

Threatened species nomination

For nominations/assessments under the Common Assessment Method (CAM).

Cover Page *(Office use only)*

Species name (scientific and common name):	<i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705)
Nomination for (addition, deletion, change):	Addition
Nominated conservation category and criteria:	Endangered B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v); C1

TSSC assessment of eligibility against the criteria:		
This assessment is consistent with the standards set out in Schedule 1, item 2.7 (h) and 2.8 of the Common Assessment Method Memorandum of Understanding.		Yes <input type="checkbox"/> No <input type="checkbox"/>
A.	Population size reduction	•
B.	Geographic range	•
C.	Small population size and decline	•
D.	Very small or restricted population	•
E.	Quantitative analysis	•

Outcome:			
<i>TSSC Meeting date:</i>			
<i>TSSC comments:</i>			
<i>Recommendation:</i>			
<i>Ministerial approval:</i>		<i>Government Gazette/ Legislative effect:</i>	

Nomination summary *(to be completed by nominator)*

Current conservation status				
Scientific name:	<i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705)			
Common name:				
Family name:	Myrtaceae	Fauna <input type="checkbox"/>		Flora <input checked="" type="checkbox"/>
Nomination for:	Listing <input checked="" type="checkbox"/>		Change of status <input type="checkbox"/>	Delisting <input type="checkbox"/>
Is the species currently on any conservation list, either in WA, Australia or Internationally?		Yes <input checked="" type="checkbox"/> If Yes; complete the following table		No <input type="checkbox"/> If No; go to the next question
Jurisdiction	List or Act name	Date listed or assessed	Listing category i.e. critically endangered	Listing criteria i.e. B1ab(iii)+2ab(iii)
International	IUCN Red List			
National	EPBC Act			
State of WA	WC Act	Assessed 5/4/2017	Endangered	B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v); C1
	DPaW Priority list	1 <input checked="" type="checkbox"/>	2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/>	
Other States or Territories				
Consistent with Schedule 1, item 2.7 (h) and 2.8 of the Common Assessment Method Memorandum of Understanding, it is confirmed that:				
<ul style="list-style-type: none"> this assessment meets the standard of evidence required by the Common Assessment Method to document the eligibility of the species under the IUCN criteria; 			Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
Comments:				
<ul style="list-style-type: none"> surveys of the species were adequate to inform the assessment; 			Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
Comments:	Refer to nomination			
<ul style="list-style-type: none"> the conclusion of the assessment remains current and that any further information that may have become available since the assessment was completed supports or is consistent with the conclusion of the assessment. 			Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
Comments:				
Nominated conservation status: category and criteria (including recommended categories for deleted species)				
Presumed extinct (EX) <input type="checkbox"/> Critically endangered (CR) <input type="checkbox"/> Endangered (EN) <input checked="" type="checkbox"/> Vulnerable (VU) <input type="checkbox"/>				
None (least concern) <input type="checkbox"/> Data Deficient <input type="checkbox"/> Conservation Dependent <input type="checkbox"/>				
What criteria support the conservation status category above?			B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v); C1	

Eligibility against the criteria					
Provide justification for the nominated conservation status; is the species eligible or ineligible for listing against the five criteria. For delisting , provide details for why the species no longer meets the requirements of the current conservation status.					
A.	Population size reduction	<ul style="list-style-type: none"> A projected population size reduction of 71 % inferred from potential mining approvals. Could meet criteria for Endangered A3(c), but insufficient information to assess as land development planning has not been finalised through the Strategic Assessment for the Perth to Peel Region. 			
B.	Geographic range	<ul style="list-style-type: none"> EOO and AOO estimated as 12 km². Number of locations is 2 based on the impact of a fire affecting the landscape and the potential impact of mining, with the eastern subpopulations being clustered and located in the Basic Raw Material Extraction Area. Continuing decline observed and projected in (i) extent of occurrence, (ii) area of occupancy, (iii) area, extent and quality of habitat, (iv) number of subpopulations, and (v) number of plants due to mining (high quality limestone resource), short interval wildfires, clearing, feral goats degrading habitat, and isolation of occurrences. Meets criteria for Endangered: B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v) 			
C.	Small population size and decline	<ul style="list-style-type: none"> Population estimate of 758 mature individuals. Potential projected population decline of 71%, with probable 20% decline in 2 generations. Continuing decline observed and projected in number of mature individuals. Largest subpopulation 500 mature individuals (66 % total). Meets criteria for Endangered C1; and for Vulnerable C2a(i) 			
D.	Very small or restricted population	<ul style="list-style-type: none"> Population estimate of 758 mature individuals. Meets criteria for Vulnerable D1 			
E.	Quantitative analysis	<ul style="list-style-type: none"> No data to assess 			
Summary of assessment information (detailed information to be provided in the relevant sections of the form)					
EOO	5.9 km ² using minimum convex polygon. Recalculated to 12 km ² so as not less than the AOO	AOO	12 km ² using the 2 km x 2 km grid method Area of mapped subpopulations 0.068 km ²	Generation length	Unknown, but likely to be long lived in absence of fire
No. locations	2	Severely fragmented		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
No. subpopulations	7	No. mature individuals		~758	
Percentage global population within WA			100		
Percentage global population within Australia			100		
Percentage population decline over 10 years or 3 generations					

