Publication date: 17/07/2020

Notice of and reason for the Final Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to list White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions as a CRITICALLY ENDANGERED ECOLOGICAL COMMUNITY in Part 1 of Schedule 2 of the Act. Listing of Critically Endangered Ecological communities is provided for by Part 4 of the Act.

This determination contains the following information:

Parts 1 & 2: Section 1.6 of the Act defines an ecological community as "an assemblage of species occupying a particular area". These features of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland are described in Parts 1 and 2 of this Determination, respectively.

Part 3: Part 3 of this Determination describes the eligibility for listing of this ecological community in Part 1 of Schedule 2 of the Act according to criteria as prescribed by the *Biodiversity Conservation Regulation 2017*.

Part 4: Part 4 of this Determination provides additional information intended to aid recognition of this community in the field.

Part 1. Assemblage of species

1.1 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is characterised by the assemblage of species listed below.

Acacia dealbata	*Acacia filicifolia*
Acacia implexa	*Acacia mearnsii*
Acaena agnipila	*Acaena ovina*
Ajuga australis	*Angophora floribunda*
Anthosachne scabra	*Aristida jerichoensis*
Aristida behriana	*Aristida ramosa*
Aristida latifolia	*Austrostipa aristiglumis*
Asperula conferta	*Austrostipa blackii*
Austrostipa densiflora	*Austrostipa scabra*
Austrostipa nodosa	*Brachychiton populneus*
Bothriochloa macra	*Bulbine bulbosa*
Brunoniella australis	*Bursaria spinosa*
Callitris glaucophylla	*Cheilanthes sieberi*
Chloris ventricosa	*Chrysocephalum apiculatum*
Chrysocephalum semipapposum	*Convolvulus spp.*
Cymbonotus lawsonianus	*Cymbopogon refractus*
Cynoglossum suaveolens	*Desmodium varians*

Dianella longifolia
Dichondra spp.
Dichopogon fimbriatus
Einadia nutans
Eucalyptus albens
Eucalyptus bridgesiana
Eucalyptus melliodora
Eucalyptus polyanthemos
Euchiton involucratum
Euphorbia drummondii
Galium spp.
Geranium solanderi
Gonocarpus elatus
Goodenia bellidifolia
Goodenia pinnatifida
Hydrocotyle laxiflora
Jacksonia scoparia
Leptorhynchos squamatus
Lomandra filiformis
Melichrus urceolatus
Microseris lanceolata
Notelaea microcarpa
Opercularia aspera
Panicum effusum
Plantago debilis
Plantago varia
Poa sieberiana
Ranunculus lappaceus
Rubus parvifolius
Rytidosperma auriculatum
Rytidosperma racemosum
Schoenus apogon
Sida corrugata
Sorghum leiocladum
Stackhousia monogyna
Stellaria pungens
Templetonia stenophylla
Tricoryne elatior
Veronica plebeia
Wahlenbergia luteola
Wurmbea dioica
Dichanthium sericeum
Echinopogon ovatus
Eremophila debilis
Eucalyptus blakelyi
Eucalyptus macrorhyncha
Eucalyptus moluccana
Eucalyptus rubida
Euchiton sphaericus
Exocarpos cupressiformis
Geranium retrorsum
Glycine spp.
Gonocarpus tetragynus
Goodenia hedearcea
Hibbertia obtusifolia
Hypericum gramineum
Jasminum suavissimum
Lissanthe strigosa
Lomandra multiflora
Microlaena stipoides
Microtis unifolia
Olearia elliptica
Oxalis perennans
Pimelea curviflora
Plantago gaudichaudii
Poa labillardieri
Poranthera microphylla
Rostellularia adscendens
Rumex brownii
Rytidosperma pilosum
Rytidosperma setaceum
Scleranthus biflorus
Solenogyne gunnii
Sporobolus creber
Stackhousia viminea
Swainsona galegifolia
Themeda triandra
Velleia paradoxa
Wahlenbergia communis
Wahlenbergia planiflora
Xerochrysum viscosum

1.2 The total species list of the community across all occurrences is likely to be considerably larger than that given above. Due to variation across the range of the community, not all of the above species are present at every site and many sites may also contain species not listed above (see section 4).

Characteristic species may be abundant or rare and comprise only a subset of the complete list of species recorded in known examples of the community. Some characteristic species

show a high fidelity (are relatively restricted) to the community, but may also occur in other communities, while others are more typically found in a range of communities.

The number and identity of species recorded at a site is a function of sampling scale and effort. In general, the number of species recorded is likely to increase with the size of the site and there is a greater possibility of recording species that are rare in the landscape.

