Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Nomination *(to be completed by nominator)*

Current conservation status	
Name of ecological community:	Unwooded freshwater wetlands of the southern Wheatbelt of Western Australia, dominated by *Duma horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor (Lake Bryde)
Other names:	Lake Bryde wetlands
Description:	The community occurs in freshwater wetlands (Lake Bryde wetland system) of the southern Wheatbelt of Western Australia. The habitat of this community is characterised by intermittent inundation and it sometimes holds little water for several consecutive years. The major components of the community and other biota depend on relatively fresh water and regular drying out of the clay and silt wetland bed for survival. In addition to *Duma horrida* subsp. *abdita* (threatened) and *Tecticornia verrucosa* across the lake floor, the wetlands support fringing open woodlands of *Eucalyptus occidentalis* over *Melaleuca strobophylla* dominated scrub.
Nomination for:	Listing under BC Act ☒ Change of status ☐ Delisting ☐

1. *Is the ecological community currently on any conservation list, either in a State or Territory, Australia or Internationally?* 2. *Is it present in an Australian jurisdiction, but not listed?*	*Provide details of the occurrence and listing status for each jurisdiction in the following table*

Jurisdiction	**List or Act name**	**Date listed or assessed (or N/A)**	**Listing category eg. critically endangered (or none)**	**Listing criteria eg. B1ab(iii)+2ab(iii) (or none)**
National	EPBC Act			
Western Australia	TEC list: WA Minister ESA list in policy	06/11/2001	Critically Endangered	CR B) i, B) ii
	Priority list		1 ☐ 2 ☐	3 ☐ 4 ☐
Other State/Territory				

Nominated conservation status: category and criteria (include recommended status for deleted ecological communities)				
Critically endangered (CR) ☒	Endangered (EN) ☐	Vulnerable (VU) ☐	Collapsed (CO) ☐	
Priority 1 ☐	Priority 2 ☐	Priority 3 ☐	Priority 4 ☐	None ☐

What criteria support the conservation status category for listing as a threatened ecological community or collapsed ecological community? *Refer to Section 32 of the Biodiversity Act 2016 for definition of 'Collapsed', and Appendix 3 table 'IUCN Red List Criteria for ecosystems version 2.2'.*	B1a(ii),b,c; B2a(ii),b,c

Eligibility against the criteria

Provide justification for the nominated conservation status; is the ecological community eligible or ineligible for listing against the five criteria. For ***delisting****, provide details for why the ecological community no longer meets the requirements of the current conservation status.*

A.	Reduction in geographic distribution *(evidence of decline)*	☐ **A1** ☐ **A2a** ☐ **A2b** ☒ **A3**
	Justification of assessment under Criterion A.	For criteria A, the ecosystem was assumed to collapse when the mapped distribution declines to zero. • According to the 2020 draft Lake Bryde Catchment Recovery Program, 77% of the surrounding catchment is on farming properties, road reserves and other crown lands, with approximately 34% (55,400 ha) of the catchment's original vegetation remaining. • The community is assumed to have been subject to a reduction in distribution of ~66%, as measured by the amount of land cleared in the catchment. As data were not accessed with regard to timing, it is assumed that the clearing has occurred since 1750. The threshold to meet vulnerable under A3 is ≥50% reduction in distribution since 1750 (EN is ≥70%). • **Meets vulnerable under criterion A3**.
B.	Restricted geographic distribution *(EOO and AOO, number of locations and evidence of decline)*	☒ **B1** (specify at least one of the following): CR ☐ **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 of assessment under Criterion B.	• B1: EOO is 55km^2 (≤2,000km^2, which is the threshold for CR). • B2: AOO is two 10x10 km grid cells (threshold for EN is 20, and for CR is two grid cells). Community meets threshold for rank CR under criterion part B2. • a): Data are available to measure decline in environmental quality (ii) (see appendix under threats). Rising groundwater levels, mobilisation of soil-stored salt and extensive secondary salinization (DBCA 2020) are indicative of an observed and continuing decline in a measure of environmental quality appropriate to characteristic biota of the ecosystem. • b): Continuing decline observed from hydrological changes (altered surface water runoff, increased inundation, and salinisation); and inferred future decline in environmental quality due to the increasing number and duration of extreme hydrological events (see Appendix 1 for further information on threats).

		• c) Community exists at one threat-defined location based on its broad dependence on a single catchment; the Lake Bryde catchment, that delivers flows to all three occurrences. The impacts associated with the catchment are a result of changes to hydrology, including increasing salinity and inundation (see Appendix 1 for further information on threats). • B3: Community is known from one threat-defined location which is prone to effects of human activities and stochastic events (such as extreme hydrological events) within a very short time period in an uncertain future (meets VU as <5 threat defined locations). • **Meets criteria for critically endangered B1a(ii),b,c; B2a(ii),b,c. Meets VU under B3.**
C.	Environmental degradation of abiotic variable *(Evidence of decline over 50-year period)*	☐ **C1** ☐ **C2** ☐ **C3**
	Justification of assessment under Criterion C.	• C1, C2: The most significant abiotic threat affecting the community is hydrological change. • Due to the increased volume of runoff and high groundwater levels, inundation events are occurring more frequently and for longer periods. These events are resulting in increased salt loads. Nine significant fill events have occurred since monitoring began in 1979. Limits of Acceptable Change recommend salt loads be less than 600 tonnes, and preferably less than 400 tonnes, during a flood event exceeding 0.3m depth (DBCA 2020). Figure 6 in Appendix 1 shows the maximum LOAC was reached a number of times since monitoring has occurred. In 2016-18, after the conveyance structure was installed to reduce inundation events, the salt load rose to 570 tonnes, significantly greater than the preferred salt load threshold. The increasing salt loads are potentially adversely effecting salt intolerant species and altering flora composition of the community. • *Duma horrida* subsp. *abdita* is a key species within the community and is therefore used as an indicator of community health and whether hydrological changes are impacting on the community. Research indicates the subspecies grows best at a soil salinity of <500mS/cm, and experiences stress when soil salinity ranges above 1500mS/m. The collapse point is considered to be a soil salinity that results in a population count of zero and no subsequent regeneration occurs in the subspecies. • Transect monitoring of the subspecies from 2008 to 2012 at Lake Bryde (figure 4) showed a decline in population numbers. Using a line of best fit for future predictions, plant numbers should reach zero by 2020 (figure 5). The current numbers are not known but are considered unlikely to follow a linear trend as the subspecies will respond to periodic events. This prediction is also unlikely to be indicative of the whole occurrence or the community as a whole. • Data from the Threatened Priority Flora database (TPFL) from East Lake Bryde indicates a decline in plant numbers from 1,924 in 1996 to 1,000 in 2001, however different survey methods may have influenced this result. Massive numbers of deaths occurred in 2002 (~50,000) at the Lakeland occurrence and the subspecies appears to be locally extinct except a small area in the east side of the lake. More recent survey data (see data below) for *Duma horrida* subsp. *abdita* has also showed some decline in total area of occupancy for