Summary of subpopulation information (detailed information to be provided in the relevant sections of the form)						
Location (include coordinates)	Land tenure	Survey information: Date of survey and No. mature individuals	Area of subpopulation	Site / habitat Condition	Threats (note if past, present or future)	Specific management actions
1. Nowergup.	City of Wanneroo	8/7/2014 50 plants (partial survey)	0.005364 km ²	Excellent	Future Mining (land purpose is Quarry). Short interval wildfires.	Investigate options for change of land purpose to conservation.
2. Nowergup.	Freehold	7/4/2008 Over 100 plants mixed with <i>Melaleuca systema</i> but with no intermediates. Normally growing at lower elevation	0.004022 km ²	Excellent	Past, present and future Clearing (site was cleared by landowner about 7 years ago without approval). A Vegetation Conservation Notice was issued and the site has regrown. Present Clearing (while land is insecure, this threat is still present). Short interval wildfires. Future Clearing (site is within Dep't of Mines & Petroleum Regionally Significant Basic Raw Material Extraction Area).	Investigate options for change of land purpose to conservation.
3. Private property, Nowergup. A. -Crown reserve, Nowergup.	Freehold Cockburn Cement Ltd	28/11/2014 500 plants	0.037538 km ²	Excellent to Very Good	Past Clearing (subpopulations are all on edges of limestone mine-pits and therefore, critical habitat for the species was most likely	Investigate options for change of land purpose to conservation.

B. 'Hopkins West' population.		25-27/11/2013 1 plant	0.000073 km ²	Very Good	cleared). Present Goats degrading habitat in westernmost site.	
C. 'Hopkins East' population.		30/9/2009- 1/10/2009 & 24/11/2009 41 plants	0.002047 km ²	Excellent	Future Clearing (subpopulations are all in sites that are within Dep't of Mines & Petroleum Basic Raw Material Extraction Area).	
4. Nowergup.	State Forest Mining Lease				Past, present and future Clearing (site is within Dep't of Mines & Petroleum Regionally Significant Basic Raw Material Extraction Area).	Investigate options for change of land purpose to conservation.
A. 'Hopkins North'	Cockburn Cement Ltd.	25-27/11/2013 46 plants	0.018794 km ²	Pristine		
B. 'Island population'		6/12/2013 20 plants	0.000475 km ²	Very Good	Present Isolation of occurrence to an 'island' exposes this subpopulation to potential single event extinction.	

Nomination detail

Please refer to the Departments guidelines on nominating species for amendment of the Western Australian threatened species lists at http://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Threatened_Species_Nomination_Guidelines_2014.pdf

For technical information on terminology used in this form, and the intent of information requirements, as they relate to an assessment of this nomination against the IUCN Red List criteria, refer to the 2001 *IUCN Red List Categories and Criteria. Version 3.1*

http://www.iucnredlist.org/documents/redlist_cats_crit_en.pdf

and *Guidelines for Using the IUCN Red List Categories and Criteria Version 11* (February 2014)


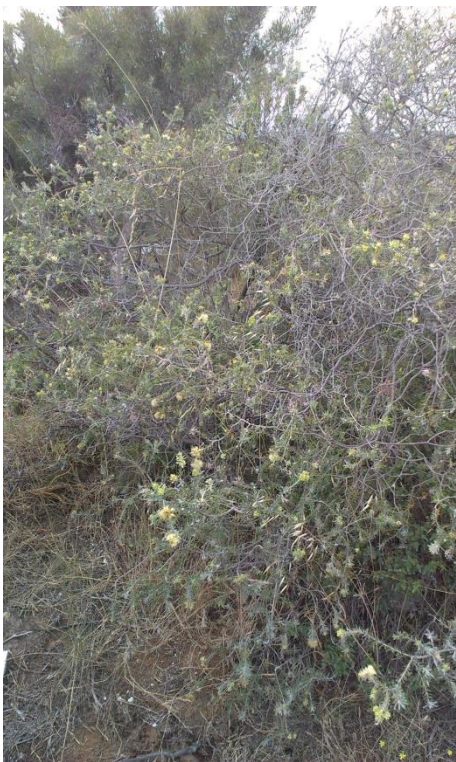
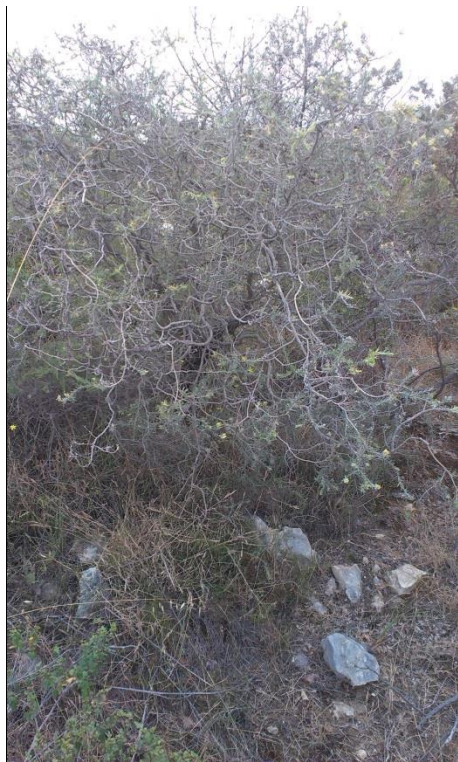
<http://cmsdocs.s3.amazonaws.com/RedListGuidelines.pdf>

