Section 1 – Eligibility for Listing		
1. Name of the ecological community		
Perched wetlands of the Wheatbelt region with extensive stands of living swamp sheoak (*Casuarina obesa*) and paperbark (*Melaleuca strobophylla*) across the lake floor.		
2. Listing Category for which the ecological community is nominated		
	WA Biodiversity Conservation Act	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
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?
Perched wetlands of the Wheatbelt region with extensive stands of living swamp sheoak (*Casuarina obesa*) and paperbark (*Melaleuca strobophylla*) across the lake floor.

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

The ecological community is referred to as above by the Department of Biodiversity, Conservation and Attractions, and data collected from the ecological community is saved and stored in the departmental TEC database, including the name.

The ecological community has been listed as follows:

The community was listed under the EPCBC Act when it came into force on 16/07/2000

In 2005, the TEC was recognised as an environmentally sensitive area under the *Environmental Protection Act 1986.*

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).

This ecological community does not appear to intergrade with other ecological communities. It is distinct in its dominant flora and vegetation structure (Low Open Woodland to Low Open Forest of *Casuarina obesa* and *Melaleuca strobophylla*), and the perched nature of the wetlands. The community will hereafter be referred to as Perched Wetlands of the Wheatbelt.

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.

These large ephemeral wetlands occur in the inland agricultural area of south-west Western Australia, and support intact *Casuarina obesa* and *Melaleuca strobophylla*-dominated stands of vegetation over the lake floor.

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).

- Occurrence 1 (DULB01) Low open woodland or low open forest and low closed forest in heteroform arrangement. Low open forest or woodland or cleared area surround.
- Occurrence 2 (LEE1) Open Low Woodland A
- Occurrence 3 (Middleton) Low woodland A of *Casuarina obesa* and *Melaleuca strobophylla* over grass (season swamp). Wetland is surrounded by a Low forest A *Eucalyptus loxophleba* over grass.
- Occurrence 4 (TOOL01) Low open woodland or low open forest and low closed forest in heteroform arrangement. Low open forest or woodland or cleared area surround.
- Occurrence 5 (WALB01) Low open woodland or low open forest and low closed forest in heteroform arrangement. Low open forest or woodland or cleared area surround.
- Occurrences 6 and 7 (DULB03 and DULBIN03) no info in TECDB.

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 occurrences of this community are perched lakes on clay or valley fill deposits, with the water in each occurrence is described as;

- Occurrence 1 (DULB01): Subhaline, poikilohaline – brackish
- Occurrence 2 (LEE1): Fresh to brackish
- Occurrence 3 (Middleton): Bores to the west of the remnant containing this occurrence have fresh water
- Occurrence 4 (TOOL01): Subhaline, poikilohaline – brackish.
- Occurrence 5 (WALB01): Subhaline, poikilohaline – brackish

Occurrences 6 and 7 (DULB03 and DULBIN03) are close to DULB01 and similar water quality is expected. (DBCA 2017) states that "Beneath Toolibin Lake, groundwater levels are lower due to groundwater abstraction through pumping. However, when the pumps are turned off for extended periods, groundwater levels rebound to levels close to the ground surface. This means it is likely that groundwater levels are near the surface within lakes that occupy the valley floor in nearby reserves (e.g. Dulbining and Walbyring lakes)."

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

From DEC (2012). Wetlands that receive run-off and rainfall, but not groundwater, are often referred to as perched wetlands. Perched wetlands have a layer of impermeable or low permeability layer of rock or soil that retains the rainwater and prevents it from infiltrating deeper into the ground. Perching can be caused by various layers, including clays, ironstone, calcrete and granite. A sufficiently thick layer of fine textured soils, such as clays, near the land surface can trap water on or close to the surface because they are less permeable and have a low capacity for water to move through them ie low hydraulic conductivity. Water loss in perched wetlands occurs mainly through evapotranspiration and surface outflows, although perched wetlands formed over a layer of low permeability soils may also have a small amount of leakage into lower layers.

From Department of Environment (2005). Land clearing and the replacement of deep-rooted perennial species with shallow-rooted annual cropping species in the Wheatbelt region of Western Australia has resulted in a reduction in evapotranspiration. This has in turn caused a rise in watertables and mobilisation of salt previously stored deep within the soil profile. These processes have had a two-fold impact on the wetlands and waterways of the Wheatbelt. The first impact of land clearing is altered hydrology. Raised watertables have caused an increase in the area of waterlogged land and increased runoff. Waterlogging of low-lying areas has affected vast areas of land in the Wheatbelt, killing vegetation not able to cope with waterlogged soils and resulting in altered ecosystems, and an accompanying loss of biodiversity. Another impact of clearing of native vegetation in the Wheatbelt has been the mobilisation of salt previously stored deep below the soil surface. This process is referred to as secondary salinization and affects many streams, rivers and wetlands of the Wheatbelt.

As a consequence of clearing of deep-rooted vegetation over 90% of the catchments of this community over the last 100 years, rising groundwater has resulted in increased inundation and salinization in the habitat of the community.

Toolibin Lake covers 65% of the total area covered by this community and has been subject to considerable study and amelioration of hydrological change since 1994. Rutherford (2020) provides an analysis, summary and new synthesis of hydrological studies on Toolibin Lake.

From Rutherford (2020) "A new conceptualisation has been produced from the integration of datasets and informs us that the movement of groundwater and solutes are slower than previously estimated…the influence of

changes in climate, in the form of infrequent episodic summer rainfall and reduced annual average rainfall became apparent in the early 2000s (Muirden and Coleman 2014). This resulted in reductions in the frequency and duration of ephemeral wetland hydro-periods, which wasn't optimal for either the flushing of stored solutes or the recovery of vegetation to minimise evaporation on Toolibin Lake.

The perched lakes are filled with surface run off water (rainfall) from the surrounding landscape. The figure below is a conceptual hydrological model from DBCA (2017) from Rutherford (in prep). The figure also notes the close connections between hydrological processes operating at Toolibin, Dulbinning and Walbyring lakes.

