INTERIM RECOVERY PLAN NO. 328

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

2012-2017

October 2012

Department of Environment and Conservation
Species and Communities Branch
Locked Bag 104, Bentley Delivery Centre, WA, 6983

Department of Environment and Conservation

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Environment and Conservation (DEC) Policy Statements Nos. 44 and 50.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

DEC is committed to ensuring that threatened ecological communities are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by DEC's Director of Nature Conservation.

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This Recovery Plan will operate from October 2012 but will remain in force until withdrawn or replaced. It is intended that, if the ecological community is still ranked Vulnerable or Endangered after five years, this Recovery Plan will be replaced or updated.

The provision of funds identified in this IRP is dependent on budgetary and other constraints affecting DEC, as well as the need to address other priorities.

Information in this IRP was accurate at December 2011.

ACKNOWLEDGMENTS

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Cover photograph by Valerie English.

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CITATION

This Interim Recovery Plan should be cited as:

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SUMMARY

Name: '*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).

Description: *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (hereafter called *Banksia attenuata* and/or *Eucalyptus marginata* woodlands) was originally described by Gibson *et al.* (1994) and occurs on sands at the base of the Scarp between Byford and Yarloop predominantly on the Pinjarra Plain and Ridge Hill Shelf. Most of the occurrences of this community type are *Eucalyptus marginata – Banksia attenuata* woodlands but the community also occurs as *Banksia* woodlands and heaths. A diverse shrub layer comprising *Hakea stenocarpa, Conostylis setosa*, and *Johnsonia* aff. *pubescens* differentiates this community type from the other two subgroups that linked quite closely to this Banksia community in Gibson *et al*. (1994) - the 'type 20 woodlands' (*Banksia attenuata* woodlands over species rich dense surublands – floristic community type 20a; and Eastern shrublands and woodlands – floristic community type 20c). *Mesomelaena pseudostygia* is common, occurring in 67% of plots in this community. The *Banksia attenuata* and/or *Eucalyptus marginata* woodlands are very species rich (62.7 species/100m^2) with low weed frequency (Gibson *et al.* 1994).

DEC Regions: Swan and South West.

DEC Districts: Swan Coastal, Perth Hills and Wellington.

Local Government Authorities: Serpentine – Jarrahdale, Harvey, Murray, Armadale, Gosnells, Swan, Bullsbrook and Waroona.

Current status: Assessed on the 18 July 1996 as Endangered. This ranking has been endorsed by the WA Minister for Environment. The community is not currently listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat requirements: Sites in *Banksia attenuata* and/or *Eucalyptus marginata* woodlands are found on a range of soils on the base of the Darling Scarp from Yarloop to Byford. Soils are mainly yellow orange and yellow sands. The community occurs largely on Guildford clays or at the boundary of Guildford unit and Ridge Hill Shelf, with a few occurrences on Bassendean, Mogumber and Southern River Units as described by Churchward and McArthur (1978).

Habitat critical to survival, and important occurrences: The critical habitat for this community is the sandy soils on which the community occurs, and the fresh superficial groundwater that probably helps to sustain key flora such as *Banksia* and *Eucalyptus* in this community, and the catchment for this groundwater.

Occurrences within Bush Forever sites, and occurrences with comparatively large intact areas of the community that are in relatively good condition outside of Bush Forever are considered important occurrences. Occurrences that provide for representation of the community across its geographic range and that can be managed for conservation and/or with conservation included in their purpose are also considered important.

Affected interests: Land owners and managers of all occurrences may be affected by actions in this plan, in particular those lands not managed by DEC or intended to be transferred to DEC management.

Indigenous interests: The South West Aboriginal Land and Sea Council (SWALSC), an umbrella group, covers the areas considered in this plan. Comment was sought from the Council about any aspects of the plan, but particularly about the proposed on-ground actions. Table 1 identifies areas of the ecological community that contain sites that are known to have particular aboriginal significance. No general significance to indigenous people has been identified for the ecological community. Action 3 identifies the intention to continue liaison with relevant groups, including indigenous groups.

Social and economic impacts and benefits: Pedestrian access by means of formal walk trails has potential to allow the aesthetic values of the community to be appreciated without degrading the community, and this

provides a social benefit. Where specific active recreational pursuits such as four wheel driving are prevented through access control, this may be perceived as a social impact, however such access control also helps to prevent the continued degradation of the community and maintain other social benefits.

Related biodiversity impacts and benefits: Recovery actions implemented to improve the quality or security of the community are likely to improve the status of any species within the community and other associated vegetation types within managed areas of remnant vegetation. Eight other threatened ecological communities (TECs), two priority ecological communities (PECs), four declared rare flora (DRF), four priority flora and seven specially protected fauna occur within remnant vegetation that contains this community, or occur close by.

Term of plan: The plan will operate from 2012 to 2017 but will remain in force until withdrawn or replaced. It is intended that, if the ecological community is still ranked endangered in Western Australia after five years, the need for further recovery actions and the need for an updated recovery plan will be evaluated by the recovery teams.

IRP Objective(s): To maintain or improve the overall condition of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in the known locations and reduce the level of threat with the aim of ensuring it does not meet criteria for a higher threat rank.

Criteria for success:

- An increase in the number of occurrences of this community managed for conservation and/or with conservation included in the purpose.
- Representative areas of the community across its geographical range with condition rank maintained, or with improved condition rank (Bush Forever scales).
- 90% or more of the aerial extent of occurrences maintained at the same condition rank, or improved (Bush Forever scales)

Criteria for failure: Decline in condition rank of 10% or more of the aerial extent of the community or failing to achieve an increase in the area managed for conservation.

Summary of Recovery Actions:

Coordinate recovery actions	Ensure hygiene conditions
Map habitat critical to survival	Monitor dieback disease, determine priority areas for treatment
Liaise with current land owners, managers	Seek to ensure fences are constructed and maintained
Establish quadrats and analyse data	Install markers and signage as required
Seek to implement Bush Forever, and avoid further clearing of the community	Disseminate information
Monitor extent and boundaries of occurrences	Support private landowners to conserve the community
Encompass monitoring within an adaptive management framework	Seek long term protection of areas of the community
Determine the 'normal range' of groundwater levels and quality	Consider climate change issues in management
Develop and implement fire management strategy	Report on success of management strategies for the community
Implement weed control, rehabilitation, and replant where necessary	

1 BACKGROUND

1.1 History, defining characteristics, and conservation significance

The significance of this diverse *Banksia/Eucalyptus* community was recognized in 1992 during a survey of remnant vegetation on the eastern side of the Swan Coastal Plain (Keighery and Trudgen 1992). The floristic community was then defined through a major statistical analysis of data from 500 plots, in Gibson *et al*. (1994). Gibson *et al*. (1994) named the community '*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain'. The community type is often referred to as 'Swan Coastal Plain community type 20b' in reference to the numerical identifier applied in Gibson *et al*. (1994).

Banksia attenuata and/or *Eucalyptus marginata* woodlands are known from yellow sands at the base of the Scarp between Byford and Yarloop. Occurrences additional to those identified in Trudgen and Keighery (1992), and Gibson *et al*. (1994) have been recognized through additional work undertaken by the former Department of Environment (DEP 1996), the Bush Forever project (Government of Western Australia 2000), studies by Local Government Authorities for the Perth Biodiversity Project (Perth Biodiversity Project 2011), and studies done by various consultants and staff from state agencies.

Banksia attenuata and/or *Eucalyptus marginata* woodlands are regionally rare, very restricted and a relatively rich community of the eastern side of the Swan Coastal Plain. It is restricted to the sands at the base of the Scarp from Chittering in the north to Yarloop in the south. It is likely that there has been a severe decline in the geographic distribution of this community due to land clearing on the Swan Coastal Plain.

In Gibson *et al*. (1994), sites of community 20b were differentiated from the other two subgroups of the 'type 20 woodlands' (*Banksia attenuata* woodlands over species rich dense shrublands – floristic community type 20a; and Eastern shrublands and woodlands – floristic community type 20c) by the occurrence of species such as *Hakea stenocarpa, Conostylis setosa,* and *Johnsonia* aff. *pubescens* as well as the absence of species restricted to the other subgroups.

The community was only known from about 168 ha when it was recommended as endangered by the Western Australian Threatened Ecological Community Scientific Committee (TECSC) in 2001. Further survey work has since revealed that it covers about 220 ha. The community is comprised of 36 highly fragmented occurrences. A broadscale location map of occurrences also occurs at appendix 2. Of the total 220 ha, approximately 85ha occurs in nature reserves and other DEC-managed reserves and lands, 69ha is in reserves for various purposes that are not managed by DEC, and 67 ha occurs on freehold land.

About 163 ha of the community is in Excellent condition or better (condition scales in volume 2 Bush Forever), 22ha is in Very Good and Good condition, with less than 1 ha Completely Degraded. About 179 ha is within Bush Forever sites (21 occurrences), and receive increased protection through planning processes. About 41ha occurs outside of Bush Forever.

Occurrences 1-3, 6-16, 18-23 and 35 of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands (Table 1) are included in Bush Forever and are areas of 'regionally significant bushland to be retained and protected forever' (Government of Western Australia 2000). Occurrences that are not included in Bush Forever mainly occur on private property, are on local government reserves and were identified after the publication of Bush Forever, or are outside of the boundary covered by Bush Forever. The Bush Forever document notes that any proposals likely to affect occurrences of threatened ecological communities will be dealt with through the 'Bush Forever planning processes, coordinated between (the then) Department of Environment and Department of Planning and Infrastructure' (now DEC and the Department of Planning).

The most significant threat to the community is clearing for residential areas and related infrastructure. Too frequent fire, weed invasion and overuse by recreational users are additional major threats to the community. With many of the occurrences surrounded by highly urbanised areas, 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.

Table 1: Extent, location and threats to occurrences

Occ #	Location	Land owner/ manager	Purpose	Estmtd area (ha)	Bush Forever site (site number)	Soil type From Churchward and McArthur (1978) and Heddle *et al*. (1980)	Major threats #	Comments
1, 2	Cardup Nature Reserve, Cardup Siding Rd (Card01,02,05,06,08,09)	Conservation Commission	Conservation of Flora and Fauna	14.8 and 33.1	Yes (352)	Guildford complex – Guildford clays system	Inappropriate fire regime (too frequent), *Phytophthora* species impacts, weed invasion,	Managed for conservation Area fenced but some fences not maintained Excellent condition (1994) Gibson *et al*. (1994) quadrats present
3	Reserve 17490 Mead St Byford (Brick02)	Shire of Serpentine-Jarrahdale	Recreation	2.6	Yes (321)	Boundary of Forrestfield Unit (Ridge Hill Shelf) and Guildford clays system	Inappropriate fire regime (too frequent), *Phytophthora* species impacts, weed invasion and disturbance due to recreation – general disturbance, trampling (by horses in particular), dieback spread and track widening	Managed for conservation Excellent condition (2005) Gibson *et al*. 1994 quadrats present
4	Reserve 31900 South Western Hwy and Burney Rd (Yarl04)	Shire of Harvey	Rubbish disposal site and sand pit	6.4	No	Forrestfield Unit – Ridge Hill Shelf	Inappropriate fire regime (too frequent), *Phytophthora* species impacts and weed invasion	Aboriginal site – Artefact scatters nearby. Purpose inconsistent with conservation management. Part of occurrence previously cleared 50% Excellent condition, 50% Good Condition (2007) Gibson *et al*. 1994 quadrats present
5	Reserve 6268 Burnside Rd, Coolup (Burnrd01)	Conservation Commission	Conservation of Flora and Fauna	7.5	No	Boundary of Forrestfield Unit (Ridge Hill Shelf) and Guildford clays system	Inappropriate fire regime (too frequent), *Phytophthora* species impacts and weed invasion	Managed for conservation Excellent condition (1995) Weed control and monitoring ny DEC Gibson *et al*. 1994 quadrats present
6	Roman Rd, Mundijong (Myroman01)	Conservation Commission	Conservation of Flora and Fauna	4.9	Yes (362)	Forrestfield Unit - Ridge Hill Shelf system	Inappropriate fire regime (too frequent), weed invasion, selective grazing by native or introduced species and illegal rubbish dumping	Managed for conservation Good condition (2008) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever (no quadrat, and not suitable for quadrat)
7	Rail Reserve Byford to Serpentine (Mybyford05)	WestNet Rail	Railway	3.0	Yes (350)	Forrestfield Unit - Ridge Hill Shelf system	Inappropriate fire regime (too frequent), weed invasion and potential clearing to upgrade the road or railway line	Excellent condition (2000) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever (no quadrat, and may not be suitable for quadrat)
8	Rail Reserve Byford to Serpentine (Mybyford06)	WestNet Rail	Railway	0.8	Yes (350)	Forrestfield Unit - Ridge Hill Shelf system	Inappropriate fire regime (too frequent), weed invasion and potential clearing to upgrade the road or railway line	Very good condition (2000) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever (no quadrat, and may not be suitable for quadrat)

9	Rail Reserve Byford to Serpentine (Mybyford07)	WestNet Rail	Railway	3.9	Yes (350)	Forrestfield Unit - Ridge Hill Shelf system	Inappropriate fire regime (too frequent), weed invasion and potential clearing to upgrade the road or railway line	Very good condition (2000) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever (no quadrat, and may not be suitable for quadrat)
10	Bella Cumming Reserve, Mundijong Town Lot 59 Keirnan St (Bella01)	Shire of Serpentine-Jarrahdale	Recreation and Parklands	2.0	Yes (350)	Forrestfield Unit - Ridge Hill Shelf system	Inappropriate fire regime (too frequent), and weed invasion	Reserve is fenced Excellent condition (2000) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever (no quadrat, and may not be suitable for quadrat)
11	Loc 300 Connell Av. Kelmscott (Connell_Plot01, Connell_Transect01, Connell_Transect02)	WAPC but managed by DEC under Section 16a agreement	Regional park	19.1	Yes (61)	Forrestfield Unit - Ridge Hill Shelf system	Trampling by recreational users, weed invasion, inappropriate fire regime (too frequent), illegal rubbish dumping and grazing by native or introduced species	Aboriginal Site – Artefacts/Scatter, Camp. Managed for conservation 80% Excellent, 20% in Very Good condition (2011) Quadrats established 2009/10. Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever Fire monitoring transects established 2009/10
12	Bob Blackburn Reserve, 3560 Williams Rd; 32 Champion Dr; 3560 Challis Rd; 28 Williams Rd Armadale (Blackburn01, Blackburn02 and Blackburn Plot 01)	City of Armadale	Public recreation (bushland portion now for Passive Recreation and Conservation (C.Omacini [1]personal communication 2010.)	5.6	Yes (62)	Forrestfield Unit - Ridge Hill Shelf	Weed invasion (introduced plantings and species introduced along tracks), approx 10% of bushland infected by *Phytophthora* species (as at 1998 inspection); inappropriate fire regime (too frequent)	Managed for conservation Excellent condition (2010) Site has a friends group and clearly defined walk trail marked by bollards Bushland fenced along Williams Rd Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever. Quadrat established 2007 (yet to be analysed).
13	Lots 109, 110 and 9008 and Crown Reserve 44573 and Road Reserve Clifford St, Maddington (Clifford01)	Main Roads WA and City of Gosnells	Vacant land - residential and drainage	5.4	Yes (53)	Boundary of Forrestfield Unit (Ridge Hill Shelf) and Guildford clays system	Clearing for tracks, weed invasion from tracks and drain, inappropriate fire regime (too frequent), trampling by recreational users	80% Excellent, 20% Very Good condition (2009) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever; no quadrat established
14	Lots 22 and 23 and Road Reserve cnr Norman Rd and South Western Hwy, Whitby (norm01, norm03, norm07)	Private	No purpose listed; under mineral tenements	58.4	Yes (354)	Forrestfield Unit – Ridge Hill Shelf	Potential for clearing; inappropriate fire regimes (too frequent); *Phytophthora* impacts appear to be present along the drainage line; grazing by native/introduced animals (western patch has lower diversity of understorey species); and some weed invasion from firebreak	Excellent condition (2005) Occurrence fenced Quadrats established for Bush Forever, and analysed.

