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Re: *Vegetation Survey of Peppermint Box and Irongrass communities at Kanmantoo Copper Mine*

Hillgrove Resources engaged EBS Ecology to undertake an assessment of the Peppermint Box Woodland and Irongrass Tussock Grassland communities mapped within the Hillgrove Resources Kanmantoo mining lease. Primarily this was to determine whether these remnant patches meet the criteria of the nationally threatened ecological communities (TEC), set out in the DEWHA document 'EPBC Act Policy Statement 3.7 Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia' (2007). A particular focus was placed on the relevant communities located within the proposed Life of Mine (LOM) disturbance increase area and these were assessed against the policy statement criteria.

Methodology

Field Survey

The field survey was undertaken by EBS Ecology staff on the 25th June, 2013.

Floristic Mapping

Previous floristic mapping was provided prior to the survey. The vegetation associations and boundaries were checked and corrected where necessary.

Extent of communities

The extent of *Lomandra* grassland patches and Peppermint Box Woodland were recorded using hand held Garmin GPS (Accuracy +/- 15m) units which are carried around the extent of the communities present. The track log was saved with the relevant patch number and entered into Arc GIS software to enable the total area to be calculated.

Species diversity

Species diversity totals were obtained from a 50 x 50m quadrat for each representative area. All species observed within the quadrats were recorded with totals compared against benchmark criteria outlined in the *Commonwealth Listing Advice on Iron-grass Natural Temperate Grassland of South Australia* (Table 1) (TSSC 2007) and the *Commonwealth Listing Advice on Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia* (Table 1) (TSSC 2007).

Table 1. Condition classes for Iron-Grass Natural Temperate Grassland of South Australia.

Condition Class	Minimum Size	Diversity of Native Species ¹	No. of Broad-leaved Herbaceous Species ¹ in addition to identified disturbance resistant species ²	No. of Perennial Grass Species ¹	Tussock Count ³
Listed ecological community					
A	0.1 ha	> 30	+10	≥5	1/m
B	0.25 ha	> 15	+3	>4	1/m
Degraded patches amenable to rehabilitation					
C		> 5	No minimum	≥1	No minimum

¹ As measured in a 50m X 50m quadrat;

² The following species are identified as disturbance resistant species: *Ptilotus spathulatus* forma *spathulatus*; *Sida corrugata*; *Oxalis perennans*; *Convolvulus erubescens*; *Euphorbia drummondii*; and, *Maireana enchylaenoides*; and,

³ As measured along a 50m transect.

Table 2. Condition classes for Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.

Condition Class	Minimum Size	Diversity of Native Species ¹	No. of Broad-leaved Herbaceous Species ¹ in addition to identified disturbance resistant species ²	No. of Perennial Grass Species ¹
Listed ecological community				
A	0.1 ha	> 30	+10	≥5
B	1 ha	> 15	+3	≥2
Degraded patches amenable to rehabilitation				
C		> 5	No minimum	≥1

¹ As measured in a 50m X 50m quadrat;

² The following species are identified as disturbance resistant species: *Ptilotus spathulatus* forma *spathulatus*; *Sida corrugata*; *Oxalis perennans*; *Convolvulus erubescens*; *Euphorbia drummondii*; and, *Maireana enchylaenoides*

Tussock Density

Tussock density was calculated by using a 50m transect through the centre of the 50m x 50m quadrat. This is used to quickly and accurately establish whether the density of tussocks meets the minimum criteria for the TEC which is 1/m². Tussocks bases or aerial parts of the plants need to be intersected by the tape to be recorded.

Survey Limitations

The survey was undertaken at a time of year which did not allow for the highest potential species diversity, which coincides with the emergence of annual herbaceous species and bulbous species from families such as Liliaceae (*Bulbine bulbosa*, *Wurmbea dioica*, and *Arthropodium* spp.), Stackhousiaceae (*Stackhousia monogyna*) and Orchidaceae.

