Australian Government
Department of Agriculture, Water and the Environment

Consultation Document on Listing Eligibility and Conservation Actions

Philoria richmondensis (Richmond Mountain Frog)

Philoria richmondensis (image: M. Mahony, University of Newcastle)

You are invited to provide your views and supporting reasons related to:

1) the eligibility of *Philoria richmondensis* (Richmond Mountain Frog) for inclusion on the EPBC Act threatened species list in the **Endangered** category and

2) the necessary conservation actions for the above species.

Evidence provided by experts, stakeholders and the general public are welcome. Responses can be provided by any interested person.

Anyone may nominate a native species, ecological community or threatening process for listing under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or for a transfer of an item already on the list to a new listing category. The Threatened Species Scientific Committee (the Committee) undertakes the assessment of species to determine eligibility for inclusion in the list of threatened species and provides its recommendation to the Australian Government Minister for the Environment.

Responses are to be provided in writing either by email to:
species.consultation@environment.gov.au

or by mail to:

The Director
Marine and Freshwater Species Conservation Section
Biodiversity Conservation Division
Department of Agriculture, Water and the Environment
PO Box 787
Canberra ACT 2601

Responses are required to be submitted by 24 July 2020.

General background information about listing threatened species

The Australian Government helps protect species at risk of extinction by listing them as threatened under Part 13 of the EPBC Act. Once listed under the EPBC Act, the species becomes a Matter of National Environmental Significance (MNES) and must be protected from significant impacts through the assessment and approval provisions of the EPBC Act. More information about threatened species is available on the department's website at: http://www.environment.gov.au/biodiversity/threatened/index.html.

Public nominations to list threatened species under the EPBC Act are received annually by the department. In order to determine if a species is eligible for listing as threatened under the EPBC Act, the Threatened Species Scientific Committee (the Committee) undertakes a rigorous scientific assessment of its status to determine if the species is eligible for listing against a set of criteria. These criteria are available on the Department's website at: http://www.environment.gov.au/system/files/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2018.pdf.

As part of the assessment process, the Committee consults with the public and stakeholders to obtain specific details about the species, as well as advice on what conservation actions might be appropriate. Information provided through the consultation process is considered by the Committee in its assessment. The Committee provides its advice on the assessment (together with comments received) to the Minister regarding the eligibility of the species for listing under a particular category and what conservation actions might be appropriate. The Minister decides to add, or not to add, the species to the list of threatened species under the EPBC Act. More detailed information about the listing process is at: http://www.environment.gov.au/biodiversity/threatened/nominations.html.

To promote the recovery of listed threatened species and ecological communities, conservation advices and where required, recovery plans are made or adopted in accordance with Part 13 of the EPBC Act. Conservation advices provide guidance at the time of listing on known threats and priority recovery actions that can be undertaken at a local and regional level. Recovery plans describe key threats and identify specific recovery actions that can be undertaken to enable recovery activities to occur within a planned and logical national framework. Information about recovery plans is available on the department's website at: http://www.environment.gov.au/biodiversity/threatened/recovery.html.

Privacy notice

The Department will collect, use, store and disclose the personal information you provide in a manner consistent with the Department's obligations under the Privacy Act 1988 (Cth) and the Department's Privacy Policy.

Any personal information that you provide within, or in addition to, your comments in the threatened species assessment process may be used by the Department for the purposes of its functions relating to threatened species assessments, including contacting you if we have any questions about your comments in the future.

Further, the Commonwealth, State and Territory governments have agreed to share threatened species assessment documentation (including comments) to ensure that all States and Territories have access to the same documentation when making a decision on the status of a potentially threatened species. This is also known as the 'common assessment method'. As a result, any personal information that you have provided in connection with your comments may be shared between Commonwealth, State or Territory government entities to assist with their assessment processes.

The Department's Privacy Policy contains details about how respondents may access and make corrections to personal information that the Department holds about the respondent, how respondents may make a complaint about a breach of an Australian Privacy Principle, and how the Department will deal with that complaint. A copy of the Department's Privacy Policy is available at: http://environment.gov.au/privacy-policy.

Information about this consultation process

Responses to this consultation can be provided electronically or in hard copy to the contact addresses provided on Page 1. All responses received will be provided in full to the Committee and then to the Australian Government Minister for the Environment.

In providing comments, please provide references to published data where possible. Should the Committee use the information you provide in formulating its advice, the information will be attributed to you and referenced as a 'personal communication' unless you provide references or otherwise attribute this information (please specify if your organisation requires that this information is attributed to your organisation instead of yourself). The final advice by the Committee will be published on the department's website following the listing decision by the Minister.

Information provided through consultation may be subject to freedom of information legislation and court processes. It is also important to note that under the EPBC Act, the deliberations and recommendations of the Committee are confidential until the Minister has made a final decision on the nomination, unless otherwise determined by the Minister.

Philoria richmondensis

Richmond Mountain Frog

Taxonomy

Conventionally accepted as *Philoria richmondensis* Knowles, Mahony, Armstrong & Donnellan, 2004. No subspecies are recognised.

Species/Sub-species Information

Description

Philoria richmondensis (Richmond Mountain Frog) is a small, squat, pear-shaped frog endemic to north-eastern NSW. Males have a snout-to-vent length (SVL) to 28 mm, and females to 27 mm. The skin is smooth, with the occasional low ridge or tubercle on the dorsal surface. Like other species in the *Philoria* genus, individuals are variable in colour and pattern. The dorsal surface is bronzy-brown to orange, with an irregular blackish band that runs across the lower back. Smaller dark blotches or spots are sometimes present, aligned on either side of the vertebral line, as well as posteriorly on the flanks. The ventral surface is dirty-white to yellow or pale orange. Faint to conspicuous irregular cross-bars are sometimes present on the upper surface of the limbs. The under surface of the legs, feet and hands are dark. The head is approximately one quarter of the snout-to-vent length and wider than it is long. The snout is bluntly rounded in profile. A supratympanic fold is present. The tympanum is hidden or indistinct. A narrow dark-brown band runs from the snout to the eye, then widens, and continues as a broad, dark stripe from the eye, through the ear, to the base of the forelimbs. The eyes are prominent with a horizontal pupil. The iris is golden above and brown below. The hind-limbs are short. The fingers and toes are long, slender, cylindrical, and unwebbed. Breeding males have a poorly developed nuptial pad on first finger and females have spatula on the first and second fingers. The description of the adult is drawn from Knowles et al. 2004; Cogger 2014; Anstis 2017; OEH 2019.

Metamorphs are very small, with an SVL to 6.4 mm. Appearance varies, with some metamorphs dark brown with bright silver spots, whilst others have dark sides and a broad, yellow-ochre, vertebral band down the back (Anstis 2017).