<table>
<tr><td></td><td></td><td>all populations, possibly a response to drought (pers comm. [redacted][1]).
<table>
<tr><th>Population</th><th>Year</th><th>AOO (sqm)</th></tr>
<tr><td>Lake Bryde</td><td>2013</td><td>32.98</td></tr>
<tr><td></td><td>2018</td><td>10.72</td></tr>
<tr><td>East Lake Bryde</td><td>2017</td><td>58.24</td></tr>
<tr><td></td><td>2018</td><td>56.84</td></tr>
<tr><td>Lakeland</td><td>2017</td><td>5.07</td></tr>
<tr><td></td><td>2018</td><td>2.68</td></tr>
</table>

Currently there are inadequate data to link population numbers of Duma horrida subsp. abdita to salt load. Therefore it is not possible to determine extent and severity of the impacts of salt loads on the species to assess against criterion C.
Due to the complexity of the hydrology and the limitations of the available monitoring data for the Duma horrida subsp. abdita, it cannot be determined 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.
C3: Inadequate data to determine if the community meets minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since 1750.
Inadequate recent monitoring data available to indicate if community meets criterion C
</td></tr>
<tr><td>D.</td><td>Disruption of biotic processes or interactions
(Evidence of decline over 50-year period)</td><td>☐ D1
☐ D2
☐ D3</td></tr>
<tr><td></td><td>Justification of assessment under Criterion D.</td><td>
D1, D2: The most significant biotic variable affecting the community is weed invasion largely associated with grazing.
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.
D1, D2, D3: Grazing has occurred throughout the catchment, due to rabbits and high numbers of kangaroos. Weeds have also invaded along tracks, firebreaks, and fringe of vegetative areas. There are no systematically collected data indicative of changes in the level of weeds in the community.
No available evidence indicates the community meets the minimum proportion of the extent (30%) or proportional severity of disruption of biotic processes (30%) over any 50-year period, or since 1750 (50% disruption of biotic processes / 50% of the extent) to meet VU under criterion D.
D3: No available evidence indicates community meets the minimum proportion of the extent (≥50%) or proportional severity of disruption of biotic processes (≥50%) since ~1750 to meet VU.
Available data do not indicate if community meets criterion D
</td></tr>
<tr><td>E.</td><td>Quantitative analysis
(statistical probability of ecosystem collapse)</td><td>
No quantitative estimates of the risk of ecosystem collapse.
Unable to assess
</td></tr>
</table>

[1] DBCA Conservation Officer Lake Bryde

Reasons for change of status			
Genuine change ☐	New knowledge ☐	Previous mistake ☐	Review/Other ☒ Listing under BC Act
Provide details: The community was initially ranked critically endangered using ranking criteria developed in WA that differ to those in the IUCN Red List Criteria for Ecosystems (version 2.2).			

Summary of assessment information *(provide detailed information in the relevant sections of the nomination form)*			
EOO	55km^2	AOO	Two 10x10 km grid cells
No. occurrences	3	Severely fragmented	Yes ☒ No ☐ Unknown ☐
Justification	The community is naturally fragmented, only occurring in freshwater wetland systems within the Lake Bryde Catchment. The community is known to exist at 3 locations, all nature or conservation reserves.		
Current known area			144 ha
Pre-industrialisation extent or its former known extent (if known)			Occupies most of its former extent.
Estimated percentage decline			~66% based on all clearing in the catchment

Summary assessment against IUCN RLE Criteria

Criterion	Rank indicated	Overall conclusion
A1	-	• Does not meet
A2a	-	• Does not meet
A2b	-	• Does not meet
A3	VU	• Level of clearing of community estimated at ~66%
B1a	CR	• EOO is ≤2,000km^2 • Hydrological changes are indicative of a measure of observed and inferred continuing decline in environmental quality.
B1b	CR	• EOO is ≤2,000km^2 • Continuing decline observed and inferred from hydrological change
B1c	CR	• EOO is ≤2,000km^2 • Ecosystem exists at one threat-defined location.
B2a	CR	• AOO can fit into two grid cells • Hydrological changes are indicative of a measure of observed and inferred continuing decline in environmental quality.
B2b	CR	• AOO is two grid cells • Continuing decline observed and inferred from the hydrological changes
B2c	CR	• AOO is two grid cells • Ecosystem exists at one threat-defined location.
B3	VU	• Known from one threat-defined location • Prone to effects resulting from extreme hydrological events • Meets criterion for VU
C1	-	• Inadequate evidence to indicate if community meets threshold for decline in proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over the past 50 years to meet VU.
C2	-	• Inadequate evidence to indicate if community meets threshold for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU.
C3	-	• Inadequate evidence to indicate if community meets threshold for proportion of extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since ~1750 to meet VU.
D1	-	• Inadequate evidence to indicate if community meets threshold for proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over the past 50 years to meet VU.
D2	-	• Inadequate evidence to indicate if community meets threshold for proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over any 50-year period to meet VU.
D3	-	• Inadequate evidence to indicate if community meets threshold for extent (≥50%) or severity of disruption of biotic processes (≥50%) since ~1750 to meet VU.
E	NA	• No quantitative estimates of the risk of ecosystem collapse.
		Plausibly meet VU under A3, B3. Meets CR under B1a(ii),b,c and B2a(ii),b,c. *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 B1a(ii),b,c; B2a(ii),b,c.**

