Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Section 1 – Eligibility for Listing		
1. Name of the ecological community		
Organic mound spring sedgeland community of the North Kimberley bioregion		
2. Listing Category for which the ecological community is nominated		
	Current ranking under WA Minister ESA list in policy	EPBC Act (wholly or as a component)
Current listing category (Please check box)	☐ Critically endangered ☐ Endangered ☒ Vulnerable ☐ Priority 1-4 ☐ Data Deficient ☐ None – not listed	Name: ☐ Critically endangered ☐ Endangered ☐ Vulnerable ☒ None – not listed
	Recommended ranking under BC Act IUCN assessment	
Proposed listing category (Please check box)	☐ Collapsed ☒ CR: Critically endangered ☐ EN: Endangered ☐ VU: Vulnerable ☐ Priority 1-4	
Select one or more of the following criteria under which the community is to be nominated for BC Act listing. (Please check box). For further details on these criteria please refer to the Attachment to this form. The information you provide in Section 3 should support the criteria you select here.	☐ Criterion A – Reduction in geographic distribution ☒ Criterion B – Restricted geographic distribution ☐ Criterion C – Environmental degradation based on change in an abiotic variable ☐ Criterion D – Disruption of biotic processes or interactions based on change in a biotic variable ☐ Criterion E – Quantitative analysis that estimates the probability of ecosystem collapse	

Section 2 – Description, Condition, Threats & Recovery
Please answer all the questions, providing references where applicable. If no or insufficient information exists to answer a question, you must indicate this instead of leaving the question blank. The answers may be provided within this form or as attachments, ensuring that responses clearly indicate which question number they refer to.
Classification **3. What is the name of the ecological community?** Note any other names that have been used recently, including where different names apply within different jurisdictions. For example, is it known by separate names in different States or regions?
Organic mound spring sedgeland community of the North Kimberley bioregion. Otherwise known as the north Kimberley mound springs.

4. What authorities/surveys/studies support or use the name?

Halse (2001) described this wetland as worthy of conservation based on the importance of the particular aquatic invertebrate assemblage present. Bennelongia (2017) also inferred the community to be of high conservation significance on the basis of their survey results.

The community was endorsed as vulnerable by the WA Minister for Environment in 2002. It was ranked using ranking criteria developed in WA, that differ from those used for the IUCN RLE. The community is not currently listed under the EPBC Act.

5. How does the nominated ecological community relate to other ecological communities that occur nearby or that may be similar to it?

Does it intergrade with any other ecological communities and, if so, what are they and how wide are the intergradation zones?
Describe how you might distinguish the ecological community in areas where there is overlap (also see Description section below).

The northern-most occurrence of the organic mound spring sedgeland community of the North Kimberley bioregion occurs 35km to the south of the Black Spring organic mound spring community, listed as Endangered in WA. The habitat and assemblages differ substantially.

Description: Black Spring organic mound spring community. Occurs in the East Kimberley and the known occurrence consists of a raised central mound supporting a forest of *Melaleuca viridiflora* (broadleaf paperbark), *Ficus* spp., *Timonius timon* and *Pandanus spiralis* (screwpine) over *Colocasia esculenta* (taro) and ferns, including *Cyclosorus interruptus* (swamp shield-fern). The tall *Phragmites karka* (tropical reed) dominates the outer edge of the mound and the entire mound is ringed by a moat of water supporting sedges and grasses. The springs contain a rich assemblage of aquatic invertebrate fauna.

Description

6. List the main features that distinguish this ecological community from all other ecological communities.

Characteristic (or diagnostic) features can be biological (e.g. taxa or taxonomic groups of plants and animals characteristic to the community; a type of vegetation or other biotic structure), or associated non-biological landscape characteristics (e.g. soil type or substrate, habitat feature, hydrological feature). Please limit your answer to those features that are specific to the ecological community and can be used to distinguish it from other ecological communities.

The community is distinguished from other mound springs in the Kimberley region by the invertebrate biota that inhabits it, and the sedgelands or grasslands that typify the core seepage zones of the springs. Other mound springs may be vegetated by forest or woodland, whereas this community supports diverse and abundant sedges and herbs with sparse emergent *Melaleuca*, *Pandanus* and *Banksia*.

7. Give a description of the biological components of the ecological community.

For instance, what species of plants and animals commonly occur in the community; what is the typical vegetation structure (if relevant).

Occurrences of the community are centred on mound spring habitat in the North Kimberley bioregion. The community is comprised of sedgelands and grasslands that are almost completely devoid of trees and shrubs due to a waterlogged seepage zone, and can also include boggy fernlands. Associated woodlands occur at the margins. The community encompasses the associated woodlands that are also affected by the hydrology of each mound spring. The community is distinguished in particular by the invertebrate biota, and also the sedgelands or grasslands that typify the core seepage zones of the springs. Most of the sedges present on these mound springs are otherwise restricted to the periphery of wetlands and creeks, or broad drainage depressions on sandier soils where grasses are dominant. Seven plant species are considered useful indicators of these mound springs, since their occurrence is almost entirely restricted to them or their margins: *Cyperus unioloides* (papyrus sedge; priority 1), *Eleocharis ochrostachys* (spike rush; priority 3), *Eriocaulon inapertum* (pipewort; priority 1), *Lobelia leucotos* (blue lobelia; priority 1), *Rhynchospora gracillima* (thin beaksedge; priority 1), *Spiranthes sinensis* (austral ladies tresses; priority 1) and *Utricularia circumvoluta* (bladderwort; priority 1). *Rhynchospora rubra* (priority 3) is also found in the community.

8. Give a description of the associated non-biological landscape characteristics or components of the ecological community.

For instance, what is the typical landscape in which the community occurs? Note if it is associated with a particular soil type or substrate; what major climatic variables drive the distribution of the ecological community (e.g. rainfall). Note particular altitudes, latitudes or geographic coordinates

The organic mound spring sedgeland community is situated in the North Kimberley bioregion. It consists of raised peaty soaks or wetlands that occur on saturated peaty black, grey/black clayey soils with some sandstone. They are situated in either low tributaries or associated with floodplains adjacent to rivers and streams (Bennelongia 2017).

The climate for the Kimberley is described as tropical with warm winters and hot, humid summers. In summer (December to February), the average maximum temperature is 33.1°C with an average minimum temperature of 22.1°C. In winter (June to August), the average maximum temperature is 29.1°C with an average minimum temperature of 8.7°C (from 1993 to 2018). The mean yearly rainfall is 996mm (from 1973 to 2018), with the majority occurring during cyclone season from November to April (data obtained from Bureau of Meteorology website: http://www.bom.gov.au/climate/averages/tables/cw_001018.shtml; for Mount Elizabeth Station 2018).

9. Provide information on the ecological processes by which the biological and non-biological components interact (where known).

The organic mound spring sedgeland community of the North Kimberley bioregion contains raised, peaty mounds surrounded by moats or bogs, that are fed by permanent freshwater seepage (Bennelongia 2017).

The mound springs occur where groundwater discharges under pressure from depth through the overlying alluvium to the surface. The springs have underlying hydrogeology, mineral composition and biogeochemical processes that are likely to be complex and variable. When monitored in 2016, water was found to be fresh and highly acidic, with pH ranging from 5.08 to 4.71 *in situ*, which is natural in peat bogs due to the release of organic acids from decomposition of plant matter (Bennelongia 2017).

10. Does the ecological community show any consistent regional or other variation across its extent, such as characteristic differences in species composition or structure?

If so, please describe these.

