

## Notice of and reasons 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 the tree *Eucalyptus boliviana* J.B.Williams & K.D.Hill as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act, and as a consequence, to omit reference to *Eucalyptus boliviana* J.B.Williams & K.D.Hill from Part 3 of Schedule 1 (Vulnerable species) of the Act. Listing of Critically Endangered species is provided for by Part 4 of the Act.

### Summary of Conservation Assessment

*Eucalyptus boliviana* J.B.Williams & K.D.Hill was found to be Critically Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3 (a) (d) (e i, iii) because: (i) *E. boliviana* has a highly restricted Extent of Occurrence (EEO) of 16 km<sup>2</sup>; (ii) *E. boliviana* is known from a single threat-defined location; and (iii) continuing decline has been observed and is projected to continue in the area, extent and/or quality of habitat and number of mature individuals due to the combined effects of increased frequency and duration of drought due to climate change and adverse fire regimes.

The NSW Threatened Species Scientific Committee has found that:

1. *Eucalyptus boliviana* (Bolivia Stringybark) is described by Williams and Hill (2001) as a “shrub or mallee to 5 m tall, sometimes a tree to 12 m. Bark persistent, long-fibrous (‘stringy’) with included thin scales, branches to 2 cm diam. smooth, weakly glaucous, quadrangular. Seedling leaves not seen. Juvenile leaves elliptical, dull green, glaucous, glabrous, 8–11 cm long, 3–6 cm wide, petioles 2–3 cm long. Adult leaves semi-glossy green with a bluish sheen, becoming glossy green with age, glabrous, highly coriaceous, similifacial, broad-lanceolate, acute or apiculate, oblique at base, 8–13 cm long, 2.0–5.0 cm wide; petioles 2.0–3.0 cm long, strongly flattened to quadrangular, usually several times twisted, decurrent into strong ribs on branchlets. Inflorescences axillary; umbellasters 7-flowered. Peduncles thick and broadly flattened, 4–10 mm long, to 7 mm wide. Mature buds sessile, glaucous, ovoid to rhomboid, often curved, strongly 3-4-angular, 7–10 mm long, 6–7 mm diam., calyptra as long as hypanthium. Flowers yellow. Filaments irregularly flexed, stamens all fertile, anthers reniform. Fruits sessile, tightly clustered, flattened-globular, weakly angular, distinctly flanged at top of hypanthium, glaucous, 4-(rarely 5)-locular, 7–11 mm long, 9–15 mm diam. Calyptra scar and stemonophore raised, 0.5–1 mm wide. Disc raised, 2–4 mm wide. Valves broadly triangular, obtuse, raised at a low angle, tips exerted. Seeds dark brown, semiglossy, pyramidal or D-shaped, 1.5–2 mm long; chaff similar, smaller.”
2. *Eucalyptus boliviana* is a naturally rare species endemic to the Bolivia Hill Range south of Tenterfield in northern NSW, being restricted to a small section of the Bolivia Hill Range around granite outcrops and slabs above 900 m elevation (OEH 2021). Approximately 75% of the total *E. boliviana* population is within the National Parks and Wildlife Service managed Bolivia Hill Nature Reserve, with the

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remaining 25% in adjoining freehold land (T. Soderquist pers. comm. August 2022).

3. The population of *Eucalyptus boliviana* is currently regarded as consisting of two subpopulations spanning a linear distance of approximately 5 km (T. Soderquist pers. comm. August 2022, *in litt.* December 2022). Four discrete stands make up the southern subpopulation and are concentrated in one area in the south of Bolivia Hill Nature Reserve, with the stands separated by largely unvegetated granite slabs and densely vegetated, steep-sided gullies over distances of up to several hundred metres (G. Phillips pers. obs. October 2020; January 2021). The northern subpopulation consists of a single large stand and is separate from all the others, being 2–3 km to the northeast of the nearest stand in the southern subpopulation (T. Soderquist pers. comm. August 2022).
4. The population of *Eucalyptus boliviana* prior to the 2017-2019 drought was estimated to be 1,500–2,000 mature individuals (T. Soderquist *in litt.* December 2022). During the 2017–2019 drought, many mature *E. boliviana* trees suffered heavy dieback including canopy and stem death (G. Phillips pers. obs. October 2020; January 2021; DPE 2022a; J. Hunter *in litt.* July 2022), with 15% of mature individuals estimated to have died across both subpopulations during and following the drought (T. Soderquist *in litt.* December 2022). The stands in the southwestern subpopulation did not suffer evenly, with the majority of trees appearing very unhealthy in two patches and mortality estimated to be at least 20%, while other stands are reported to have lower losses of around 10% of mature individuals (G. Phillips pers. obs. October 2020, January 2021; Hunter 2022; T. Soderquist *in litt.* December 2022). Recruitment since the breaking of the drought is occurring, albeit slowly and sparsely. However, as not all unhealthy mature trees appear to be recovering, the decline in mature individuals appears likely to continue at least into the immediate future (G. Phillips pers. obs. October 2020, January 2021; T. Soderquist pers. comm. August 2022; *in litt.* December 2022). Thus, the population of mature individuals is currently estimated to be 1,275–1,700, 15% lower than pre-drought estimates.
5. The geographic distribution of *Eucalyptus boliviana* is very highly restricted. The Area of Occupancy (AOO) of *E. boliviana* was calculated using 2 x 2 km grid cells, the scale recommended by IUCN (2022) and was estimated to be 16 km<sup>2</sup>. The Extent of Occurrence (EOO) is based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2022) and was estimated to be 3.3 km<sup>2</sup>. However, where EOO is less than or equal to AOO then IUCN guidelines recommend EOO estimates be changed to be equal to AOO to ensure consistency with the definition of AOO as an area that fits within EOO (IUCN 2022). Therefore, the EOO for *E. boliviana* is also estimated to be 16 km<sup>2</sup>.
6. When the most serious plausible threat of increased frequency and duration of drought due to climate change is considered, both subpopulations of *Eucalyptus boliviana* can be considered to be within a single threat-defined location, as per the IUCN definition (IUCN 2022), given drought effects are likely to be consistent across the full range of the species.