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GOVERNMENT OF WESTERN AUSTRALIA

Summary of location (occurrence) information *(provide detailed information in the relevant sections of the nomination form)*						
Occurrence	Land tenure	Survey information: date of survey	Condition*	Area of occurrence (ha)	Threats *(note if past, present or future)*	Specific management actions
BRYDE1	Conservation Park and Water Reserve	1987 1993 1996 1998 2001 2001 2004 2008	100% very good (2004) (may not reflect current status)	54.3	Salinisation Altered surface drainage Weed invasion (*past, present, future*) Extreme hydrological events (eg prolonged flooding) (*current, future*)	Surface water conveyance structure completed in 2009 to reduce prolonged inundation and salt accumulation. Weed management includes monitoring for weeds at revegetation sites and along firebreaks and tracks
BRYDE2	Nature Reserve	1987 1993 1996 1996 1998 2001 2001 2008	100% Excellent (1998) (may not reflect current status)	87.5	Salinisation (*past, present, future*) Extreme hydrological events (eg prolonged flooding) (*current, future*))	
LL1a, LL1b	Nature Reserve	1987 1993 1996 1996 1998 2001 2001 2008	100% Excellent (1998) (may not reflect current status)	1.9	Salinisation (*past, present, future*) Extreme hydrological events (eg prolonged flooding) (*current, future*)	

*Condition to IUCN Criteria, condition categories from (Keighery (1994) Vegetation Condition Scale (Government of WA 2000)) are defined below:

Good ('Pristine', 'Excellent', 'Very Good' using Bush Forever (2000) scale): This includes vegetation ranging from 'Pristine' - with no obvious signs of disturbance, to 'Excellent' - Vegetation structure intact, with disturbance only affecting individual species, weeds are non-aggressive species and 'Very Good' - Vegetation structure altered, obvious signs of disturbance eg: from repeated fires, dieback, logging, grazing.

Medium ('Good' using Bush Forever (2000) scale): This includes vegetation categorised as '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 and grazing.

Poor ('Degraded' using Bush Forever (2000) scale): Basic vegetation structure severely impacted by disturbance such as partial clearing, dieback, logging and grazing. Scope for regeneration but not to a state approaching good condition without intensive management.

Beyond recovery ('Completely degraded' using Bush Forever (2000) scale): Vegetation structure is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native shrubs and trees.

APPENDIX 1 THREATS

Hydrology

Surface water hydrology

The Lake Bryde community is in a valley in a surface-water dominated catchment (Figure 1), with 10 sub-catchments delivering flows to different parts of the valley floor (Farmer *et al*. 2002). Land clearing since the 1960s resulted in changes to surface runoff. The removal of vegetation increased runoff that resulted in an increased frequency of more prolonged and deeper inundation of the catchment's valley floor (DBCA 2020). Winter rainfall and surface water flows on the upper slopes are usually confined to minor, well-defined drainage channels. These flows are frequently blocked by natural colluvial and aeolian deposits with flows tending to pond. This ponding of water leads to the accumulation of salts and increases the salt load within the lake (DBCA 2020).