The mound springs have a similar general structure, consisting of a central mound that over time has become raised and to some extent dried out in sections, with a surrounding moat or bog, however variation exists in physicochemical attributes, vegetation and aquatic invertebrates (Bennelongia 2017).

11. Does the ecological community provide habitat for any listed threatened species and/or endemic species?

If so, please note the species and whether the species is listed on State and/or national lists and the nature of their dependence on the ecological community.

There are eight taxa with priority status in Western Australia in the organic mound springs sedgeland community: *Cyperus unioloides* (priority 1), *Eleocharis ochrostachys* (priority 3), *Eriocaulon inapertum* (priority 1), *Lobelia leucotos* (priority 1), *Rhynchospora gracillima* (priority 1), *Rhynchospora rubra* (priority 3), *Spiranthes sinensis* (priority 1) and *Utricularia circumvoluta* (priority 1).

The Rainbow Bee Eater, *Merops ornatus*, was recorded at site GibbR1 by Bennelongia (2017) and is listed as migratory under s209 of the *Environment Protection and Biodiversity Conservation Act 1999*.

Several rarely collected aquatic invertebrate species also occur within the mound springs community. Bennelongia (2017) recorded a unique and undescribed *Arrenurus* from Drysdale 1a, referred to as *Arrenurus* sp. WA27 in DBCA (2019); the darwinulid ostracod *Alicenula serricaudata*, a largely groundwater associated species with a Gondwanan distribution, was recorded at two springs (Drysdale1a, MtElizabeth4) by Bennelongia (2017), plus other Kimberley springs by DBCA (2019), and are the first records for Australia. The atyid shrimp *Caridina spelunca*, which is restricted to groundwater associated habitats in the central Kimberley, was found by Bennelongia (2017) in site MtElizabeth4 (Bennelongia 2017; DBCA 2019).

12. Identify major studies on the ecological community (authors, dates, title and publishing details where relevant).

Barrett, M. and English, V. (2017) A flora and vegetation survey of North Kimberley mound springs, Mt Elizabeth Station. Department of Parks and Wildlife, WA.

Bennelongia Environmental Consultants (2017) *Ecological Character of Kimberley Mound Springs*. Bennelongia Environmental Consultants.

Department of Biodiversity, Conservation and Attractions (draft 2019) Biodiversity Survey, Mapping, Delineation and Assessment of Selected Organic Mound Springs of the Kimberley Region. Department of Biodiversity, Conservation and Attractions, Perth.

Distribution

13. Describe the distribution across WA and nationally.

State the appropriate bioregions where the ecological community occurs. Attach or provide any maps showing its distribution with details of the source of the maps, or explain how they were created and the datasets used.

The organic mound spring sedgeland community is known from nine mapped occurrences over a range of 60km within the North Kimberley bioregion. It occurs on three pastoral leases: Drysdale River (PL 49578); Mt Elizabeth (PL 49426); and Gibb River (PL 49688).

14. What is the area of distribution of the ecological community?

For answers to parts a, b, c & d: please identify whether any values represent extent of occurrence or area of occupancy (as described in the Attachment); provide details of the source(s) for the estimates and explain how they were calculated and the datasets used.

14 a. What is the current known area (in ha)? 112ha

14 b. What is the pre-industrialisation extent or its former known extent (in ha)? An ecological community is considered to be naturally restricted if it has a pre-industrialisation area of occupancy that is less than 10 000 ha or a pre-industrialisation extent of occurrence that is less than 100 000 ha (refer to the Attachment A)

The extent of the organic mound spring sedgeland community of the North Kimberley bioregion is believed to be stable.

14 c. What is the estimated percentage decline of the ecological community?

See above

14 d. What data are there to indicate that future changes in distribution may occur?

Climate change trends were sourced from National Climate Change Adaptation Research Facility (NCCARF) website (accessed 2019). Predictions indicate the hydrological regime is likely to be affected by rainfall decline. More extreme fire behaviour, the result of higher temperatures and a greater number of severe fire danger days is also likely. Extreme fires can impact the edges of mound springs, facilitating weed invasion, cattle impacts, and a general trend of drying out of the springs.

Patch size

15. What is the typical size (in ha) for a patch of the ecological community (if known)?

Explain how it was calculated and the datasets that are used. Relevant data includes the average patch size, the proportion of patches that are certain sizes, particularly proportions below 10 ha and below 100 ha, (but also below 1 ha and above 100 ha, for example). This could be presented as the range of patch sizes that comprise 90% of the occurrences.

The organic mound spring sedgeland community of the North Kimberley bioregion was mapped using ArcGIS© and a range of data sources including quadrat and survey data, on ground survey, aerial photography, and topographic maps. Minimum patch size is 3.2ha and maximum patch size is 32.77ha. The mean patch size is 12.5ha (see table below for patch size proportions).

Table 1. Proportion of occurrences with a certain patch size.

Patch size (hectares)	Number of occurrences
<1	0
<10	7 (77.8%)
<100	2 (22.2%)
>100	0

16. Quantify, if possible, the smallest percentage or area required for a patch of the ecological community to be considered viable.

This refers to the minimum size of a remnant that can remain viable without active management. It may be determined through the requirements for dominant native species, level of species diversity, or the nature of invasive weeds.

All areas of the organic mound spring sedgeland community of the North Kimberley bioregion that are in good condition have been mapped. There is no minimum area specified for a patch that could remain viable without active management. Patches vary in size and in the absence of threatening processes those that are considered in good condition do not require active management.

Functionality

17. Is the present distribution of the ecological community severely fragmented?

If so, what are likely causes of fragmentation?
If fragmentation is a natural or positive characteristic of this ecological community, please explain this and state the reason.
Severely fragmented refers to the situation in which increased extinction risk to the ecological community results from most remnants being found in small and relatively isolated patches.

The organic mound spring sedgeland community is naturally fragmented. It occurs as discrete patches located in the North Kimberley Bioregion.

18. Has there been a loss or decline of functionally important species?

This refers to native species that are critically important in the processes that sustain or play a major role in the ecological community and whose removal has the potential to precipitate change in community structure or function sufficient to undermine the overall viability of the community.

The flora species and sedgeland structure of the community are a part of characterising and differentiating the community. Changes to the floristic composition are likely to occur through the impacts of cattle, weed invasion, and changes to fire regimes and hydrology.

18 a. If yes, which species are affected?

Native flora species will be affected by weeds. Fire will affect those species that are fire sensitive. Cattle trample the mound springs vegetation and introduced nutrients and weed seed to the sites.

18 b. How are the species functionally important and to what extent have they declined?

Cattle grazing and trampling, weed invasion, frequent fire and hydrological changes may impact on the mound springs resulting in a reduction in diversity and occurrences to dry out. Systematic monitoring is required to determine the severity of the impacts.

Reduction in community integrity

19. Please describe any processes that have resulted in a reduction in integrity and the consequences of these processes, e.g. loss of understorey in a woodland. Include any available information on the rate of these changes.

This recognises that an ecological community can be threatened with extinction through on-going modifications that do not necessarily lead to total destruction of all elements of the community. Changes in integrity can be measured by comparison with a benchmark state that reflects as closely as possible the natural condition of the community with respect to the composition and arrangement of its abiotic and biotic elements and the processes that sustain them. Please provide a description of the benchmark state where available. For further information please refer to the Guidelines.

The structure of the organic mound spring sedgeland community of the North Kimberley bioregion is generally freshwater seepages and vegetated mound springs with internal moats. When in good condition the community contains well developed vegetation with a relatively rich aquatic habitat.