Results

Thirteen sites were assessed in the Peppermint Box (*Eucalyptus odorata*) Woodland remnants across the mine site, whilst four sites were assessed in the Irongrass (*Lomandra* spp.) Grassland remnants. Seven Peppermint Box (*Eucalyptus odorata*) Woodland sites qualified as the TEC condition class B, whilst four qualified as condition class C which are regarded as degraded patches amenable to rehabilitation. *Eucalyptus odorata* patch 11, which falls within the proposed impact area, was not assessed due to the low quality woodland community present. This patch had a very low density of Peppermint Box trees in the overstorey with an understorey dominated by *Austrostipa scabra*, forming a dense climax community with low diversity of indigenous herbaceous and grass species. This does not subsequently form part of the Threatened Ecological Community.

Of the four Irongrass (*Lomandra* spp.) Grassland sites assessed, two qualified as the TEC condition class B, and two qualified as condition class C which are regarded as degraded patches amenable to rehabilitation. Table 3 shows the species recorded for each of the sites. Table 4 and 5 displays the results of the assessment against the EPBC listing criteria for each site. Figure 1 shows locations of each site and condition rating assigned as assessed against the EPBC listing criteria. In addition, the mapping also displays the amendments to the vegetation mapping across the mine site.

TYPE	Scientific Name	Common Name	Comm. Status	SA Status	OD1	OD2	OD3	OD4	OD5	OD6	OD7	OD8	OD9	OD10	OD11	OD12	OD13	LOM1	LOM2	LOM3	LOM4
H	<i>Plantago drummondii</i>	Dark Plantain					✓											✓			
	<i>Acacia microcarpa</i>	Manna Wattle					✓			✓	✓										
H	<i>Vittadinia blackii</i>	Narrow-leaf New Holland Daisy					✓		✓									✓			
H	<i>Chenopodium desertorum</i> ssp.	Desert Goosefoot							✓		✓							✓			
	<i>Maireana brevifolia</i>	Short-leaf Bluebush							✓		✓	✓				✓					
	<i>Rhagodia candolleana</i> ssp. <i>candolleana</i>	Sea-berry Saltbush																			
H	<i>Lepidosperma viscidum</i>	Sticky Sword-sedge								✓				✓							
	<i>Pittosporum angustifolium</i>	Native Apricot							✓												
G	<i>Lomandra multiflora</i> ssp. <i>dura</i>	Hard Mat-rush							✓	✓		✓		✓					✓		
G	<i>Lomandra densiflora</i>	Soft Tussock Mat-rush								✓				✓					✓		
G	<i>Lomandra micrantha</i> ssp. <i>micrantha</i>	Small-flower Mat-rush																			
H	<i>Goodenia robusta</i>	Woolly Goodenia							✓										✓		
G	<i>Austrostipa elegantissima</i>	Feather Spear-grass								✓											
H	<i>Burchardia umbellata</i>	Milkmaids								✓											
H	<i>Goodenia pinnatifida</i>	Cut-leaf Goodenia								✓									✓		
H	<i>Prasophyllum</i> sp.	Leek-orchid																			
H	<i>Lagenophora</i> sp.	Bottle-daisy								✓											
H	<i>Compositae</i> sp.	Daisy Family								✓											
G	<i>Austrodanthonia</i> sp.																				
H	<i>Wahlenbergia stricta</i> ssp. <i>stricta</i>	Tall Bluebell										✓	✓					✓			✓
	<i>Dodonaea viscosa</i> ssp. <i>spatulata</i>	Sticky Hop-bush										✓	✓	✓					✓		
H	<i>Calostemma purpureum</i>	Pink Garland-lily								✓	✓										
	<i>Cryptandra amara</i> var.	Cryptandra												✓					✓		
H	<i>Erodium</i> sp.	Heron's-bill/Crowfoot																✓			✓
H	<i>Acaena echinata</i>	Sheep's Burr																	✓	✓	✓
G	<i>Themeda triandra</i>	Kangaroo Grass																	✓		✓