Section 1: Taxonomy

1.1 Current taxonomy	
Species name and Author:	<i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705)
Subspecies name(s) and Author:	
Is the species/subspecies conventionally accepted?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Is there any controversy about the taxonomy?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
<i>If not conventionally accepted and/or if there is any controversy; provide details:</i>	
Has the species/subspecies been formally named?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Has the species/subspecies been recently described?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
<i>If the species has not been formally named or described; is it in the process of being described? Is there an anticipated date for the publication of the description? Has a type specimen been deposited? And if so provide the registration number and where deposited.</i>	Greg Keighery is in the process of revising the <i>Melaleuca systema</i> complex, of which there will be the widespread <i>M. systema</i> , a northern species, an inland species and two very localised taxa from the Swan Coastal Plain.
If there are any closely related taxa provide details and include key distinguishing features:	<p>Part of the <i>Melaleuca systema</i> complex.</p> <p><i>Melaleuca systema</i> has leaves crowded, 5-7 mm long, triquetrous in cross section, 1-1.5 mm wide, with an acute tip, hairs at the base and prominent oil glands.</p> <p><i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705) has leaves that are 15-20 mm long, flat in cross section, approximately 3 mm wide, with a blunt-acute apex, hairy, with oil glands not prominent.</p> <p><i>M. systema</i> subsp. Kemerton differs from the other members of the complex on the Swan Coastal Plain, in being tall shrub to small tree, 3-5 m tall. Leaves crowded towards ends of branchlets, lamina 9-13 mm long, terete, with along pungent point, glabrous and lacking oil glands.</p>
1.2 Taxonomic history	

Are there recent synonyms for the species?		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
<i>If Yes; provide details of synonyms:</i>	Previously non-specific part of the <i>M. systema</i> complex.		
Have there been recent changes in the taxonomy or nomenclature?		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
<i>If Yes; provide details of changes:</i>	The revision of the <i>M. systema</i> complex has identified <i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705) as a separate taxon.		
1.3 Hybridisation			
Is there any known hybridism with other species in the wild?		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/> Unknown <input type="checkbox"/>
<i>If Yes; Where does this occur and how frequently?</i>	No known occurrences.		

Section 2: Species information

2.1 Morphology / physical description	
<p><i>Insert photograph(s) of species or provide as an attachment:</i></p> <p>All photographs were taken by iPhone at private property, Nowergup.</p> <div>    </div>	



Species description:	<p>Informal field description</p> <p><i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705) is an erect shrub that can grow to 2.5 m in height and 2-3 m in width. Older stems have grey furrowed bark with 'twiggy' branchlets that break easily. <i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705) produces numerous terminal inflorescences of yellow flowers with branchlets growing out when flowering is finished. Flowering time is late November to late December. It was observed to be in full flower in one population when the co-occurring <i>M. systema</i> had finished.</p>
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2.2 Biology (provide details)

Biological Habitat

Melaleuca sp. Wanneroo (G.J. Keighery 16705) is known to co-occur often as a dominant, in dense patches with other *Melaleuca* species, predominantly *M. systema*, when growing on very shallow soils over limestone 'caprock' on ridges.

Vegetation community descriptions include:

M. systema, *M. huegelii* and/or *M. cardiophylla* within a Closed Tall Shrubland to Shrubland. An Open Low Heath, Sedgeland and/or Herbland may occur at the site, depending upon the level of limestone outcropping.

Associated species include:

Acacia alata var. *tetrantha*, *A. lasiocarpa*, *Thomasia triphylla*, *Leucopogon parviflorus*, *Grevillea preissii*, *Banksia sessilis* var. *cygnorum*, *Xanthorrhoea preissii*, *Calothamnus quadrifidus*, *Templetonia retusa*, *Astroloma microcalyx*, *Conostylis pauciflora* subsp. *euryrhipis*, *C. candicans*, *Tricoryne elatior*, *Hardenbergia comptoniana*, *Dianella revoluta*, *Desmocladius flexuosus*, *Lepidosperma calcicola* and *Lomandra maritima*. Occasional *Eucalyptus petrensis* grows as an overstorey of one subpopulation.

2.3 Ecology (provide details)

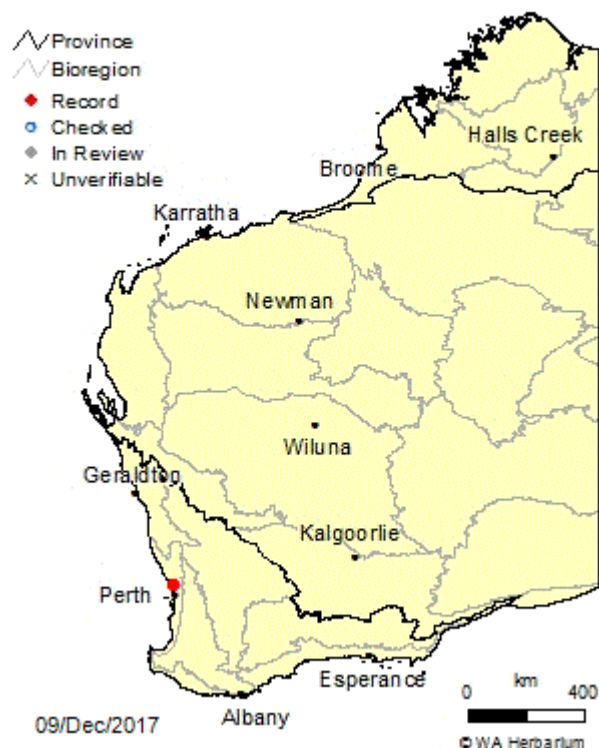
- Specific insect pollinators were not seen during surveys. However, at one subpopulation, honeyeaters and moths were observed.
- No research has been carried out on flower, fruit and seed development.
- Although there were small plants within subpopulations, no juveniles or seedlings were recorded.
- Adult plants are killed by fire.