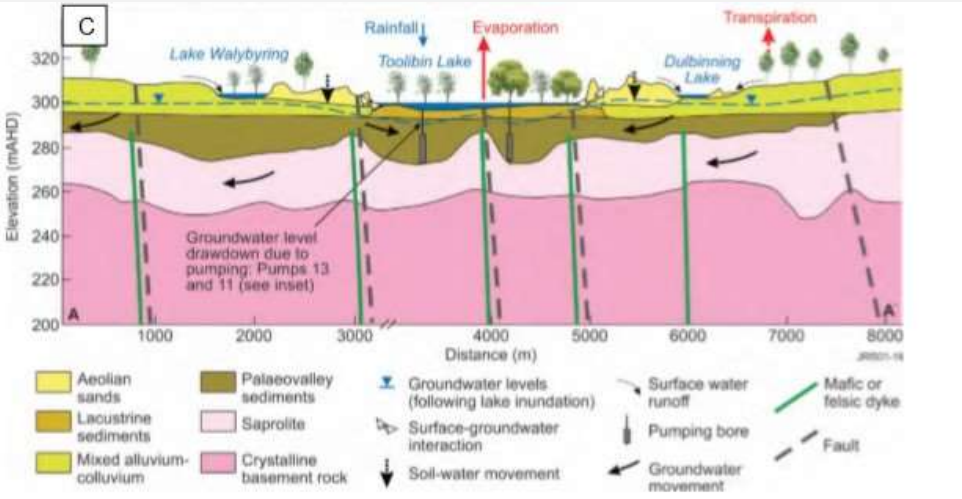

Figure 5: Toolibin Lake conceptual hydrological model

Note: (from Rutherford (in prep); (a) May 2015 orthophoto showing the location of Toolibin Lake pumping bores in relation to the extent of palaeovalley sediments mapped by airborne geophysics (b) Spatial distribution of regolith materials and water balance dynamics along cross section A-'A and (c) October 2006 groundwater gradients during lake inundation event (note the drawdown from groundwater pumping is sustained with >0.5m of lake water and major gradients are moving groundwater both towards the lake as well as from the central area of the lake towards the margins)

Figure 1: Conceptual Hydrological Model for Toolibin Lake (Figure 5 from Rutherford (in prep)).

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.

See Section 7.

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.

DBCA (2017) When the lakes in the catchment fill with water for at least six months, they provide breeding and feeding habitat for migratory waterbirds, including the freckled duck (*Stictonetta naevosa*), which has a very small breeding population in south-west WA. The lakes also support breeding colonies of cormorants, egrets, night herons and spoonbills that are otherwise scarce or absent in the inland agricultural area of south-west WA. The Toolibin Lake catchment boasts more than 300 natural plant species and 18 natural mammal species as well as a wide diversity of insects, reptiles, amphibians and terrestrial birds.

DPAW (2013) notes that Toolibin Lake Occurrence 4 (Tool01) supports the EPBC listed species Australasian Bittern (resident waterbird) and malleefowl (terrestrial resident), EPBC migratory species including common greenshank, glossy ibis, great egret, oriental plover, rainbow bee-eater, wheatbelt threatened freckled duck (resident waterbird). The western rosella (inland species) and white-browed babbler (terrestrial resident) also occur.

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

Bell, D. and Froend, R. (1990). Mortality and growth of tree species under stress at Lake Toolibin in the West Australian Wheatbelt.

Bourke, L. and Rutherford, J. (2018), Hydrological response of Toolibin Lake to inundation in February 2017, Department of Biodiversity, Conservation and Attractions, Kensington, Western Australia.

Department of Biodiversity, Conservation and Attractions (2017). Toolibin Lake Catchment Recovery Plan (2015) 2015–35
https://www.dpaw.wa.gov.au/images/documents/conservation-management/wetlands/recovery_catchments/toolibin_recovery_plan_2015-35.pdf

Department of Conservation and Land Management (1998). Major Project Review Toolibin Lake Recovery Plan Project Number 350 Report prepared by A Smith and K J Wallace on behalf of the Toolibin Lake Recovery Team October 1998, Department of Conservation and Land Management

Department of Conservation and Land Management (2003). Water balance and salinity trend, Toolibin catchment, Western Australia. Report prepared by Shawan Dogramaci, Richard George, Geoff Mauger and John Ruprecht for the Department of Conservation and Land Management.

Department of Parks and Wildlife (2013). Toolibin Lake Natural Diversity Recovery Catchment Project Summary. https://www.wickepin.wa.gov.au/Assets/TLNDRC_project_summary.pdf

Rutherford, J. (2020) Hydrological conceptualisation of Toolibin Lake and catchment. Department of Biodiversity, Conservation and Attractions, Perth.

Toolibin Lake Recovery Plan (1994). Prepared by the Toolibin Lake Recovery Team and Toolibin Lake Technical Advisory Group, September 1994. Perched wetlands of the Wheatbelt region with extensive stands of living sheoak and paperbark across the lake floor (Toolibin Lake) Recovery Plan (1994).

WAWA (1987). The Status and Future of Lake Toolibin as a Wildlife Reserve. A report prepared by the Northern Arthur River Wetlands Committee. Western Australian Water Authority. Report No. WS 2.

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.