Species presence and relative abundance (dominance) will vary from site to site as a function of environmental factors such as soil properties (chemical composition, texture, depth, drainage), topography, climate and through time as a function of disturbance (*e.g.* fire, logging, grazing) and weather (*e.g.* flooding, drought, extreme heat or cold).

At any one time, above ground individuals of some species may be absent but the species may be represented below ground in the soil seed bank or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers.

The species listed above are vascular plants, however the community also includes micro-organisms, fungi and cryptogamic plants as well as vertebrate and invertebrate fauna. These components of the community are less well documented.

Part 2. Particular area occupied by the ecological community

2.1 The assemblage of species listed in Part 1.1 above which characterises White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland occurs within NSW in the Brigalow Belt South, Nandewar, New England Tableland, Sydney Basin, NSW North Coast, South Eastern Highlands, South East Corner, NSW South Western Slopes and Riverina Bioregions. The assemblage of species is also known to occur in the South Eastern Queensland Bioregion in Queensland and the Victorian Midlands Bioregion in Victoria.These bioregions are defined by SEWPaC (2012) Interim Biogeographic Regionalisation for Australia, Version 7. Department of Sustainability, Environment, Water, Population and Communities.
http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/maps.html

2.2 It is the intent of the NSW Threatened Species Scientific Committee that all occurrences of the ecological community (both recorded and as yet unrecorded, and independent of their condition) that occur within these bioregions be covered by this Determination.

Part 3. Eligibility for listing

3.1 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland was listed as an Endangered Ecological Community under the *Threatened Species Conservation (TSC) Act* 1995 in 2002 under the name White Box Yellow Box Blakely's Red Gum Woodland. The Final Determination was based on a state-wide conservation assessment as required under the *TSC Act* (1995) and was subject to a minor amendment in 2012. Since the original listing, the Ecological Community has been listed nationally as Critically Endangered under the Commonwealth *Environmental Protection and Biodiversity Conservation Act* (1999) under the name White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland. The NSW Threatened Species Scientific Committee has reviewed the Commonwealth listing documents (TSSC 2006) and

undertaken a conservation assessment of this Ecological Community at the national scale using IUCN criteria as provided for under the *Biodiversity Conservation Act 2016* (NSW TSSC 2020).

3.1.1 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is not eligible for listing as a collapsed ecosystem. Guidelines for the application of IUCN Red List of ecosystems categories and criteria state that ecosystem collapse is analgous to the extinction of a species and has occurred "when all occurrences [of the ecological community] lose defining biotic or abiotic features, no longer sustain the characteristic native biota, and have moved outside their natural range of spatial and temporal variability in composition, structure and/or function" (Bland *et al*. 2017). There is evidence that examples of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland continue to support the community's characteristic biota, their interactions and ecological function (see 3.1.4).

3.1.2 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland has undergone a very large reduction in geographic distribution. The Community has been extensively cleared throughout its range and remnants typically are small, isolated, highly fragmented, occur in predominantly cleared landscapes and exhibit highly modified understoreys (TSSC 2006). Based on a compilation of available maps depicting the current extent of the community, TSSC (2006) estimated that less than 5% of the original distribution remained, however the extent to which remaining examples continue to support characteristic biota, their interactions and function is unknown. The loss of detectable tree cover is a reasonably reliable proxy for overall decline of community distribution because there is evidence that the removal of trees has historically been associated with other land management practices that have been transformative of the ecological community as a whole (see 3.1.4). However, there are multiple pathways of decline and degradation that ultimately lead to different states of this community. Hence, not all examples where trees remain retain diverse and functional understoreys or faunal communities and, conversely, the loss of tree cover alone does not preclude continued ecological function. Loss of understory diversity may also be symptomatic of loss of function, however the extent to which this reflects a permanent or temporary loss depends on the mechanism and severity of disturbance as well as any measures that are undertaken to reverse decline.

The very large historical decline in geographic distribution is corroborated by other sources (Benson 2008, Tozer *et al.* 2010, Armstrong *et al.* 2013), although there is some uncertainty surrounding the current extent of the community and its pre-1750 distribution. For example, in NSW Benson (2008) estimated the pre-1750 extent in NSW of Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South-western Slopes Bioregion (vegetation community ID 277, one component of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland) to be 500,000 ha (±30%), of which he estimated 30,000 ha (±30%) remains. The extent remaining was therefore estimated to be 6% (inferred to be within the range 3 – 11%). Similar uncertainty surrounds the extent of reduction of Benson's (2008) other vegetation communities that are components of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland: ID 276 (estimated pre-1750 extent 40,000 ha, 10% extant, range 3 – 30%), ID 278 (estimated pre-1750 extent 30,000 ha, 20% extant, range 7 – 60%), ID 282 (estimated pre-