[1] Ms Corinne Omacini: City of Gosnells

15 and 16	Lot 778 Karnup Rd, Serpentine (Paul01 and Paul06)	WestNet Rail and Shire of Serpentine – Jarrahdale	Sport ground, recreation, racecourse and showground/rail way purposes and road verge	3.9 and 1.1	Yes (375)	Forrestfield Unit – Ridge Hill Shelf	Trampling by horses, recreational users (BMX), tracks; inappropriate fire regime (too frequent); possibly *Phytophthora* species; weed invasion along tracks, particularly African lovegrass *(Eragrostis curvula),* veltgrass *(Ehrharta calycina*), *Watsonia meriana* var. *bulbillifera* and some wild oats (*Avena fatua),* clearing for tracks and around communications tower	Aboriginal site – Ceremonial, Mythological Varying condition over tenures – mostly excellent to very good condition Fenced Management plan Current use: golf course, pony club, polocrosse club and nature conservation Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever (no quadrat, and may not be suitable for quadrat)
17 and 18	CR 32352 Lambkin Nature Reserve and Road Reserve, Tonkin St., Serpentine (xlamb02 and xlamb01)	Conservation Commission and Shire of Serpentine-Jarrahdale	Conservation of flora and fauna; vacant land - residential and road verge	0.01 and 0.6	Part Yes (375)	Forrestfield Unit – Ridge Hill Shelf	Disturbance due to recreational activities; inappropriate fire regime (too frequent); weed invasion	Aboriginal site – Ceremonial, Mythological Mostly excellent condition (2010) Quadrat established by B.Keighery in xlamb01, and analysed. xlamb02 considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever (no quadrat).
19	Road Reserve, Hall Rd, Serpentine (Hall01)	Shire of Serpentine-Jarrahdale	Road reserve	0.4	Yes (365)	Forrestfield Unit – Ridge Hill Shelf	Disturbance due to recreational activities; inappropriate fire regime (too frequent); weed invasion	Aboriginal site – Ceremonial, Mythological 50% in Excellent, 30% in Very Good and 20% Good condition (2002) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever (no quadrat)
20	CR 46587 Hall Serpentine (Hall03)	Conservation Commission	Conservation of Flora and Fauna	0.4	Yes (365)	Forrestfield Unit – Ridge Hill Shelf	Disturbance due to recreational activities (eg. tracks); inappropriate fire regime (too frequent); weed invasion (*Watsonia*)	Aboriginal site – Ceremonial, Mythological 90% in Excellent, 5% in Very Good and 5% in Good condition (2002) Occurrence is fenced Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands – no quadrat
21 and 22	Watkins Road Nature Reserve (CR23012), Lot441 and UCL on Watkins Rd, Mundijong (Watkins01, Watkins Plot 1, Watkins02)	Conservation Commission/ Shire of Serpentine-Jarrahdale/Public Transport Authority of WA	Conservation of Flora and Fauna/ no purpose listed	5.1 and 7.6	Yes (360)	Forrestfield Unit – Ridge Hill Shelf	Disturbance due to recreational activities (horses, dirt bike tracks, car tracks and clearing); weed invasion (from illegal rubbish dump and historical grazing), inappropriate fire regime (too hot and frequent) – central southern area missing adult trees as a result of fire of disease; over grazing by rabbits and kangaroos, potential for altered surface drainage due to road grading	Managed for conservation Mostly in Excellent to Very Good condition, approx 5% Completely Degraded (2011) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever. Quadrat established (yet to be analysed) Weed control by Urban Nature and Swan Coastal District DEC

23	2 George Wiencke Dr, Perth Airport (perth03, myperth03)	Commonwealth of Australia/ Westralia Airports Corporation	Government Purposes	1.4	Yes (386)	Bassendean system	Potential for clearing, sand track through eastern portion of occurrence; weed invasion (*Gladiolus*); inappropriate fire regime (too frequent)	Aboriginal site – bridge camp Conservation precinct 7 managed for conservation Mostly in Excellent condition (2002) Quadrat established for Bush Forver (2000), and analysed
24	CR11160 and CR43703 Bancell Rd, Wagerup (Bancell01, Bancell02)	Shire of Waroona/ Electricity Corporation - Western Power	Timber and Gravel/ Depot and power pole dumping	5.6	No	Forrestfield Unit - Ridge Hill Shelf	*Phytophthora species*; disturbance due to recreational activities (tracks); weed invasion (*Watsonia* and grassy weeds); rubbish dumping; grazing by cattle and kangaroos; inappropriate fire regime (too frequent)	Purpose inconsistent with conservation management 70% in Excellent, 30% in Good condition (2002) Considered by environmental consultants to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands – no quadrat, but species analysis supports conclusion
25	Lots 3, 9, 10, 11 and 12, Rushton Rd, Martin (myrush01, Rush02)	City of Gosnells	No purpose listed	7.5	No	Forrestfield Unit - Ridge Hill Shelf	Inappropriate fire regime (too frequent); weed invasion (*Watsonia*, Cape Tulip (*Moraea* sp.), Paterson's curse (*Echium plantagineum*); trampling by recreational users; rubbish dumping; *Phytophthora* spp. impacts and vehicle tracks	Managed for conservation Mostly in Excellent condition (2002) Bushland is fenced off Two quadrats established for Bush Forever and analysed
26	Lot 202 on cnr of Smith & Chittering Rds, Bullsbrook (Chittering01, Chittering Plot1)	City of Swan	Conservation and Recreation	2.3	No	Mogumber	Disturbance due to recreational activities (horse riding); weed invasion; inappropriate fire regime (too frequent) and *Phytophthora* species impacts	Aboriginal sites – (Ceremonial, Mythological, Modified Tree); Bullsbrook camp; Ellen Brook/Upper Swan (mythological) Managed for conservation Excellent condition (2009) Considered by environmental consultant to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands. Quadrat established 2006 by DEC Species and Communities Branch (not yet analysed).
27	Creyk Park Lot 141 on Lilian Ave, Armadale (Creyk01)	City of Armadale	Recreation	0.8	No	Forrestfield Unit – Ridge Hill Shelf	Weed invasion (from edges and tracks, *Acacia longifolia* and teatree plantings); inappropriate fire regime (too frequent); disturbance due to recreational activities (BMX jumps), potential for *Phytophthora* spp. impacts	Managed for conservation Condition scale (2004); 80% Excellent, 20% Good (2007) Fenced Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands (B. Keighery) – no quadrat, and bushland may not be suitable for quadrat analysis.
28	CR44606 Canning Location 4071, cnr Railway Av and Cammillo Rd, Kelmscott (Cammillo01)	City of Armadale	Recreation (recently changed to Passive Recreation and Conservation (C.Omacini *pers comm*., 2010.)	0.2	No	Forrestfield Unit – Ridge Hill Shelf	Weed invasion (*Watsonia*, *Gladiolus*, love grass (*Eragrostis* sp.), wild oats (*Avena fatua*) – throughout occurrence), *Phytophthora* spp. impacts, illegal rubbish dumping; inappropriate fire regime (too frequent)	Managed for conservation Condition 100% Good (2007) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands (B. Keighery) – no quadrat, and bushland not suitable for quadrat analysis Fenced with farmstyle fencing

29	Lot 91 Owen Rd, Armadale (Depot01)	City of Armadale	Vacant land – residential, depot site	0.1	No	Forrestfield Unit – Ridge Hill Shelf	Weed invasion, potential for *Phytophthora* spp. impacts, illegal rubbish dumping; inappropriate fire regime (too frequent)	Managed for conservation Condition 100% Very Good (2007) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands (B. Keighery) – no quadrat and bushland not suitable for quadrat analysis.
30	CR9820 and CR24748 Third Ave, Kelmscott (John Dunn01)	Dept of Planning /City of Armadale	Cemetery/Recreation, Sport Ground	0.2	No	Forrestfield Unit – Ridge Hill Shelf	Clearing for development; weed invasion (kikuyu (*Pennisetum clandestinum*), love grass); *Phytophthora* spp. impacts; inappropriate fire regime (too frequent)	Managed for conservation Condition 100% Very Good (2007) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands – (B. Keighery) no quadrat and bushland not suitable for quadrat analysis Fencing behind soccer goals
31	CR34326 Lake Rd, Armadale (Moore01)	City of Armadale	Recreation (recently changed to Passive Recreation and Conservation (C.Omacini *pers comm.,* 2010.)	0.3	No	Southern River complex	Inappropriate fire regime (too frequent); potential *Phytophthora* species impacts; weed invasion	Managed for conservation Condition 100% Good (2007) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands (B. Keighery) – no quadrat and bushland not suitable for quadrat analysis Surrounded by farm style fencing
32	CR39579 Kendal Way, Armadale; 63 Ypres Road, Cammillo; 11 Grovelands Dr, Cammillo (Kendal01)	City of Armadale/ Anglican Homes Inc/City of Armadale	Recreation/Aged home/Centre (recently changed to Passive Recreation and Conservation (C.Omacini *pers comm*., 2010.)	2.4	No	Forrestfield Unit – Ridge Hill Shelf	Weed invasion, *Phytophthora* species impacts, inappropriate fire regime (too frequent); trampling by recreational users	Partly managed for conservation Condition 100% Very Good (2007) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands (B. Keighery) – no quadrat and bushland not suitable for quadrat analysis Fenced along Grovelands Drive. Farmstyle and small fences installed in reserve
33	CR39208 Creyk Park Reserve, Armadale - Canning Location 3481 (Creyk02)	City of Armadale	Public Recreation; Reserve	0.2	No	Forrestfield Unit – Ridge Hill Shelf	Weed invasion; inappropriate fire regime (too frequent); trampling by recreational users, clearing for BMX tracks and jumps; potential *Phytophthora* species impacts	Managed for conservation Condition 100% Very Good (2004) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands – no quadrat and bushland not suitable for quadrat analysis Fenced
34	CR31901 South Western Hwy (Myyarl03)	Commissioner of Main Roads	Sand	5.2	No	Boundary of Forrestfield (Ridge Hill shelf) and Guilford complexes (Guildford clays)	Clearing; weed invasion; inappropriate fire regime (too frequent); potential mineral sand mining applications	Aboriginal site within approx 20m – scatters Purpose not consistent with conservation Excellent condition (2003) No quadrat in Myyarl03; quadrat in Yarl04 analysed

35	Lot 101, Kiln Rd, Byford (Austral02, Austral Plot02)	Bristile Holdings Pty. Ltd	No purpose listed – clay extraction adjacent	4.5	Yes (271)	Forrestfield Unit – Ridge Hill Shelf	Weed invasion; *Phytophthora* species impacts; grazing by native/introduced species	Aboriginal sites – artefacts and scatter Excellent condition Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever. Quadrat established 2007 (not yet analysed).
36	Lot 2 Nettleton Road, along Beenyup Rd, Byford (Nett01, Nett06, Nett09)	Aspen	Residential development planned for portion	4.3		Boundary of Forrestfield Unit – Ridge Hill Shelf, Guilford complexes (Guildford clays) and Darling Scarp	Clearing for development Recreational activities (BMX)	Condition 100% Very Good (2009) Considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands by environmental consultants, data supports conclusion. No quadrats established and not suitable for quadrat analysis.

#The potential impacts of drying climate would be applicable to all occurrences of the community so is not listed as a specific threat applicable to individual occurrences

Table 2: Bores within 300m of occurrences - depth to groundwater

occ. number, name	Depth to groundwater static level (m) below ground when drilled.
2 (Card05,06,08,09)	2.13m (from top of casing in bore 273m SW of CARD08 on 29 September 1998) SITE_ID-12572708 6m (in bore 305m SW of CARD08 on 26 October 1995) SITE_ID-20023674 2 m (in bore 325.4m S of CARD08 on 17 November 1999) SITE_ID-20083794
3 (Brick02)	**5m (in bore 166.2m NW of Occ in 1978) SITE_ID-20021424**
6 (Myroman01)	**2.44 m (in bore 277.8m NW of Occ on date unknown) SITE_ID-20023364** **1.83 m (in bore 268m WNW of Occ on date unknown) SITE_ID-20023371** 2.13 m (in bore 319.2m WSW of Occ on date unknown) SITE_ID-20023372
7 (Mybyford05)	**5.18 m (in bore 252.2m NNW of Occ on date unknown) SITE_ID-20023328** **5 m (in bore 204.2m NNW of Occ on 1 February 1989) SITE_ID-20023591** 0 m (in bore 300m W of Occ in 1971) SITE_ID-20023329 **4.57 m (in bore 168m SW of Occ in 1935) SITE_ID-20023333** **3.66 m (in bore 235.8m SW of Occ in 1914) SITE_ID-20023334**
8 (Mybyford06)	**1.36 m (in bore 143m south of Occ on 29 September 1998) SITE_ID-12572858**
9 (Mybyford07)	**1.52 m (in bore 170.2m SW of Occ on date unknown) SITE_ID-20023317**
10 (Bella01)	**2.13 m (in bore 197.4m W of Occ on date unknown) SITE_ID-20023309** ***3.2 m (in bore 28m S of Occ on date unknown) SITE_ID-20023327*** **2.74 m (in bore 120m S of Occ in 1956) SITE_ID-20023325**
12 (Blackburn01, Blackburn02 and Blackburn Plot 01)	4.880m (in bore 300m SW of BLACKBURN02 in 1969) SITE ID- 20021216 **8.530m (in bore 160m SW of BLACKBURN in 1969) SITE ID- 20021217**
14 (Norm01, Norm03, Norm07)	19 m (in bore 287.4m S of norm01 in 1969) SITE_ID-20038108
15 and 16 (Paul01, Paul06)	3.400m (in bore 310m N of Paul01 on 9 March 2000) SITE ID- 20084192 **2.740m (in bore 260m NE of Paul06 on date unknown) SITE ID- 20023455** ***0.910m (in bore 70m NE of Paul06 in 1968) SITE ID- 20023452*** 0.610m (in bore 310m E of Paul06 in 1950) SITE ID- 20023447 **4.880m (in bore 230m E of Paul06 in 1942) SITE ID- 20023441** 3.660m (in bore 230m E of Paul06 on date unknown) SITE ID- 20023442
17 and 18 (xlamb01 and xlamb02)	**0.610m (in bore 295m ENE of xlamb02 in 1950) SITE ID- 20023447** **3.350m (in bore 165m SSE of xlamb01 on date unknown) SITE ID- 20023453** **4.880m (in bore 230m NE of xlamb02 in 1942) SITE ID- 20023441** **3.050m (in bore 220m SSW of xlamb01 on date unknown) SITE ID- 20023454** 2.740m (in bore 305m N of xlamb02 on date unknown) SITE ID- 20023455

