MAJOR ROAD PROJECTS VICTORIA

SEPTEMBER 2020

EPBC ACT OFFSET MANAGEMENT PLAN

GROWLING GRASS FROG AND SOUTHERN BROWN BANDICOOT (HAREWOOD)

2135645A-SE-27-ECO-REP-0001 Rev06

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EPBC Act Offset Management Plan
Growling Grass Frog and Southern Brown Bandicoot (Harewood)

Major Road Projects Victoria

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REV	DATE	DETAILS
01	10/07/2020	Preliminary draft for comment
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	NAME	DATE	SIGNATURE
Prepared by:	[redacted]	10/07/2020	
Reviewed by:	[redacted]	10/07/2020	
Approved by:			

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GLOSSARY

DAWE	Department of Agriculture, Water and the Environment (formerly DoEE)
DELWP	Department of Environment, Land, Water and Planning
DoEE	Department of Environment and Energy (formerly DoE)
DoE	Department of the Environment
EES	Environment Effects Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FFG Act	Flora and Fauna Guarantee Act 1988
FMP	Fauna Management Plan
HKWR Road	Healesville-Koo Wee Rup Road
MNES	Matters of National Environmental Significance
MRPV	Major Road Projects Victoria
MSA	Melbourne Strategic Assessment
OMP	Offset Management Plan
P&E Act	*Planning and Environment Act 1987*
PD	Preliminary Documentation
PMST	Protected Matters Search Tool
SCO	Specific Control Overlay
SERU	South Eastern Roads Upgrade
SRU	Suburban Roads Upgrade
TA	Technical Advisor
TPZ	Tree Protection Zone
VBA	Victorian Biodiversity Atlas
VQA	Vegetation Quality Assessment

ACKNOWLEGEMENTS

[redacted]

1 INTRODUCTION

1.1 CONTEXT

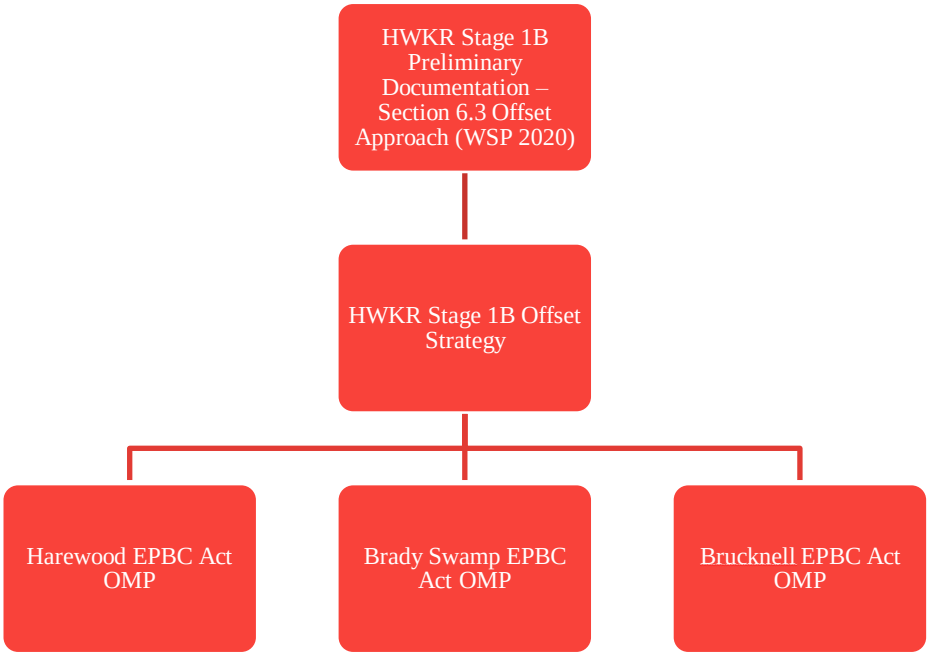
The EPBC Act Offset Management Plan (OMP) for Harewood has been prepared to offset residual impacts of the Healesville-Koo Wee Rup Road Upgrade (Stage 1B) project (the Project) to Growling Grass Frog *Litoria raniformis* and Southern Brown Bandicoot *Isoodon obeslus obesulus.* Growling Grass Frog is a listed Matter of National Environmental Significance (MNES) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Project is located approximately 55 kilometres south east of Melbourne within the Cardinia Shire Local Government Area.

Further information on the impact of the Project on MNES, proposed avoidance and mitigation measures, and the overarching approach to offsets is provided in the Preliminary Documentation (WSP 2020) that is publicly available here https://roadprojects.vic.gov.au/projects/south-eastern-roads-upgrade/healesville-koo-wee-rup-road.

The OMP for Harewood forms part of the Healesville-Koo Wee Rup Road Offset Strategy (Arup 2020). The Offset Strategy expands on the commitments in the Preliminary Documentation and provides for a package of direct offsets for Growling Grass Frog and Southern Brown Bandicoot. The other two OMPs included as part of the Offset Strategy are Brady Swamp (Growling Grass Frog offsets only) and Brucknell (Southern Brown Bandicoot offsets only).

The Offset Strategy describes how the offset requirements for the Project will be achieved across the three OMPs, how the objectives of the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012) will be achieved and includes the EPBC Act Offsets Assessment Guide calculations. The OMPs focus specifically on the management actions to be implemented at each site, and how these actions will benefit the MNES and other significant values on site.

The figure below illustrates the hierarch of offset documentation submitted as part of the Project.



2 HAREWOOD OFFSET SITE

2.1 OFFSET SITE DETAILS

Table 2.1 Offset site details

ITEM	DETAILS
Landholder	[redacted]
Address / lot details	Street Address: 3300 South Gippsland Highway, Koo Wee Rup, VIC 3981
Local Government area	Cardinia Shire
Catchment Management Authority	Port Phillip and Westernport
Bioregion	Gippsland Plain bioregion
Total Offset area	~ 12.70 hectares (To be updated following area corrected by surveyor)
EPBC Offset area required	12.7 hectares (comprising 0.33 ha breeding and 1.54 ha dispersal habitat for Growling Grass Frog, and 10.79 ha dispersal habitat for Southern Brown Bandicoot). NB: Growling Grass Frog dispersal and Southern Brown Bandicoot dispersal habitat areas overlap in some instances.
Planning zones & Overlays	Rural Conservation Zone (RCZ1) — Environmental Significance Overlay (ESO2) — Significant Landscape Overlay (SLO2) — Land Subject to Inundation Overlay (LSIO) — Heritage Overlay (HO116) — Areas of Aboriginal Cultural Heritage Sensitivity

The Harewood estate is located directly adjacent to the North Western Port Nature Conservation Reserve in Tooradin, Victoria (Figure 2.1). The address is 3300 South Gippsland Highway, Koo Wee Rup. It is also adjacent to the Western Port Ramsar Wetland and is diagonally adjacent to The Inlets, one of the few larger examples of the former Koo Wee Rup Swamp outer boundary (Yugovic & Mitchell 2006). Established in the mid-1860s as a pastoral landholding, the social and natural history of the property is well-documented in *Harewood, Western Port - Stardust to Us* (Macwhirter 2016). Today, approximately half of the property comprises areas of restored and remnant native vegetation and is known to support populations of both Growling Grass Frog and Southern Brown Bandicoot.

The Harewood offset site was identified by several organisations including Melbourne Water, DELWP and City of Casey as a potential offset site. Harewood is within close proximity to the Project location (4.9 km southwest of the project area) and is identified in the *Southern Brown Bandicoot Strategic Management Plan for the former Koo Wee Rup Swamp area* (Ecology Australia 2009). In addition, the property is also identified in the sub-regional strategies for both the Southern Brown Bandicoot (DEPI 2014b) and the Growling Grass Frog (DEPI 2013) as a strategically important habitat link for both species' populations within the former Koo Wee Rup Swamp area.

This offset site is situated on privately owned land in a Rural Conservation Zone (RCZ1) within the Cardinia Planning Scheme. It is covered by an Environmental Significance Overlay (ESO2), a Significant Landscape Overlay (SLO2), a Land Subject to Inundation Overlay (LSIO), a Heritage Overlay (HO116) and an Areas of Aboriginal Cultural Heritage Sensitivity. The property is currently un-encumbered and there are no conservation covenants on the property. The

landowner is committed to providing offsets and is prepared to enter into an agreement secured under a conservation a Trust for Nature covenant.

Figure 2.1 Study area location and proximity to the HKWR Road Upgrade project, which is 4.9km north-east (red outline)

2.2 SITE HISTORY

Prior to European settlement, the offset site would likely have supported several vegetation types, including those outlined in Table 2.2 below.

Table 2.2 Pre-existing vegetation at Harewood

VEGETATION TYPE	EQUIVALENT EVC	LOCATION	HEIGHT^
Open woodland dominated by Coast Manna-gum *Eucalyptus pryoriana*	Damp Sands Herb-rich Woodland (EVC 3)	on the higher elevated sandy ridges in the centre Endersby and Macwhirter (2010)	>2m above sea level on sandy ridges
Thickets of Paperbark *Melaleuca ericifolia* scrub	Swamp Scrub (EVC 55)	in the property's north (Westaway 1997) on the edge of the former Dalmore Swamp (Yugovic & Mitchell 2006)	1.7 – 1.9m above sea level, subject to freshwater inundation
Poa dominated estuarine grassland	Estuarine Flats Grassland (EVC 914)	Whilst grasslands are prevalent to the south of the homestead now, it is likely the natural extend of estuarine grassland was present but had a greater proportion of saltmarsh in lower areas prior to the construction of the levee bank	1.5 – 1.7m above sea level, subject to freshwater inundation

VEGETATION TYPE	EQUIVALENT EVC	LOCATION	HEIGHT^
Saltmarsh and estuarine wetlands	Coastal Saltmarsh (EVC 9) Estuarine Wetland (EVC 10)	Adjacent to mangrove shrubland, channels and low-lying areas adjacent to marine estuary	<1.5m above sea level
Mangrove shrubland	Mangrove Shrubland (EVC 140)	in the mudflats and inlets (Westaway 1997)	At sea level

^ heights roughly correlate with vegetation type, in Endersby and Macwhirter (2010)

In the mid-nineteenth century, almost all the native vegetation was removed and converted into farmland or areas of exotic grassland around the homestead. In addition, the construction of levees, at a similar time, would have disrupted the original tidal regime at the site, reducing soil salinity and allowing for the development of grassland vegetation (Westaway 1997). Despite this, some native species such as *Melaleuca ericifolia*, *Phragmites australis*, *Poa poiformis, Gahnia filum* and *Atriplex paludosa* persisted (Westaway 1997). See Figure 2.2 for the elevation and levee banks.

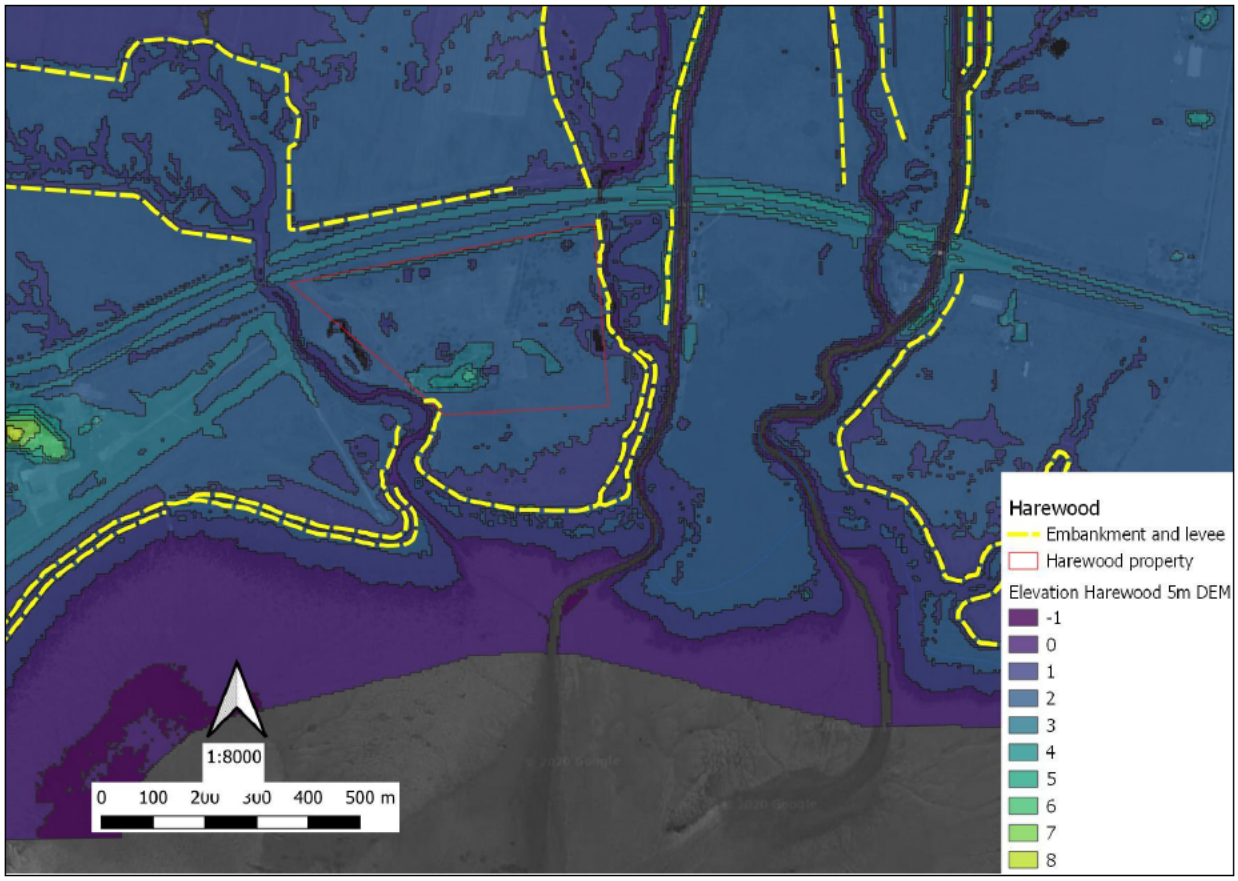


Figure 2.2 Elevation and embankments

Since then, work has been done to revegetate the Harewood property, including the construction of several tidal inlet pools between the homestead and Western Port Bay that are contiguous with the Cardinia Creek and Lyall's Inlet tidal plains. Since cessation of grazing, Coastal Tussock-grass grassland has expanded in low-lying areas. In addition, in the early 2000's, ponds were constructed at the northern extent of the property, adjacent to the South Gippsland Highway. See progression of these works in Figure 2.3, Figure 2.4 and Figure 2.5 below.

Figure 2.3 Study area map from 11/5/2004 – prior to construction of bund along South Gippsland Highway and wetlands close to highway

Figure 2.4 Study area from 9/02/2010 – shows construction of bund along South Gippsland Highway and wetlands close to highway

Figure 2.5 Study area in 18/10/2017 showing development of wetlands and patches of Flax-leaf broom in flower (highlighted in black polygon)

Today, the Harewood property retains approximately 12.7 hectares of habitat for both Growling Grass Frog and Southern Brown Bandicoot (as calculated from the GIS and as shown in Figure 3.3 as 'GGF breeding', 'GGF dispersal' and 'SBB dispersal'). There are remnant habitat areas to the east and west of the property that are contiguous with near coastal, tidal estuarine floodplains and low-lying brackish flats, as well as mangrove shrublands. The site supports created wetlands, restored scrub and grasslands and revegetation of grassy woodland communities across the northern portion of the property. The centre of the property is regularly slashed and retains several managed paddocks, access tracks, the household and associated sheds and outbuildings. An ornamental pond north of the main household was constructed circa 1970s; this site now supports a population of Growling Grass Frog. There are garden beds and windbreaks of exotic flora within proximity of the buildings, and mowed lawns that extend south from the buildings to the mangrove shrublands and estuarine grassland and saltmarsh wetlands of the Westernport foreshore (refer to Figure 2.11).

2.3 GROWLING GRASS FROG

2.3.1 SPECIES PRESENCE

Targeted surveys for Growling Grass Frog were undertaken during the spring/summer survey season between 2019 and 2020, using a combination of call playback and spotlighting. The property has six wetlands, each of which were surveyed on four occasions. All wetlands have been constructed and are typically 0.04 to 0.09 ha in size.

Table 2.3 Growling Grass Frog survey details

SURVEY DATE	TIME	OBSERVER
23/10/2019	6:40- 9:45pm	Peter Gannon
31/10/2019	7:30- 10:45pm	Peter Gannon
20/11/2019	12:20- 2:00pm	Peter Gannon
5/02/2020	9:00am – 2:30pm	Peter Gannon

An estimate of between 65 and 160 Growling Grass Frogs were recorded calling during afternoons and in response to evening call playback surveys. A large Growling Grass Frog population (greater than 40 individuals) was identified within the ornamental pond (Wetland 1), whilst fewer Growling Grass Frogs were recorded within each of the other five smaller wetlands (Wetland 2-5). In addition to calling, basking Growling Grass Frogs were also observed floating on vegetation at the margins of Wetland 1, 3 and 4. Other amphibians recorded during targeted surveys include Common Froglet *Crinia signifera*, Spotted Marsh Frog *Limnodynastes tasmaniensis* and Verreaux's Tree Frog *Litoria verreauxii verreauxii*. The survey results are outlined below in Table 2.4 and the location of each surveyed wetland is shown on Figure 2.6.

Water quality testing was also undertaken at each of the six wetlands (shown in Figure 2.6 as Wetland 1-6). Electrical conductivity (EC) readings across the six wetlands ranged from 8.33ms to 12.94ms; this is considered to be at the higher end of the range tolerated by Growling Grass Frog. Heard et al. (2014) identified that salinity (and temperature) has a negative effect on both the probability and intensity of chytrid infections amoung frog populations, and it is expected that the wetlands within the study area will therefore confer some additional protections against chytridiomycosis and the long-term fecundity of the species (Heard et al. 2014).

Table 2.4 Growling Grass Frog survey results

SITE	AREA (HA)	GROWLING GRASS FROG RECORDED	ESTIMATED POPULATION SIZE	WATER QUALITY RESULTS				CHYTRID EDNA RESULTS
				EC (MS)	PH	TDS	TEMP (°C)	
1	0.09	Yes – on all four occasions	40-60	10.50	7.28	7.38	22.9	Not detected
2	0.05	Yes – on all four occasions	5-20	12.94	7.40	9.19	22.9	Not detected
3	0.05	Yes – on all four occasions	5-20	10.31	4.85	7.07	24.9	Not detected
4	0.05	Yes – on all four occasions	5-20	9.64	6.25	6.81	24.3	Not detected
5	0.04	Yes – on all four occasions	5-20	8.33	6.58	5.91	24.3	Not detected
6	0.06	Yes – on all four occasions	5-20	Not sampled				Not detected

Figure 2.6 Growling Grass Frog survey sites

2.3.2 HABITAT

Growling Grass Frog habitat is defined by still or slow moving water bodies such as lagoons, swamps, lake and farm dams with emergent vegetation consisting of sedges and rushes (e.g. *Typha* sp., *Phragmites* sp. and *Eleocharis* sp.). Submerged vegetation is important for breeding success as it provides egg-laying sites, calling stages for males and food and shelter for tadpoles. Areas within the offset site that are suitable for Growling Grass Frog breeding purposes are shown in Figure 2.6 above as 'GGF breeding', with ponds labelled 'Wetland 1-6'.

Common Reed *Phragmites australis* swaths surrounding waterbodies provides habitat for Growling Grass Frog foraging, dispersal and shelter, and includes the shallow parts of ponds (up to approximately 1.5m) where there is a complex vegetation structure at the wetland margins. Refuge habitat includes soil cracks, fallen timber, debris and dense vegetation and low, frequently inundated floodplains (Department of Environment Water Heritage and the Arts 2009) as found within these areas. Growling Grass Frog dispersal habitat areas are shown in Figure 2.6 above as 'GGF dispersal'.

Photo 1 Growling Grass Frog breeding wetland

Photo 2 Growling Grass Frog observed at Wetland 1

Photo 3 Terrestrial over-wintering habitat with logs for shelter surrounding a pond with breeding habitat

2.3.2.1 SITE

Six wetlands at Harewood are considered to provide suitable breeding habitat for Growling Grass Frogs with suitable terrestrial over-wintering and dispersal habitat mapped around the wetlands as shown on Figure 2.6 above. The area of each wetland and the dispersal/over-wintering habitat are outlined in Table 2.5 below.

Table 2.5 Area of Growling Grass Frog habitat types

HABITAT TYPE	WETLAND NUMBER	AREA (HA)	ECOLOGICAL VEGETATION CLASS (EVC)
Breeding Habitat	1	0.09	Tall Marsh
	2	0.05	Tall Marsh
	3	0.05	Aquatic Herbland
	4	0.05	Aquatic Herbland
	5	0.04	Aquatic Herbland
	6	0.06	Tall Marsh
Dispersal/Over-wintering habitat		1.54	Aquatic Herbland, Estuarine Flats Grassland, Tall Marsh and Swamp Scrub - regrowth

The wetland breeding habitat was primarily mapped as Ecological Vegetation Class (EVC) Tall Marsh and contains species such as Common Reed *Phragmites australis* and Common Spike-sedge *Eleocharis acuta*. The terrestrial habitat was mapped as Brackish Sedgeland and Estuarine Flats Grassland EVCs (See Figure 2.11) and contained high cover of understorey species such as Finger Rush *Juncus subsecundus*, Coast Tussock-grass *Poa poiformis var. poiformis* and Toowoomba Canary-grass **Phalaris aquatica* and includes logs and rocks to provide shelter.

2.3.2.2 CONNECTIVITY

Historically, a large Growling Grass Frog metapopulation extended across the former Koo Wee Rup Swamp, but the species is now largely restricted to artificial waterbodies such as farm dams and agricultural drains in the region (Hamer A.J. & Organ A. 2008). Harewood has been identified in the sub-regional strategy for Growling Grass Frog as a strategically important habitat link within the former Koo Wee Rup swamp area (DEPI 2013). It is important for this species' survival that populations have the ability to interact with other populations or have the ability to establish new populations when waterbodies fill and new habitat becomes available. The Harewood population is within dispersal distance of the North Western Port Nature Conservation Reserve, where there are also records for the species (See Figure 2.7 below) and Cardinia Creek, which is recognised in the Sub-regional Strategy (DEPI 2013) as having an important population. In addition, the site is diagonally adjacent to The Inlets, one of the few large examples of the outer swamp boundary of the former Koo Wee Rup Swamp (Yugovic & Mitchell 2006), is part of a cluster of recent VBA records in the Dalmore – Koo Wee Rup region in the VBA (DELWP 2020b) as well as recent surveys by WSP in 2019 close to the study area.

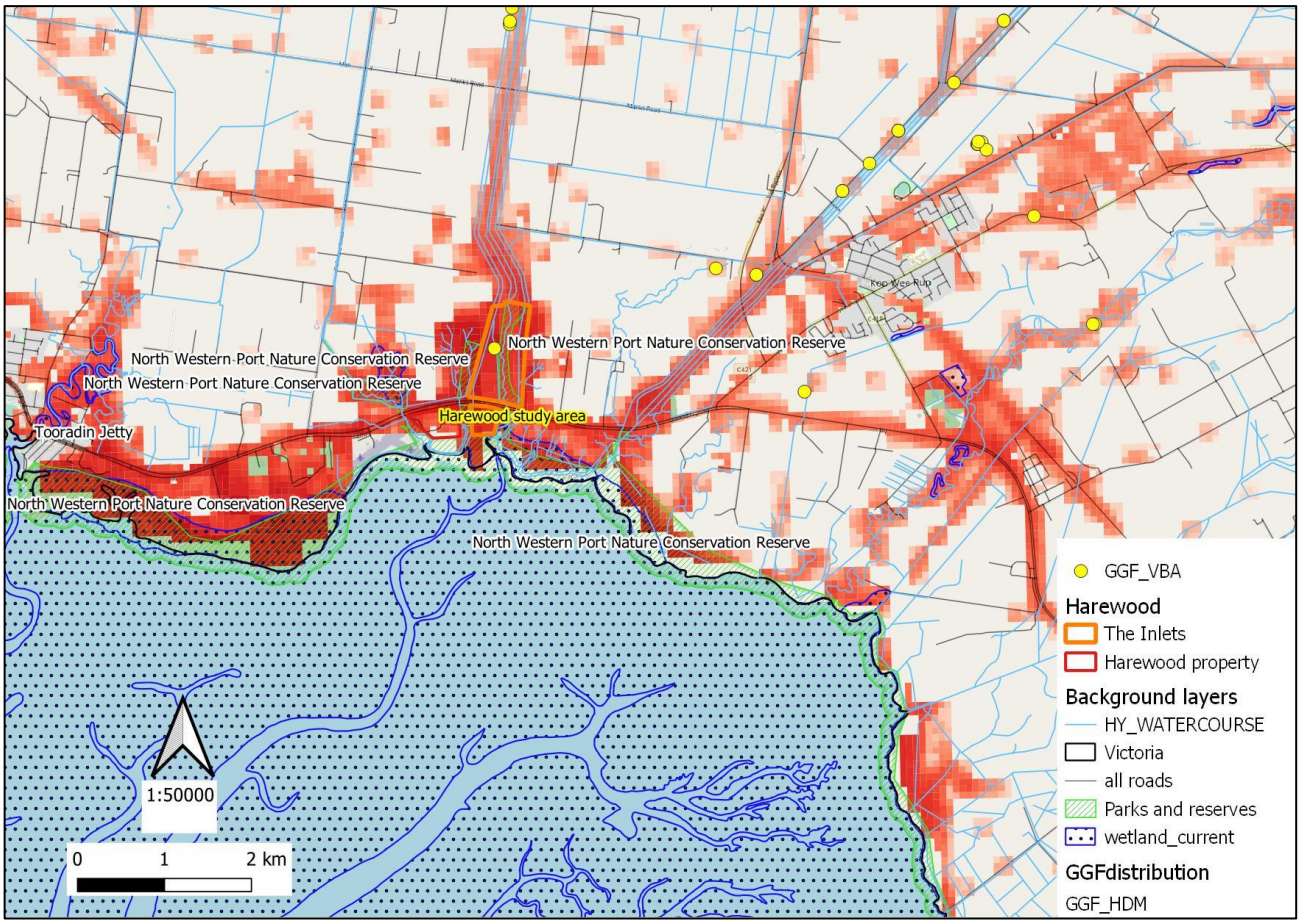


Figure 2.7 Growling Grass Frog records

2.3.3 THREATS

The key threats to the Growling Grass Frog as described in the National Recovery Plan (Clemann & Gillespie 2012) are described below.

2.3.3.1 HABITAT LOSS

Most of the Growling Grass Frog's historical range has been subject to land clearing for agriculture and urban developments. The species relies on movement between waterbodies to maintain population viability. Habitat loss has resulted in a lack of connectivity between populations.

The draining of wetlands to create more available land for agriculture has also resulted in habitat losses across parts of the species range.

2.3.3.2 DISEASE

The disease Chytridiomycosis caused by a fungal pathogen has been found to infect the Growling Grass Frog. The waterborne pathogen infects both tadpoles and the skins of adults impacting the physiological function, ultimately resulting in high mortality. It is highly likely that chytridiomycosis plays a key role in the decline in this species.

2.3.3.3 PREDATION

Eggs and tadpoles of Growling Grass Frog may be vulnerable to predation from fish predators such as the introduced Eastern Gambusia *Gambusia holbrooki*. Foxes *Vulpes vulpes* and Cats *Felis catus* are effective predators found within the range of the Growling Grass Frog which may also be contributing to the species decline.

2.3.3.4 BIOCIDES

The semi-permeable skin of amphibians renders them particularly susceptible to biocides and other pollutants. A herbicide has been implicated in the decline of at least some populations of Growling Grass Frogs. The overall impact is unknown but could be considerable.

2.4 SOUTHERN BROWN BANDICOOT

2.4.1 SPECIES PRESENCE

Monitoring for Southern Brown Bandicoot at Harewood has been undertaken since 2011 by David Nicholls and his team as a part of the Southern Brown Bandicoot Recovery efforts and as a part of the research in the paper *Assessment of the monitoring of ground-dwelling mammals in northern western Port, Victoria* (Nicholls, Coates & Ibbetson 2018). Southern Brown Bandicoot were first recorded at Harewood in 2013, following camera deployment in mid-2011. They were then recorded each year from 2013 to 2016. There were no camera deployments in 2017 but this was then resumed in 2018 and 2019 without records (Nicholls 2020) – see Appendix C for report.

The intermittent occupancy records at Harewood are characteristic of Southern Brown Bandicoot with similar trends in occupancy observed in five other populations (Nicholls 2020). As such, *"The absence of* (Southern Brown Bandicoot) *images from Harewood for 2018-2019 is not necessarily indicative of a true absence into the future"* (Nicholls 2020).

Southern Brown Bandicoot has been recorded at Harewood in 2020 and nearby in Melbourne Water land during surveys undertaken to support the preparation of the OMP. Surveys were undertaken using a combination of infra-red sensory remote cameras and hair tubes as part of the preparation of the OMP. To date, five rounds of camera surveys have been conducted with an increasing number of cameras deployed during subsequent rounds. Round 4 and 5 consisted of 28 cameras deployed within and in close proximity to the Harewood property (refer to Figure 2.8). The details and results for each survey to date are provided below in Table 2.6.

Monitoring is proposed as part of the OMP to monitor the species' ongoing use of the site.