1750 extent 70,000 ha, 7% extant, range 2 – 21%), ID 312 (estimated pre-1750 extent 40,000 ha, 7.5% extant, range 4 – 14%), ID 266 (estimated pre-1750 extent 800,000 ha, 6% extant, range 3 – 12%), ID 267 (estimated pre-1750 extent 70,000 ha, 11% extant, range 4 – 34%), ID 274 (estimated pre-1750 extent 8,000 ha, 12.5% extant, range 8.5 – 20%), ID 275 (estimated pre-1750 extent 6,000 ha, 17% extant, range 5.5 – 50%), ID 347 (estimated pre-1750 extent 12,000 ha, 37.5% extant, range 12.5 – 100%), ID 279 (estimated pre-1750 extent 12,000 ha, 33% extant, range 11 – 100%). Despite these uncertainties, the plausible range estimated for the amount remaining includes values less than 10% for almost all of the components of the community described by Benson (2008). Furthermore, the plausible ranges for those variants estimated to have been most extensively distributed in NSW (ID 266 and ID 277) suggest that these have almost certainly been reduced to less than 10% of their pre-1750 distribution.

There is evidence that clearing of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is ongoing and has increased in recent years. Approximately three quarters of the distribution of the community occurs in NSW (TSSC 2006). During the period 2009 – 2016 an average of 395 ha of Grassy Woodland (sensu Keith 2004) was lost annually across NSW to agriculture-related activities within the range of the community (figures cited combine the generic categories of cropping, conversion to pasture and thinning) and a further 155 ha/annum due to infrastructure developments (NSW DPIE 2019) (losses attributed to forestry activities and fire have also been catalogued but are not discussed here as their impact on the conservation risk for the community is likely to be low).

Clearing of Grassy Woodland for agriculture rose during the period 2016-2017 to 654 ha (166% of the average over the preceding seven years) and to 1,344 ha (340%) for the period 2017-2018, while losses attributable to infrastructure rose to 216 ha (138% of the 2009-2016 average) and 589 ha (378% of the 2009-2016 average), respectively (https://www.environment.nsw.gov.au/resources/nativeveg/nsw-woody-vegetation-change-data-spreadsheet-2017-18.xlsx accessed 3/7/19). The average areas cleared annually over the period 2009-2018 and attributable to either agriculture or infrastructure in the bioregions in which the community occurs are (figures for NSW): Brigalow Belt South 2630 ha, Nandewar 659 ha, New England Tableland 934 ha, South Eastern Queensland 760 ha, Sydney Basin 1320 ha, NSW North Coast 1273 ha, Riverina 143 ha South Eastern Highlands 440 ha, South East Corner 151 ha, NSW South Western Slopes 746 ha. Clearing of vegetation in Queensland annually averaged for the same period was 2322 ha in the New England Tableland Bioregion and 129,678 ha in the Brigalow Belt Bioregion (QES 2018).

In addition to the figures cited above, an unknown area of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland has been subjected to clearing of understorey species, probably in addition to the sowing of exotic pasture, or the clearing of *Eucalyptus* regrowth in derived grassland (P. Spark *in litt.* Feb 2020). The rates of clearing or modification of areas of derived grassland are also unknown and difficult to measure (Friends of Grassland *in litt.* Jan 2020). As a result, all estimates of the rates of clearing cited above are likely to underestimate the current rate of decline in distribution.

Clearing is likely to continue at least in the short term in NSW under the current regulatory framework. The most recent data on clearing rates (see above) indicates that the latest legislation changes have been accompanied by a tripling of agricultural clearing of Grassy

Woodlands. The Audit Office of NSW (2019) has reported: "The clearing of native vegetation on rural land is not effectively regulated and managed [in NSW] because the processes in place to support the regulatory framework are weak. There is no evidence-based assurance that clearing of native vegetation is being carried out in accordance with approvals. Responses to incidents of unlawful clearing are slow, with few tangible outcomes. Enforcement action is rarely taken against landholders who unlawfully clear native vegetation. There are processes in place for approving land clearing but there is limited follow-up to ensure approvals are complied with." Considering the evidence for historical, recent and contemporary clearing in combination, it is very likely that the reduction in the distribution of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland exceeds 90% when averaged across the entire range of the community. 'Clearing of native vegetation' is listed as a Key Threatening Process under the Act.

3.1.3 The geographic distribution of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is not restricted. The best estimate of the extent of occurrence (EOO) is 702,800 km^2, based on a minimum convex polygon enclosing likely occurrences of the community, the method of assessment recommended by Bland *et al.* (2017). The best estimate of the area of occupancy (AOO) is 151,100 km^2 based on 10 x 10 km grid cells (with a minimum of 1% occupied by the community), the scale recommended for assessing AOO by Bland *et al.* (2017). The best estimates of EEO and AOO derive from a compilation of maps from multiple sources. Not all of the areas occupied by the community are covered by maps of appropriate scale and accuracy. Therefore, the values for EOO and AOO quoted above may underestimate the true values.