A condition class can be applied to the community as a whole based on:

- Presence of weed taxa, and level of weed cover
- Level of cattle damage
- Presence or absence of previously recorded natural strata of the vegetation present
- The presence/absence and species composition of flora and fauna

- Hydrological changes within the springs.

Survey and Monitoring

20. Has the ecological community been reasonably well surveyed?

Provide an overview of surveys to date, including coverage of different land tenure, and the likelihood of the ecological community's current known distribution and/or patch size being a true reflection of its actual distribution (consider area of occupancy and area of extent, including any data on number and size of patches).

An extensive survey of the organic mound spring sedgeland community of the North Kimberley bioregion was undertaken in 2016 at four occurrences (Drysdale1a, GibbR1, MtElizabeth4 and MtElizabeth3a). The survey was undertaken by Bennelongia Environmental Consultants to document and describe:

- Physical attributes and water chemistry;
- Wetland vegetation;
- Aquatic invertebrate species and assemblages;
- Observations of bird use of the springs; and
- Conservation status of the species recorded.

Quadrats were installed to further measure:

- GPS locations;
- Habitat description;
- Site features such as topography, soil and lithology;
- Structure of vegetation including height, crown cover, habit and dominant species;
- Vegetation condition;
- Estimated time since fire;
- Flora taxa present, including height and percentage cover.

Flora and vegetation surveys were conducted on four occurrences of the mound springs on Mount Elizabeth Station in June 2016 (Barrett and English 2017). Six permanent quadrats were established to describe the flora and vegetation in detail and enable replicate monitoring of long-term condition changes including:

- MtElizabeth4 (Waterfall Yard Spring)
    - 3 quadrats established:
        - 50x50m - core seepage zone
        - 50x50m - woodland (dampland) adjacent to seepage zone
        - 40x60m – fernland downslope of core seepage zone
    - general vegetation descriptions across mound spring complex
    - flora list for vegetation of the mound spring complex.
- MtElizabeth1a/d (Middle Spring)
    - 1 quadrat established (50x50m) in core seepage zone
    - flora list for vegetation of the mound spring complex.
- MtElizabeth2a/b (Gap Spring)
    - 1 quadrat established (50x50m) in core seepage zone
    - flora list for vegetation of the mound spring complex.
- MtElizabeth3a (Mud Spring/Kangaroo Spring)
    - 1 quadrat established (50x50m) in core seepage zone
    - flora list for vegetation of the mound spring complex.

21. Where possible, please indicate areas that haven't been surveyed but may add to the information required in determining the community's overall viability and quality.

Include commentary on issues to do with accessing different land tenures within the area of distribution, including private property, and the likelihood that these areas may include occurrences.

It is possible that additional occurrences of the community exist and may be located in future surveys. Boundaries of known occurrences of the organic mound spring sedgeland community of the North Kimberley bioregion do not require checking or redefining as they have been adequately surveyed.

22. Is there an ongoing monitoring program? If so, please describe the extent and length of the program.

Historically, monitoring of the organic mound spring sedgeland community of the North Kimberley bioregion has been opportunistic. In 2015 DBCA staff surveyed all occurrences to determine threats and condition (Chemello 2015).

The surveys undertaken in 2016 by Bennelongia Environmental Consultants and by Barrett and English (2017) provided information on condition and threats of four occurrences of the community, the establishment of permanent quadrats to record flora and vegetation, an inventory of aquatic invertebrates and water chemistry and soils, and an updated boundary. This information can be used as a baseline for future monitoring and procedures for monitoring.

Condition Classes and Thresholds

23. Do you think condition classes/thresholds apply to this ecological community? If not, give reasons.

The Committee recognises that ecological communities can exist in various condition states. In reaching its decision the Committee uses condition classes and/or thresholds to determine the patches that are included or excluded from the listed ecological community (see the Guidelines for details of the process of determining condition classes). Relevant here is recognition of different states following disturbance and the natural recovery of the occurrence towards a higher condition class.

The minimum status for this community to be considered viable is Good Condition. This refers to a patch in which "Vegetation structure altered but retains basic vegetation structure or ability to regenerate it. Obvious signs of disturbance e.g. impacts from cattle such as grazing and trampling, partial clearing, hydrological changes, presence of very aggressive weeds" (Keighery (1994) Vegetation Condition Scale (Government of WA 2000)). No minimum patch size is specified, as future viability will depend on management. Very small areas are known to be able to maintain their condition if they are subject to very minimal disturbance.

24. If so, how much of the community would you describe as in relatively <u>good condition</u>,

i.e. likely to persist into the long-term with minimal management?

'Good condition' in this context relates to WA condition categories 'Very Good to Pristine' as below (see ^ below in Table 2). Therefore 75ha or 85.6% of the known occurrences was in good condition when last surveyed from 2015 to 2019, and contain high native flora and fauna species diversity, maintain integrity of vegetation structure, and minimal weed/introduced species cover. The community is subject to ongoing threats, and requires substantial management to protect from pressures such as trampling and grazing from cattle, spread of introduced species, inappropriate fire regimes, and hydrological changes.

Table 2: Vegetation condition of North Kimberley mound springs between 2015 and 2019

Occurrence number (portion of occurrence estimated as percentage in brackets)	**Total area (ha)**	**Condition when last surveyed**
1 (20%), 2 (20%), 3 (50%), 6 (30%), 8 (15%)	~9.2	^^^Poor ('degraded', 'completely degraded' using Bush Forever (2000) scale)
5 (25%), 6 (40%)	~3.3	^^Medium ('good' using Bush Forever (2000) scale)
1 (80%), 2 (80%), 3 (50%), 4 (100%), 5 (75%), 6 (30%), 7 (100%), 8 (85%), 9 (100%)	~74.8	^Good ('pristine', 'excellent', 'very good' using Bush Forever (2000) scale)

25. What features or variables do you consider to be most valuable for identifying a patch of the ecological community in relatively <u>good condition</u>?

Variables for establishing the highest condition class may include: patch size; connectivity; native plant species composition; diversity and cover (for example in overstorey; mid-shrub and/or understorey layers); recognised faunal values; and cover of weeds or other invasive species.

See Section 24 above.

^This includes vegetation ranging from 'Pristine' - with no obvious signs of disturbance and native plant species diversity fully retained or almost so, zero or almost so weed cover/abundance, to 'Excellent' - Vegetation structure intact, with disturbance only affecting individual species, weeds are non-aggressive species, and the area contains high native plant species diversity, with less than 10% weed cover, and 'Very Good' - Vegetation structure altered, obvious signs of disturbance eg: from grazing, inappropriate fire regimes, hydrological changes, and aggressive weeds are present, with moderate native plant species diversity, and typical weed cover is less than 20% (5 – 20%).

26. How much of the community would you describe as in relatively <u>medium condition</u>, i.e. likely to persist into the long-term future with management?

In this context, medium condition relates to WA condition categories 'Very Good to Good' as below (see ^^below and Table 2 above). Therefore 3ha or 3.8% of the community is considered to be in medium condition, and contains medium plant species diversity, reduced vegetation structure, and a medium level of weed/introduced species cover.

^^This includes vegetation categorised as 'Good' - Vegetation structure significantly altered by very obvious signs of disturbance. Retains basic vegetation structure or ability to regenerate it.

27. Please describe how you would identify areas in <u>medium condition</u> using one or a combination of indicators such as species diversity, structure, remnant size, cover of weeds or other invasive species, etc.

See section 26 above.