Tadpoles are small, growing to 19 mm in total length. The body is very small (5.5 mm) and oval, with the abdomen wider than it is deep. The snout is rounded. The intestinal mass is visible. At later stages the body turns darker with increased grey pigmentation. Fins are shallow and clear, with numerous blood vessels. The dorsal fin begins from just onto body, with the tail tip broadly rounded. The eyes are lateral in earlier stages, dorso-lateral later. Oral disc edges are slightly keratinised (Anstis 2017).

Distribution

The Richmond Mountain Frog has the smallest distribution of any frog in the *Philoria* genus (Newell 2018), being endemic to a small area of continuous forest covering three National Parks in north-east NSW (Richmond Range, Toonumbar, and Yabbra), approximately 50 km west of Lismore (Knowles et al. 2004; Cogger 2014; Anstis 2017; OEH 2019). Known sites are Culmaran Creek and Sandy Creek in Richmond Range National Park (NP); Cob O'Corn Creek and Iron Pot Creek in Toonumbar NP; and Haystack Creek and Little Haystack Creek in Yabbra NP (Knowles et al. 2004; Willacy et al. 2015; OEH 2019). The maximum elevation within these National Parks is 920 m (NPWS 2005), with the Richmond Mountain Frog restricted to mid to high elevations (400–800 m) where the habitat is characterised by cooler temperatures and greater moisture content, due to high rainfall and cloud interception (Laidlaw et al. 2011; Hero et al. 2015).

The Richmond Mountain Frog predominantly inhabits areas of old growth subtropical rainforest and, to a lesser degree, wet sclerophyll forest. The dominant canopy tree (at mid to higher elevations) in the Richmond Range is *Argyrodendron trifoliatum* (White Booyong), with wet

sclerophyll forest a mix of *Lophostemon confertus* (Brush Box), *Eucalyptus grandis* (Flooded Gum), *E. microcorys* (Tallowwood) and *Corymbia variegata* (Richmond Range Spotted Gum) (NPWS 2005). Under this canopy, the species is found in highly localised distributions, typically burrowed in loose, moist soil or moss, in or beside headwaters of streams (Knowles et al. 2004; Cogger 2014). Females are sometimes found under logs not far from streams (Anstis 2017).

Relevant Biology/Ecology

The biology and ecology of the Richmond Mountain Frog is not fully understood. It was only formally described in 2004, and much of the ecological understanding is based around better known *Philoria* species (Knowles et al. 2004). Further studies are required to provide information on population (size, structure and dynamics), habitat requirements, and breeding biology. However, the habitat and reproductive biology of all species in the genus are recognised as being similar and can be described in general (Hollis 2004; Knowles et al. 2004).

The Richmond Mountain Frog is a terrestrial breeding frog. Males call from buried positions in nest sites comprised of small water-filled chambers excavated in mud under rocks or leaf litter, under the banks of small creeks, or in the sphagnum mat of bogs. The call is a low-pitched, single, guttural 'bork', repeated intermittently and in response to other males in a chorus, each at a slightly different pitch (Knowles et al. 2004; Hoskins et al. 2009; Anstis 2017). Breeding is known from August to early January (Willacy et al. 2015; Anstis 2017), with peak calling activity from early September to November (Willacy et al. 2015). Daily calling activity is associated with a morning and evening period. Calling is primarily influenced by spring and early summer rainfall events, with the highest frequency of calling overlapping with temperatures between 15–16 °C (Willacy et al. 2015). It is thought that increased nest moisture cues all species within the *Philoria* genus to commence calling, with rainfall providing a suitable environment for egg and tadpole survival (Knowles et al. 2004; Lopez 2016; Newell 2018).

Females lay a relatively small clutch of large, unpigmented eggs in the nest (Knowles et al. 2004; Cogger 2014). Field observations put egg clutch counts at under 50. At the time of egg-laying, the female excretes a jelly like mucous and beats air bubbles into it, and the contained eggs, with her spatula-shaped fingers. Over time, the resulting foam loses its bubbles to become a still jelly, but whilst present, provides adequate oxygen for the early embryo stage (Seymour et al. 1995; Knowles et al. 2004; Anstis 2017).

Tadpoles (and at least one parent) remain in the nest throughout their entire development, until they emerge post metamorphosis. While in the nest, tadpoles develop in a mixture of jelly and the very shallow water that drains through the nest (Hollis 2004; Knowles et al. 2004; Anstis 2017). Tadpoles are non-feeding and rely upon a residual yolk reserve for nutrition (Hollis 2004; Knowles et al. 2004; Hero et al. 2015).

There are no detailed studies on the movement patterns of the Richmond Mountain Frog. However, Newell (2018) observed that species in the *Philoria* genus rarely move far from nest sites. Tracking of the related *P. frosti* (Baw Baw Frog) show the range of movement is relatively small (0–11 m^2 in breeding periods and approximately 3–1000 m^2 post breeding season). This conforms to other amphibian movement studies that show most species do not move further than several hundred metres from their breeding sites (Hollis 2004).

The diet of adult Richmond Mountain Frogs is not known, although other *Philoria* species feed on *Hymenoptera* species (sawflies, wasps, bees, and ants), *Collembola* species (wingless arthropods), *Arachnia* species (spiders), *Amphipoda* species (crustaceans), *Orthoptera* species (crickets), *Diptera* species (true flies), *Coleoptera* species (beetles), *Hemiptera* species (true bugs), and insect larvae (Lima et al. 2000).

The longevity of the Richmond Mountain Frog is also unknown. However, sampling of the related Baw Baw Frog, at montane elevations (960–1299 m), has identified the maximum age of individuals of this species to be 9.5 years for males and 11.5 years for females. Males reach reproductive maturity at 3.5 years, and females at 5.5 years (Hollis 2004). This gives a potential generation length of six to eight years for the Baw Baw Frog. The Richmond Mountain Frog is

likely to be on the lower end of this range, given the colder climate in the distribution range of the Baw Baw Frog (endemic to the Central Highlands of Victoria) likely increases the maximum age of individuals. Therefore, generation length for the Richmond Mountain Frog is tentatively set at six years but should be adjusted as ecological knowledge of the species improves.