3.1.4 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is subject to a number of threatening processes that have caused severe declines in biotic processes and interactions throughout its range and are likely to cause continuing decline in the future. Multiple sources attest to an almost complete conversion of the community to agricultural production (Prober 1996, Prober and Thiele 2004, Keith 2004, Benson 2008), although the impact of this varies over its range. The grazing of domestic stock, in either woodland remnants or in areas in which the tree canopy has been removed or thinned, has been the most widespread activity. The impacts of grazing vary depending on the historical grazing regime (timing, intensity, continuity), methods employed to improve pasture (fertilizer application, augmentation with exotic or native species) and the extent of associated impacts on soil structure and biota (soil erosion, compaction) (Prober 1996). Less than 10% of the original distribution of the community is likely to have avoided the long-term impacts of pastoralism in areas confined to cemeteries and railway easements (Prober and Thiele 2004) and Traveling Stock Routes (TSRs). Even so, compositional changes associated with differential management practices in these areas have been recorded (Prober and Thiele 2004) and such remnants are still exposed to grazing by the introduced rabbit which also exacerbates the effects of grazing by domestic stock throughout the distribution of the community (Keith 2004). Historically, since their establishment in the European era, grazing regimes in TSRs were characterised by short periods of heavy grazing separated by long periods of rest, which allowed the persistence of species sensitive to grazing. Recent changes in the administration of TSRs in the New England Tableland, Nandewar and Brigalow Belt South Bioregions have resulted in increases in the duration of grazing in TSRs and reductions in the period of rest. These changes in management have resulted in increased degradation of remnants (David Carr *in litt.* Feb. 2020).

The impacts of grazing following the removal of the tree canopy (*i.e*. grazing carried out on native grasslands derived from White Box – Yellow Box – Blakely's Red Gum Grassy Woodland) are likely to be less than those associated with grazing following pasture improvement (Prober 1996). Nevertheless, grazing has been shown to lead to a reduction in understorey species diversity and richness due to the loss of native species that are both highly palatable and intolerant of grazing by domestic stock (Keith 2004). Many previously widespread species such as *Dianella revoluta, Diuris dendrobioides, Microseris lanceolata, Pimelea curviflora* and *Templetonia stenophylla* are now confined to the least disturbed remnants (Prober and Thiele 1995). Shifts in the dominance of pasture species from *Themeda triandra*, *Austrostipa aristiglumis* and *Poa* spp. to *Austrostipa scabra* subsp. *falcata, Rytidosperma* spp. and *Bothriochla macra* have also been observed as grazing intensity increases and is attributed to differential palatability and resilience to grazing among species (Moore 1953). Grazing coupled with burning may lead to the dominance of *Aristida ramosa* (Lodge and Whalley 1989). The reduction of native plant cover by grazing presents opportunities for the invasion of the community by exotic plant species. Coolatai Grass (*Hyparrhenia hirta*) and African Love Grass (*Eragrostis curvula*) are recognised as among the most prominent and invasive of these. Populations of these species have been observed to colonise rapidly following heavy grazing or fire and their propagules are spread widely by vehicles, stock movements and roadside slashing (David Carr *in litt.* Feb. 2020). Many of these impacts may be difficult to reverse and certain species may be permanently lost. Nevertheless, areas of derived native grassland subject to grazing usually retain some native species and functioning ecological processes, and it is possible that the habitat value of these grasslands can be at least partially restored following a cessation of grazing and with the regeneration of tree species.

Historically, pasture improvement practices have proven to be most economically viable in a cooler, winter rain-dominated climate and have therefore been more extensively applied in southern parts of the distribution of the community (Prober 1996). The associated impacts are evidenced by trends of increasing cover and abundance of exotic plant species from the north to the south of its range, and agricultural practices may also be partially responsible for the decrease in species diversity from north to south (Prober 1996). Pasture improvement is intermediate on a spectrum of impact between the clearing of woody vegetation to facilitate grazing of derived native grassland and conversion to cropping. The restoration of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland or Derived Native Grassland following conversion to cropping is unlikely, however remnant paddock trees retain important habitat functions in such landscapes, particularly old trees with many hollows (Law *et al.* 2000). The relative proportions of land given over to grazing on native or improved pasture and cropping are unknown.

The condition of remnants ranges from relatively good to highly degraded, such as paddock remnants with weedy understories and only a few hardy natives left. Some remnants of the community may consist of only an intact overstorey or an intact understorey but may still have high conservation value due to the flora and fauna they support. Other sites may be important faunal habitat, have significant occurrences of particular species, form part of corridors or have the potential for recovery. The conservation value of remnants may be independent of remnant size. The invasion of native plant communities by exotic perennial grasses and Competition and grazing by the feral European Rabbit *Oryctolagus cuniculus* (L.) have been listed as a Key Threatening Processes under the Act.