Table 2.6 Southern Brown Bandicoot survey details and results

SURVEY ROUND	DATE RANGE OF SURVEY	NUMBER OF CAMERAS & HAIR TUBES DEPLOYED	TOTAL NUMBER OF SOUTHERN BROWN BANDICOOT RECORDED
REMOTE CAMERA SURVEYS			
1	30/10/19 – 20/11/19	5 cameras	No Southern Brown Bandicoots
2	28/11/19 – 07/12/19	9 cameras	No Southern Brown Bandicoots
3	31/03/20 – 15/05/2020	10 cameras	One Southern Brown Bandicoot (highly likely) on 15/04/2020 – see photos below
4 (many repeat baiting rounds)	27/05/2020 – 1/07/2020 re-baited approx. weekly	28 cameras	One Southern Brown Bandicoot on 15/06/2020 – see photos below
5 (many repeat baiting rounds	1/07/2020 – 11/08/2020 re-baited approx. weekly	28 cameras	Southern Brown Bandicoots were recorded on the Melbourne Water land: Site C23 - 1 SBB 23/07/2020 Images 0216-0220 - 1 SBB 08/08/2020 Images 0331-0335

SURVEY ROUND	DATE RANGE OF SURVEY	NUMBER OF CAMERAS & HAIR TUBES DEPLOYED	TOTAL NUMBER OF SOUTHERN BROWN BANDICOOT RECORDED
			Site C24 - 1 SBB 23/07/2020 Images 0031-0045
HAIR FUNNELS			
1	27/05/2020	40 hair tubes	No Southern Brown Bandicoots
Southern Brown Bandicoot surveys were completed by [redacted]			

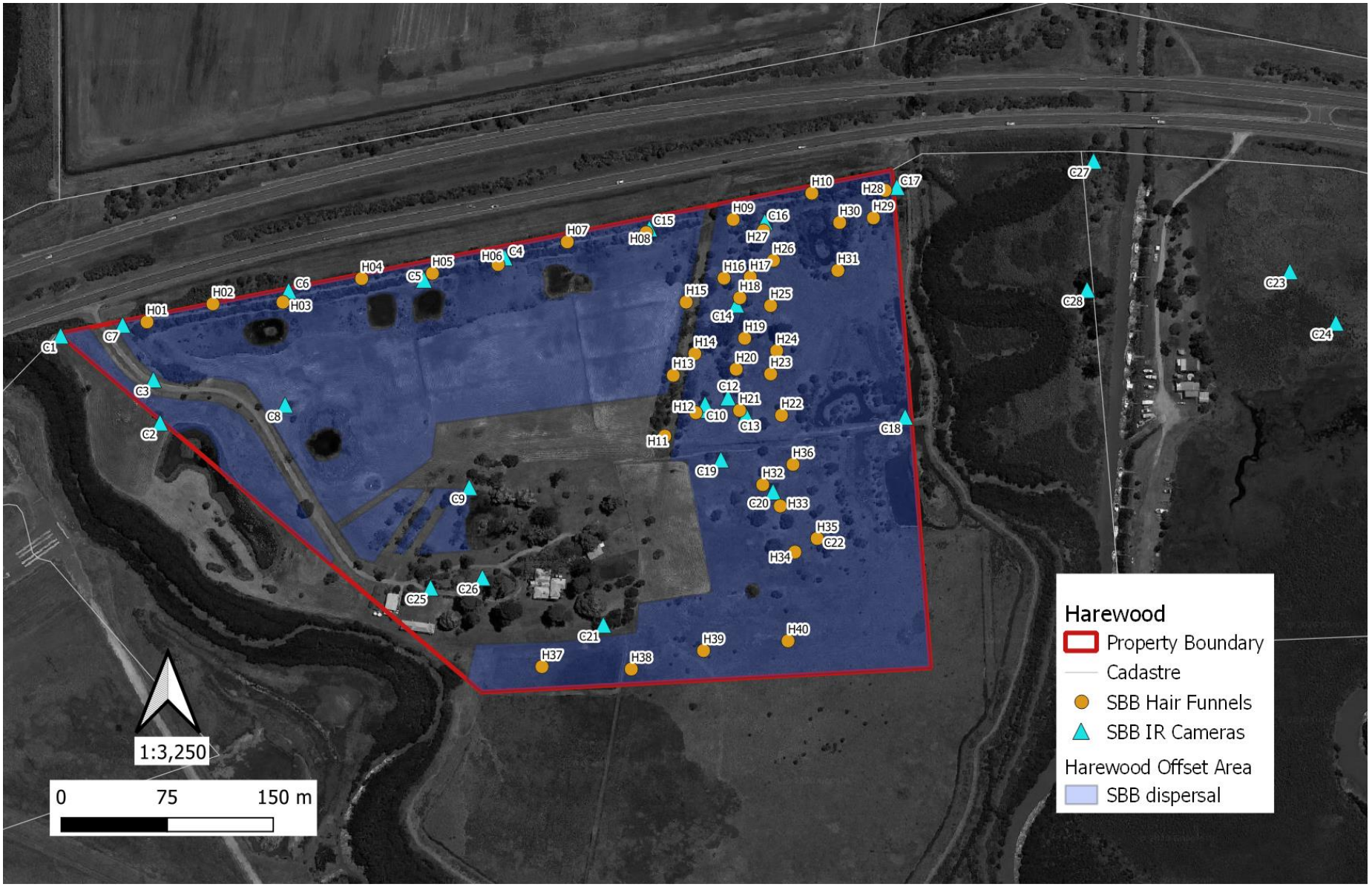


Figure 2.8 Southern Brown Bandicoot camera and hair funnel survey sites at Harewood

Targeted surveys for Southern Brown Bandicoot undertaken by WSP using infrared cameras have identified Southern Brown Bandicoot on site. One image, captured on 15/04/2020 at site C3 (see Figure 2.8 above), has been verified by several ecologists and is considered highly likely to be a Southern Brown Bandicoot (refer to Photo 4 and Photo 5 below). However, due to poor image quality, the identification of the animal in the image couldn't be confirmed with 100% certainty.

A second record, two images of one individual captured on 15/06/2020, more conclusively identifies the presence of Southern Brown Bandicoot at Harewood. The record was captured south of the homestead at IR camera location C21 (see Figure 2.8 above). This second record is shown below in Photo 6 and Photo 7.

Photo 4 Infra-red camera image of Southern Brown Bandicoot (highly likely) captured on 15/04/2020 at site C3 (left) and a zoomed in version of the same photo (right).

Photo 5 Infra-red camera image of Southern Brown Bandicoot (highly likely) captured on 15/04/2020 at site C3 (left) and a zoomed in version of the same photo (right). Note short tail length. White at end of tail is actually a stick and not the tip of a Common Ringtail Possum, as viewed on preceding image.

Photo 6 Infra-red camera image of a Southern Brown Bandicoot head captured on 15/06/2020 at site C21 (left) and a zoomed in version of the same photo (right).

Photo 7 Infra-red camera image of a Southern Brown Bandicoot captured on 15/06/2020 at site C21 (left) and a zoomed in version of the same photo (right). Note this image was taken only 30 seconds after Photo 6 and clearly shows the unique short tail of a Southern Brown Bandicoot.

Photo 8 Southern Brown Bandicoot recorded onsite by landowner in 2017 from the garden just north of Harewood House between driveway and row of Agapanthus.

Photo 9 Example of infra-red camera set up using Reconyx Hyperfire camera and bait station

2.4.2 HABITAT

The Southern Brown Bandicoot inhabits a variety of habitats including heathland, shrubland, sedgeland and heathy open forest. Within these vegetation types they show a preference for areas of dense vegetation cover, and are also found in native bushland and areas of exotic shrubby and grassy vegetation species. Suitable habitat generally requires 50-80% vegetation cover in the 0.2-1m height range (DSEWPaC 2011a). Areas of remnant and regenerating bushland within the offset area has a structure suitable for Southern Brown Bandicoot, as well as non-native areas with dense thickets of Flax-leaf Broom **Genista linifolia* and Toowoomba Canary-grass **Phalaris aquatica,* (see Figure 2-8 and Figure 2-11).

2.4.2.1 SITE

Suitable dispersal habitat mapped at Harewood is displayed on Figure 2.8 above (identified as 'SBB dispersal'). It includes several different EVCs which contain dense understory cover, with the more important factor for habitat suitability for this species being vegetation structure. The EVCs are mapped in Figure 2.11 below and described in Section 2.5.2.

2.4.2.2 CONNECTIVITY

Southern Brown Bandicoots were recorded 140m east of Harewood between 2011 and 2013 by Mal Legg for Parks Victoria and City of Casey on the levee bank on the western side of Cardinia Creek (Legg 2013). This was reported as a

small population which appears to fluctuate between breeding seasons. Southern Brown Bandicoots were also recorded 250 m to the east of Harewood within the Waterway Reserve, east of Cardinia Creek, during targeted surveys conducted by Ecology Australia for Melbourne Water (Ecology Australia 2017). This study further identified, based on historical records and the study results, that Southern Brown Bandicoot are likely to permanently occupy the Waterway Reserve, and that given the amount of potential habitat at the Reserve and the connectivity and distribution of potential habitat in the surrounding landscape, the Reserve may support a sizeable 'sub-population', which forms part of the broader population in the Koo Wee Rup area (Ecology Australia 2017). The Waterway Reserve Southern Brown Bandicoot habitat is contiguous with the Harewood property and is considered to be an extension of the Reserve's habitat extent.

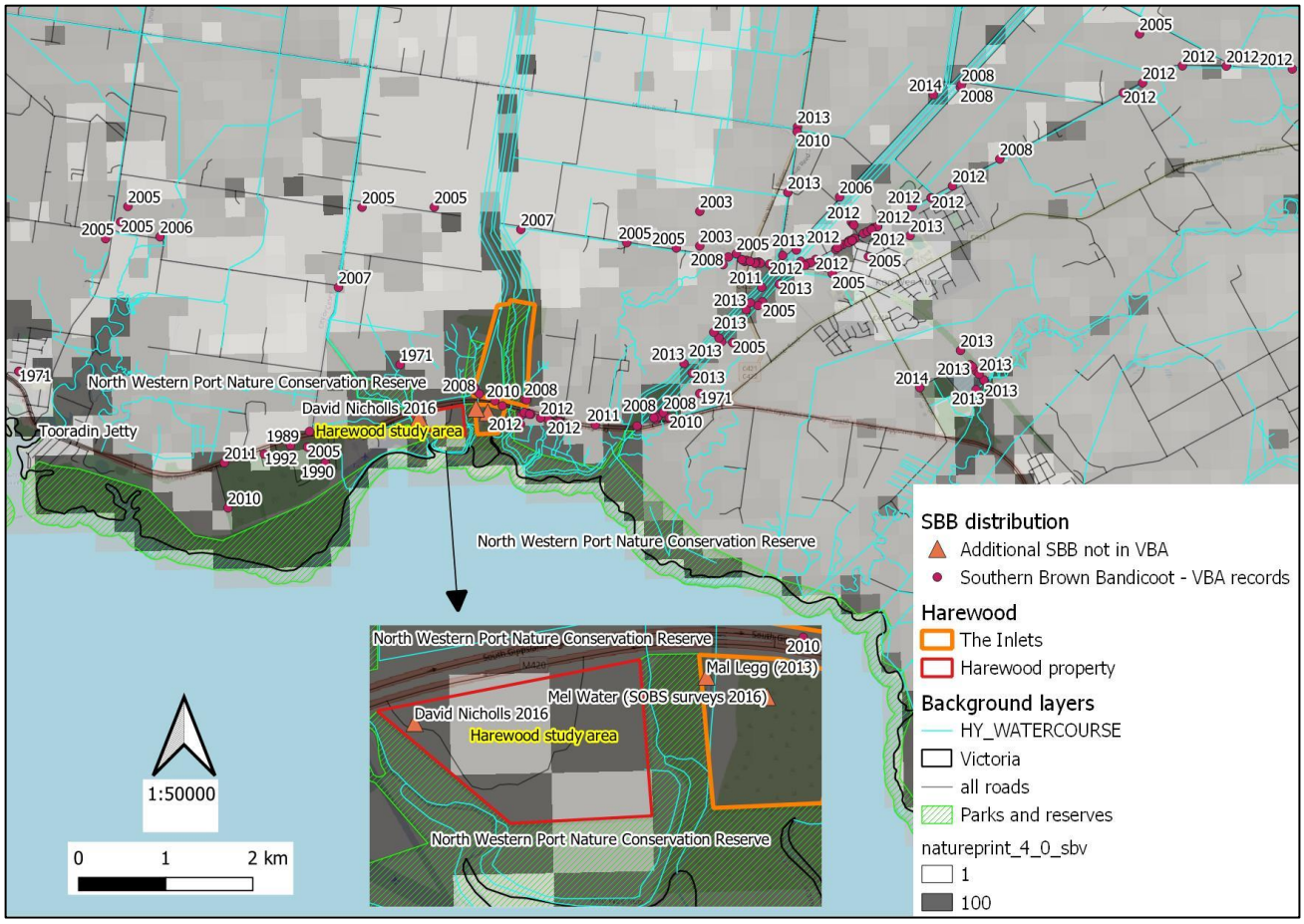


Figure 2.9 Southern Brown Bandicoot records

2.4.3 THREATS

The EPBC Act Conservation Advice for the Southern Brown Bandicoot (Threatened Species Scientific Committee 2016) outlines the main threats to the species as described below.

2.4.3.1 HABITAT LOSS AND MODIFICATION

The species has suffered significant loss of habitat for urban development and agriculture. Remaining native habitat can be rendered unsuitable for the species due to inappropriate fire regimes or stock grazing reducing the understorey cover.

2.4.3.2 PREDATION

The species is preyed upon by introduced species including Red Fox *Vulpes vulpes* and feral and domestic Cats *Felis catus*. Predation is worse in areas of low vegetation cover or where habitat is highly fragmented.

2.4.3.3 FRAGMENTATION

Small populations suffer from inbreeding depression and are at higher risk of extinction than larger populations. Dispersal of males is important in Southern Brown Bandicoot populations for gene flow. Habitat connectivity is important to aid dispersal, narrow linear patches of vegetation such as along roadsides and rail corridors are important, particularly in highly fragment landscapes.

2.4.3.4 WEEDS

Weed invasion can degrade Southern Brown Bandicoot habitat complexity but can also be used by Southern Brown Bandicoot (Brown & Main 2010).

2.5 OTHER VALUES

2.5.1 FLORA AND FAUNA SPECIES

DATABASE SEARCH & HISTORICAL RECORDS

The Commonwealth EPBC Act Protected Matters Search Tool (PMST) was used to determine the likely ecological values of the proposed offset site. The PMST query returned a total of 62 EPBC listed flora and fauna species that are predicted to occur within a 5km radius of the offset site. This includes; 36 birds, two fish, one frog, eight mammals, three reptiles, one shark and 11 plant species. The PMST query also returned a total of 60 listed migratory species. This included 18 migratory marine bird species, nine migratory marine species, five migratory terrestrial species and 28 migratory wetland species.

Several species that were returned in the PMST report are unlikely to be found at the site based on their habitat requirements. This includes fauna reliant on pelagic or marine environments such as albatross, petrels, whales, sharks and marine turtles (which were returned in the database search based on the proximity of the study area to Western Port Bay).

Of the remainder EPBC listed species returned in the PMST report, two fauna species have been recorded at the site and an additional one species has been recorded within a 1km radius (refer below to Table 2.7).

There are historical records of Growling Grass Frogs within a 20km radius of Harewood. This includes approximately 270 records of Growling Grass Frogs since 2002 (DELWP 2020b). As noted above, this property is also recognized in several Growling Grass Frog conservation and recovery strategies as an important link for the species' persistence in the region (DEPI 2013, 2014b; Ecology Australia 2009).

Similarly, historical records identify the former Koo Wee Rup Swamp area as supporting a number of Southern Brown Bandicoot populations (Macwhirter 2016). The draining of the swamp and urbanization of the region has increased the number of threatening processes on the Southern Brown Bandicoot, however they have managed to persist in narrow, linear strips of native and non-native vegetation in cluster populations at Bayles, Cardinia, Dalmore, Koo Wee Rup, and further afield at Bunyip, Adam's Creek and The Gurdies (Coates, Nicholls & Willig 2008). The Royal Botanic Gardens at Cranbourne is also known to support a large population within the predator resistant gardens enclosure (Coates, Nicholls & Willig 2008; Ecology Australia 2009).

FIELD RECORDS

FLORA

A total of 130 plant species have been recorded at the proposed offset site of which 72 species (55%) are native and 58 species (45%) are exotic (refer to Appendix B1). Of these, three are listed on the *Advisory list of rare or threatened plants in Victoria* (DEPI 2014a).

FAUNA

A total of 100 fauna species have been recorded at the Harewood property and an additional 56 species have VBA records within a 1km radius of the site (refer to Appendix B2). Of these, three are listed under the EPBC Act, nine are

listed under the FFG Act and 16 are listed on the *Advisory List of Threatened Vertebrate Fauna in Victorian* (DSE 2013). These significant flora and fauna species, and their conservation status, are outlined in Table 2.7 below.

Table 2.7 Significant flora and fauna species recorded at or within close proximity to Harewood

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS	RECORDED BY WSP	HAREWOOD NATURE GUIDE	1KM VBA SEARCH
FLORA					
Grey Mangrove	*Avicennia marina subsp. australasica*	r	✓	✓	N/A
Marsh Saltbush	*Atriplex paludosa subsp. paludosa*	r	✓	✓	N/A
Yellow Sea-lavender	*Limonium australe*	r		✓	N/A
FAUNA					
Caspian Tern	*Hydroprogne caspia*	nt L		✓	✓
Common Sandpiper	*Actitis hypoleucos*	vu		✓	✓
Glossy Grass Skink	*Pseudemoia rawlinsoni*	vu			✓
Great Egret	*Ardea alba*	vu L		✓	✓
Growling Grass Frog	*Litoria raniformis*	VU en L	✓	✓	✓
Hooded Robin	*Melanodryas cucullata*	nt L			✓
Intermediate Egret	*Ardea intermedia*	en L		✓	
Latham's Snipe	*Gallinago hardwickii*	nt		✓	✓
Lewin's Rail	*Lewinia pectoralis*	vu L		✓	✓
Pacific Gull	*Larus pacificus*	nt			✓
Pied Cormorant	*Phalacrocorax varius*	nt		✓	✓
Regent Honeyeater	*Anthochaera phrygia*	CR cr L			✓
Royal Spoonbill	*Platalea regia*	nt		✓	✓
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	EN nt L	✓		✓
Southern Toadlet	*Pseudophryne semimarmorata*	vu		✓	
Swamp Skink	*Lissolepis coventryi*	vu L		✓	✓

Key for table above:

EPBC Act: CR = Critically Endangered, EN = Endangered, VU = Vulnerable
FFG Act: L = listed as threatened,
Victorian Advisory List: cr = Critically Endangered, en = Endangered, vu = Vulnerable, r = rare, nt = near threatened, p = All infraspecific taxa included in Advisory List

Harewood is known to support both Growling Grass Frog and Southern Brown Bandicoot, with recent and historical records available from the site (Endersby & Macwhirter 2010; Macwhirter 2016; Nicholls 2020); Landowner - [redacted] pers comm). The site also supports many native flora and fauna species including several species listed under

the FFG Act such as Caspian Tern *Hydroprogne caspia*, Great Egret *Ardea alba*, Intermediate Egret *Ardea intermedia*, Hooded Robin *Melanodryas cucullata*, Lewin's Rail *Lewinia pectoralis* and Swamp Skink *Lissolepis coventryi*, all of which are well-documented in the Harewood Nature Guide (Endersby & Macwhirter 2010) and (Robertson 1997) for Swamp Skink. Refer to Figure 2.10 below for the location of significant species recorded by WSP within and in close proximity to Harewood.

Figure 2.10 Significant flora and fauna recorded at Harewood by WSP

2.5.2 ECOLOGICAL VEGETATION CLASSES

The property lies within the Gippsland Plain bioregion and has restored, rehabilitated and remnant patches of native vegetation of brackish and estuarine vegetation communities including the following EVCs listed with associated state conservation significances where available (DELWP 2020a).

- Aquatic Herbland (EVC 653), Endangered
- Brackish Herbland (EVC 538), Not listed in Gippsland Plains bioregion
- Brackish Sedgeland (EVC 13), Not listed in Gippsland Plains bioregion
- Coastal Saltmarsh (EVC 9), Least concern
- Damp Sands Herb-rich Woodland (EVC 3), Vulnerable
- Estuarine Flats Grassland (EVC 914), Endangered
- Estuarine Wetland (EVC 10), Least concern
- Mangrove Shrubland (EVC 140), Least concern
- Swamp Scrub (EVC 55), Endangered
- Tall Marsh (EVC 821), Not listed in Gippsland Plains bioregion

Approximately half of the offset site comprises areas of remnant estuarine grasslands and woodlands, creation of wetlands, restored grassland and swamp scrub and revegetation of grassy woodland communities across the northern sector of the property; descriptions of EVCs are provided below. They are based on the descriptions used for Index of Wetland Condition (IWC) assessment method (DELWP 2018b; Frood 2009) and those provided in EVC Benchmarks for the Gippsland Plain Bioregion (DELWP 2018a), with adaption to the specific species and conditions recorded at the site.

AQUATIC HERBLAND – EVC 653

Aquatic Herbland is widespread across Victoria and is a semi-permanent to seasonal wetland vegetation type. Aquatic Herbland was mapped within six ponds across the site and was dominated by herbaceous aquatic species such as Common Water-ribbons *Cycnogeton procerum,* Common Spike-sedge *Eleocharis acuta*, Variable Willow-herb *Epilobium billardierianum* and Common Reed *Phragmites australis*. Some exotic herbaceous weeds were also recorded including; Aster-weed **Aster subulatus*, Water Buttons **Cotula coronopifolia*, and Toowoomba Canary-grass **Phalaris aquatica.*

BRACKISH HERBLAND - EVC 538

Scattered in inland and near-coastal areas, including estuarine sites, Brackish Herbland is dominated by species tolerant of mildly saline conditions and intermittent inundation. Three small linear patches of Brackish Herbland were mapped in the north-central area of the Harewood estate, which are likely to evolve into Estuarine Wetland or Tall Marsh if left unmown. These patches were found to support several species including; Shiny Swamp-mat *Selliera radicans,* Creeping Brookweed *Samolus repens var. repens,* Creeping Monkey-flower *Thyridia repens,* Rounded Noon-flower *Disphyma crassifolium subsp. clavellatum* and low growing Common Reed *Phragmites australis*.

BRACKISH SEDGELAND - EVC 13

Brackish Sedgeland is found scattered in near-coastal and western inland areas. This EVC consists of a medium to tall sedgeland, dominated by salt-tolerant sedges in association with a low grassy/herbaceous ground-layer. At Harewood, one small patch of Brackish Sedgeland was mapped in the east of the property, adjacent to a patch of Estuarine Wetland. Native species recorded within this EVC include; Marsh Saltbush *Atriplex paludosa subsp. paludosa*, Rounded Noon-flower *Disphyma crassifolium subsp. clavellatum* Australian Salt-grass *Distichlis distichophylla* and Coast Saw-sedge *Gahnia trifida*. Two herbaceous weeds Aster-weed **Aster subulatus* and Toowoomba Canary-grass **Phalaris aquatica w*ere also observed.

COASTAL SALTMARSH – EVC 9

This EVC occurs in bands or zones on and immediately above marine and estuarine tidal flats. One linear patch of Coastal Saltmarsh was mapped in the eastern end of the property and another just outside the eastern property boundary, along the drainage line. These patches were found to support one significant species, Marsh Saltbush *Atriplex paludosa subsp. paludosa*, listed as rare on the Victorian Advisory List (DEPI 2014a). Other native species recorded include; Rounded Noon-flower *Disphyma crassifolium subsp. clavellatum*, Australian Salt-grass *Distichlis distichophylla*, Trailing Hemichroa *Hemichroa pentandra*, Creeping Brookweed *Samolus repens var. repens*, Thick-head Glasswort *Sarcocornia blackiana*, Beaded Glasswort *Sarcocornia quinqueflora*, Sand Spurrey *Spergularia spp,* Austral Seablite *Suaeda australis*, Shrubby Glasswort *Tecticornia arbuscular,* Streaked Arrowgrass *Triglochin striata* and Narrow-leaf Wilsonia *Wilsonia backhousei*. One herbaceous weed, Hastate Orache**Atriplex prostrata* was also recorded.

DAMP SANDS HERB-RICH WOODLAND – EVC 3

Occurring on flat or undulating areas on moderately fertile, well-drained soil, this EVC typically supports grassy or bracken-dominated eucalypt forests or open woodlands with a large shrub layer and a diverse ground layer. At Harewood, Damp Sands Herb-rich Woodland was mapped throughout the north-east corner of the property and are a result of revegetation throughout the property. These areas were dominated by Black Wattle *Acacia mearnsii* and Common Reed *Phragmites australis*. Species that were recorded with a lower cover abundance in this EVC include; Blackwood *Acacia melanoxylon,* Coast Manna-gum *Eucalyptus viminalis subsp. pryoriana*, Swamp Gum *Eucalyptus ovata,* Coast Wattle *Acacia longifolia subsp. sophorae*, Rough Fireweed *Senecio hispidulus*, Sweet Vernal-grass *Anthoxanthum odoratum,* Bent Grass *Deyeuxia spp,* Australian Salt-grass *Distichlis distichophylla,* Mat Grass *Hemarthria uncinata var. uncinata*and, Weeping Grass *Microlaena stipoides var. stipoides*, Coast Tussock-grass *Poa*

poiformis var. poiformis, Brown-back Wallaby-grass *Rytidosperma duttonianum* and Wetland Wallaby-grass *Rytidosperma semiannulare*.

Two woody weeds, Blackberry **Rubus fruticosus spp. agg and* Flax-leaf Broom **Genista linifolia,* wer recorded within this EVC, along with several herbaceous weeds including Toowoomba Canary-grass **Phalaris aquatica*, Large Quaking-grass **Briza maxima*, Flatweed **Hypochaeris radicata* and Bridal Creeper **Asparagus asparagoides.*

ESTUARINE FLATS GRASSLAND – EVC 914

A tussock grassland to sedgeland that occurs in low-lying coastal sites, typically beyond the zone of normal tidal inundation. Two distinct areas of Estuarine Flats Grassland were mapped across the Harewood property. Patches along the northern property boundary were dominated by species such as Wetland Wallaby-grass *Rytidosperma semiannulare*, Swamp Paperbark *Melaleuca ericifolia*, Common Reed *Phragmites australis* and Shiny Swamp-mat *Selliera radicans*. This community is in development and may morph into Tall Marsh and/or Swamp Scrub. Weed cover was relatively low, comprising herbaceous weed species such as Slender Centaury **Centaurium tenuiflorum* Hairy Hawkbit **Leontodon saxatilis subsp. saxatilis* and Slender Bird's-foot Trefoil **Lotus angustissimus*.

In comparison, areas mapped in the south as Estuarine Flats Grassland were of somewhat variable in condition, dominated by Coast Tussock-grass *Poa poiformis var. poiformis*, Rounded Noon-flower *Disphyma crassifolium subsp. Clavellatum*, Australian Salt-grass *Distichlis distichophylla*, Common Blown-grass *Lachnagrostis filiformis*, Rough Fireweed *Senecio hispidulus*, and Pale Rush *Juncus pallidus*. Some areas have higher levels of Toowoomba Canary-grass **Phalaris aquatica* and support several other herbaceous weeds including; Asparagus **Asparagus officinalis*, Aster-weed **Aster subulatus*, Flatweed **Hypochaeris radicata*, Hastate Orache **Atriplex prostrata*, Prickly Lettuce **Lactuca serriola*, Hairy Hawkbit **Leontodon saxatilis subsp. saxatilis*, Black Nightshade **Solanum nigrum*, Common Vetch **Vicia sativa*, Slender Centaury **Centaurium tenuiflorum*, Spear Thistle **Cirsium vulgare* and Perennial Rye-grass **Lolium perenne*.

This community may resemble the EPBC Act threatened community *Natural Damp Grassland of the Victorian Coastal Plains* but the greater presence of halophytic plants and location on estuarine flats indicate this community is not present.

ESTUARINE WETLAND – EVC 10

Consists of rushland/sedgeland vegetation occurring in regularly-inundated wetlands along the coast in in association with larger estuarine floodplains and behind saltmarshes. At Harewood, Estuarine Wetland was mapped across the property in linear patches bordering Mangrove Shrubland, Coastal Saltmarsh and Swamp Scrub EVCs. The patches of Estuarine Wetland are dominated by Sea Rush *Juncus kraussii subsp. australiensis*, Rounded Noon-flower *Disphyma crassifolium subsp. clavellatu* and Coast Tussock-grass *Poa poiformis var. poiformis* with occurrences of Marsh Saltbush *Atriplex paludosa subsp. paludosa*, Grey Mangrove *Avicennia marina subsp. australasica* Australian Salt-grass *Distichlis distichophylla*, Knobby Club-sedge *Ficinia nodosa*, Chaffy Saw-sedge *Gahnia filum*, Beaded Glasswort *Sarcocornia quinqueflora*, Sand Spurrey *Spergularia spp*, Austral Seablite *Suaeda australis* and Streaked Arrowgrass *Triglochin striata*. One woody weed, Flax-leaf Broom **Genista linifolia*, was recorded as well as several herbaceous weeds including; Asparagus **Asparagus officinalis*, Aster-weed **Aster subulatus*, *Spear Thistle **Cirsium vulgare*, Yorkshire Fog **Holcus lanatus*, Toowoomba Canary-grass **Phalaris aquatica* and Common Sow-thistle **Sonchus oleraceus*.