Threats

Table 1: Threats impacting the Richmond Mountain Frog in approximate order of severity of risk, based on available evidence

Number	Threat factor	Threat type and status	Evidence base
1.0	Climate Change		
1.1	Increased temperature intensity/frequency and change to precipitation patterns	known current	Climate change is expected to cause a pronounced increase in extinction risk for frog species over the coming century, with terrestrial breeding frogs identified as some of the most vulnerable taxa (Hero et al. 2005; Lemckert & Penman 2012; Hagger et al. 2013; Pearson et al. 2014; Lopez 2016). Climate projections for eastern Australia include reduced rainfall, increased average temperatures, and more frequent droughts. These conditions will increase the scale, frequency and intensity of wildfires (CSIRO 2007; CSIRO & Bureau of Meteorology 2015) and could affect Richmond Mountain Frog recruitment levels. Rainfall and temperature have been observed to influence the duration and frequency of male choruses (Hollis 2004; Willacy et al. 2015; Lopez 2016), with a change in pattern potentially shortening the breeding season. In addition, any reduction in moisture levels in nesting sites may impact on egg and larval development (Lemckert & Penman 2012). Studies have suggested a continuing contraction of climate suitable envelopes for subtropical rainforest by 2050, isolating remnant vegetation and dependent animals to small pockets along suitable ranges (Mellick et al. 2013; Lopez 2016). In addition, shifts in distribution to higher altitudes by endemic montane communities, mirroring any increase in temperature, may cause further geographical range contraction and increase the risk of

			extinction (Hagger et al. 2013; Lopez 2016). *Philoria* species may be buffered to a degree from climate change due to inhabiting closed canopy rainforests, which are a thermally stable environment (Lopez 2016), and through their burrows, with a barrier of soil and water further reducing temperature extremes (Willacy et al. 2015; Lopez 2016). However, despite this protection, impacts from climate change have been observed. Patch occupancy surveys conducted in 2014 and repeated in 2019 failed to detect frogs at formerly known lower elevation sites, with prolonged drought conditions thought to be responsible for frog absence (D Newell 2020. pers comm 15 April).
1.2	Increased intensity/frequency of wildfire	known current	Localised extinction of frogs has been observed through wildfire events. Johnson (1971) found the critical thermal limit for *Taudactylus diurnus* (Day Frog), a climatically similar montane rainforest species, was 31.1 ± 1.2 ºC. However, as a burrowing species, the Richmond Mountain Frog may face a reduced threat from fire, although this is not confirmed at this time. Climate projections for eastern Australia of higher temperatures and change to rainfall patterns will increase the scale, frequency and intensity of wildfires in the region (CSIRO 2007; CSIRO & Bureau of Meteorology 2015). In 2019-20, following years of drought (DPI 2020), catastrophic wildfire conditions culminated in fires that covered an unusually large area of eastern and southern Australia. In many places, the fires burnt with high intensity. The full impact of the 2019-20 bushfires has yet to be determined. The bushfires will not have impacted all areas equally: some areas burnt at very high intensity whilst other areas burnt at lower intensity, potentially even leaving patches unburnt within the fire footprint. However, an initial analysis estimates that 5–10 percent of the distribution range of the

			Richmond Mountain Frog was impacted. This sort of event is increasingly likely to reoccur, as a result of climate change.
2.0	Habitat loss and fragmentation		
2.1	Vegetation clearance/habitat fragmentation	known current	Due to large-scale clearing, much of the remaining subtropical rainforest of north-east NSW occurs in a discontinuous arc along the Great Dividing Range (Hagger et al. 2013). This clearing is likely to have substantially reduced the distribution range of the Richmond Mountain Frog (Knowles et al. 2004). The Richmond Mountain Frog population is protected, with the entire population contained within the NSW National Park network. However, in places, the canopy has been opened through historic logging and significant eucalypt dieback. This has encouraged the establishment of weeds in the understorey, which have reduced habitat quality (NPWS 2005). In addition, an anticipated decline in the amount of montane rainforest habitat is predicted under moderate (RCP6.0) and extreme (RCP8.5) climate change scenarios (Lopez 2016). The Richmond Mountain Frog population is considered severely fragmented. The known sites are spread across three National Parks (Knowles et al. 2004; Willacy et al. 2015; OEH 2019), with most separated from the next nearest site by approximately 20 km (Willacy et al. 2015). This isolation, together with the low dispersal ability of the species (and associated poor recolonisation potential) (Newell 2018), reduces the likelihood of recovery from future extreme events (Hollis 2004; Hagger et al. 2013) and is recognised as a major threat to the persistence of the Richmond Mountain Frog (OEH 2019).
3.0	Disease		
3.1	Chytridiomycosis caused by chytrid fungus	known current	Chytridiomycosis is an infectious disease caused by the amphibian chytrid fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*).

			Infected subpopulations exhibit diverse susceptibility to *Bd*. Some species do not exhibit any apparent symptoms, whilst others are extremely vulnerable, resulting in mass die-off and extinction (DOEE 2016). The Richmond Mountain Frog is located at mid-high elevations (above 400 m) where cooler temperatures are suitable for *Bd* (Hero & Morrison 2004; Skerratt et al. 2010; Hero et al. 2015; Lopez 2016). However, the Richmond Mountain Frog has not been tested for *Bd* susceptibility and Murray & Skerratt (2012) identified the Richmond Mountain Frog as having a low probability of infection due to being only ephemerally associated with aquatic habitats. There is no evidence of *Bd* related declines for the species and its disappearance from historical sites is thought to be related to climate change (drought) rather than disease. Eradicating *Bd* is difficult. Some amphibian species are reasonably tolerant, acting as a natural reservoir, spreading the pathogen, which persists even at low host densities. There is no evidence that *Bd* has disappeared from any known location in eastern Australia (Voyles et al. 2009; Newell et al. 2013).
4.0	Invasive species		
4.1	Invasive weeds	potential current	In the distribution range of the Richmond Mountain Frog, significant areas of Lantana infestation are prevalent in areas previously logged, and where eucalypt dieback has occurred (NPWS 2005). Other encroaching noxious weeds include Groundsel Bush (*Baccharis halimifolia),* Crofton Weed (*Ageratina adenophora*), Mistflower (*A. riparia*), and giant Parramatta Grass (*Sporobolus indicus var.major*) (NPWS 2005). However, invasion by these weeds is thought to be a minor issue, with most sites still dominated by *Tetragonia tetragonioides* (Native Spinach). The effect of these weeds is not known, but they may have negative

			impacts on the thermal buffering provided by the rainforest canopy (Lopez 2016), suitability of areas for egg laying, and changes to invertebrate assemblages, which are an important component of the diet of *Philoria* species (Lima et al. 2000).
4.2	Invasive fauna	potential current	Feral Pigs (*Sus scrofa*), feral goats (*Capra hircus*) and domestic cattle occur in the region of the Richmond Mountain Frog (NPWS 2005; OEH 2019), where their grazing on native vegetation, trampling, and use of breeding habitat as wallows is a potential threat (Hollis 2011; DOEE 2017). Little is known about predation on the Richmond Mountain Frog but introduced predators (such as the feral cat (*Felis catus*)) may present a threat to adults (Hollis 2011).

Assessment of available information in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the followin

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

The generation length for the Richmond Mountain Frog is not known. However, at montane elevations (960 – 1300 m), the related Baw Baw Frog is believed to have a generation length of six to eight years (Hollis 2004). Due to the warmer climate in the distribution range of the Richmond Mountain Frog (and the lower elevation the species is found), the lower-end of this

timeframe can be tentatively used but should be adjusted as ecological knowledge improves. Therefore, the relevant timescale for this criterion is considered to be 18 years.

