Exhibition period: 01/02/19 – 29/03/19 Proposed Listing date: 01/02/19

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 *Rhodomyrtus psidioides* (G.Don) Benth. as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act. Listing of Critically Endangered species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Rhodomyrtus psidioides is eligible for listing as Critically endangered under Clause 4.2 (a) (e) because: i) the species is projected to experience a population reduction of > 80% (CR threshold) over three generations or 10 years due to the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

The NSW Threatened Species Scientific Committee has found that:

1. *Rhodomyrtus psidioides* (G.Don) Benth. (family Myrtaceae) is described as a: "Shrub or small tree to 12 m high with brown scaly bark; young branchlets and inflorescences pubescent with pale hairs. Leaves with lamina narrow-ovate to elliptic or oblong, 5–25 cm long, 2.5–6.5 cm wide, apex shortly acuminate, base cuneate, upper surface glabrous and glossy, lower surface paler; lateral veins conspicuous, intramarginal vein absent; oil glands numerous and conspicuous; petiole 15–20 mm long. Flowers 5-merous, in cymes or raceme-like inflorescences; peduncles 10–25 mm long. Petals elliptic, 7–10 mm long, white or pink. Stamens up to 5 mm long. Ovary 4-locular. Berry globose or ovoid, 15–25 mm long, 10–15 mm wide, yellow and fleshy; persistent sepals reflexed near summit" (PlantNET 2018).

2. *Rhodomyrtus psidioides* is currently known to occur from Broken Bay, approximately 90 km north of Sydney, New South Wales (NSW), to Maryborough in Queensland. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW.

3. *Rhodomyrtus psidioides* flowers in late spring to early summer, producing fruits in summer (PlantNET 2018). *Rhodomyrtus psidioides* is known to occur in rainforest and adjoining margins of sclerophyll vegetation, often near creeks and drainage lines. The species has been described as a pioneer species in disturbed environments (Williams and Adam 2010) and is locally common in disturbed areas, such as regrowth and rainforest margins. Suitable habitat for *R. psidioides* is likely to occur in the following vegetation types: Subtropical Rainforests, Warm Temperate Rainforests, Littoral Rainforests, and Wet Sclerophyll Forests (Keith 2004; Floyd 2008). The species has been documented occurring in association with *Acacia bakeri*, *Archontophoenix cunninghamiana*, *Argyrodendron* spp., *Calamus* spp., *Cryptocarya laevigata*, *Elaeocarpus grandis*, *Elaeocarpus kirtonii*, *Glochidion sumatranum*, *Livistona australis*, *Lophostemon confertus*, *Orites excelsa* and *Pilidiostigma rhytispermum*.

4. *Rhodomyrtus psidioides* is listed as a characteristic species in the Final Determination for the Endangered Ecological Community (EEC) 'Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions' under the Act. The species is also highly likely to occur in the followings EECs listed under the Act (though is not listed as a

characteristic species): 'Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions', 'Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion', and 'Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion'. The species may possibly occur in the following EECs listed under the Act (though is not listed as a characteristic species): 'Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregion', 'River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions' and 'Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions'.

5. *Rhodomyrtus psidioides* has moderately restricted geographic range. The estimated extent of occurrence (EOO) of *R. psidioides* is 134,428 km^2. The EOO is based on a minimum convex polygon enclosing all occurrences of the species, the method of assessment recommended by IUCN (2017). The area of occupancy (AOO) is estimated as 884 km^2 based on 2 km x 2 km grid cells, the scale recommended for assessing AOO by IUCN (2017).

6. The number of mature individuals of *Rhodomyrtus psidioides* is currently unknown, but reasonably expected to be > 20,000 individuals. No formal estimates of total abundance of *R. psidioides* across its range or of extinction-risk status prior to 2010 have been located (B. Makinson *in litt*. April 2016). Evidence from abundance notes accompanying vouchered herbarium specimens and field observations (B. Makinson *in litt*. April 2016) infer that local populations may consist of small patches of a few dozen co-occurring mature plants.

7. The survival of *Rhodomyrtus psidioides* is severely threatened by infection from the exotic rust fungus *Austropuccinia psidii* (Myrtle Rust). The 'Introduction and establishment of Exotic Rust Fungi of the order Austropucciniales pathogenic on plants of the family Myrtaceae' is listed as a Key Threatening Process under the Act. *Austropuccinia psidii* was first detected in Australia on the NSW Central Coast in April 2010 and has since established in natural ecosystems throughout coastal NSW, south-east Queensland and far north Queensland (Carnegie and Lidbetter 2012; Pegg et al. 2014). *Austropuccinia psidii* also has a limited distribution in Victoria, Tasmania and the Northern Territory (Carnegie *et al*. 2016).

8. *Rhodomyrtus psidioides* is a known host of *Austropuccinia psidii* (Zauza *et al*. 2010) and is characterised as 'Extremely Susceptible' to *A. psidii* infection (Pegg *et al*. 2014). All plant parts have been documented as being affected by *A. psidii* infection, including leaves, stems, flowers and fruits (Pegg *et al*. 2014; Carnegie *et al.* 2016). The disease rating system of Pegg *et al*. (2014) documents species susceptibility to *A. psidii* infection along a continuum from 'Relatively Tolerant' to 'Extremely Susceptible'. 'Extremely Susceptible' species exhibit "rust sori…on all expanding leaves, shoots and juvenile stems; foliage dieback; evidence of stem and shoot dieback" (Pegg *et al.* 2014).

