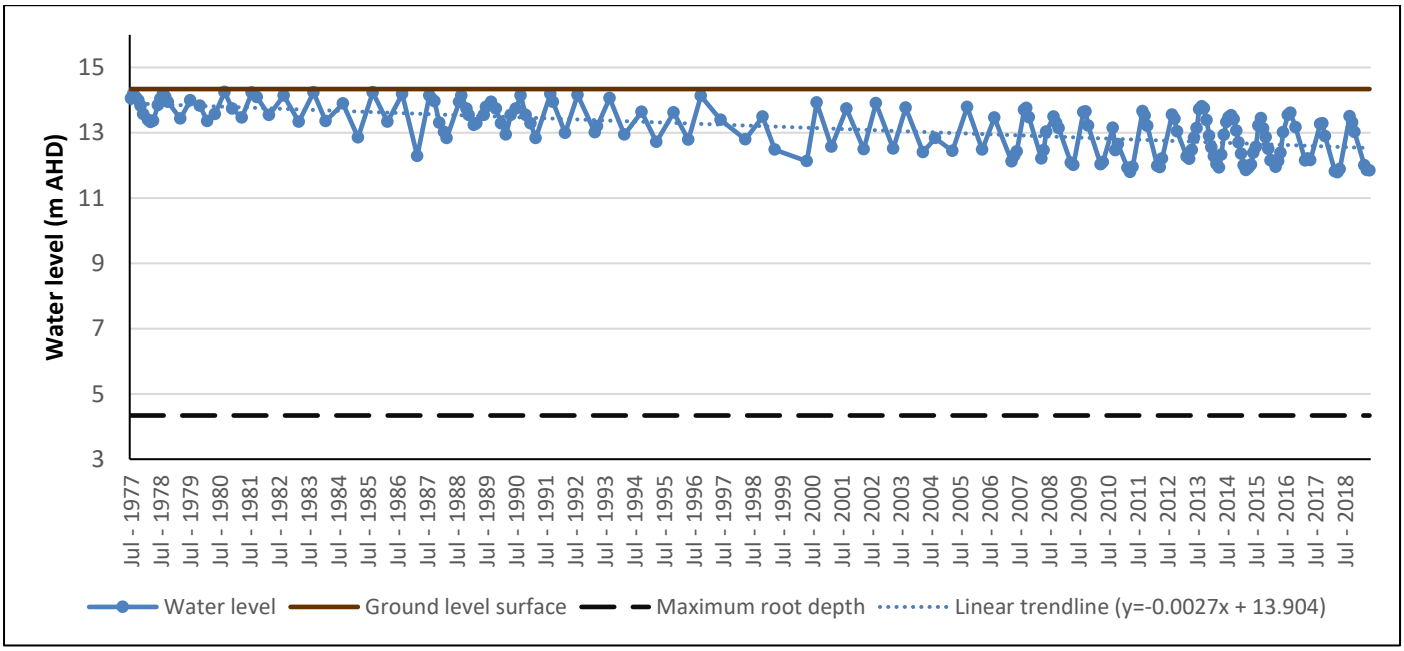

Figure 6a. Hydrograph of monitoring bore located 18m south of occurrence WATER03 (25), and 373m east of occurrence WATER06_Webb (site ref: 61118038), sampling the superficial Swan aquifer (DoW 2020).