Section 3: Geographic range

3.1 Distribution

Insert map(s) of the species distribution, or provide as an attachment:

Melaleuca sp. Wanneroo (G.J. Keighery 16705)



Map from Western Australian Herbarium (1998–).

What is the current distribution of the species within Western Australia?

Melaleuca sp. Wanneroo (G.J. Keighery 16705) is restricted to limestone ridges within the locality of Nowergup, 35 km north of Perth, Western Australia. It is currently known from an extensively cleared region, and subpopulations are scattered across a 3.3 km (east to west) by 3.0 km (north to south) area.

What percentage of the species distribution is within WA?

100

What is the current distribution of the species within the other Australian States and Territories?

N/A

Does the species occur outside of Australia?

Yes ☐ No ☒

If Yes, what percentage of the species distribution is within Australia, or what is the significance of the occurrence in Australia?

What is the current international trend for the species?

3.2 Migration

Is the species migratory?

Yes ☐ No ☐

Is the migration within WA or within Australia or international?

3.3 Extent of Occurrence (EOO) within Australia			
What is the current EOO?		5.9 km ²	
How has this been calculated?		This was calculated by determining the locations of extant subpopulations and using Quantum GIS v1.8.0 to map a minimum convex hull to calculate the area.	
What is the historical EOO?		Estimated as 34 km ²	
What is the current EOO trend?		Decreasing <input checked="" type="checkbox"/> Increasing <input type="checkbox"/> Stable <input type="checkbox"/>	
Provide details on the current trend – quantify if possible		The local limestone areas of Regionally Significant Basic Raw Materials were identified as potential critical habitat. Cleared areas within that zone were identified as the potential extent of historic <i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705) populations.	
If there has been a change in EOO when did this change occur?		Most likely from about 1970 to current.	
Was the change observed, estimated, inferred or projected?		Estimated and inferred.	
If the EOO is decreasing / declining, is it continuing?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Is the continuing decline observed, estimated, inferred or projected?		<p>Observed – extensions of limestone mining boundaries can be seen on aerial photography where <i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705) occurs.</p> <p>Estimated – the entire area is currently categorised for Regionally Significant Basic Raw Material extraction.</p> <p>Inferred – for some subpopulations, the critical habitat has had to be inferred, due to surveys being undertaken by consultants prior to mining and land is now unable to be accessed for current data.</p> <p>Projected – All the eastern subpopulations are currently categorised under Regionally Significant Basic Raw Materials for the Strategic Assessment of the Perth to Peel Region (SAPPR) and have the potential to be cleared thereby reducing the current EOO.</p>	
Is there extreme fluctuation in EOO?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, provide details:			
3.4 Area of Occupancy (AOO) within Australia			
What is the current AOO?		12 km ² with an area of occupied habitat of 0.068 km ² .	
How has this been calculated?		<p>AOO estimated using a 2 km x 2 km grid overlain over the subpopulations.</p> <p>Area of occupied habitat estimated using polygons within ArcGIS v10.1 to determine the current areas of each subpopulation and combining them into a total.</p>	
What is the historical AOO?		Area of historic occupied habitat estimated 0.1171 km ² .	
What is the current AOO trend?		Decreasing <input checked="" type="checkbox"/> Increasing <input type="checkbox"/> Stable <input type="checkbox"/>	

Provide details on the current trend – quantify if possible	<p>Unable to quantify.</p> <p>Limestone mining has occurred in the Nowergup locality for some time. Within working mine sites, the mine face is continuing to encroach on the habitat of the species.</p> <p>The loss of critical habitat has been projected under the assumption of minesite approvals under the SAPPR. All the eastern subpopulations are currently categorised under Regionally Significant Basic Raw Materials for the SAPPR and have the potential to be cleared.</p>
If there has been a change in AOO when did this change occur?	Most likely from about 1970 to current.
Was the change observed, estimated, inferred or projected? Give details.	As per the Extent of Occurrence in 3.3 above and it has been inferred that more <i>M. sp. Wanneroo</i> (G.J. Keighery 16705) plants would have occurred on the ridges where non-working mine pits occur and potentially on ridges of adjacent lands that have been cleared for other purposes. If the SAPPR land use categories are approved without change it is projected that more critical habitat and existing subpopulations will be cleared.
If the AOO is decreasing / declining, is it continuing?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Is the continuing decline observed, estimated, inferred or projected? Give details.	It is specifically observed in the extension of mining boundaries on aerial photography.
Is there extreme fluctuation in AOO?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, provide details:	
Does the species have a restricted AOO?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
If Yes, provide details:	<i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705) is restricted to limestone ridges within the locality of Nowergup within a 3.3 km (east to west) by 3.0 km (north to south) area.
3.5 Number of Locations	
<p>'Locations' are defined as a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. The size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. Where a taxon is affected by more than one threatening event, location should be defined by considering the most serious plausible threat. (IUCN 2001).</p>	
At how many locations does the species occur?	Two. This has been derived from considering the impact of a fire affecting the landscape and the potential impact of mining. For the eastern location, subpopulations are separated by either continuous native bushland or are within 500 m of each other. Hop-overs and ember attacks could easily occur. These subpopulations are also categorised in the area of Regionally Significant Basic Raw Materials for the SAPPR, and thus at risk of future mining. The western subpopulation is outside this zone and has a greater separation by cleared land with respect to the threat from fire.
Has there been a change in the number of locations?	Decrease <input type="checkbox"/> Increase <input checked="" type="checkbox"/> No change <input type="checkbox"/>
If there has been a change, when did	Clearing of numerous limestone ridges inside the Extent of Occurrence