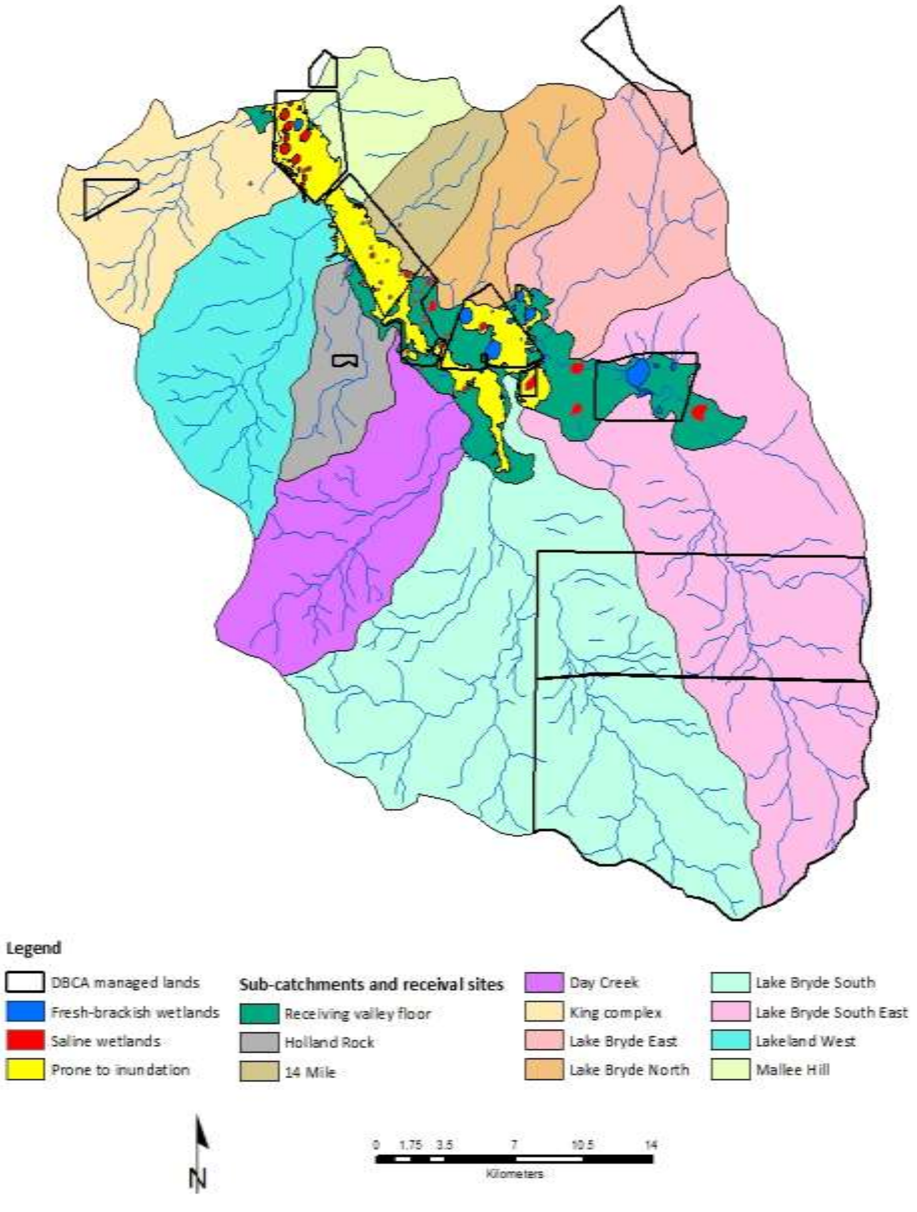

Figure 1: Surface water hydrological features of the upper Lake Bryde Catchment (from DBCA 2020). (Three of the fresh-brackish wetlands correspond to the Lake Bryde community – see also Appendix 2)

Increased inundation and salinisation contributes to significant plant deaths in the vegetation of the valley floor and an increase in salt load for Lake Bryde (DBCA 2020). Recently, Lake Bryde was inundated for two years, while East lake Bryde was inundated for about than 2.5 years. After the lakes dried out the vegetation on both lakes showed signs of recovery. However, the recovery in the more heavily salt affected southern part of Lake Bryde was very poor. In the sections of the valley floor which remained inundated for many months, plant deaths were noted in melaleuca and mallee communities. As the valley floor dried out, these same communities recovered through seedling recruitment, except where the communities had previously been impacted by salinity. It those areas, the original community tended to be replaced by *Tecticornia* species. The original vegetation assemblage here tends to be replaced as salinity becomes an issue (DBCA 2020). The detrimental effects this process is having was also recorded in East Lake Bryde. Vegetation on the lakebed of wetland 097 (Bryde2) was affected by waterlogging and salinity with samphire in central areas and areas of degraded Melaleuca shrubland adjacent. Few Melaleuca seedlings were seen in these degraded areas compared to areas of Melaleuca shrubland regenerating on slightly elevated areas on the edge of the lake (Rick 2017).

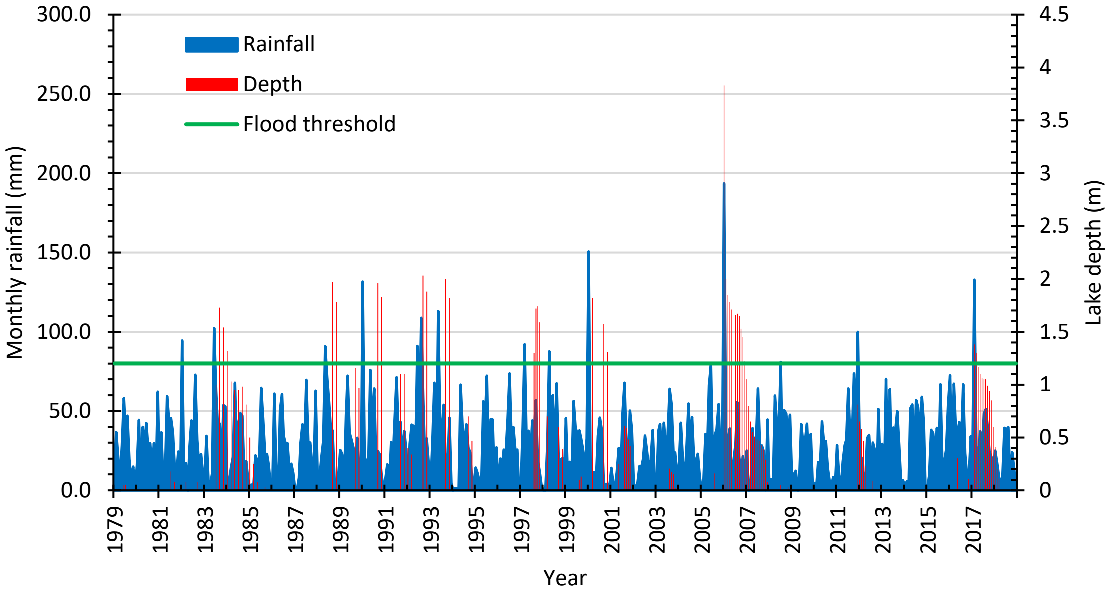

Figure 2: Catchment rainfall and lake depth at Lake Bryde (DBCA 2020).

Groundwater hydrology

The groundwater chemistry has been monitored sporadically since the 1990s. Most samples from valley floor bores were found to be highly saline (>35,000 mg/l) and consequently toxic to most terrestrial plants (DBCA 2020). Rising groundwater therefore poses a major threat to the community as it occupies sites with shallow groundwater tables. Most valley floor bores tend to have ground water tables at less than 2.0 metres below ground level (mbgl) as seen in figure 3. At this depth, the ongoing discharge of groundwater through evaporation will likely lead to the accumulation of salt in the soil profile, to the detriment of those plant species sensitive to salinity and shallow groundwater tables (DBCA 2020).