	3.660m (in bore 230m ENE of xlamb02 on date unknown) SITE ID- 20023442 ***0.910m (in bore 90m NNE of xlamb02 in 1968) SITE ID- 20023452*** **4.000m (in bore 210m S of xlamb01 on 23 May 1998) SITE ID- 20023695** 1.830m (in bore 325m SW of xlamb01 on date unknown) SITE ID- 20023457
19 (Hall01)	**3.59m (in bore 159.5m SW of Occ on 12 January 1987) SITE_ID20023235**
21 and 22 (Watkins01, Watkins Plot 1, Watkins02)	**15m (in bore 203.6m SE of WATKINS PLOT 1 on 2 December 1990) SITE_ID-20038156**
24 (Bancell01, Bancell02)	1.22 m (in bore 286.5m ENE of Bancell01 on date unknown) SITE_ID-20016563 (soak) 4.57 m (in bore 213.75m SE of Bancell01 on date unknown) SITE_ID-20016564
25 (Myrush01, Rush02)	**1.52 m (in bore 205.2m W of Rush02 on date unknown) SITE_ID-20038565** **4.88m (in bore 217.7m NW of Rush02 on date unknown) SITE_ID-20038313**
26 (Chittering01, Chittering Plot1)	**10.97 m (in bore 228m ENE of CHITTERING PLOT1 on 15 February 1988) SITE_ID-20041085** **11.28 m (in bore 202.3m NNW of CHITTERING PLOT1 in 1969) SITE_ID-20040992** **7.62 m (in bore 202.3m NNW of CHITTERING PLOT1 in 1970) SITE_ID-20041034**
28 (Camillo01)	***5.180m (in bore 75m SSW of Occ on 15 January 1973) SITE ID- 20038452*** **7.840m (in bore 285m WNW of Occ in 1972) SITE ID- 20038577**
29 (Depot01)	**6.700m (in bore 160m NE of Occ on 16 June 1997) SITE ID- 20038923** 2.440m (in bore 270m WSW of Occ in 1970) SITE ID- 20021220
30 (John Dunn01)	**4.270m (in bore 290m NE of Occ 1972) SITE ID- 20038587** ***0.490m (in bore 85m NE of Occ on 18 December 1967) SITE ID- 20038691***
31 (Moore01)	**0.610m (in bore 280m NW of Occ in 1967) SITE ID – 20018266** **4.570m (in bore 120m S of Occ in 1968) SITE ID- 20018579** **5.000m (in bore 210m E of Occ on 15 May 1983) SITE ID- 20019053** **3.960m (in bore 240m SW of Occ on 2 February 1980) SITE ID- 20018982** ***4.000m (in bore 90m NW of Occ on 20 September 1999) SITE ID- 20083820***
32 (Kendal01)	**0.610m (in bore 145m N of Occ in unknown year) SITE ID- 20018876**
33 (Creyk02)	**2.130m (in bore 280m W of Occ on 7 February 1980) SITE ID- 20038782**
35 (Austral02, Austral Plot02)	-
36 (Nett01,06 And 09)	***2.3380m (in bore 100m NE of NETT01 on 29 September 1998) SITE ID- 12574099*** **3.000m (in bore 110m S of NETT06 on 10 November 1997) SITE ID- 20038926**

Source: Department of Water - Water Information System (WIN).
Bores within 200m of occurrences – bold; bores within 100m of occurrence - bold italic.

1.2 Description of Occurrences

Occurrences 1 and 2 (Card01, 02, 05-09) occur in the Cardup Nature Reserve vested with the Conservation Commission. Approximately 48ha of the 70ha reserve contains *Banksia attenuata* and/or *Eucalyptus marginata* woodlands, about 7.8ha of the reserve contains the 'vulnerable' TEC '*Eucalyptus calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain' (community type 3b as described in Gibson *et al.* 1994) and the rest of the reserve is other vegetation in a degraded condition or belonging to other non-threatened community types. While most of the area of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands within this reserve is in Excellent condition a few areas are in a poorer condition. Wildfire occurred in the southern portion of occurrence 1 and northern portion of occurrence 2 in 1993. Bush Forever recommends that the existing purpose, care, control and management of the reserve be maintained. The priority 2 *Johnsonia pubescens* subsp. *cygnorum* is found at this site and the vulnerable *Calyptorhynchus banksii* (Forest Red-tailed Black Cockatoo) is known to visit the site.

Occurrence 3 (Brick02) occurs within Bush Forever site 321; Brickwood Reserve and adjacent bushland, Byford) for which a management plan has been drafted (Shire of Serpentine-Jarrahdale 2009). The majority of the 18.6ha reserve contains the critically endangered TEC '*Eucalyptus calophylla - Kingia australis* woodlands on heavy soils, Swan Coastal Plain', and small areas of the vulnerable TEC 'dense shrublands on clay flats', and approximately 2.5ha of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands. The site is utilized reasonably extensively for recreation, and has been impacted by trampling by horses and infestation with *Phytophthora* due to disturbance. Bush Forever recommends the existing purpose, care, control and management of the reserve be maintained, that the purpose of the reserve be amended to include conservation and appropriate mechanisms applied in consultation with the management body. The area of the reserve that contains the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands has been fenced and signposted to note the significance of the TEC at the site. The area was assessed and mapped for *Phytophthora* species in January 2000. This study concluded that the disease had spread through most of the vegetation except in the occurrence of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands. Phosphite treatment was applied to the dieback front in February 2002 to reduce the likelihood of disease spread into the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands. The Priority 3 *Acanthophis antarcticus* (Southern Death Adder) has been recorded in this reserve.

Occurrences 4 and 34 (Yarl04 and Myyarl03) occur on two Crown reserves. 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). Sand appears to have been excavated up to the boundary of the occurrence and edge effects such as increased wind speed and weed invasion as a result of this clearing, and altered subsoil drainage due to excavation could potentially impact the occurrence. The TEC '*Eucalyptus calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain' (hereafter called *Eucalyptus calophylla - Eucalyptus marginata* woodlands on sandy clay soils) is also recorded within the site. The last known fire occurred in the south-eastern portion of occurrence 34 in 1983.

Occurrence 5 (Burnrd01) occurs on an unnamed reserve proposed as an A class nature reserve. The reserve also contains an occurrence of the TEC '*Eucalyptus calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain'. Control of *Watsonia* and monitoring has been undertaken within this nature reserve (K. Brown[2] personal communication 2010). Aerial imagery indicates that the community may also occur on nearby private property. In 1962 a fire burnt through two-thirds of the southern portion of the occurrence, and in February 2007 a fire occurred at the southern extremity.

Occurrence 6 (Myroman01) occurs within the Bush Forever site 'Roman Road Bushland, Whitby'. It occurs in an un-named nature reserve created in 2002 for the purpose of conservation of flora and fauna and is 'proposed parks and recreation' in Bush Forever. Approximately 60% of the reserve contains *Banksia attenuata* and/or *Eucalyptus marginata* woodlands and there is evidence of historical disturbance such as grazing, and subsequent weed invasion. The reserve is long unburnt; with the last fire recorded in 1938 when the whole reserve burnt.

[2] Ms Kate Brown: DEC Urban Nature

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'. Only half of occurrence 7 occurs in the Bush Forever site. The occurrences may be threatened by future upgrades to the road or rail lines. Occurrence 9 contains a significant occurrence of *Eucalyptus lane-poolei*.

Occurrence 10 (Bella01) is within Bella Cumming Reserve which has been fenced. The site is generally in Excellent condition with some weed invasion along tracks.

Occurrence 11 (Connell) covers most of Bush Forever site Connell Avenue Bushland, Kelmscott. A small portion of the bushland was burnt in 2001. DEC undertook a prescribed burn in the north east corner of the reserve in October 2009 and a wildfire took place in a small southern portion of the bushland in December 2009. DEC 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.

Information from a survey organised by DEC Swan Coastal District indicates that this occurrence is mostly not infested with dieback disease caused by *Phytophthora* species but this conclusion was rated with a low confidence rating, and a patch in the western portion was rated infested with a medium confidence rating.

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. 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 reserve was apparently almost entirely burnt in the summer of 1992 and 1993. Two hot fires burnt the bushland in succession, killing many of the older trees. Two smaller fires occurred in 1999 and in January 2002 (C. Omacini, personal communication 2010). In 2004, bushland in the corner of Champion Drive and Williams Rd was burnt.

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. Weed mapping in 2008 identified 11 weed species. The extent of weed proliferation varies across Bob Blackburn Flora Reserve, with areas around the edges containing denser infestations.The highest density of weeds occurs on the corner of Williams Rd and Champion Drive (C. Omacini, personal communication 2010).

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. A quadrat was also established in 2007 by DEC in seeking to confirm the identity of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands at the site.

Occurrence 13 (Clifford01) comprises the majority of the vegetation at this site with the TEC '*Eucalyptus calophylla - Eucalyptus marginata* woodlands on sandy clay soils' and 'Herb rich shrublands in clay pans' also present. The site is made up of four lots, three of which are managed by Main Roads WA and a narrow reserve through the middle for drainage managed by the City of Gosnells. The occurrence is within the Bush Forever site Clifford Street Bushland, Maddington. The occurrence may be planned for off ramps from the adjacent Tonkin Highway. According to survey organised by DEC Swan Coastal District, this occurrence is dieback infested, however, this conclusion is rated a low confidence rating. The DRF *Conospermum undulatum* occurs at the site. A quadrat was established in 2007 by DEC in seeking to confirm the identity of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands at the site.

Occurrence 14 (Norm01, 03 and 07) occur on freehold land in Whitby with the communities '*Eucalyptus calophylla – Eucalyptus marginata* woodlands on sandy clay soils' and the Priority 3 '*Eucalyptus haematoxylon - Eucalyptus marginata* woodlands on Whicher foothills'. The site has several mineral tenements over it. The bushland also contains the DRF *Drakaea elastica* and *Tetraria australiensis,* and was noted to be important

habitat for fauna with many species recorded according to Bush Forever. 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 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.

Occurrence 16 occurs mostly on rail reserve but also extends into some Unallocated Crown Land (UCL) and road reserves. The middle of the bushland area has been cleared for a communications tower. A fire occurred in the southern portion of this occurrence in autumn 2006. The occurrence is in good condition, and has BMX tracks and horse jumps throughout. Both of the occurrences are known to contain the DRF *Tetraria australiensis*, the Priority 3 *Isopogon drummondii* and the Priority 4 *Anthotium junciforme*.

Occurrences 17 and 18 (xLamb01 and xLamb02) are in very good condition with occurrence 19 containing very few weeds. There is some *Watsonia meriana* var. *bulbillifera* and weeds encroaching from paddock adjacent to occurrence 17 (xLamb01). The DRF *Tetraria australiensis* also occurs in the reserve. Weed mapping and control of Watsonia were conducted in 2009 by DEC's Swan Coastal District. A fire burnt through the entire area of occurrence 17 and 18 in May 2006.

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, along with occurrences of the critically endangered TEC '*Eucalyptus calophylla – Xanthorrhoea preissii* woodlands and shrublands' and the endangered TEC 'Shrublands on dry clay flats.' Although the occurrences are in excellent condition, the occurrence 19 is more degraded due to *Watsonia* invasion. The Priority 4 flora *Anthotium junciforme* is present within occurrence 19 and the Priority 3 flora *Synaphea* sp. Serpentine occurs in occurrence 20.

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. The 'endangered' TEC 'Southern wet shrublands' also occurs at the site. A disused rubbish tip occurs adjacent, and there has been an illegal rubbish dumping site within occurrence 21. The majority of the bushland at the site is long unburnt. Grassy annual weeds and *Watsonia borbonica* have become established in patches, however *Watsonia* control and monitoring were undertaken in 2009 and 2010 by DEC's Urban Nature group.

Occurrence 23 (Perth03 and Myperth03) occur within the Bush Forever site Perth Airport and Adjacent Bushland which is Commonwealth land leased by Westralia Airports Corporation (WAC). Two other TECs are recorded on this site - *'Banksia attenuata* woodland over species rich dense shrublands' and 'Herb rich saline shrublands in clay pans'. Surveys supervised by DEC Swan Coastal District indicate this occurrence is mostly dieback infested, the northeast portion is not interpretable, and a small area of the southern border was not infested as at 2003. 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 provenanced stock, but direct seeding was the method used in the past (K. Bradshaw[3] personal communication 2011).

Occurrence 24 (Bancell01, 02) is adjacent to the Wagerup refinery and occurs over two Crown reserves. Part of reserve 11160 has been cleared for timber and gravel. The DRF *Tetraria australiensis* occurs nearby.

Occurrence 25 (Myrush01 and Rush02) is not in a Bush Forever site as the area is incorrectly mapped as outside the Swan Coastal Plain in Churchward and McArthur (1978), and Bush Forever only covers the Coastal Plain. Lots 9, 10, 11 and 12 are proposed to be included in the Darling Range Regional Park. Quarrying and excavation have significantly impacted the south-eastern section of Lots 9,10,11 and 12 historically; and fire,

[3] Ms Kobi Bradshaw: Westralia Airports Corporation

weed invasion and recreational pursuits (equestrian, off road vehicles, motorcycles) are also impacting the bushland. Env Australia Pty Ltd (2008) recommends that management practices that ensure the continued protection of conservation values of lots 9, 10, 11, 12 and 3 Rushton and Quarry Roads, Martin (that includes occurrence 25) be developed and implemented. The document recommends weed management, and dieback is highlighted as a potential issue. A large area of the bushland has been mapped as being infested with dieback (W. van Lieven[4] personal communication 2010). The bushland is fenced, weed mapping has been undertaken, dieback management plans are in place and an overall management plan is in the process of being drafted. The DRF *Darwinia apiculata* and the Priority 4 flora *Calothamnus rupestris* have been recorded in and near this occurrence. In April 1993 a fire occurred throughout the whole bushland area.

Occurrence 26 (Chittering01) is just outside of the Bush Forever site Burley Park and Adjacent Bushland and has been recorded as dieback free. The site is managed by the City of Swan for Conservation and Recreation. There are localised degraded areas due to horse riders, and weeds around tracks. This is the only occurrence of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands recorded on the Mogumber system and analysis of quadrat data is required to verify the identification.

Occurrences 27 and 33 (Creyk01 and 02) are within Creyk Park Reserve which is adjacent to a sports oval and housing. The City of Armadale has mapped dieback in the area and the bushland is treated on a four year rotation phosphite program. A dieback front has progressed within the reserve and native species decline has become evident (C. Omacini personal communication, 2010). Survey commissioned by DEC Swan Coastal District, however, indicates the majority of the occurrence is uninfested, and this conclusion is rated a high confidence rating. A fire occurred in Creyk Park bushland in 2003 in the corner of the reserve closest to Lindley Ave and Kembla St, however the fire history of the larger portion of the bushland reserve is unknown (C. Omacini personal communication, 2010). Controlled burning is planned within the reserve followed by intensive weed control.

The occurrence is threatened by weeds invading from the edges and also introduced plantings such as *Acacia longifolia* and *Leptospermum laevigatum* and track creation for BMX bicycles. 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*, *Eragrostis curvula* (African love grass), *Freesia* and woody eastern states species. Recent mapping located a number of new weed species and these are now targeted for weed control (C. Omacini personal communication).

Occurrence 28-31 (Cammillo01, Depot01, John Dunn01 and Moore01) occur on reserves or freehold land. The City of Armadale manages these reserves for conservation to help ensure ongoing protection of the TEC. The City monitors weeds with GPS mapping every five years and annually prepares a weed control contract for each of these bushland areas. The City of Armadale recently changed the reserve purposes from "C Class Reserves for Recreation" to "C Class Reserves for Passive Recreation and Conservation" for Cammillo and Eva and Bill Moore Reserves to ensure that the purpose reflected the conservation values.

Occurrence 28 in Cammillo reserve in Kelmscott is adjacent to Kelmscott farm school. Information from DEC Swan Coastal District indicates that this occurrence is mostly not infested with dieback (high confidence level), uninterpretable around the southern and eastern edge and infested (high confidence level) in the north-eastern corner. This occurrence is in good condition but is threatened by a large variety of weeds and garden waste dumping. The draft area management plan (City of Armadale 2010) states that "Grass and bulbous weeds pose the greatest threat to the reserve due to their invasive nature and ability to spread and dominate. The annual control of grass weeds such as African love grass and perennial veldt grass is a priority. Previous weed control efforts in the bushland have been sporadic and hence the control of invasive grasses unsuccessful."