MANGROVE SHRUBLAND – EVC 140

This EVC occurs in intertidal zones and is dominated by mangroves. Mapped just outside the eastern and western property boundaries, Mangrove Shrubland at Harewood is dominated by Grey Mangrove *Avicennia marina subsp. australasica* (listed as rare on the Victorian Advisory List) and Shrubby Glasswort *Tecticornia arbuscular*.

SWAMP SCRUB – EVC 55

Formerly widespread in cooler lowland areas of southern Victoria, Swamp Scrub occurs on relatively fertile swampy flats and consist of dense shrubby vegetation dominated by Myrtaceous shrubs/small trees and. At Harewood, this EVC was mapped along the northern property boundary and is dominated by Swamp Paperbark *Melaleuca ericifolia* and several woody weeds including; Flax-leaf Broom **Genista linifolia*, Blackberry **Rubus fruticosus spp. agg* and Gorse **Ulex europaeus*. Other species recorded include; Blackwood *Acacia melanoxylon*, Small-leaved Clematis *Clematis*

microphylla, Crane's Bill *Geranium spp* and Common Reed *Phragmites australis,* as well as several herbaceous weeds such as Toowoomba Canary-grass **Phalaris aquatica.* Asparagus **Asparagus officinalis,* Cocksfoot **Dactylis glomerate* and Flatweed **Hypochaeris radicata.*

TALL MARSH – EVC 821

Tall Marsh can be found scattered across lowland Victoria. Tall Marsh EVC is a wetland habitat dominated by tall emergent graminoids, typically in thick, species-poor swards. The structure is variously rushland, sedgeland or reedbed, locally closed or in association with Aquatic Herbland, as is the case at Harewood. Several sites across the property have been mapped as Tall Marsh, though some areas of Tall Marsh with higher levels of halophytic plants may resemble Estuarine Reddbed (EVC 952). Dominant species include Common Reed *Phragmites australis,* Sea Rush *Juncus kraussii subsp. australiensis* and Shiny Swamp-mat *Selliera radicans.* Other speices recorded in less abundance include; Little Club-sedge *Isolepis marginata,* Common Blown-grass *Lachnagrostis filiformis,* Coast Tussock-grass *Poa poiformis var. poiformis,* Creeping Monkey-flower *Thyridia repens,* Bristly Wallaby-grass *Rytidosperma setaceum* and Rough Fireweed *Senecio hispidulus.* Several exotic herbaceous weeds were also recorded such as Sweet Vernal-grass **Anthoxanthum odoratum,* Asparagus **Asparagus officinalis,* Hastate Orache **Atriplex prostrata,* Flatweed **Hypochaeris radicata,* Hairy Hawkbit *Leontodon saxatilis subsp. saxatilis,* Buck's-horn Plantain **Plantago coronopus* and Paspalum **Paspalum dilatatum.*

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Marsh Saltbush Atriplex paludosa subsp. paludosa (rare in Victoria)</td><td>Mangrove Shrubland EVC 140 dominated by a rare plant Grey Mangrove Avicennia marina subsp. australasica</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Brackish Sedgeland EVC 13</td><td>Estuarine Flats Grassland south-east of Harewood house</td></tr>
</table>

	
Estuarine Wetland	Damp Sands Herb-rich Woodland
	
Aquatic Herbland	Tall Marsh

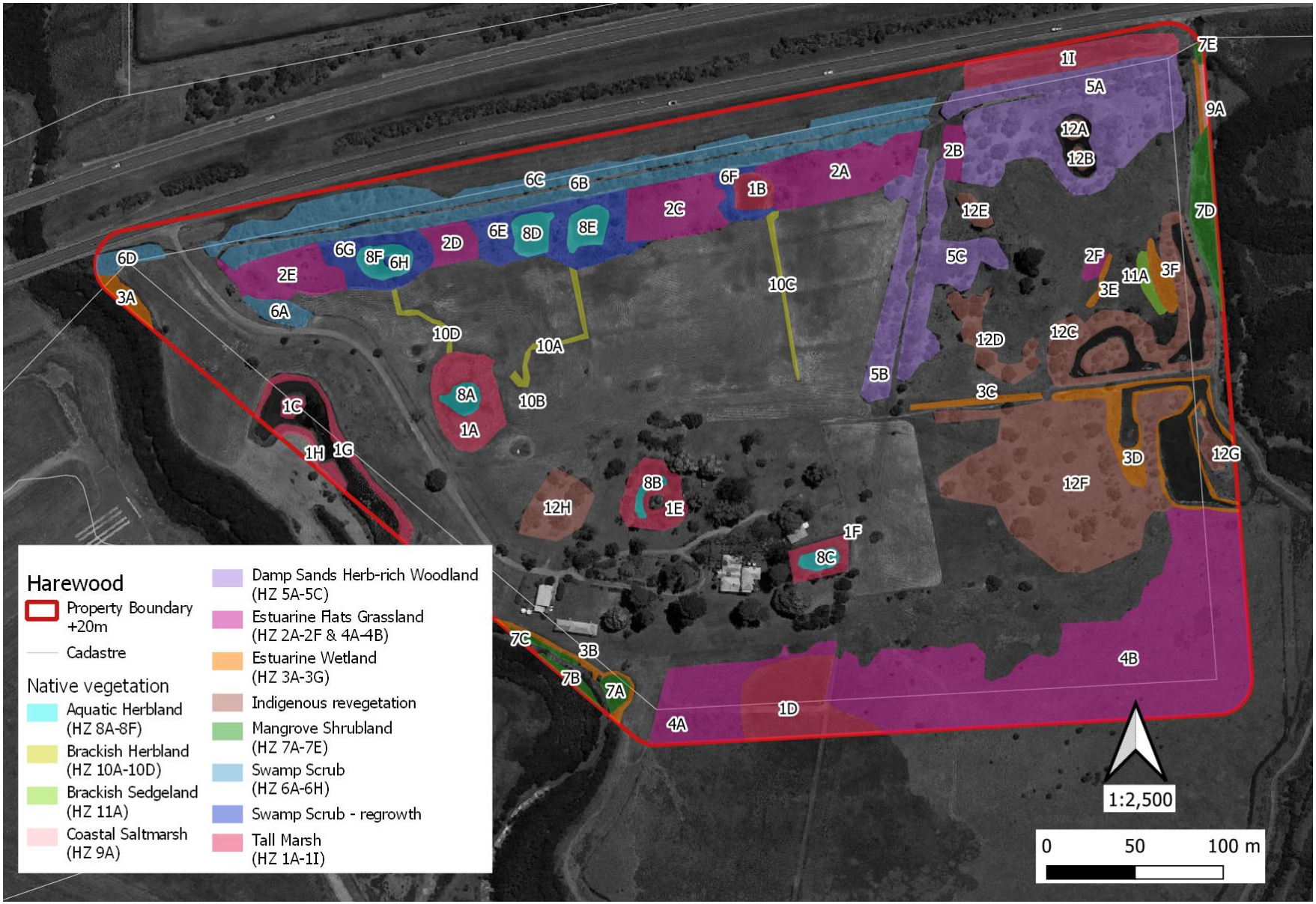


Figure 2.11 Ecological vegetation classes

3 HAREWOOD SITE MANAGEMENT OBLIGATIONS

EPBC Offset management obligations at Harewood will focus on the maintenance and improvement (revegetation) of habitat connectivity to Westernport foreshore reserve and improvements to the long-term viability of the on-site Southern Brown Bandicoot and Growling Grass Frog populations. Additional obligations include weed control to improve on-site habitat, predator control and long-term monitoring of Growling Grass Frog and Southern Brown Bandicoot populations.

3.1.1 SECURITY

The property is currently un-encumbered, and there are no conservation covenants that would prohibit agricultural land-use that is consistent with a Rural Conservation Zone, including grazing by stock and cultivation. A key component of securing offsets at this site therefore will be the establishment of a Trust for Nature Deed of covenant for the conservation of land pursuant to section 3A of the *Victorian Conservation Trust Act 1972* (Vic). The conservation covenant will enact this OMP and the management and monitoring requirements set out below. Annual reports will be supplied to both the DAWE and to MRPV (to be published on the MRPV EPBC compliance website).

The figures below identify the extent of the conservation covenant to be placed on Title and includes all areas of habitat that is to be made available for EPBC Growling Grass Frog and Southern Brown Bandicoot offset credits.

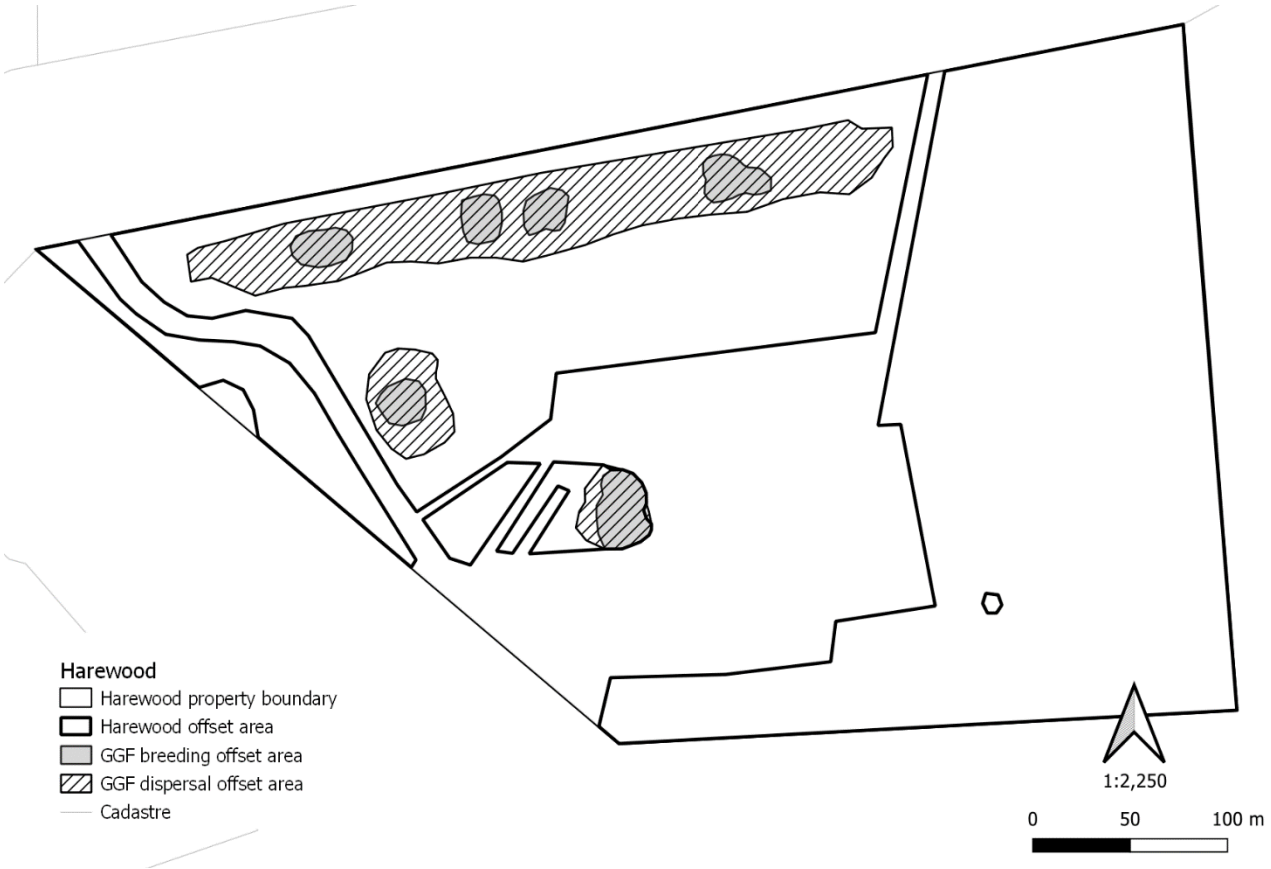


Figure 3.1 EPBC Growling Grass Frog offset areas at Harewood

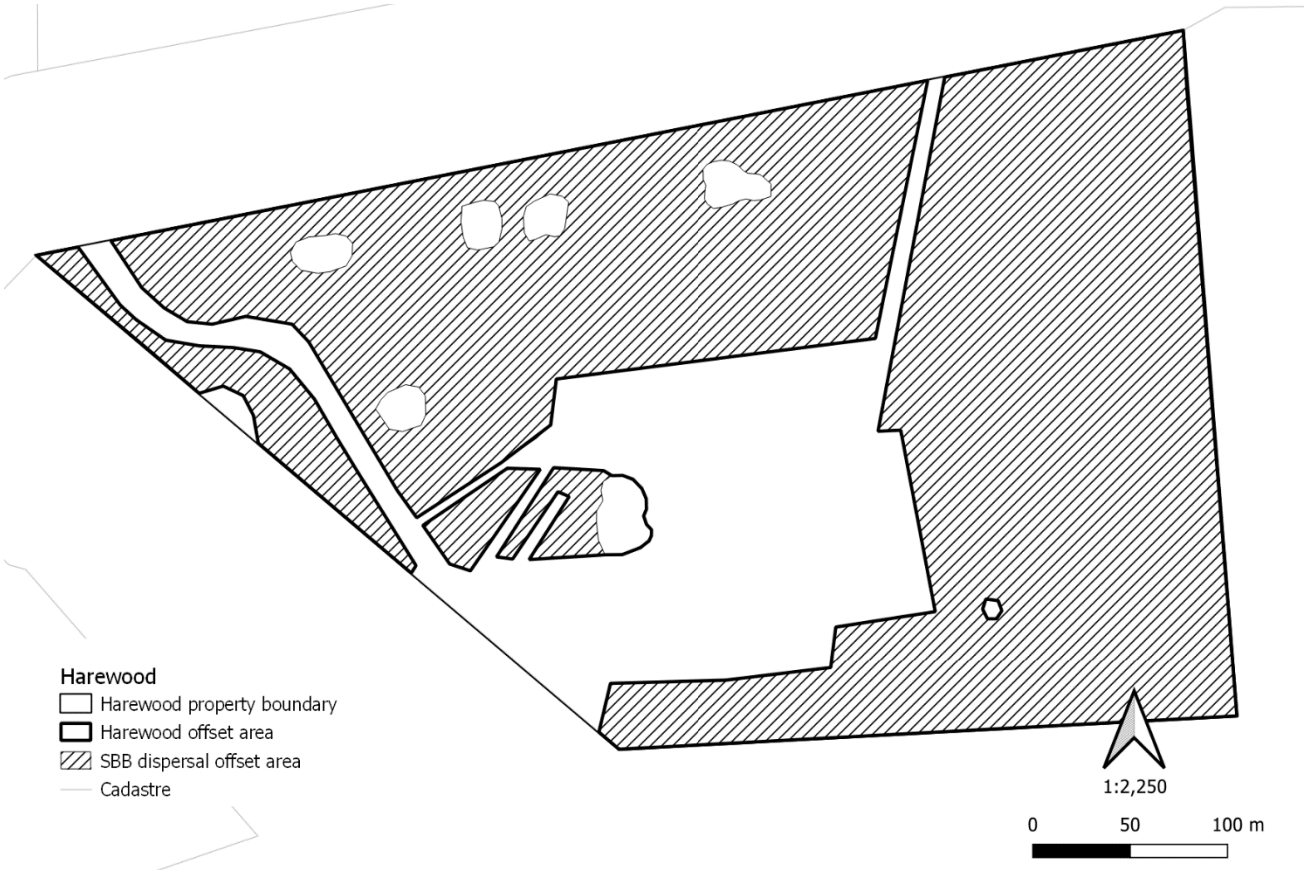


Figure 3.2 EPBC Southern Brown Bandicoot offset areas at Harewood

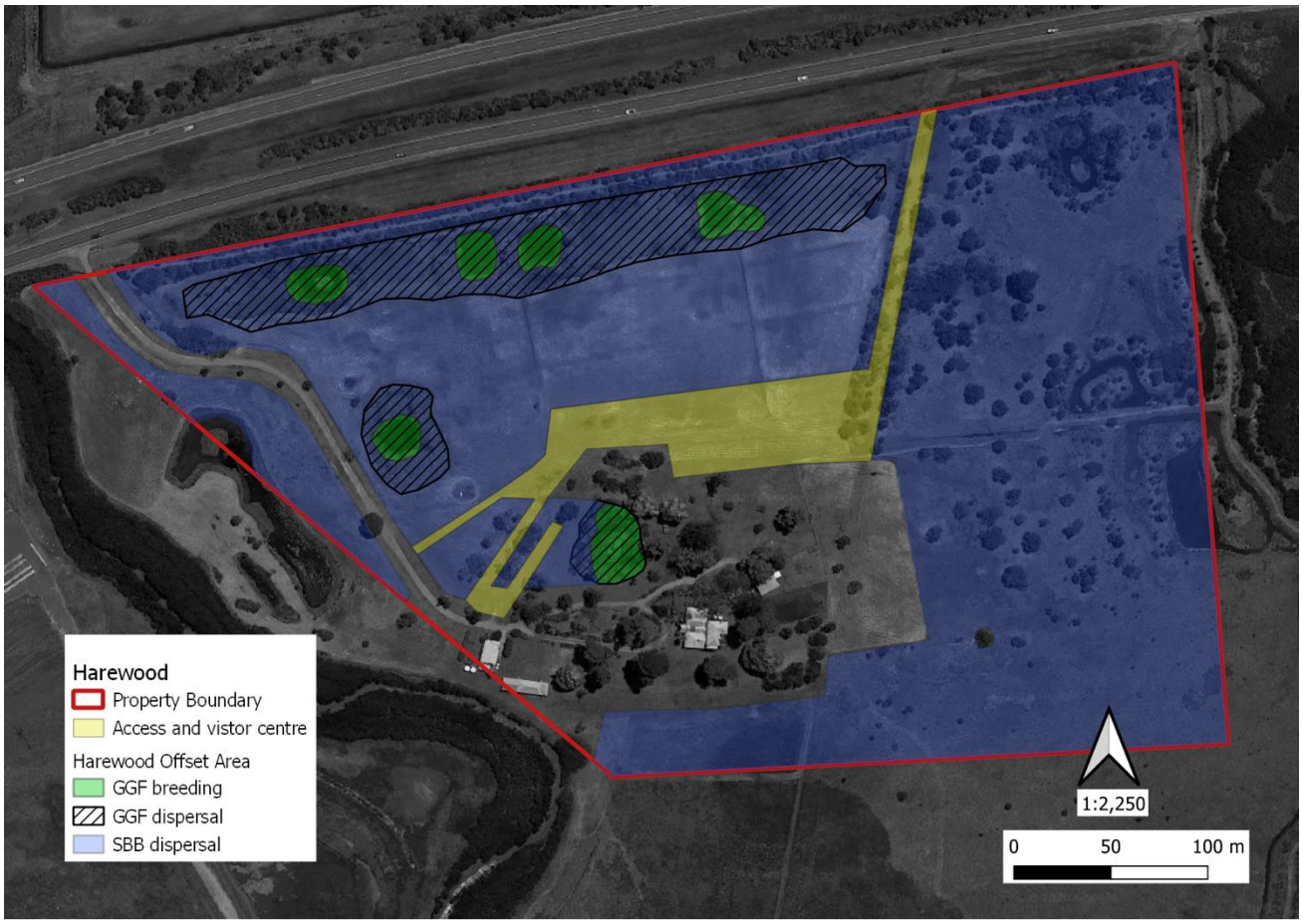


Figure 3.3 EPBC Growling Grass Frog and Southern Brown Bandicoot offset areas at Harewood

3.2 SUMMARY OF MANAGEMENT OBLIGATIONS

The management obligations will include:

- Place a conservation covenant on the offset area.
- Establish clear delineation of different management area by the installation of fencing or bollards.
- Focus on restoring vegetation communities, similar to that prior to clearing of the former Koo Wee Rup swamp. Revegetation will enhance Southern Brown Bandicoot and Growling Grass Frog connectivity.
- Control of woody weeds recognise existing weedy invasive species such as Blackberry and Flax-leaf Broom, and planted native and exotic vegetation, act as habitat for Southern Brown Bandicoot. The area of native vegetation to be planted will exceed the area of woody weed removal. Plantings will also occur in areas were woody weed control is implemented to avoid any localised impacts of woody weed control on Southern Brown Bandicoot.
- Implement a feral/introduced predator control program.

3.2.1 OFFSET MANAGEMENT AREAS

The offset site identified above in Figure 3.3 is comprised of management areas for the provision of Growling Grass Frog breeding and dispersal offsets, and for Southern Brown Bandicoot dispersal offsets. Each management area is comprised of different habitat zones, where each habitat zone was defined and assessed as per the *Vegetation Quality Assessment* (VQA) methodology (Department of Sustainability and Environment 2004). The management areas therefore represent

sites of similar habitat type and ecological function (with exception on Management Area 4), and will be managed and improved on site by the landowner in accordance with the management prescriptions set out below.

The areas for management are divided into four distinct areas, based on their similarity and management needs and similarity of EVCs present – see Table 3.1 and Figure 3.4 below.

Table 3.1 Management areas and respective EVCs

MANAGEMENT AREAS	AREA (HA) ^	BROAD VEGETATION / HABITAT TYPE	EVCS PRESENT	BROAD MANAGEMENT OBJECTIVES
Management area 1	1.459	Wetlands	Tall Marsh Brackish Herbland Aquatic Herbland Swamp Scrub Estuarine Wetland	Maintenance of existing ecological values.
Management area 2	1.577	Estuarine grassland	Estuarine Flats Grassland	Maintenance of existing ecological values, higher level of management to reduce dominant weeds such as Toowoomba Canary-grass. Limit plantings to only scattered woody shrubs planted in clumps for habitat.
Management area 3	1.343	Woodland and scrub	Damp Sands Herb-rich Woodland Swamp Scrub	Maintenance of existing ecological values where understorey developed. For other areas, especially along the embankment, staged woody weed removal (see Section 3.2.3.3) and staged replacement of indigenous woody plants.
Management area 4	6.794	Predominantly exotic understorey vegetation and revegetation	Indigenous revegetation areas Slashed paddocks Mown lawns	Enhancement of existing ecological values where revegetation developed. Instigation of habitat rehabilitation and restoration in areas of predominantly exotic vegetation including facilitated natural regeneration, revegetation, soil scraping, ecological burning and cessation of slashing.
^ Total area of habitat available within the offset site equates to 12.7 hectares, which accounts for overlap of Southern Brown Bandicoot and Growling Grass Frog dispersal habitat sites.				

Management area 4 includes areas of both native and non-native habitat for Southern Brown Bandicoot. Habitat areas within this management aggregate are comprised of planted, indigenous flora, as well as areas dominated by Flax-leaf Broom **Genista linifolia* and Toowoomba Canary-grass **Phalaris aquatica*. Whilst ecological values within this management area may be considered degraded, there are areas approaching 50-80% average understorey foliage cover in the 0.2-1.0 m height range that offer good habitat and cover for Southern Brown Bandicoot. Management Area 4 is therefore included in the Offset Site, with emphasis on successional weed control and staged regeneration of indigenous flora and habitat improvement (see Section 3.2.4.2 for details).

Figure 3.4 below identifies the four management areas, and Figure 2.11 identifies the EVCs that were mapped and assessed at each of the habitat zones.

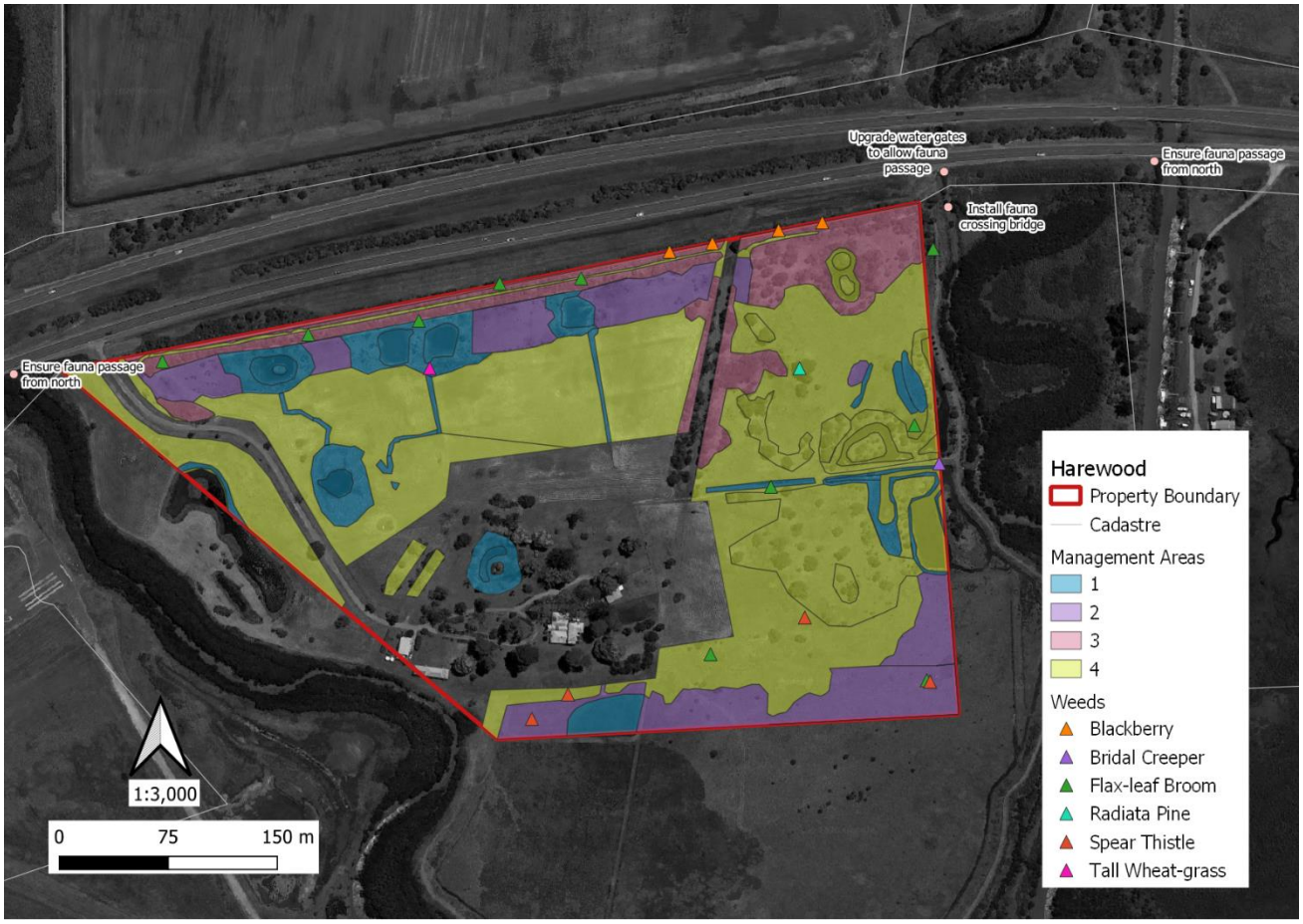


Figure 3.4 Management Areas, fauna connectivity measures and indicative high threat weed locations

3.2.2 FENCING

There is little to no risk of stock inadvertently entering the property from the South Gippsland Highway or from across the inlets. There is a single fenced grazing paddock east of the homestead, not included in the offset area, which is used to graze a pony; these fences are in good condition and adequate to contain low stock levels. No changes to fences are therefore proposed, however, fences need to be maintained to DELWP fencing standards outlined in *Management standards for native vegetation offset sites, September 2019* or better in order to ensure there is no stock impacts within the offset area.

3.2.3 WEED CONTROL

The control of woody and herbaceous weeds are mandatory management actions under a Trust for Nature conservation covenant. Key management actions required for the maintenance and improvement of Southern Brown Bandicoot and Growling Grass Frog habitat, and is a management requirement for weed control that applies to the whole of the offset site. Improved habitat values, in particular through control of woody weeds with successional establishment of indigenous flora and EVC appropriate canopy structure and cover, will also help address key threats to the long-term survivability of these target species such as habitat loss and habitat connectivity (see also Section 2.4.3).

Weed management requirements will therefore include (at minimum):

- Reduce woody weeds to less than 20% projected foliage cover within the offset area whilst simultaneously facilitating, through natural recruitment and/or supplementary revegetation, successional establishment of EVC

appropriate species, cover and canopy habitats. This applies to woody understorey habitat for Southern Brown Bandicoot as well as wetland habitat for Growling Grass Frog (see also Section 3.2.3.3).

- Control herbaceous weeds and ensure that weed cover does not increase within the offset site area.
- Monitor for and control new and emerging weeds.

Further details of successional woody weed control for Southern Brown Bandicoot are also provided in Section 3.2.4.2 below.

3.2.3.1 WOODY WEEDS

Woody weed cover within the offset site is variable with some areas dominated by Blackberry and Flax-leaf Broom and some areas with little to no woody weed cover. Table 3.2 below identifies the woody weed species recorded on site and appropriate means to reduce the cover of these. All care must be taken to avoid off-target impacts that could result in the loss of native vegetation or habitat, and to ensure that there is no spill or inadvertent drift of chemical into neighbouring wetland areas. The use of herbicides is to be in accordance with the manufacturer's instructions (label instructions) and is to be minimised wherever practicable, with preference given to manual control techniques.

