

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 herb *Veronica blakelyi* (B.G.Briggs & Ehrend.) B.G.Briggs as an ENDANGERED SPECIES in Part 2 of Schedule 1 of the Act and, as a consequence, to omit reference to *Veronica blakelyi* (B.G.Briggs & Ehrend.) B.G.Briggs from Part 3 of Schedule 1 (Vulnerable species) of the Act. Listing of Endangered species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Veronica blakelyi (B.G.Briggs & Ehrend.) B.G.Briggs was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3(b)(d)(e, i, ii, iii).

The NSW Threatened Species Scientific Committee has found that:

1. *Veronica blakelyi* (B.G.Briggs & Ehrend.) B.G.Briggs (Plantaginaceae) is a small, slender, softly woody herb endemic to the Central Tablelands of New South Wales (NSW). *Veronica blakelyi* was previously known as *Derwentia blakelyi* (Briggs and Ehrendorfer 1992) and '*Parahebe* sp. E.' in Jacobs and Pickhard (1981). In 2007 species in the genus *Derwentia* were transferred to the genus *Veronica* (Garnock-Jones *et al.* 2007).
2. NSW Flora Online (PlantNet 2022) states *Veronica blakelyi* is a "Small glabrous and glaucous shrub or woody herb to 50 cm high, with one to several erect softly woody stems from a narrow rootstock; stems mostly unbranched below inflorescence and dying back after fruiting, internodes to 1.5–6 cm long. Leaves usually recurved, V-shaped in cross section, ovate to lanceolate, mostly 2.5–5.5 cm long, 10–20 mm wide, apex ± acute, base cordate or truncate or cuneate, margins with 8–18 pairs of shallow teeth; sessile. Racemes mostly 8–40 cm long, 15–35-flowered. Calyx lobes 3–5.5 mm long and 0.7–1.3 mm wide in fruit. Corolla 6–7 mm long, bright blue-violet. Capsule broad-ovate, 4–6.5 mm long, 3–3.5 mm wide, truncate or emarginate, glabrous, glaucous."
3. *Veronica blakelyi* is thought to only occur in the greater Newnes area, after suspected recent local extinction at Nullo Mountain from drought. There are a small number of records of *V. blakelyi* outside of the Newnes area, near Mt Horrible, the Coricudgy Range, Peel and Jaunter area which were previously used to assess the distribution of *V. blakelyi*. These occurrences are very unlikely to be extant, either because the records are decades old, misidentified or mislocated. In the greater Newnes area, *V. blakelyi* is found scattered over 50 sites from Clarence to near Cullen Bullen, mostly in the Gardens of Stone State Conservation Area.
4. *Veronika blakelyi* has a highly restricted geographical range. The Extent of Occurrence (EOO) is 222 km² and the Area of Occupancy (AOO) is 196 km². The EOO and AOO are minimum estimates for the species based on confirmed extant

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records, which are all from the greater Newnes area. The Extent of Occurrence (EOO) is based on a minimum convex polygon enclosing all mapped occurrences of the species and the AOO is based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2022), the method of assessment recommended by IUCN (2022).

5. *Veronica blakelyi* is estimated to have a moderately low population size of 3,700–4,300 mature individuals. There is insufficient data available to confidently make any inference of overall population trend over time; however, both increases and decreases of *V. blakelyi* have been recorded from six sites. Large increases in individuals have been observed at two sites: Happy Valley Swamp went from 300 individuals in 2007 to 1700 in 2022 (over 500% in 15 years) and upper Marangaroo Swamp from 50 individuals in 2019 to 165 in 2022 (330% in three years). These increases have probably been caused by fire stimulating germination and three years of above average rainfall facilitating successful recruitment in a species that grows in wet habitats (Bureau of Meteorology 2022; V. Wong pers. obs. September 2022). *Veronica blakelyi* has been reported to have disappeared at local sites in the greater Newnes area after the 2013 and 2019–2020 fires (H. Evans *in litt.* September 2022; C. Jonkers pers. comm. August 2022; H. Zimmer and D. Tiernay *in litt.* 2018), including from the margins of undermined swamps in 2019–2020 that suffered extensive peat incineration (Keith *et al.* 2021) (but not the slopes above the swamps) and from extensive post-fire track and trail clearing (200 individuals killed at Long Swamp) (H. Evans *in litt.* September 2022).
6. Mortality from drought is thought to be responsible for the loss of hundreds of individuals of *Veronica blakelyi* at Nullo Mountain (Hayden Washington pers. comm. September 2022; V. Wong pers. obs. October 2022). In the late 1990s *V. blakelyi* was recorded in large numbers at three sites on Nullo Mountain; however, surveyors in 2018 and 2022 could not relocate any of these plants, and it is likely that the species is now locally extinct or at most very severely declined in population size (Hayden Washington pers. comm. September 2022; V. Wong pers. obs. October 2022). The prolonged drought of 2017–2020 is likely to have killed the subpopulation (Hayden Washington pers. comm. September 2022) and subsequent dense post-fire understory regrowth has likely inhibited or prevented resprouting or recruitment by *V. blakelyi* (V. Wong pers. obs. September 2022). On the Newnes plateau, *V. blakelyi* was observed to die back on upper southern slopes during severe drought conditions in 2019 and 2012 (C. Jonkers pers. comm. August 2022).
7. *Veronica blakelyi* is a long-lived perennial that produces annual stems from its perennial base. *Veronica blakelyi* flowers are short-tubed and subactinomorphic (nearly radially symmetrical). The stems emerge in late winter and spring (V. Wong pers. obs. September 2022) and flower in summer with a spray of small bright blue-violet flowers that dieback after fruiting (PlantNET 2022). *Veronica* spp. does not have markedly different adult and juvenile forms (Briggs and Ehrendorfer 1992).
8. The lifespan of *Veronica blakelyi* is unknown; however, estimates of longevity can be inferred from other species of *Veronica* from the Austraits database (Falster *et al.* 2021). In Austraits, most species of *Veronica* have estimates of longevity of <50 years or <100 years (Falster *et al.* 2021) or 10–30 years for the obligate seeder