Occurrence 29 occurs on a depot site surrounded by industrial land. The occurrence is in very good condition being long unburnt, and has a deep litter layer. Weeds such as *Erharta calycina*, *Eragrostis curvula*, couch (*Cynodon dactylon*), Geraldton carnation weed (*Euphorbia terracina*), deadly nightshade (*Solanum* spp.) and *Watsonia* have all been recorded within this small piece of bushland and are priorities for weed control. The dieback status of this occurrence is not interpretable, according to information from DEC Swan Coastal District,

[4] Mr Wayne van Lieven: City of Gosnells

and there is no visual evidence of dieback in the occurrence, however mulch has been known to be dumped and could be a source of infestation.

Occurrence 30 occurs in John Dunn Memorial Park, and grassy weeds are common within the reserve, providing up to 40% of the vegetative cover (C. Omacini personal communication, 2010). These weeds have previously been controlled with grass selective herbicide and will continue to be controlled by the Shire.

Occurrence 31 in Eva and Bill Moore Reserve, has been 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 and inferred infestation in the other reserves. Phosphite treatment is undertaken in reserves to help reduce the impact of dieback.

There are no fire records for John Dunn bushland, the Depot bushland or Cammillo Rd Bushland Reserve. The last fire events are unknown, but estimated to have been more than ten years ago. Eva and Bill Moore Heathland was almost entirely burnt in 2003 (C. Omacini personal communication, 2010).

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.

The City of Armadale monitors weeds with GPS mapping every five years and annually prepares a weed control contract for the area. Large areas of the reserve are relatively weed free, however fire and dieback disease are causing degradation and weed invasion. *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 (C. Omacini personal communication 2010).

According to the draft management plan (City of Armadale 2010) "Kendal Court Bushland Reserve was entirely burnt in 1999. Half the reserve was again burnt in January 2005 however the exact location of the fire is unknown. It is likely that these arson events resulted in hot fires. In 2002 a fuel assessment was undertaken in Kendal Court Reserve. Litter loads were found to be 3.45 tonnes per hectare, well below the FESA recommended fuel load of 8.0 tonnes per hectare for effective fire control with direct attack on the ground. The fuel assessment also noted the occurrence of many grassy weed species. Whilst the fuel loading is likely to have increased since 2002, significant achievements in weed control have also reduced the amount of fuel within the reserve".

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 35 (Austral01) occurs on privately owned freehold land in the Bush Forever site Cardup Brook Bushland, Cardup/Peel Estate. The vulnerable TEC '*Eucalyptus calophylla - Eucalyptus marginata* woodlands on sandy clay soils' is also considered to occur within the bushland area.

Occurrence 36 Nettleton Rd (Nett01, Nett06, and Nett09) occurs on private land managed by a residential development group. At the time of this plan, the land owners planned to develop part of the Lots and to conserve a proportion of the bushland, and the proposal was being considered by Western Australian Planning Commission.

Data on all known occurrences of TECs are held in the Threatened Ecological Communities Database at DEC's Species and Communities Branch, Kensington.

1.3 Habitat requirements

The *Banksia attenuata* and/or *Eucalyptus marginata* woodlands are found on a range of soils on the base of the Darling Scarp from Yarloop to Byford. Soil types are mainly gravelly orange and yellow sands. The community occurs largely on Guildford clays or at the continuum of Guildford with Ridge Hill Shelf, Forrestfield, but there are also a few occurrences recorded from Bassendean, Mogumber and Southern River Units as described by Churchward and McArthur (1978). One occurrence is also mapped on the Darling Scarp Unit, but the soil and landform mapping at this site is not correct and it should be mapped as Ridge Hill Shelf (Occurrence 25, Rushton Rd - B. Keighery[5] personal communication).

1.4 Habitat critical to survival, and important occurrences

Critical habitat is habitat identified as being critical to the survival of a listed TEC. The critical habitat for this community is the sandy soils on which the community occurs, and the fresh superficial groundwater that probbably helps to sustain key flora such as *Banksia* and *Eucalyptus* species in this community, and the catchment for this groundwater.

Occurrences within Bush Forever sites, and occurrences with comparatively large intact areas of the community that are in relatively good condition outside of Bush Forever are considered important occurrences. Occurrences that provide for representation of the community across its geographic range and that can be managed for conservation and/or with conservation included in their purpose are also considered important.

1.5 Related biodiversity impacts and benefits

Declared rare flora (DRF) that have been recorded in occurrences of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands include *Conospermum undulatum, Drakaea elastic, Darwinia apiculata* and *Tetraria australiensis.* The DRF species, *Acacia anomala* occurs very close to and may occur within occurrences of the community. Priority flora that have been recorded in occurrences of this community include *Johnsonia pubescens* subsp. c*ygnorum*, *Synaphea* sp. Serpentine (G.R. Brand 103), *Synaphea odocoileops* and *Calothamnus rupestris*. Two priority species, *Anthotium junciforme* and *Acacia oncinophylla* subsp. *oncinophylla*, occur very close by and may occur within occurrences of the community.

Other threatened and priority ecological communities (PECs), most of which are described in Gibson *et al*. (1994), that are found in bushland adjacent to occurrences of the '*Banksia attenuata* and/or *Eucalyptus marginata* woodlands' are as follows:

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

[5] Mrs Bronwen Keighery: DEC Science Division

Declared threatened and priority fauna which occur within a 2km radius of occurrences of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands include:

- the endangered *Calyptorhynchus latirostris* (Carnaby's Cockatoo)
- the endangered *Calyptorhynchus baudinii* (Baudin's Cockatoo)
- the vulnerable *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo)
- the vulnerable *Dasyurus geoffroii* (Chuditch)
- the vulnerable *Egernia stokesii badia* (Western Spiny-tailed Skink)
- the vulnerable *Phascogale tapoatafa* ssp. (WAM M434) (Brush-tailed Phascogale, Wambenger)
- the vulnerable *Setonix brachyurus* (Quokka)
- the priority 1 *Arbanitis inornatus* (Trapdoor spider)
- the priority 3 *Acanthophis antarcticus* (Southern Death Adder)
- the priority 4 *Hydromys chrysogaster* (Water-rat, Rakali)
- the priority 4 *Morelia spilota imbricata* (Carpet Python)
- the priority 5 *Isoodon obesulus fusciventer* (Quenda)
- other specially protected fauna *Falco peregrinus* (Peregrine Falcon)

Recovery actions implemented to improve the habitat quality or security of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands are likely to also benefit the DRF and priority flora populations, threatened and priority fauna populations and occurrences of other TECs and PECs that occur within the same patches of bushland.

1.6 Biological and ecological characteristics

Plant taxa that commonly occur in the community are listed in Appendix 1. The mean species richness for nine quadrats in the community surveyed by Gibson *et al.* (1994) was 62.7 species in 100 square metres. An average of 1.4 weed species were recorded per quadrat in the Gibson *et al.* (1994) study, which is lower than that found in the closely related community type 'Eastern shrublands and woodlands (community type 20c as described in Gibson *et al.* (1994)), and is considered to be a low level of weed invasion. This floristic information does not include species data for many of the occurrences that have been entered on the TEC database. The floristic community type of some of the occurrences listed in Table 1 was determined by experienced staff from DEC, botanists who worked on Bush Forever, and environmental consultants, and was derived from analysis of soil and landform characteristics and species composition (occurrences 6-13; 15, 17; 19-22; 24 and 26-35). Where the vegetation at particular sites is not in sufficiently good condition, the size of the area is inadequate, where there is a high turnover of plant communities, or it is not possible to access the site (eg private land), it will not be possible to collect stringent data about species composition and to undertake appropriate analysis to confirm the floristic community type present. These sites are noted in Table 1.

The following is an extract from Gibson *et al.* (1994) that describes the differences between the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands and other floristic communities that are closely allied to the type:
"Community type 20 occurs from Koondoola south to Yarloop. Sites in this community type were generally *Banksia attenuata* woodland, *Eucalyptus marginata – Banksia attenuata* woodlands or shrublands. The three subgroups of this community type share high frequencies of species in species group O with community type 28 which encompasses much of the *Banksia* woodland sites on Spearwood Dunes. However this community lacks most species of group A which are common on the Spearwood System.

Sites in community type 20a were found on sandy soils near Koondoola and also the base of the Scarp at Forrestfield covering two distinct land form units, Southern River Unit (part of the Bassendean system), and Karrakatta unit (part of the Spearwood system). The Environmental Geology series (Gozzard 1986) also places the sites north of Perth on the Spearwood Dunes. Structurally this group was either *Banksia attenuata* woodlands or *Eucalyptus marginata – Banksia attenuata* woodlands. This group is the richest of any of the *Banksia* communities recorded, with an average species richness of 67.4 species/site. Weed frequency was low and the community was distinctive in having a diverse shrub layer and *Mesomelaena pseudostygia* occurs in all plots. Sites of community type 20a are differentiated from the other two subgroups by occurrence of species such as *Alexgeorgea nitens, Daviesia nudiflora, Synaphea spinulosa, Hibbertia racemosa, Stylidium calcaratum*

and a variety of other taxa occurring at low frequency. These unusual Banksia woodlands were previously identified by Keighery and Trudgen (1992) and Keighery and Keighery (1992, 1993).

Community type 20b was found on sands at the base of the Scarp between Byford and Yarloop. Most sites in this community type were *Eucalyptus marginata – Banksia attenuata* woodlands but *Banksia* woodlands and heaths were also found. Again *Mesomelaena pseudostygia* was common occurring in 67% of plots. Species that differentiated this subgroup included *Hakea stenocarpa, Conostylis setosa* and *Johnsonia* aff. *pubescens* as well as the absence of species restricted to the other subgroups.

Sites in community type 20c were largely scrubs and some *Banksia attenuata* woodlands again on sands of Forrestfield or Guildford Unit. Species in species groups C and D were largely restricted to this community. Again *Mesomelaena pseudostygia* was a ubiquitous species. This community contained taxa more common on the Scarp (eg *Templetonia biloba*) and taxa such as *Neurachne alopecuroides*, a species more typical of marri-wandoo woodlands of the heavy soils. Species richness was again high in this community type (64 species/site) with average weed frequency rising to four species per plot."

1.7 Soils and Hydrology

Banksia attenuata and/or *Eucalyptus marginata* woodlands has been recorded from six different landform and soil types as defined by Churchward and McArthur (1978).

One occurrence, occurrence 31, is mapped on the Southern River Geomorphological Unit of the group described as Aeolian Deposits by Churchward and McArthur (1978). This unit is described as 'sandplain with low dunes and many intervening swamps; iron and humus podzols, peats and clays'.

One occurrence, occurrence 23, is located on the Bassendean aeolian deposits. These are defined as 'sand plains with low dunes and occasional swamps; iron or humus podzols; areas of complex steep dunes' in Churchward and McArthur (1978). Bassendean sands are further described in Department of Conservation and Environment (DCE) (1980) as a series of dunes that are parallel to the coast and inland of the Tamala Limestone. The sands are generally fine to medium grained, but course in places. The soils form a 15km wide zone between the Pinjarra Plain and the coastal belt and consist of low hills of quartz sand with seasonal swamps.

One occurrence, occurrence 26, is mapped on the Mogumber unit of the Dandaragan Plateau. This unit is described as 'lateritic remnants with grey sands on the lower slopes and depressions'. Wilde and Low (1978) describe the plateau as a sand and laterite covered plain that occurs between the Darling Scarp to the east, and the Gingin Scarp to the South West. This occurrence may actually be related to a different floristic community type, however, statistical analyses of comprehensive quadrat data are required to verify the identification.

Occurrence 36 is mapped as apparently occurring on the Darling Plateau – Major Valleys and Scarps by Churchward and McArthur (1978), but this is not correct when the soil and landform are examined on site.

Occurrences 1 and 2 occur on the Guildford Unit of the Fluviatile Deposit group as mapped by Churchward and McArthur (1978). The soils are otherwise known as the Guildford clays. The Unit is described as 'Flat Plain with medium textured deposits; yellow older duplex soils'.

Occurrences 4, 6-12, 14-22, 24, 25, 27-30, 32, 33 and 35 are within the Forrestfield Unit - Ridge Hill Shelf group as described by Churchward and McArthur (1978). They describe the Forrestfield Unit as 'laterised foothills of the Darling Scarp characterised by gravelly and sandy spurs'. This area consists of coalescing alluvial fans at the bottom of the scarp and remnants of marine terraces (Ecologia Environmental Consultants 1991). The Forrestfield Unit consists of a belt one to three kilometres wide between the Darling and Gingin Scarps and the Darling Fault, from Walyunga National Park to Harvey. This system has been extensively cleared for agriculture, mining, forestry, and urban development. Only 3.1 percent of the original 14,414 hectares of the unit remained uncleared in 1986 (Ecologia Environmental Consultants 1991).

Occurrences 3, 5, 13 and 34 occur on the boundary of the Forrestfield Unit – Ridge Hill Shelf group and the Guildford Unit of the Fluviatile Deposit group as mapped by Churchward and McArthur (1978).

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

1.8 International Obligations

This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that Convention. However, as this community is not listed under any specific international agreement, the implementation of other international environmental responsibilities is not affected by this plan.

1.9 Affected Interests

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 DEC, WestNet Rail, WA Planning Commission (WAPC), Main Roads WA, the Commonwealth Government, the Department of Planning, Western Power, the Public Transport Authority and private companies. Some lands held by WAPC are intended to be transferred to DEC management, however government agencies, local government and private landowners managing other land will be affected by the implementation of this plan.

1.10 Historical and current threatening processes

Clearing

Clearing for agriculture and urbanisation has been extensive on the Ridge Hill Shelf on the eastern side of the Swan Coastal Plain, where many occurrences of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands are located, so it is assumed that a large proportion of the original extent of this community has probably been cleared. Although many occurrences are included in Bush Forever, actions recommended under Bush Forever have not yet been implemented for many of these areas, and security is not yet assured. Most of the Bush Forever sites are surrounded by urban areas and are subject to associated impacts including increased fire frequency, recreational over-use, weed invasion etc. Some parts of Bush Forever sites are likely to be proposed for development, such as clearing for infrastructure including high tension power lines.

Many occurrences are not in tenure that is secure, and tenure security is a particular consideration for occurrences that are not Bush Forever sites and are not in reserves with conservation included in the purpose. Areas which may be associated with potential developments for road and railway works, housing and/or industry include occurrences 3, 4, 7-9, 13-16,19, part of 21, 23-25, 27-33, 34, 35 and 36. A number of occurrences have already been cleared (for example occurrence 4 contains a large sandpit. 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, with up to 3,000 homes to be built (Urban Pacific Limited 2009).

The presence of TECs is taken into consideration when evaluating the impact of any proposed development. As a result of amendments to the *Environmental Protection Act 1986,* any clearing of native vegetation requires a permit, unless done for an exempt purpose. Threatened ecological communities have been defined under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, as environmentally sensitive areas. Provisions in these regulations that allow day-to-day routine vegetation clearing activities without a permit do not therefore apply to clearing within TECs. Any clearing proposals in a TEC are to be undertaken under a specific permit.

Introduction and spread of disease

Dieback disease caused by *Phytophthora* species has the potential to impact the community, although it is not known if *Banksia attenuata* and/or *Eucalyptus marginata* woodlands is very susceptible to the disease. Elevated dry sands are quite hostile to dieback, and the disease may not spread rapidly there despite the number of highly susceptible species. Dieback usually spreads much more slowly on the yellow and orange sands on which these *Banksia attenuata* and/or *Eucalyptus marginata* woodlands generally occur than it does on soils of the Bassendean system. Regardless, even small, slow-moving infestations of dieback can be exacerbated by soil disturbance and movement, and may be significant in such small areas of this remnant vegetation.