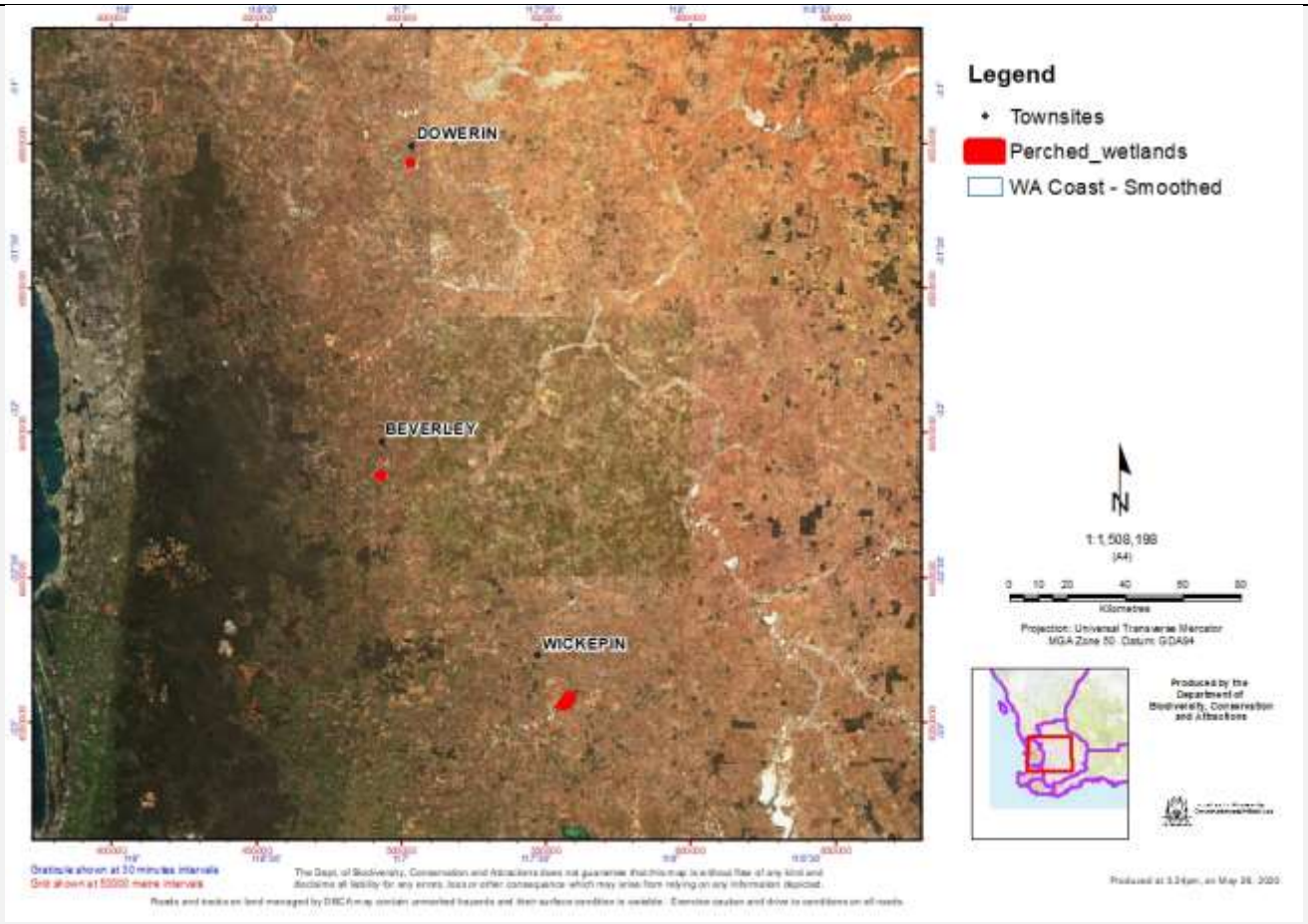

Figure 2: Distribution of the Perched wetlands of the Wheatbelt region with extensive stands of living swamp sheoak (*Casuarina obesa*) and paperbark (*Melaleuca strobophylla*) across the lake floor

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)?

446 ha

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)

Based on ~90% loss of the community the community originally covered ~ 4460ha (100/10x446ha)

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

Based on the level of vegetation clearing in the regions in which the community occurs, it is estimated that there has been a ~90% reduction in the extent of this ecological community since 1750.

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

The community may be subject to further loss due to hydrological impacts and weed invasion in particular, that may result in further decline or collapse of some occurrences.

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.

Patch sizes are: Tool01-289.1ha; Dulb01-19.2 ha; Dulb03-7.1ha; Dulbin03-15.2ha; Walb01-53.2ha; Middleton-45.1ha; Lee-17.8ha.

The current total known area of occurrences for this ecological community is 446.6ha. One occurrence, DULB03 is under 10ha, 5 occurrences (DULB01, WALB01, Middleton, DULBIN03 and LEE1) are between 10ha and 100ha in size, and one occurrence (TOOL01) is ~ 289ha.

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.

The minimum viable condition 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. from partial clearing, dieback, logging, grazing. 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 condition if they are subject to very minimal disturbance.

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 matrix in which the community occurs is very highly cleared agricultural landscape. The community is highly fragmented, with five occurrences in relatively close proximity separated by a road. Other isolated occurrences are approximately 100km and 200km north west of the other occurrences, separated by mostly cleared agricultural lands.

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.

Historical loss of whole occurrences through clearing of vegetation has caused the decline of all functionally important species in some locations. Bell and Froend (1990) discuss the response of some of the dominant and functionally important species within Occurrence 4 (TOOL01- Lake Toolibin) to increased salinity "Tree species occupying the bed and margins of Lake Toolibin…were permanently marked in 1983 and then remeasured after 5 years to determine survival, growth and vigour. Trees of the lake margins *Eucalyptus rudis* and *Melaleuca strobophylla* showed the greatest mortality, greatest reduction in vigour classification and smallest growth increments to the environmental conditions of the lake now being affected by secondary salinization…*Casuarina obesa* populations in the more saline areas of the lake environment showed increased mortalities, decreased vigour and reduced growth compared to the trees of area of the lake with more favourable conditions."

Hydrological flows of more saline water are managed to some degree in Toolibin Lake. The surface water management infrastructure regulates surface water to Toolibin Lake and its surrounding nature reserves that

contain additional occurrences of the community (Dulbining and Walbyring). Saline surface flows are also diverted around one occurrence on private land. These controls are expected to help sustain the key tree species in these occurrences.

18 a. If yes, which species are affected?

See section above.

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

The species *Melaleuca strobophylla* and *Casuarina obesa* comprise the dominant and defining structural strata of this ecological community and their loss would constitute collapse of the community if left unmanaged. The extent of their decline over a five year period is described in Section 18 above.

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 loss of vegetation from a buffering perspective amplifies the effects of clearing, through ability of weeds to infiltrate the occurrences, and outcompete native species for resources, resulting in changes to community structure and species diversity.

The prevalence of weeds recorded in five of the occurrences, and the absence of management of weeds in six of the seven occurrences leads to the inference that unmanaged weed invasion will cause continuing decline in environmental quality of this community.

Reduction of inflow events including incident rainfall also impact the community by reducing available fresh water required to support dominant trees, and understorey species.

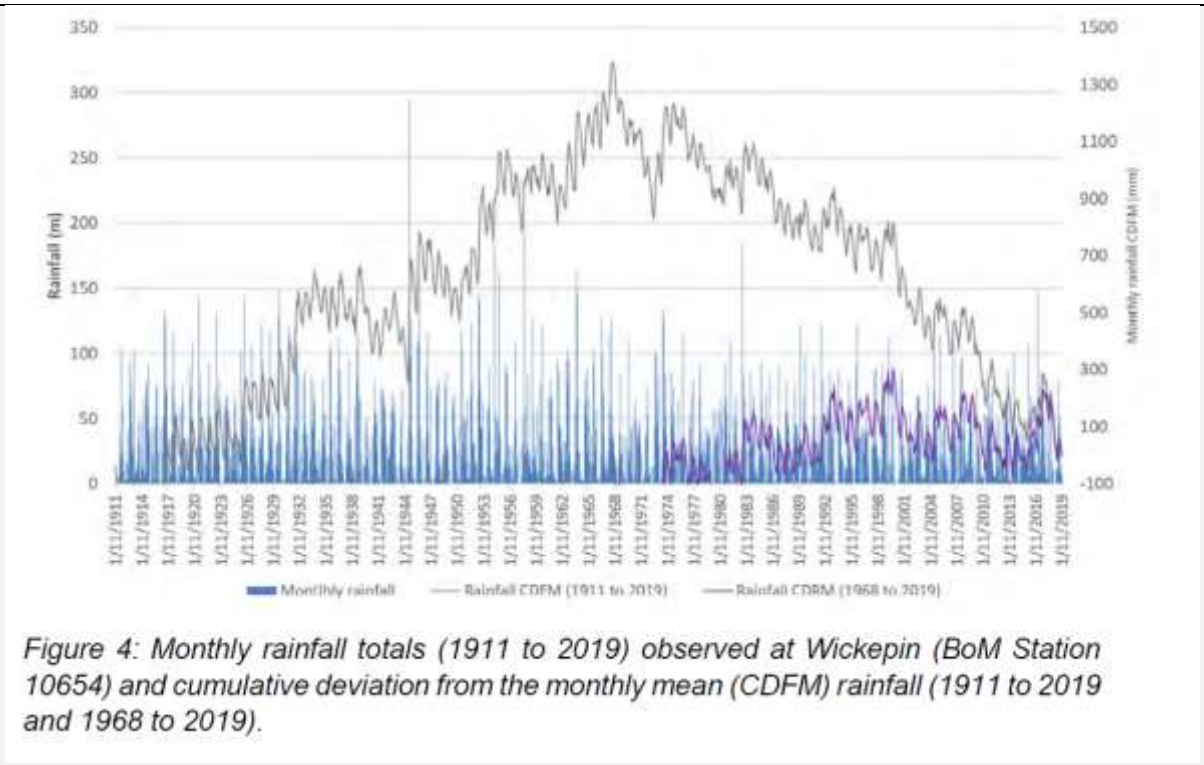

Figure 4: Monthly rainfall totals (1911 to 2019) observed at Wickepin (BoM Station 10654) and cumulative deviation from the monthly mean (CDFM) rainfall (1911 to 2019 and 1968 to 2019).