Table 3.2 High threat woody weeds recorded on the property

SCIENTIFIC NAME	COMMON NAME	% TOTAL COVER				METHOD	TIMING
		MA1	MA2	MA3	MA4		
**Genista linifolia*	Flax-leaf Broom	<5	<5	20-30	10	Removal by hand, large plants to be cut and painted. Remove seed-heads from the site and dispose. Follow staged weed removal guidelines below	Any time of year
**Rubus fruticosus spp. agg.*	Blackberry	<5	<5	20-30	10	Control small patches by hand tools and spray large patches Follow staged weed removal guidelines below	Active growing season in spring to summer
**Ulex europaeus*	Gorse	5-10	5-10	5-10	5-10	Removal by hand, large plants to be cut and painted. Remove seed-heads from the site and dispose.	Any time of year

3.2.3.2 HERBACEOUS WEEDS

The spread of high threat herbaceous weeds is to be managed within the offset site and, where practicable to do so, infestations are also to be eliminated. This will involve treatment of all herbaceous weeds on site through careful and judicious use of herbicides and the application of manual control methods wherever practicable. Emphasis is to be placed on ensuring that herbaceous weed cover levels do not increase within the offset site, and that infestations are not able to spread into neighbouring areas.

All care must be taken to avoid off-target impacts and the loss of native vegetation or habitat, and to ensure that there is no spill or inadvertent drift of chemical into neighbouring wetland areas or the offset site. The use of herbicides is to be in accordance with the manufacturer's instructions (label instructions) and is to be minimised wherever practicable, with preference given to manual control techniques.

Table 3.3 High threat herbaceous weeds recorded on the property

SCIENTIFIC NAME	COMMON NAME	% TOTAL COVER			
		MA1	MA2	MA3	MA4
**Agrostis capillaris*	Brown-top Bent		1-5	1-5	
**Anthoxanthum odoratum*	Sweet Vernal-grass		1-5	1-5	20
**Asparagus asparagoides*	Bridal Creeper		1-5	1-5	1-5
**Aster subulatus*	Aster-weed	1-5	1-5		
**Bromus catharticus*	Prairie Grass			1-5	
**Cenchrus clandestinus*	Kikuyu		1-5		
**Cirsium vulgare*	Spear Thistle	1-5	1-5	1-5	1-5
**Cotula coronopifolia*	Water Buttons	1-5			
**Dactylis glomerata*	Cocksfoot			1-5	20
**Ehrharta erecta var. erecta*	Panic Veldt-grass			1-5	
**Ehrharta longiflora*	Annual Veldt-grass			1-5	
**Holcus lanatus*	Yorkshire Fog	1-5	1-5	1-5	
**Leontodon saxatilis subsp. saxatilis*	Hairy Hawkbit	1-5	1-5		
**Lophopyrum ponticum*	Tall Wheat-grass	1-5	1-5		
**Paspalum dilatatum*	Paspalum			5	
**Paspalum distichum*	Water Couch	1-5	1-5		
**Phalaris aquatica*	Toowoomba Canary-grass	1-5	1-5	1-5	30
**Plantago coronopus*	Buck's-horn Plantain	5	5		
**Trifolium fragiferum var. fragiferum*	Strawberry Clover	1-5			
**Trifolium repens var. repens*	White Clover		1-5	1-5	1-5
**Vulpia bromoides*	Squirrel-tail Fescue			1-5	

3.2.3.3 STAGED WEED REMOVAL

The persistence of Southern Brown Bandicoot at this property suggests that woody weeds currently offer habitat opportunities for this species and it is considered likely that these weed thickets offer some protections against predation by foxes. The control of woody weeds on site therefore is to be sympathetic to the needs of this species, and contractors are to ensure that no Southern Brown Bandicoot are injured or harmed during control programs. Successional control, involving the staged removal of woody weeds with (re)establishment of indigenous species will therefore be a key component of Southern Brown Bandicoot habitat improvement works at this site.

Weed removal, particularly for woody weeds, should occur in multiple stages and in a mosaic fashion to retain cover for Southern Brown Bandicoot wherever possible, as identified in the *Draft Referral Guidelines for the endangered Southern Brown Bandicoot* (DSEWPaC 2011a). These guidelines have specific recommendations for staged removal of exotic vegetation coupled with successional establishment of appropriate habitat.

Southern Brown Bandicoot use a wide variety of native and exotic vegetation in the study area. As such, management of any terrestrial vegetation (including removal of weeds such as Flax-leaf Broom **Genista linifolia,* Toowoomba Canary Grass **Phalaris aquatica* and Blackberry **Rubus fruticosus*) must be undertaken generally in accordance with *The Guidelines for best-practice management of modified habitats for Southern Brown Bandicoots* (Masters, Talyor & Maclagan 2019) (see also extracts provided in Appendix E). This includes the following:

- where practicable, establish suitable vegetation nearby before clearing of pest plants and native vegetation commences
- stagger/stage removal of pest plant species and replace with indigenous alternatives over time, while ensuring >50% understory vegetation remains at all times
- implement a rapid intense revegetation program following weed removal using bandicoot-suitable plant species, ensuring a high plant density in the understorey to prevent the re-growth of weeds
- ensure that there are no gaps of greater than 7m created in Southern Brown Bandicoot habitat and protective harbour during weed removal works
- avoid creating gaps >7m between Southern Brown Bandicoot habitat rehabilitation sites as these may hinder movement of Southern Brown Bandicoots.

3.2.4 REVEGETATION AND HABITAT RESTORATION

This section sets out species specific management and restoration works that are required within the offset area. Further generalist management requirements that apply to the whole offset area are also provided.

3.2.4.1 GROWLING GRASS FROG

Management of the Growling Grass Frog habitat areas is generally aimed at improving connectivity between breeding ponds and maintaining current conditions. It is acknowledged that the current management of the property has maintained and improved the Growling Grass Frog population on site, including development of the northern chain of breeding ponds and an increase in habitat availability and the total Growling Grass Frog population. The landowner has demonstrated that the application of a shallow scrape of surface soils can be an effective means of both controlling Toowoomba Canary-grass and Flax-leaf Broom, whilst simultaneously establishing Growling Grass Frog breeding ponds (see time-lapse aerials provided in Figure 2.3 to Figure 2.5). Regular mowing / slashing of areas between the ponds and the homestead (as currently conducted by the landowner) as well as the management of visitors to the historic homestead (including parking of vehicles Wetlands 1 and 2) has not had a detrimental effect on the dispersal of the Growling Grass Frog population to the northern ponds. Changes to management within the offset area set out below have therefore incorporated the landowner's requirement to maintain existing land-uses, whilst also providing opportunities to expand on habitat maintenance and restoration activities aimed at improving Growling Grass Frog long-term survivability and fecundity.

Any Growling Grass Frog habitat restoration will be done with consideration of the Growling Grass Frog Habitat Design Standards (DELWP 2017). Habitat enhancement features and works include the following:

- Enhancement of Growling Grass Frog dispersal habitat between Wetlands 1, 2 and 3 on Figure 2.6 to create a 'chain of wetland' habitat; this could include modification of slashing in those areas (except the access track) such as maintaining greater cover during Growling Grass Frog dispersal periods, placement of logs, rocks and sensitive weed control. This covers an area of approximately 0.3 ha between areas of native vegetation dominated habitat.
- Establishment of Growling Grass Frog connectivity through natural recruitment of Tall Marsh and Aquatic Herbland appropriate species. Facilitate natural regeneration by removal of woody weeds and grassy and herbaceous weeds with sensitive management methods (eg. preference for hand removal of weeds or low use of herbicides within proximity of wetlands). Implement supplementary revegetation works if natural recruitment is not evident after 2-3 years (see wetland descriptions in Section 2.5.2 and Appendix B for EVC appropriate flora).

- Establishment of an access track (eg 1-3m wide) between Wetlands 1 and 2 in order to facilitate visitor access to the historic Harewood homestead, and to ensure that there is no direct water link between these ponds thereby facilitating control of the spread of Mosquito Fish **Gambusia holbrooki* on site. The access track pavement at this location is to be friendly to Growling Grass Frog migration requirements, such as a grassed track stabilised with geotextile as currently exists in the northeast of the property.
- Investigate options to create Growling Grass Frog breeding ponds through judicious scrape of surface soils and creation of pondages (as successfully conducted on site by the current landowner; see also aerial time-lapse photography provided in Figure 2.3 to Figure 2.5).

3.2.4.2 SOUTHERN BROWN BANDICOOT

A large portion of Management Area 4 is dominated by Toowoomba Canary-grass and Flax-leaf Broom; whilst these species are environmental weeds they both offer harbour and habitat for Southern Brown Bandicoot. There is an opportunity to improve these areas through staged weed control with successional (re)establishment of indigenous habitat.

The key aim of revegetation and habitat enhancement for the Southern Brown Bandicoot is to provide 50-80% average understorey foliage cover in the 0.2-1.0 m height range (DSEWPaC 2011a), with works to follow prescriptions provided in the *Guidelines for best-practice management of modified habitats for Southern Brown Bandicoots*; provided in Appendix E). Any revegetation works will be followed up with a weeding and watering program that lasts for at least 24 months from planting to ensure the successful establishment of new habitat. Revegetation should allow for a contingency planting of 20% to replace any plants that fail during the first two years.

Any proposed revegetation works or habitat replacement needs to recognise existing weedy invasive species such as Blackberry and Flax-leaf Broom, and planted native and exotic vegetation that are acting as habitat for Southern Brown Bandicoot. This habitat needs to be either managed and maintained and/or slowly replaced with appropriate indigenous species through a staged habitat replacement program, as described in Section 3.2.3.3 and in Appendix E. Care must also be taken during work programs to ensure that there are no Southern Brown Bandicoot harbouring in areas being targeted for weed removal works; if encountered, these sites should be left for a minimum period of two weeks to ensure that Southern Brown Bandicoot individuals have opportunity to move to sites outside of the works area.

Previous habitat restoration work involved scraping topsoil to a depth of approximately 10 – 30 cm along the front of the property (northern boundary) for an area of approximately 30 m wide x 350 m long. This approach has successfully restored fauna habitat for Southern Brown Bandicoot and Growling Grass Frog and EVCs including Swamp Scrub, Tall Marsh and Estuarine Flats Grassland, as demonstrated in Section 2.2. Topsoil scraping removes weed seeds, propagules and excessive nutrients and has also been undertaken successfully in grassy ecosystems by Greening Australia (https://www.greeningaustralia.org.au/wp-content/uploads/2017/11/7_Grassy_Groundcover_Gazette_June_2009.pdf). Thus maintaining this approach should continue to restore habitat for Southern Brown Bandicoot and Growling Grass Frog at the site.

Revegetation and habitat restoration works will be undertaken in Management Area 4 and will involve a range of measures including but not limited to the following:

- Enhance Southern Brown Bandicoot dispersal habitat across the offset site through staged weed control coupled with successional establishment of indigenous habitat (see also Section 3.2.3.3).
- Instigate habitat rehabilitation and restoration in areas of predominantly exotic vegetation using techniques such as weed control with successional revegetation, soil scraping, and cessation of slashing within management area 4.
- Ensure there is adequate post-scrape weed management to encourage natural regeneration.
- Monitor weed control areas for natural recruitment of EVC appropriate flora and establishment of indigenous habitat, and supplement these areas as required with revegetation of indigenous species to minimise re-establishment of controlled weeds.

- Install fencing or bollards to demarcate the extent of areas reserved for Harewood visitor functions including the access alignment, parking areas and pedestrian walkways.
- Ensure that staged weed control programs are conducted in accordance with procedures set out above in Section 3.2.3.3, and that the creation of 'bare areas' is avoided and minimised to gaps of less than 7 metres.
- Investigate opportunities to work with neighbouring properties and public land managers to implement the following management measures, acknowledging these would require consultation with adjacent land holders such as Parks Victoria and Melbourne Water (shown on Figure 3.4):
  - install minor fauna crossing bridge over the unnamed tributary of Cardinia Creek,
  - upgrade water gates to allow fauna passage as well as water,
- ensure fauna passage along Cardinia Creek and Lyells Inlet.Facilitated natural regeneration:
  - Natural regeneration in areas with predominantly exotic vegetation, will be encouraged by a range of methods including soil scraping, revegetation, ecological burning, changed/cessation of slashing across an approximate area of 2.8 ha. Scraped soil will be used outside of offset area to build up a carparking area
  - Natural regeneration to occur over three years (approximately 0.95 ha per year) so that any disruption to Southern Brown Bandicoot habitat is minimised and post-scrape weed management remains manageable
  - Scraping will be done by suitably-qualified machine operators (such as the current landowner's manager or similar) to a depth of 10-30 cm
  - Ensure there is adequate post-scrape weed management to encourage natural regeneration.
- Revegetation:
  - Revegetation will occur in an area approximately 2.4 ha and should occur over the first three years to create cover and habitat suitable for Southern Brown Bandicoot.
  - Within one month following weed removal, revegetate equivalent area according to most appropriate EVC for the soil types, elevation and periods of inundation, according to Section 2.2 elevation map and nearby EVCs in Section 2.5.2. Lower lying areas are most likely to support Estuarine Flats Grassland unless there is a drainage channel or areas which experience longer periods of inundation which might support Swamp Scrub or one of the wetland EVCs. Higher elevated areas with sandy soils are more likely to support species from Damp Sands Herb-rich Woodland EVC.
  - Planting density should be in accordance with *Revegetation planting standards* (DSE 2006)
  - Assume revegetating to *Revegetation planting standards* will create habitat suitable for SBB, if > 90% survival of tall graminoids and shrubs.
- Supplementary planting
  - Supplementary planting will occur in an area approximately 1.4 ha where there is typically some canopy species but fewer understorey species. This should occur over the first three years to create additional cover and habitat suitable for Southern Brown Bandicoot.
  - Supplementary planting may also need to occur in circumstances where natural regeneration and revegetation have not achieved cover requirements.

Following annual monitoring, additional plantings will be undertaken to ensure Southern Brown Bandicoot cover requirements are met, i.e. 50-80% cover in 0.2 – 1 m range over 10 years.

- In addition, the following actions will be undertaken to preserve existing and created habitats:- Ensure that any stock held on site are contained outside any offset areas.

3.2.4.3 SWAMP SKINK HABITAT CONSIDERATION

Although the habitat restoration activities are focused on Southern Brown Bandicoot and Growling Grass Frog, there should be some consideration of Swamp Skink as, according to the study by Robertson (1997), an important population is present at Harewood. The following measures should therefore be considered to maintain the population of Swamp Skink:

- Ideal revegetation and restoration for Swamp Skink are to concentrate on achieving a dense cover of native ground layer species (tussock grasses, sedges, sparse low shrubs <1 m in height). Taller shrubs can be used but only at low densities (~25% canopy cover). Tree plantings should be avoided.
- Removal of weeds is to be done carefully in a staged (mosaic) manner to retain adequate patches of ground layer plants as habitat. Hand weeding in areas of skink habitat is preferable because it is less likely to damage lizard burrows as may occur when using mechanical methods of weed removal.
- The use of herbicides should be limited as these chemicals may impact directly on lizards and their insect prey. If herbicide application is required, this will be limited to spot spraying not broad spraying.
- Revegetation activities will be limited to the activity season to minimise direct mortality of sheltering (hibernating) lizards.
- Mowing and slashing of vegetation can result in killing lizards and should be avoided where possible in habitat of the Swamp Skink. However, if slashing is required, leave as much height as possible to prevent soil scalping.
- Any scalping for habitat restoration should have a salvage and relocation plan for Swamp Skinks.

3.2.5 PEST ANIMAL CONTROL

The intent of feral animal control programs is to reduce ecological pressures associated with grazing and degradation of habitat areas, and the predation of Southern Brown Bandicoot and Growling Grass Frog and the regional fauna. Feral animals include (not limited to) grazers – rabbit, deer, goat and livestock – and predators – fox, cat and dog; responsive control measures are to be promptly implemented within the offset areas should other feral species be identified during the monitoring programs. The intent is to prevent the spread of, and as far as possible eradicate any established pest animals within the offset site. Successful control of pest animals will result in reduced predation and material gains in the habitat conditions on site (e.g. rabbits), which will directly benefit the Southern Brown Bandicoot and Growling Grass Frog population and its long-term population viability.

An integrated approach to pest animal management is outlined in Table 3.4 below. A combination of control techniques will achieve the best outcomes because different methods will target different sections of the pest populations at different times. All care must be taken to avoid off-target impacts or inadvertent harm to native fauna. Regardless of the control option(s) used, these must be the most effective, safe and humane methods available.

Monitoring of any new or emerging pest animal threats will be treated promptly by the landowner.

Table 3.4 Pest and feral animals identified within the offset site

MANAGEMENT AREA(S)	COMMON NAME	METHOD	TIMING
All	Rabbits	Fumigate and hand collapse rabbit burrows; disperse surface harbour taking care to ensure no impacts to Growling Grass Frog or Southern Brown Bandicoot Bait as necessary using Pindone When baiting, collect and dispose of carcasses to prevent poisoning of native predators	Ongoing / summer baiting

MANAGEMENT AREA(S)	COMMON NAME	METHOD	TIMING
All	Foxes	Remove dens or disperse surface harbour taking care to ensure no impacts to Growling Grass Frog or Southern Brown Bandicoot Engage qualified and licenced trapper / shooter Investigate use of Canid Pest-ejectors on the property	Ongoing
All	Cats	Engage qualified and licenced trapper / shooter; ensure Southern Brown Bandicoot are not impacted	Ongoing
All	Rabbits, foxes & cats	Monitor and control	Ongoing
All	Goat, pig and/or deer	Monitor and control as necessary	Ongoing
All	New & emerging pest animals	Monitor and control	Ongoing

3.2.6 WATER SECURITY

Growling Grass Frog breeding and dispersal success is largely dependent on natural wetting and filling of the wetlands during the breeding season, and natural drying of the wetlands during summer months putting pressure on the species to disperse into the wider landscape. Water security arrangements ensuring that natural hydrological inundation and drying cycles are maintained at this site and within the wetlands are therefore critical for the long-term viability of a Growling Grass Frog population at this site.

The landowner will be responsible for ensuring that there is no direct pumping from the wetlands for stock watering, in particular during the Growling Grass Frog breeding season. The landowner will also be responsible for ensuring that there are no artificial impediments to natural inundation / flow patterns from upstream water sources on the property, and no artificial impediments to natural outflow and drying cycles from the wetlands during summer months.

Furthermore, there is to be no introduction of pollutants to the wetlands, no vehicle access during wet cycles, and no pumping of ground-water from the property that may impact the natural hydrology of this site.

3.2.7 OFFSET SITE MONITORING AND REPORTING

This OMP requires the landowner to submit a report annually for each year of the ten years of this OMP (see Table 3.5 – Management Actions) and thereafter at the reasonable request of DAWE or MRPV. The monitoring report is to be provided annually and is to include details of the monitoring and management works conducted within the offset site.

3.2.7.1 POPULATION MONITORING

The intent of this OMP is to conserve and maintain the existing Southern Brown Bandicoot and Growling Grass Frog population within the offset site area. Monitoring of the Southern Brown Bandicoot and Growling Grass Frog population is therefore a requirement of this OMP. The results of the monitoring will also be used to assess the efficacy of other actions conducted on site, and will inform responsive, adaptive management actions if required (see Section 3.2.7.6). The monitoring will also be conducted against baseline Growling Grass Frog and Southern Brown Bandicoot populations currently present on site and as detailed in Sections 2.3.1 and 2.4.1.

The specific monitoring programs are to be in general accord with EPBC survey guidelines for both species and as set out below.

GROWLING GRASS FROG POPULATION MONITORING

Monitoring methods are based on the survey guidelines in the *Significant impact guidelines for the vulnerable growling grass frog (Litoria raniformis)* (DEWHA 2009) and the *Survey guidelines for Australia's threatened frogs* (DEWHA

2010). Each of the six Growling Grass Frog breeding sites, shown in Figure 2.6 as 'Wetland 1 to 6', will be visited twice per monitoring period, and surveyed for approximately 20 minutes using call playback followed by spotlighting/visual searches. Call playback will involve a one minute calling period followed by a 30 second listening period, repeated once. Approximately 50 metres of each of the wetlands will also be surveyed with spotlighting at the completion of each playback survey. Occupancy will be recorded for each site as well as the number of frogs detected.

Monitoring is to be conducted at intervals of years 1, 2 ,3, 5 and 10, which is consistent with the *Healesville-Koo Wee Rup Road Upgrade - Fauna Monitoring Program* (WSP 2020). If targets are not being met (i.e. Growling Grass Frog are not recorded or new habitats are not yet being occupied) the habitat management actions set out in this OMP are to be reviewed and alternative programs adopted in consultation with DAWE and MRPV (see also Section 3.2.7.6) until targets are met.

Monitoring of nearby Reference sites will help to control for climatic variability in detection. Annual monitoring targeting November-December, but extending into the broader survey season where required, is also proposed.

SOUTHERN BROWN BANDICOOT POPULATION MONITORING

Monitoring methods are based on the survey guidelines in the *EPBC Act draft referral guidelines for the endangered southern brown bandicoot (eastern), Isoodon obesulus obesulus* (DSEWPaC 2011a), and includes the use infra-red remote cameras.

Monitoring is to be conducted at intervals of years 1, 2 ,3, 5 and 10, which is consistent with the *Healesville-Koo Wee Rup Road Upgrade - Fauna Monitoring Program* (WSP 2020). A minimum of five cameras are to be set up for each deployment, consistent with (DSEWPaC 2011a) which states that for affected areas >10 ha ≤ 30 ha, 1 camera per 2 ha are needed. The offset area for Southern Brown Bandicoot is just under 11 ha.

At each site, an infra-red remote camera baited with peanut butter, oats, golden syrup and truffle oil will be placed for a two-week period at one monitoring point. The camera location will be mapped, permanently marked (if practicable), bearing of the camera direction recorded (south-facing recommended), and photographs taken such that the precise setup can be replicated in future monitoring events. Monitoring locations should be selected based on habitat suitability, presence of active diggings and with some consideration of camera security.

At the end of the two-week period, the camera will be removed for one month. After one month a camera will be installed at each site and a second round of monitoring conducted to maximise the likelihood of detecting Southern Brown Bandicoot if present at the site.

Setup and camera settings will be as follows:

- Cameras to be baited with 5:1:2 mixture of rolled oats, golden syrup and peanut butter, plus approx. 20 ml/kg of truffle oil, secured in an inaccessible bait holder.
- Camera to be approx. 50 cm above ground level.
- Bait to be set up 1-3 m in front of each camera. Trim vegetation between the camera and bait and around bait if required.
- Sensitivity: high
- Quiet period: 15 seconds
- 5 photographs per trigger

Daily presence/absence and the cumulative number of nights that Southern Brown Bandicoot are detected will be recorded for each site and the results included in the annual monitoring reports. Fox and cat activity detected on cameras will be similarly recorded. This will also inform actions conducted around pest animal controls set out in Section 3.2.5.

The quality of the Southern Brown Bandicoot habitat will also be assessed once per monitoring season, using a consistent proforma, and with photographs taken. Where relevant, any additional works required to improve habitat quality

(particularly within areas identified for staged weed control and successional establishment of indigenous habitat) will be identified.

The habitat assessment proforma will include scoring of:

- Ground layer density (vegetation at the 0.2-1m height range)
- Shelter availability (i.e. presence of low shrubs, scrub piles, logs etc)
- Plant species and structural canopy diversity
- Patch size (size of patch of habitat of similar quality)
- Connectivity
- Presence of native vegetation (given a low weighting as the species is known to utilise suitable exotic vegetation, however this is worth scoring as habitat improvement should aim to use native species).

The above habitat assessment features are based on published habitat preferences of the species (as summarised in the species' DAWE profile and provided in Appendix E) and local studies (e.g. (Maclagan, Coates & Ritchie 2018; Masters, Talyor & Maclagan 2019; S. J. Maclagan 2019)). The habitat monitoring point will be identified by a short wooden stake, located nearby each of the camera bait locations. Habitat characteristics and quality will be scored for a 5 m radius of the point and a photograph of the stake taken facing south.

The results of the Southern Brown Bandicoot monitoring will be used to inform variation / adaptation of the monitoring program in the event that Southern Brown Bandicoot are not detected or detected at low numbers (see Section 2.4.1 for details). Under such circumstances the implementation of additional monitoring sites should be considered, with regard for processes set out in the responsive / adaptive management procedures in Section 3.2.7.6 below.

3.2.7.2 HABITAT ASSESSMENT

Monitoring of cover of vegetation in 0.2 – 1 m range to ensure suitable habitat for Southern Brown Bandicoot.

Focus on areas where weed management, natural regeneration, and revegetation have occurred, to determine if supplementary planting is required.

3.2.7.3 PHOTOPOINTS

– Focus on areas where management will be undertaken.

Permanent photo-points are to be established within the offset site at locations that are representative of the different management areas of habitat for Southern Brown Bandicoot and Growling Grass Frog. Photographs taken from these points are to be representative of the annual habitat conditions and are to provide a visual, temporal assessment of the effectiveness of meeting objectives set out in this OMP. Photographs are therefore to be taken from each photo-point annually and will use the same general direction, trajectory and camera settings as is practicable. The location of photo-points is to be permanently marked on site using painted star-pickets (or equivalent) and as recorded on an aerial map of the offset site.

Photographs and annual monitoring reports are to be submitted at least two months prior to the anniversary date of the execution of the covenant to allow time for compliance to be assessed before the anniversary date.

3.2.7.4 CHYTRID DISEASE

As part of the monitoring, assessment of the fungus *Batrachochytrium dendrobatidis* which causes Chytridomycosis (Chytrid) in frogs will also occur. Monitoring of the fungus via eDNA analysis of water samples is recommended to be completed at least once (e.g. year four) throughout the ten year management in conjunction with annual monitoring at three accessible locations. Sample supplies and analysis can be obtained and undertaken by CESAR (http://cesaraustralia.com/). Samples taken in 2019 show that Chytrid was not found indicating that it may not be present at the site.

Maintenance of a Chytrid free site will be difficult, however, the following preventative protocols and hygiene controls, as adopted from the Commonwealth's *Hygiene protocols for the control of diseases in Australian frogs* (DSEWPaC 2011b), will be implemented on the property and within the offset area in an effort to avoid and minimise this potential risk:

- No frogs will be introduced to the property or handled as part of the monitoring surveys
- No water from external sources will be introduced to the property or offset site (natural water inflows excepted)
- Footwear and any sampling equipment used such as dipping nets will be thoroughly cleaned and disinfected prior to and after surveying the site using bleach solution (1% sodium hypochlorite) or other disinfectant known to kill Chytrid Fungus (e.g. Phytoclean).

3.2.7.5 ANNUAL REPORTING

The annual monitoring reports are to detail progress made against the commitments set out in this OMP. Annual monitoring reports should therefore provide enough detail in the form of written comments and supporting evidence that an assessor can easily determine the completion of/progress against the commitments for each management area.

Details of the monitoring reports are to include (but not be limited to):

- results of monitoring conducted on site of fencing, weed control programs and pest/feral animal control actions
- management works completed within the offset site including the results of fencing upgrade and new installation programs
- results of the Growling Grass Frog and Southern Brown Bandicoot population monitoring programs including any findings on population dynamics
- details of any events or impacts that have affected the offset site such as water pollution events, changes to natural hydrology and water flow regimes, illegal access by pedestrians, uncontrolled stock access and any associated impacts, or any events that have had a material impact on the Growling Grass Frog and Southern Brown Bandicoot populations and their long-term viability on site.

The results of the monitoring programs are to be reported to MRPV for publication on the MRPV EPBC Compliance website. Any major breaches of the management programs and/or impacts on the target species is to be reported immediately to MRPV by the landowner and/or their appointed contractors.

3.2.7.6 RESPONSIVE / ADAPTIVE MANAGEMENT

The monitoring program is required to identify any significant failings in the implementation or outcomes of the OMP, and any new or emerging threats that require an immediate and adaptive response. The development of an appropriate and responsive addition or variation of the OMP will be developed in consultation with the landowner and MRPV, and, if necessary, is to be endorsed by DAWE. It will also be necessary to involve DELWP in any management variations that are likely to impact on the provision of State offset credits.

Examples of significant failings in the implementation or outcomes of the OMP would include bushfire, habitat and/or water contamination due to chemical spills, significant population decline of the target species, major fence failures and/or stock impacts within habitat areas, or events that are considered to be significant enough to warrant an adaptive management approach within the offset areas.

In the event of a significant detrimental impact within the offset area and/or failing of the OMP, the landowner will:

- promptly notify MRPV and DAWE
- develop responsive management plan to address impacts
- update the OMP and/or review implementation period (i.e. extend if required to address impacts).

3.3 MANAGEMENT ACTIONS TABLE

This following table sets out a timeline for delivery of management commitments, to be used for reporting purposes.