Furthermore, *Banksia attenuata*, which is often a key species in this community, is highly susceptible to the disease. Negative tests for *Phytophthora* do not prove the absence of *Phytophthora*, therefore these areas need to be treated with caution (Stukely 2009).

Dieback disease results in the loss of susceptible species and may result in altered composition and structure of vegetation. Infected areas will need to be mapped to help guide future management such as rehabilitation, treatment of priority areas with phosphite used to control dieback, and closure of specific tracks where vehicle or foot access may spread or amplify disease impact. The risk of introduction and spread can be further minimised by ensuring good hygiene practices which involve the adequate washing down of any equipment used on or adjacent to the community and restricting access by vehicles, people and machinery to dry soil conditions. Areas adjacent to infected areas, those downslope from infected areas and areas where access is not controlled are highly susceptible to dieback infestation.

Other disease causing pathogens can be mistaken for dieback when interpretation has not been undertaken. These include aerial cankers and the Australian Honey Fungus also known as *Armillaria* (white rot). These pathogens can be highly destructive and particularly *Armillaria* could be carried into bushland areas with mulch as it survives on dead plant material.

Inappropriate fire regimes

Fires are likely to have a significant effect on the vegetation composition in Mediterranean ecosystems such as those in the south-west of Western Australia (Abbott and Burrows 2003). Different ecosystems may require particular fire regimes to assist regeneration.

If an appropriate frequency of fires is exceeded, species that are obligate seeders may not have sufficient time to flower and produce seed. If the time between fires is too long, obligate seeders may become senescent and be unable to regenerate. Therefore, fires must occur at appropriate intervals and possibly the appropriate season and intensity to sustain the integrity of plant communities. The draft management plan for reserves in the City of Armadale (City of Armadale 2010) recommends “No fire regime, history of fire interval, season, intensity or patchiness is optimal for all species. However, for Swan Coastal Plain urban bushland areas, it is recommended that planned burns should not be conducted more regularly than at least 12 to 15 years”.

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. Many of the occurrences have been burnt recently. Fire regime is a major consideration in Management Plans that have been developed for bushland that contains TECs (eg Shire of Serpentine Jarrahdale 2009).

Burrows (2008) notes that there is no single optimum fire regime that will meet all management objectives, but that there are fire regimes that can be applied based on available evidence. Burrows (2008) recommends fire regimes based on vital attributes, regimes that provide for diversity of frequency, season and intensity, and provide habitat diversity, and a fine-grain mosaic of habitats. Burrows (2008) suggests that if these fire regimes are implemented in an adaptive management framework, they provide good data and can lead to better fire management.

The juvenile period of many species that occur in the community is listed in Appendix 1. Although the juvenile periods of many taxa are not known, the data included in Appendix 1 can be used as a guide. 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 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). These long juvenile periods should also be taken into account when designing appropriate fire regimes for this community.

Drying climate also needs to be considered when designing appropriate fire regimes. It is likely that reduced rainfall will cause diminishing growth rates, and plant maturation times will also therefore increase. Longer inter-fire intervals will therefore be desirable.

The DEC's Species and Communities Branch staff has set up fire monitoring transects and three quadrats at occurrence 11 (Connell01) prior to recent prescribed burning. This is the beginning of a study into the effects of fire frequency on *Banksia attenuata* and/or *Eucalyptus marginata* woodlands. A fire management plan is in place for occurrence 3 (Brick02) and it is proposed that the plan will be reviewed every three to five years, integrating weed control with fire management for best optimal biodiversity outcomes (Shire of Serpentine-Jarrahdale (2009).

Disturbances within remnants often lead to an increase in weed invasion, particularly where remnants are small. Therefore, fire frequency should be minimised unless future studies indicate that fire is not occurring frequently enough. In addition, the risk of fire is increased by the presence of grassy weeds in the understorey, as they are likely to be more flammable than the original native species in the herb layer. The increased number of fires may well be impacting the community in terms of structure, composition and level of weed invasion. Areas that have been recently burnt should be monitored to determine if weed control is required. The general floristics of as many sites in comparatively good condition as possible require monitoring so that the community's response to fire can be elucidated.

There are few data available through which fire regimes that enhance/protect the composition of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands can be elucidated so that what actually constitutes an appropriate fire regime will require investigation. It seems 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 in recent decades (V. English personal observation 2010).

Disturbance due to recreational use / maintenance activities

Many occurrences are in areas utilized heavily for public recreation where visitation is high and the impact from recreational users from trampling, rubbish dumping and track creation is increased. Occurrence 4 is actually listed as a rubbish disposal site, however, according to shire records, this purpose has now ceased and rehabilitation of the site is planned. Apart from being visually unappealing, rubbish, in particular garden waste, introduces weed seeds into the bushland and increases the fire hazard.

Many sites have also been used as unofficial BMX and off-road bike tracks and jumps. These tracks and jumps lead to further clearing, track widening, the potential spread of weeds and disease such as dieback and the degradation of vegetation by vehicle tyres.

A number of occurrences are near rural/semi-rural areas and have been long used by horse riders (occurrences 3, 15, 21, 25 and 26). The use of these areas of bushland for horse riding can lead to the spread of weeds and diseases such as dieback as well as the creation of new tracks or the widening of existing tracks. A number of equestrian clubs that utilise the areas, however, do manage the bushland through removing dumped rubbish (eg. occurrence 25) and may accept guidance about how to better manage the bushland.

Maintenance activities in and around occurrences have caused some level of disturbance. Occurrences 7-9 are railway reserves, therefore railway upgrades may disturb vegetation. There has been historic clearing around the communications tower at occurrence 16, and surface drainage may have been altered due to road grading activities around occurrence 21. Depot and power pole dumping are the actual purposes of the bushland that contains occurrence 24. Almost all occurrences would be expected to be affected by firebreak construction and maintenance as they occur in small vegetation remnants. It is important to construct and maintain firebreaks, however this will need to be undertaken with minimal disturbance to the vegetation.

Weed invasion

Weed invasion is usually increased by disturbances such as fires (prescribed burns and wildfires), firebreak maintenance and grazing if weed propagules are present. Some sites are burnt relatively frequently by arsonists, and have suffered increased weed invasion as a consequence. Most of the occurrences of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands are close to, or surrounded by, urban areas that act as weed sources, and would be susceptible to weed invasion following any disturbance. Weeds suppress early plant growth by competing for soil moisture, nutrients and light. They increase the fire hazard due to the easy ignition of high fuel loads, which are produced annually by many weed species. There are tracks throughout occurrences of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands and weeds have invaded to varying extents along these tracks and from the outer edges of the vegetation hence tracks should be a priority for weed control. Piles of soil scraped from tracks and disused sand pits generally contain high concentrations of weeds and act as a weed source. These piles and pits should be avoided when tracks are cleared, or be removed where they already exist. The most common weeds found in occurrences are *Gladiolus caryophyllaceus* and *Watsonia meriana* var*. bulbillifera.*

Weed control programs may be necessary to maintain or improve the condition of occurrences of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in the long term. Brown and Brooks (2002) state that the aims of weed control are to maintain the pre-invasion condition of the habitat (prevention); control or arrest ongoing weed invasion (intervention); and reverse the degraded condition of the habitat where applicable (rehabilitation). A weed control program would involve (adapted from Brown and Brooks 2002):

- identifying weeds present at the site and classifying according to the threat they pose.
- accurately mapping the boundaries of weed populations, especially those that pose a greater threat.
- selecting an appropriate herbicide or other method of weed control for those weeds present.
- controlling weeds that pose the greatest threat to the community and which are in the early stages of invasion.
- implementing a strategic control program for established weed populations, with highest priority to those posing the greatest threat to the community.
- rehabilitation through reintroduction of local native species where areas are no longer capable of regenerating following weed control.

Mining / quarrying

There may be historical evidence of quarrying in some occurrences. At present, there are mineral sand mining applications over some occurrences (e.g. occurrence 34, Myyarl03) and an open sand pit is listed as the purpose of one occurrence (occurrence 4, Yarl04). Several live and pending mining tenements for titanium and mineral sands occur over occurrence 14 (Norm 01, 03 and 07).

Grazing and trampling by native and introduced fauna

Grazing by native and introduced fauna has been noted for occurrence 6 (Myroman01) where historical grazing is thought to have occurred; 11 (Connell01) where large numbers of rabbits may be present; 14 (Norm01, 03, 07) and 21 (Watkins01) where there is evidence of rabbits, foxes, kangaroos and historical grazing; 24 (Bancell01, 02) where cattle grazing has been noted near the entrance to the reserve and occurrence 35 (Austral02). Grazing of the community by fauna such as rabbits, cattle and high numbers of kangaroos is likely to cause or have caused alterations to the species composition, by the selective grazing of edible species, the introduction of weeds and nutrients, trampling and general disturbance. Grazing and trampling would also have an impact on the establishment of young plants thereby limiting natural recruitment.

Climatic variation

Some of the potential impacts expected as a consequence of climate change may be a threat to the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands. In addition, the tolerance of particular species to changes that may occur in association with climate change including changes in rainfall and temperatures is generally

unknown. If biota that are significant in dispersing seeds and cross pollinating species are impacted by climate change, then this may also directly impact the community.

The now fragmented state of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands results in them being highly vulnerable to disturbance. Climate change may present a particular threat to the community in the form of increased fire regimes, increased drought impacts and possibly weed invasion.

A well managed reserve system would act as a buffer to stochastic events. The management of other threatening processes such as increased weed invasion or fire frequency that may be exacerbated by climate change will be important in maintining resilience to this potential threat (Barrett *et al*. 2009). Fire management in particular will need to be coordinated with all land managers, to ensure that the most ecologically, spatially and seasonally appropriate regime is implemented.

Plant deaths that occurred following the driest winter on record in 2010 were noted in control line intercept transects that were established to monitor recovery from fire in occurrence 11 (Connell01; V. English personal observation). Monitoring sites such as these from which detailed data are being gathered can be used to monitor future impacts of extreme climatic events such as prolonged drought on composition of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands.

The minimisation of the impact of other threats is probably the most important aspect of increasing the resilience of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in the face of climate change.

1.11 Guide for Decision-Makers

Section 1.10 above provides details of current and possible future threats. Proposed developments in the immediate vicinity of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands require assessment. No developments should be approved unless the proponent can demonstrate that they will have no significant impact on important occurrences of the community.

1.12 Conservation status

Banksia attenuata and/or *Eucalyptus marginata* woodlands meet the following criterion for endangered (EN) ecological communities:

B) Current distribution is limited, and:

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

1.13 Indigenous interests

The South West Aboriginal Land and Sea Council (SWALSC), an umbrella group, covers the areas considered in this plan. Comment was sought from the Council about any aspects of the plan, but particularly about the proposed on-ground actions. Table 1 identifies areas of the ecological community that contain sites that are known to have particular aboriginal significance. No general significance to indigenous people has been identified for the ecological community. Action 3 identifies the intention to continue liaison with relevant groups, including indigenous groups.

1.14 Social and economic impacts and benefits:

Pedestrian access by means of formal walk trails has potential to allow the aesthetic values of the community to be appreciated without degrading the community, and this provides a social benefit. Where specific active recreational pursuits such as four wheel driving are prevented through access control, this may be perceived as a social impact, however such access control also helps to prevent the continued degradation of the community and maintain other social benefits

1.15 Strategies for recovery

To identify, and influence the management of, the areas in which the community occurs, in order to maintain the natural biological and non-biological attributes of the sites and the current area covered by the community.

To conduct appropriate research into the ecological characteristics of the community in order to develop further understanding about the management actions required to maintain or improve its condition.

2 RECOVERY OBJECTIVE AND CRITERIA

IRP Objective(s): To maintain or improve the overall condition of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in the known locations and reduce the level of threat with the aim of ensuring it does not meet criteria for a higher threat rank.

Criteria for success:

- an increase in the number of occurrences of this community managed for conservation and/or with conservation included in the purpose.
- representative areas of the community across its geographical range maintained in the same or improved condition (Bush Forever condition scales).
- 90% or more of the aerial extent of occurrences maintained at the same condition rank, or improved.

Criterion for failure:

- decline in condition rank of 10% or more of the aerial extent of the community, or
- failure to achieve an increase in the area managed for conservation.

3. RECOVERY ACTIONS

The responsible authority is frequently listed as the relevant DEC district. This refers largely to initiating and guiding actions. However, in general the relevant DEC district, in liaison with the Species and Communities Branch and the relevant Recovery Team share the primary responsibility for securing funds for, and/or coordinating the implementation of, recovery actions.

Existing Recovery Actions

DEC's Species and Communities Branch have sent notification letters that include maps and details about the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands community to all relevant land owners and managers. Copies of the letters were also sent to the relevant DEC district for record keeping purposes.

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 in the process of being updated (City of Armadale 2010) and a City of Armadale Environmental Officer has provided a range of updated information to DEC for use in this plan. 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 currently completing a detailed management plan which will make recommendations on access, weed control, fire management, revegetation and dieback (T. Rees[6] personal communication 2011).

[6] Mr Toby Rees: City of Gosnells

DECs Swan Coastal District and DEC's Urban Nature group have been coordinating weed management work at Watkins Rd Nature Reserve (occurrences 21 and 22). In August 2009 vegetation condition and weed mapping for 29 species was mapped across the reserve. *Watsonia borbonica* was mapped in density classes across the reserve. In 2009 a very small area of *Watsonia* affecting *Banksia attenuata* and/or *Eucalyptus marginata* woodlands was controlled and *Watsonia* was treated in the entire area of the TEC in 2010 (J. Cullity[7] personal communication 2011).

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 soon be mapped, and the reserve will then be included in the 2011 weed control program (C. Harwood[8] personal communication 2011). In 2005 the Cable Sands mine was closed and rehabilitation begun. An assessment was carried out by Ekologica in 2007 (WALGA Natural Area Initial Assessment Database, accessed 2011) that outlined several management recommendations (C. Harwood[9] personal communication 2011) as follows:

- control invasive weed infestations, particularly tree lucerne (*Chamaecytisus proliferus*), *Watsonia* and Victorian tea-tree (*Leptospermum laevigatum*).
- reduce the potential for spread of disease caused by *Phytophthora* spp. within the reserve by limiting operations causing soil movement to dry weather conditions
- ensure plant species used for rehabilitation are locally sourced
- identify the site as a conservation area using signage
- seek funding through South West Catchment Council program to improve management and conservation of the biodiversity values of this reserve.

The Shire of Serpentine-Jarrahadale has a management plan in place for Brickwood Reserve and Briggs Park (Shire of Serpentine-Jarrahdale 2009).

Five monitoring transects and three quadrats were established in occurrence 11 (Connell Ave) to determine the effect of fire regime on the species composition of the community. The transects measure 10-20m in length, are permanently marked, and were monitored in 2009, 2010 and 2011.

Monitoring the extent and boundaries has been completed for all occurrences.

Future Recovery Actions

1 Coordinate recovery actions

The Swan and South West Region Threatened Flora and Communities Recovery Teams consider all TECs and threatened flora in DEC's South West and Swan Regions. The recovery teams will continue to assist DEC in coordinating recovery actions for the community and other DRF and TECs in their regions. Information on progress will be provided in annual reports to DEC's Corporate Executive and funding bodies.

Responsibility: DEC (Swan and South West Regions), in conjunction with recovery teams
Cost: $5,000 per year
Completion date: Ongoing

[7] Ms Julia Cullity: DEC Urban Nature
[8] Ms Chrissie Harwood: Shire of Harvey
[9] Ms Chrissie Harwood: Shire of Harvey

2 Map habitat critical to survival

Although habitat critical to survival is described in Section 1.4, the areas as described have not yet been mapped and that will be done under this action. If any additional occurrences are located, then this habitat will also be determined and mapped for these locations.