28. How much of the community would you describe as in relatively <u>poor condition</u>, i.e. unlikely to be recoverable with active management?

In this context, poor relates to WA condition categories 'Degraded' and 'Completely Degraded', (see ^^^below and Table 2 above), so therefore 9ha or 10.6% of the community is considered to be in poor condition, with vegetation containing minimal native flora, presence of aggressive weeds, and evidence of high level disturbance.

^^^This includes vegetation rated as 'Degraded' - basic vegetation structure severely impacted by disturbance, the vegetation requires intensive management, and disturbance such as grazing, trampling, inappropriate fire regimes, partial clearing, hydrological changes are present, very aggressive weeds are present at high density, and very low native plant species diversity is observed (20 – 70%) to 'Completely Degraded' where vegetation structure is no longer intact and the area is completely or almost completely without native flora, referred to also as 'Parkland Cleared', with very low to no native species diversity (weed species greater than 70%).

29. Please describe how you would identify areas in <u>poor condition</u> using one or a combination of indicators such as species diversity, structure, remnant size, cover of weeds or other invasive species, etc.

See section 28 above.

Threats

Note: If you plan to identify <u>climate change</u> as a threat to the ecological community, please refer to the Guidelines for information on how this should be addressed.

30. Identify <u>PAST</u> threats to the ecological community indicating whether they are *actual* or *potential*.

Past threats include grazing and trampling by introduced fauna, spread of introduced flora, and hydrological change; all of which are <u>actual</u> threats.

31. Identify <u>CURRENT</u> threats to the ecological community indicating whether they are *actual* or *potential*.

Current threats include grazing and trampling by introduced fauna (actual), increased fire (potential), spread of introduced flora (actual) and hydrological change (potential).

32. Identify FUTURE threats to the ecological community indicating whether they are *actual* or *potential*.

Future threats include grazing and trampling by introduced fauna (actual), increased fire frequency and severity (potential), spread of introduced flora (actual) and hydrological change (actual). Drying climate is a potential future threat to the community.

For each threat describe:

322 a. How the threat has impacted on this ecological community in the past.

Introduced fauna

Feral pigs and free ranging cattle access the organic mound spring sedgeland community of the North Kimberley bioregion. Unless fences are maintained cattle can cause physical damage to the vegetation of the mound spring complex and the peat based substrates through trampling, resulting in large erosion gullies; as well as grazing the regenerating vegetation, altering the species composition by selectively removing edible species and potentially causing an increase in drying of the mound springs through vegetation removal. Water temperatures may also subsequently rise, with potential concomitant effects on aquatic invertebrates. Although fences are quite effective at excluding cattle compared to the adjacent high stocking rates, a few cattle do penetrate the fenced areas and continued annual maintenance of the fences will be necessary. In addition to physical disturbance, faeces of cattle contaminate the soil and water, particularly in open water, causing nutrient enrichment. This may enhance the introduction of weeds as well as elevate nutrient levels in the groundwater. This adversely affects the aquatic invertebrates that rely on the water supply (Barrett and English 2017).

Deep erosion gullies on the edges of the core spring zone were evident during survey in 1999. In 2016 they appeared to have regenerated very well following fencing to prevent stock access. However, a survey in 2019 revealed pig and cattle damage inside the fence with extensive erosion occurring at the water outflow point on Middle Spring (see figure below).

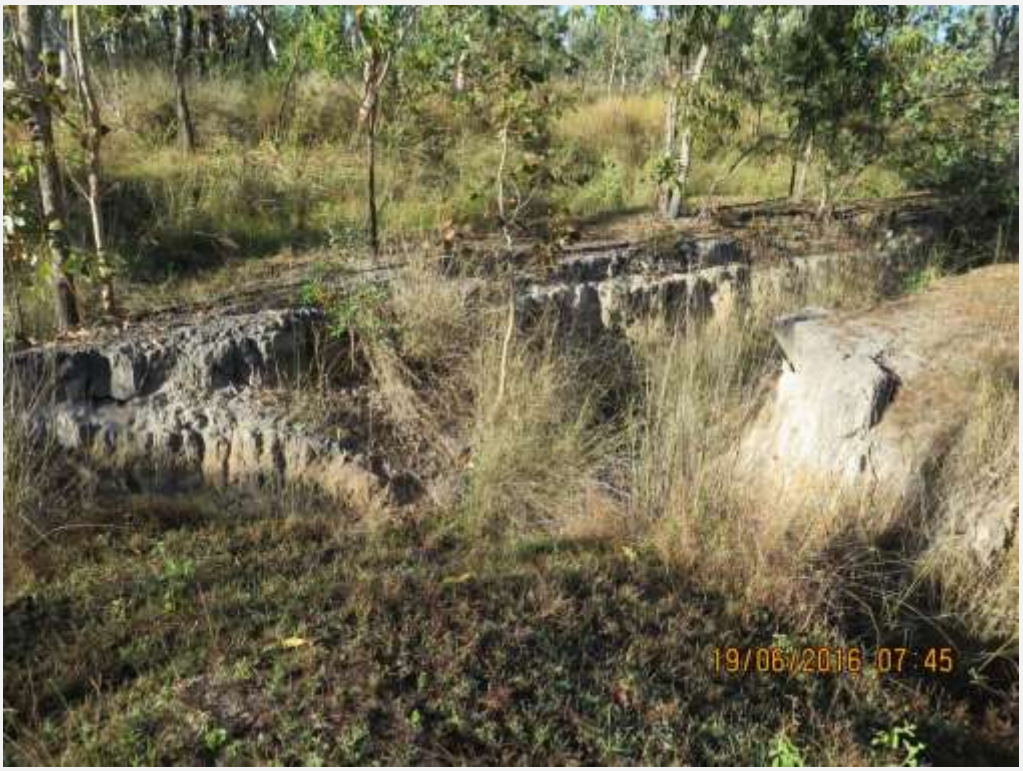

Figure 1. 2016 Middle Spring regeneration in erosion channels (from Barrett and English 2017).

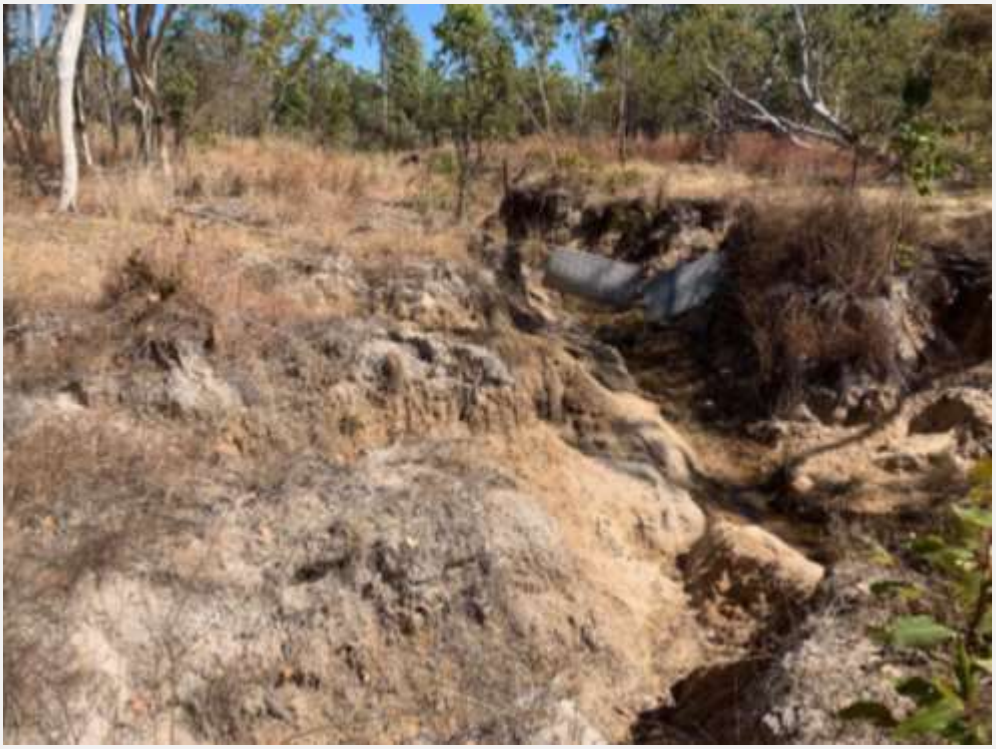

Figure 2. 2019 significant erosion at water outflow point at MtElizabeth1a/d (Middle spring) (from Chemello 2019).