3.1.5 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is subject to a number of threatening processes that are likely to cause continuing decline in environmental quality within the near future.

Extensive areas of the community are subject to dryland salinity which arises as a consequence of elevated water tables (Yates and Hobbs 1997). For example, Littleboy *et al.* (2001) estimated a total of 93,000 ha of land on the south-west slopes of NSW was affected by dryland salinity. The impacts of salinity are particularly pronounced where the species *Eucalyptus melliodora* and *E. blakelyi* were previously dominant because these species occur in lower topographic positions where the water table is close to the surface (TSSC 2006). Elevated soil salinity has been associated with *Eucalytpus* dieback and the death of understorey species as well as invasion by exotic species (Briggs and Taws 2003, Taws 2003).

Extensive areas of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland are subject to elevated soil nitrogen as a result of the application of chemical fertilizers (Benson 2008). Elevated nitrogen has been associated with the invasion of weeds and eventual conversion from native to exotic pasture (Prober *et al.* 2004a, 2004b). Elevated soil nutrients are thought to transfer to the foliage of *Eucalyptus* species making them more attractive to insects and thus promoting dieback associated with insect attack (Keith 2004).

The structure and composition of the community are influenced by fire regimes. Fire mediates competitive interactions among understory species and prolonged absence of fire may result in declines in species diversity as less competitive species are excluded (Lunt and Morgan 2002). Fire promotes the regeneration of shrub species, particularly those with seed dormancy broken by heat, and the dynamics of such species are sensitive to the length of the fire interval (Prober *et al.* 2017). For example, successive fires separated by intermediate to long intervals can result in shrub encroachment whereas short to intermediate intervals maintain open grassy understoreys (Prober *et al.* 2017).

3.2 Criteria for listing

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is eligible to be listed as a Critically Endangered Ecological Community in accordance with Part 4 of the Act as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing an extremely high risk of extinction in Australia in the immediate future, as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017*:

Clause 4.9 – Reduction in geographic distribution of ecological community
(Equivalent to IUCN criterion A)
Assessment Outcome: Critically endangered under Clause 4.9 (a)

The ecological community has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of its component species:			
	(a)	for critically endangered ecological communities	a very large reduction in geographic distribution
	~~(b)~~	~~for endangered ecological communities~~	~~a large reduction in geographic distribution~~
	~~(c)~~	~~for vulnerable ecological communities~~	~~a moderate reduction in geographic distribution~~

Clause 4.10 – Restricted geographic distribution of ecological community
(Equivalent to IUCN criterion B)
Assessment Outcome: Least Concern

The ecological community's geographic distribution is:				
	~~(a)~~	~~for critically endangered ecological communities~~		~~very highly restricted.~~
	~~(b)~~	~~for endangered ecological communities~~		~~highly restricted.~~
	~~(c)~~	~~for vulnerable ecological communities~~		~~moderately restricted.~~
and at least 1 of the following conditions apply:				
	(d)	there is a projected or continuing decline in any of the following:		
		(i)	a measure of spatial extent appropriate to the ecological community,	
		(ii)	a measure of environmental quality appropriate to characteristic biota of the ecological community,	
		(iii)	a measure of disruption to biotic interactions appropriate to characteristic biota of the ecological community,	
	(e)	There are threatening processes that are likely to cause continuing decline in either geographic distribution, environmental quality or biotic interactions within the near future,		
	~~(f)~~	~~The ecological community exists at:~~		
		~~(i)~~	~~for critically endangered ecological communities~~	~~an extremely low number of locations.~~
		~~(ii)~~	~~for endangered ecological communities~~	~~a very low number of locations.~~
		~~(iii)~~	~~for vulnerable ecological communities~~	~~a low number of locations.~~

Clause 4.11 – Environmental degradation of ecological community
(Equivalent to IUCN criterion Clause C)
Assessment Outcome: Data Deficient under Clause 4.11 (a)

The ecological community has undergone or is likely to undergo within a time span appropriate to the life cycle and habitat characteristics of its component species:			
	~~(a)~~	~~for critically endangered ecological communities~~	~~a very large degree of environmental degradation.~~
	~~(b)~~	~~for endangered ecological communities~~	~~a large disruption of biotic processes or interactions.~~
	~~(c)~~	~~for vulnerable ecological communities~~	~~a moderate degree of environmental degradation.~~

Clause 4.12 – Disruption of biotic processes or interactions in ecological community
(Equivalent to IUCN criterion D)
Assessment Outcome: Critically endangered under Clause 4.12 (a)