<p>this change occur?</p>	<p>for mining or other purposes is shown on current mapping within the locality where <i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705) occurs. This has resulted in an east-west separation of the current extent. It is likely that the changes occurred gradually since the mid 1900's.</p>	
<p>Was the change observed, estimated, inferred or projected? Give details.</p>	<p>The change is inferred.</p>	
<p>If the number of locations is decreasing / declining, is it continuing?</p>		<p>Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p>
<p>Is the continuing decline observed, estimated, inferred or projected? Give details.</p>	<p>The number of locations as defined by the single event threat of extinction is not currently continuing. However, if approval for mining of Regionally Significant Basic Raw Materials under the SAPPR is granted, there is potential for all plants known, within the eastern Extent of Occurrence, to be cleared. This change is projected.</p>	
<p>Is there extreme fluctuation in the number of locations?</p>		<p>Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p>
<p><i>If Yes, provide details:</i></p>		
<p>Does this species occur on any off-shore islands?</p>		<p>Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p>
<p><i>If Yes, provide details:</i></p>		
<p>3.6 Fragmentation</p>		
<p>Is the distribution fragmented?</p>		<p>Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p>
<p>The phrase 'severely fragmented' refers to the situation in which increased extinction risks to the taxon results from the fact that most of its individuals are found in small and relatively isolated subpopulations (in certain circumstances this may be inferred from habitat information). These small subpopulations may go extinct, with a reduced probability of recolonization.</p>		
<p>Is the distribution severely fragmented?</p>		<p>Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p>
<p><i>If Yes, provide details:</i></p>		
<p>3.7 Land tenure</p>		
<p>Is the species known to occur on lands managed primarily for nature conservation? i.e. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation</p>		<p>Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p>
<p><i>If Yes; provide details:</i></p>		
<p>Is the species known to occur on lands that are under threat? i.e. mining tenement, zoned for development</p>		<p>Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p>
<p><i>If Yes; provide details:</i></p>	<p>This is detailed above in Section 3 and within the initial Nomination section, i.e. categorised under Regionally Significant Basic Raw Materials for the SAPPR.</p>	
<p>Provide details of other land tenures where the species occurs as this relates to the species conservation status</p>	<ul style="list-style-type: none"> • Local government reserve with the purpose of quarry. • State Forest, under mining lease and currently is being mined. • Freehold, currently being mined. 	

Section 4: Habitat

4.1 Habitat (provide details in response to the question below)

<p>Described the habitat suitable for the species (biological and non-biological). Include descriptions of specific purpose habitat (e.g. foraging, breeding, roosting, seasonal migration, different life stages).</p>	<p>Non-biological</p> <p>The climate is warm Mediterranean with a long-term (1944-2015) average annual rainfall of 770 mm (BOM 2015).</p> <p>Plants occur on upper slopes of rugged limestone ridges or where a high proportion of limestone outcropping occurs. Soils are shallow grey to mossy black sands, depending on the amount of limestone 'caprock'. Aspect is variable.</p> <p>Biological</p> <p><i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705) is a dominant species where it is found and co-occurs with <i>M. systema</i>, <i>M. huegelii</i> and/or <i>M. cardiophylla</i>. An Open Low Heath, Sedgeland and/or Herbland may occur at the site, depending upon the level of limestone outcropping. Associated species include:</p> <p><i>Acacia alata</i> var. <i>tetrantha</i>, <i>A. lasiocarpa</i>, <i>Thomasia triphylla</i>, <i>Leucopogon parviflorus</i>, <i>Grevillea preissii</i>, <i>Banksia sessilis</i> var. <i>cygnorum</i>, <i>Xanthorrhoea preissii</i>, <i>Calothamnus quadrifidus</i>, <i>Templetonia retusa</i>, <i>Astroloma microcalyx</i>, <i>Conostylis pauciflora</i> subsp. <i>euryrhipis</i>, <i>C. candicans</i>, <i>Tricoryne elatior</i>, <i>Hardenbergia comptoniana</i>, <i>Dianella revoluta</i>, <i>Desmocladius flexuosus</i>, <i>Lepidosperma calcicola</i> and <i>Lomandra maritima</i>. Occasional <i>Eucalyptus petrensis</i> grows as an overstorey of one subpopulation.</p>	
<p>If the species occurs in a variety of habitats, is there a preferred habitat?</p>		
<p>Does the species use refugia? (include what is it and when is it used)</p>		
<p>Is the habitat restricted in extent or number of locations?</p>		<p>Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p>
<p>If Yes, provide details:</p>	<p>The critical habitat is restricted to upper slopes and saddles of limestone ridges.</p>	
<p>Is this species reliant on a threatened or priority species or ecological community?</p>		<p>Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p>
<p>If Yes, provide details:</p>		
<p>Are there any other species (sympatric species) that may affect the conservation status of the nominated species?</p>		<p>Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p>
<p>If Yes, provide details:</p>		
<p>What is the area, extent, abundance of habitat?</p>	<p>Habitat critical to the survival of the species includes the AOO of the 7 subpopulations, areas of similar habitat surrounding known subpopulations (limestone ridges and upper slopes with <i>Melaleuca systema</i>) that provide potential habitat for natural range extension), remnant vegetation that surrounds and links populations within the 3 km x 3 km range (necessary to allow pollinators to move between populations) and possibly the local catchment of the surface waters that maintain the habitat of the species and additional occurrences of similar habitat that may contain the species or be suitable for future</p>	