Figure 3: Monthly rainfall totals (1911 to 2019 - blue) observed at Wickepin (BoM Station 10654) and cumulative deviation from the monthly mean (CDFM) rainfall (1911 to 2019 (grey) and 1968 to 2019 (purple) from Rutherford (2020)

Monthly rainfall totals (1978 to 2017) observed at Wickepin (BoM Station 10654) (ave annual rainfall 408.5mm) and cumulative deviation from the monthly mean (CDFM) rainfall (1911 to 2017). Decreases in average annual rainfall became evident in the 1970s.

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).

Most occurrences of wooded freshwater wetlands in the central wheatbelt were cleared historically. The remainder are largely subject to altered hydrology through increased inundation and/or salinisation. It is likely that the current known extent of the community is its full extent, given the limited native vegetation remaining in the region, and in particular the extremely limited occurrence of wooded freshwater wetlands.

Five of the known occurrences of this community have been surveyed since 1994 (Occurrence 1 DULB01 in 1994, Occurrence 2 LEE1 in 1998, Occurrence 3 Middleton in 2004, Occurrence 4 TOOL01 in 1994 and 2018, and Occurrence 5 WALB01 in 1994). Occurrences 6 and 7 (DULB03 and DULBIN03) are within Dulbining Reserve, where hydrological studies have been conducted (DBCA 2018, Bourke and Rutherford 2018, and CALM 2004).

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.

Flora and vegetation surveys of Occurrences 6 (DULB03) and 7 (DULBIN03) would contribute to the description of the community.

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

The hydrology of Toolibin Lake in particular has been very well studied (from Department of Conservation and Land management 2003): "Toolibin Lake and its catchment is one of the most extensively investigated areas in terms of groundwater and surface water hydrology and salinity management strategies in Western Australia.... The aim of most investigations was to understand the physical and chemical processes which caused the deterioration of the catchment and lake environment (e.g. George 1998), or to test the usefulness of various salinity management options, to control salinity of the lake." Many subsequent hydrological surveys and studies have occurred since 1993 (see references in section 12 above).

Vegetation monitoring has also occurred for Toolibin Lake. Rutherford (2020) includes a map of vegetation monitoring plots and a biomass density map, see below.

Figure 4: A. Ecoscape vegetation monitoring plots in Toolibin Lake (Ecoscape 2005) and B. Biomass density map for Toolibin Lake (Colletti *et. al*. 2014) (Figure 15 in Rutherford 2020).

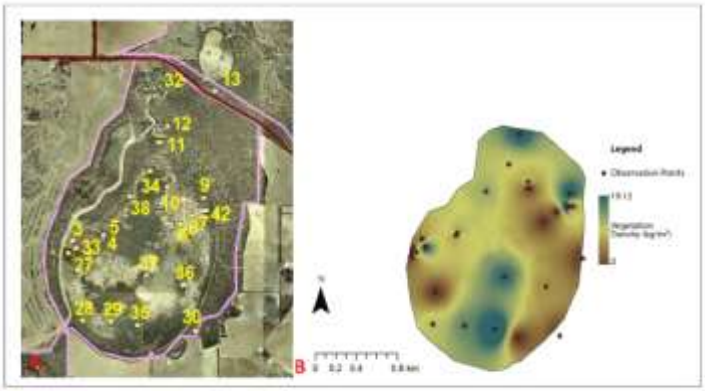

Figure 15 A. Ecoscape vegetation monitoring plots in Toolibin Lake (Ecoscape 2005) and B. Biomass density map for Toolibin Lake (Colletti et. al. 2014)

DBCA (2017) discusses ongoing hydrological monitoring undertaken at Toolibin Lake and Dulbining Lake, as follows: "Intensive groundwater and surface water investigations of the lake and catchment commenced in the 1970s when the average rainfall levels were higher and both shallow groundwater and surface water inflows were first identified as threats to biota. In the late 1990s, hydrological management systems were installed in the Toolibin Lake catchment to manage the excess groundwater and surface water to minimise the decline of the fringing and lake bed vegetation, and to maintain a functional bird habitat at Toolibin Lake. This included installation of a groundwater pumping system and surface water diversion within Toolibin Lake and enhancement of a number of ephemeral up-gradient drains. Groundwater and surface water monitoring systems were also put in place to increase understanding of how water and salt were moving in the catchment, and to assess the performance of the management systems…Reductions in average annual rainfall and soil moisture have caused drought stress to deep-rooted perennial vegetation over the past 10 to 15 years. Some vegetation death has occurred but this has been difficult to quantify spatially due to the sparse canopy of many species. Colletti *et al*. (2015) modelled water use of deep-rooted perennial natural species, calculating transpiration rates and changes in biomass during lake inundation. Results suggest that under a drier climate, competition for water between species increases."

(DBCA, 2017) "Randomly located photo-point monitoring sites have been established to collect information on the properties and processes for each vegetation element. Randomising site location is critical to avoid selection bias

and improve causal inferences, better enabling information to be generalised to the entire element and to capture the overall impacts of the various threatening processes. Provisional limits of acceptable change for vegetation elements are described as follows: For each vegetation element, the abundance (measured as per cent cover) of any key indicator natural species should decrease by no more than 25 per cent in no more than 25 per cent of monitoring sites (in relation to the initial reference estimates) during the management period.

Specific software has been developed to facilitate the management of the photo-point data and the monitoring of LoAC (limits of acceptable change for species abundance and key threatening processes) .... Additionally, data from the photographs may allow other properties such as intactness to be quantified for future values-delivery analyses and will allow for the subjective assessment of aspects of the vegetation such as condition and reproduction."

(DBCA, 2017) "A weed management program is in place for Toolibin Lake and adjacent nature reserves. A photo-point monitoring program is in place that focuses on monitoring the introduction and spread of weed species in order to instigate a management response to control or remove species that pose a threat to priority biological elements."

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 viable condition 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. from partial clearing, dieback, logging, grazing. Presence of very aggressive weeds." (Keighery (1994) Vegetation Condition Scale in 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?