The ecological community has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of its component species:			
	(a)	for critically endangered ecological communities	a very large disruption of biotic processes or interactions
	~~(b)~~	~~for endangered ecological communities~~	~~a large disruption of biotic processes or interactions~~
	~~(c)~~	~~for vulnerable ecological communities~~	~~a moderately large disruption of biotic processes or interactions~~

Clause 4.13 – Quantitative analysis of probability of collapse of ecological community
(Equivalent to IUCN criterion E)
Assessment Outcome: Data deficient

The probability of collapse of the ecological community is estimated to be:			
	~~(a)~~	~~for critically endangered species~~	~~extremely high~~
	~~(b)~~	~~for endangered ecological communities~~	~~a large disruption of biotic processes or interactions~~
	~~(c)~~	~~for vulnerable species~~	~~high~~

Dr Anne Kerle
Chairperson
NSW Threatened Species Scientific Committee

Part 4. Additional information about the ecological community

The following information is additional to that required to meet the definition of an ecological community under the Act. It is provided to assist in the recognition of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Given natural variability, along with disturbance history, the community may sometimes occur outside the typical range of variation in the features described below.

4.1 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland comprises an aggregation of Grassy Woodlands (sensu Keith 2004) occurring on the tablelands and western slopes of the Great Dividing Range from the Darling Downs in southern Queensland south to central Victoria. In New South Wales, the community corresponds broadly with Keith's (2004) Western Slopes Grassy Woodlands, Southern Tableland Grassy Woodlands and New England Grassy Woodlands classes. In Queensland the community comprises parts of Neldner *et al.*'s (2015) Temperate eucalypt woodlands Broad Vegetation Group. In Victoria, the community forms parts of the Dry Forests, Plains Woodlands or Forests and Lower Slopes or Hills Woodlands Ecological Vegetation Class Groupings (Victorian DELWP 2005). Nationally, White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland falls within the Temperate Eucalypt Woodland formation of Keith (2017).

4.2 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is characterised by widely-spaced trees with canopies not touching and projected foliage cover generally less than 30% (Prober *et al.* 2017). Tree height ranges from approximately 15 – 30 m and declines with increasing aridity from east to west (Keith 2004, Prober *et al.* 2017). Canopy cover may be higher in remnants exhibiting *Eucalyptus* regrowth following fire, logging, clearing, dieback or tree death due to natural causes. In such cases, canopy cover may exceed 30% and may be continuous, while tree heights may tend toward the lower end of the range. Conversely, the canopy may be completely absent in areas of derived native grassland where tree removal has occurred, and in such areas higher abundance of groundcover species may be present. Understorey shrubs are typically sparse or absent (Prober *et al.* 2017). The groundcover is dominated by perennial tussock grasses interspersed with a diverse range of forb species with the families Asteraceae and Fabaceae, and the orders Liliales and Asparagales well represented (Prober *et al.* 2017).

4.3 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is characteristically dominated by one or more of the species *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) and *E. blakelyi* (Blakely's Red Gum). *Eucalyptus moluccana* may be co-dominant in the Nandewar Bioregion (TSSC 2006) and in the north-western corner of the Sydney Basin Bioregion in the upper Hunter valley. Hybrids or intergrades between these and other species of *Eucalyptus* listed in Part 1 are considered to be part of the characteristic assemblage of species. A number of understorey species are typically found throughout almost the entire range of the community, with the exception of the extreme north of its distribution and areas where they have been excluded by grazing. These include: "the dominant tussock grasses *Themeda triandra* and *Poa sieberiana* and a range of other forbs and grasses such as *Chrysocephalum apiculatum, Hypericum gramineum, Geranium solanderi, Glycine clandestina, Dianella revoluta [sic], D. longifolia, Asperula conferta, Leptorhynchos squamatus, Goodenia pinnatifida, Pimelea curviflora, Stackhousia monogyna, Cheilanthes sieberi, Austrostipa scabra, Bulbine bulbosa,*

Lomandra filiformis and *Oxalis perennans* occupying the inter-tussock spaces" (Prober 1996).

4.4 In the western parts of its range (generally the western slopes below 700 m ASL (Keith 2004)), White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is typically dominated by *Eucalyptus albens*, although *E. melliodora* and *E. blakelyi* may be co-dominant or dominant in localised areas such as along non-permanent water courses and in deeper soils associated with valley floors (Prober 1996). Other co-dominant tree species occurring on the western slopes include *Brachychiton populneus* subsp. *populneus* (Kurrajong) and *Callitris glaucophylla* (White Cypress Pine) (Keith 2004). *Eucalyptus melanophloia* (Silver Ironbark) and *E. pilligaensis* (Narrow-Leaved Grey Box) may also occur in the north-west of the distribution (Keith 2004) and *E. microcarpa* (Grey Box) at the western limits of the distribution (Prober and Thiele 2004), however these three species of *Eucalyptus* are not characteristic of the community and they are only occasionally present. Shrub and sub-shrub species such as *Bursaria spinosa* (Blackthorn), *Cassinia sifton* (Sifton Bush), *Eremophila debilis* (Winter Apple), *Notelaea microcarpa* (Native Olive), *Pimelea curviflora* (Curved Rice Flower) and *Templetonia stenophylla* (Leafy Templetonia) may be observed in the western parts of the range, although generally with low cover and abundance (Keith 2004).