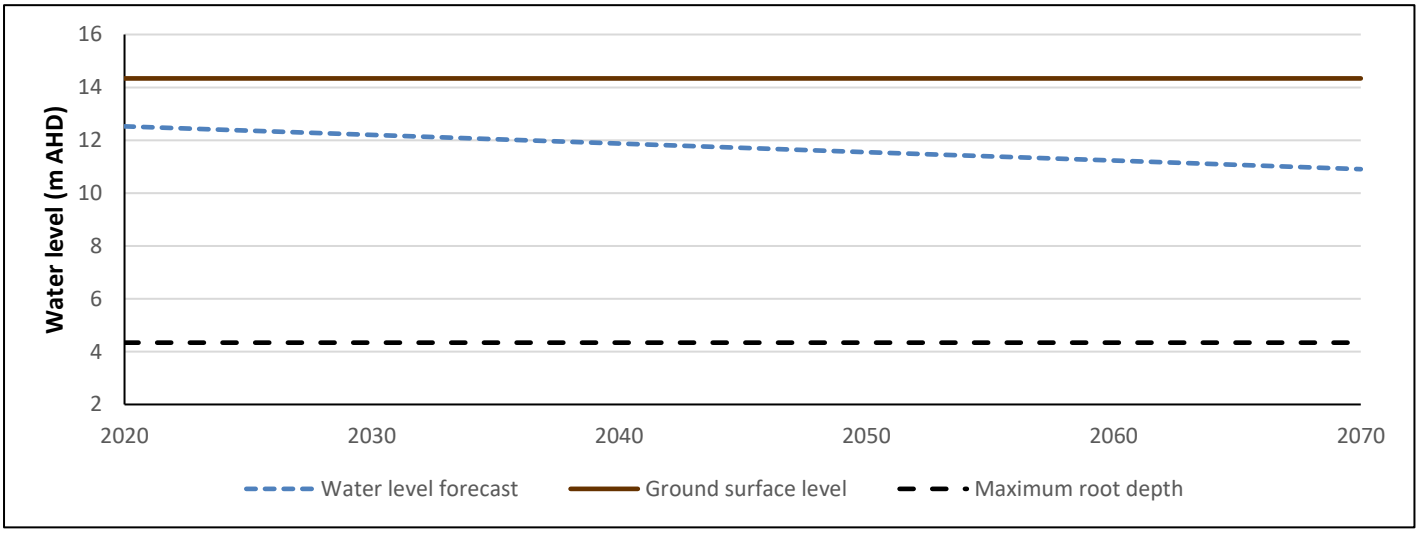

Figure 6b. A 50-year forecast of groundwater level decline at occurrence WATER03 (25) and WATER06_Webb (40) (site ref: 61118038) calculated using the trendline (y=-0.0027x + 13.904).