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7. On Bolivia Hill, *Eucalyptus boliviana* grows in open shrubland, low woodland, and open forest possessing a shrubby understorey among granite outcrops above 900 m elevation (Williams and Hill 2001; OEH 2021; DPE 2022b). Bolivia Hill is a unique granitic intrusion known as the Bolivia Hill Leucomonzogranite (Geoscience Australia 2022) and receives 800–900 mm of rainfall annually (Hunter 2002). The coarse, shallow soils derived from the Leucomonzogranite are characterised by high sodium and potassium content and *E. boliviana* is predicted to especially prefer the high sodium concentrations (Bui *et al.* 2017).
8. *Eucalyptus boliviana* commonly co-occurs with *E. prava*, *Callitris endlicheri*, *Acacia adunca*, *Leptospermum nova-angliae*, *Micromyrtus sessilis* and *Leucopogon neoanglicus* (Williams and Hill 2001; Phillips 2020). In the more densely vegetated sites, *E. andrewsii*, *E. macrorhyncha*, *E. dealbata*, *E. caleyi* and *E. youmanii* may also contribute to the canopy (OEH 2021). *Eucalyptus boliviana* has been recorded in the Plant Community Types (PCT) New England Rockplate Shrubland (PCT 3854), Northern New England Orange Gum Exposed Woodland (PCT 3711), Mole River Blackbutt Woodland (PCT 3707) and Tenterfield Plateau Stringybark Sheltered Forest (PCT 3507) (Hunter 2002; DPE 2022b, 2022c). However, the species may not be restricted to these PCTs, and it may be found in other PCTs within the area.
9. *Eucalyptus boliviana* has been recorded resprouting after fire (Hunter 2002), and this is likely to be the primary response of the species following major disturbance. The species is considered a combination resprouter, resprouting from epicormic shoots in the stems after most fires, with resprouting from the basal lignotuber only occurring after complete crown destruction (Nicolle 2006). Seedling recruitment is intermittent and rarely observed without disturbance as most seed is held in a canopy-stored seedbank, with seed being gradually released over time or *en masse* following death of a stem or branch (Tozer and Bradstock 1997; G. Phillips pers. obs. October 2020). Given this, it is considered that fire may be required to stimulate stronger germination (OEH 2021); however, data or observations are unavailable to confirm this.
10. The main threats to *Eucalyptus boliviana* include increased frequency and duration of drought due to climate change and adverse fire regimes, with the browsing of seedlings by herbivores including feral goats and clearing for the construction and maintenance of fences and fire trails noted as localised threats. ‘Anthropogenic Climate Change’, ‘High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition’, ‘Competition and habitat degradation by feral goats (*Capra hircus*)’, and ‘Clearing of native vegetation’ are listed as key threatening processes under the Act.
11. Decline has been observed and is strongly inferred to continue in the area, extent and quality of habitat and number of mature individuals of *Eucalyptus boliviana* due to the combined effects of increased frequency and duration of drought due to climate change, together with adverse fire regimes. Historically, some small stands of *E. boliviana* identified by botanists no longer appear to be extant, having not been relocated for over two decades (OEH 2021; T. Soderquist *in litt.* December 2022). Additionally, during and following the 2017–2019 drought, substantial mortality has occurred in the *E. boliviana* population, with the number of mature