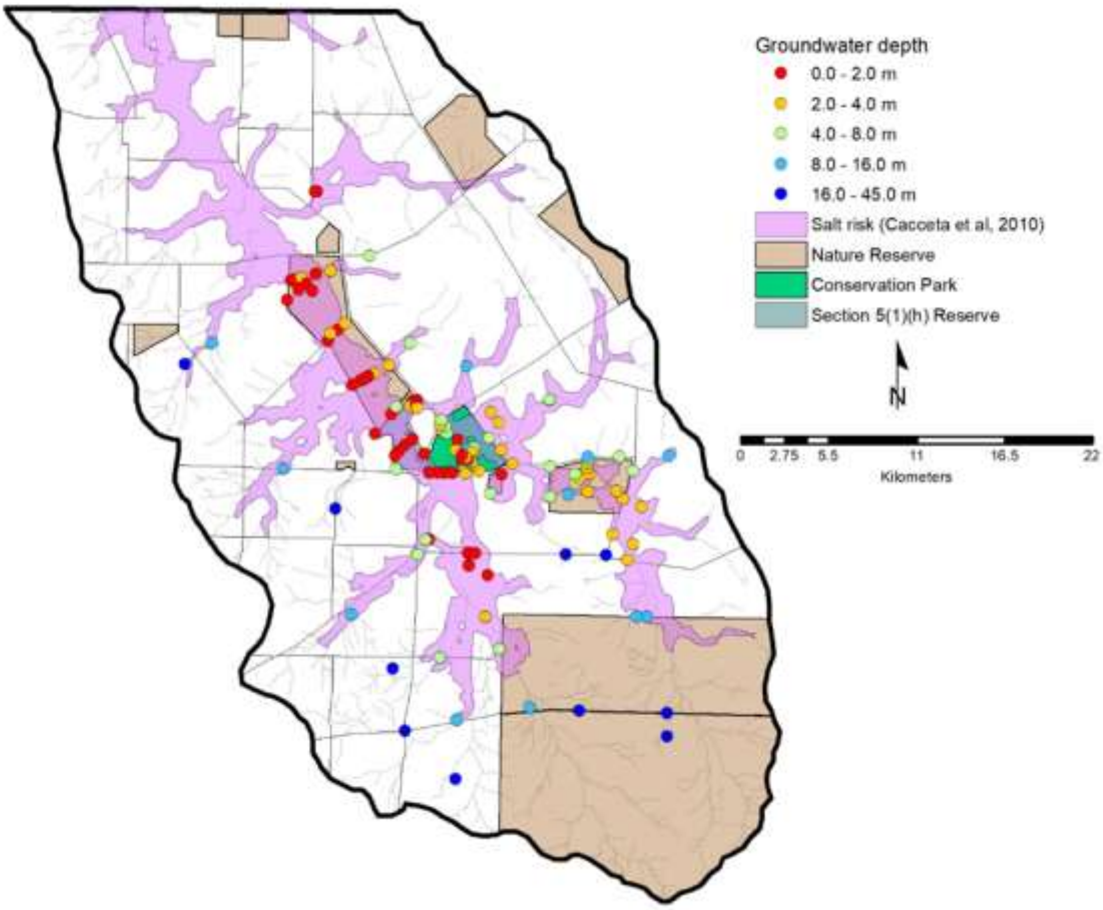

Figure 3: Groundwater depth and the salinity risk zone in the Lake Bryde Catchment (DBCA 2020).

According to the Limits of Acceptable change, Lake Bryde's groundwater should be at a minimum of 2 mbgl when the wetland is dry. Currently the groundwater level is approximately 0- 2 mbgl. In East Lake Bryde, the accepted limit is at a minimum of 2 mbgl when the wetland is dry. Currently the depth ranges between 2.0 and 3.0 m (DBCA 2020). These groundwater levels are very close to the threshold of acceptable change and the threat of the level rising continually poses a major threat to the community, with approximately 14% of DBCA managed conservation reserves and 68% of the conservation reserves within the catchment also likely to be affected. An assessment of long-term future risk is however dependant on future climate trends (Bourke and Ferguson 2015). The regular monitoring of groundwater between the 1990s and 2019 does not substantiate this concern. Bourke and Ferguson (2015) suggested the drying climate is a contributing factor, producing short-term oscillations in groundwater level, the long-term trend is for relatively static ground water depths.

Salinity

The Lake Bryde ecological community is dominated by *Duma horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor. Soil salinity is a key threatening factor as it threatens the persistence of *Duma horrida* subsp. *abdita*. Judd *et al*. (2010) found that the species grows best where soil salinities are below 500 mS/m. Newland *et al*. (2010) reported that *D. horrida* subsp. *abdita* experienced stress at soil salinity ranges above 1500 mS/m and that plant deaths occurred above 2,100 mS/m. *Tecticornia verrucosa* can tolerate more saline surface and ground waters and will replace *D. horrida* subsp. *abdita* with increasing salinities (Judd *et al*. 2010). The following figures show a continual decline in plant numbers at Lake Bryde when monitored from 2008 to 2012 and a projected future decline (data from Chow 2013). Figure 4 indicates a prediction of decline of numbers of *Duma horrida* subsp. *abdita* to zero by 2020 however current numbers are not known. The numbers of plants is unlikely to follow a linear trend as it will respond to periodic events such as periodic flooding and drying.