Responsibility: DEC (SCB, Swan Coastal and Wellington District)
Cost: $10,000 in the first year, $2,000 pa thereafter
Completion date: Year 1

3 Liaise with current land owners, land managers and other relevant groups

Most of the occurrences of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands are privately owned or managed by authorities other than DEC. The involvement of relevant landholders and managers (such as local government authorities, government departments, and holders of mineral extraction leases) is essential to the recovery process. In particular the involvement of the Cities of Armadale, Swan and Gosnells and the Shires of Harvey, Serpentine-Jarrahdale and Waroona in the recovery of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands will be extremely important. 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 and gravel as well as pole dumping by Western Power). Continued liaison with stakeholders involving occurrences not in secure conservation tenures, such as with regard to mineral tenements in the vicinity of occurrence 14 on private property in Byford, and the potential for development proposals over various occurrences (occurrence 4 (YARL04), 24 ((Bancell01, 02), 14 (Norm01, 03, 07), 23 (Perth03, MyPerth03), will be important.

Input and involvement will also be sought from any Aboriginal groups that have an active interest in areas that contain *Banksia attenuata* and/or *Eucalyptus marginata* woodlands.

Responsibility: DEC (Swan Coastal, Perth Hills, and Wellington Districts; Urban Nature; Species and Communities Branch (SCB))
Cost: $5,000 per year for all liaison (not including vehicle costs)
Completion date: Ongoing

4 Establish quadrats and analyse data

Permanent 10m by 10m quadrats should ideally be established in all occurrences to confirm the presence of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands at each site. Sites considered to contain occurrences of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands based on data in Bush Forever, or from data collected by people with high level expertise in on-ground analysis of habitat and species composition of the *Banksia* communities on the Swan Coastal Plain are listed in Table 1. As also noted in Table 1, in some cases the conclusion about community type present has not been confirmed through statistical analysis of quadrat data. For many sites such analysis will not be possible due to unsuitable vegetation condition, size of patches, or high turnover of habitat and associated plant communities (eg. occurrences 7 (Mybyford05), 8 (Mybyford06), 9 (Mybyford07), 6 (Myroman01), 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 gain data useful for statistical analysis.

Where possible permanent quadrats should be established as per the methods of Gibson *et al*. (1994) and scored (i.e. all flora species present recorded) at least twice at appropriate times. The scoring of quadrats should be planned around the flowering times of the majority of the species present. Spring and late spring is best for *Banksia attenuata* and/or *Eucalyptus marginata* woodlands (September, and late October/early November). It is possible that annual rainfall will influence results for quadrats established, and scorings across a series of additional seasons or even years may be needed. The species data from quadrats established should be compared and analysed against data held in Gibson *et al*. (1994) using appropriate statistical techniques and parameters (eg using PATN, Primer or PC-ORD).

Other quadrats that have been established, but data are yet to be included in analyses, include occurrences 11 (Connell_Plot01 and 02); 12 (Blackburn Plot 01); 13 (Cliff_Plot1); 21 (Watkins Plot 1); 26 (Chittering Plot 1); and 35 (Austral Plot02). All of these were considered to be *Banksia attenuata* and/or *Eucalyptus marginata* woodlands in Bush Forever. Additional occurrences of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands are thought to occur at Burley Park, Bullsbrook East and east of Connell Avenue Bushland, Kelmscott. Quadrats have already been established in these areas.

Surveys of new potential occurrences of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands locations have been carried out in North Dardanup Primary School bushland (reserve 5997), reserves on Aitken Rd Yarloop, and private property on Rapids Road, Serpentine. These potential new occurrences are awaiting more detailed survey, quadrat establishment or statistical analysis of data before being confirmed as new occurrences of the community. Additional occurrences will be entered onto the TEC database, including boundary information, condition and threatening processes.

Responsibility: DEC, (Swan Coastal, Perth Hills, and Wellington Districts and SCB) in consultation with land managers
Cost: $15,000 in years 1, 2, 3
Completion date: Year 3

5 Seek to implement Bush Forever recommendations, and avoid further clearing of the community

Further clearing or destruction by other means especially of examples of the community in good condition needs to be minimised wherever possible through negotiation, planning and acquisition. 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 1-3, 6-16, 19-23, 35 and parts of 17 and 18 making up approximately 81% (178ha) of the total area of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands and are within Bush Forever sites. Approximately 33% (72ha) of the total area of the community occurs within conservation reserves.

DEC will continue to work with the Bush Forever Office of Department of Planning, and other relevant agencies, groups, and individuals to implement recommendations in Bush Forever that relate to sites that contain this community.

Responsibility: DEC (Swan Coastal, Perth Hills Districts), relevant local authorities and the Department of Planning.
Cost: $5,000 pa
Completion date: Ongoing

6 Monitor the extent and boundaries of occurrences

Occurrences will be monitored at least every five years. Boundaries can be determined from current aerial photographs and ground-truthing. Land manager permission will be required for on-ground studies where occurrences occur on private property.

GPS mapping of all occurrence boundaries has already been completed and added to the TEC database. However the accuracy and recency of the mapping of the boundaries varies and as such some occurrences should be re-visited and their boundaries defined better. The majority of boundary mapping for *Banksia attenuata* and/or *Eucalyptus marginata* woodlands was completed around 2000 – 2002. Occurrences that are a priority for re-mapping include occurrences 7, 8, 9, 17, 18, 23 and 34. The boundarties of occurrences 1, 2, 11, 13, 14, 15, 16, 19, 20, 21, 22, 24, 25, 26, 31, 33 and 35 may also need to be further refined.

Responsibility: DEC (Swan Coastal, Perth Hills, and Wellington Districts, Urban Nature, SCB) in consultation with land managers
Cost: $20,000 every fifth year
Completion date: Ongoing

7 Encompass monitoring within an adaptive management framework

Research will be designed to increase the understanding of characteristics of the community to assist future management decisions. Such research will ideally include:

- The impact of weeds on the community.
- The role of disturbance in regeneration of the community.
- The recovery of the community following fires and burns (this will be considered in the fire management strategy).
- Important biological processes in the community, eg pollination biology, germination requirements, longevity and time taken for significant plant taxa in the community to reach maturity.
- Investigation into changes in community composition following weed control

There are permanent quadrats set up in many occurrences (Gibson *et al.* 1994; DEP 1996, DEC unpublished data). Where vegetation is in suitable condition, permanent quadrats should be established in additional areas, utilising methods as described in Gibson *et al*. (1994). Data collected will include weed levels, plant species diversity and species composition of flora. All native and weed species were recorded in quadrats that were previously established, but quantitative data that would provide information about density or cover for each species were generally not included in standard quadrat monitoring. Occurrences will continue to be monitored every five years to provide information on composition, and condition. This information will be added to the TEC database.

Five monitoring transects have also been established to determine the impact of fire regime on the community (occurrence 11 – Connell). Transects measure 10-20m in length, are permanently marked, and were monitored in 2009, 2010 and 2011.

Populations of major weeds will be accurately mapped in occurrences of the community where weeds are a significant threat, and appropriate herbicides or other method of weed control determined. Boundaries of weed populations will be accurately mapped using a differential GPS and appropriate herbicides or other method of weed control determined for each occurrence. Transects established to monitor weed levels will be monitored annually. DEC Urban Nature staff have carried out mapping and weed trials at occurrences 21 and 22 (Watkins01, Watkins02).

Other monitoring established in the community includes monitoring programs established as part of the Management Plan for Brickwood Reserve (Serpentine Jarrahdale Shire 2009). To monitor the effectiveness of weed management and changes in the impacted plant community over time, transects should be run from the disturbed edges of the bushland into intact areas, and quadrats placed at intervals along each transect. Transects should be placed so changes in the spread of weeds away from the disturbed edge can be detected. This type of detailed monitoring is required to quantify the effects of on-ground management. Determining the impact of factors such as changed fire frequency would require a monitoring program such as that established by Clarke (2009).

Monitoring Protocols will be based on those developed through the Resource Condition Monitoring project (eg Clarke 2009, and Brown and Clarke 2009) as a basis. The monitoring will be linked to areas where active management or impacts are anticipated, so analysis of results can be incorporated to improve management of fire, hydrology, disease, weed control and other factors, as is recommended for an adaptive management framework.

Monitoring data collected by DEC will be entered into the Site Species database (developed by E.A Griffin) where possible. The results of data analysis will be added to the TEC database as recommended in English and Blyth (1997). This information is essential for determining changes in the community over time and the effects of specific events (e.g. too frequent fire). Quadrat data have been entered into the Site Species database.

Remote sensing data such as ‘Vegetation Trend’ from Landsat TM provides a coarse measure of change in vegetation cover. The interpretation of these data requires ground truthing as factors such as recovery from fire

may not otherwise be evident. This remote sensing method may be suitable for some aspects of monitoring in future.

Responsibility: DEC (Swan Coastal and Wellington District, Swan Region), Science Division, SCB
Cost: $20,000 per year
Completion date: Ongoing

8 Determine the 'normal range' of groundwater levels and quality

There are currently no bores recorded within the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands, however, as noted in Table 2, available data suggest the community may well have a level of groundwater dependence. Historical and current data from bores closest to the community will be examined to determine trends in groundwater levels and quality. This will provide a description of the normal range and fluctuation in water levels and quality, in the habitat of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands on heavy soils, although the data will be indicative only, as no bores actually occur within the mapped area of the community. Data may also be indicative of tolerance levels when linked with monitoring of the composition of the community, and can then be applied to environmental impact assessment processes.

Responsibility: DEC (Swan Coastal and Wellington Districts, SCB) in consultation with landholders, land managers
Cost: $7,000 pa in years 2, 3 to investigate available data
Completion date: Year 3

9 Develop and implement fire management strategy that encompasses the following:

9.1 Implement adaptive management of the fire regime

There is a need for research into recovery of the community from fire, and to determine the implications of findings for management. This would also include developing a fire history map of the occurrences, which is updated annually. The draft management plan for Brickwood Reserve seeks to address this issue (Serpentine Jarrahdale Shire 2009). As mentioned, there are also transects established in occurrence 11 (Connell) for the purpose of long term monitoring of the effects of fire regime on composition.

Given that 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 species, information in Appendix 1 indicates that an inter-fire interval of greater than ten years is likely to be required to retain the full species composition of the community. Species that occur in the community that have 100 percent scorch kill of soil stored seed include *Petrophile macrostachya* with a period of 60 months to flowering, followed by other species such as *Lysinema ciliatum* (48 months to flowering), *Acacia stenoptera* (36 months), *Velleia trinervis* (32 months) and *Calytrix flavescens* (30 months). As the juvenile period of many taxa is not known, and given that drying climate will lengthen the time species take to mature, it will be essential to have a conservative approach to determining inter-fire intervals.

As a start point it is recommended that a minimum inter-fire interval of ten years is implemented in the community, and this should be applied in a variety of seasons, and intensities, for example 60-80% of the community to be burnt in a low intensity spring burn. This should be interspersed with much longer inter-fire intervals such as 3-4 times the juvenile period of the slowest maturing species, which on currently available information for taxa in the community would be 15-20 years. The outcomes of implementation of this regime on the composition and structure of the community should be quantitatively monitored and results and data analysis incorporated into an adaptive management framework.

Responsibility: DEC (Swan Coastal and Wellington Districts; SCB) in consultation with all stakeholders
Cost: $5,000 pa
Completion date: Ongoing

9.2 Maintain strategic firebreaks, and ensure minimal impacts from fire suppression

Maintenance of existing firebreaks is appropriate where firebreaks are already constructed, unless maintenance is likely to cause spread or intensification of dieback or otherwise degrade the community. 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. No new firebreaks should be constructed in intact vegetation in occurrences. Local DEC staff should be involved in planning fire break construction and maintenance for all occurrences of the community.

Fire management or response plans have been developed for some occurrences (occurrence 11 Connell Ave, occurrence 6 Roman Rd, occurrence 3 Brickwood Reserve). Fire fighting authorities need to recognise the importance of not constructing new tracks during their operations, including during wildfires. The use of heavy machinery to create new firebreaks within the community will be avoided because additional disturbance would encourage further weed invasion, and chemicals that may be toxic to the community should not be used.

Fire response plans should be developed with FESA, the relevant local governments and DEC for each remnant containing the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands. Plans should specify factors such as no planned burns without consultation with DEC, no construction of new firebreaks, a fire-fighting strategy, implementation of dieback hygiene for all vehicles, routine fuel and weed monitoring, and maintenance of firebreaks. Plans will need to be developed through liaison between all stakeholders.

The responsibility for managing fires is dependent upon who manages the land. DEC is responsible for fire management on land managed by DEC outside the metropolitan gazetted fire district, while FESA is responsible for this in gazetted areas and non-DEC-land (L. Sage[10] personal communication 2010).

A local DEC staff member will endeavour to be present during wildfires and controlled burns in remnants that contain occurrences of the community, to advise on protecting the conservation values of the community.

Responsibility: DEC (Swan Coastal, Perth Hills and Wellington Districts) in liaison with surrounding landholders
Cost: Cost of firebreaks $5,000 pa
Completion date: Ongoing

10 Implement weed control, rehabilitation, and replant where necessary

Weed control plans will be initiated for areas of bushland that contain the community where necessary and will be based on information from weed mapping. The highest priority will be to control weeds, in the early stages of invasion where possible, that pose the greatest threat to the community, for example some perennial grass weeds and *Gladiolus caryophyllaceus*. Appropriate methods of weed control are found in Brown and Brooks (2002) and may include hand weeding or localised application of herbicide. The herb layer is an integral part of this plant community and care will be taken to minimise disturbance of native herbs in any weed control program.

Rehabilitation through reintroduction of local native species may be necessary if areas are no longer capable of regenerating following weed control. Piles of weed-contaminated soil in any occurrences should be removed and the areas replanted. Tracks excess to requirements should be closed and left to revegetate naturally, or revegetation facilitated through seeding or brushing as necessary. Only seed from the same occurrence should be used for rehabilitation. No seed from other areas should be introduced into occurrences. Occurrences 4 (YARL 04) and 24 (Bancell Rd) have been subject to physical disturbance in the past.

Responsibility: DEC (Swan Coastal, Perth Hills and Wellington Districts) in consultation with landholders, land managers.

[10] Mr Leigh Sage: DEC Swan Coastal District

Cost: $40,000 pa for weed control in all occurrences; rehabilitation requirements of other occurrences need to be determined
Completion date: Ongoing

11 Ensure hygiene conditions

Risk of introduction or amplification of disease will be minimised by ensuring good hygiene procedures. This will involve washdown of any equipment used adjacent to the community, and restricting access by vehicles and machinery to dry soil conditions.

Standard practice should ensure that all vehicles using tracks through remnants that contain the community are free of soil, or plant propagules, and that no vehicles drive off existing tracks within these remnants. These measures will also act to minimise the risk of introduction of other diseases and weeds into the community.

Responsibility: All personnel operating machinery in the occurrences
Cost: $2,000 pa
Completion date: Ongoing

12 Monitor dieback disease and determine priority areas for treatment

Some occurrences have been assessed and mapped for dieback. Other 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). Data on dieback presence and impact, and future biodiversity implications (eg loss or decline of DRF or priority taxa, structurally or functionally important taxa) are likely to be important determinants of the priority of treatment of individual occurrences.

Occurrences of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands that are infested with dieback are occurrence 1-3, 11-15, 23, 25, 28, 32 and 35. Dieback infestation has not been confirmed in occurrence 29, and occurrence 30 is under threat from disease introduction. 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.

Responsibility: DEC (Swan Coastal, Perth Hills and Wellington Districts) in consultation with managers of occurrences
Cost: $10,000 year 1, $2,000 per year thereafter
Completion date: Ongoing

13 Seek to ensure fences are constructed and maintained

Appropriate fencing for all occurrences will be designed to permit authorised vehicle access for operational purposes, allow foot access and protect rehabilitation areas in high usage zones where necessary. Consultation will be required with owners of any occurrences located on land managed by authorities other than DEC to determine appropriate locations for fences.