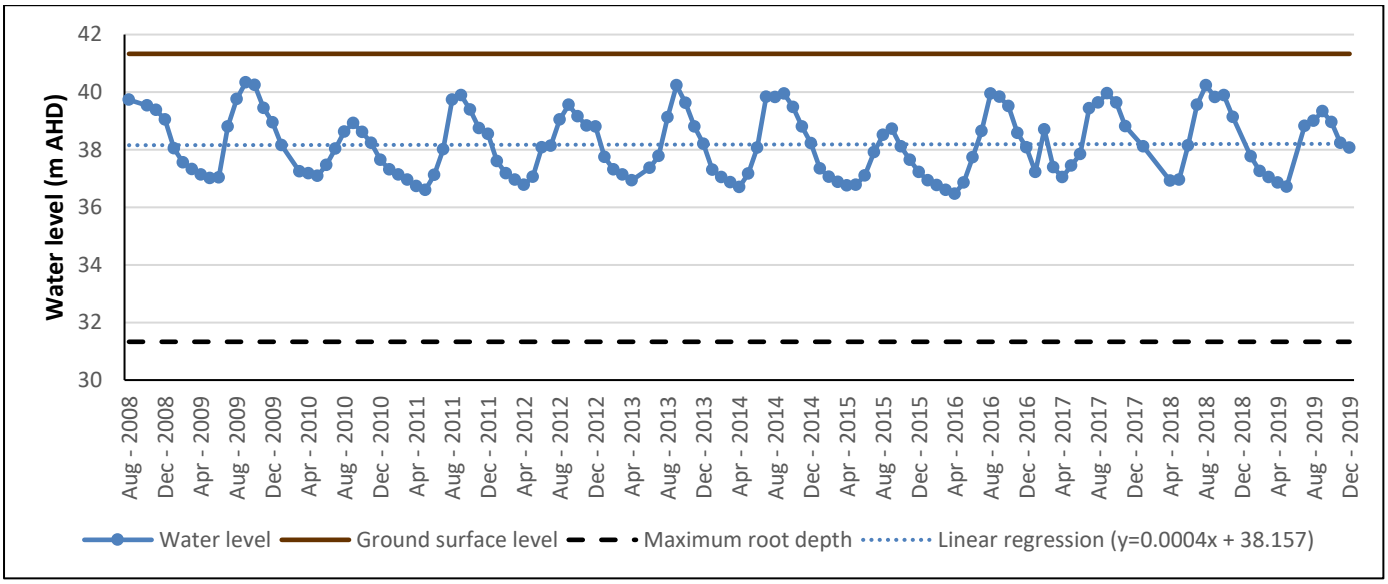

Figure 7. Hydrograph of monitoring bore located 341m west of occurrence nthdanth01 (39) (site ref: 61410655), sampling the superficial Swan aquifer (DoW 2020).

Salinisation and Inundation

Salinisation can increase as a result of evaporation of increased volumes of surface water, especially where saline superficial aquifers are in contact with the surface. This is especially true for clay soils, which inhibit rainfall infiltration and result in high evaporation rates and concentration of salts (Davidson 1995).

The level of risk from groundwater and salinity levels in occurrences (Occurrence 5 – TALB12 in particular) requires monitoring to determine if salinisation or increased inundation pose a major threat to the community.

APPENDIX 2 Distribution of SCP3c

The map above shows the extent of distribution of the SCP3c community. This community has a range of 206km, with the southernmost occurrence at Stratham and the northernmost at Bullsbrook. The map is indicative of 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).

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APPENDIX 3 IUCN Red List Criteria for ecosystems (version 2.2) (IUCN 2017)

A. Reduction in geographic distribution over ANY of the following time periods:				
		CR	EN	VU
A1	Present (over the past 50 years).	≥ 80%	≥ 50%	≥ 30%
A2a	Future (over the next 50 years).	≥ 80%	≥ 50%	≥ 30%
A2b	Future (over any 50 year period including the present and future).	≥ 80%	≥ 50%	≥ 30%
A3	Historic (since 1750).	≥ 90%	≥ 70%	≥ 50%
B. Restricted geographic distribution indicated by EITHER B1, B2 or B3:				
		CR	EN	VU
B1	Extent of a minimum convex polygon enclosing all occurrences (Extent of Occurrence)	≤ 2,000 km²	≤ 20,000 km²	≤ 50,000 km²
	AND at least one of the following (a-c):			
	(a) An observed or inferred continuing decline in **EITHER**:			
	i. a measure of spatial extent appropriate to the ecosystem; **OR**			
	ii. a measure of environmental quality appropriate to characteristic biota of the ecosystem; **OR**			
	iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem.			
	(b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years.			
	(c) Ecosystem exists at …	1 location	≤ 5 locations	≤ 10 locations
B2	The number of 10 × 10 km grid cells occupied (Area of Occupancy)	≤ 2	≤ 20	≤ 50
	AND at least one of a-c above (same sub-criteria as for B1).			
B3	A very small number of locations (generally fewer than 5) **AND** prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and thus capable of collapse or becoming Critically Endangered within a very short time period (B3 can only lead to a listing as VU).			VU
C. Environmental degradation over ANY of the following time periods:				
			Relative severity (%)	
C1	Extent (%)	≥ 80	≥ 50	≥ 30

	The past 50 years based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 80	≥ 50	≥ 30
C2	The next 50 years, or any 50-year period including the present and future, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 90	≥ 70	≥ 50
C3	Since 1750 based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 90	CR	EN	VU
		≥ 70	EN	VU	
		≥ 50	VU		
D. Disruption of biotic processes or interactions over ANY of the following time periods:					
			Relative severity (%)		
		Extent (%)	≥ 80	≥ 50	≥ 30
D1	The past 50 years based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 80	≥ 50	≥ 30
D2	(D2a) The next 50 years, or (D2b) any 50-year period including the present and future, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table: OR	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 90	≥ 70	≥ 50
D3	Since 1750, based on a change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 90	CR	EN	VU
		≥ 70	EN	VU	
		≥ 50	VU		
E. Quantitative analysis					
			CR	EN	VU
… that estimates the probability of ecosystem collapse to be:			≥ 50% within 50 years	≥ 20% within 50 years	≥ 10% within 100 years