Table 3.5 Management actions table – Year 1–10

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
Year 1						
Offset Security	All	Ensure offset secured via TfN conservation covenant and that agreement is signed by Landowner and lodged on Title	Section 3.1.1	At commencement of agreement	Ensure offset secured via covenant	Landowner / contractor
Fencing	All	Stock exclusion from offset area	Section 3.2.2	Within 3 months of commencement of the agreement	Maintain fencing to ensure any stock kept on site are retained to the grazing paddock east of the homestead	Landowner / contractor
	All	No threats to the offset site currently exist, if a new or emerging threat arises erect a fence immediately to ensure that the new threats are controlled.	Section 3.2.2	Immediately on identification of new or emerging threat	Construct and/or upgrade fencing as required to control new and/or emerging threats.	Landowner / contractor
Woody Weeds	1 and 2	Monitor for and minimise all woody weeds. Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)	Section 3.2.3.1	Ongoing	<5% projected foliage cover of woody weeds, with no mature plants present at the end of Year 10. Current levels are at 5% projected foliage cover or less Minimise off-target damage; avoid impacts to wetlands	Landowner / contractor
	3	Conduct staged woody weed control works with successional regeneration / revegetation of indigenous habitat; retain indigenous plants and canopies	Section 3.2.3.1 & 3.2.3.3	Ongoing	<20% projected foliage cover of all listed woody weeds, at the end of Year 10. Current levels are 20-50% projected foliage cover Minimise off-target damage; avoid all native plants	Landowner / contractor

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
		Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)				
	4	Conduct staged woody weed control works with successional regeneration / revegetation of indigenous habitat; retain indigenous plants and canopies Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)	Section 3.2.3.1 & 3.2.3.3	Ongoing	<10% cover of all listed woody weeds, at the end of Year 10. Current levels are 20-50% Minimise off-target damage; avoid all native plants	Landowner / contractor
	All	Monitor for and eliminate all new & emerging woody weeds	Section 3.2.3.1	Ongoing	<1% cover of all woody weeds, with no mature plants present at the end of Year 10	Landowner / contractor
Herbaceous Weeds	All	Monitor for and control all herbaceous weeds. Refer to Section 3.2.3.3 for list of herbaceous weeds, their control method and timing of actions	Section 3.2.3.2	Ongoing	No increase in cover of herbaceous weeds beyond current levels Minimise off-target damage (avoid all native plants)	Landowner / contractor
	All	Monitor for and eliminate all new & emerging herbaceous weeds	Section 3.2.3.2	Ongoing	<1% cover of all new and emerging herbaceous weeds at the end of Year 10	Landowner / contractor
Habitat rehabilitation	4	Commence facilitation of natural regeneration. Commence revegetation and supplementary planting for habitat rehabilitation one month after weed control.	Section 3.2.4	Throughout Year 1	Facilitate natural regeneration up to a third of the total area of 2.8 ha. Revegetation and supplementary planting up to a third of the areas identified (2.4 ha and 1.4 ha respectively).	Landowner / contractor

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
					Progression towards 50-80% average understorey foliage cover in the 0.2-1.0m height range	
Pest Animals	All	Monitor for and control rabbits. Refer to Section 3.2.5 for a list of control methods and timing of actions	Section 3.2.5	Ongoing	Minimal surface disturbance within the offset site No active rabbit warrens to be present No rabbits within GGF and SBB dispersal habitat structures (ground logs & surface habitat)	Landowner / contractor
	All	Monitor for and control foxes and cats. Refer to Section 3.2.5 for a list of control methods and timing of actions	Section 3.2.5	Ongoing	Participation in regional control programs Investigate use of Canid Pest Ejectors (CPEs) and/or shooting control methods Controlled foxes and cats	Landowner / contractor
	All	Monitor for and control all new and emerging pest animals	Section 3.2.5	Ongoing	Control numbers of any new & emerging pest animals	Landowner / contractor
Water security	All	No pumping for stock watering, maintenance of natural flow patterns and drying cycles, maintenance of water sources and connectivity to waterways/wetlands, no introduction of pollutants, no ground-water pumping, no vehicle access during wet cycles.	Section 3.2.6	Ongoing	No disturbance of water flows (inflow and outflow) within the property limits No take of water	Landowner / contractor
Monitoring	All	Conduct seasonal monitoring of Growling Grass Frog generally in accordance with *Significant impact*	Section 3.2.7.1	Years 1, 2 ,3, 5 and 10	Monitoring of Southern Brown Bandicoot and Growling Grass Frog population	Ecological consultant & MRPV

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
		guidelines for the vulnerable growling grass frog (DEWHA 2009) and the *Survey guidelines for Australia's threatened frogs* (DEWHA 2010) Conduct seasonal monitoring of Southern Brown Bandicoot generally in accordance with *EPBC Act draft referral guidelines for the endangered southern brown bandicoot (eastern), Isoodon obesulus obesulus* (DSEWPaC 2011a)			Reporting of Southern Brown Bandicoot and Growling Grass Frog population dynamics within the Offset Site	
Adaptive Management	All	Monitor for new high threats. For each new threat identified, develop an integrated program of management and control actions to be implemented	Section 3.2.7.6	Ongoing – develop program within three months of identifying a new threat.	Develop an integrated program of management and control actions for MRPV / DAWE approval Implement program upon MRPV / DAWE approval.	Landowner / Ecological consultant / MRPV & DAWE
Annual Reporting	All	Prepare and submit an annual report	Section 3.2.7.5	Submit at least two months prior to agreement anniversary date	Annual report is signed, dated and submitted by the landowner at least two months prior to the anniversary date of the agreement. Report provides enough detail in the form of written comments and supporting evidence that an assessor can easily determine the completion of / progress against the commitments for each Management Area. Obligations of the landowner have been met and the obligations form is read, signed, dated and submitted with the annual report.	Landowner / MRPV

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
					Progress and actions, as well as failings or any new and emerging threats, are reported on the MRPV EPBC compliance website and reported to DAWE.	
Year 2						
Fencing	All	Stock exclusion from offset area	Section 3.2.2	Within 3 months of commencement of the agreement	Maintain fencing to ensure any stock kept on site are retained to the grazing paddock east of the homestead	Landowner / contractor
	All	No threats to the offset site currently exist, if a new or emerging threat arises erect a fence immediately to ensure that the new threats are controlled.	Section 3.2.2	Immediately on identification of new or emerging threat	Construct and/or upgrade fencing as required to control new and/or emerging threats.	Landowner / contractor
Woody Weeds	1 and 2	Monitor for and minimise all woody weeds. Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)	Section 3.2.3.1	Ongoing	<5% projected foliage cover of woody weeds, with no mature plants present at the end of Year 10. Current levels are at 5% projected foliage cover or less Minimise off-target damage; avoid impacts to wetlands	Landowner / contractor
	3	Conduct staged woody weed control works with successional regeneration / revegetation of indigenous habitat; retain indigenous plants and canopies Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)	Section 3.2.3.1 & 3.2.3.3	Ongoing	<20% projected foliage cover of all listed woody weeds, at the end of Year 10. Current levels are 20-50% projected foliage cover Minimise off-target damage; avoid all native plants	Landowner / contractor

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
	4	Conduct staged woody weed control works with successional regeneration / revegetation of indigenous habitat; retain indigenous plants and canopies Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)	Section 3.2.3.1 & 3.2.3.3	Ongoing	<10% cover of all listed woody weeds, at the end of Year 10. Current levels are 20-50% Minimise off-target damage; avoid all native plants	Landowner / contractor
	All	Monitor for and eliminate all new & emerging woody weeds	Section 3.2.3.1	Ongoing	<1% cover of all woody weeds, with no mature plants present at the end of Year 10	Landowner / contractor
Herbaceous Weeds	All	Monitor for and control all herbaceous weeds. Refer to Section 3.2.3.3for list of herbaceous weeds, their control method and timing of actions	Section 3.2.3.2	Ongoing	No increase in cover of herbaceous weeds beyond current levels Minimise off-target damage (avoid all native plants)	Landowner / contractor
	All	Monitor for and eliminate all new & emerging herbaceous weeds	Section 3.2.3.2	Ongoing	<1% cover of all new and emerging herbaceous weeds at the end of Year 10	Landowner / contractor
	All	Facilitate successional recruitment of indigenous flora and improvement of habitat values	Section 3.2.3.2	Ongoing	Improved indigenous flora recruitment rates Improved habitat values, greater floristic cover and diversity	Landowner / contractor
Habitat rehabilitation	4	Continue facilitating natural regeneration. Commence revegetation and supplementary planting for habitat rehabilitation one month after weed control.	Section 3.2.4	Ongoing	Facilitate up to another third of the total area of 2.8 ha. Revegetation and supplementary planting up to another third of the areas identified (2.4 ha and 1.4 ha respectively).	Landowner / contractor

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
					Progression towards 50-80% average understorey foliage cover in the 0.2-1.0m height range	
Pest Animals	All	Monitor for and control rabbits. Refer to Section 3.2.5 for a list of control methods and timing of actions	Section 3.2.5	Ongoing	Minimal surface disturbance within the offset site No active rabbit warrens to be present No rabbits within GGF and SBB dispersal habitat structures (ground logs & surface habitat)	Landowner / contractor
	All	Monitor for and control foxes and cats. Refer to Section 3.2.5 for a list of control methods and timing of actions	Section 3.2.5	Ongoing	Participation in regional control programs Investigate use of Canid Pest Ejectors (CPEs) and/or shooting control methods Controlled foxes and cats	Landowner / contractor
	All	Monitor for and control all new and emerging pest animals including deer	Section 3.2.5	Ongoing	Control numbers of any new & emerging pest animals	Landowner / contractor
Water security	All	No pumping for stock watering, maintenance of natural flow patterns and drying cycles, maintenance of water sources and connectivity to waterways/wetlands, no introduction of pollutants, no ground-water pumping, no vehicle access during wet cycles.	Section 3.2.6	Ongoing	No disturbance of water flows (inflow and outflow) within the property limits No take of water	Landowner / contractor
Monitoring	All	Conduct seasonal monitoring of Growling Grass Frog generally in	Section 3.2.7.1	Years 1, 2 ,3, 5 and 10	Monitoring of Southern Brown Bandicoot and Growling Grass Frog population	Ecological consultant & MRPV

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
		accordance with DEWHA (2009) and DEWHA (2010) Conduct seasonal monitoring of Southern Brown Bandicoot generally in accordance with DSEWPaC (2011a)			Reporting of Southern Brown Bandicoot and Growling Grass Frog population dynamics within the Offset Site	
Adaptive management	All	Monitor for new high threats. For each new threat identified, develop an integrated program of management and control actions to be implemented.	Section 3.2.7.6	Ongoing – develop program within three months of identifying a new threat.	Develop an integrated program of management and control actions for MRPV / DAWE approval Implement program upon MRPV / DAWE approval.	Landowner / Ecological consultant / MRPV & DAWE
Annual reporting	All	Prepare and submit an annual report	Section 3.2.7.5	Submit at least two months prior to agreement anniversary date	Annual report is signed, dated and submitted by the landowner at least two months prior to the anniversary date of the agreement. Report provides enough detail in the form of written comments and supporting evidence that an assessor can easily determine the completion of / progress against the commitments for each Management area. Obligations of the landowner have been met and the obligations form is read, signed, dated and submitted with the annual report. Progress and actions, as well as failings or any new and emerging threats, are reported on the MRPV EPBC compliance website and reported to DAWE.	Landowner / MRPV

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
Year 3						
Fencing	All	Stock exclusion from offset area	Section 3.2.2	Within 3 months of commencement of the agreement	Maintain fencing to ensure any stock kept on site are retained to the grazing paddock east of the homestead	Landowner / contractor
	All	No threats to the offset site currently exist, if a new or emerging threat arises erect a fence immediately to ensure that the new threats are controlled.	Section 3.2.2	Immediately on identification of new or emerging threat	Construct and/or upgrade fencing as required to control new and/or emerging threats.	Landowner / contractor
Woody Weeds	1 and 2	Monitor for and minimise all woody weeds. Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)	Section 3.2.3.1	Ongoing	<5% projected foliage cover of woody weeds, with no mature plants present at the end of Year 10. Current levels are at 5% projected foliage cover or less Minimise off-target damage; avoid impacts to wetlands	Landowner / contractor
	3	Conduct staged woody weed control works with successional regeneration / revegetation of indigenous habitat; retain indigenous plants and canopies Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)	Section 3.2.3.1 & 3.2.3.3	Ongoing	<20% projected foliage cover of all listed woody weeds, at the end of Year 10. Current levels are 20-50% projected foliage cover Minimise off-target damage; avoid all native plants	Landowner / contractor
	4	Conduct staged woody weed control works with successional regeneration / revegetation of indigenous habitat; retain indigenous plants and canopies	Section 3.2.3.1 & 3.2.3.3	Ongoing	<10% cover of all listed woody weeds, at the end of Year 10. Current levels are 20-50% Minimise off-target damage; avoid all native plants	Landowner / contractor

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
		Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)				
	All	Monitor for and eliminate all new & emerging woody weeds	Section 3.2.3.1	Ongoing	<1% cover of all woody weeds, with no mature plants present at the end of Year 10	Landowner / contractor
Herbaceous Weeds	All	Monitor for and control all herbaceous weeds. Refer to Section 3.2.3.3 for list of herbaceous weeds, their control method and timing of actions	Section 3.2.3.2	Ongoing	No increase in cover of herbaceous weeds beyond current levels Minimise off-target damage (avoid all native plants)	Landowner / contractor
	All	Monitor for and eliminate all new & emerging herbaceous weeds	Section 3.2.3.2	Ongoing	<1% cover of all new and emerging herbaceous weeds at the end of Year 10	Landowner / contractor
	All	Facilitate successional recruitment of indigenous flora and improvement of habitat values	Section 3.2.3.2	Ongoing	Improved indigenous flora recruitment rates Improved habitat values, greater floristic cover and diversity	Landowner / contractor
Habitat rehabilitation	4	Continue to facilitate natural regeneration. Commence revegetation and supplementary planting for habitat rehabilitation one month after weed control..	Section 3.2.4	Ongoing	Regenerate remaining third of the total area of 2.8 ha. Revegetation and supplementary planting remaining third of the areas identified (2.4 ha and 1.4 ha respectively). Progression towards 50-80% average understorey foliage cover in the 0.2-1.0m height range	Landowner / contractor
Pest Animals	All	Monitor for and control rabbits. Refer to Section 3.2.5 for a list of control methods and timing of actions	Section 3.2.5	Ongoing	Minimal surface disturbance within the offset site	Landowner / contractor

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
					No active rabbit warrens to be present No rabbits within GGF and SBB dispersal habitat structures (ground logs & surface habitat)	
	All	Monitor for and control foxes and cats. Refer to Section 3.2.5 for a list of control methods and timing of actions	Section 3.2.5	Ongoing	Participation in regional control programs Investigate use of Canid Pest Ejectors (CPEs) and/or shooting control methods Controlled foxes and cats	Landowner / contractor
	All	Monitor for and control all new and emerging pest animals including deer	Section 3.2.5	Ongoing	Control numbers of any new & emerging pest animals	Landowner / contractor
Water security	All	No pumping for stock watering, maintenance of natural flow patterns and drying cycles, maintenance of water sources and connectivity to waterways/wetlands, no introduction of pollutants, no ground-water pumping, no vehicle access during wet cycles.	Section 3.2.6	Ongoing	No disturbance of water flows (inflow and outflow) within the property limits No take of water	Landowner / contractor
Monitoring	All	Conduct seasonal monitoring of Growling Grass Frog generally in accordance with DEWHA (2009) and DEWHA (2010) Conduct seasonal monitoring of Southern Brown Bandicoot generally in accordance with DSEWPaC (2011a)	Section 3.2.7.1	Years 1, 2 ,3, 5 and 10	Monitoring of Southern Brown Bandicoot and Growling Grass Frog population Reporting of Southern Brown Bandicoot and Growling Grass Frog population dynamics within the Offset Site	Ecological consultant & MRPV

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
Adaptive management	All	Monitor for new high threats. For each new threat identified, develop an integrated program of management and control actions to be implemented	Section 3.2.7.6	Ongoing – develop program within three months of identifying a new threat.	Develop an integrated program of management and control actions for MRPV / DAWE approval Implement program upon MRPV / DAWE approval.	Landowner / Ecological consultant / MRPV & DAWE
Annual reporting	All	Prepare and submit an annual report	Section 3.2.7.5	Submit at least two months prior to agreement anniversary date	Annual report is signed, dated and submitted by the landowner at least two months prior to the anniversary date of the agreement. Report provides enough detail in the form of written comments and supporting evidence that an assessor can easily determine the completion of / progress against the commitments for each Management area. Obligations of the landowner have been met and the obligations form is read, signed, dated and submitted with the annual report. Progress and actions, as well as failings or any new and emerging threats, are reported on the MRPV EPBC compliance website and reported to DAWE.	Landowner / MRPV

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
Years 4-10						
Fencing	All	Stock exclusion from offset area	Section 3.2.2	Within 3 months of commencement of the agreement	Maintain fencing to ensure any stock kept on site are retained to the grazing paddock east of the homestead	Landowner / contractor
	All	No threats to the offset site currently exist, if a new or emerging threat arises erect a fence immediately to ensure that the new threats are controlled.	Section 3.2.2	Immediately on identification of new or emerging threat	Construct and/or upgrade fencing as required to control new and/or emerging threats.	Landowner / contractor
Woody Weeds	1 and 2	Monitor for and minimise all woody weeds. Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)	Section 3.2.3.1	Ongoing	<5% projected foliage cover of woody weeds, with no mature plants present at the end of Year 10. Current levels are at 5% projected foliage cover or less Minimise off-target damage; avoid impacts to wetlands	Landowner / contractor
	3	Conduct staged woody weed control works with successional regeneration / revegetation of indigenous habitat; retain indigenous plants and canopies Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)	Section 3.2.3.1 & 3.2.3.3	Ongoing	<20% projected foliage cover of all listed woody weeds, at the end of Year 10. Current levels are 20-50% projected foliage cover 50-80% average understorey foliage cover in the 0.2-1.0m height range Minimise off-target damage; avoid all native plants	Landowner / contractor
	4	Conduct staged woody weed control works with successional regeneration / revegetation of indigenous habitat; retain indigenous plants and canopies	Section 3.2.3.1 & 3.2.3.3	Ongoing	<10% cover of all listed woody weeds, at the end of Year 10. Current levels are 20-50% 50-80% average understorey foliage cover in the 0.2-1.0m height range	Landowner / contractor

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
		Monitor for any re-sprouting or seedlings and eradicate (either spot spray or hand pull)			Minimise off-target damage; avoid all native plants	
	All	Monitor for and eliminate all new & emerging woody weeds	Section 3.2.3.1	Ongoing	<1% cover of all woody weeds, with no mature plants present at the end of Year 10	Landowner / contractor
Herbaceous Weeds	All	Monitor for and control all herbaceous weeds. Refer to Section 3.2.3.3 for list of herbaceous weeds, their control method and timing of actions	Section 3.2.3.2	Ongoing	No increase in cover of herbaceous weeds beyond current levels Minimise off-target damage (avoid all native plants)	Landowner / contractor
	All	Monitor for and eliminate all new & emerging herbaceous weeds	Section 3.2.3.2	Ongoing	<1% cover of all new and emerging herbaceous weeds at the end of Year 10	Landowner / contractor
	All	Facilitate successional recruitment of indigenous flora and improvement of habitat values	Section 3.2.3.2	Ongoing	Improved indigenous flora recruitment rates Improved habitat values, greater floristic cover and diversity	Landowner / contractor
Habitat rehabilitation	4	Ongoing management of weeds to facilitate natural regeneration. Replace any lost plantings in revegetation and supplementary planting in in areas, as needed for habitat rehabilitation.	Section 3.2.4	Ongoing	Progression towards 50-80% average understorey foliage cover in the 0.2-1.0m height range	Landowner / contractor
Pest Animals	All	Monitor for and control rabbits. Refer to Section 3.2.5 for a list of control methods and timing of actions	Section 3.2.5	Ongoing	Minimal surface disturbance within the offset site No active rabbit warrens to be present	Landowner / contractor

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
					No rabbits within GGF and SBB dispersal habitat structures (ground logs & surface habitat)	
	All	Monitor for and control foxes and cats. Refer to Section 3.2.5 for a list of control methods and timing of actions	Section 3.2.5	Ongoing	Participation in regional control programs Investigate use of Canid Pest Ejectors (CPEs) and/or shooting control methods Controlled foxes and cats	Landowner / contractor
	All	Monitor for and control all new and emerging pest animals including deer	Section 3.2.5	Ongoing	Control numbers of any new & emerging pest animals	Landowner / contractor
Water security	All	No pumping for stock watering, maintenance of natural flow patterns and drying cycles, maintenance of water sources and connectivity to waterways/wetlands, no introduction of pollutants, no ground-water pumping, no vehicle access during wet cycles.	Section 3.2.6	Ongoing	No disturbance of water flows (inflow and outflow) within the property limits No take of water	Landowner / contractor
Monitoring	All	Conduct seasonal monitoring of Growling Grass Frog generally in accordance with DEWHA (2009) and DEWHA (2010) Conduct seasonal monitoring of Southern Brown Bandicoot generally in accordance with DSEWPaC (2011a)	Section 3.2.7.1	Years 1, 2 ,3, 5 and 10	Monitoring of Southern Brown Bandicoot and Growling Grass Frog population Reporting of Southern Brown Bandicoot and Growling Grass Frog population dynamics within the Offset Site	Ecological consultant & MRPV

MANAGEMENT ACTIONS	AREAS	MANAGEMENT ACTION DESCRIPTION	REFERENCE SECTION FOR ACTION	TIMING	TARGET TO BE ACHIEVED	PERSON RESPONSIBLE
Adaptive management	All	Monitor for new high threats. For each new threat identified, develop an integrated program of management and control actions to be implemented	Section 3.2.7.6	Ongoing – develop program within three months of identifying a new threat.	Develop an integrated program of management and control actions for MRPV / DAWE approval Implement program upon MRPV / DAWE approval.	Landowner / Ecological consultant / MRPV & DAWE
Annual reporting	All	Prepare and submit an annual report	Section 3.2.7.5	Submit at least two months prior to agreement anniversary date	Annual report is signed, dated and submitted by the landowner at least two months prior to the anniversary date of the agreement. Report provides enough detail in the form of written comments and supporting evidence that an assessor can easily determine the completion of / progress against the commitments for each Management area. Obligations of the landowner have been met and the obligations form is read, signed, dated and submitted with the annual report. Progress and actions, as well as failings or any new and emerging threats, are reported on the MRPV EPBC compliance website and reported to DAWE.	Landowner / MRPV

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APPENDIX A

EPBC CALCULATORS

A1 OFFSET ASSESSMENT CALCULATIONS

Table A.1 below outlines the rationale and assumptions used to determine values used in the EPBC calculators in Appendix A2. Values used in the calculators are deliberately conservative to account for the uncertainty associated with delivery of 'future' ecological outcomes; these values have also been developed in consultation with DAWE and are based on the EPBC *how to guide* (undated, available online).

Table A.1 EPBC offset site value assumptions

EPBC CALCULATOR ATTRIBUTE DESCRIPTION	VALUE USED	VALUE RATIONALE
Time over which loss is averted (max. 20 years) The foreseeable timeframe (in years) over which changes in the level of risk to a proposed offset site can be considered and quantified.	20	This OMP for Harewood includes a 10 year program for delivery of conservation outcomes, which will be secured on Title with an in-perpetuity conservation covenant. The conservation covenant will protect the offset area against detrimental land-use and loss of 'accumulated' environmental Gains for the target species.
Time until ecological benefit Estimated time (in years) that it will take for the habitat quality improvement of the proposed offset to be realised.	10	Improvement works aimed at increasing the habitat values within the offset site, as well as implementation of predator control programs, will be included in the OMP. These programs will run for a minimum period of 10 years, with gains to be maintained in perpetuity under covenant. Whilst ecological benefits will be realised at commencement of the management programs, the timeframe used in the calculators is 10 years in order to ensure that all benefits are accounted for in offset calculations.
Risk of loss (%) without Offset Describes the chance that the habitat on the proposed offset site will be completely lost (i.e. no longer hold any value for the protected matter) over the foreseeable future (in this case 20 years) in the absence of active conservation management.	Harewood: 40%	This equates to the 'business as usual' scenario that is a current option at Harewood, and accounts for the likelihood of habitat values decreasing on site via an adverse impact, change in landuse or by gradual degradation over time. Whilst it is expected that habitat values will persist, as they have to date, there remains a risk of loss if these sites are not actively managed and the gains secured with a conservation covenant. The offset area at Harewood is currently being managed for environmental weed invasion which, in the absence of active management, is considered likely to degrade habitat values over the long-term. This offset area has been given a higher risk assessment for loss without active offset management.
Risk of loss (%) with Offset Describes the chance that the habitat on the proposed offset site will be completely lost (i.e. no longer hold any value for the protected matter) over the foreseeable future (in this case 20 years) in the presence of active conservation management.	Harewood: 20%	This value accounts for risk mitigation measures, such as (but not limited to) implementation of offset area management plans and on-Title conservation covenants, leading to maintenance and improvement of habitat values and, by default, improvements in the fecundity and long-term population viability of the target species. The offset area will be encumbered with a conservation covenant placed on Title which will enforce conservation management processes that are to be implemented on site. These will include, at minimum, management of environmental weeds and predators, maintenance and improvement of habitat values, and monitoring and reporting on each of the target species' population dynamics and fecundity. Details of the OMP are to be developed in consultation with DAWE and secured on Title at initiation of EPBC Permit conditions for the project. Whilst the risk of loss is reduced with the incorporation of active offset management, a small risk of loss associated with unplanned burning, climate change and unforeseen impacts remains and is therefore factored into the values used in the EPBC calculators. On-going environmental weed invasion at Harewood is considered unlikely with the implementation of conservation covenants (and associated annual reporting procedures) and an OMP. A risk remains however for this site associated with weeds, and the potential for impacts associated with sea-level rise.

EPBC CALCULATOR ATTRIBUTE DESCRIPTION	VALUE USED	VALUE RATIONALE
Confidence in result Level of certainty that the proposed conservation outcomes can be achieved (based on existing evidence) and surety that the offset site will not decline.	70%	The OMP will be secured on Title with a conservation covenant. The covenants are an effective and reliable means of ensuring that the OMP and ecological outcomes set out therein are delivered over the 10 year period, and that gains are maintained into the future (minimum 20 years with covenants in perpetuity). The higher degree of site security imposed through the conservation covenants will also ensure that future landowners are aware of the ecological commitments that encumber the property, including the 'loss of right' to graze, subdivide or develop these sites. The OMP will also contain a monitoring and reporting component that will further ensure that commitments are adhered to and delivered. The progress of offset management will also be reported on the MRPV EPBC compliance website, with notifications to DAWE as required in the EPNC Permit conditions.
Confidence in result Level of certainty about the overall likelihood of the success of the proposed offset.	70%	Monitoring within the offset sites undertaken by WSP has confirmed that Harewood retains meta-populations of Growling Grass Frog. The Harewood Growling Grass Frog meta-population is supported by a chain of wetlands suitable for breeding purposes, interspersed with dispersal habitat and connectivity to the Cardinia Creek corridor. The wetlands at Harewood also offer ponds with a range of salinity that is thought to confer some protections against chytrid fungus. Therefore, there is no expectation that this offset site cannot provide for this Growling Grass Frog population into the future. There are historical records of Southern Brown Bandicoot at Harewood and the site is known as a strategic link between a meta-population at the Royal Botanic Gardens Cranbourne, and cluster populations linked via the highway, railway and Westernport foreshore corridors. Southern Brown Bandicoot was detected during the current surveys at low numbers; WSP is confident that this species will be present on site, and that Southern Brown Bandicoot will be detected at higher numbers during more seasonably favourable conditions. Improvement of Southern Brown Bandicoot habitat at this site is therefore considered likely to result in gains associated with Southern Brown Bandicoot population persistence and, with the right seasonal conditions, Southern Brown Bandicoot breeding.

Table A.2 below provides a breakdown of future habitat values at Harewood with, and without, future offset management regimes. These values have been developed in consultation with DAWE and reflect conservative assessments of habitat values for Growling Grass Frog and Southern Brown Bandicoot at the site. Habitat values associated with the 'continuance of current landuse rights' take into account rights to develop, graze or clear the habitat areas, whereas habitat value gains associated with the implementation of conservation management works (as secured on Title) reflect future values that can confidently be delivered based on current knowledge of the offset habitat area and the capacity of current landowners to deliver positive outcomes.

Table A.2 EPBC offset site projected habitat values

EPBC CALCULATOR ATTRIBUTE DESCRIPTION	CURRENT / PROJECTED HABITAT VALUE	HABITAT VALUE RATIONALE
HAREWOOD GROWLING GRASS FROG BREEDING HABITAT QUALITY		
Current habitat quality (scale of 0-10) As provided in Appendix H of the PD.	7	-

EPBC CALCULATOR ATTRIBUTE DESCRIPTION	CURRENT / PROJECTED HABITAT VALUE	HABITAT VALUE RATIONALE
Future quality without Offset (scale of 0-10) Habitat quality of the offset site predicted to occur without active improvement.	7	The habitat value for Growling Grass Frog breeding sites within Harewood are not expected to decline in the near future (and in the absence of active conservation management). This assumption is based on the long-term residence of Growling Grass Frog within the meta-population pond (with no foreseeable changes in habitat status) and zoning of the property (current zoning is unlikely to support future subdivision or development of the site). Capacity for environmental weed invasion is low due to seasonal flooding regimes and the willingness of current landowners to maintain these sites.
Future quality with offset (scale of 0-10) Habitat quality of the offset site predicted to occur with active improvement.	8	There is potential to increase the site condition within the Growling Grass Frog breeding offset area through on-going environmental weed control works and through improvement of water security arrangements via the conservation covenants to be placed on Title. Future landowners, in the absence of a conservation covenant, are unlikely to be as willing to control environmental weeds within these sites and have the potential to harvest water from the breeding ponds for maintenance of the grounds and gardens.
HAREWOOD GROWLING GRASS FROG DISPERSAL HABITAT QUALITY		
Current habitat quality (scale of 0-10) As provided in Appendix H of the PD.	5	-
Future quality without Offset (scale of 0-10) Habitat quality of the Offset Site predicted to occur without active improvement.	5	The habitat value for Growling Grass Frog dispersal habitat within Harewood is not expected to decline in near future (and in the absence of active conservation management). This assumption is based on the zoning of the property (current zoning is unlikely to support future subdivision or development of the site), and the willingness of current landowners to maintain these areas.
Future quality with offset (scale of 0-10) Habitat quality of the offset site predicted to occur with active improvement.	6	There is potential to increase the site condition within the Growling Grass Frog dispersal offset area through on-going environmental weed control works and substitutional revegetation programs. Future landowners, in the absence of a conservation covenant, are unlikely to be as willing to control environmental weeds within these sites and have the potential to regularly slash / mow these sites and increase the grounds area around the homestead.
HAREWOOD SOUTHERN BROWN BANDICOOT DISPERSAL HABITAT QUALITY		
Current habitat quality (scale of 0-10) As provided in Appendix H of the PD.	5	-
Future quality without Offset (scale of 0-10) Habitat quality of the offset site predicted to occur without active improvement.	4	The habitat value for Southern Brown Bandicoot dispersal habitat within Harewood, in the absence of funding for works, is expected to decline due to environmental weed invasion and predation by fox. Southern Brown Bandicoot are particularly vulnerable to fox predation and regional control programs (as conducted by government Agencies) are in decline.
Future quality with offset (scale of 0-10) Habitat quality of the offset site predicted to occur with active improvement.	6	There is potential to increase the site condition within the Southern Brown Bandicoot dispersal offset area through on-going environmental weed control works and substitutional revegetation programs. Future landowners, in the absence of a conservation covenant, are unlikely to be as willing to control environmental weeds within these sites and have the potential to regularly slash / mow these sites and increase the grounds area around the homestead. A long-term fox control program at this site is also considered likely to increase Southern Brown Bandicoot stocking rates.