Occurrences which require fencing include occurrences 5 - 9, 11, 13, 17 - 19, 21- 24, 26, 29 and 34 - 36. Fencing maintenance is required at occurrences 1 and 2.

The southern section of Brickwood reserve containing occurrence 3 (Brick02) is fenced along Soldiers Road and along almost boundaries with private property. It was not fenced along its boundary with Lot 108 owned by the WA Baptist Hospital and Homes Trust Inc as at March 2011.

Responsibility: DEC (Swan Coastal, Perth Hills and Wellington Districts) in consultation with land managers

Cost: $10,000 pa for maintenance
Completion date: Ongoing

14 Install markers and signage as required

To reduce the likelihood of accidental destruction, DEC will mark, or encourage the appropriate authorities to mark, occurrences of threatened ecological communities on roadsides, tracks and firebreaks, with the same pegs as used to mark DRF. Pegs are already in place alongside some occurrences, as they mark the location of DRF. Where these pegs are located on the boundary of the community there is no need to put additional pegs in place, but additional pegs will be put in where the full extent of the community is not marked. These will be placed about 50 m either side of the boundaries of the community to provide a protective buffer. TEC signage with the relevant DEC district's contact number should be placed at all DEC managed land containing this TEC. Occurrences of TECs along Main Roads reserves in the Swan Coastal and Perth Hills Districts have been signposted by Main Roads. DEC has also installed signage at occurrence 3 (Brick 02).

Some WestNet Rail reserves are signposted for TECs and they are aware of their presence and minimize disturbance when undertaking work. None of the reserves under the management of the City of Armadale have been signposted to indicate the presence of TECs.

Responsibility: DEC (Swan Coastal, Perth Hills, and Wellington Districts)
Cost: $5000 in year 1, $2,000 in year 2
Completion date: Year 1

15 Disseminate information about *Banksia attenuata* and/or *Eucalyptus marginata* woodlands

To prevent accidental destruction or damage to the community and gain public support for its conservation, information about the community will continue to be provided by staff from DEC to all stakeholders including landholders, and other managers of land that contain the community. This will include information from the TEC database, and maps indicating the location of the community. Information about private land will only be disseminated if permission is granted by the relevant land manager.

DEC staff will ensure regular liaison with landowners and managers of land that contain the community to ensure threatened ecological community information is up to date.

An information sheet that includes a description of the community, its habitat, threats, recovery actions and photographs should be produced and distributed to the relevant land managers as well as posted on the DEC website.

Responsibility: DEC (Swan Coastal, Perth Hills, and Wellington Districts and SCB)
Cost: $5,000 in the first year; $1,000 pa thereafter
Completion date: Ongoing

16 Support private landowners to conserve the community

Landowners with this communitiy will be advised of incentives that are available, including funds available under the 'Caring for our Country' program, to ensure long term protection of the community.

Responsibility: DEC (Swan Coastal, Perth Hills Districts)
Cost: $2,000 pa
Completion date: Ongoing

17. Seek long term protection of areas of the community

If effective management for conservation seems unlikely to result from recommendations included in this plan, or if suitable areas that contain the community become available, DEC will negotiate to have the remnants that contain the community, and adequate buffer areas where required, protected through perpetual protection

agreements or acquired and reserved as conservation reserves vested with the Conservation Commission of WA.

This recommendation applies to the following public lands:

- occurrence 4 (Yarl04)
- occurrence 10 (Bella01)
- occurrence 13 (Clifford01)
- occurrence 24 (Bancell01, Bancell02);
- occurrence 34 (Myyarl03);

This action refers to the following privately owned occurrences:

- occurrence 14 (Norm01, Norm03, Norm07)
- occurrence 35 (Austral02, Austral Plot02)
- occurrence 36 (Nett01, Nett06 And Nett09).

Responsibility: DEC (Land Unit, Swan Coastal, Perth Hills, and Wellington Districts, SCB); private land owners; Landgate
Cost: Market price of private land at time of purchase
Completion date: To be determined; when land and resources available

18 Consider climate change issues in management

Managing the impacts of emerging threatening processes such as increased periods of drought, fire frequency and possibly water abstraction that may be exacerbated by climate change, through the implementation of actions listed in this plan will be an important part of maximising resilience of the *Banksia attenuata* and/or *Eucalyptus marginata* woodlands to the effects of climate change. In addition, the maintenance and conservation management of intact areas of vegetation that currently help buffer the community, and ways and means of maintaining or improving the connectivity of the occurrences of the community will also help to maximise this resilience and will be sought wherever possible.

The impacts of potential increases in drought frequency and duration and of increased fire frequency will be incorporated into monitoring programs wherever possible.

Responsibility: DEC (Swan Coastal, Perth Hills, and Wellington Districts, SCB) in consultation with land owners and managers
Cost: $2,000 pa for additional monitoring
Completion date: Ongoing

19 Report on success of management strategies for the community

Reporting on the success of overall strategies to maintain or improve condition of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands will be done in annual reports prepared by DEC in liaison with the recovery teams, for DEC's Corporate Executive. A final report will be presented as part of the review and update of the recovery plan, if deemed necessary.

Responsibility: DEC (Swan Coastal, Perth Hills, and Wellington Districts) in liaison with the recovery teams
Cost: $5,000 per year
Completion date: Ongoing

4. TERM OF PLAN

This Interim Recovery Plan will operate from October 2012 to September 2017 but will remain in force until withdrawn or replaced. After five years, the need to review, or update this plan will be determined.

5. REFERENCES

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

Barrett, S., Comer, S., McQuiod, N., Porter, M., Tiller, C. and Utber, D. (2009). Identification and Conservation of Fire Sensitive Ecosystems and Species of the South Coast Natural Resource Management Region. Department of Environment and Conservation, South Coast NRM. Albany, Western Australia.

Brown, K. and Brooks, K. (2002) *Bushland weeds; a practical guide to their management*. Environmental Weeds Action Network (Inc), Western Australia.

Brown, K. and Clarke, V. (2009). Weed control within Brixton Street Wetlands Herb Rich Shrublands in Clay Pans (FCT 8) Threatened Ecological Community. Unpublished report prepared for Significant Native Species and Ecological Communities – Resource Condition Monitoring Project. DEC, Perth.

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

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

Clarke, V. (2009). Monitoring the impacts of fire and *Phytophthora* within the shallow soil plant communities of the Mt Lindesay Threatened Ecological Community, Denmark WA. Unpublished report prepared for Significant Native Species and Ecological Communities – Resource Condition Monitoring Project. DEC, Perth.

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.

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.

Department of Conservation and Environment (1980). Atlas of Natural Resources Darling System Western Australia. Perth.

Department of Environmental Protection (1996). *System 6 update program unpublished site and area records and analysis*. Environmental Protection Authority, Perth, Western Australia.

Dieback Working Group 2000, '*Managing Phytophthora dieback – guidelines for local government*', Dieback Working Group, Western Australia.

Ecologia Environmental Consultants (1991*). Bushmead Rifle Range Development Draft Environmental Impact Statement: Biological Survey*. Unpublished report for Australian Property Group.

English, V. and Blyth, J. (1997) *Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province*. Project N702, Final Report to Environment Australia. Department of Conservation and Land Management. Perth, 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.

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.

Gozzard, J.R. (1986). *Perth Sheet 2034 II and part Sheets 2034 II and 2134 III, Environmental Geology Series.* Geological Survey of Western Australia, Department of Minerals and Energy, Perth.

Keighery, G.J. and Keighery, B.J. (1992). *Plant Communities of the Northern Swan Coastal Plain – with Special Reference to Uncommon and Potentially Rare Plant Communities* . In: Bushland in Our Backyard. Editors N. Gibson and B.J. Keighery. Wildflower Society of WA Inc., Nedlands.

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.

Keighery, G.J. and Keighery, B.J. (1993). Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Parts V - IX. Wildflower Society of Western Australia (Inc.), Nedlands.

Markey, A. (1997). A Florstic Survey of the Northern Darling Scarp. Unpublished report to the WA Department of Conservation and Land Management, the WA Department of Environmental Protection and WA Conservation Council (Inc.) for the Australian Heritage Commission.

Perth Biodiversity Project (2011). Natural Area Initial Assessment Database http://spatial.agric.wa.gov.au/naia/code/default.asp, Acessed February 28, 2011.

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

Stukely M. (2009). *Phytophthora* Dieback – detecting the pathogen. Information Sheet 8/2009. Department of Environment and Conservation, Kensington, WA.

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.

Wilde, S.A. and Low, G.H. (1978). 1: 250,000 Geological Series – Map and Explanatory Notes. Perth Sheet SH50-14. Geological Survey of Western Australia. Perth.

APPENDIX 1

Vascular Plants recorded from at least 50% of plots in occurrences (from Gibson *et al*, 1994)

All other data sourced from NatureMap (accessed, 2010)

Taxon	Fire response	Months to first flowering	Longevity	Dieback response
Acacia barbinervis subsp. *barbinervis* scps				
Acacia sessilis				
Acacia stenoptera	100% scorch kills, in soil seed storage	36	Perennial	Inferred evidence of resistance
Acacia willdenowiana				
Adenanthos meisneri	Survives 100% scorch, basal sprouts	36	Perennial	Inferred moderate susceptibility
Agrostocrinum scabrum	100% scorch kills, in soil seed storage	22	Perennial	
Allocasuarina fraseriana	Survives 100% scorch, epicormics	36	Perennial	Good evidence of high susceptibility
Allocasuarina humilis				
Allocasuarina thuyoides	Survives 100% scorch, basal sprouts	36	Perennial	Inferred high susceptibility
Amphipogon turbinatus	Survives 100% scorch, soil suckers	12	Perennial	Inferred evidence of resistance
Andersonia lehmanniana				
Anigozanthos humilis	Survives 100% scorch, soil suckers	24	Perennial	Inferred variable susceptibility
Anigozanthos manglesii	Survives 100% scorch, soil suckers	12	Perennial	Inferred variable susceptibility
Aotus procumbens				
Arnocrinum preissii			Perennial	
Astroloma pallidum	Survives 100% scorch, soil suckers	24	Perennial	Some evidence of moderate susceptibility
Astroloma stomarrhena				
Austrostipa campylachne	Survives 100% scorch, soil suckers	20	Perennial	Inferred evidence of resistance
Austrostipa compressa	100% scorch kills, in soil seed storage	6	Annual	Good evidence of resistance
Baeckea camphorosmae	Survives 100% scorch, basal sprouts	6	Perennial	
Banksia attenuata	Survives 100% scorch, epicormics	48	Perennial	Inferred high susceptibility
Banksia grandis	Survives 100% scorch, epicormics	24	Perennial	Good evidence of high susceptibility
Banksia menziesii	Survives 100% scorch, epicormics	24	Perennial	Some evidence of high susceptibility
Beaufortia macrostemon				
Bossiaea eriocarpa	Survives 100% scorch, basal sprouts	12	Perennial	
Bossiaea eriocarpa (Large flowered form, BJK & NG 229) scps				
Bossiaea ornata	100% scorch kills, in soil seed storage	32	Perennial	Inferred evidence of resistance
Burchardia umbellata	Geophyte (Survives 100% scorch)	18	Perennial	Some evidence of resistance
Caesia occidentalis			Perennial	
Caladenia discoidea			Perennial	
Caladenia flava	Geophyte (Survives 100% scorch)	24	Perennial	Inferred evidence of resistance
Caladenia reptans	Geophyte (Survives 100% scorch)	19	Perennial	
Calectasia cyanea	Survives 100% scorch, soil suckers	24	Perennial	
Calytrix angulata				
Calytrix flavescens	100% scorch kills, in soil seed storage	30	Perennial	
Cassytha glabella				
Cassytha micrantha	100% scorch kills, in soil seed storage	24	Perennial	
Centrolepis aristata			Annual	
Centrolepis drummondiana			Annual	

Chamaescilla corymbosa	Geophyte (Survives 100% scorch)	7	Perennial	
Chordifex sinuosus			Perennial	
Chorizema rhombeum	100% scorch kills, in soil seed storage	21	Perennial	
Comesperma calymega	Survives 100% scorch, soil suckers	24	Perennial	Good evidence of moderate susceptibility
Comesperma virgatum				
Conospermum stoechadis	Survives 100% scorch, basal sprouts	24	Perennial	Some evidence of moderate susceptibility
Conostephium pendulum				
Conostephium preissii				
Conostylis aurea	Survives 100% scorch, basal sprouts	24	Perennial	
Conostylis juncea			Perennial	
Conostylis setigera	100% scorch kills, in soil seed storage	24	Perennial	Good evidence of resistance
Conostylis setosa	Survives 100% scorch, soil suckers	18	Perennial	
Corymbia calophylla	Survives 100% scorch, epicormics	48	Perennial	Good evidence of resistance
Crassula colorata			Annual	
Cristonia biloba				
Cyathochaeta avenacea	Survives 100% scorch, basal sprouts	6	Perennial	Good evidence of resistance
Cyathochaeta clandestina			Perennial	
Dampiera alata	Survives 100% scorch, soil suckers	12	Perennial	
Dampiera linearis	Survives 100% scorch, soil suckers	24	Perennial	Good evidence of resistance
Dasypogon bromeliifolius	Survives 100% scorch, large apical bud	6	Perennial	Some evidence of variable susceptibility
Dasypogon obliquifolius			Perennial	
Daviesia costata				
Daviesia decurrens	Survives 100% scorch, basal sprouts	18	Perennial	
Daviesia divaricata				
Daviesia physodes	Survives 100% scorch, basal sprouts		Perennial	
Daviesia triflora				
Drosera erythrorhiza	Geophyte (Survives 100% scorch)	11	Perennial	Good evidence of resistance
Drosera glanduligera	Geophyte (Survives 100% scorch)	12	Annual	
Drosera macrantha	Geophyte (Survives 100% scorch)		Perennial	
Drosera menziesii	Geophyte (Survives 100% scorch)	8	Perennial	
Drosera menziesii subsp. *penicillaris*			Perennial	
Drosera paleacea scps subsp. *paleacea*			Perennial	
Drosera stolonifera			Perennial	
Drosera subhirtella			Perennial	
Dryandra nivea	Survives 100% scorch, soil suckers	24	Perennial	Inferred moderate susceptibility
Eremaea asterocarpa subsp. *asterocarpa*				
Eremaea pauciflora subsp. *pauciflora* scps				
Eriochilus dilatatus	Geophyte (Survives 100% scorch)	12	Perennial	Inferred evidence of resistance
Eucalyptus marginata	Survives 100% scorch, epicormics	48	Perennial	Good evidence of moderate susceptibility
Gastrolobium nervosum				
Gompholobium confertum				
Gompholobium knightianum	100% scorch kills, in soil seed storage	21	Perennial	Inferred evidence of resistance
Gompholobium preissii	100% scorch kills, in soil seed storage	21	Perennial	Inferred evidence of resistance
Gompholobium tomentosum	100% scorch kills, in soil seed storage	31	Perennial	Inferred evidence of resistance
Grevillea pilulifera	Survives 100% scorch, basal sprouts		Perennial	