For the purposes of relating condition to IUCN Criteria, good condition related to WA condition categories 'Very Good to Pristine' as below (see ^ and Table 1 below) are considered to be in good condition, so therefore 135.2 ha or 31.9% of occurrences with known condition are considered to be in good condition, and contain high native plant species diversity, maintain integrity of vegetation structure, and minimal weed/introduced species cover. All occurrences are in rural areas and are subject to the ongoing pressures/disturbances associated with hydrological change, salinization, weed infiltration, and grazing etc.

Table 1: Known vegetation condition of occurrences of Perched wetlands of the Wheatbelt region

Condition Ranking (Keighery 1994) from Government of Western Australia 2000)	**Hectares**
Excellent	62.9
Very Good	72.3
Good	289.1
Total	**424.3ha**

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 repeated fires, dieback, logging, grazing, 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?

For the purposes of relating condition to IUCN Criteria, medium condition relates to WA condition categories 'Very Good to Good' as below (see ^ below and Table 1 above), so therefore 289.1ha or 68.1 % of occurrences with known condition are considered to be in medium condition, and contain medium plant species diversity, reduced of vegetation structure, and a medium level of weed/introduced species cover.

^This includes vegetation ranging from 'Very Good-Good' and 'Good' - Vegetation structure altered but retains basic vegetation structure or ability to regenerate it, obvious signs of disturbance are present, from activities including partial clearing, dieback, logging, grazing, and very aggressive weeds are present, with low native plant diversity (5 – 50%).

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?

For the purposes of relating condition to IUCN Criteria, poor condition in this instance relates to WA condition categories 'Degraded' and 'Completely Degraded', (see ^ below and Table 1 above), so 0 ha or 0% of known occurrences are considered to be in poor condition, with vegetation containing minimal native flora, presence of aggressive weeds, and evidence of much disturbance.

^ This includes vegetation ranging from 'Degraded' Basic vegetation structure severely impacted by disturbance, the vegetation requires intensive management, and disturbance such as partial clearing, dieback, logging and grazing 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 climate change as a threat to the ecological community, please refer to the Guidelines for information on how this should be addressed.

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

Table 2: Summary of threats to occurrences of the Perched wetlands of the wheatbelt ecological community**#**

Source: Threatened Ecological Communities database, and DPaW 2015 Management plan for Toolibin Lake

Occurrence	Threat	Timing
Occurrence 1 (DULB01)	Salinisation, increased inundation, grazing, altered fire regimes	Present, future
Occurrence 2 (Lee1)	Salinisation, increased inundation, weed invasion, altered fire regimes	Present, future
Occurrence 3 (Middleton)	Hydrological change, weed invasion, altered fire regimes	Past, present, future
Occurrence 4 (Tool01)	Salinisation, increased inundation, weed invasion, grazing, altered fire regimes	Past, present, future
Occurrence 5 (WALB01)	Salinisation, increased inundation, weed invasion, grazing, altered fire regimes	Past, present, future
Occurrence 6 (DULB03)	Salinisation, increased inundation, weed invasion, grazing, altered fire regimes	Past, present, future
Occurrence 7 (DULBIN03)	Salinisation, increased inundation, weed invasion, grazing, altered fire regimes	Past, present, future

Hydrological changes in the form of increased salinisation and inundation are the most significant threats to the community. The hydrology of the largest and most important occurrence of the community at Toolibin Lake has been managed artificially with groundwater pumps operating in the lake since 1994 (DPaW 2015). The implementation of the surface water management infrastructure has regulated surface water such that high saline flows are now diverted away from the lake and surrounding nature reserves that contain additional occurrences of the community (Dulbining and Walbyring). As a result of these management interventions, and aided by a drying climate in recent decades, the broad conservation values of Toolibin Lake and the surrounding reserves and the associated occurrences of this community have been maintained despite severe pressure from altered hydrology (DPaW 2015).

Groundwater rises and increased surface water flows in the Toolibin Lake catchment are typical of those commonly seen in the Wheatbelt region. Between the 1920s and 1970s the replacement of deep-rooted perennial natural vegetation with shallow- rooted, low water use annual crops and pastures resulted in catchment-scale changes to the water balance (Froend et al. 1987, George et al. 2005). This change created a water surplus, which manifests as persistent surface water run-off and groundwater recharge (Figure 5). Both processes provide more water, and water with generally higher salinities, to the biological elements within wetland systems.

Salinisation and increased water logging results in changes to structure and composition of the community with replacement of non-salt tolerant plants and increases in salt tolerant flora where hydrological controls are not effective in fully preventing increases in salinization. DBCA (2017) also notes that 'root zone anoxia and salt

toxicity' are direct risk factors for altered hydrology within the Lake Toolibin ecological community, and that 'senescence in serotinous obligate seeder (native) plants is a risk factor as a result of altered fire regimes.

(From DPaW 2015) In the late 1990s, hydrological management systems were installed in the Toolibin Lake catchment to manage the excess groundwater and surface water to minimise the decline of the fringing and lake bed vegetation. This included installation of a groundwater pumping system and surface water diversion within Toolibin Lake and enhancement of a number of ephemeral up - gradient drains. Groundwater and surface water monitoring systems were also put in place to increase understanding of how water and salt were moving in the catchment, and to assess the performance of the management systems.

Weed invasion is an additional threat to the community. The variety of the weed species is uncertain at Toolibin Lake due to the extended periods of dry experienced over the last few decades. It is likely that if periods of more frequent inundation return, such as those typical of previous decades, the issue of aquatic weeds will also need to be addressed (DPaW 2015). Altered hydrology, excessive grazing and inappropriate fire regimes may all contribute to creating disturbances that can facilitate establishment of weed species.

Altered fire regimes in the form of reduced fire frequency since 1750 results in increased senescence of the flora. The historical clearing of vegetation for agriculture and the movement of Aboriginal people from across the Wheatbelt had a profound effect on fire regimes. The landscape is now largely cleared of natural vegetation, and bushfires are actively suppressed to protect life and property, so natural fires are unable to spread. The time between successive fires on many small Wheatbelt reserves now exceeds the life cycle of many plant species dependent on fire (DPaW 2015).

(from DPaW 2015) Kangaroos and rabbits are key problem species in the catchment when they occur in high densities. The numbers of western grey kangaroos have declined across the Wheatbelt landscape as habitat loss and fragmentation have increased with clearing for agriculture. Western grey kangaroos appear to preferentially graze and browse in natural vegetation but, depending upon seasonal conditions, may spend a portion of their time in adjoining paddocks. At Toolibin Lake while kangaroos have been observed browsing on *Casuarina obesa*, it is unclear whether they are responsible for widespread damage to seedlings. Rabbits are also having a significant impact on the regeneration of natural vegetation and seedlings planted for revegetation projects throughout the catchment. They compete with natural animals for grazing resources. Agricultural crops provide a food source for rabbits. Rabbits can also disperse viable weed seed through their scats, and their latrines and warrens provide productive sites for weed establishment.

DBCA (2017) also note the threats of introduction and proliferation of pathogens, disease (*Phytophthora* infection) causing mortality in natural plant species.

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

See section 30 above.