A2 EPBC CALCULATOR

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Harewood - Growling Grass Frog (Breeding)

Matter of National Environmental Significance	
Name	Growling Grass Frog - Breeding
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	0.2%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Breeding habitat dams, wetlands and drainagelines	Area	0.546	Hectares	Consultancy report, EPBC referral and GIS mapping
			Quality	7	Scale 0-10	
			Total quantum of impact	0.38	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset									
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0								
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)									
Threatened species habitat																				
Area of habitat	Yes	0.38	Adjusted hectares	Harewood GGF breeding habitat	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	0.3344	Risk of loss (%) without offset	40%	Risk of loss (%) with offset	20%								
									Future area without offset (adjusted hectares)	0.2	Future area with offset (adjusted hectares)	0.3	0.07	70%	0.05	0.04	0.05	13.02%	No	
					Time until ecological benefit	10	Start quality (scale of 0-10)	7	Future quality without offset (scale of 0-10)	7	Future quality with offset (scale of 0-10)	8	1.00	70%	0.70	0.69				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	0.3822	0.05	13.02%	No	$0.00	#DIV/0!	#DIV/0!
Area of community	0				$0.00		$0.00
					$0.00	**#DIV/0!**	**#DIV/0!**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Harewood - Growling Grass Frog (Dispersal)

Matter of National Environmental Significance	
Name	Growling Grass Frog
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	0.2%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Category 1 habitat vegetated 200m buffer breeding habitat	Area	3.692	Hectares	Consultancy report, EPBC referral and GIS mapping
			Quality	6	Scale 0-10	
			Total quantum of impact	2.22	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	2.22	Adjusted hectares	Harewood GGF dispersal habitat	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	1.54	**Risk of loss (%) without offset**	40%	**Risk of loss (%) with offset**	20%								
									Future area without offset (adjusted hectares)	0.9	**Future area with offset (adjusted hectares)**	1.2	0.31	70%	0.22	0.21	0.19	8.47%	No	
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	5	**Future quality without offset (scale of 0-10)**	5	**Future quality with offset (scale of 0-10)**	6	1.00	70%	0.70	0.69				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	2.2152	0.19	8.47%	**No**	$0.00	#DIV/0!	#DIV/0!
Area of community	0				$0.00		$0.00
					$0.00	**#DIV/0!**	**#DIV/0!**

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Harewood - Southern Brown Bandicoot (Dispersal)

Matter of National Environmental Significance	
Name	Southern Brown bandicoot
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	1.2%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Breeding, foraging and dispersal habitat	Area	5.078	Hectares	Consultancy report, EPBC referral and GIS mapping
			Quality	7	Scale 0-10	
			Total quantum of impact	3.55	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset									
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0								
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)									
Threatened species habitat																				
Area of habitat	Yes	3.55	Adjusted hectares	Harewood SBB dispersal habitat area	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	10.79	Risk of loss (%) without offset	40%	Risk of loss (%) with offset	20%								
									Future area without offset (adjusted hectares)	6.5	Future area with offset (adjusted hectares)	8.6	2.16	70%	1.51	1.19	1.52	42.72%	No	
					Time until ecological benefit	10	Start quality (scale of 0-10)	5	Future quality without offset (scale of 0-10)	4	Future quality with offset (scale of 0-10)	6	2.00	70%	1.40	1.24				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary

Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost ($)		
					Direct offset ($)	Other compensatory measures ($)	Total ($)
Birth rate	0				$0.00		$0.00
Mortality rate	0				$0.00		$0.00
Number of individuals	0				$0.00		$0.00
Number of features	0				$0.00		$0.00
Condition of habitat	0				$0.00		$0.00
Area of habitat	3.5546	1.52	42.72%	No	$0.00	#DIV/0!	#DIV/0!
Area of community	0				$0.00		$0.00
					$0.00	**#DIV/0!**	**#DIV/0!**

APPENDIX B

OFFSET SITE ASSESSMENT

B1 SITE FLORA LIST

STATUS	SCIENTIFIC NAME	COMMON NAME	CALP ACT	PLANTED	HAREWOOD GUIDEBOOK	RECORDED BY WSP	TALL MARSH	NON NATIVE VEGETATION	ESTUARINE FLATS GRASSLAND	ESTUARINE WETLAND	ESTUARINE FLATS GRASSLAND	REVEG	DAMP SANDS HERB-RICH WOODLAND	SWAMP SCRUB	COASTAL SALTMARSH	AQUATIC HERBLAND	BRACKISH SEDGELAND
	Acacia dealbata	Silver Wattle	-	Yes		✓											
#	*Acacia longifolia subsp. sophorae*	Coast Wattle	-			✓							+				
	Acacia mearnsii	Black Wattle	-		✓	✓						2	2				
	Acacia melanoxylon	Blackwood	-		✓	✓							1	1			
	Acacia stricta	Hop Wattle		Yes		✓											
*	*Acetosella vulgaris*	Sheep Sorrel	-			✓		1									
*	*Agrostis capillaris*	Brown-top Bent	-			✓											
	Allocasuarina verticillata	Drooping Sheoak		Yes		✓											
	Althenia cylindrocarpa	Long-fruit Water-mat				✓											
*	*Anthoxanthum odoratum*	Sweet Vernal-grass	-			✓	1	3					1				
	Apium annuum	Annual Celery	-		✓	✓											
*	*Asparagus asparagoides*	Bridal Creeper	R			✓						+	+				
*	*Asparagus officinalis*	Asparagus	-			✓	+			+	1			+			
*	*Aster subulatus*	Aster-weed	-		✓	✓				+	1					x	x
	Atriplex cinerea	Coast Saltbush	-		✓	✓											
r	*Atriplex paludosa subsp. paludosa*	Marsh Saltbush	-		✓	✓				1					x		x
*	*Atriplex prostrata*	Hastate Orache	-			✓	+				1				x		
	Austrostipa stipoides	Prickly Spear-grass	-		✓	✓											
r	*Avicennia marina subsp. australasica*	Grey Mangrove	-		✓	✓				+							
*	*Briza maxima*	Large Quaking-grass	-			✓							1				

STATUS	SCIENTIFIC NAME	COMMON NAME	CALP ACT	PLANTED	HAREWOOD GUIDEBOOK	RECORDED BY WSP	TALL MARSH	NON NATIVE VEGETATION	ESTUARINE FLATS GRASSLAND	ESTUARINE WETLAND	ESTUARINE FLATS GRASSLAND	REVEG	DAMP SANDS HERB-RICH WOODLAND	SWAMP SCRUB	COASTAL SALTMARSH	AQUATIC HERBLAND	BRACKISH SEDGELAND
*	*Briza minor*	Lesser Quaking-grass	-			✓		1									
*	*Bromus catharticus*	Prairie Grass	-			✓											
*	*Bromus diandrus*	Great Brome	-			✓											
*	*Bromus hordeaceus*	Soft Brome	-		✓	✓											
*	*Callitriche stagnalis*	Common Water-starwort				✓											
	Cassinia aculeata subsp. aculeata	Common Cassinia	-	Yes	✓	✓											
	Cassinia sifton	Sifton Bush				✓											
*	*Cenchrus clandestinus*	Kikuyu	-			✓											
*	*Centaurium erythraea*	Common Centaury	-			✓											
*	*Centaurium tenuiflorum*	Slender Centaury	-		✓	✓			+		+						
*	*Cirsium vulgare*	Spear Thistle	C		✓	✓				+	+	1					
	Clematis microphylla s.l.	Small-leaved Clematis	-			✓						1		1			
*	*Coprosma repens*	Mirror Bush	-			✓											
*	*Cotula coronopifolia*	Water Buttons	-		✓	✓										x	
	Crassula sieberiana	Sieber Crassula	-		✓	✓											
	Cycnogeton procerum (broad erect leaf variant)	Common Water-ribbons	-		✓	✓										x	
*	*Cynodon dactylon*	Couch	-			✓	+										
*	*Dactylis glomerata*	Cocksfoot	-		✓	✓								1			
*	*Daucus carota*	Carrot	-			✓		1									
	Deyeuxia spp.	Bent Grass	-			✓							+				
	Dianella longifolia s.l.	Pale Flax-lily	-			✓											
	Disphyma crassifolium subsp. clavellatum	Rounded Noon-flower	-		✓	✓				2	+				x		x

STATUS	SCIENTIFIC NAME	COMMON NAME	CALP ACT	PLANTED	HAREWOOD GUIDEBOOK	RECORDED BY WSP	TALL MARSH	NON NATIVE VEGETATION	ESTUARINE FLATS GRASSLAND	ESTUARINE WETLAND	ESTUARINE FLATS GRASSLAND	REVEG	DAMP SANDS HERB-RICH WOODLAND	SWAMP SCRUB	COASTAL SALTMARSH	AQUATIC HERBLAND	BRACKISH SEDGELAND
	Distichlis distichophylla	Australian Salt-grass	-		✓	✓				1	1	1	1		x		x
*	*Ehrharta erecta var. erecta*	Panic Veldt-grass	-			✓						1					
*	*Ehrharta longiflora*	Annual Veldt-grass	-			✓											
	Eleocharis acuta	Common Spike-sedge	-			✓										x	
	Epilobium billardierianum	Variable Willow-herb	-		✓	✓										x	
*	*Erigeron spp.*	Fleabane	-			✓											
	Eucalyptus ovata	Swamp Gum	-	Some planted		✓							+				
	Eucalyptus viminalis subsp. pryoriana	Coast Manna-gum	-	Some planted		✓						+	1				
	Ficinia nodosa	Knobby Club-sedge	-		✓	✓				1		+					
*	*Fumaria bastardii*	Bastard's Fumitory	-			✓						+					
	Gahnia filum	Chaffy Saw-sedge	-		✓												
	Gahnia trifida	Coast Saw-sedge				✓				+							x
*	*Genista linifolia*	Flax-leaf Broom	C		✓	✓				1		2 (20%)	2	3			
	Geranium spp.	Crane's Bill	-			✓								+			
	Goodenia ovata	Hop Goodenia		Yes		✓											
	Hemarthria uncinata var. uncinata	Mat Grass	-			✓						1	1				
	Hemichroa pentandra	Trailing Hemichroa	-		✓	✓									x		
*	*Holcus lanatus*	Yorkshire Fog	-		✓	✓				+							
*	*Hypochaeris radicata*	Flatweed	-			✓	+	1			1	+	1	+			
	Isolepis marginata	Little Club-sedge	-			✓	1		1								
	Juncus kraussii subsp. australiensis	Sea Rush	-		✓	✓	2			3							
	Juncus pallidus	Pale Rush	-		✓	✓			+		+						

STATUS	SCIENTIFIC NAME	COMMON NAME	CALP ACT	PLANTED	HAREWOOD GUIDEBOOK	RECORDED BY WSP	TALL MARSH	NON NATIVE VEGETATION	ESTUARINE FLATS GRASSLAND	ESTUARINE WETLAND	ESTUARINE FLATS GRASSLAND	REVEG	DAMP SANDS HERB-RICH WOODLAND	SWAMP SCRUB	COASTAL SALTMARSH	AQUATIC HERBLAND	BRACKISH SEDGELAND
	Juncus subsecundus	Finger Rush	-			✓											
	Lachnagrostis filiformis	Common Blown-grass	-		✓	✓	1		1		1						
*	*Lactuca serriola*	Prickly Lettuce	-			✓					1	1					
*	*Leontodon saxatilis subsp. saxatilis*	Hairy Hawkbit	-		✓	✓	1		+		1						
	Leptospermum continentale	Prickly Tea-tree	-	Yes		✓											
P	*Limonium australe*	Yellow Sea-lavender	-		✓												
*	*Lolium perenne*	Perennial Rye-grass	-		✓	✓					+						
	Lomandra longifolia	Spiny-headed Mat-rush	-		✓												
*	*Lophopyrum ponticum*	Tall Wheat-grass	-			✓											
*	*Lotus angustissimus*	Slender Bird's-foot Trefoil	-			✓			+								
*	*Lotus subbiflorus*	Hairy Bird's-foot Trefoil	-			✓		+									
	Lythrum hyssopifolia	Small Loosestrife	-		✓	✓											
r #	*Melaleuca armillaris subsp. armillaris*	Giant Honey-myrtle	-	Yes		✓											
#	*Melaleuca ericifolia*	Swamp Paperbark	-		✓	✓			2					2			
	Melaleuca squarrosa	Scented Paperbark	-		✓												
	Microlaena stipoides var. stipoides	Weeping Grass	-			✓							+				
	Microtis parviflora	Slender Onion-orchid	-		✓												
	Microtis spp.	Onion Orchid	-			✓		1									
#	*Myoporum insulare*	Common Boobialla	-	Yes		✓											

STATUS	SCIENTIFIC NAME	COMMON NAME	CALP ACT	PLANTED	HAREWOOD GUIDEBOOK	RECORDED BY WSP	TALL MARSH	NON NATIVE VEGETATION	ESTUARINE FLATS GRASSLAND	ESTUARINE WETLAND	ESTUARINE FLATS GRASSLAND	REVEG	DAMP SANDS HERB-RICH WOODLAND	SWAMP SCRUB	COASTAL SALTMARSH	AQUATIC HERBLAND	BRACKISH SEDGELAND
r	*Olearia minor*	Satin Daisy-bush	-	Likely Incorrect	✓												
	Ozothamnus ferrugineus	Tree Everlasting	-	Yes		✓											
*	*Parapholis incurva*	Coast Barb-grass	-			✓											
*	*Paspalum dilatatum*	Paspalum	-			✓	+	2									
*	*Paspalum distichum*	Water Couch	-			✓											
*	*Phalaris aquatica*	Toowoomba Canary-grass	-		✓	✓	+	1		1	4	4	2	2		x	x
*	*Phalaris minor*	Lesser Canary-grass	-		✓												
	Phragmites australis	Common Reed	-		✓	✓	3	1	2				3	1		x	
*	*Phytolacca octandra*	Red-ink Weed				✓											
*	*Pinus brutia*	Lone Pine	-	Yes		✓											
*	*Pinus radiata*	Radiata Pine	-	Yes		✓											
*	*Plantago coronopus*	Buck's-horn Plantain	-		✓	✓	+										
*	*Plantago lanceolata*	Ribwort	-		✓	✓		1									
	Poa poiformis var. poiformis	Coast Tussock-grass	-		✓	✓	1		+	2	1	+	+				
*	*Polypogon monspeliensis*	Annual Beard-grass	-		✓	✓											
*	*Prunus spp.*	Prunus	-			✓											
*	*Romulea rosea*	Onion Grass	-			✓		1									
*	*Rubus fruticosus spp. agg.*	Blackberry	C			✓						+	+	2			
*	*Rumex crispus*	Curled Dock	-			✓						+					
	Rytidosperma duttonianum	Brown-back Wallaby-grass	-			✓							1				
	Rytidosperma semiannulare	Wetland Wallaby-grass	-			✓			3				1				

STATUS	SCIENTIFIC NAME	COMMON NAME	CALP ACT	PLANTED	HAREWOOD GUIDEBOOK	RECORDED BY WSP	TALL MARSH	NON NATIVE VEGETATION	ESTUARINE FLATS GRASSLAND	ESTUARINE WETLAND	ESTUARINE FLATS GRASSLAND	REVEG	DAMP SANDS HERB-RICH WOODLAND	SWAMP SCRUB	COASTAL SALTMARSH	AQUATIC HERBLAND	BRACKISH SEDGELAND
	Rytidosperma setaceum	Bristly Wallaby-grass	-			✓	+										
	Samolus repens var. repens	Creeping Brookweed	-		✓	✓									x		
	Sarcocornia blackiana	Thick-head Glasswort	-		✓										x		
	Sarcocornia quinqueflora	Beaded Glasswort	-		✓	✓				1					x		
	Schoenus apogon	Common Bog-sedge	-			✓											
	Selliera radicans	Shiny Swamp-mat	-		✓	✓	2		2								
	Senecio glomeratus	Annual Fireweed	-		✓	✓											
	Senecio hispidulus s.l.	Rough Fireweed	-			✓	+				1		+				
	Senecio pinnatifolius	Variable Groundsel	-		✓	✓											
*	*Solanum nigrum s.l.*	Black Nightshade	-			✓					1						
*	*Sonchus oleraceus*	Common Sow-thistle	-			✓				+							
	Spergularia spp.	Sand Spurrey	-			✓				+					x		
	Spergularia tasmanica	Native Sea-spurrey	-		✓												
	Suaeda australis	Austral Seablite	-		✓	✓				+					x		
	Tecticornia arbuscula	Shrubby Glasswort	-		✓	✓									x		
	Thyridia repens	Creeping Monkey-flower	-		✓	✓	+										
*	*Trifolium fragiferum var. fragiferum*	Strawberry Clover	-			✓											
*	*Trifolium repens var. repens*	White Clover	-		✓												
	Triglochin striata	Streaked Arrowgrass	-		✓	✓				1					x		
	Typha domingensis	Narrow-leaf Cumbungi	-		✓	✓											
*	*Ulex europaeus*	Gorse	C		✓	✓								2			

STATUS	SCIENTIFIC NAME	COMMON NAME	CALP ACT	PLANTED	HAREWOOD GUIDEBOOK	RECORDED BY WSP	TALL MARSH	NON NATIVE VEGETATION	ESTUARINE FLATS GRASSLAND	ESTUARINE WETLAND	ESTUARINE FLATS GRASSLAND	REVEG	DAMP SANDS HERB-RICH WOODLAND	SWAMP SCRUB	COASTAL SALTMARSH	AQUATIC HERBLAND	BRACKISH SEDGELAND
*	*Vicia hirsuta*	Tiny Vetch	-			✓											
*	*Vicia sativa*	Common Vetch	-			✓					1						
	Viminaria juncea	Golden Spray	-	Yes		✓											
*	*Vulpia bromoides*	Squirrel-tail Fescue	-			✓		1									
	Wilsonia backhousei	Narrow-leaf Wilsonia	-			✓									x		

Key for table above:
** Introduced Species*
 # Native but some strands may be alien
Victorian Advisory List: r = Rare, p = All infraspecific taxa included in Advisory List
CaLP Act Status: C=Regionally Controlled Weeds, R = Restricted Weeds

B2 SITE FAUNA LIST – INCIDENTAL

STATUS	COMMON NAME	SCIENTIFIC NAME	RECORDED BY WSP	HAREWOOD GUIDEBOOK	1KM VBA SEARCH
BIRDS					
	Australasian Pipit	*Anthus novaeseelandiae*		✓	
	Australasian Swamphen	*Porphyrio melanotus*		✓	✓
	Australian Hobby	*Falco longipennis*		✓	✓
	Australian Magpie	*Gymnorhina tibicen*	✓	✓	✓
	Australian pelican	*Pelecanus conspicillatus*		✓	✓
	Australian Pipit	*Anthus australis*			✓
	Australian Raven	*Corvus coronoides*			✓
	Australian Shelduck	*Tadorna tadornoides*		✓	✓
	Australian White Ibis	*Threskiornis molucca*		✓	✓
	Australian Wood Duck	*Chenonetta jubata*	✓	✓	
	Barn Owl	*Tyto alba*		✓	✓
	Bassian Thrush	*Zoothera lunulata*		✓	✓
	Black Kite	*Milvus migrans*			✓
	Black Swan	*Cygnus atratus*		✓	✓
	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		✓	✓
	Black-shouldered Kite	*Elanus axillaris*		✓	✓
	Blue-winged Parrot	*Neophema chrysostoma*			✓
	Brown Falcon	*Falco berigora*		✓	✓
	Brown Goshawk	*Accipiter fasciatus*			✓
	Brown Quail	*Synoicus ypsilophorus*		✓	✓
	Brown Thornbill	*Acanthiza pusilla*		✓	✓
	Brown-headed Honeyeater	*Melithreptus brevirostris*			✓
	Brush Bronzewing	*Phaps elegans*		✓	
	Buff-banded Rail	*Hypotaenidia philippensis*			✓
nt L	Caspian Tern	*Hydroprogne caspia*		✓	✓
	Chestnut Teal	*Anas castanea*		✓	✓

STATUS	COMMON NAME	SCIENTIFIC NAME	RECORDED BY WSP	HAREWOOD GUIDEBOOK	1KM VBA SEARCH
*	Common Blackbird	*Turdus merula*		✓	✓
	Common Bronzewing	*Phaps chalcoptera*			✓
*	Common Myna	*Acridotheres tristis*		✓	✓
vu	Common Sandpiper	*Actitis hypoleucos*		✓	✓
*	Common Starling	*Sturnus vulgaris*		✓	✓
	Crested Pigeon	*Ocyphaps lophotes*			✓
	Crested Tern	*Thalasseus bergii*			✓
	Crimson Rosella	*Platycercus elegans*			✓
	Dusky Woodswallow	*Artamus cyanopterus*			✓
	Eastern Cattle Egret	*Bubulcus coromandus*		✓	✓
	Eastern Rosella	*Platycercus eximius*		✓	✓
	Eastern Yellow Robin	*Eopsaltria australis*			✓
	Eurasian Coot	*Fulica atra*			✓
*	Eurasian Skylark	*Alauda arvensis*		✓	✓
*	European Goldfinch	*Carduelis carduelis*		✓	✓
*	European/ Common Greenfinch	*Chloris chloris*		✓	✓
	Fan-tailed Cuckoo	*Cacomantis flabelliformis*		✓	✓
	Galah	*Eolophus roseicapilla*		✓	✓
	Gang-gang Cockatoo	*Callocephalon fimbriatum*			✓
	Golden Whistler	*Pachycephala pectoralis*			✓
	Golden-headed cisticola	*Cisticola exilis*		✓	✓
	Great Cormorant	*Phalacrocorax carbo*		✓	✓
vu L	Great Egret	*Ardea alba*		✓	✓
	Grey Butcherbird	*Cracticus torquatus*	✓	✓	✓
	Grey Currawong	*Strepera versicolor*			✓
	Grey Fantail	*Rhipidura albiscapa*	✓	✓	✓
	Grey Shrike-thrush	*Colluricincla harmonica*	✓	✓	✓
	Grey Teal	*Anas gracilis*		✓	

STATUS	COMMON NAME	SCIENTIFIC NAME	RECORDED BY WSP	HAREWOOD GUIDEBOOK	1KM VBA SEARCH
	Hoary-headed Grebe	*Poliocephalus poliocephalus*		✓	
nt L	Hooded Robin	*Melanodryas cucullata*			✓
	Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*			✓
*	House Sparrow	*Passer domesticus*		✓	✓
en L	Intermediate Egret	*Ardea intermedia*		✓	
nt	Latham's Snipe	*Gallinago hardwickii*		✓	✓
	Laughing Kookaburra	*Dacelo novaeguineae*	✓		✓
vu L	Lewin's Rail	*Lewinia pectoralis*		✓	✓
	Little Black Cormorant	*Phalacrocorax sulcirostris*	✓	✓	✓
	Little Corella	*Cacatua sanguinea*			✓
	Little Grassbird	*Poodytes gramineus*		✓	✓
	Little Pied Cormorant	*Microcarbo melanoleucos*		✓	✓
	Little Raven	*Corvus mellori*		✓	✓
	Magpie-lark	*Grallina cyanoleuca*	✓	✓	✓
	Masked Lapwing	*Vanellus miles*		✓	✓
	Mistletoebird	*Dicaeum hirundinaceum*			✓
	Musk Lorikeet	*Glossopsitta concinna*			✓
	Nankeen Kestrel	*Falco cenchroides*		✓	✓
	New Holland Honeyeater	*Phylidonyris novaehollandiae*		✓	✓
	Noisy Miner	*Manorina melanocephala*			✓
	Pacific Black Duck	*Anas superciliosa*	✓	✓	✓
nt	Pacific Gull	*Larus pacificus*			✓
	Pallid Cuckoo	*Cacomantis pallidus*		✓	✓
	Peregrine Falcon	*Falco peregrinus*			✓
nt	Pied Cormorant	*Phalacrocorax varius*		✓	✓
	Rainbow Lorikeet	*Trichoglossus moluccanus*			✓
	Red Wattlebird	*Anthochaera carunculata*		✓	✓
	Red-browed Finch	*Neochmia temporalis*		✓	✓
	Reed-Warbler	*Acrocephalus australis*			✓

STATUS	COMMON NAME	SCIENTIFIC NAME	RECORDED BY WSP	HAREWOOD GUIDEBOOK	1KM VBA SEARCH
CR cr L	Regent Honeyeater	*Anthochaera phrygia*			✓
	Restless Flycatcher	*Myiagra inquieta*			✓
nt	Royal Spoonbill	*Platalea regia*		✓	✓
	Rufous Whistler	*Pachycephala rufiventris*			✓
	Satin Flycatcher	*Myiagra cyanoleuca*			✓
	Scarlet Robin	*Petroica boodang*			✓
	Shining Bronze-Cuckoo	*Chrysococcyx lucidus*			✓
	Silver Gull	*Chroicocephalus novaehollandiae*		✓	✓
	Silvereye	*Zosterops lateralis*		✓	✓
	Singing Honeyeater	*Gavicalis virescens*		✓	✓
*	Spotted Dove	*Streptopelia chinensis*		✓	✓
	Spotted Pardalote	*Pardalotus punctatus*			✓
	Straw-necked Ibis	*Threskiornis spinicollis*		✓	✓
	Striated Fieldwren	*Calamanthus fuliginosus*		✓	✓
	Striated Pardalote	*Pardalotus striatus*			✓
	Striated Thornbill	*Acanthiza lineata*		✓	
	Stubble Quail	*Coturnix pectoralis*			✓
	Sulphur-crested Cockatoo	*Cacatua galerita*		✓	✓
	Superb Fairy-wren	*Malurus cyaneus*		✓	✓
	Swamp Harrier	*Circus approximans*		✓	✓
	Tawny Frogmouth	*Podargus strigoides*		✓	
	Tree Martin	*Petrochelidon nigricans*			✓
	Wedge-tailed Eagle	*Aquila audax*			✓
	Welcome Swallow	*Hirundo neoxena*		✓	✓
	White-browed Scrubwren	*Sericornis frontalis*		✓	✓
	White-eared Honeyeater	*Nesoptilotis leucotis*			✓
	White-faced Heron	*Egretta novaehollandiae*	✓	✓	✓
	White-fronted Chat	*Epthianura albifrons*			✓

STATUS	COMMON NAME	SCIENTIFIC NAME	RECORDED BY WSP	HAREWOOD GUIDEBOOK	1KM VBA SEARCH
	White-naped Honeyeater	*Melithreptus lunatus*			✓
	White-plumed Honeyeater	*Ptilotula penicillata*		✓	✓
	White-throated Treecreeper	*Cormobates leucophaea*			✓
	White-winged Triller	*Lalage tricolor*			✓
	Willie Wagtail	*Rhipidura leucophrys*		✓	✓
	Yellow-billed Spoonbill	*Platalea flavipes*			✓
	Yellow-faced Honeyeater	*Caligavis chrysops*		✓	✓
	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*			✓
	Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*		✓	✓
MAMMALS					
*	Black Rat	*Rattus rattus*	✓	✓	✓
	Black-tailed Wallaby	*Wallabia bicolor*	✓		✓
*	Brown Rat	*Rattus norvegicus*	✓		
	Common Brush-tailed Possum	*Trichosurus vulpecula*			✓
	Common Wombat	*Vombatus ursinus*	✓	✓	✓
*	Domestic Cat (feral)	*Felis catus*	✓		✓
	Eastern Grey Kangaroo	*Macropus giganteus*	✓		✓
	Eastern Ring-tailed Possum	*Pseudocheirus peregrinus*			✓
*	European Brown Hare	*Lepus europaeus*	✓		
*	European Rabbit	*Oryctolagus cuniculus*	✓	✓	✓
	Gould's Wattled Bat	*Chalinolobus gouldii*			✓
*	Hog Deer	*Cervus porcinus*		✓	
*	House Mouse	*Mus musculus*	✓	✓	✓
	Large Forest Bat	*Vespadelus darlingtoni*			✓
	Little Forest Bat	*Vespadelus vulturnus*			✓
*	Red Fox	*Vulpes spp.*	✓	✓	✓
*	Sambar Deer	*Cervus unicolor*			✓
	Short-beaked Echidna	*Tachyglossus aculeatus*	✓	✓	✓

STATUS	COMMON NAME	SCIENTIFIC NAME	RECORDED BY WSP	HAREWOOD GUIDEBOOK	1KM VBA SEARCH
EN nt L	Southern Brown Bandicoot	*Isoodon obesulus obesulus*	✓		✓
	Swamp Rat	*Rattus lutreolus*		✓	✓
	White-striped Freetail Bat	*Tadarida australis*			✓
REPTILES					
	Blotched Blue-tongued Lizard	*Tiliqua nigrolutea*		✓	✓
	Egernia	*Liopholis whitii*			✓
vu	Glossy Grass Skink	*Pseudemoia rawlinsoni*			✓
	Lowland Copperhead	*Austrelaps superbus*		✓	✓
	Metallic Skink	*Niveoscincus metallicus*		✓	✓
	Red-bellied Black Snake	*Pseudechis porphyriacus*		✓	
vu L	Swamp Skink	*Lissolepis coventryi*		✓	✓
AMPHIBIANS					
	Common Froglet	*Crinia signifera*	✓		
VU en L	Growling Grass Frog	*Litoria raniformis*	✓	✓	✓
	Southern Bullfrog	*Limnodynastes dumerilii*		✓	
vu	Southern Toadlet	*Pseudophryne semimarmorata*		✓	
	Spotted Marsh Frog (race unknown)	*Limnodynastes tasmaniensis*	✓		
	Verreaux's Tree Frog	*Litoria verreauxii verreauxii*	✓		
FISH & AQUATIC SPECIES					
	Southern Shortfin Eel	*Anguilla australis*			✓
	Yellow-eye Mullet	*Aldrichetta forsteri*			✓

Key for table above:

** Introduced Species*
EPBC Act: CR = Critically Endangered, EN = Endangered, VU = Vulnerable
FFG Act: L = listed as threatened
Victorian Advisory List: cr = critically endangered, en = Endangered, vu = Vulnerable, nt = near threatened

B3 VEGETATION QUALITY ASSESSMENT RESULTS

The wetlands were assessed using the Vegetation Quality Assessment (VQA) method (Department of Sustainability and Environment 2004). Vegetation Quality Assessment results are provided in Table B.1.