TYPE	Scientific Name	Common Name	Comm. Status	SA Status	OD1	OD2	OD3	OD4	OD5	OD6	OD7	OD8	OD9	OD10	OD11	OD12	OD13	LOM1	LOM2	LOM3	LOM4
	<i>Pomaderris paniculosa</i> ssp.																		✓		✓
H	<i>Haloragis aspera</i>	Rough Raspwort																	✓		
G	<i>Amphipogon strictus</i>	Spreading Grey-beard Grass																	✓		✓
	<i>Scaevola aemula</i>	Fairy Fanflower																	✓		
	<i>Bursaria spinosa</i> ssp.	Bursaria																	✓		
H	<i>Asperula</i> sp.	Woodruff																	✓		
G	<i>Enneapogon nigricans</i>	Black-head Grass																			✓
H	<i>Diuris behrii</i>	Behr's Cowslip Orchid		V	✓					✓											
H	<i>Ptilotus erubescens</i>	Hairy-tails		R			✓														
H	<i>Stackhousia monogyna</i>	Creamy Candles			✓																
H	<i>Wurmbea dioica</i> ssp.				✓																
H	<i>Arthropodium strictum</i>	Common Vanilla-lily			✓							✓									
H	<i>Cynoglossum suaveolens</i>	Sweet Hound's-tongue			✓					✓											
H	<i>Ptilotus spathulatus</i>	Pussy-tails						✓													

Vegetation type, G = Grass, H = Broadleaf Herbaceous species (count excludes disturbance resistance species listed in Tables 1 & 2.)

Table 3. EPBC assessment against the criteria results.

Peppermint Box sites								
Site	Easting	Northing	Size	Native species	Herbaceous species additional to disturbance resistant	Grass species	TEC? (ABC)	Patch
A			0.1ha	>30	10	≥5		
B			1ha	>15	3	≥2		
C				>5	no minimum	≥1		
OD1	318098	6115279	17.454	20	12	4	B	10
OD2	318020	6115236	17.454	16	8	3	B	10
OD3	318060	6115367	17.454	20	12	3	B	10
OD4	318142	6115473	17.454	11	4	4	C	10
OD5	318025	6115659	7.657	21	9	6	B	12
OD6	318246	6115323	17.454	27	17	6	B	10
OD7	317505	6115534	2.83	11	3	3	C	14
OD8	317882	6115668	7.657	16	7	4	B	12
OD9	317710	6115563	5.331	6	3	2	C	13
OD10	318226	6115846	17.454	17	7	5	B	10
OD11	317954	6116352	11.137	7	1	3	C	6
OD12	316597	6116330	1.22	3	0	2	NO	1
OD13	316816	6116033	3.541	4	1	3	NO	2

Table 4. EPBC assessment against the criteria results.

Irongrass Grassland sites									
Site	Easting	Northing	Size	Native species	Herbaceous species additional to disturbance resistant	Grass species	TEC? (ABC)	Patch	Tussocks per m ²
A			0.1ha	>30	10	≥5			>1
B			1ha	>15	3	≥4			>1
C				>5	no minimum	≥1			>1
LOM1	318155	6114317	14.542	14	7	5	C	22	>1
LOM2	317930	6114029	0.98	27	10	9	B	28	>1
LOM3	317919	6114045	0.98	5	1	2	C	28	>1
LOM4	317932	6114303	0.337	17	8	6	B	30	>1