Weeds

Weeds change the natural diversity of ecological communities and are a risk to the North Kimberley Mound Springs. They displace native plants and compete with them for light, nutrients and water. Weeds can also prevent recruitment, cause changes to soil nutrients, and affect abundance of native fauna. They can also impact on other conservation values by harbouring pests and diseases, and increasing the fire risk (Barrett and English 2017).

Most of the mound springs are relatively weed free except for site GIBBR1 that contained an infestation of grader grass (*Themeda quadrivalvis*) on the southern border (Chemello 2015). On the north-west margin of MtElizabeth2a/b (Gap Spring), just inside the fence adjacent to the cattle trough, a dense patch of weeds (*Emilia sonchifolia*, *Gomphrena celosioides*, *Sida cordifolia*, *Stylosanthes scabra*, and *Triumfetta pentandra*) was recorded. likely associated with past disturbance. None of these weeds was located any further into the swamp, however all are potentially invasive with increased cattle disturbance (Barrett and English 2017).

Occurrence MtElizabeth3a (Mud/Kangaroo spring) contain grader grass (*Themeda quadrivalvis*) within about 20m of the core seepage zone and is of concern. *Emilia sonchifolia* and *Stylosanthes scabra* were also present in the same area.

Occurrence MtElizabeth1a/d (Middle spring) contained two weed species, *Hibiscus sabdariffa* and *Stylosanthes ?viscosa* on the spring/woodland boundary.

Passiflora foetida was observed on the south east side of the core seepage area at site MtElizabeth4 (Waterfall Yard spring) and has been removed. This species should be carefully monitored and controlled as it is highly invasive.

Hydrological changes

The mound springs are dependent on a constant supply of fresh groundwater. There is no information available about the aquifers that support the community, or about the ecological water requirements of the mound springs. At a local scale, groundwater is exploited to provide drinking water for stock. Water is piped out of the core seepage zones for stock usage at MtElizabeth2a/b (Gap Spring), MtElizabeth3a (Mud/Kangaroo Spring) and MtElizabeth1a/d (Middle Spring) (Chemello 2015), and this helps to minimise potential impacts associated with this usage. The extent of impacts of this usage to the mound springs flora and fauna that depend on the constant

supply of freshwater is not clear. *Banksia dentata* deaths upslope of the core seepage zone at MtElizabeth2a/b (Gap Spring) may relate to damage associated with hydrological changes (either increases or decreases in the water table). This zone was about 50 x 25m, and an estimated 50% tree death was observed, with many other living trees consisting of mostly dead branches. Beyond 25m of the margin of the core seepage zone very few *Banksias* were dead. The position of the dead plants on the swamp margin, and lack of an effect on *Banksia* trees in the adjacent woodland supports a hydrological cause (Barrett and English 2017). Banksias within the spring area at MtElizabeth3a (Mud/Kangaroo spring) also appeared stressed when surveyed in 2019.

Further development of stock usage of the stations has the potential to increase water usage, and has potential to result in an increase in water abstraction. Where abstraction proposals do occur within the area there will need to be extra management considerations.

Inappropriate fire regimes

In the Kimberley Region and across northern Australia, inappropriate fire regimes pose a significant threat to biodiversity. Fire management regimes have changed from small scale, patchy burning by Aboriginal people, that resulted in small scale mosaics of burnt and unburnt vegetation. These practices provided buffers against unplanned wildfires. More recently, recurring extensive and intense fire patterns in the mid to late dry season have occurred (Carwardine *et al*. 2011; Rangelands NRM 2011).

Inappropriate fire regimes are a potential risk to the mound springs community. Historically, fires in the mound springs were probably only very occasional and the majority of the community is long unburnt. Grassy weeds, such as those surrounding Gibb River and Mt Elizabeth occurrences, are highly flammable and increase the risk of fire. Despite being inundated, the springs are still able to carry a fire, as was observed in Drysdale2a/b that burnt in 2015 (Chemello 2015). An increase in the fire frequency and severity in the community may alter the structure and composition, damaging the vegetation and the organic soil. The peat soils of the mound springs require particular fire management considerations as they can be damaged or destroyed by fires that smoulder for long periods. Appropriate management will be required to ensure the impacts of fire do not increase as the region is predicted to become even more fire prone with a drying climate (CSIRO and BOM 2015).

322 b. What its expected effects are in the future. Include or reference supporting research or information.

- The impact of cattle and feral pig disturbance to the springs is likely to continue unless fencing is installed and/or constantly maintained at occurrences to prevent access.
- It is likely that frequent intense fires will continue to threaten the integrity of the community through impacting on species diversity and encouraging weed invasion.
- *Themeda quadrivalvis* is likely to become a major threat to the community if not managed (Barrett and English 2017).
- Increasing future abstraction of groundwater for domestic and industrial use has the potential to impact the community due to drawdown.
- If new leaseholders seek to develop ecotourism of the mound spring zones, increased visitation has the potential to impact the springs through trampling, and potentially increased fire frequency.
- Organic mound spring sedgeland community of the North Kimberley bioregion is at risk from a drying climate with effects such as reduced surface water due to less rainfall, and higher temperatures. The tolerance of particular species to changes that may occur in association with a drying climate, including changes in rainfall and temperatures, is generally unknown. Climate change predictions for northern WA are as follows (from NCCARF website: https://www.nccarf.edu.au/sites/default/files/attached_files_publications/PDF%20Report%20Card%20Low%20Res.pdf); accessed 29 May 2019):
    - Rainfall will reduce slightly in the Kimberley by 2030, compared to 1975-2007 baseline.
    - Changes in annual rainfall and temperature may result in loss of vegetation due to a change in surface water runoff from a decline in rainfall, as well as more extreme fire behaviour, the result of higher temperatures and a greater number of severe fire danger days.

322 c. Identify whether the threat only affects certain portions or occurrences. Give Details.

The threats listed above are likely to impact on all occurrences.

33. Identify any natural catastrophic event/s

Explain its likely impact and indicate the likelihood of it occurring (e.g. a drought/fire in the area every 100 years). Catastrophic events are those with a low predictability that are likely to severely affect the ecological community.

Climate models for northern WA predict warmer temperatures and a slight reduction in rainfall. This may result in loss of vegetation due to changes in the hydrologic regime from a decline in rainfall, as well as more extreme fire behaviour, the result of higher temperatures and a greater number of severe fire danger days.

The incidence of more frequent and intense fires is likely. Major fires can occur any time and have potential for major impacts to the structure of the community, increasing weed invasion.