9. Extensive field assessments of *Austropuccinia psidii* damage on *Rhodomyrtus psidioides* across its entire range show infection is widespread and severe (Carnegie *et al*. 2016; J. Willis *in litt*. April 2018). Carnegie *et al*. (2016) assessed 18 sites for the impact of *A. psidii* on *R. psidioides* between January and October 2014, approximately 3–3.5 years after *A. psidii* had established across the range of this host species. Sites were distributed between Wambina Nature Reserve, near Gosford in NSW, to Tallebudgera Valley, near Beechmont, in south-east Queensland. Sites were a mixture of locations where *A. psidii* infection on *R. psidioides* was already known to occur, and sites where no known infection had been documented (A. Carnegie *in litt*. July 2016). *Austropuccinia psidii* was detected as present on *R. psidioides*

plants in a range of age classes at all sites, and no other plant disease established in Australia presents similar symptoms (Walker 1983). At all sites, approximately 20 individuals of *R. psidioides* were assessed for crown transparency using the scheme of Schomaker *et al*. (2007), the incidence of *A. psidii* (% infected) on mature leaves, immature leaves, flowers and fruit and rated for disease prevalence using the scheme in Pegg *et al.* (2012). Individuals were considered dead when crown transparency reached 100%. These comprehensive assessments of populations document mortality in *R. psidioides* across 15 of the 18 sites. Of the 297 trees assessed, 57% surveyed were dead (100% crown transparency), with four sites having 50–75% mortality, two sites with 95% mortality, and two sites with 100% mortality (Carnegie *et al*. 2016). Observations from botanists and seed collectors infer that *R. psidioides* populations in many of these locations were healthy prior to *A. psidii* establishment (Shaw 2015). All age classes of trees, as assessed by tree height, were similarly affected by *A. psidii* infection (Carnegie *et al.* 2016). Disease incidence was greater on immature leaves (average incidence of 94.5%; standard error 2.1%) than on mature leaves (average incidence of 38.4%; standard error 3.2%) and an average disease rating score of 3.87 (0–4 scale; standard error 0.05) was documented. *Ad hoc* observations during surveys were also made to identify regenerating seedlings and/or suckers. Few seedlings and regenerating shoots of *R. psidioides* were found and those that were located showed evidence of infection with *A. psidii* and associated dieback (Carnegie *et al*. 2016).

10. Ongoing observations in 2016 of a smaller sub-sample of observed populations from Carnegie *et al*. (2016) since the end of the documented study period (2011–2014) estimate mortality has increased to over 80% (A. Carnegie *in litt.* July 2016). Ongoing observations also indicate that there has been no evidence of regenerating populations surviving, with all seedlings/suckers observed being killed by *A. psidii* (A. Carnegie *in litt*. July 2016). Root sucker regeneration of *R. psidioides* has been identified at some sites in northern NSW (e.g. Shark Bay near Iluka, Shelley Beach near Ballina) (G. Pegg *in litt*. July 2016). However, of the >80 root suckers at the Shark Bay population 60% showed severe decline with all leaves lost to *A. psidii* infection at the last assessment (June 2016). No seedlings have been identified from any of the sites. The continued, rapid decline of mature plants and lack of successful regeneration severely threaten the long-term viability of *R. psidioides* in the wild.

    Populations of *Rhodomyrtus psidioides* are projected to continue to decline rapidly due to infection by *Austropuccinia psidii*. Large reductions in population size across the range of *R. psidioides* since infection from *A. psidii* have been documented over a short period of time (57% mortality over a period of 3–3.5 years (2011–2014)) relative to the estimated generation length of the species of 20 years (B. Makinson *in litt*. April 2016). Soil-stored seed banks are unlikely to be extensive for this species given its affinity for rainforest environments with high litter decomposition rates. Under documented rates of decline due to infection by *A. psidii*, *R. psidioides* is projected to undergo a 99% reduction in population size across its range within three generations. All age classes of *R. psidioides* have been documented to be affected by *A. psidii* (Carnegie *et al*. 2016) which severely reduces the capacity of infected populations to recover through time.

11. Quantitative findings of very large declines in *Rhodomyrtus psidioides* populations due to *Austropuccinia psidii* infection reported in Carnegie *et al*. (2016) are supported by field botanists who have encountered the species during routine botanical surveys and seed collecting over multiple years (B. Makinson *in litt*. April 2016; J. Willis *in litt*. April 2018).

12. There has been little evidence of resistance to *Austropuccinia psidii* infection in populations of *Rhodomyrtus psidioides* to date (Pegg *et al*. 2014; J. Willis *in litt*. April 2018). Three individual plants in the Gold Coast region of Queensland have shown some evidence of resistance to *A. psidii* infection (J. Willis *in litt*. April 2018), however the prospect for naturally selected resistance emerging before the collapse of populations is currently considered small.