The population size of the Richmond Mountain Frog is not known with certainty. However, from patch surveys conducted in 2014 and repeated in 2019, a population of under 1000 individuals is suspected (D Newell 2020. pers comm 15 April). All observations are restricted to a small number of calling males. Knowles et al. (2004) observed the largest number of calling males at any one site to be three, and surveys in 2019 counted a maximum of 14 calling males on any single transect (D Newell 2020. pers comm 15 April). In addition, *Philoria* species are thought to be among the rarest vertebrates in eastern Australia (Knowles et al. 2004), with the Richmond Mountain Frog having the smallest distribution range in the genus (Newell 2018). A total of just 45 records of the Richmond Mountain Frog (across all known sites) are in the Atlas of Living Australia (as of 18 December 2019) (ALA 2019). In addition to these low surveyed numbers, *Philoria* species are habitat specialists, restricted to higher elevations (Knowles et al. 2004). These elevations are home to the largest concentration of threatened anuran species (41 percent) (Hero & Morrison 2004) and from where populations of the related Baw Baw Frog have experienced significant declines (Hollis 2004; Knowles et al. 2004).

Terrestrial breeding frogs have been identified as some of the most vulnerable taxa to climate change (Hero et al. 2005; Lemckert & Penman 2012; Hagger et al. 2013; Pearson et al. 2014; Lopez 2016), with *Philoria* species restricted to higher elevations (Knowles et al. 2004), where climate change is likely to have the greatest impact (Hero et al. 2015). Climate projections for eastern Australia include reduced rainfall, increased average temperatures, and more frequent droughts. These conditions will increase the scale, frequency and intensity of wildfires (CSIRO 2007; CSIRO & Bureau of Meteorology 2015) and could affect Richmond Mountain Frog recruitment levels. The duration and frequency of male choruses has been observed to be influenced by rainfall and temperature (Hollis 2004; Willacy et al. 2015; Lopez 2016), with a change in pattern potentially shortening the breeding season, and a reduction in moisture levels in nesting sites possibly impacting on egg and larval development (Lemckert & Penman 2012).

Impacts from climate change have already been observed. Patch occupancy surveys conducted in 2014 and repeated in 2019 failed to detect frogs at formerly known lower elevation sites, with prolonged drought conditions thought to be responsible for frog absence (D Newell 2020. pers comm 15 April). In addition, the general trend in endemic mountain species is to move to higher altitudes, mirroring the increase in temperature. However, these shifts in distribution may cause geographical range contractions, resulting in a significant reduction of suitable habitat and increased risk of extinction (Hagger et al. 2013; Lopez 2016).

The recent 2019-20 bushfires are likely to have reduced the Richmond Mountain Frog population and may have accelerated any population decline, with 5–10 percent of the Richmond Mountain Frog's distribution range overlapping with the fire-affected areas. These fires covered an unusually large area and, in many places, burnt with an unusually high intensity. The impact of the bushfires on the Richmond Mountain Frog has yet to be examined but its pre-fire imperilment, together with the extent of potential mortality as a result of fire and the unfavourable post-fire conditions (loss of shelter, increased susceptibility to predators, and loss of food-stuff), as well as a reduction in future recruitment (egg and tadpole death), has led the Department to identify it as one of the highest priority species for urgent management intervention (DAWE 2020).

However, given the relatively small area of the Richmond Mountain Frog's distribution that overlapped with fire-affected areas, together with limited baseline data on population size and pre-fire declines, and the short timeframe the species has been recognised (first described in 2004), the Committee has determined that there are **insufficient data** to demonstrate if the species is eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 2.	Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy			
		Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1.	Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2.	Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions indicating distribution is precarious for survival:				
(a)	Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b)	Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c)	Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations;(iv) number of mature individuals			

Evidence:

The Richmond Mountain Frog has a restricted geographical range, being endemic to a small area of continuous forest covering Richmond Range, Toonumbar, and Yabbra National Parks in NSW (Knowles et al. 2004; Cogger 2014; Anstis 2017; OEH 2019), with the species restricted to mid to high elevations (above 400 m). Based on the mapping of all the point records for the species (1992-2004) (obtained from state governments, museums and CSIRO) the Extent of Occurrence (EOO) has been estimated at 550 km^2, and the Area of Occupancy (AOO) at 20 km^2. The EOO was calculated using a minimum convex hull, and the AOO calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines 2014. The EOO meets the threshold for listing as Endangered under sub criterion B1 and the AOO meets the threshold for listing as Endangered under sub criterion B2.

The Richmond Mountain Frog population is considered severely fragmented, meeting sub criterion (a), with a projected greater than 50 percent of AOO in habitat patches that are not viable and with habitat patches separated by large distance (IUCN 2019). Only six sites are known, located in three different National Parks (Knowles et al. 2004; Willacy et al. 2015; OEH 2019). Most of these sites are separated by approximately 20 km, with only the sites in Toonumbar National Park in close proximity (Willacy et al. 2015).

Based on ongoing threats, the Richmond Mountain Frog population is projected to continue to decline in EOO, AOO, extent and quality of habitat, number of locations or subpopulations, and number of mature individuals, thereby meeting sub criterion (b)(i,ii,iii,iv,v). In particular, the small population size, already high degree of isolation of subpopulations (Knowles et al. 2004; Willacy et al. 2015; OEH 2019), and the low dispersal ability (and associated poor recolonisation potential) of the species (Newell 2018), reduces the likelihood of recovery from extreme events associated with climate change (Hagger et al. 2013) (as identified in Criterion 1).

Climate change is already thought to have impacted the population. Prolonged drought is believed to be responsible for the absence of frogs at formerly known lower elevation sites during the 2014 and 2019 breeding seasons (D Newell 2020. pers comm 15 April), and impacts from the 2019-20 bushfires are suspected, with 5–10 percent of the Mountain Frog's distribution range overlapping with the fire-affected areas (DAWE 2020). The NSW Scientific Committee has identified the Richmond Mountain Frog as likely to become extinct unless the circumstances and factors threatening its survival or evolutionary development cease to operate (NSW Scientific Committee 2005).

The data presented above appear to demonstrate that the species is **eligible for listing as Endangered (B1 & B2(a)(b)(i, ii, iii, iv, & v))** under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status.

This conclusion should therefore be considered tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 3. Population size and decline				
		Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals		**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2	An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

The population size of the Richmond Mountain Frog is not known with certainty. However, it is suspected to be very small and considered likely under 1000 individuals (see Criterion 1), meeting the threshold for listing as Endangered.

The Richmond Mountain Frog population is projected to continue decline based on the ongoing threats to the population, most notably climate change (as identified in Criterion 1). The small population size, already high degree of isolation of subpopulations (Knowles et al. 2004; Willacy et al. 2015; OEH 2019), and the low dispersal ability (and associated poor recolonisation potential) of the species (Newell 2018), reduces the likelihood of recovery from extreme events associated with climate change (Hagger et al. 2013).