	translocations.	
What is the quality of habitat?	Condition ratings of the known subpopulations range from Very Good to Pristine (State of WA 2000).	
Is there a decline in habitat area, extent or quality?		Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
If there is a decline, is the decline continuing?		Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Provide details:	The decline is due to current mining and approval of development proposals within the Extent of Occurrence.	
What is the critical habitat or habitat important for the survival of the species?	Limestone ridges and upper slopes and/or a high level of limestone outcropping.	

Section 5: Population

‘Population’ is used in a specific sense in the Red List Criteria that is different to its common biological usage. Population is here defined as the total number of mature individuals of the taxon. In the case of taxa obligately dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used. (IUCN 2001)

‘Subpopulations’ are defined as geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less).

5.1 Subpopulations				
Location (include coordinates)	Land tenure	Survey information: Date of survey and No. mature individuals	AOO	Site / habitat Condition
1. Nowergup.	City of Wanneroo	8/7/2014 50 plants (partial survey)	0.005364 km ²	Excellent
2. Nowergup.	Freehold	7/4/2008 100 plants	0.004022 km ²	Excellent.
3A. Nowergup.	Freehold	28/11/2014 ~500 plants	0.037538 m ²	Excellent to Very Good
3B ‘Hopkins West’ subpopulation.	Cockburn Cement Ltd	30/9/2009 to 1/10/2009 & 24/11/2009 1 plant	0.000073 km ²	Very Good

3C 'Hopkins East' subpopulation.	Cockburn Cement Ltd	41 plants	0.002047 km ²	Excellent
4A 'Hopkins North' subpopulation.	State Forest Mining Lease Cockburn Cement Ltd	25-27/11/2013 46 plants	0.018794 km ²	Pristine
4B 'Island' subpopulation.	State Forest Mining Lease Cockburn Cement Ltd.	20	0.000475 km ²	Very Good

5.2 Population size (Australian context) *(include how numbers were determined/calculated)*

What is the total population size?	758 plants (Some subpopulations have been estimated)
What is the number of subpopulations?	7
What percentage of the population is within WA?	100
What percentage of the population is within Australia?	100

5.3 Population dynamics (Australian context) *(include how numbers were determined/calculated)*

What is the number of mature individuals?	758 plants (Some subpopulations have been estimated)
What is the number of immature individuals?	0
What is the number of senescing/past reproductive individuals?	Unknown
What is the maximum number of mature individuals per subpopulation?	N/A
What is the percentage of mature individuals in the largest subpopulation?	100
What percentage of mature individuals is within WA?	100
What percentage of global mature individuals is within Australia?	100
What is the age of sexual maturity?	Unknown. Related <i>Melaleuca systema</i> will flower in 3-4 years from seed, less than 1 year from cuttings or re-sprouts. Seeds need about 6 months to mature in capsules, held on plant for several years.
What is the life expectancy?	Unknown. The related Kemerton plants are killed by fire, <i>M. systema</i> re-sprouts, unsure what regeneration response <i>M. sp.</i> Wanneroo (G.J.

	Keighery 16705) has.		
What is the generation length?	N/A		
What is the reproductive capacity? (i.e. litter size or number of seeds)	N/A		
What is the reproductive success?	N/A		
5.4 Population trend			
What is the current population trend (mature individuals)?	Decreasing <input checked="" type="checkbox"/> Increasing <input type="checkbox"/> Stable <input type="checkbox"/>		
What is the percentage of the population change and over what time period?	<p>In the short term it is expected that 3 subpopulations will be cleared for limestone mining. This is a 71% reduction.</p> <p>Two further subpopulations are under threat as they are within the BRM category under the SAPPR. The SAPPR agreement will be enacted over a 30 year time period.</p>		
How has this been calculated?	As a projection of the current status of subpopulations and plant numbers into the future for known events.		
If the trend is decreasing; are the causes of the reduction understood?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Have the causes of the reduction ceased?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Are the causes of the reduction reversible?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Is the reduction continuing (continuing decline)?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Has the change been observed, estimated, inferred or is it suspected (direct observation, index of abundance appropriate to the species)?	Direct observation of mined areas and the expectation of future mining approvals within Regionally Significant BRM.		
When was the reduction or is it anticipated to occur?	Past <input checked="" type="checkbox"/> Present <input checked="" type="checkbox"/> Future <input checked="" type="checkbox"/>		
What is the period of time for the reduction (in years and generations)?	From about 1970 (review of historical aerial photography) to an expected 30 year agreement for mining of Regionally Significant BRM is 76 years.		
Has there been a reduction in the number of subpopulations?			Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input checked="" type="checkbox"/>
<i>If Yes, provide details:</i>	As detailed in previous sections, it has been estimated and inferred that there has been a reduction in the EOO and AOO, which will have resulted in a reduction in the number of subpopulations.		
Are there extreme fluctuations in population size?			Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>If Yes, provide details:</i>	Unknown.		
5.5 Translocations and captive/enclosed subpopulations			
Have there been translocations (introduction or re-introduction)?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Are there proposed translocations (introduction or re-introduction)?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>