13. No effective or practical chemical, biological or management control is currently available for protecting populations of *Rhodomyrtus psidioides* in natural ecosystems from *Austropuccinia psidii* infection. Repeated monthly application of registered fungicides (e.g. triadimenol) for extremely high value assets concentrated in small local areas may be feasible, but is impractical for widespread control. Where triadimenol has been used in experimental trials of *A. psidii* control in natural populations of *R. psidioides*, applications repeated at longer than a monthly interval did not control infection (Carnegie *et al*. 2016). Whilst some biological control agents have been trialled to control *A. psidii* in Eucalyptus plantations overseas the likelihood that these controls will become viable options for eradication in Australia in the time frame relevant to the regeneration capacity of *R. psidioides* is negligible (Glen *et al*. 2007). Manipulation of the environment via management actions (e.g. fire management) to control *A. psidii* on *R. psidioides* would likely lead to high infection rates on resprouting leaf material which is known to be highly susceptible to infection (Carnegie *et al*. 2016). In the absence of an effective control strategy for *A. psidii* further rapid declines of *R. psidioides* populations and individuals are highly likely.

14. The ubiquity of susceptible species in the family Myrtaceae in the Australian landscape makes broad-scale eradication or containment of *Austropuccinia psidii* unlikely (Glen *et al*. 2007). The predominantly airborne nature of the rust spores and inadvertent dispersal by human activity (Carnegie and Cooper 2011) infers that *Rhodomyrtus psidioides* populations and individuals in conservation reserves may be no more secure than any other land tenure. It is expected that surviving plants and populations of *R. psidioides* will continue to be subject to a significant spore load, whether as wind-borne spores or by other vectors. This continued exposure severely reduces the likelihood of population recovery in *R. psidioides* (B. Makinson *in litt*. April 2016).

15. No adequate *ex-situ* collections of *Rhodomyrtus psidioides* material exist (G. Errington *in litt*. October 2016). Current holdings of wild-collected seed at the NSW Seedbank number < 50 seeds from few accessions, of which more than half are immature and probably non-viable, and a small number from a self-pollinated cultivated plant (B. Makinson *in litt*. April 2016). The Australian Seed Bank partnership reports that the conservation seed bank at Mt Coot-tha, Brisbane, has one batch of *R. psidioides* seed, and the Australian National Botanic Gardens, Canberra, has one batch stored since 1983 (B. Makinson *in litt.* April 2016). On the basis that field observations show a severe decline in fruit production since 2012, NSW Seedbank collectors do not expect to be able to find significant collectable quantities of fruit or seed of *R. psidioides* now or in the future (R. Johnstone *in litt*. October 2014). Some tissue culture collections are currently held within the NSW PlantBank at the Australian Botanic Garden, Mount Annan NSW.

16. It is reasonably suspected that some populations of *Rhodomyrtus psidioides* may also have undergone significant decline because of other past and current threats, such as land-clearing (particularly in rainforest clearing efforts in northern NSW for agriculture), fragmentation of populations, and weed invasion. These threats have been documented as causes of decline in the EEC 'Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South

East Comer Bioregions' where *R. psidioides* is a named as a characteristic species (Adam 1987, 1992; Floyd 1990; Mills 1996).

17. *Rhodomyrtus psidioides* (G.Don) Benth. 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 Regulation 2017*:

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Critically endangered under Clause 4.2 (a).

(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, or~~
(2) - The determination of that criteria is to be based on any of the following:			
	~~(a)~~	~~direct observation,~~	
	~~(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: not met.

The geographic distribution of the species is:			
	~~for~~ ~~(a)~~ ~~(b)~~ (c)	~~for~~ ~~critically endangered~~ ~~endangered species~~ vulnerable species	~~very highly restricted~~ ~~highly restricted~~ 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: not met.

The estimated total number of mature individuals of the species is:						
	~~(b)~~	~~for~~ ~~critically endangered species~~ ~~endangered species~~ ~~vulnerable species~~			~~very low~~ ~~low~~ ~~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):~~				
		~~(ii)~~	~~for~~ ~~critically endangered species~~ ~~endangered species~~ ~~Vulnerable species~~		~~Very large~~ ~~Large~~ ~~moderate, or~~	
	~~(e)~~	~~both of the following apply:~~				
		~~(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:~~		
				~~(II)~~	~~for~~ ~~critically endangered species~~ ~~endangered species~~ ~~Vulnerable species~~	~~Extremely low~~ ~~very low~~ ~~low, or~~
			~~(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:			
	~~(b)~~	~~for~~ ~~critically endangered species~~ ~~endangered species~~ ~~Vulnerable species~~	~~Extremely low~~ ~~very low~~ ~~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:			
	~~(b)~~	~~for~~ ~~critically endangered species~~ ~~endangered species~~ ~~Vulnerable species~~	~~Extremely high~~ ~~very high.~~ ~~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.~~

Dr Marco Duretto
Chairperson
NSW Threatened Species Scientific Committee

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