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V. hillebrandii (DELWP 2021). Ramets (clump of tillers capable of producing further offshoots) are used to estimate generation time and a *V. blakelyi* ramet lifespan of 50–100 years would mean the generation length of *V. blakelyi* is 25–50 years.

9. *Veronica blakelyi* grows in eucalypt forest, often in moist areas such as drainage lines, gullies, beside creeks and into the edges of swamps (NSW Scientific Committee 2000; habitat notes from NSW Bionet Atlas, Atlas of Living Australia and herbarium specimen records) or on the lower slopes of southerly facing hills (C. Jonkers pers. comm. August 2022), often below small cliffs or rock outcrops (D. Binns *in litt.* May 1999). Briggs and Leigh (1998) note *V. blakelyi* is found on sandstone and shale soils of low fertility. *Veronica blakelyi* has often been recorded on the edges of tracks and trails indicating that it grows well in areas of disturbance. The swamp habitats of *V. blakelyi* are threatened ecological communities (TECs): Newnes Plateau Shrub Swamps in the Sydney Basin Bioregion which is listed as Endangered under the Act.
10. *Veronica blakelyi* resprouts after fire. The longevity of the seedbank of *V. blakelyi* is unknown. At Nullo Mountain, no seedling recruitment has been observed since 2020 following drought and fire, suggesting a short-lived seedbank that may be exhausted (H. Washington pers. comm. September 2022; V. Wong pers. obs. October 2022).
11. *Veronica blakelyi* seeds are very small and likely to be dispersed by wind and water. Seed dispersal could occur across relatively short distances by wind and much longer distances along drainage lines.
12. *Veronica blakelyi* is threatened by changes to hydrology and erosion from mining activities, vegetation clearing and habitat damage by track and trail maintenance and off-road vehicles, increasing severity of drought and increased temperature from ongoing climate change, competition from weeds, habitat damage from hard-hoofed herbivores and disease (NSW Scientific Committee 2000; NSW Government 2022).
13. Longwall (underground) coal mining is an inferred, ongoing threat to the habitat of *Veronica blakelyi*. Underground coal mining threatens the habitat of *V. blakelyi* through two main processes: (i) altering swamp hydrology so that they become susceptible to peat fires and (ii) erosion in and around swamps and creeklines as a result of undermining and/or mine water discharge (Mason *et al.* 2021; Keith *et al.* 2022; Krogh *et al.* 2022). Over the last two decades, 15 of approximately 100 swamps (13% of the area of the Newnes Plateau Shrub Swamps) have been impacted by longwall coal mining (Department of Planning Industry and Environment 2020).
14. Vegetation clearing and habitat damage from track and trail maintenance and off-road vehicle use is an observed, ongoing threat to *Veronica blakelyi*. The native vegetation on the Newnes plateau has been damaged and extensively fragmented by the establishment of tracks to support mining, past forestry activities and off-road vehicle activity (trailbikes and 4WD vehicles) that use its extensive 700+ km network of tracks and unformed trails (NSW NPWS 2022a, D. Taylor pers. comm. October 2022).