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

See section 30 above. Weeds compete with native species, alter the structure of the community, and increased fire risk (flammable annual weed species). DBCA (2017) notes the variety of the weed species is uncertain at Toolibin Lake due to the extended periods of dry experienced over the last few decades.

Rutherford (2020) notes "The two main hydrological stressors that threaten Toolibin Lake's ecological values are caused by the long-term effects of land clearing and changed land use as well as more recent changes in climate.

The WA Wheatbelt is renowned for its lengthy time lags in exhibiting hydrological changes due to being characterised by moderate to low rainfall, subdued landscapes and sluggish aquifers."

Rutherford's (2020) also notes "The more recent rapid decline in groundwater levels indicates that deeper aquifers have become more sensitive to the current drier climate cycles. If the dry cycle continues the vadose zone will increase in thickness, which in turn will reduce discharge and evapotranspiration and encourage the vertical movement of near-surface solutes to the water table. This change is likely to help re-establish vegetation in previously seasonally waterlogged areas but will also sustain, and possibly increase, winter surface water salinity where groundwater levels intersect the land surface. Conversely, if there is a return to a wet climate cycle changes in water table salinities will be smaller and flushing in the vadose zone reduced. The lag time in groundwater levels responding to changes in the climate cycles may also play an important role. As discussed previously, in the eastern catchment groundwater in the upper landscape recharge areas responds to rainfall events slowly, which means not all measured groundwater levels reviewed here have adjusted to the long-term rainfall deficit. Therefore, discharge, possibly via interflow, upgradient of LT01, may continue to occur under dry climate cycles. The result being the continuation of higher salinity fluxes until groundwater levels show a broadscale decline."

For <u>each</u> threat describe:
322 a. How the threat has impacted on this ecological community in the past.

See Section 30 above.

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

See Section 30 above.

Grazing by native or introduced species will continue to inhibit recolonisation by native species and alter vegetation structure (rabbits and high numbers of kangaroos).

Weed invasion will continue to alter structure of the community, and increase fire risk.

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

See section 30 above.

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.

Drought, or localised floods that result in longer periods of waterlogging or increased salinisation, are considered to be the most likely natural catastrophic events for this ecological community.

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?

Altered fire regimes in the form of reduced fire frequency since 1750 have likely resulted in increased senescence of the flora. It is also likely that disturbance in the form of fire would result in increased regeneration of the flora, and increased weed invasion in the community.

Bell and Froend (1990) discuss the response of some of the dominant species of Occurrence 4 - Lake Toolibin to increased salinity "Tree species occupying the bed and margins of Lake Toolibin…were permanently marked in 1983 and then remeasured after 5 years to determine survival, growth and vigour. Trees of the lake margins *Eucalyptus rudis* and *Melaleuca strobophylla* showed the greatest mortality, greatest reduction in vigour classification and smallest growth increments to the environmental conditions of the lake now being affected by secondary salinization…*Casuarina obesa* populations in the more saline areas of the lake environment showed increased mortalities, decreased vigour and reduced growth compared to the trees of area of the lake with more favourable conditions."

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

Significant deterioration in the health of the vegetation across Lake Toolibin was first noted in the early 1970s. Revegetation works have been undertaken within Occurrence 4 (TOOL01) at Lake Toolibin for more than 20 years.

(DBCA 2017) Toolibin Recovery plan "The survey found that M. *strobophylla* has regenerated in parts of the lake over the past two decades, providing some evidence that current management has been successful (although the exact causes of the patterns of regeneration are not known)."

Bourke and Rutherford (2018) undertook hydrological surveys following a series of rainfall events across the Great Southern District. In February 2017 over a 72-hour period more than 100 mm "was delivered across the catchment area of Toolibin Lake, representing a 1-5 % probability of occurrence in any given year (greater than a 20-year ARI (Annual Recurrence Interval)…On 11th February 2017, the separator diversion gates at the inlet to Toolibin Lake were closed, thereby diverting fresh (salinities less than 1,000 mg/L total dissolved solutes (TDS)) surface water to the lake. On the 12th February 2017 water levels in the lake peaked at 2.24 m, equating to about 4,094 ML, covering a surface area of 273 Ha. The lake was inundated for over twelve months, with the recession commencing in late winter 2017. Lake water levels receded at a rate of around 4.3 mm per day, until April 2018, when the lake had receded to several isolated pools'…

"Decadal changes have produced challenges for surface water that include water flows being less frequent, shorter lived, poorly connected and harder to measure with respect to flow rates and water quality (Cattlin et al. 2004, Callow et al. 2008, Muirden and Coleman 2014). As a result, less water (fresh or saline) is being delivered to the biological elements and, as a consequence, the frequency, intensity and duration of lake hydroperiods (the period in which a soil area is waterlogged), for Toolibin and other lakes, have changed. In the same period, groundwater levels have continued to rise in deeper aquifers in some areas of the catchment ([redacted] pers. com., Rutherford et al. (in prep)). Up-gradient of the valley floor, seasonal shallow aquifers develop less often, and many bores drilled to depths of less than five metres in the uplands and valley margins have been dry since the early 2000s (Rutherford et al. (in prep)). These changes have reduced groundwater recharge as well as soil moisture levels. Beneath Toolibin Lake, groundwater levels are lower due to groundwater abstraction through pumping. However, when the pumps are turned off for extended periods, groundwater levels rebound to levels close to the ground surface. This means it is likely that groundwater levels are near the surface within lakes that occupy the valley floor in nearby reserves (e.g. Dulbining and Walbyring lakes). This also indicates that the hydrology, and the vegetation that depends on those hydrological regimes, is unlikely to continue its recovery in the absence of ongoing management interventions to stabilise groundwater levels and quality.

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).

Department of Biodiversity, Conservation and Attractions (2017). Toolibin Lake Recovery Plan 2015-35, DBCA, Perth.

https://www.dpaw.wa.gov.au/images/documents/conservation-management/wetlands/recovery_catchments/toolibin_recovery_plan_2015-35.pdf

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.

DBCA (2017) "To ameliorate…impacts particularly at Toolibin Lake and other downstream wetlands, a number of measures have been put in place. These include: revegetation with natural species to manage surface water flows and connect the conservation reserves; the installation of infrastructure to manage the water balance at Toolibin Lake through diverting surface water flows and pumping of groundwater; and monitoring of groundwater and surface water hydrology, to monitor how water and salt move in the catchment and assess the performance of the management systems, and biodiversity. A number of other threatening processes have been identified in the catchment resulting from human modification of the environment, that also require management. These include problem species, such as kangaroos, rabbits and environmental weeds, and the frequency and intensity of natural processes, such as fire regimes, that have changed substantially since colonial settlement..."

"There has been measurable improvement in the survival and regeneration of key plant species on the Toolibin Lake floor and in the surrounding area. With favourable weather conditions, waterbirds are still likely to visit and breed at Toolibin Lake and the surrounding wetlands as observed during previous fill events. The implementation of the surface water management infrastructure has regulated surface water such that high saline flows are now diverted away from the lake and its surrounding nature reserves. Groundwater levels have decreased, which coincides with the commencement of pumping in 1997 and an extended period of low rainfall... As a result of these management interventions, and aided by a drying climate in recent decades, the broad conservation values of Toolibin Lake and the surrounding reserves have been maintained despite severe pressure from altered hydrology."