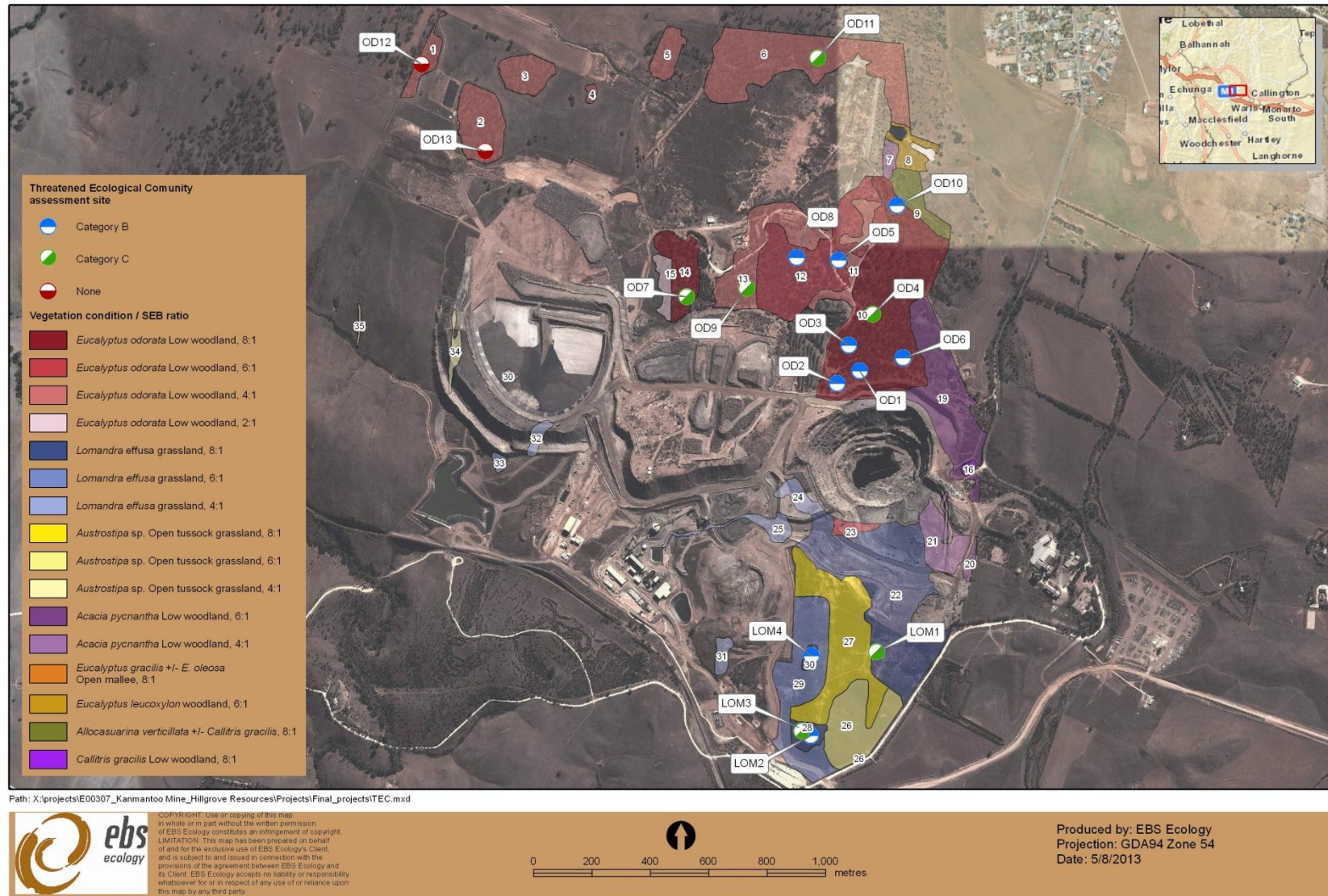


Figure 1. Vegetation mapping and EPBC assessment sites.

References

Department of the Environment and Water Resources (2007) *EPBC Act Policy Statement 3.7 Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia'*

Threatened Species Scientific Committee (2007) *Commonwealth Listing Advice on Iron-grass Natural Temperate Grassland of South Australia* [Listing Advice].

Threatened Species Scientific Committee (TSSC) (2007) *Commonwealth Listing Advice on Iron-grass Natural Temperate Grassland of South Australia* [Listing Advice].