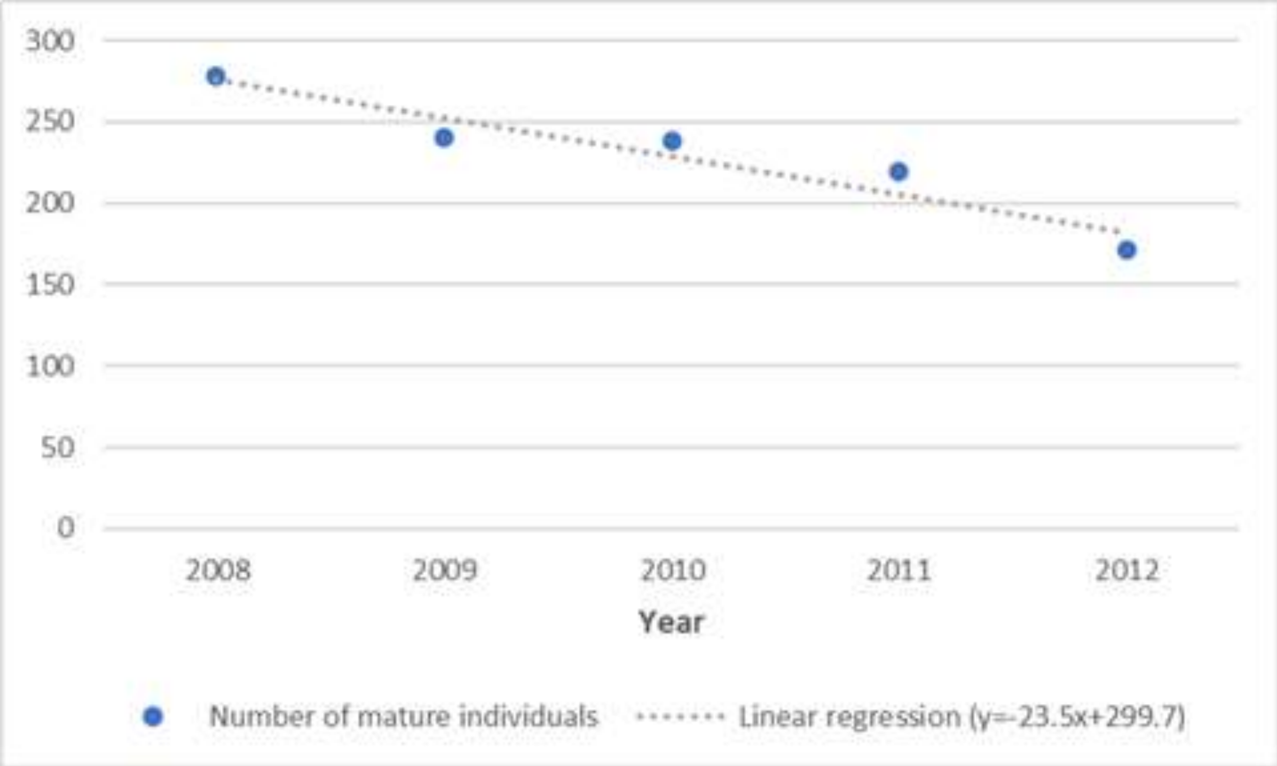

Figure 4: Number of mature individuals of *Duma horrida* subsp. *abdita* recorded within 7 transects at Lake Bryde from 2008 to 2012 (data from Chow 2013).

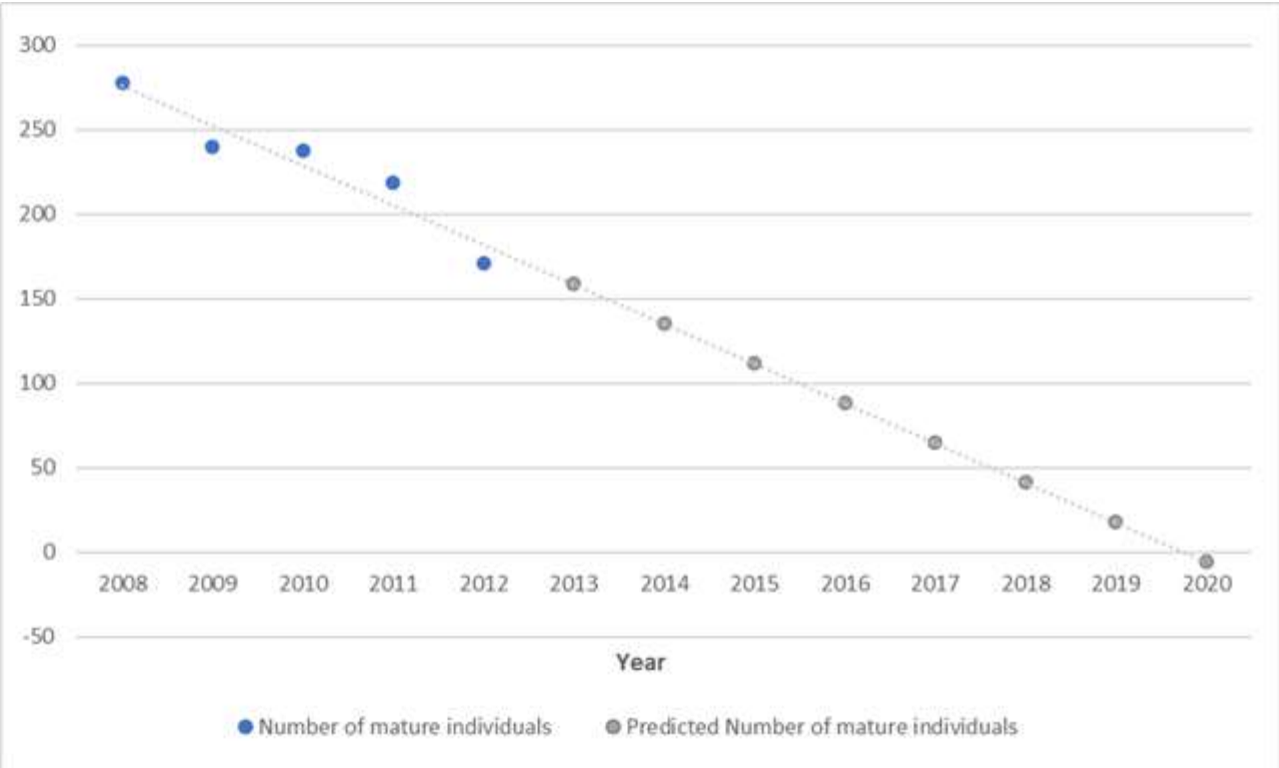

Figure 5: Number of mature individuals of *Duma horrida* subsp. *abdita* recorded within 7 transects and the linear regression forecasted to 2020 (y=-23.5x+299.7) (data from Chow 2013).

Since monitoring began in 1979 the wetland has experienced nine significant fill events. The salt load rose to approximately 1200 tonnes in 1997 and then declined to 800 tonnes at the time of the 2006-07 fill event, due to an outflow which contained much of the Lake's salt load, as seen in Figure 6. The Lake Bryde Recovery Plan 2020-2040 refers to a threshold, that if the Limit of Acceptable Change is not exceeded (i.e. abundances do not change too much), detectable natural species will not be lost. When referring to this Limit of Acceptable Change, the salt load of the Lake

Bryde wetland during any fill event exceeding 0.3m depth should be less than 600 tonnes, and preferably, less than 400 tonnes (DBCA 2020). In 2016 to 2018, after the conveyance structure was installed to reduce inundation events, the salt load rose to 570 tonnes, which is still significantly over the preferred salt load threshold.