Are there captive/enclosed/cultivated subpopulations?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Are there proposed captive/enclosed/cultivated subpopulations?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Are there self-sustaining translocated subpopulations?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, provide details:	
Are there translocated subpopulations that are not self-sustaining?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, provide details:	
Are there self-sustaining captive/enclosed subpopulations?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, provide details:	
Are there captive/enclosed subpopulations that are not self-sustaining?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, provide details:	
Other information on translocations and captive/enclosed subpopulations for the species (including failures):	
5.6 Important subpopulations	
<p><i>Identify any subpopulations that are important or necessary for the long-term survival of the species and provide details for why they are considered as such (i.e. key breeding, edge or range, maintenance of genetic diversity):</i></p> <p>All subpopulations are important for the long-term survival of the species, due to the very low EOO and niche specificity to limestone outcrops that are under threat from Regionally Significant Basic Raw Material extraction. It could be assumed that the subpopulations with the highest number of plants are more important. However, genetic research has not been undertaken to confirm this.</p>	

Section 6: Survey

6.1 Survey methods (Provide details)	
What survey methods are applicable to the species?	<p>For densely populated sites, population boundary recording in conjunction with transect-based survey (using DGPS) is potentially the most applicable.</p> <p>Population boundary recording and plot-based monitoring could be undertaken within areas where permanent markers can be installed within the rugged limestone.</p>
Are there preferred or recommended survey methods that yield better results for the species?	As above.
Are there special requirements, techniques, expertise or other considerations that are necessary when surveying for this species?	Knowledge of the species characteristics is required.
Are there reasons why the species	<i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705) has been considered part

may not be detected during surveys?	of a <i>M. systema</i> complex. Therefore, there is the potential for some consulting botanists to not consider the differing characters as being a separate entity in past surveys.		
Can the species be identified in the field? Yes time of flowering leaf/length width ratios		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
<i>Provide details:</i>	Time of flowering leaf/length width ratios		
Can the species be easily confused within similar species in the field?		Yes <input type="checkbox"/>	No <input type="checkbox"/>
<i>Provide details:</i>	Potentially - not if the differentiating characteristics are known, but may be if surveyors are not aware of this taxon.		
<i>List any published survey guidelines, guidance statements, protocols, standard operating procedures or other documents that are relevant to conducting surveys for this species.</i>			
6.2 Survey effort			
Has the species been well surveyed?		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
Have targeted surveys been conducted for the species?		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
<i>Provide details of the successful and unsuccessful surveys undertaken for the species:</i>	<p>Successful surveys are those listed in the Location and Population tables in previous sections of this form. The species has a highly specific habitat that has been targeted for surveys for development proposals, and for other threatened species or an ecological community that occur on the same landforms.</p> <p>The nomination authors are unable to access the reports for all of the surveys undertaken for historical and current mining and development approvals. Therefore, it is expected that there have been unsuccessful surveys undertaken for the species where approvals have been granted.</p> <p>A number of <i>Melaleuca</i> spp. specimens have been taken for confirmation, with some of these returning successful results for <i>M. sp.</i> Wanneroo during surveys undertaken for <i>Eucalyptus argutifolia</i> (limestone preference) and the TEC 26a (<i>Melaleuca huegelii</i> – <i>M. systema</i> (formerly <i>M. acerosa</i>) shrublands on limestone ridges, within, and outside of, the current area of extent.</p>		
6.3 Research (Provide details)			
Need to complete revision of <i>Melaleuca systema</i>			
A genetic analysis of forms of <i>Melaleuca systema</i>			
Has the species been well researched?		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/> Partially <input type="checkbox"/>
What research has been or is being conducted?	None		
What are the knowledge gaps for the species?	<p>Impacts of fire.</p> <p>Appropriate fire intervals.</p> <p>Specific ecological and biological requirements to better understand the growth and habitat requirements in-situ and if the need for translocation is identified.</p> <p>A genetic analysis of forms of <i>Melaleuca systema</i> and provenance testing</p>		

	<p>(Forms of <i>M. systema</i> used in revegetation projects on Swan Coastal Plain – documented in Keighery and Keighery (2015) Wild Perth-The past and present plant communities and plants of the bushland between Perth and the coast, page 89, are quite unlike local plants).</p> <p>Life History and fire ecology of members of the group.</p>
Research recommendations:	
6.4 Monitoring (<i>Provide details</i>)	
Is the species being monitored, either directly (targeted) or indirectly (general monitoring)?	<p>The species is not being directly monitored. Six of the seven subpopulations are on lands that are used for limestone mining and access to these areas is problematic. Aerial photography is currently the only method used to observe changes in the habitat.</p> <p>Indirect management is occurring through knowledge of the species and sites being identified and commented on when approvals for development are proposed.</p>
What methods are used for monitoring?	As above.
Monitoring recommendations:	<p>Recording and reviewing subpopulation boundaries, establishment of permanent monitoring transects and/or plots and photo monitoring is recommended. However, as detailed above, access is problematic.</p> <p>Changing the conservation status of the species by listing it under state and federal legislation, will present better opportunities to enable access to the known sites for recording of population boundaries. If access is denied, there will be opportunities to convey species management conditions to land managers under legislative requirements.</p>