Climate change is already thought to have impacted the population. Prolonged drought is believed to be responsible for the absence of frogs at formerly known lower elevation sites during the 2014 and 2019 breeding seasons (D Newell 2020. pers comm 15 April), and impacts from the 2019-20 bushfires are suspected, with 5–10 percent of the Mountain Frog's distribution range overlapping with the fire-affected areas (DAWE 2020). The NSW Scientific Committee has identified the Richmond Mountain Frog as likely to become extinct unless the circumstances and factors threatening its survival or evolutionary development cease to operate (NSW Scientific Committee 2005).

There is no estimation of the number of mature individuals in each subpopulation. However, the low number of total individuals recorded, together with only a limited number of known sites, with few frogs recorded during surveys, points to each subpopulation being very small. Each subpopulation is therefore considered to be under 250 mature individuals, meeting the threshold for Endangered under sub criterion C2(a)(i).

The data presented above appear to demonstrate that the species is **eligible for listing as Endangered (C2(a)(i))** under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low (Medium-term future)[1]**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**
D2[1] Only applies to the Vulnerable category Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time	-	-	**D2.** Typically: area of occupancy < 20 km2 or number of locations ≤ 5

[1] The IUCN Red List Criterion D allows for species to be listed as Vulnerable under Criterion D2. The corresponding Criterion 4 in the EPBC Regulations does not currently include the provision for listing a species under D2. As such, a species cannot currently be listed under the EPBC Act under Criterion D2 only. However, assessments that demonstrate eligibility for listing under other criteria may include information relevant to D2. This information will not be considered by the Committee in making its assessment of the species' eligibility for listing under the EPBC Act, but may assist other jurisdictions to adopt the assessment outcome under the common assessment method.

Evidence:

The population size of the Richmond Mountain Frog is not known with certainty. However, it is suspected to be very small and considered likely under 1000 individuals (see Criterion 1), meeting the threshold for listing as Vulnerable under this criterion.

In addition, the Richmond Mountain Frog meets the quantitative threshold for Vulnerable under subcriterion D2, with the number of locations being five or under. A location is defined as "a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present" (IUCN 2019). The Richmond Mountain Frog has a very restricted distribution range (Newell 2018), with the EOO estimated at 550 km^2, and the AOO at 20 km^2. Given the extent of the 2019-20 bushfires, this AOO can be identified as one location, which could be rapidly affected by a single bushfire event.

The data presented above appear to demonstrate the species is eligible for **Vulnerable** listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Population viability analysis appears not to have been undertaken, there are insufficient data to demonstrate if the species is eligible for listing under this criterion. However, the purpose of this

consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered tentative at this stage, as it may be changed as a result of responses to this consultation process.

Conservation Actions

Recovery Plan

A decision about whether there should be a recovery plan for this species has not yet been determined. The purpose of this consultation document is to elicit additional information to help inform this decision.

Primary conservation actions

2019-20 bushfire response

- As per the guidance developed by Southwell (2020), conduct rapid on-ground surveys to establish extent of habitat and population loss as a result of the 2019-20 bushfires, and to provide a baseline for ongoing population monitoring. Note: population monitoring should only be conducted during the breeding season, particularly during peak calling activity, from early September to November.
- Protect unburnt areas within or adjacent to recently burnt areas from further fire, in order to provide refuge sites, as well as protecting (from fire) unburnt areas that are not adjacent to burnt areas.
- Control introduced predators to support recovery of populations affected by fires, or populations near areas that have been affected by fire.
- Control introduced herbivores in burnt areas to support habitat recovery post fire.
- Establish the impact of fire retardants, used to fight bushfires, on frog populations.
- Weed control and habitat restoration works may support the regeneration of forest habitat at some localised sites. Note that herbicide formulations can be toxic to frogs and tadpoles, particularly if they contain glyphosate and surfactants (Mann et al. 2003).

Conservation and management priorities

Habitat loss, disturbance and modifications

- Protect unburnt areas within or adjacent to recently burnt areas from further fire, in order to provide refuge sites, as well as protecting (from fire) unburnt areas that are not adjacent to burnt areas.
- Identify key sites and implement a program ensuring suitable habitat is maintained.
- Investigate options for enhancing the resilience of the species' current habitat to climate change.
- Investigate options for providing new habitat that would be suitable for the species under climate change scenarios.
- Reconnect isolated rainforest patches with corridors of wet forest, particularly along drainage lines in stream headwaters.
- Protect the areas of occupancy of the Richmond Mountain Frog during the planning and implementation of controlled burns in the region.

- Maintain tracks, particularly board-walks, and relocate recreational activities and roads away from sensitive habitat and breeding sites.

Invasive species (including threats from grazing, trampling, predation)

- In areas burnt by the 2019-20 bushfires, control of introduced predators may be required to support population recovery, and control of introduced herbivores will aid habitat recovery. Weed control and habitat restoration may be needed in localised areas to support habitat regeneration. Note that herbicide formulations can be toxic to frogs and tadpoles, particularly if they contain glyphosate and surfactants (Mann et al. 2003).
- Develop and implement longer-term strategies to control introduced and native predators by implementing eradication programs as necessary.
- Monitor and control damage to riparian areas by feral pigs. Control numbers and fence key sites, where feasible.
- Assess the impact of exotic weeds on habitat suitability for the Richmond Mountain Frog. If impact is shown to be significant, develop a strategy for control or elimination of the invasive weeds. Note that herbicide formulations can be toxic to frogs and tadpoles, particularly if they contain glyphosate and surfactants (Mann et al. 2003).

Impacts of domestic species

- Use fencing, or other measures where applicable, to reduce the access of domestic stock to stream banks.

Stakeholder Engagement

- Provide input into the various impact assessment and planning processes on measures to protect the Richmond Mountain Frog and its habitat. These include water resource plans, park management plans and environmental impact assessments.
- Interested nature conservation groups could be engaged in conservation management activities, such as survey and monitoring, but should be made aware of the need to follow correct field practices and hygiene protocols to mitigate the risks of trampling and disease transmission. If necessary, use workshops to aid stakeholders in developing the skills and knowledge required to manage threats to this species while undertaking these activities.

Disease

- Collect and analyse samples from all monitoring programs for the species, to test for the presence of chytrid fungus, the susceptibility of the Richmond Mountain Frog to *Bd*, and improve understanding of disease spread throughout the species' range.
- Minimise the spread of the amphibian chytrid fungus by implementing suitable hygiene protocols (Murray et al. 2011) to protect priority populations as described in the Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DOEE 2016).
- Provide disease identification and prevention protocols (methods of handling, diagnostic keys, etc.) to researchers and land managers for use in the field.

Survey and Monitoring priorities

- Conduct rapid on-ground surveys to establish extent of habitat and population loss as a result of the 2019-20 bushfires, and to provide a baseline for ongoing population

monitoring. Note: population monitoring should only be conducted during breeding season, particularly during peak calling activity, from early September to November.