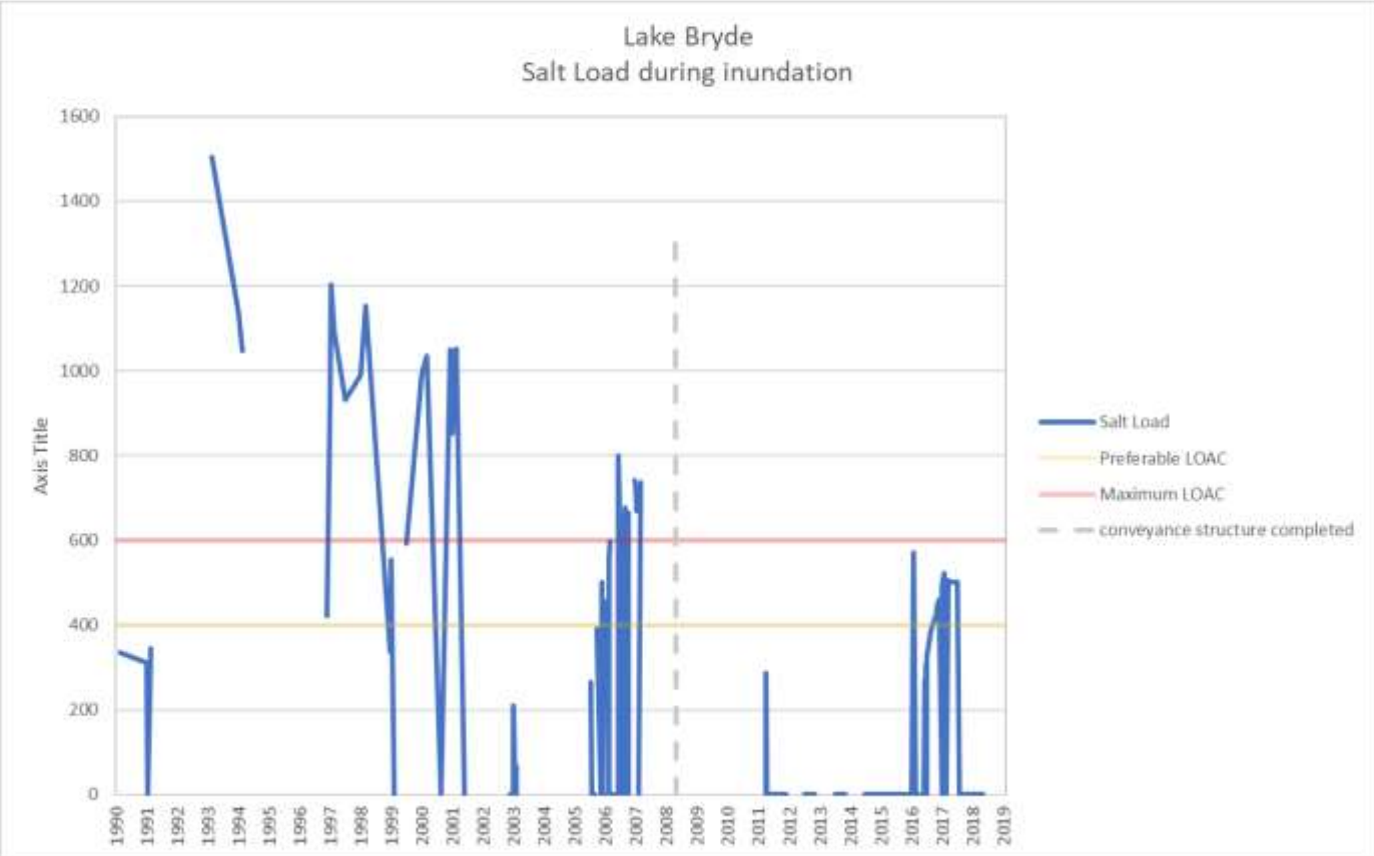

Figure 6: Salt Load of Lake Bryde (*pers comm.* [redacted]).

The salt load of the East Lake Bryde wetland during any fill event exceeding 0.3m depth should be less than 400 tonnes, and preferably, less than 300 tonnes. The only salt load estimate for East Lake Bryde dates to the 2006 fill event (1.88m depth) when the salt load estimate was 500 tonnes, noticeably above the threshold.

High salinity groundwater in the root zone has the potential to kill vegetation and will eventually result in the loss of natural species (DBCA 2020) and therefore is a significant threat in the Lake Bryde Ecological community.

Drying climate

Climate studies show that over the last 40 years, the average annual temperature of Western Australia has increased by about 1°C. Depending on future greenhouse gas emissions, the latest climate projections for Western Australia show the average annual temperature increasing by 0.5–1.3°C by 2030 and by 1.1-5.1°C by the end of the century (Sudmeyer *et al*. 2016).

The Lake Bryde catchment experiences a Mediterranean climate with warm to hot summers (December to February) and mild, wet winters (June to August). Long-term average rainfall is approximately 359 mm per year, with the highest monthly rainfall generally occurs in cooler months.

The rainfall data from BOM weather stations at Lake Grace, Newdegate and Pingrup shows a modest declining trend in annual rainfall since records commenced, from 375mm (predicted) in 1913 to 336mm (predicted) in 2018 (figure 7). The data also suggest a trend towards increasing summer rainfall and declining winter rainfall (AEGIC 2016).