Table B.1 Vegetation Quality Assessment results – Harewood

BIOREGION	GIPPSLAND PLAIN	GIPPSLAND PLAIN	GIPPSLAND PLAIN	GIPPSLAND PLAIN	GIPPSLAND PLAIN	GIPPSLAND PLAIN	GIPPSLAND PLAIN	GIPPSLAND PLAIN	GIPPSLAND PLAIN	GIPPSLAND PLAIN	GIPPSLAND PLAIN
Habitat Zone	1A-1I	2A-2F	3A-3G	4A & 4B	5A-5C	6A-6H	7A-7E	8A-8F	9A	10A-10D	11A
EVC	Tall Marsh	Estuarine Flats Grassland	Estuarine Wetland	Estuarine Flats Grassland	Damp Sands Herb-rich Woodland	Swamp Scrub	Mangrove Shrubland	Aquatic Herbland	Coastal Saltmarsh	Brackish Herbland	Brackish Sedgeland
EVC #	821	914	10	914	3	53	140	653	9		13
Conservation significance	TBC	Endangered	Endangered	Endangered	Vulnerable	Endangered	Least Concern	Endangered	Least Concern		
Large Old Trees	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a		
Canopy Cover	n/a	n/a	n/a	n/a	5	3	n/a	n/a	n/a		
Understorey	15	15	15	10	15	5	15	15	15		
Lack of Weeds	7	9	7	0	7	0	7	7	7		
Recruitment	3	6	1	1	3	3	10	6	3		
Organic Litter	5	3	5	4	5	4	n/a	5	3		
Logs	n/a	n/a	n/a	n/a	2	n/a	n/a	n/a	n/a		
EVC Standardiser	1.36	1.36	1.36	1.36	1	1.25	1.36	1.36	1.36		
Landscape Context	5	14	14	14	14	14	14	14	14		
Final Habitat Score	45.80	58.88	52.08	34.40	51.00	32.75	57.52	58.88	52.08		

B4 FROG HABITAT ASSESSMENT SHEETS

Frog Habitat Assessment

Cluster/region: Harewood	Site: wetlands 1-6	Personnel: PG	Photos taken?
Date: 23 / 10 / 2019	Time: 18.40 - 21.45	GPS: see GIS	Wpt:

Weather conditions: warm, calm

Waterbody type: Wetlands (sediment pond, treatment wetland, lake, lagoon pond, quarry)

Hydroperiod: Seasonal (Estimate (TBC) - permanent, semi-permanent, ephemeral, intermittent)

Water level: Full (depth (cm) if known AND % of wetland area (i.e. within margin) under water)

Year of construction:	Year of desilting (if applicable):

Aquatic vegetation *Mapped by zone (Z1 - drawdown zone; Z2 - emergent zone; Z3 - open water/subm. zone)*

Areas (GIS) - Zone 1: Zone 2: Zone 3:

Zone 1 dom. taxa	Cover		Zone 2 dom. taxa	Cover		Zone 3 dom. taxa	Cover	
			Phragmites australis	60%	Z2			
			Eleocharis acuta	10%	Z2			
Estimate of flora sp. richness - across Z1, Z2 and Z3								

Fringing vegetation (description) % Tree cover within 10m of water's edge:

Aquatic Herbland

Major fringing habitat type (w'in 10m): (mown, grazed, rank growth, bare, rocks, landscaped, shrubby)

Terrestrial refuge (estimate of % cover of rocks and logs (>5 cm diameter) within 10 m of water's edge)

Rocks: No Logs: Yes

Water quality Instrument(s):

Water temp: pH: Turb:

Salinity (uS/cm) Other:

Frogs recorded (calling / dip-netting)		Dip-netting conducted?	Y/N	(5-10)
Crinia signifera	✓all	Limnodynastes dumerili		
Geocrinia victoriana		Limnodynastes peronii		
Litoria ewingii	✓W3 & 4	L. tasmaniensis		
Litoria leseuri		Neobatrachus sudelli		
Litoria peronii		Pseudophryne bibronii		
Litoria raniformis	✓all	P. semimarmorata		
Litoria verreauxi		Other:		

Gambusia observed? Approx. # captured (dip-netting) -

[Yes/No & estimate: none, few (c. <10), moderate (c. 10-50), many (>50)]

Other records or potential interest:

(e.g. yabbies, eels)

Notes:

GGF not responding to call-back, calling at random intervals

Frog Habitat Assessment

Cluster/region: Harewood	Site: wetlands 1-6	Personnel: PG	Photos taken?
Date: 31 / 10 / 2019	Time: 19.30 - 20.45	GPS: see GIS	Wpt:

Weather conditions: warm, light breeze

Waterbody type: Wetlands (sediment pond, treatment wetland, lake, lagoon pond, quarry)

Hydroperiod: Seasonal (Estimate (TBC) - permanent, semi-permanent, ephemeral, intermittent)

Water level: Full (depth (cm) if known AND % of wetland area (i.e. within margin) under water)

Year of construction: | **Year of desilting (if applicable):**

Aquatic vegetation *Mapped by zone (Z1 - drawdown zone; Z2 - emergent zone; Z3 - open water/subm. zone)*

Areas (GIS) - Zone 1: Zone 2: Zone 3:

Zone 1 dom. taxa	Cover		Zone 2 dom. taxa	Cover		Zone 3 dom. taxa	Cover	
			Phragmites australis	60%	Z2			
			Eleocharis acuta	10%	Z2			
Estimate of flora sp. richness - across Z1, Z2 and Z3								

Fringing vegetation (description) % Tree cover within 10m of water's edge:

Aquatic Herbland

Major fringing habitat type (w'in 10m): (mown, grazed, rank growth, bare, rocks, landscaped, shrubby)

Terrestrial refuge (estimate of % cover of rocks and logs (>5 cm diameter) within 10 m of water's edge)

Rocks: No Logs: Yes

Water quality Instrument(s):

Water temp: pH: Turb:

Salinity (uS/cm) Other:

Frogs recorded (calling / dip-netting)		Dip-netting conducted?	Y/N	(5-10)
Crinia signifera	✓all	Limnodynastes dumerili		
Geocrinia victoriana		Limnodynastes peronii		
Litoria ewingii		L. tasmaniensis		
Litoria leseuri		Neobatrachus sudelli		
Litoria peronii		Pseudophryne bibronii		
Litoria raniformis	✓all	P. semimarmorata		
Litoria verreauxi	✓w3	Other:		

Gambusia observed? Approx. # captured (dip-netting) -

[Yes/No & estimate: none, few (c. <10), moderate (c. 10-50), many (>50)]

Other records or potential interest:

(e.g. yabbies, eels)

Notes:

Frog Habitat Assessment

Cluster/region: Harewood	Site: wetlands 1-6	Personnel: PG	Photos taken?
Date: 20 / 11 / 2019	Time: 12.20 - 14.00	GPS: see GIS	Wpt:

Weather conditions: warm, light breeze

Waterbody type: Wetlands (sediment pond, treatment wetland, lake, lagoon pond, quarry)

Hydroperiod: Seasonal (Estimate (TBC) - permanent, semi-permanent, ephemeral, intermittent)

Water level: Full (depth (cm) if known AND % of wetland area (i.e. within margin) under water)

Year of construction: **Year of desilting (if applicable):**

Aquatic vegetation *Mapped by zone (Z1 - drawdown zone; Z2 - emergent zone; Z3 - open water/subm. zone)*

Areas (GIS) - Zone 1: Zone 2: Zone 3:

Zone 1 dom. taxa	Cover		Zone 2 dom. taxa	Cover		Zone 3 dom. taxa	Cover	
			Phragmites australis	60%	Z2			
			Eleocharis acuta	10%	Z2			
Estimate of flora sp. richness - across Z1, Z2 and Z3								

Fringing vegetation (description) % Tree cover within 10m of water's edge:

Aquatic Herbland

Major fringing habitat type (w'in 10m): (mown, grazed, rank growth, bare, rocks, landscaped, shrubby)

Terrestrial refuge (estimate of % cover of rocks and logs (>5 cm diameter) within 10 m of water's edge)

Rocks: No Logs: Yes

Water quality Instrument(s):

Water temp: pH: Turb:

Salinity (uS/cm) Other:

Frogs recorded (calling / dip-netting)		Dip-netting conducted?	Y/N	(5-10)
Crinia signifera	✓1, 4-6	Limnodynastes dumerili		
Geocrinia victoriana		Limnodynastes peronii		
Litoria ewingii		L. tasmaniensis		
Litoria leseuri		Neobatrachus sudelli		
Litoria peronii		Pseudophryne bibronii		
Litoria raniformis	✓all	P. semimarmorata		
Litoria verreauxi		Other:		

Gambusia observed? Approx. # captured (dip-netting) -

[Yes/No & estimate: none, few (c. <10), moderate (c. 10-50), many (>50)]

Other records or potential interest:

(e.g. yabbies, eels)

Notes:

GGF strong calling during afternoon

Frog Habitat Assessment

Cluster/region: Harewood	Site: wetlands 1-6	Personnel: PG	Photos taken?
Date: 05 / 02 / 2020	Time: 9.00 - 14.30	GPS: see GIS	Wpt:

Weather conditions: warm, light breeze, coudy

Waterbody type: Wetlands (sediment pond, treatment wetland, lake, lagoon pond, quarry)

Hydroperiod: Seasonal (Estimate (TBC) - permanent, semi-permanent, ephemeral, intermittent)

Water level: Full (depth (cm) if known AND % of wetland area (i.e. within margin) under water)

Year of construction: | **Year of desilting (if applicable):**

Aquatic vegetation *Mapped by zone (Z1 - drawdown zone; Z2 - emergent zone; Z3 - open water/subm. zone)*

Areas (GIS) - Zone 1: Zone 2: Zone 3:

Zone 1 dom. taxa	Cover		Zone 2 dom. taxa	Cover		Zone 3 dom. taxa	Cover	
			Phragmites australis	60%	Z2			
			Eleocharis acuta	10%	Z2			
Estimate of flora sp. richness - across Z1, Z2 and Z3								

Fringing vegetation (description) % Tree cover within 10m of water's edge:

Aquatic Herbland

Major fringing habitat type (w'in 10m): (mown, grazed, rank growth, bare, rocks, landscaped, shrubby)

Terrestrial refuge (estimate of % cover of rocks and logs (>5 cm diameter) within 10 m of water's edge)

Rocks: No Logs: Yes

Water quality Instrument(s):

Water temp: pH: Turb:

Salinity (uS/cm) Other:

Frogs recorded (calling / dip-netting)		Dip-netting conducted?	Y/N	(5-10)
Crinia signifera	✓all	Limnodynastes dumerili		
Geocrinia victoriana		Limnodynastes peronii		
Litoria ewingii		L. tasmaniensis		
Litoria leseuri		Neobatrachus sudelli		
Litoria peronii		Pseudophryne bibronii		
Litoria raniformis	✓all	P. semimarmorata		
Litoria verreauxi	✓w3	Other:		

Gambusia observed? Approx. # captured (dip-netting) -

[Yes/No & estimate: none, few (c. <10), moderate (c. 10-50), many (>50)]

Other records or potential interest:

(e.g. yabbies, eels)

Notes:

GGF calling intermittently (while setting up IR cameras for SBB)

Gambusia visually obeserved in Swan Lake (not in GGF wetland areas)

APPENDIX C

SOUTHERN BROWN BANDICOOT OBSERVATIONS FROM CAMERA TRAPPING AT AND NEAR HAREWOOD, TOOADIN, VICTORIA (NICHOLLS 2020)

Southern Brown Bandicoot observations from camera trapping at and near Harewood, Tooadin, Victoria

D G Nicholls

29 January 2020 at 16:43

Contents

1 Preliminary

The following comment and the hidden R script document the data sources and the processing used to produce this report. These ensure transparency and reproducability. The working directory in which the current **R** session is being executed is /Users/david2018/Dropbox/R projects/camtrapR/CTwp/All and if there is no **.R_Cache** folder within this directory then the **.R_Cache** folder will be found in the directory one level above the *current working directory*.

The script that has been used to generate this report is Harewood_202001_SBBv123.Rmd [1].

2 Introduction

The property *Harewood* has been monitored with camera trapping since mid 2011. We have used three sites on the property and we have one camera trap station adjacent and others near by at Woodlot Lane, Deep Creek, Swamp Tower. See maps, Figures 1 to 3. This note provides results from one site on *Harewood* from late 2013.

The presence of Southern Brown Bandicoot is a key component of any site evaluation for an offset under the EPBC Act.

[1] Script executed on computer: Davids-iMac-Pro.local by user: david2018 at 29 Jan 2020 at 16:43.

3 Methods

The procedures follow Nicholls *et al* (2018). The observations summarised here include: The earlier stations (using Scout Guard cameras) from 2011-07-22 to 2011-09-11 were in the northeast corner of the property. Reconyx cameras were deployed from September 2013 to December 2016 and again from January 2018 and on-going. A record is the metadata for each image captured of the target species.

Figure 1: Map of *Harewood* and surrounding study area showing the sites of mutliple camera stations in a rural landscape. The stations at Freeman's property and Woodlot Lane in the east, *Harewood* in the centre and Deep Creek and Swamp Tower in the west are marked. Public land reserves are mapped. The clusters of coloured symbols mark the camera trap stations; the colours indicate the project-experiment. GIS data from VicMap. Aerial photograph is dated 3 December 2004.

Figure 2: Map of *Harewood* (outlined in blue) showing the sites camera stations (three on *Harewood* and one adjacent, north of the highway). Public land reserves are mapped. The clusters of coloured symbols mark the camera trap stations; the colours indicate the project-experiment. Examples are green on-going monitoring, red one-off ~30 day deployment.

Table 1: Number of images by month and year at Harewood

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2013	0	0	0	0	0	0	0	0	12	15	9	15	51
2014	6	0	0	0	0	0	0	0	0	0	0	826	832
2015	0	0	9	1	20	3	0	0	0	0	0	252	285
2016	66	24	0	0	3	44	0	0	0	0	0	0	137
2018	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	72	24	9	1	23	47	0	0	12	15	9	1093	1305

4 Results

The Southern Brown Bandicoot was detected by the cameras at a number of locations near *Harewood* (see Figure 3).

4.1 Southern Brown Bandicoot captures at *Harewood*

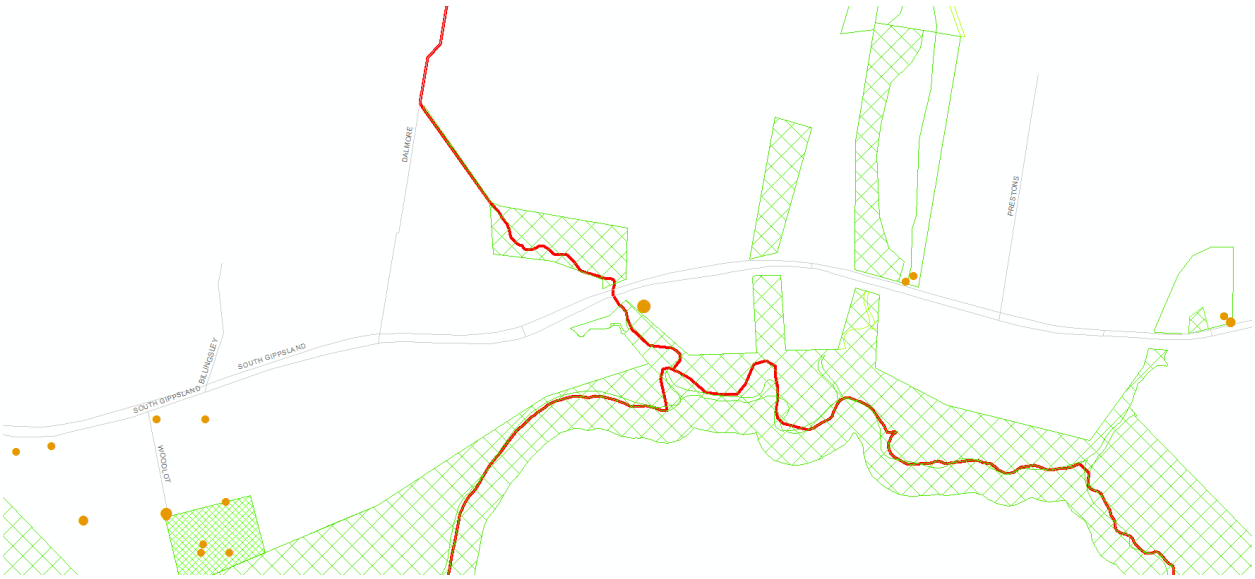

Figure 3: Map of *Harewood* and surrounding area showing stations where Southern Brown Bandicoots were detected.

We have 1305 Southern Brown Bandicoot records; the first was 2013-09-18 16:06:10 and the most recent was 2016-06-25 13:08:46.

There were successful deployments in 2011 but there were no Southern Bown Bandicoot recorded.

The Southern Brown Bandicoot records for subsequent year at *Harewood* are tabulated by year and month (Table 1).

NB. The Southern Brown Bandicoot was not recorded in 2011, nor for the months of July and August in any year between 2014-2016. There was no trapping in 2017 but it was restarted and has been continuous from 23 January 2018 through to the present (results processed to December 2019), we have not recorded the bandicoot in those years.

4.2 Southern Brown Bandicoot captures from nearby locations

The Southern Brown Bandicoot was detected at stations around Woodlot Lane (in the nature conservation reserve and the adjacent farmland and roadside), Deep Creek and Koo Wee Rup Swamp Tower. A timeline of the number of images, per day, of Southern Brown Bandicoot for four stations, monitored continuously, shows that the species is detected intermittently. There was no trapping in 2017 at these sites.

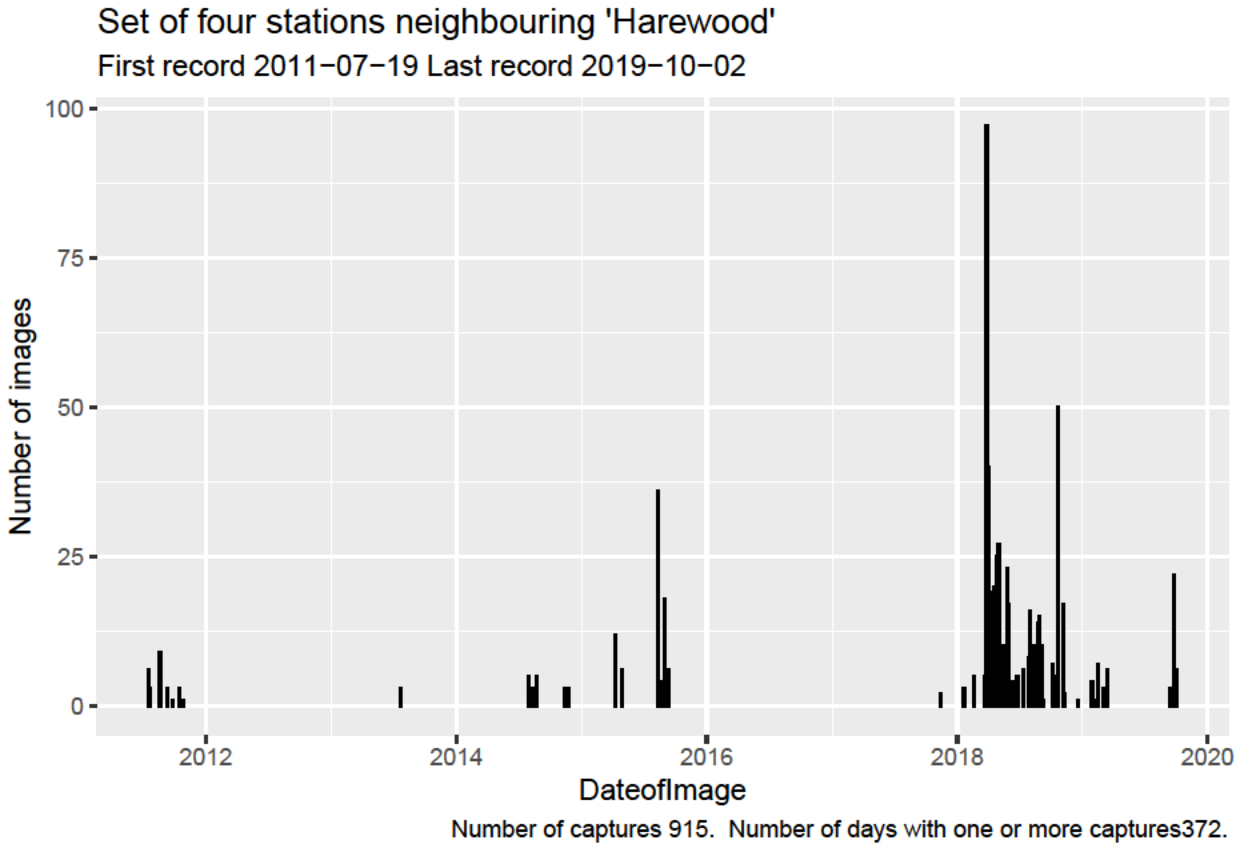

Figure 4: Timeline illustrating the variability in the detection (as measured by the number of records per day) combinine four stations near *Harewood*. The camera trap effort is nominally equal across the time period, except for 2017 when no cameras were operating.

5 Discussion

Harewood is connected to other Southern Brown Bandicoot habitats that are occupied by the bandicoot, at Woodlot Lane to the east and at Deep Creek and Swamp Tower to the west. This augers well for the local population. The intermittent occupancy records are characteristic of the species. We have an on-going study to quantify changes in occupancy with year, season and over time. The timeline of dections near *Harewood* (Figure 4) illustrates this. As a further preliminary example, the raw observations for five stations around the Cranbourne Gardens again indicate the variability, as detected, from the camera images (Figure 4). These sites may not be continually occupied though the bandicoot persists, perhaps in part from a source population at the Cranbourne Gardens. The absence of images from *Harewood* for 2018-2019 is not necessarily indicative of a true absence into the future.

The national parks of Victoria have been considered as providing a long term future for the species. This view is challenged because there have been extensive and repeated fires in the Grampians NP (2006, 2014), most of the habitat of the bandicoot was burnt in Wilson Promontory NP (2005, 2009, 2019) and the recent (January 2020) ferocious fires in East Gippsland have burnt extensive areas including the bandicoot habitat.

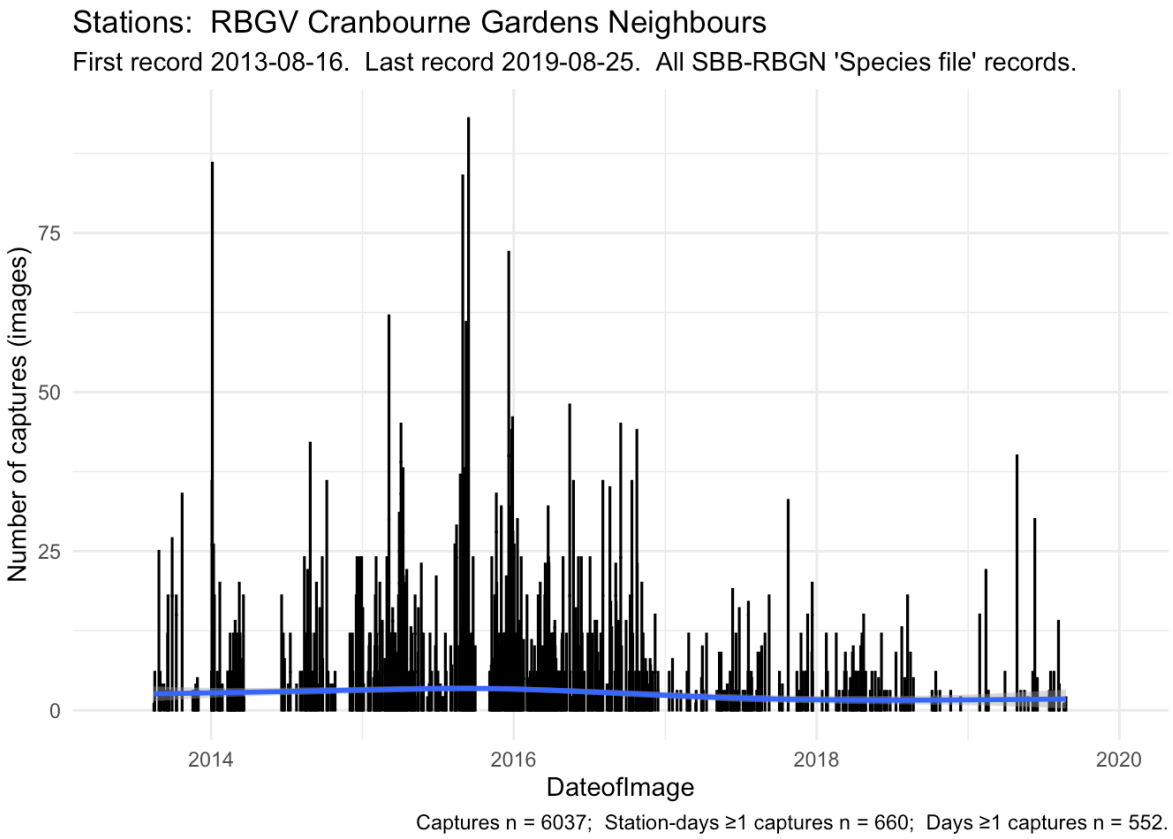

Figure 5: Plot of the number of images as a timeline for camera trap stations surrounding the Cranbourne Gardens. For this site the number of detections peaked in 2016. Anecdotal summaries provided at the SBB Regional Recovery Group meetings from the Cranbourne Gardens (*pers comm.* T Coates) and from Bunyip State Park (*pers comm.* VNPA Nature Watch S Blair) report a reduced proportion of sites occupied in recent years. However preliminary inspection of the 1.2 million record SBBRRG dataset suggests that the bandicoot population responses are not sychonised across this landscape. Compare the two lines in this paper.

There are five meta-populations of the Southern Brown Bandicoot in Victoria (Coates *et al.* 2008). One of these is the meta-population of the south central region of Victoria, the region southeast of Melbourne to Wilsons Promontory. It, especially, may now be an important refuge for the species. This habitat includes rural land which is much less likely to burn with the ferocity experienced in the native vegetation of national parks. The areas burnt may be smaller and more fragmeneted that the extensive fires in the parks. Further there is an on-going substantial investment to manage the conservation of the species in this region with the Melbourne Strategic Assessment Southern Brown Bandicoot Conservation Strategy.

6 Acknowledgements

The support of the Southern Brown Bandicoot Regional Recovery Group and especially Terry Coates is gratefully acknowledged. The Western Port Biosphere Reserve Foundation, Sarah Maclagan, Malcolm Legg, Melbourne Water and Ecology Australia approved the sharing and/or provided data. Land owners and land managers allowed access to their properties. Federal, state and local governments and Wettenhall Environment Trust provided funds for aspects of this project. AO Nicholls was responsible for the computer programming that is needed to manage the large dataset and craft this computer-generated report.

7 References

Coates TD, Nicholls D, Willig R 2008. The distribution of the Southern Brown Bandicoot *Isoodon obesulus obesulus* in south central Victoria. The Victorian Naturalist 125(5), 129-139.

Nicholls, DG, TD Coates, SA Ibbetson. 2018. Assessment of the monitoring of ground-ddwelling mammals in northern Western Port, Victoria. The Victorian Naturalist 135 (4), 96-107.