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15. *Veronica blakelyi* is inferred to be intolerant to prolonged drought and warmer, drier climatic conditions of projected in the region under climate change. *Veronica blakelyi* is suspected to have been locally extirpated from Nullo Mountain in 2018 as a result of drought. From 2017 to 2019, Nullo Mountain experienced three consecutive years of annual rainfall around 30-40% below the long-term average (Bureau of Meteorology 2022). In 2018 no individuals could be found from a population previously reported in its “hundreds” (H. Washington pers. comm. October 2022). This population is not expected to persist in the soil seedbank in large numbers. Similarly in 2022, after fire in 2019–2020 fire and three years of above average rainfall, no resprouting individuals or seedlings could be found (V. Wong pers. obs. October 2022), suggesting that the soil seedbank did not survive the drought. In comparison, on the Newnes plateau, severe drought conditions during 2017–2019 were not as severe as at Nullo Mountain, and the impact on the species appears to have been more transient. While *Veronica blakelyi* was observed to die back on upper southern slopes in 2019 (C. Jonkers pers. comm. August 2022), it was observed to resprout and recruit seedlings during the following three years of above average rainfall (various database records; V. Wong pers. obs. October 2022). Negative impacts of warmer, drier conditions at Newnes were also observed during the drought of the late 2012 when *V. blakelyi* died back on upper southern slopes (C. Jonkers pers. comm. August 2022). An intolerance of *Veronica blakelyi* to warmer, drier conditions is consistent with its suspected evolutionary history as a relic species from the Last Glacial Maximum when conditions were colder and drier (Benson and Baird 2012). Droughts across the Australian continent are becoming more severe and longer in duration as long-term climate conditions become more arid (Abram *et al.* 2021) and this is likely to increase the threat that drought poses to *V. blakelyi*. Average temperatures in the greater Newnes area are predicted to increase by over 2°C by 2060–2079 (AdaptNSW 2022). If *V. blakelyi* is adapted to cooler climates, then it is inferred that warmer temperatures would adversely affect the population. *Veronica blakelyi* currently grows in the highest part of the landscape and thus cannot escape increasing temperatures by migrating to higher altitudes. Losses from more severe droughts and warmer temperatures on the Newnes Plateau may be offset to some degree by increased annual average rainfall, which is predicted to increase by 1% by 2040 and 5% by 2060–2080. ‘Anthropogenic climate change’ is listed as a Key Threatening Process under the Act.
16. Intact groundwater-dependant peat swamps are likely to provide habitat refuge to *Veronica blakelyi* during severe drought (Keith *et al.* 2022); however, modelling of the effect of climate change on upland swamps forecasts a progressive contraction of swamp habitat (Keith *et al.* 2014). Drought conditions leave undermined swamps especially vulnerable to destruction by peat fires as occurred in the 2019-20 bushfires (Keith *et al.* 2021, 2022; Mason *et al.* 2021).
17. Disease is a potential threat to *Veronica blakelyi*, especially considering the high level of human disturbance due to the extensive trail network on the Newnes plateau and the subsequent increased probability of disease spread. However, there is no information available on the susceptibility of *V. blakelyi* to disease, including Root Rot Fungus, *Phytophthora cinnamomi*.

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18. Feral Pigs *Sus scrofa* and Sambar Deer *Rusa unicolor* may impact swamp and creek bank habitat of *Veronica blakelyi*, as they use wet areas of the landscape for feeding and wallowing (Bengsen *et al.* 2014; Forsyth *et al.* 2009). Feral Pigs and Deer are present in low numbers in the greater Newnes area and prior to the gazetting of the Gardens of Stone SCA were harvested in low numbers by private, authorised hunters (H. Evans *in litt.* August 2022). Currently, the damage they are causing to the Newnes area is minimal, but these pest species can increase rapidly in numbers if not controlled. As such, Feral Pigs and Deer are considered a potential, ongoing threat to *V. blakelyi*. ‘Herbivory and environmental degradation caused by feral deer’ and ‘Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* Linnaeus 1758’ are listed as Key Threatening Processes under the Act.
19. The greater Newnes area is highly disturbed from forestry activities, mining and off-road vehicle use which has promoted the introduction and localised spread of many weed species. Competition from weeds is a potential, ongoing threat to *Veronica blakelyi*. On the Newnes Plateau priority species to target for ongoing weed control include Blackberry *Rubus fruticosus*, pine *Pinus radiata* wildlings, Himalayan Honeysuckle *Leycesteria formosa*, Pampas Grass *Cortaderia selloana*, Scotch Thistle *Onopordum acanthium* and other problematic herbaceous species (Baird 2020).
20. *Veronica blakelyi* (B.G.Briggs & Ehrend) B.G. Briggs is not eligible to be listed as a Critically endangered species
21. *Veronica blakelyi* (B.G.Briggs & Ehrend) B.G. Briggs is eligible to be listed as an Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a very high risk of extinction in Australia in the near 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: Endangered under Clause 4.3(b)(d)(e i, ii, iii)

Clause 4.2 – Reduction in population size of species

(Equivalent to IUCN criterion A)

Assessment Outcome: Data Deficient

(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:			
	(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.
(2) - The determination of that criteria is to be based on any of the following:			
	(a)	direct observation,	

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	(b)	an index of abundance appropriate to the taxon,
	(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: Endangered under Clause 4.3(b)(d)(e i, ii, iii)

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
and at least 2 of the following 3 conditions apply:			
	(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)(e ii (B))

The estimated total number of mature individuals of the species is:				
	(a)	for critically endangered species	very low, or	
	(b)	for endangered species	low, or	
	(c)	for vulnerable species	moderately low,	
and either of the following 2 conditions apply:				
	(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: Not met

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: Not 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
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Supporting Documentation:

Wong V (2023) Conservation Assessment of *Veronica blakleyi* (B.G.Briggs & Ehrend.)B.G. Briggs (Plantaginaceae). NSW Threatened Species Scientific Committee.

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