34. Additional biological characteristics

Identify and explain any additional biological characteristics particular to the community or species within it that are threatening to its survival (e.g. low genetic diversity). Identify and explain any models addressing survival or particular features.

344 a. How does it respond to disturbance?

Intense, frequent fires within the community may alter its structure and composition, removing the vegetation and the organic soil and increasing the invasion of weeds. The peat soils of the mound springs may also be damaged or destroyed by fires as it is likely they would smoulder for long periods. Peat accumulates over very long periods, up to thousands of years, so recovery from severe damage to the peat substrate would be very prolonged.

Drying climate needs to be considered when designing appropriate fire regimes. It is likely that reduced rainfall will cause diminishing growth rates, and plant maturation times may also therefore increase. Longer inter-fire intervals are therefore likely to be desirable.

Physical disturbance, such as from cattle and feral pig grazing and trampling, can alter the floristic composition of the community by selectively removing edible species, as well as causing physical damage.

34 b. How long does it take to regenerate and/or recover?

Personal observations ([redacted]) and photographic evidence indicate that the core seepage zones in a number of springs recovered remarkably well within four years of fencing, where previously the impact from stock was high (Barrett and English 2017). Regeneration times following fire will be dependent on the severity of the fire. Recovery will be very prolonged if peat is severely damaged.

Threat Abatement and Recovery

35. Identify key management documentation available for the ecological community, e.g. recovery plans, biodiversity management programmes, or site specific management plans (e.g. for a reserve).

Management recommendations occur in the following reports:

- Barrett, M. and English, V. (2017) A flora and vegetation survey of North Kimberley mound springs, Mt Elizabeth Station. Department of Parks and Wildlife, WA.
- Bennelongia Environmental Consultants (2017) *Ecological Character of Kimberley Mound Springs*. Bennelongia Environmental Consultants.
- Chemello, D. (2015) Mound Spring Survey August 2015. Department of Parks and Wildlife.

36. Give an overview of how threats are being/potentially abated and other recovery actions underway and/or proposed. Identify who is undertaking these activities and how successful the activities have been to date.

- In 2012 all the springs on Mt Elizabeth station with the exception of MtElizabeth4 (Waterfall Yard) were fenced by the pastoralist utilising funds provided by DBCA as a part of the Kimberley Science and Conservation Strategy. MtElizabeth4 (Waterfall Yard) hasn't been fenced due to high likelihood of wet season floods damaging fence lines. The existing fence is simply a pastoral fence line. Gibb River Spring (GIBBR1) was fenced in 2013/14.
- Control of *Passiflora foetida* was undertaken at MtElizabeth4 (Waterfall Yard spring).

- Memoranda of Understanding (MoUs) between the pastoralists and DBCA were developed and signed in 2014. The MoUs outlines the requirements of both parties for the continual management and protection of the mound springs. Part of the MoUs includes the fencing of the springs and the requirements for ongoing maintenance of the fences (Chemello 2019).
- A biodiversity survey was undertaken for selected organic mound springs of the Kimberley Region in 2016 and 2017. The survey collected information on:
    - the community, including description, condition and threats;
    - permanent quadrats to record flora and vegetation;
    - inventory of aquatic invertebrates and water chemistry;
    - updated mapping of the wetland assemblages; and
    - recommendations for management.

37. What portion of the current extent of the ecological community is protected in a reserve set aside for conservation purposes, and what proportions are private land, or other tenure? Give details including the name of the reserves, and the extent the ecological community is protected within these reserves.

None of the community is protected on lands with conservation tenure. Occurrences are on three pastoral leases: Drysdale River (PL 49578); Mt Elizabeth (PL 49426); and Gibb River (PL 49688).

378 a. Which of the reserves are actively managed?
Note which, if any, reserves have management plans and if they are being implemented.

Memoranda of Understanding exist between pastoral station owners and DBCA to manage the mound springs. The station owners check and repair the fences approximately every two years. The Wunggurr Rangers also maintain the fence at the spring on Gibb station and manage the grader grass within the fence.

378 b. Give details of any other forms of protection, such as conservation covenants, and whether the protection mechanisms are permanent.

None

378 c. Indigenous interests
Is the nominated ecological community or parts thereof known to occur on any culturally significant sites? If so comment on any issues with respect to aboriginal interests, in particular with regard to management of the ecological community.

There are no culturally significant sites that intersect with the community. The Traditional Owners are Wilinggin.

378 d. Native Title
Do Native Title or Indigenous Protected Areas apply to any parts of the community? If so comment on any issues with respect to exclusive possession and rights to plants and animals, in particular with regard to management of the ecological community.

A Native Title Claim was registered with the Native Title Tribunal in 2004 by Wanjina-Wunggurr Wilinggin (WAD6015/1999).

39. Give details of recovery actions that are or could be carried out at the local and regional level, e.g. develop and implement management plan for the control of specific weed species (regional), undertake weeding of known sites (local).

Recommendations in Chemello (2015) or Barrett and English (2017) include:

- Ongoing inspection and repair of fence lines to exclude cattle;
- Monitoring for pig presence and impact with management actions taken if pigs are present (eg trapping, shooting);
- Protection from frequent and intense fires through a prescribed early dry season burn regime;
- Continue photo monitoring points to establish any trends occurring on site.
- Seek to fence additional areas of the mound spring complex at MtElizabeth4 (Waterfall Yard Spring) including the more degraded areas east of the fenceline/track;

- Seek to fence eroded drainage channels on the south east side near the river, and the north eastern edge of the core seepage zone at MtElizabeth1a/d (Middle Spring), that are not currently encompassed by fencing. Erosion gullies could also be filled with rock to help prevent further degradation;
- Map significant weed/s and control/eradicate them (including a small patch of weeds at MtElizabeth2a/b (Gap Spring), grader grass adjacent to MtElizabeth3a (Mud Spring), *Passiflora foetida* at MtElizabeth4 (Waterfall Yard Spring));
- Design and implement a project to determine the hydrological drivers of the mound spring ecosystems. The information should then be employed as a guide to management of abstraction; and
- Design and implement a monitoring program that utilises already established quadrats. This should be designed to provide information about the success of land management in the sensitive environment of the mound spring ecosystem.

40. Is there an existing support network for the ecological community that facilitates recovery? e.g. an active Landcare group, Conservation Management Network.

No

41. Describe methods for identifying the ecological community including when to conduct surveys.

For example, season, time of day, weather conditions; length, intensity and pattern of search effort; and limitations and expert acceptance; recommended methods; survey-effort guide. Include references.

The following methods describe surveys of vegetation and invertebrates:

Vegetation (from Barrett and English 2017)

Surveys should be undertaken in June. Quadrats permanently marked with 1.6m star pickets with yellow caps in each corner. The north east corner pegs marked with white stripes denoting the quadrat number (eg 2 stripes = Q2). As the quadrats are permanently marked, they are suitable for future scoring and analysis of change, for monitoring purposes. Flora specimens should be collected from the central core mound spring seepage areas, and the damplands that surround the springs. Where suitable, flora specimens to be provided to the WA Herbarium for lodging. The quadrat information for each site include:

- GPS location
- soil and landform
- comprehensive flora list
- vegetation structure
- vegetation condition
- threatening processes
- management recommendations

Physico-chemical sampling (from Bennelongia 2017)

Physico-chemical information includes electrical conductivity (EC), pH and temperature (measured in-situ with a WP 81 field meter), water samples (collected for laboratory analysis by ChemCentre, Bentley, WA), and analytes (assessed for each sample - TDS, pH, EC, major ions, ammonia, nitrate, nitrite, soluble reactive phosphorous (P_SR), total N and total P).