- Regular monitoring should be undertaken for a small number of subpopulations from August to December when male frogs are known to call. This survey work should build on patch survey work previously conducted in 2014 and 2019 (prior to the 2019-20 bushfires). Note: Frogs should not be disturbed at breeding sites under any circumstances.
- Broad scale regular monitoring should be undertaken over the species' known range. Sites should span the altitudinal and latitudinal range and a range of other habitat characteristics. These data will be used to assess the species' status and assess further declines or re-establishment/recovery of subpopulations.
- Survey sites within the known range of the species where the environment is considered likely to be suitable for the species to identify whether subpopulations exist that are previously unknown.

Information and research priorities

- Understand the potential influence of climate change on the long-term survival prospects of the species, due to altered temperatures, rainfall patterns, bushfires, environmental stressors and diseases.
- Model microhabitat usage of this species beyond burrows, by gathering more detailed geo-climatic (e.g. soil moisture) and physiological data (e.g. operative temperatures and water loss).
- Measure the critical thermal limits and preferred temperatures of the species to ascertain its physiological limits, sensitivity and vulnerability. Include potential impacts of temperature on other life stages.
- Research potential management strategies to control eucalypt dieback, including controlling population imbalances of *Manorina melanophrys* (Bell Miners) and their role in forest regeneration.
- Investigate options for linking, enhancing or establishing additional populations.
- Improve understanding of the extent and impact of infection by the amphibian chytrid fungus on the Richmond Mountain Frog to better inform how to apply existing or new management actions relevant to the recovery. This includes knowledge on:
    - The susceptibility of the Richmond Mountain Frog to the fungus;
    - the different strains of the fungus;
    - levels of virulence;
    - mechanisms for resistance to the disease;
    - treatment options;
    - husbandry methods;
    - the potential of other species to act as reservoirs or vectors for transmission of the fungus (Department of the Environment and Energy 2016).
- Investigate population genetics to provide a baseline on effective population size, heterozygosity and structure among the various populations.
- Improve understanding of husbandry methods for the species.

- Investigate options for reintroductions/translocations/augmentation from captive population if populations continue to become increasingly fragmented and isolated.

Collective list of questions – your views

SECTION A GENERAL

1. Is the information used to assess the nationally threatened status of the species robust? Have all the underlying assumptions been made explicit? Please provide justification for your response.

2. Can you provide additional data or information relevant to this assessment?

3. Have you been involved in previous state, territory or national assessments of this species/subspecies? If so, in what capacity?

PART 1 – INFORMATION TO ASSIST LISTING ASSESSMENT

SECTION B DO YOU HAVE ADDITIONAL INFORMATION ON THE ECOLOGY OR BIOLOGY OF THE SPECIES? (If no, skip to section C)

Biological information

4. Can you provide any additional or alternative references, information or estimates on longevity, average life span and generation length?

5. Do you have any additional information in the ecology or biology of the species not in the current advice/plan?

SECTION C ARE YOU AWARE OF THE STATUS OF THE TOTAL NATIONAL POPULATION OF THE SPECIES? (If no, skip to section D)

Population size

6. Has the survey effort for this taxon been adequate to determine its national adult population size? If not, please provide justification for your response.

7. Do you consider the way the population size has been derived to be appropriate? Are there any assumptions and unquantified biases in the estimates? Did the estimates measure relative or absolute abundance? Do you accept the estimate of the total population size of the species? If not, please provide justification for your response.

8. If not, can you provide a further estimate of the current population size of mature adults of the species (national extent)? Please provide supporting justification or other information.

   If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible subspecies numbers, and also choose the level of confidence you have in this estimate:

   Number of mature individuals is estimated to be in the range of:

   ☐ 1–50 ☐ 51–250 ☐ 251–1000 ☐ >1000 ☐ >10 000

   Level of your confidence in this estimate:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, information suggests this range

☐ 95–100% - high level of certainty, information indicates quantity within this range

☐ 99–100% - very high level of certainty, data are accurate within this range

SECTION D ARE YOU AWARE OF TRENDS IN THE OVERALL POPULATION OF THE SPECIES? (If no, skip to section E)

9. Does the current and predicted rate of decline used in the assessment seem reasonable? Do you consider that the way this estimate has been derived is appropriate? If not, please provide justification of your response.

Evidence of total population size change

10. Are you able to provide an estimate of the total population size in 2008-2010 *(at or soon after the start of the most recent three generation period)*? Please provide justification for your response.

    If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible subspecies numbers, and also choose the level of confidence you have in this estimate.

    Number of mature individuals is estimated to be in the range of:

    ☐ 1–50 ☐ 51–250 ☐ 251–1000 ☐ >1000 ☐ >10 000

    Level of your confidence in this estimate:

    ☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on

    ☐ 31–50% - more than a guess, some level of supporting evidence

    ☐ 51–95% - reasonably certain, information suggests this range

    ☐ 95–100% - high level of certainty, information indicates quantity within this range

    ☐ 99–100% - very high level of certainty, data are accurate within this range

11. Are you able to comment on the extent of decline in the species/subspecies' total population size over the last approximately 10 years? Please provide justification for your response.

    If, because of uncertainty, you are unable to provide an estimate of decline, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of decline, and also choose the level of confidence you have in this estimated range.

    Decline estimated to be in the range of:

    ☐ 1–30% ☐31–50% ☐51–80% ☐81–100% ☐90–100%

    Level of your confidence in this estimated decline:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, suggests this range of decline

☐ 95–100% - high level of certainty, information indicates a decline within this range

☐ 99–100% - very high level of certainty, data are accurate within this range

12. Please provide (if known) any additional evidence which shows the population is stable, increasing or declining.

SECTION E ARE YOU AWARE OF INFORMATION ON THE TOTAL RANGE OF THE SPECIES? (If no, skip to section F)

Current Distribution/range/extent of occurrence, area of occupancy

13. Does the assessment consider the entire geographic extent and national extent of the species/subspecies? If not, please provide justification for your response.

14. Has the survey effort for this species/subspecies been adequate to determine its national distribution? If not, please provide justification for your response.

15. Is the distribution described in the assessment accurate? If not, please provide justification for your response and provide alternate information.

16. Do you agree that the way the current extent of occurrence and/or area of occupancy have been estimated is appropriate? Please provide justification for your response.

17. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the extent of occurrence and/or area of occupancy.

    If, because of uncertainty, you are unable to provide an estimate of extent of occurrence, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of extent of occurrence, and also choose the level of confidence you have in this estimated range.