8 Appendix

The session information includes:

```
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## Platform: x86_64-apple-darwin15.6.0 (64-bit)
## Running under: macOS Catalina 10.15.2
##
## Matrix products: default
## BLAS:   /Library/Frameworks/R.framework/Versions/3.6/Resources/lib/libRblas.0.dylib
## LAPACK: /Library/Frameworks/R.framework/Versions/3.6/Resources/lib/libRlapack.dylib
##
## locale:
## [1] en_AU.UTF-8/en_AU.UTF-8/en_AU.UTF-8/C/en_AU.UTF-8/en_AU.UTF-8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
## [1] bookdown_0.16   knitr_1.26      lubridate_1.7.4 ggplot2_3.2.1
## [5] SOAR_0.99-11
##
## loaded via a namespace (and not attached):
##  [1] Rcpp_1.0.3       magrittr_1.5     tidyselect_0.2.5 munsell_0.5.0
##  [5] colorspace_1.4-1 R6_2.4.1         rlang_0.4.2      highr_0.8
##  [9] dplyr_0.8.3      stringr_1.4.0    tools_3.6.1      grid_3.6.1
## [13] gtable_0.3.0     xfun_0.11        withr_2.1.2      htmltools_0.4.0
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## [25] purrr_0.3.3      glue_1.3.1       evaluate_0.14    rmarkdown_2.0
## [29] labeling_0.3     stringi_1.4.3    compiler_3.6.1   pillar_1.4.2
## [33] scales_1.1.0     pkgconfig_2.0.3
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APPENDIX D

PROTECTED MATTERS SEARCH TOOL (PMST) REPORT

Australian Government
Department of the Environment and Energy

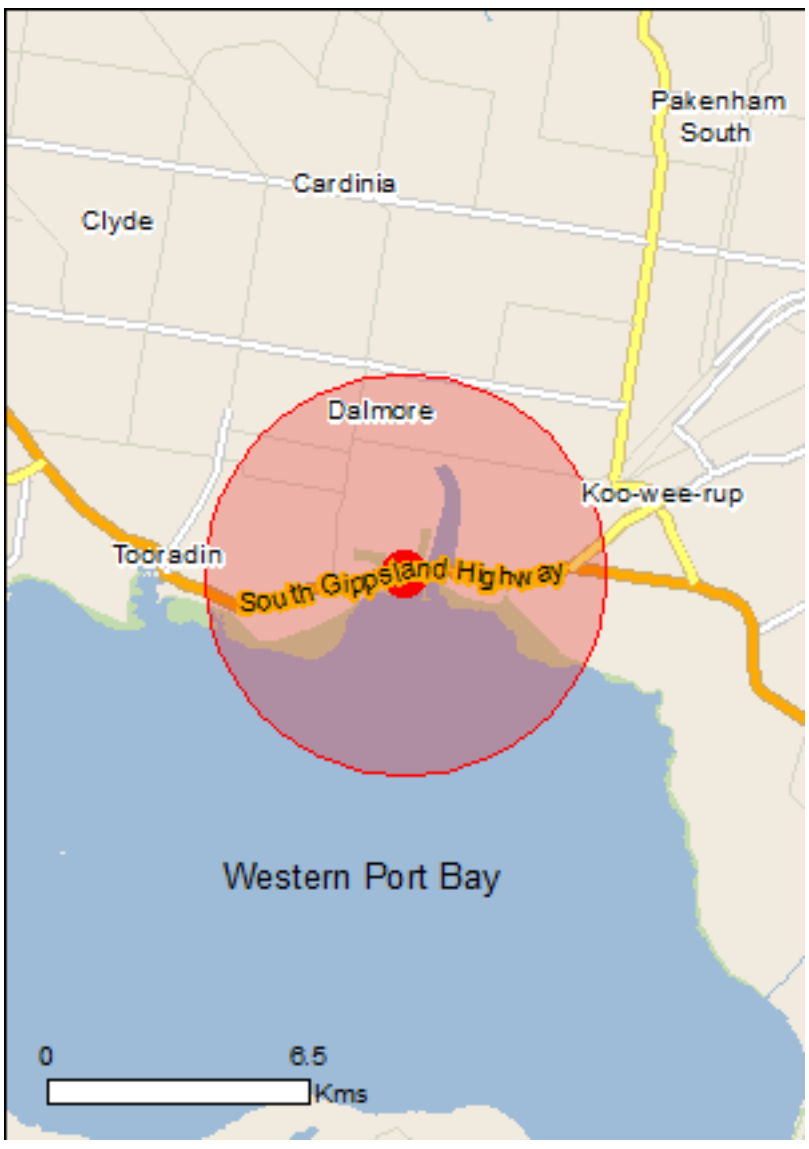
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

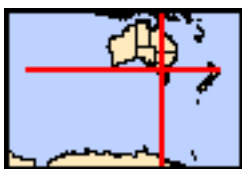
Report created: 06/07/20 10:47:46



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	62
Listed Migratory Species:	60

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	71
Whales and Other Cetaceans:	7
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	46
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Western port	Within Ramsar site

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Natural Damp Grassland of the Victorian Coastal Plains	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Thalassarche cauta		
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma		
Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida		
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini		
Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis cucullatus cucullatus		
Hooded Plover (eastern), Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat likely to occur within area
Fish		
Galaxiella pusilla		
Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Vulnerable	Species or species habitat likely to occur within area
Prototroctes maraena		
Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area
Frogs		
Litoria raniformis		
Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Antechinus minimus maritimus		
Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Isoodon obesulus obesulus		
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat may occur within area
Petauroides volans		
Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Potorous tridactylus tridactylus		
Long-nosed Potoroo (SE Mainland) [66645]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
[Pteropus poliocephalus](#)		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Plants		
[Amphibromus fluitans](#)		
River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat likely to occur within area
[Caladenia orientalis](#)		
Eastern Spider Orchid [83410]	Endangered	Species or species habitat may occur within area
[Dianella amoena](#)		
Matted Flax-lily [64886]	Endangered	Species or species habitat known to occur within area
[Glycine latrobeana](#)		
Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat likely to occur within area
[Prasophyllum frenchii](#)		
Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid, Swamp Leek-orchid [9704]	Endangered	Species or species habitat likely to occur within area
[Prasophyllum spicatum](#)		
Dense Leek-orchid [55146]	Vulnerable	Species or species habitat likely to occur within area
[Pterostylis chlorogramma](#)		
Green-striped Greenhood [56510]	Vulnerable	Species or species habitat may occur within area
[Pterostylis cucullata](#)		
Leafy Greenhood [15459]	Vulnerable	Species or species habitat may occur within area
[Senecio psilocarpus](#)		
Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat likely to occur within area
[Thelymitra epipactoides](#)		
Metallic Sun-orchid [11896]	Endangered	Species or species habitat may occur within area
[Xerochrysum palustre](#)		
Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
[Caretta caretta](#)		
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
[Chelonia mydas](#)		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Dermochelys coriacea](#)		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Sharks		
[Carcharodon carcharias](#)		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		

Name	Threatened	Type of Presence
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		

Name	Threatened	Type of Presence
Balaena glacialis australis		
Southern Right Whale [75529]	Endangered*	Species or species habitat known to occur within area
Caperea marginata		
Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus		
Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat likely to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa incana Wandering Tattler [831]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus		
Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris		
Great Knot [862]	Critically Endangered	Roosting known to occur within area

Name	Threatened	Type of Presence
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Heteroscelus incanus Wandering Tattler [59547]		Roosting known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat may occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur

Name	Threatened	Type of Presence
		within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov. Pacific Albatross [66511]	Vulnerable*	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable*	Species or species habitat likely to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Caperea marginata		
Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis		
Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat may occur within area
Tursiops aduncus		
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str.		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
North Western Port N.C.R.	VIC

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis		
Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis		
European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris		
European Greenfinch [404]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Turdus philomelos Song Thrush [597]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Western Port	VIC

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-38.21284 145.43187

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX E

SOUTHERN BROWN BANDICOOT HABITAT RESTORATION GUIDELINES

E1 SOUTHERN BROWN BANDICOOT HABITAT RESTORATION GUIDELINES

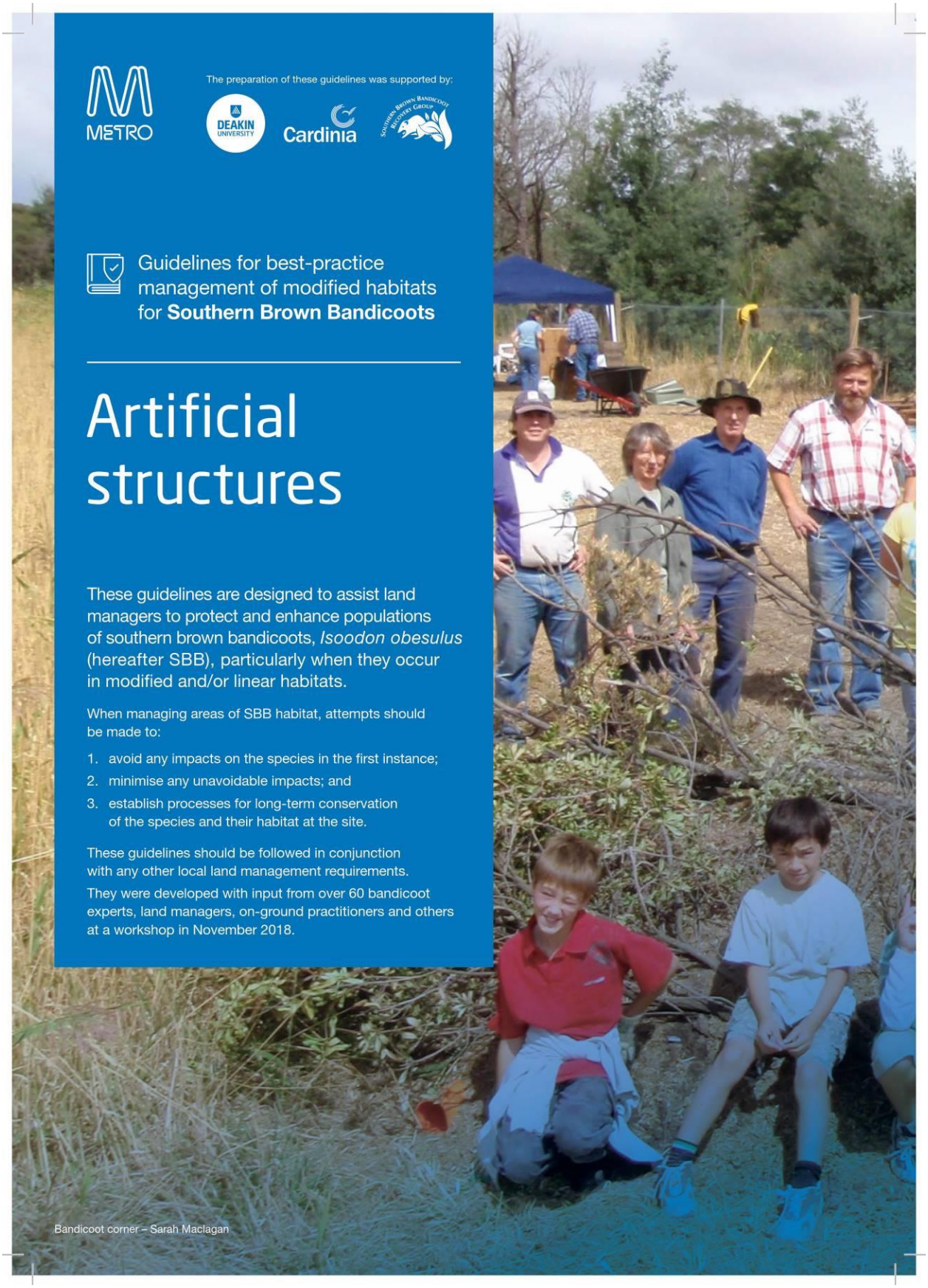
Selected sections from *Guidelines for best-practice management of modified habitats for Southern Brown Bandicoots* (Masters, Talyor & Maclagan 2019)

Guidelines supported by Metro Trains, Deakin University, Cardinia Shire Council and Southern Brown Bandicoot Recovery Group. This also includes Southern Brown Bandicoot artificial shelter Cardinia Shire Council (undated). Available at: https://www.cardinia.vic.gov.au/downloads/download/231/southern_brown_bandicoot.

Selected sections included in this Appendix:

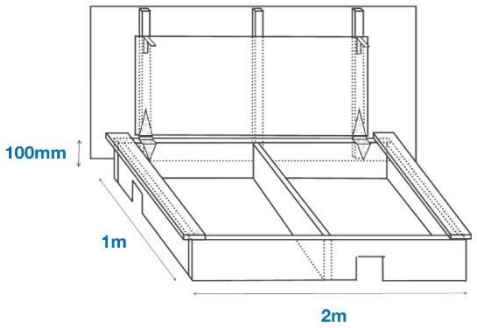
- Appendix E1: Artificial structures
- Appendix E2: Pest plants
- Appendix E3: Revegetation
- Appendix E4: Vegetation management

E2 ARTIFICIAL STRUCTURES



Artificial structures

- Artificial structures can provide SBB with additional cover and protection from introduced predators although they should not be used to replace the cover provided by dense vegetation.
- Man-made structures can be placed in areas where SBB are known to inhabit, and where natural options for cover or nesting are limited.
- A simple design for a DIY SBB hide is provided below:



- Piles of brush and woody debris can also be used to provide shelter. Use existing, natural woody debris (logs, branches etc.) and place it in piles of at least **1.0m²** in areas where SBB are known to occur, especially if vegetation cover is lacking.
- Place shelters a maximum of **10m** apart in areas where the vegetation has been cleared to facilitate the movement of SBB between areas of suitably dense vegetation.
- Monitor structures to determine if they are used by SBB.
- Conduct community education/engagement and install signage in areas containing artificial structures.
- Share or publish findings on the usage of artificial structures, especially with respect to size, shape, material used and spacing.

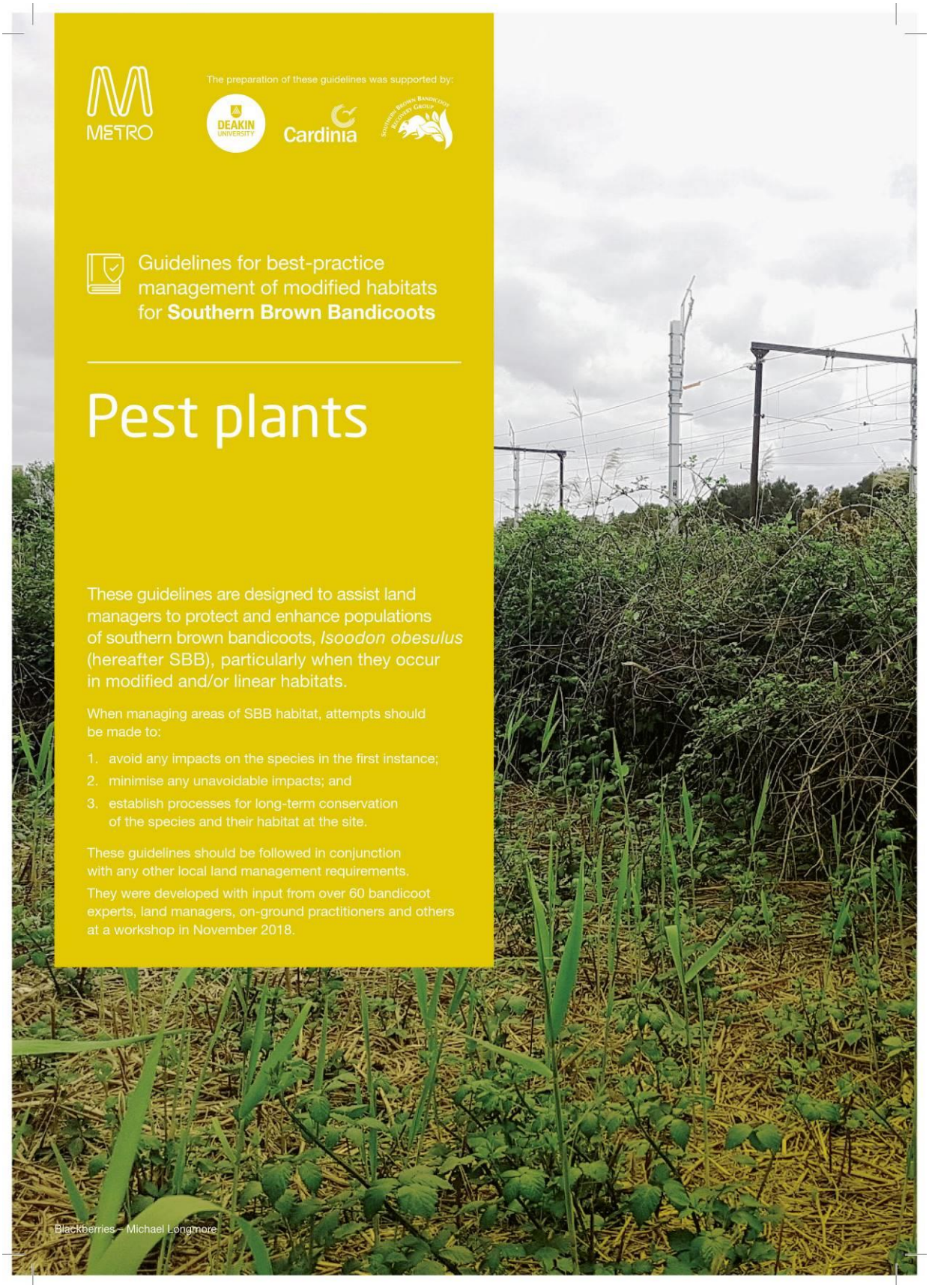
Debris pile - Main Drain – Sarah Maclagan

For additional information refer to the other Guidelines:

Artificial structures | Fire | Community engagement | Pest animals | Pest plants | Revegetation | Road and rail impacts | Vegetation management

First published November 2019. Compiled by N. Masters, R. Taylor and S. Maclagan.

E3 PEST PLANTS



Pest Plants

- Identify pest plant species present at a site and check legal obligations to remove them.
- Pest plant species such as blackberry, gorse, flax-leaf broom, boneseed and African boxthorn provide dense, prickly cover and are often used by SBB for shelter and/or food.
- Conduct surveys of SBB usage of areas containing pest plant species to assess the habitat value where the infested area:
  - is greater than **25m²** in size;
  - occurs within **50m** of potential SBB habitat; or
  - contains an understorey vegetation structure of **>50%** average foliage density in the **0.2-1m** height range.
- Ideally, establish suitable vegetation nearby before clearing of pest plant species commences.
- Stagger/stage removal of pest plant species and replace with indigenous / native alternatives over time, while ensuring **>50%** understory vegetation remains at all times.
- Avoid creating gaps **>7m** as these may hinder SBB movement.
- Use targeted spot-spraying, 'wiping' or cut and paint methods rather than spraying more broadly in areas known/likely to provide SBB habitat.
- Herbicide spraying is acceptable in areas **>30m** from known/likely SBB habitat.
- Implement a rapid intense revegetation program following weed removal using bandicoot-suitable plant species, ensuring a high plant density in the understorey to prevent the re-growth of weeds.
- If present, remove pine trees and Sweet Pittosporum, as these suppress the growth of understorey/ groundcover vegetation.
- Only a medium to long-term approach to pest plant management will deliver success, so ensure adequate funding is provided for ongoing monitoring and maintenance works.
- Work collaboratively with adjacent landholders to prevent the re-introduction of pest plant species from adjacent land.
- Implement strict hygiene procedures on maintenance and construction vehicles, machinery, personnel and during revegetation projects to reduce the spread of pest plant species.
- When unable to remove pest plant species, prevent pest plant species from spreading by containing existing infestations.

For additional information refer to the other Guidelines:

Artificial structures | Fire | Community engagement | Pest animals | **Pest plants** | Revegetation | Road and rail impacts | Vegetation management

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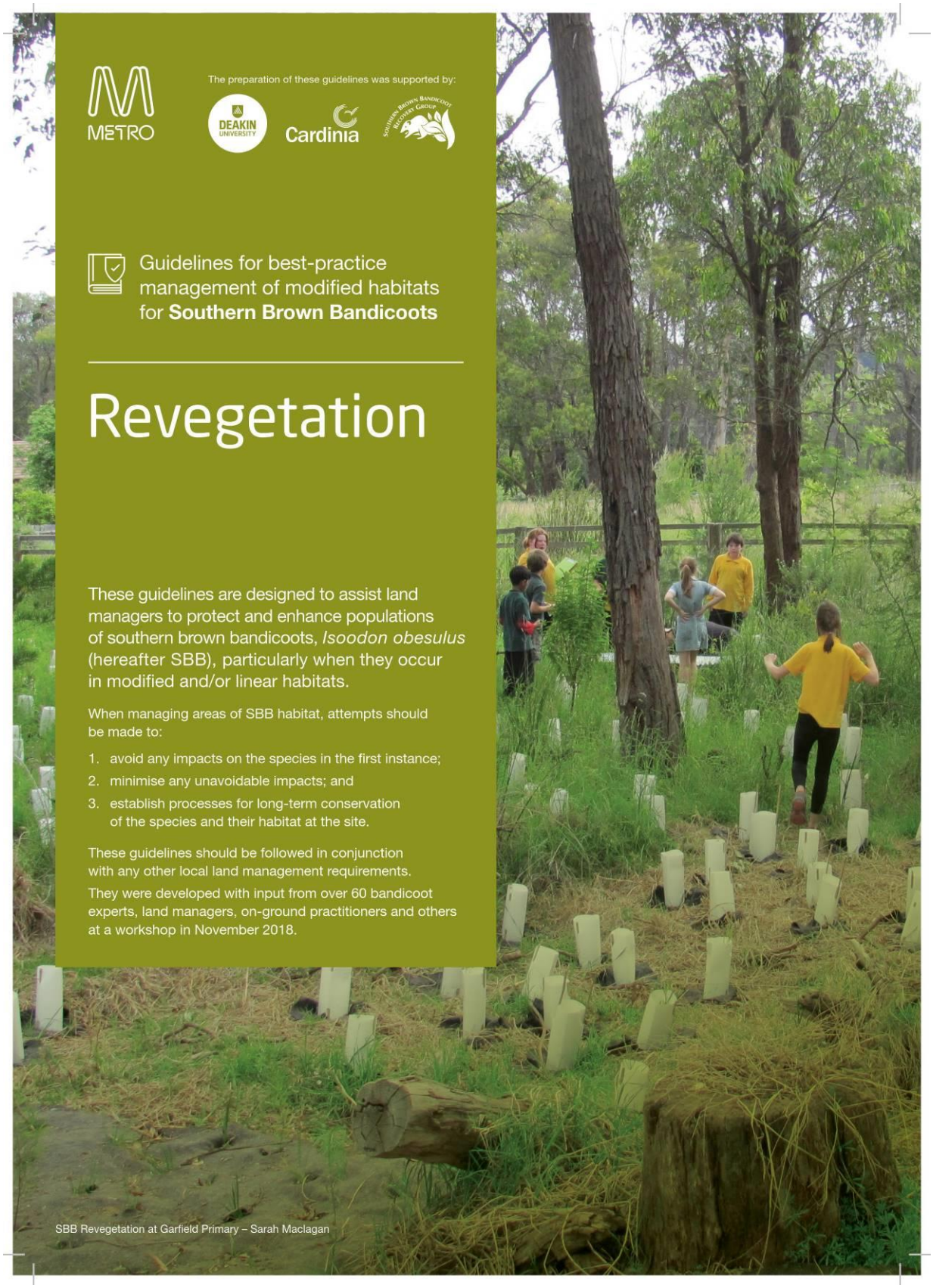
E4 REVEGETATION



SBB Revegetation at Garfield Primary – Sarah Maclagan

Revegetation

- Aim to provide dense groundcover with **>50%** average foliage density within the **0.2-1 m** height range.
- Consult with the local community to determine their expectations and willingness to get involved in planting and maintenance activities.
- Consider and budget for the use of mulch and/or jute matting to suppress weed competition while the new vegetation establishes.
- Ensure any revegetation works are followed up with a weeding and watering program that lasts for at least **24** months from planting to ensure the successful establishment of new habitat.
- Allow for a contingency planting of **20%** in any revegetation project to replace any plants that fail during the first two years.
- Consider other local animal and plant species' requirements to maximise biodiversity outcomes.
- Where invasive weed species like blackberry or gorse are to be replaced, use native prickly shrubs that are indigenous to the area and/or those recommended in **Table 1**.

Plant advice

- Use indigenous plant species whenever possible.
- Contact your local indigenous plant nursery and visit your council website for advice on plant selection.
- Refer to **Table 1** for a list of recommended bandicoot-friendly plant species.
- Assess local conditions and soil types to identify the most suitable indigenous plants for the specific location.

Provide connectivity corridors

- Corridors should be as wide as possible to maximise habitat potential. Ideally, they should have a minimum width **>10m**, but a width of **30m** or greater is better.
- Corridors as narrow as **5m** wide still have some value for SBB and should be provided wherever possible.

Table 1 – Native plant species recommended for inclusion in revegetation projects to create or restore habitat for Southern Brown Bandicoot. Use indigenous forms wherever possible.

Structural Group	Common Name	Genus/Species
Understorey (0-1m) Planted densely to achieve required 50%–80% cover.	Berry Saltbush	*Atriplex semibaccata*
	Spear Grasses	*Austrostipa spp.*
	Tall Sedge Carex apressa	*Carex apressa*
	Pale Flax Lily	*Dianella longifolia*
	Black Anther Flax Lily	*Dianella revoluta*
	Rounded Noon Flower	*Disphyma crassifolium*
	Nodding Saltbush	*Einadia nutans*
	Ruby Saltbush	*Enchylaena tomentosa*
	Knobby Club Rush	*Ficinia nodosa*
	Thatch Saw Sedge	*Gahnia radula*
	Rushes	*Juncus spp.*
	Sword-sedges	*Lepidosperma spp.*
	Spiny Headed Mat Rush	*Lomandra longifolia*
	Weeping Grass	*Microlaena stipoides*
	Tussock Grasses	*Poa spp.*
	Native Raspberry	*Rubus parvifolius*
	Wallaby Grasses	*Rytidosperma spp.*
	Kangaroo Grass	*Themeda triandra*
	Small Grass Tree	*Xanthorrhoea minor*
Understorey (1-2m)	Health Wattle	*Acacia brownii*
	Common Appleberry	*Billardiera scandens*
	Rock Correa	*Correaq glabra*
	Common Correa	*Correa glabra*
	Red Fruited Saw Sedge	*Gahnia sieberiana*
	Hop Goodenia	*Goodenia ovata*
	Rosemary revillea	*Grevillea rosmarinifolia*
	Purple Coral Pea	*Hardenbergia violacea*
	Seaberry Saltbush	*Rhagodia candolleana*
Mid-storey	Prickly Moses	*Acacia verticillata*
	Hedge Wattle	*Acacia paradoxa*
	Hairpin Banksia	*Banksia spinulosa*
	Riber Bottlebrush	*Callistemon sieberi*
	Small Leaved Clematis	*Clematis microphylla*
	Sticky Hop Bush	*Dodonea viscosum*
	Bushy Needlewood	*Hakea decurrens*
	Yellow Hakea	*Hakea nodosa*
	Burgan	*Kunzea ericoides*
	Prickly Tea Tree	*Leptopermm continentale*
	Silky Tea Tree	*Leptospermum myrsinoides*
	Tree Violet	*Melicytus dentatus*
	Swamp Paperbark	*Melaleuca ericifolia*
Over-storey (>4m)	Silver Wattle	*Acacia dealbata*
	Lightwood	*Acacia implexa*
	Black Wattle	*Acacia mearnsii*
	Blackwood	*Acacia melanoxylon*
	Golden Wattle	*Acacia pycnantha*
	Black Sheoak	*Allocasuarina littoralis*
	Drooping Sheoak	*Allocasuarina verticillata*
	Silver Banksia	*Banksia marginata*
	Coast Banksia	*Banksia integrifolia*
	Saw Banksia	*Banksia serrata*
	Sweet Bursaria	*Bursaria spinosa*
	Gums	*Eucalyptus spp.*

For additional information refer to the other Guidelines:

Artificial structures | Fire | Community engagement | Pest animals | Pest plants | **Revegetation** | Road and rail impacts | Vegetation management

First published November 2019. Compiled by N. Masters, R. Taylor and S. Maclagan.

E5 VEGETATION MANAGEMENT

Vegetation management

- SBB require dense groundcover vegetation with **>50%** average foliage density within the **0.2-1m** height range.
- Aim to maintain habitat connectivity for SBB by avoiding gaps **>7m** wide.
- Where grassy vegetation needs slashing/mowing, retain a **>3m** wide contiguous strip of cover to allow for SBB movement.
- Limit stock grazing and vehicle access in areas of vegetation likely to provide habitat for SBB.
- Provide buffer zones of suitable dense vegetation **>10m** wide between developments and known or likely SBB habitat.
- SBB are often slow to move from the path of vehicles/ machinery. Where vehicles/machinery are required to move through SBB habitat, they should not exceed a speed of **5km/hr** (i.e. walking speed) to allow animals a greater chance of moving out of their path.
- To "push" SBB towards suitable habitat, any vegetation slashing or clearing should be done in a pattern that maintains connectivity of habitat for as long as possible and avoids creating isolated patches (i.e. strip or zig-zag pattern).

Slashing in the Rail Corridor – Katrina Lewis

- Where possible, cutting blades should be set at a height of **20cm** or higher, to avoid the chance of blades striking SBB.
- Where substantial vegetation is being removed, provide artificial structures to provide alternative refuge for SBB (see Guideline on "Artificial Shelters").

For additional information refer to the other Guidelines:

Artificial structures | Fire | Community engagement | Pest animals | Pest plants | Revegetation | Road and rail impacts | **Vegetation management**

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ABOUT US

WSP is one of the world's leading engineering professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, planners, surveyors, environmental specialists, as well as other design, program and construction management professionals. We design lasting Property & Buildings, Transportation & Infrastructure, Resources (including Mining and Industry), Water, Power and Environmental solutions, as well as provide project delivery and strategic consulting services. With approximately 48,000 talented people globally, we engineer projects that will help societies grow for lifetimes to come.