Invertebrate sampling (from Bennelongia 2017)

Aquatic invertebrates are collected with a bilge pump. A 1m length core of consolidated peat is extracted and the hole allowed to fill with porewater. Water is then pumped through a 53µm net using the bilge pump and retained material preserved in 100% ethanol. Owing to the low transmissivity of the mound substrate (mostly detritus and peat) it is necessary to dig a small well (i.e. 30cm x 30cm) around the base of the pump to allow water to infiltrate the pumping zone. This results in the possibility of collecting incidental 'wash-in' surface water taxa. Sorting is carried out in the laboratory under dissecting microscopes and all aquatic invertebrates identified to species level where possible. Animals dissected and examined under the compound microscopes as necessary. Species are identified using relevant keys, where available; otherwise, appropriate anatomical features from keys are used to characterise undescribed species, to which voucher codes are assigned.

Some samples can be collected by sweep-netting through a range of surface water habitats.

42. Are there other any aspects relating to the survival of this ecological community that you would like to address?

No

Section 3 - Justification for this nomination

In order for the nomination to be considered further, one or preferably more of the following criteria need to be fulfilled and substantiated. A clear case for why the ecological community is eligible for listing under the criteria is required, including evidence as to how it meets the requirements for listing under a particular listing category, e.g. 'David *et al*. (1999) finding of 95% decline in geographic distribution suggests it should be listed as critically endangered'. The type of data available will determine which criteria will be used to justify the application of a listing category.
At least one criterion must trigger the thresholds of a listing category as indicated in the Attachment. Criteria may be of different levels of listing category e.g. Criterion 1 = CR and Criterion 3 = VU.

43. Provide data that demonstrates why the ecological community meets at least one of the following criteria for the nominated listing category.

Please use data provided in previous sections to demonstrate how it specifically meets at least one of the following criteria. Advice on how to interpret the listing criteria is in Attachment A. Provide a response for every sub-criterion.

Criterion A: Reduction in geographic distribution.

Criterion A	
☐ CR ☐ EN ☐ VU ☒ not eligible	☐ **A1** ☐ **A2a** ☐ **A2b** ☐ **A3**

Justification for assessment under Criterion A:

For criterion A, the ecosystem was assumed to collapse when the mapped distribution declines to zero.

There is no evidence to indicate the organic mound spring sedgeland community of the North Kimberley bioregion has incurred the threshold ≥30% reduction in geographic distribution over any 50-year time period, or a ≥50% reduction since ~1750 (ie. the minimum requirements to meet the category VU under criterion A).
Does not meet criterion A

Criterion B: Restricted geographic distribution.

Criterion B	
☒ CR ☐ EN ☐ VU ☐ not eligible	☒ **B1** (specify at least one of the following) ☐ **a)(i)** ☐ **a)(ii)** ☐ **a)(iii)** ☒ **b)** ☐ **c);** ☐ **B2** (specify at least one of the following) ☐ **a)(i)** ☐ **a)(ii)** ☐ **a)(iii)** ☐ **b)** ☐ **c);** ☐ **B3** (only for Vulnerable Listing)

Justification for assessment under Criterion B:

For criterion B, the ecosystem was assumed to collapse when the mapped distribution declines to zero.

B1: The extent of a minimum convex polygon enclosing the occurrences of the organic mound spring sedgeland community of the North Kimberley bioregion is 1,137km^2 (≤2,000km^2, which is less than the threshold minimum for CR). There is also evidence of continuing decline in the community from the impacts of cattle and weed invasion, and inferred from future changes to the hydrological regime with groundwater abstraction. Therefore, the community's status under criterion B1 is critically endangered.
B2: The organic mound spring sedgeland community of the North Kimberley bioregion is estimated to occupy seven 10 × 10km square grid cells (threshold for EN is 20 and for CR is two grid cells). As for Criterion B1, there is also evidence of continuing decline in the community from the impacts of cattle and weeds; and inferred from future changes to the hydrological regime with groundwater abstraction. Therefore, the community's status under criterion B2b is endangered.
a): Inadequate data are available to measure decline in spatial extent, environmental quality or disruption to biotic interactions to support ranking under B1a or B2a.

b): Historically, decline was observed from the impacts of cattle. Although all the occurrences have been fenced, cattle continually damage the fences and are able to access some springs. This results in damage to the vegetation and causes erosion. Grader grass (*Themeda quadrivalvis*) is present at four occurrences and has the potential for major impacts to the mound springs. Other current observed threats are cattle damage at other occurrences, too frequent or intense fires and inferred future changes to the hydrologic regime associated with groundwater abstraction. Groundwater is currently exploited to provide drinking water for stock and further development of stock usage at some stations is muted. This has the potential to result in an increase in water usage and abstraction. *Banksia dentata* deaths observed upslope of the core seepage zone at MtElizabeth2a/b (Gap Spring) may relate to damage associated with hydrological changes and banksias within the spring area at MtElizabeth3a (Mud/Kangaroo spring) also appeared stressed when surveyed in 2019.
c): The community exists at three threat-defined locations based on their location on three different pastoral leases and therefore subject to differing management regimes and threats (threshold for CR is one and for EN is five threat-defined locations).
B3: Known from three threat-defined locations and prone to effects of human activities or stochastic events within a very short time period in an uncertain future and thus capable of collapse or becoming CR within a very short time period (meets VU under B3 as <5 threat defied locations).
The organic mound spring sedgeland community of the North Kimberley bioregion is known from three locations and therefore meet vulnerable status under criterion B3.

Meets CR under B1b.
Meets EN under B1c, B2b, B2c.
Meets VU under B3

Criterion C: Environmental degradation based on change in an abiotic variable.

Criterion C	
☐ CR ☐ EN ☐ VU ☒ not eligible	☐ **C1** ☐ **C2** ☐ **C3**

Justification for assessment under Criterion C:

A significant abiotic variable that affects the community is considered to be loss of peat substrate from frequent or intense fire. Collapse is defined as complete loss of the peat substrate that supports the community. An increase in the fire regime within the community has the potential to alter the floristic structure and composition, removing the vegetation, and the organic soil that support both the flora and invertebrate assemblages. The peat substrate of the mound spring requires particular fire management considerations as it can be damaged or destroyed by fires that smoulder for long periods. Available data indicate that degradation of the peat substrate is minimal and unlikely to meet the minimum thresholds for proportion of the extent (≥30%) with ≥30% proportional severity of disruption of abiotic processes over any 50-year period, or ≥50% since ~1750 with ≥50% proportional severity to meet VU under criterion C. The impact of future fires is unknown.

Does not meet criterion C.

Criterion D: Disruption of biotic processes or interactions based on change in a biotic variable.

Criterion D	
☐ CR ☐ EN ☐ VU ☒ not eligible	☐ **D1** ☐ **D2** ☐ **D3**

Justification for assessment under Criterion D:

The most significant biotic variable affecting the community is considered to be physical impacts of grazing and trampling by cattle. Collapse under criterion D is defined as a decline in vegetation condition to totally degraded (Bush Forever scales; ie beyond recovery) as a consequence of grazing and trampling by introduced fauna. It was estimated that 86% of the community was in good condition when last surveyed between 2015 and 2019. Therefore there is no evidence to indicate that the community meets the minimum thresholds for vulnerable under criterion D: ie ≥30% of the extent of the community affected to at least 30% severity over any 50-year period, or ≥50% of the extent affected to ≥50% severity since ~1750.