    Current extent of occurrence is estimated to be in the range of:

    ☐ <100 km^2 ☐ 100 – 5 000 km^2 ☐ 5 001 – 20 000 km^2 ☐ >20 000 km^2

    Level of your confidence in this estimated extent of occurrence

    ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

    ☐ 31–50% - more than a guess, some level of supporting evidence

    ☐ 51–95% - reasonably certain, data suggests this range of decline

    ☐ 95–100% - high level of certainty, data indicates a decline within this range

    ☐ 99–100% - very high level of certainty, data is accurate within this range

    If, because of uncertainty, you are unable to provide an estimate of area of occupancy, you may wish to provide an estimated range. If so, please choose one of the ranges suggested

in the table below of ranges of area of occupancy, and also choose the level of confidence you have in this estimated range.

Current area of occupancy is estimated to be in the range of:

☐ <10 km^2 ☐ 11 – 500 km^2 ☐ 501 – 2000 km^2 ☐ >2000 km^2

Level of your confidence in this estimated extent of occurrence:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, data suggests this range of decline

☐ 95–100% - high level of certainty, data indicates a decline within this range

☐ 99–100% - very high level of certainty, data is accurate within this range

SECTION F ARE YOU AWARE OF TRENDS IN THE TOTAL RANGE OF THE SPECIES? (If no, skip to section G)

Past Distribution/range/extent of occurrence, area of occupancy

18. Do you consider that the way the historic distribution has been estimated is appropriate? Please provide justification for your response.

19. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the former extent of occurrence and/or area of occupancy.

    If, because of uncertainty, you are unable to provide an estimate of past extent of occurrence, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of past extent of occurrence, and also choose the level of confidence you have in this estimated range.

    Past extent of occurrence is estimated to be in the range of:

    ☐ <100 km^2 ☐ 100 – 5 000 km^2 ☐ 5 001 – 20 000 km^2 ☐ >20 000 km^2

    Level of your confidence in this estimated extent of occurrence

    ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

    ☐ 31–50% - more than a guess, some level of supporting evidence

    ☐ 51–95% - reasonably certain, data suggests this range of decline

    ☐ 95–100% - high level of certainty, data indicates a decline within this range

    ☐ 99–100% - very high level of certainty, data is accurate within this range

    If, because of uncertainty, you are unable to provide an estimate of past area of occupancy, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of past area of occupancy, and also choose the level of confidence you have in this estimated range:

    Past area of occupancy is estimated to be in the range of:

☐ <10 km^2 ☐ 11 – 500 km^2 ☐ 501 – 2000 km^2 ☐ >2000 km^2

Level of your confidence in this estimated extent of occurrence:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, data suggests this range of decline

☐ 95–100% -high level of certainty, data indicates a decline within this range

☐ 99–100% - very high level of certainty, data is accurate within this range

PART 2 – INFORMATION FOR CONSERVATION ADVICE ON THREATS AND CONSERVATION ACTIONS

SECTION G DO YOU HAVE INFORMATION ON THREATS TO THE SURVIVAL OF THE SPECIES? (If no, skip to section H)

20. Do you consider that all major threats have been identified and described adequately?

21. To what degree are the identified threats likely to impact on the species/subspecies in the future?

22. Are the threats impacting on different populations equally, or do the threats vary across different populations?

23. Can you provide additional or alternative information on past, current or potential threats that may adversely affect the species/subspecies at any stage of its life cycle?

24. Can you provide supporting data/justification or other information for your responses to these questions about threats?

SECTION H DO YOU HAVE INFORMATION ON CURRENT OR FUTURE MANAGEMENT FOR THE RECOVERY OF THE SPECIES? (If no, skip to section I)

25. What planning, management and recovery actions are currently in place supporting protection and recovery of the species/subspecies? To what extent have they been effective?

26. Can you recommend any additional or alternative specific threat abatement or conservation actions that would aid the protection and recovery of the species/subspecies?

27. Would you recommend translocation (outside of the species' historic range) as a viable option as a conservation actions for this species/subspecies?

SECTION I DO YOU HAVE INFORMATION ON STAKEHOLDERS IN THE RECOVERY OF THE SPECIES? (If no, skip to Part 3)

28. Are you aware of other knowledge (e.g. traditional ecological knowledge) or individuals/groups with knowledge that may help better understand population trends/fluctuations, or critical areas of habitat?

29. Are you aware of any cultural or social importance or use that the species has?

30. What individuals or organisations are currently, or potentially could be, involved in management and recovery of the species/subspecies?

31. How aware of this species are land managers where the species is found?

32. What level of awareness is there with individuals or organisations around the issues affecting the species/subspecies?

    a. Where there is awareness, what are these interests of these individuals/organisations?

    b. Are there populations or areas of habitat that are particularly important to the community?

PART 3 – ANY OTHER INFORMATION

33. Do you have comments on any other matters relevant to the assessment of this species?

References cited in the advice

Anstis M (2017). Philoria richmondensis in *Tadpoles and frogs of Australia*, 2nd edition. New Holland Publishers, Australia. pp 513-514.

Cogger HG (2014). Reptiles and Amphibians of Australia, 7th edition. CSIRO Publishing, Collingwood, Victoria. p 66.

Drielsma M & Ferrier S (2009). Rapid evaluation of metapopulation persistence in highly variegated landscapes. *Biological Conservation* 142, 529–540.

Hagger V, Fisher D, Schmidt S & Blomberg S (2013). Assessing the vulnerability of an assemblage of subtropical rainforest vertebrate species to climate change in south-east Queensland. *Austral Ecology* 38, 464-475.

Hero JM & Morrison C (2004). Frog declines in Australia: global implications. *Herpetological Journal* 14, 175-186.

Hero JM, Williams SE, & Magnusson WE (2005). Ecological traits of declining amphibians in upland areas of eastern Australia. *Journal of Zoology* 267, 221-232.

Hero JM, Roberts JD, Hoskin CJ, Lowe K, Narayan EJ, & Bishop PJ (2015). Austral amphibians – Gondwanan relicts in peril in A. Stow, N. Maclean & GI Holwell (eds) *Austral Ark: the state of wildlife in Australia and New Zealand*. Cambridge University Press, United Kingdom. pp 440-465.

Hollis G (2004). Ecology and conservation biology of the Baw Baw Frog Philoria frosti (Anura: Myobatrachidae): distribution, abundance, autoecology and demography. Department of Zoology, University of Melbourne.

Hollis G (2011). National Recovery Plan for the Baw Baw Frog Philoria frosti. In: Environment DoSa (ed). Melbourne.

Hoskin CJ, James S, & Grigg GC (2009). Ecology and taxonomy-driven deviations in the frog call-body size relationship across the diverse Australian frog fauna. *Journal of Zoology* 278, 36-41.

Johnson CR (1971). Thermal relations and water balance in the Day Frog, Taudactylus diurnus, from an Australian Rainforest. *Aust. J. Zool*. 19, 35–9.

Knowles R, Mahony M, Armstrong J, & Donnellan S (2004). Systematics of sphagnum frogs of the genus *Philoria* (Anura: Myobatrachidae) in eastern Australia, with the description of two new species. *Records of the Australian Museum* 56(1), 57-74.