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individuals estimated to have declined by approximately 15% (T. Soderquist *in litt.* December 2022). While limited seedling recruitment observed in some stands may sustain and stabilise numbers in those stands, recruitment in other stands is very limited (T. Soderquist *in litt.* August 2022, December 2022). Additionally, the overall health of mature trees remains poor despite substantial rainfall since 2020, with limited to no resprouting and senescent individuals still in decline (G. Phillips pers. obs. October 2020, January 2021; Hunter 2022; T. Soderquist *in litt.* August 2022, December 2022). Under projected future climate conditions for the region, drought is expected to increase in frequency and duration (Reichstein *et al.* 2013; Trenberth *et al.* 2013; Allen *et al.* 2015; AdaptNSW 2022). Therefore, it can be reasonably inferred that future drought-induced mortality events in *E. boliviana*, such as that seen in 2017-2019, will become more common, exacerbating observed declines. Adverse fire regimes may also contribute to decline by the elimination of stems capable of resprouting and increased mortality of mature individuals if severe fires were to become more frequent, as seen in other eucalypts (Etchells *et al.* 2020; Zimmer *et al.* 2021). Conversely, too infrequent fire may limit recruitment episodes required to replenish senescent stands (Keeley 1995; OEH 2021). These threats mean that the quality and availability of habitat and number of mature individuals of *E. boliviana* are likely to remain under pressure, with currently observed declines strongly inferred to continue into the future.

12. *Eucalyptus boliviana* J.B.Williams & K.D.Hill is eligible to be listed as a Critically Endangered species 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*:

## Assessment against *Biodiversity Conservation Regulation 2017* criteria

The Clauses used for assessment are listed below for reference.

**Overall Assessment Outcome: Critically Endangered under Clause 4.3 (a)(d)(e i, iii).**

### Clause 4.2 – Reduction in population size of species (Equivalent to IUCN criterion A)

**Assessment Outcome: Data deficient.**

<b>(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:</b>			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or
	(c)	for vulnerable species	a moderate reduction in population size.
<b>(2) - The determination of that criteria is to be based on any of the following:</b>			
	(a)	direct observation,	
	(b)	an index of abundance appropriate to the taxon,	

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	(c)	a decline in the geographic distribution or habitat quality,
	(d)	the actual or potential levels of exploitation of the species,
	(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

**Clause 4.3 - Restricted geographic distribution of species and other conditions  
(Equivalent to IUCN criterion B)**

**Assessment Outcome: Critically Endangered under Clause 4.3 (a)(d)(e i, iii)**

<b>The geographic distribution of the species is:</b>			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
<b>and at least 2 of the following 3 conditions apply:</b>			
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,	
	(e)	there is a projected or continuing decline in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	habitat area, extent or quality,
		(iv)	the number of locations in which the species occurs or of populations of the species,
	(f)	extreme fluctuations occur in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	the number of locations in which the species occur or of populations of the species.

**Clause 4.4 - Low numbers of mature individuals of species and other conditions**

**(Equivalent to IUCN criterion C)**

**Assessment Outcome: Vulnerable under Clause 4.4 (c)(d iii)(e i, ii(A III)).**

<b>The estimated total number of mature individuals of the species is:</b>				
	(a)	for critically endangered species	very low, or	
	(b)	for endangered species	low, or	
	(c)	for vulnerable species	moderately low,	
<b>and either of the following 2 conditions apply:</b>				
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):		
		(i)	for critically endangered species	very large, or
		(ii)	for endangered species	large, or
		(iii)	for vulnerable species	moderate,
	(e)	both of the following apply:		

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		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and		
		(ii)	at least one of the following applies:		
		(A)	the number of individuals in each population of the species is:		
			(I)	for critically endangered species	extremely low, or
			(II)	for endangered species	very low, or
			(III)	for vulnerable species	low,
		(B)	all or nearly all mature individuals of the species occur within one population,		
		(C)	extreme fluctuations occur in an index of abundance appropriate to the species.		

### Clause 4.5 - Low total numbers of mature individuals of species

(Equivalent to IUCN criterion D)

**Assessment Outcome: Not met.**

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

### Clause 4.6 - Quantitative analysis of extinction probability

(Equivalent to IUCN criterion E)

**Assessment Outcome: Data deficient.**

The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

### Clause 4.7 - Very highly restricted geographic distribution of species—vulnerable species

(Equivalent to IUCN criterion D2)

**Assessment Outcome: Met.**

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.
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Senior Professor Kristine French  
Chairperson  
NSW Threatened Species Scientific Committee

## Supporting Documentation:

Phillips G.P. (2023) Conservation Assessment of *Eucalyptus boliviana* J.B.Williams & K.D.Hill (Myrtaceae). NSW Threatened Species Scientific Committee.

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