Does not meet criterion D.

Criterion E: Quantitative analysis that estimates the probability of ecosystem collapse.

Criterion E	
☐ CR ☐ EN ☐ VU ☒ not eligible	

Justification for assessment under Criterion E:

The ecosystem was not assessed under Criterion E as there were no quantitative estimates of the risk of ecosystem collapse.

Summary assessment against IUCN RLE Criteria

Criterion	Rank indicated	Overall conclusion
A1	-	• Does not meet criterion
A2a	-	• Does not meet criterion
A2b	-	• Does not meet criterion
A3	-	• Does not meet criterion
B1a	-	• EOO is ≤2,000km^2 • Inadequate available data to indicate if decline in spatial extent, environmental quality or disruption to biotic interactions that would meet lowest thresholds of the criterion (VU) • Does not meet criterion
B1b	CR	• EOO is ≤2,000km^2 • Threat from cattle impacts, weed invasion, erosion and frequent fire, and inferred future changes to hydrology • Meets CR as level of threat considered 'non-trivial'.
B1c	EN	• EOO is ≤2,000km^2 • Ecosystem exists at three threat-defined locations based on the threat from cattle impacts and inferred hydrological change • EOO and number of threat-defined locations indicate rank EN.
B2a	-	• AOO is seven grid cells • Inadequate information available to indicate decline in a measure of spatial extent, environmental quality and disruption to biotic interactions that would meet minimum thresholds of the criterion (VU) • Does not meet criterion
B2b	EN	• AOO is seven grid cells • Threat from grazing, trampling, weed invasion, frequent fire, and inferred future changes to hydrology • Meets EN as level of threat considered 'non-trivial'
B2c	EN	• AOO is seven grid cells • Ecosystem exists at three threat-defined locations based on the threat from cattle impacts and inferred hydrological change • AOO and number of threat-defined locations indicate rank EN.
B3	VU	• Known from three threat-defined locations • Prone to the effects of human activities or stochastic events within a short time period including introduced fauna, weed invasion, and frequent fire, and inferred future changes in hydrology and drying and warming climate • Meets criterion for VU
C1	-	• Does not meet the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over past 50 years to meet VU.
C2	-	• Does not meet the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU.
C3	-	• Does not meet the minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since ~1750 to meet VU.
D1	-	• Does not meet the minimum thresholds for proportion of the extent (≥30%) and proportional severity of disruption of biotic processes (≥30%) over past 50 years to meet VU.
D2	-	• Does not meet the minimum thresholds for proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over any 50-year period to meet VU.

D3	-	• Does not meet the minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of biotic processes (≥50%) since ~1750 to meet VU.
E	NA	• No quantitative estimates of the risk of ecosystem collapse.
		Meets CR under B1b. Meets EN under B1c, B2b, B2c. VU is plausible under B3. *The highest risk category obtained by any of the assessed criteria will be the overall risk status of the ecosystem'* (IUCN RLE Guidelines V1.1 page 42). **Meets CR under B1b.**

Section 4 – References/Standard of Scientific Evidence/Critical habitat

Note: The opinion of appropriate scientific experts may be cited (with their approval) in support of a nomination. If this is done the names of the experts, their qualifications and full contact details must also be provided in the reference list below. Harvard style of referencing is preferred.

44. Please provide copies of key documentation/references used in the nomination.

Barrett, M. and English, V. (2017) A flora and vegetation survey of North Kimberley mound springs, Mt Elizabeth Station. Department of Parks and Wildlife, WA.

Bennelongia Environmental Consultants (2017) Ecological Character of Kimberley Mound Springs. Bennelongia Environmental Consultants.

Carwardine, J., O'Connor, J.T., Legge, S., Mackey, B., Possingham, H. and Martin, T. (2011) Priority threat management to protect Kimberley wildlife. CSIRO Ecosystem Sciences, Brisbane.

Chemello, D. (2015) Mound Spring Survey August 2015. Department of Parks and Wildlife.

Chemello, D. (2019) Mound spring visit July 2019. Department of Parks and Wildlife.

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.

Department of Biodiversity, Conservation and Attractions (draft 2019) Biodiversity Survey, Mapping, Delineation and Assessment of Selected Organic Mound Springs of the Kimberley Region. Department of Biodiversity, Conservation and Attractions, Perth.

Government of Western Australia (2000) Bush Forever. Department of Environmental Protection, Perth.

Halse, S. (2001) Comments on Kimberley Mound Springs sampled by Sally Black. Unpublished Report, Department of Conservation and Land Management.

Keighery, B.J. (1994) Bushland Plant Survey. A Guide to Plant Community Survey for the Community. Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia.

Rangeland NRM Western Australia (2011) The Kimberley Project Group 2009−2011. Caring for Our Country.

45. Statement on the Standard of Scientific Evidence

Published data on the organic mound spring sedgeland community of the North Kimberley bioregion was sufficient to apply some of the criteria in the Red List of Ecosystems. The outcomes of the assessment are considered robust for the criteria that were applied.

46. Has this document been reviewed and/or have relevant experts been consulted?
If so, indicate by whom and provide their contact details.

The document was reviewed by the following people:

Nature Conservation Coordinator, DBCA East Kimberley District.

Principal Ecologist, DBCA Species and Communities Program.

DBCA Principal Research Scientist, Biodiversity and Conservation Science.

47. Do you wish to propose any areas of habitat for consideration as Critical Habitat for the nominated community? If so, refer to Ministerial Guideline No 5 and attached a separate nomination proposal addressing the matters required under that guideline. Indicate location/s including a map, and attached shapefiles.

Section 5 - Nominator Details & Declaration

48. Contact Details

Note: Nominator details are subject to the provision of the *Privacy Act 1988*

Title/Full Name	[redacted]
Organisation or Company name	Department of Biodiversity, Conservation and Attractions
Postal address	17 Dick Perry Avenue, Kensington Post: Locked Bag 104, Bentley Delivery Centre, WA 6983.
Email	[redacted]
Phone	[redacted]
Fax	

49. Declaration

Signature (Or insert electronic signature)	***I declare that the information in this nomination form and any attachments is true and correct to the best of my knowledge.***
Date signed	

Section 6 – Completed nomination form checklist

Please check all items on this list have been completed or are included with your nomination.

- ☐ I have read and applied the further information and guidelines for completing this nomination form in Attachment A
- ☐ Nominator details including name, address contact phone number included
- ☐ Name of the EC
- ☐ Any other names it is known by
- ☐ Map included or attached
- ☐ References cited
- ☐ If questions are left unanswered, a statement indicating that insufficient information is available

A description of:

- ☐ Biological components of the ecological community
- ☐ Non biological components of the ecological community
- ☐ Key interactions and functional processes
- ☐ Characters distinguishing it from other ecological communities
- ☐ Key species (dominant, characteristic or diagnostic, threatened etc)
- ☐ Known or estimated current extent of the ecological community
- ☐ Past/current/future threats including actual/potential, how/ where, how being/how could be abated
- ☐ Which listing category/categories it should be listed under and why

How to lodge your nomination

Completed nominations may be lodged either:

1. by email to: **communities.data@dbca.wa.gov.au**

If submitting by email, please also mail hard copies of attachments that cannot be emailed.

OR

2. by mail to: Species and Communities Branch
Department of Biodiversity, Conservation and Attractions, WA Government
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

If submitting by mail, please include an electronic copy on memory stick or CD.

Appendix 1. Organic mound spring sedgeland community of the North Kimberley bioregion community (red)