Grevillea wilsonii	Survives 100% scorch, basal sprouts		Perennial	
Haemodorum laxum	Geophyte (Survives 100% scorch)	6	Perennial	Inferred evidence of resistance
Haemodorum loratum			Perennial	
Haemodorum sparsiflorum	Geophyte (Survives 100% scorch)	12	Perennial	
Haemodorum spicatum	Geophyte (Survives 100% scorch)	12	Perennial	
Hakea lissocarpha	Survives 100% scorch, basal sprouts	29	Perennial	Some evidence of variable susceptibility
Hakea ruscifolia	Survives 100% scorch, soil suckers	24	Perennial	Inferred moderate susceptibility
Hakea stenocarpa				
Hemiandra pungens	100% scorch kills, in soil seed storage	24	Perennial	
Hibbertia acerosa	Survives 100% scorch, basal sprouts		Perennial	
Hibbertia amplexicaulis	Survives 100% scorch, basal sprouts	18	Perennial	
Hibbertia huegelii				
Hibbertia hypericoides	Survives 100% scorch, basal sprouts	22	Perennial	
Hibbertia vaginata				
Hovea chorizemifolia	Survives 100% scorch, basal sprouts	29	Perennial	Inferred evidence of resistance
Hovea trisperma var. *grandiflora*				
Hovea trisperma var. *trisperma*				
Hyalosperma cotula	100% scorch kills, in soil seed storage	12	Annual	
Hypocalymma robustum	Survives 100% scorch, basal sprouts	24	Perennial	
Hypolaena exsulca			Perennial	
Jacksonia lehmannii				
Jacksonia sternbergiana	100% scorch kills, on plant seed storage		Perennial	
Johnsonia aff. pubescens gjk 5249 scps	100% scorch kills, in soil seed storage	24	Perennial	
Johnsonia pubescens	100% scorch kills, in soil seed storage	24	Perennial	
Johnsonia pubescens subsp. *cygnorum* Keighery			Perennial	
Kennedia coccinea	100% scorch kills, in soil seed storage	20	Perennial	Inferred evidence of resistance
Kingia australis	Survives 100% scorch, large apical bud	2	Perennial	Good evidence of resistance
Labichea punctata	Survives 100% scorch, soil suckers	22	Perennial	
Laxmannia sessiliflora subsp. *australis*			Perennial	
Laxmannia squarrosa			Perennial	
Lechenaultia biloba	Survives 100% scorch, soil suckers	24	Perennial	
Lepidobolus preissianus			Perennial	
Lepidosperma aff. *angustatum scps*				
Lepidosperma angustatum	Survives 100% scorch, soil suckers	26	Perennial	Inferred evidence of resistance
Lepidosperma eastern terete scps (BJK&NG 232)				
Lepidosperma leptostachyum	Survives 100% scorch, soil suckers	24	Perennial	Inferred evidence of resistance
Leporella fimbriata	Geophyte (Survives 100% scorch)	12	Perennial	Inferred evidence of resistance
Levenhookia pusilla	Killed by 100% scorch (any 1,2,3)	10	Annual	
Levenhookia stipitata			Ephemeral	
Lobelia tenuior	Killed by 100% scorch (any 1,2,3)	6	Annual	
Logania serpyllifolia	100% scorch kills, in soil seed storage	24	Perennial	Some evidence of resistance
Lomandra caespitosa	Survives 100% scorch, soil suckers	33	Perennial	
Lomandra hermaphrodita			Perennial	
Lomandra nigricans	Survives 100% scorch, soil suckers	6	Perennial	Inferred evidence of resistance
Lomandra preissii	Survives 100% scorch, soil suckers	12	Perennial	

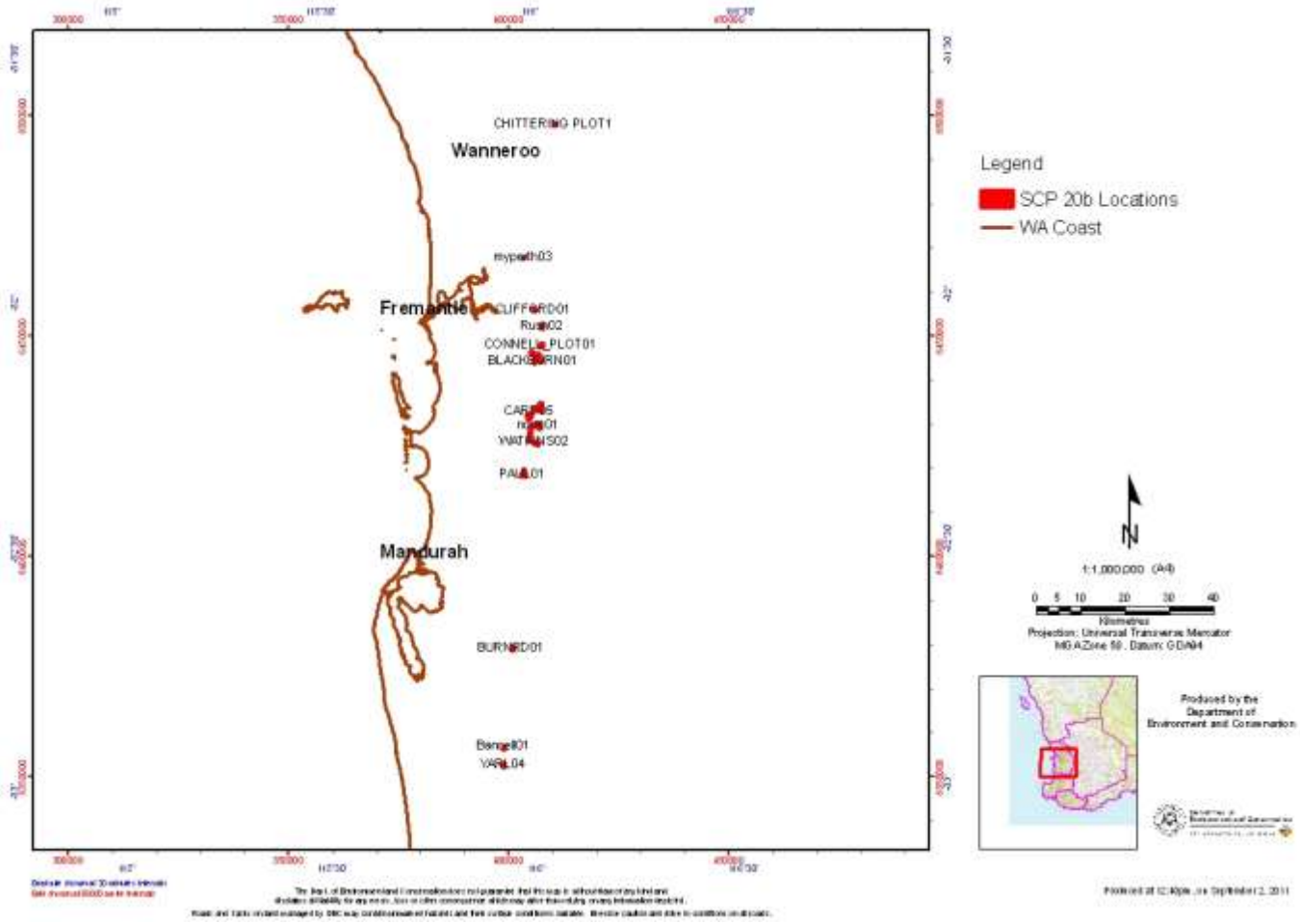
Lomandra purpurea	100% scorch kills, no seed storage	12	Perennial	
Lomandra sericea			Perennial	
Loxocarya fasciculata	Survives 100% scorch, soil suckers	12	Perennial	Some evidence of moderate susceptibility
Lyginia barbata	Survives 100% scorch, basal sprouts	21	Perennial	Inferred evidence of resistance
Lyperanthus nigricans	Geophyte (Survives 100% scorch)	9	Perennial	
Lysinema ciliatum	Killed by 100% scorch (any 1,2,3)	48	Perennial	Good evidence of high susceptibility
Melaleuca acerosa	Survives 100% scorch, basal sprouts	24	Perennial	
Melaleuca thymoides	Survives 100% scorch, basal sprouts	44	Perennial	Good evidence of moderate susceptibility
Mesomelaena graciliceps			Perennial	
Mesomelaena pseudostygia	Survives 100% scorch, soil suckers		Perennial	
Mesomelaena tetragona	Survives 100% scorch, soil suckers	22	Perennial	Good evidence of resistance
Mesomelaena aff graciliceps yarl 04 scps (BJK&NG 146)				
Monotaxis grandiflora				
Neurachne alopecuroidea	Survives 100% scorch, soil suckers	13	Perennial	Inferred evidence of resistance
Notodanthonia occidentalis (Vickery) Veldk.				
Nuytsia floribunda	Survives 100% scorch, epicormics	24	Perennial	
Patersonia juncea	Survives 100% scorch, soil suckers	12	Perennial	
Pentapeltis peltigera	Survives 100% scorch, soil suckers	9	Perennial	
Persoonia angustiflora				
Petrophile linearis	Survives 100% scorch, basal sprouts	25	Perennial	
Petrophile macrostachya	100% scorch kills, in soil seed storage	60	Perennial	
Petrophile striata				
Philotheca spicata				
Phlebocarya ciliata	Survives 100% scorch, basal sprouts	18	Perennial	
Phlebocarya filifolia			Perennial	
Pimelea suaveolens				
Pimelea sulphurea				
Pithocarpa sp. scps				
Podolepis gracilis	Killed by 100% scorch (any 1,2,3)	12	Annual	
Poranthera microphylla	100% scorch kills, in soil seed storage	12	Annual	
Prasophyllum parvifolium	Geophyte (Survives 100% scorch)	12	Perennial	Inferred evidence of resistance
Prasophyllum sp. scps				
Pronaya fraseri	100% scorch kills, in soil seed storage		Perennial	
Pterochaeta paniculata	100% scorch kills, in soil seed storage		Annual	
Pterostylis recurva	Geophyte (Survives 100% scorch)	24	Perennial	Inferred evidence of resistance
Pterostylis vittata	Geophyte (Survives 100% scorch)	9	Perennial	Inferred evidence of resistance
Quinetia urvillei	100% scorch kills, in soil seed storage	9	Annual	
Scaevola calliptera	100% scorch kills, in soil seed storage		Perennial	
Scaevola repens var. *repens*				
Schoenus brevisetis			Perennial	
Schoenus caespititius			Perennial	
Schoenus clandestinus			Perennial	
Schoenus sp. aff. *breviculmis* sthcst			Perennial	
Schoenus subbarbatus "Royce 2872" scps			Perennial	
Schoenus subbulbosus	Survives 100% scorch, soil suckers	12	Perennial	Inferred evidence of resistance

Schoenus subflavus			Perennial	
Scholtzia involucrata				
Siloxerus humifusus			Annual	
Sowerbaea laxiflora	Survives 100% scorch, soil suckers	7	Perennial	
Stachystemon vermicularis				
Stackhousia monogyna	Killed by 100% scorch (any 1,2,3)	12	Perennial	
Stirlingia latifolia	100% scorch kills, in soil seed storage	24	Perennial	
Stylidium brunonianum	100% scorch kills, in soil seed storage	12	Perennial	
Stylidium piliferum	100% scorch kills, in soil seed storage	12	Perennial	
Stylidium repens	Survives 100% scorch, soil suckers	7	Perennial	Good evidence of resistance
Stylidium schoenoides	100% scorch kills, in soil seed storage	7	Perennial	
Stypandra glauca	Survives 100% scorch, soil suckers	18	Perennial	
Styphelia tenuiflora	Survives 100% scorch, soil suckers	29	Perennial	Inferred moderate susceptibility
Tetraria capillaris			Perennial	
Tetraria octandra	Survives 100% scorch, soil suckers	12	Perennial	
Tetrarrhena laevis	Survives 100% scorch, soil suckers	18	Perennial	Inferred evidence of resistance
Tetratheca hirsuta	Killed by 100% scorch (any 1,2,3)	22	Perennial	
Thelymitra crinita	Geophyte (Survives 100% scorch)	6	Perennial	Inferred evidence of resistance
Thysanotus manglesianus	Survives 100% scorch, soil suckers	6	Perennial	
Thysanotus patersonii	Survives 100% scorch, soil suckers	22	Perennial	
Thysanotus thyrsoideus	100% scorch kills, in soil seed storage		Perennial	
Thysanotus triandrus	Survives 100% scorch, soil suckers	24	Perennial	
Trachymene pilosa	100% scorch kills, in soil seed storage	12	Annual	
Trichocline spathulata	Survives 100% scorch, soil suckers	9	Perennial	
Tricoryne elatior	100% scorch kills, in soil seed storage	24	Perennial	
Tricoryne humilis	Survives 100% scorch, soil suckers	8	Perennial	
Tripterococcus brunonis	Survives 100% scorch, soil suckers	8	Perennial	
Velleia trinervis	100% scorch kills, in soil seed storage	32	Perennial	
Xanthorrhoea gracilis	Survives 100% scorch, large apical bud	9	Perennial	Inferred high susceptibility
Xanthorrhoea preissii	Survives 100% scorch, large apical bud	9	Perennial	Good evidence of high susceptibility
Xanthosia huegelii	Survives 100% scorch, basal sprouts	32	Perennial	
Xylomelum occidentale	Survives 100% scorch, epicormics	12	Perennial	Inferred variable susceptibility
* *Anagallis arvensis*	100% scorch kills, in soil seed storage	10	Annual	
* *Briza maxima*	Killed by 100% scorch (any 1,2,3)	6	Annual	Inferred evidence of resistance
* *Ehrharta longiflora*	100% scorch kills, no seed storage	12	Annual	
* *Eragrostis curvula*			Perennial	
* *Hypochaeris glabra*		24	Biennial	
* *Monadenia bracteata*	Geophyte (Survives 100% scorch)	12	Perennial	Inferred evidence of resistance
* *Trifolium campestre*			Annual	
* *Ursinia anthemoides*	100% scorch kills, in soil seed storage	12	Annual	

* = introduced species

Note: Quadrat data from DEP (1996) has not been incorporated into this table. Information is based on plots in Occurrences 1, 2, 3, 4 and 5 only.

Appendix 2: Locations of *Banksia attenuata* and/or *Eucalyptus marginata* woodlands



Appendix 3: Summary of costs for each recovery action

Recovery Action	Year 1	Year 2	Year 3	Year 4	Year 5
Coordinate recovery actions	$5,000	$5,000	$5,000	$5,000	$5,000
Map habitat critical to survival	$10,000	$2,000	$2,000	$2,000	$2,000
Liaise with current land owners, land managers	$5,000	$5,000	$5,000	$5,000	$5,000
Establish quadrats and analyse data	$15,000	$15,000	$15,000		
Seek to implement Bush Forever recommendations, avoid further clearing	$5,000	$5,000	$5,000	$5,000	$5,000
Survey newly located occurrences	$5,000	$5,000	$5,000	$5,000	$5,000
Monitor the extent and boundaries					$20,000
Encompass monitoring within an adaptive management framework	$20,000	$20,000	$20,000	$20,000	$20,000
Determine 'normal range' of groundwater levels and quality		$7,000	$7,000		
Develop and implement a Fire Management Strategy	$10,000	$10,000	$10,000	$10,000	$10,000
Implement weed control, rehabilitation, replanting	$40,000	$40,000	$40,000	$40,000	$40,000
Ensure hygiene conditions	$2,000	$2,000	$2,000	$2,000	$2,000
Monitor dieback and determine priority areas for treatment	$10,000	$2,000	$2,000	$2,000	$2,000
Seek to ensure fences are constructed and maintained	$10,000	$10,000	$10,000	$10,000	$10,000
Install markers and signage as required	$5,000	$2,000			
Disseminate information	$5,000	$1,000	$1,000	$1,000	$1,000
Support private landowners to conserve the community	$2,000	$2,000	$2,000	$2,000	$2,000
Seek long term protection of areas of the community	na	na	na	na	na
Consider climate change issues in management	$2,000	$2,000	$2,000	$2,000	$2,000
Report on success of management strategies	$5,000	$5,000	$5,000	$5,000	$5,000
Total	**$156,000**	**$140,000**	**$138,000**	**$116,000**	**$136,000**

Total of all costs over five years: (not including uncosted actions) $686,000