Occurrence 3 (Middleton) wetland is within a remnant that was fenced in the early 1990s as part of a Remnant Vegetation Protection Scheme covenant area.

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.

- Occurrence 4 (TOOL01) is located within the Toolibin Nature Reserve (R24556) is vested with the Conservation Commission of WA, for Conservation of flora and fauna.
- Occurrence 5 (WALB01) is located within the Walbyring Nature Reserve (R 14398) is vested with the Conservation Commission of WA, for Conservation of flora and fauna
- Occurrences 1, 6 and 7 (DULBIN01, DULB03 and DULBIN 03 respectively) are located within Dulbining Nature Reserve (R 9617) is vested with Conservation Commission of WA, for Conservation of flora and fauna
- Occurrence 3 (Middleton) is Middleton Swamp, which is a treed seasonal wetland is on private land. The wetland is within a remnant which was fenced in the early 1990s as part of a Remnant Vegetation Protection Scheme covenant area.
- Occurrence 2 (LEE1) is located on private property and is being managed and conserved by the owner.

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

Occurrence 4 (TOOL01) - Lake Toolibin is actively managed, through revegetation, diversion and pumping of groundwater, bunding and monitoring of surface water and ground water hydrology (see Section 36 above).

Dulbining and Walbyring lakes are very close to Toolibin Lake and high saline flows are also diverted away from these lakes and the nature reserves that support them.

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

Lake Toolibin is a Ramsar site.

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.

DBCA (2017) The catchment has important cultural heritage values, and is located within the area of the Wilman Aboriginal language group. An Aboriginal heritage site on the western boundary of Toolibin Lake is listed with the Department of Planning, Lands and Heritage (Lake Torrbarn site ID: 4434). This unregistered artefact site is recorded as a camp. The ability to carry out customary activities on country is an important part of Aboriginal culture and connection to the land. CALM Act managed lands and waters within the catchment provide for Aboriginal people to carry out customary activities. Toolibin Lake and surrounds are recognised on the Australian Heritage Database (Registered Place Id 18116) and the State Government of Western Australia's Department of Planning, Lands and Heritage (Heritage Place Number 7312).

The Wickepin area has also become culturally important for its association with Australian author Albert Facey, who lived near the lake in the 1920s and 1930s.

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.

See section 38c above.

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).

Recovery actions through management of hydrological issues at Lake Toolibin are described in section 36 above.

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

A recovery team exist for Lake Toolibin.

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.

This ecological community can be identified through location of the dominant species, with extensive stands of living swamp sheoak (*Casuarina obesa*) and paperbark (*Melaleuca strobophylla*) across the lake floor. Water quality/conductivity of lakes that contain these two dominant species, and soil and geology assessment undertaken to determine whether the lakes are perched.

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

The close relationships and linkage of water flow in the lakes of the Toolibin catchment are evident in Bourke and Rutherford (2018). They also noted that satellite imagery captured on 28th February 2017 indicated that water levels in all of the lakes in the vicinity of Toolibin Lake appeared at, or close to, capacity.

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	☐ **A1**
☒ EN	☐ **A2a**
☐ VU	☐ **A2b**
☐ not eligible	☒ **A3**

Justification for assessment under Criterion A:

For criterion A, the community is assumed to collapse when the mapped distribution declines to zero.

From https://www.wickepin.wa.gov.au/Assets/TLNDRC_project_summary.pdf) "Over 90% of the catchment has been cleared of deep-rooted native vegetation on the last 100 years". A reduction in both geographic distribution and number of occurrences of at least 90% is inferred. Aerial photography shows the very limited remaining vegetation in the region (see Figure 2 above).

Calculations of vegetation statistics undertaken for the IBRA region of the Avon Wheatbelt (pre-1750 extent of 9,517,110 ha) indicate 18.5% of vegetation remains and 1.4% of the 1750 extent is protected for conservation. With regard to the Katanning (AVW02) IBRA subregion in which the ecological community occurs, the pre-1750 extent was calculated as 2,992,929 ha, of which 13.1% remains, and 1.27% is protected for conservation.
It is assumed that the level of clearing of the IBRA region and in the Katanning subregion reflect the clearing in this community. As data were not accessed with regard to timing, it is assumed that the clearing has occurred since 1750. The community is assumed to have been subject to a reduction in geographic distribution of ~87%. The threshold to meet endangered under A3 is 70% reduction in distribution since 1750.

Plausibly meets criteria for Endangered under criterion A3

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 community is assumed to collapse when the mapped distribution declines to zero.

B1 The Extent of Occurrence (EEO) for this ecological community is 4792km². This falls within the threshold of ≤20,000km² (endangered).
b. Community is subject to significant hydrological change, and weed invasion, that are likely to cause continuing decline in environmental quality and disruption of biotic processes within the next 20 years.
c. Community is considered to occur at 3 threat-defined locations based on 3 clusters of occurrences subject to similar hydrological processes in the catchments (threshold for EN is ≤5 threat-defined locations).
Plausibly meets EN under B1b, B1c.

B2 The Area of Occupancy (AAO) for this community is one 10x10km grid cell. Although the community occupies three grid cells, the occurrences in the centre (Middleton) and northern (Lee) cells are very small and account for <1% of the grid cell area, and negligibly contribute to risk spreading (IUCN guidelines V1.1 2017 state '*large numbers of small patches contribute a negligible risk-spreading effect to that of larger patches and a correction may be applied by excluding from the AOO those grid cells that contain patches of the ecosystem type that account for less than 1% of the grid cell area).* Using these guidelines, two cells were excluded from the AOO calculation.

This falls within the threshold of critically endangered under B2 subcriterion (≤2 grid cells).
Plausibly meets CR under B2b, EN under B1b, B1c, B2c.

B3: The number of threat-defined locations for this ecological community is 3, based on 3 clusters of occurrences that are within particular catchments and subject to similar hydrological processes. This is ≤5 threat-defined locations required to meet B3. Community therefore meets VU under Criterion B3.

Meets CR under B2b, EN under B1b, B1c, 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:

Hydrological changes in the form of increased salinisation and inundation are the most significant threats to the community. A collapse state is considered to be a level of salinization that results in total loss of the main tree species in the community (*Melaleuca strobophylla* and *Casuarina obesa*).