Laidlaw MJ, McDonald WJF, Hunter JR, & Kitching RL (2011). Subtropical rainforest turnover along an altitudinal gradient. *Memoirs of the Queensland Museum – Nature* 55(2), 271-290.

Lemckert FL & Penman TD (2012). Climate change and Australia's frogs: how much do we need to worry? in D Lunney & P Hutchings (eds) *Wildlife and climate change: towards robust conservation strategies for Australian fauna*. Mosman, New South Wales. pp 92-98.

Lima AP, Magnusson WE, & Williams DG (2000). Differences in diet among frogs and lizards coexisting in subtropical forests of Australia. *Journal of Herpetology* 34(1), 40-46.

Lopez MF (2016). Distribution, ecology, disease and physiology of a mountain-top endemic frog in the face of climate change: a study on *Philoria loveridgei*. Griffith University, Australia.

Mann RM, Bidwell JR & Tyler MJ (2003). Toxicity of herbicide formulations to frogs and the implications for product registration: a case study from Western Australia. *Applied Herpetology* 1, 13–22.

Mellick R, Wilson PD, & Rossetto M (2013). Post-glacial spatial dynamics in a rainforest biodiversity hot spot. *Diversity* 5, 124–138.

Murray KA & Skerratt LF (2012). Predicting wild hosts for amphibian chytridiomycosis: integrating host life-history traits with pathogen environmental requirements. *Human and Ecological Risk Assessment* 18(1), 200-224.

Newell D (2018). An update on frog declines from the forests of subtropical eastern Australia in H Heatwole & JJL Rowley (eds) *Status of conservation and decline of amphibians Australia, New Zealand, and Pacific Islands*. CSIRO publishing, Clayton South. pp 29-37.

Parris KM (2004). Environmental and spatial variables influencing the composition of frog assemblages in sub-tropical eastern Australia. *Ecography* 27, 392 – 400.

Pearson RG, Stanton JC, Shoemaker KT, Aiello-Lammens ME, Ersts PJ, Horning N, Fordham DA, Raxworthy CJ, Ryu HY, McNees J & Akçakaya HR (2014). Life history and spatial traits predict extinction risk due to climate change. *Nature Climate Change* 4. pp 217-221.

Penman TD, Lemckert FL & Mahony MJ (2006). A preliminary investigation into the potential impacts of fire on a forest dependent burrowing frog species. *Pacific Conservation Biology* 12(1), 78-83.

Seymour RS, Mahony MJ, & Knowles R (1995). Respiration of embryos and larvae of the terrestrially breeding frog *Kyarranus loveridgei*. *Herpetologica* 51(3), 369-376.

Skerratt LF, McDonald KR, Hines HB, Berger L, Mendez D, Phillott AD, Cashins SD, Murray KA, & Speare R (2010). Application of the survey protocol for chytridiomycosis to Queensland, Australia. *Diseases of Aquatic Organisms* 92, 117-129.

Voyles J, Young S, Berger L, Campbell C, Voyles WF, Dinudom A, Cook D, Webb R, Alford RA, Skerratt LF & Speare R (2009) Pathogenesis of Chytridiomycosis a cause of catastrophic amphibian declines. *Science* 326(5952), 582-585.

Willacy RJ, Mahony M, & Newell DA (2015). If a frog calls in a forest: Bioacoustic monitoring reveals the breeding phenology of the endangered Richmond Mountain Frog (*Philoria richmondensis*). *Austral Ecology* 40, 625-633.

Other sources cited in the advice

ALA (Atlas of Living Australia) (2019). *Philoria Richmondensis*. Accessed: 18 December 2019 Available at: https://biocache.ala.org.au/occurrences/search?q=lsid:urn:lsid:biodiversity.org.au:afd.taxon:df58b980-3068-4491-81d5-74a6512047cf#tab_chartsView

CSIRO (2007). Climate Change in Australia. Viewed: 26 February 2020 Available at: http://www.climatechangeinaustralia.gov.au/

CSIRO and Bureau of Meteorology (2015). Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report, CSIRO and Bureau of Meteorology, Australia.

DAWE (Department of Agriculture, Water and the Environment) (2020). Wildlife and threatened species bushfire recovery research and resources. Viewed: 12 February 2020 Available at: https://www.environment.gov.au/biodiversity/bushfire-recovery/research-and-resources

DNPRSR (Department of National Parks, Recreation, Sport & Racing) (2013). Main Range National Park and Spicers Gap Road Conservation Park Management Statement 2013. Viewed: 05 February 2020 Available at: https://parks.des.qld.gov.au/managing/plans-strategies/statements/pdf/main-range.pdf

DOEE (Commonwealth Department of the Environment and Energy) (2016). Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis, Commonwealth of Australia 2016. Viewed: 18 October 2019 Available at:

http://www.environment.gov.au/biodiversity/threatened/publications/tap/infection-amphibians-chytrid-fungus-resulting-chytridiomycosis-2016

DOEE (Commonwealth Department of the Environment and Energy) (2017). Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*), Commonwealth of Australia 2017. Viewed: 23 October 2019 Available at: http://www.environment.gov.au/system/files/resources/b022ba00-ceb9-4d0b-9b9a-54f9700e7ec9/files/tap-feral-pigs-2017.pdf

DPI (NSW Department of Primary Industries) (2020). Drought in NSW. Viewed: 13 February 2020 Available at: https://www.dpi.nsw.gov.au/climate-and-emergencies/droughthub/drought-in-nsw

DPIE (NSW Department of Planning, Industry and Environment) (2005). Philoria richmondensis (a frog) – endangered species listing. Viewed: 14 February 2020 Available at: https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2004-2007/philoria-richmondensis-a-frog-endangered-species-listing

Murray KA, Skerratt L, Marantelli G, Berger L, Hunter D, Mahony M & Hines H (2011). Hygiene protocols for the control of diseases in Australian frogs. Viewed: 18 October 2019 Available at: http://www.environment.gov.au/biodiversity/invasive-species/publications/hygiene-protocols-control-diseases-australian-frogs

NPWS (NSW National Parks and Wildlife Service) (2005). The parks and reserves of the northern Richmond Range (including Richmond Range, Toonumbar and Mallanganee National Parks and Hogarth Range nature reserve): plan of management. Viewed: 16 December 2019 Available at: https://www.environment.nsw.gov.au/research-and-publications/publications-search/the-parks-and-reserves-of-the-northern-richmond-range-plan-of-management.

OEH (NSW Office of Environment and Heritage) (2019). Philoria richmondensis – profile. Viewed: 14 February 2020 Available at: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10972

Southwell D (2020). Design considerations for post natural disaster (fire) on-ground assessment of status of species, ecological communities, habitats and threats. Threatened Species Recovery Hub. Viewed: 28 May 2020 Available at: http://www.environment.gov.au/system/files/pages/a8d10ce5-6a49-4fc2-b94d-575d6d11c547/files/draft-post-fire-rapid-assessment-guide.pdf