4.5 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is typically dominated by *E. melliodora* (Yellow Box) and *E. blakelyi* (Blakely's Red Gum) in the eastern parts of its range (generally the tablelands above 600m ASL (Keith 2004)). Other tree species are sometimes associated with the community either as occasional occurrences or infrequent sub-dominants, but rarely as co-dominant species. In the south-east these include *E. bridgesiana* (Apple Box), *E. goniocalyx* (Bundy) and occasionally *E. nortonii* (Large-Flowered Bundy). In the north-east, species include *Angophora floribunda* (Rough-Barked Apple), *E. bridgesiana* (Apple Box) and occasionally *E. caliginosa* (Broad-Leaved Stringybark) or *E. youmanii* (Youman's Stringybark) Keith 2004). *Bursaria spinosa* (Blackthorn), *Hibbertia obtusifolia* (Hoary Guinea Flower) and *Lissanthe strigosa* (Peach Heath) also occur in the eastern parts of the range, along with *Cassinia longifolia* and *Exocarpos cupressiformis* (Native Cherry) in the south-east, and *Acacia filicifolia* (Fern-Leaved Wattle), *A. implexa* (Hickory Wattle), *Cassinia quinquefaria* and *Jacksonia scoparia* (Dogwood) in the north-east (Keith 2004).

4.6 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland may occur in the upper Hunter and Goulburn River Valleys where the Great Dividing Range is low (Ollier 1982), and the climate is suitable for the incursion of species from the west of the divide. In this area the community is typically dominated by *Eucalyptus 'albemol'* (a presumed intergrade between *E. albens* and *E. moluccana* (McRae and Cooper 1985)), although *E. melliodora* and *E. blakelyi* may be co-dominant or dominant in localised areas along non-permanent creeks. Further east, White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is replaced by communities representing Keith's (2004) Coastal Valley Grassy Woodlands vegetation class such as Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions and Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions, both listed as Endangered under the *Biodiversity Conservation Act 2016*. The transition between these communities is gradual and the boundary is therefore vague, in part because *E. moluccana* is distributed discontinuously

throughout the region, but occurring only in localised stands in depressions and other low points in the landscape in the upper Hunter (but dominant in the lower Hunter), while *Corymbia maculata* co-dominates with *E. 'albemol'* on low hills in some areas (Peake 2005). White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland does not occur east from the Singleton district.

4.7 Floristic composition and abundance may vary significantly in the derived native grassland component of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland across its geographical range, particularly following periods of good rainfall. With the removal of canopy trees, access to additional light, nutrients and soil water allows increased abundance of some species over others, such that grassland areas may be dominated by only a few of the characteristic species.

4.8 Patterns in the composition of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland are correlated with climatic and topographic gradients across the range of its distribution. Longitudinal gradients in elevation, topographic variability, annual rainfall (Prober and Thiele 2004) and average temperature (Prober *et al.* 2017) are primarily reflected in the composition of the overstorey and shrub stratum as described above, while the composition of the groundcover is less variable from the western to the eastern parts of the range (Keith 2004). Latitudinal gradients in rainfall seasonality (summer dominant in the north vs winter dominant in the south) and temperature are more strongly reflected in the composition of the understorey (Prober 1996). Species such as *Rostellularia adscendens, Chloris ventricosa* (Plump Windmill Grass)*, Rytidosperma racemosum, Brunoniella australis* (Blue Trumpet)*, Cymbopogon refractus* (Barbed Wire Grass)*, Swainsona galegifolia* (Smooth Darling-Pea)*, Notelaea microcarpa* (Native Olive)*, Stackhousia viminea* (Slender Stackhousia)*, Olearia elliptica* (Sticky Daisy Bush)*, Jasminum suavissimum, Plantago gaudichaudii* (Narrow Plantain)*, Dichanthium sericeum* (Queensland Bluegrass)*, Plantago debilis* and *Wahlenbergia communis* (Tufted Bluebell) are restricted to more northern areas (Prober 1996). Fewer species are apparently restricted to southern areas, but include *Gonocarpus elatus, Austrostipa blackii, Aristida behriana* (Bunch Wiregrass)*, Xerochrysum viscosum, Rytidosperma auriculatum* and *Austrostipa nodosa*, and this apparently contributes to the observed inverse relationship between species richness and latitude (Prober 1996). Conversely, the decrease in species richness and accompanying turnover of native herbs and forbs from north to south is accompanied by an increase in the richness and abundance of exotic species (Prober 1996).