Section 7: Threats

7.1 Threats (detail how the species is being impacted, i.e. how severe, the extent, evidence of the impact)

Threat <i>(describe how the threat impacts on the species. Include abiotic and biotic causes, human related e.g. exploitation, and biological characteristics of the species e.g. low genetic diversity)</i>	Extent <i>(give details of impact on whole species or specific subpopulations)</i>	Impact <i>(what is the level of threat to the conservation of the species)</i>	Evidence	Time period <i>(past, present, future)</i>
Clearing for mining or other development.	Four of the seven known subpopulations have been partially impacted by limestone mining.	Severe Potentially more susceptible to in-breeding from fragmentation. Continued clearing would result in fewer plants and smaller areas of critical habitat, which are more susceptible to all other threats. If suitable critical habitat is not conserved, a lack of refugia and suitable translocation sites will result, making it difficult to re-introduce or augment populations in the wild.	Observation of aerial photography over time showing the area of clearing within the EOO.	Past, present and future

Degradation of habitat.	Sites where mine faces have dissected subpopulations will continue to be degraded by edge effects.	Unknown.	Sites that have been given a Very Good condition rating confirms degradation has occurred.	Past, present and future
Change to fire regime (short interval fires).	Likely to affect whole species	Unknown, but likely for all freehold lands.	No direct evidence for changes from fire. However, there is a high likelihood that such threats have impacted on subpopulations and their critical habitat, prior to identification.	Past, present and future
Livestock.	Subpopulation 3	Unknown, but likely for all freehold lands.	A goat herd was observed at the site of Subpopulation 3a, that is close and accessible to two other nearby Subpopulations 3b and c.	Past, present and future
Impacts of surface hydrological changes.	Likely to affect whole species	Unknown, but likely for all freehold lands.	No direct evidence for hydrological changes. However, there is a high likelihood that such threats have impacted on subpopulations and their critical habitat, prior to identification.	Past, present and future

Section 8: Management

8.1 Current management	
Is the species managed?	Yes, directly <input type="checkbox"/> Yes, indirectly <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes; provide details of current or past management actions:	
Does the species benefit from the management of another species or ecological community?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
If Yes; provide details:	<p>Management of areas where the TEC 26a (<i>Melaleuca huegelii</i> – <i>M. systema</i> (formerly <i>M. acerosa</i>) shrublands on limestone ridges, and the PEC3 24 (Northern Spearwood shrublands and woodlands) occur, can indirectly benefit <i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705).</p> <p>However, as the species has not always been found within the above communities, the benefits have been minimal.</p>
8.2 Recovery planning	
Is there an approved Recovery Plan (RP) or Interim Recovery Plan (IRP) for the species?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
List all relevant recovery plans or interim recovery plans (including draft, in-preparation, out-of-date, national and other State/Territory plans, and plans for other species or ecological communities that may benefit or be relevant to the nominated species)	
List other documents that may be relevant to the management of the species or the lands on which it occurs (i.e. area management plans, conservation advices, referral guidelines)	
8.3 Management recommendations	
<p>As mentioned within the first table under 'Specific Management Actions', land acquisition into conservation estate is possibly the only avenue, given the current circumstances of all known sites having non-conservation purposes.</p> <p>Other management actions that may benefit the conservation of the species include:</p> <ul style="list-style-type: none"> • Protect the sites from fire unless required for ecological reasons, and implement early intervention in any wildfires which may threaten the sites; • If practical, fence sites to protect the habitat from grazing from goats; • Survey for additional populations; • Protect populations and their habitat from limestone mining; • Liaise with landowners to encourage sympathetic management and protect the remnant vegetation on which the species occurs; • Monitor the populations for evidence of goats or weed impacts, or changes in plant or site health; • Collect seed for storage and <i>ex situ</i> propagation; • Establish new populations on secure tenure through implementation of translocations; • Determine species pollination ecology, seed germination requirements and viability, and longevity. 	

Section 9: Nominator details

Nominator name(s):	
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Contact details:	
Date submitted:	15 March 2017
<i>If the nomination has been refereed or reviewed by experts, please provide their names and contact details:</i>	
Greg Keighery (Senior Principal Research Scientist)	

Section 10: References

9.1 References
<p>Reports</p> <p>Coffey environments (2010) Flora and Vegetation Assessment M70/138 Hopkins Road, Nowergup. Unpublished report.</p> <p>GHD (2014) Cockburn Cement Ltd. Nowergup tenements Flora & fauna assessment report. Unpublished report.</p> <p>IUCN (2011) Guidelines for using the IUCN Red List Categories and Criteria. Version 9.0 (September 2011).</p> <p>Keighery, GJ & Keighery, BJ (2015). Wild Perth-The past and present plant communities and plants of the bushland between Perth and the coast. WA Wildflower Society, Nedlands.</p> <p>Electronic information</p> <p>Department of Parks and Wildlife (2014) Corporate Data. Cadastre June 2014.</p> <p>Department of Parks and Wildlife Threatened Species and Communities Database (last accessed on 1st June, 2016)</p> <p>Landgate SLIP data layers</p> <p>Western Australian Herbarium (1998-) FloraBase—the Western Australian Flora. Department of Environment and Conservation. http://florabase.dpaw.wa.gov.au [last accessed on 3 June 2016].</p>