The hydrology of the largest and most important occurrence of the community at Toolibin Lake has been managed artificially with groundwater pumps operating in the lake since 1994 (DPaW 2015). Toolibin Lake occupies 289ha, which is 65% of the total area of the community**.** The implementation of the surface water management infrastructure has regulated surface water such that high saline flows are now diverted away from the lake and its surrounding nature reserves. Groundwater levels have decreased, which coincides with the commencement of pumping in 1997 and an extended period of low rainfall. It is therefore difficult to extricate the current status of the level of environmental degradation caused by hydrological change, from very major management interventions that have improved the status of the hydrology of Lake Toolibin. Dulbining and Walbyring lakes are very close to Toolibin Lake and high saline flows are also diverted away from these lakes and the nature reserves that support them. These two groups of lake areas represent another 21.1% of the area of the community. As a result of these management interventions, and aided by a drying climate in recent decades, the broad conservation values of Toolibin Lake and the surrounding reserves and the associated occurrences of this community have been maintained despite severe pressure from altered hydrology (DPaW 2015).

Surface flows of saline water have also been diverted to protect an occurrence on private land. In addition, broadscale replanting has been undertaken at Toolibin Lake, making assessment of the status of the stands of *Melaleuca strobohphylla* and *Casuarina obesa* in the absence of plantings impossible.

As it is not possible to assess the likely status of the community in the absence of very major management interventions in the last 26 years at the largest occurrences so it is not possible to assess the community against Criterion C.

It is possible that a number of occurrences may have reached a collapse state prior to 2020 in the absence of hydrological and other interventions.

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

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

Justification for assessment under Criterion D:

- Weed invasion is a significant threat to the community.
- The severity of weed invasion associated with collapse is uncertain, but it is assumed conservatively that the community reaches a collapsed state when only 10% (plausible range 0–20%) of its plant species are native.
- The largest occurrence, occupying 289ha and 65% of the total area of the community, has been subject to major management interventions including weed control and replanting of native flora. It is not possible to predicts the likely status of the community in relation to the level of weed invasion in the absence of major management that has taken place since 1994.
- Available data do not indicate if the community meets the threshold for disruption of biotic processes of a 30% severity over 30% of the extent of the community in any 50-year time period, or 50% thresholds since 1750 to meet VU.
- It is possible that some occurrences the community would have reached a collapse state in the absence of considerable management intervention since 1994.

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

Crierion E	
☐ CR ☐ EN ☐ VU ☒ not eligible	

Justification for assessment under Criterion E:

- No quantitative estimates of the risk of ecosystem collapse have been completed.

Unable to assess

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.

Bell, D. and Froend, R. (1990). Mortality and growth of tree species under stress at Lake Toolibin in the West Australian Wheatbelt.

Bourke, L. and Rutherford, J. (2018), Hydrological response of Toolibin Lake to inundation in February 2017, Department of Biodiversity, Conservation and Attractions, Kensington, Western Australia.

Department of Environment and Conservation (2012). Department of Environment and Conservation, Perth, Western Australia.

Department of Conservation and Land Management (1998). Major Project Review Toolibin Lake Recovery Plan Project Number 350 Report prepared by A Smith and K J Wallace on behalf of the Toolibin Lake Recovery Team October 1998, Department of Conservation and Land Management

Department of Conservation and Land Management (2003). Water balance and salinity trend, Toolibin catchment, Western Australia. Report prepared by S. Dogramaci, R. George, G. Mauger and J. Ruprecht for the Department of Conservation and Land Management.

Department of Parks and Wildlife (2013). Toolibin Lake Natural Diversity Recovery Catchment Project Summary. https://www.wickepin.wa.gov.au/Assets/TLNDRC_project_summary.pdf

Department of Biodiversity, Conservation and Attractions (2017). Toolibin Lake Catchment Recovery Plan (2015) 2015–35
https://www.dpaw.wa.gov.au/images/documents/conservation-management/wetlands/recovery_catchments/toolibin_recovery_plan_2015-35.pdf

Department of Environment (2005). Water Notes. Advisory notes for land managers on river and wetland restoration. The Ecology of Wheatbelt lakes. WN 33. October 2005. Natural Heritage Trust.
Rutherford, J. (2020). Hydrological conceptualisation of Toolibin Lake and catchment. Department of Biodiversity, Conservation and Attractions, Perth.
Toolibin Lake Recovery Plan (1994). Prepared by the Toolibin Lake Recovery Team and Toolibin Lake Technical Advisory Group, September 1994. Perched wetlands of the Wheatbelt region with extensive stands of living sheoak and paperbark across the lake floor (Toolibin Lake) Recovery Plan (1994).
Western Australian Water Authority (1987). The Status and Future of Lake Toolibin as a Wildlife Reserve. A report prepared by the Northern Arthur River Wetlands Committee. WAWA Report No. WS 2.

45. Statement on the Standard of Scientific Evidence

Some occurrences have been subject to major systematic monitoring programs, and others have not. Some occurrences are subject to ad hoc monitoring of boundaries, condition and composition as resources permit, that provide some of the required information. There are sufficient data to confidently assess the community against the criteria that have been applied.

It is not possible to fully assess the likely status of the community in the absence of very major management interventions in the last 26 years at the largest occurrences. It is likely that some occurrences would have reached a collapse state in relation to hydrology in the absence of management interventions.

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 has been reviewed within the Department.

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.

No.

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	DBCA
Postal address	DBCA Kensington
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	

Table 1: Summary assessment against IUCN RLE Criteria

Criterion	Rank indicated	Overall conclusion
A1	-	• Available data do not indicate if community meets criterion
A2a	-	• Available data do not indicate if community meets criterion
A2b	-	• Available data do not indicate community meets criterion
A3	EN	• Reduction of ~87% of vegetation in the IBRA subregion assumed to be applicable to community (≥70% since 1750) • Meets EN
B1a	-	• EOO is ≤20,000km^2 • Inadequate data available for a measure of decline
B1b	EN	• EOO is ≤20,000km^2 • Subject to hydrological change, weed invasion, that are likely to cause continuing decline within the next 20 years
B1c	EN	• EOO is ≤20,000km^2 • Ecosystem exists at three threat defined locations based on clusters of occurrences and likely impacts of hydrological change
B2a	-	• AOO is one grid cell • Inadequate data available for a measure of decline
B2b	CR	• AOO is one grid cell • Subject to hydrological change, weed invasion, that are likely to cause continuing decline within the next 20 years • Meets criterion for CR
B2c	EN	• AOO is one grid cell • Ecosystem exists at 3 threat defined locations • Meets criterion of EN
B3	VU	• Known from 3 threat-defined locations • Meets criterion for VU
C1	-	• Not possible to determine if community would meet the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over past 50 years to meet VU in the absence of major management actions already in place.
C2	-	• Not possible to determine if community would meet the minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU in the absence of major management actions already in place.
C3	-	• Not possible to determine if community would meet the minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since 1750 to meet VU in the absence of very major management actions already in place.
D1	-	• Available data do not indicate if the community meets the minimum thresholds for proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over past 50 years to meet VU.
D2	-	• Available data do not indicate if the community meets 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	-	• Available data do not indicate if the community meets minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of biotic processes (≥50%) ~1750 to meet VU.

E	NA	• No quantitative estimates of the risk of ecosystem collapse.
		Meets CR under B2b. Meets EN under A3, B1b, B1c, B2c. Meets VU under B3 Plausible range of rank: VU to EN. *'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 B2b.**

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.