4.9 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is known to occur on hilly to undulating landscapes in areas with soils of moderate fertility derived from a range of lithologies, including alkaline and acid volcanics, granites, sediments, serpentinites and metamorphics (Prober and Thiele 2004). While there are apparently no clear relationships between lithology and understorey composition across the range of the community, its western limits correspond to a transition to soils of Tertiary or Quaternary alluvial origin, which is associated with the replacement of *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) and *E. blakelyi* (Blakely's Red Gum) with *E. microcarpa* (Grey Box) and *E. populnea* (Poplar Box or Bimble Box) as overstorey dominants and the replacement of *Themeda triandra* (Kangaroo Grass) and *Poa sieberiana* (Snow Grass) with other grass species (Prober and Thiele 2004).

4.10 The distribution of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland spans a range in elevation from approximately 170 m ASL on the western slopes of the Great Dividing Range to approximately 1200 m on the Northern Tablelands of NSW (Beadle 1981), although occurrences on the ranges are typically at lower elevations (Prober *et al.* 2017). The topography on which the community occurs ranges from flat in the west of its range to hilly and undulating in the east (Prober and Thiele 2004). Annual rainfall across its distribution increases from west to east and is generally within the range 500 – 800 mm (Prober 1996; Keith 2004), although the community may occur in areas receiving as little as 400 mm/annum on the western slopes (Beadle 1981, Prober *et al.* 2017) and in some areas of the Southern Tablelands of NSW rainfall may be as high as 900 mm/annum (Keith 2004). Rainfall season varies from summer dominant in the north to weakly winter dominant in the south (Prober 1996, Keith 2004). Average annual temperature increases from east to west (Prober *et al.* 2017) and from south to north (Keith 2004) across the range of its distribution.

4.11 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is a primary component of the following Regional Ecosystems in Queensland: 11.8.2a, 11.8.8, 11.9.9a, 13.3.1, 13.11.8, 13.12.8 and 13.12.9, and comprises a smaller component of Regional Ecosystems: 11.3.23, 12.8.16 (at the far western edge of the bioregion), 13.3.4, 13.11.3 and 13.11.4 (TSSC 2006). White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland forms a component of the Victorian Ecological Vegetation Classes 47 – Valley Grassy Forest, 55 – Plains Grassy Woodland, 175 – Grassy Woodland. These classes occur in the Highlands – Northern Fall, Northern Inland Slopes, Riverina and Goldfields Victorian bioregions (TSSC 2006). In NSW, the community may form a component of Benson's (2008) Vegetation Community IDs 266, 267, 274, 275, 276, 277, 278, 279, 282, 312, 347. Map Units described in local and regional scale classifications and maps attributed to the community by TSSC (2006) are listed in NSW TSSC (2020). White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland may also comprise parts of Tozer *et al.*'s (2010) Map Units GWp24, DSF p35, GWp420) and Armstrong *et al.*'s (2013) (p24, u19, u178 (all); p23, u20 (part)). A component of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is listed as endangered in the Australian Capital Territory (Yellow Box – Red Gum Grassy Woodland). The degree to which the vegetation units referred to in this paragraph correspond to White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is uncertain and site-by-site assessment is required.

4.12 White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is included within the critically endangered ecological community listed under the *Environment Protection and Biodiversity Conservation Act 1999* as "White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derved Native Grassland". However, the Commonwealth listing advice excludes some patches, here regarded as White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland, on the basis of condition or structure thresholds (including patch size, ground cover and tree density).

For the purpose of establishing the risk of ecosystem/community collapse due to ongoing decline in distribution, it is not possible on the basis of available data, to specify thresholds in either tree cover or species diversity which are indicative of loss of function because: i) no single threshold is appropriate for the range of circumstances and pathways leading to

different states of degradation (and hence the potential for recovery); ii) the point at which an ecological community has ceased to function in its original form is inherently uncertain, and the scientific basis upon which symptoms such as loss of tree cover and diversity can be related to ecological function is not established in this case; and iii) recovery may be dependent on active remediation, therefore thresholds can not be determined in absolute terms because they depend on social (collective will) and economic (cost of remediation) factors.

The NSW TSSC recognises that a range of metrics have been developed for the purpose of prioritising occurrences of TECs for conservation management (Oliver 2002, TSSC 2006). The Committee recognises the need for flexibility to adapt recovery and management priorities to different settings and action types, hence it does not propose prescriptive or generic thresholds for this purpose.

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