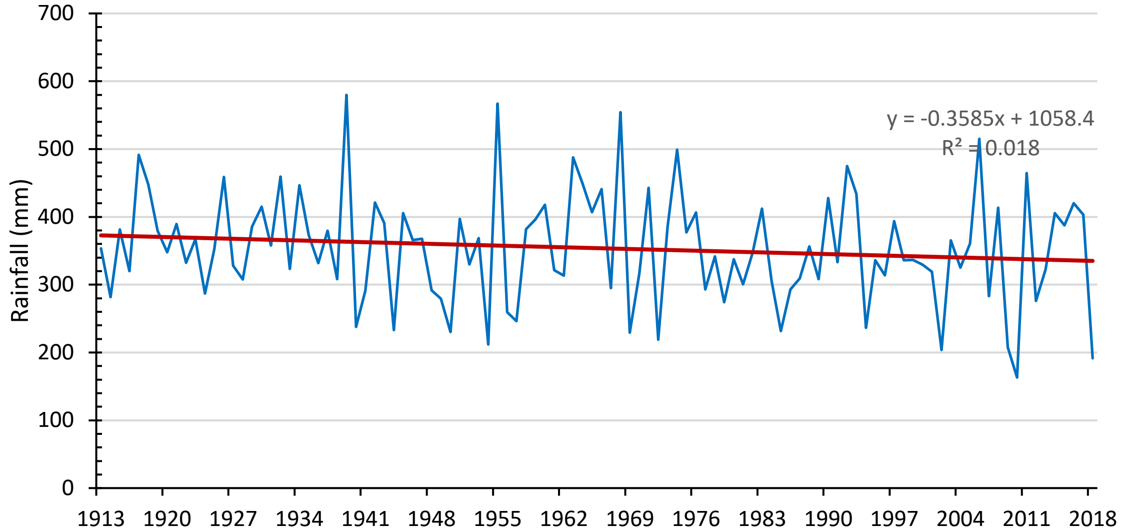

Figure 7: Annual rainfall records show a declining trend (DBCA 2020).

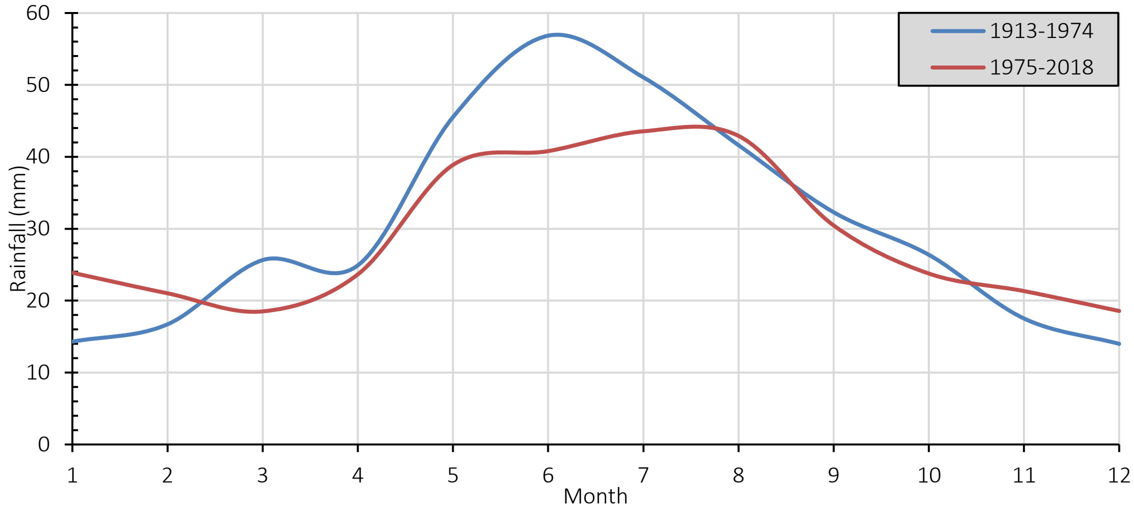

Figure 8: Changes in the catchment's monthly rainfall trends (DBCA 2020).

Lake Bryde's rainfall is predominantly in winter and can generate significant surface water flows to inundate the valley floor. Summer rainfall events now account for a greater proportion of runoff events which cause valley floor inundation events (Bourke and Ferguson 2015). This may be a threat as the severity and intensity of extreme weather events are expected to increase (Steffen *et al*. 2017; DWER 2019). For the Lake Bryde Catchment and other areas of the Wheatbelt, this is likely to see an increase in the intensity, length and frequency in heatwaves, droughts, extreme rainfall events, fire season and fire weather conditions.

Grazing

Grazing of vegetation causes variation to the species composition, both in the selective grazing of edible species, and in the introduction of weeds because of trampling, general disturbance, and weed seeds in droppings. If not controlled, kangaroos and rabbits throughout the catchment are likely to cause the loss of natural species through unsustainable mortality on seedlings and more mature plants (DBCA 2020). The Lake Bryde Catchment Recovery Plan 2020-2040 suggests that it is unlikely that rabbits will be eradicated over the management period and kangaroos are native fauna, and therefore both require ongoing control.

Weed invasion

The negative effects related to invasion by weed species are well understood and documented (Lawes and Grice 2010). Competitively superior weed species present a threat to many of the native flora. Weed species are often introduced and quick to establish in disturbed areas. Threats including excessive grazing and inappropriate fire regimes often contribute to creating a disturbance that can facilitate the establishment of weed species. In comparison to the higher areas in the catchment, weeds were more common in Nature Reserve 29024 (LL1a, LL1b), East Lake Bryde (BRYDE2) and Lake Bryde Reserve (BRYDE1), where there is a threat in all three occurrences (DBCA 2020). The Lake Bryde Catchment Recovery Plan 2020-2040 recommends weed monitoring at revegetation sites and along firebreaks and tracks and weed control when required.

Altered fire regimes

The management of fire for biological diversity is a particularly complex issue (Gosper *et al*. 2013) that was initially considered a significant threat to natural species, particularly in terms of physical damage. Plant species vary in their response to fire according to their life history and different frequency, timing and intensity of fires may be optimal for different plant species (Brooks and Carley 2013b, a). The time since the last major bushfire in many parts of the catchment is estimated to be between 40 and 50 years (DBCA 2020). This may be approaching the interval at which species dependent on fire for regeneration may be lost from bushland reserves. The vegetation of the relatively small reserves within the Lake Bryde catchment may be more susceptible to grazing, predation and weed competition following fire (DBCA 2020).

Surrounding Land Use

Farming properties, in the form of freehold lands, occupy approximately 116,279 ha or 72% of the surrounding catchment (Figure 9). Toxic exposure to herbicide spray drift and excessive concentrations in water may be an issue in vegetation death but further investigation is required to verify the issue.

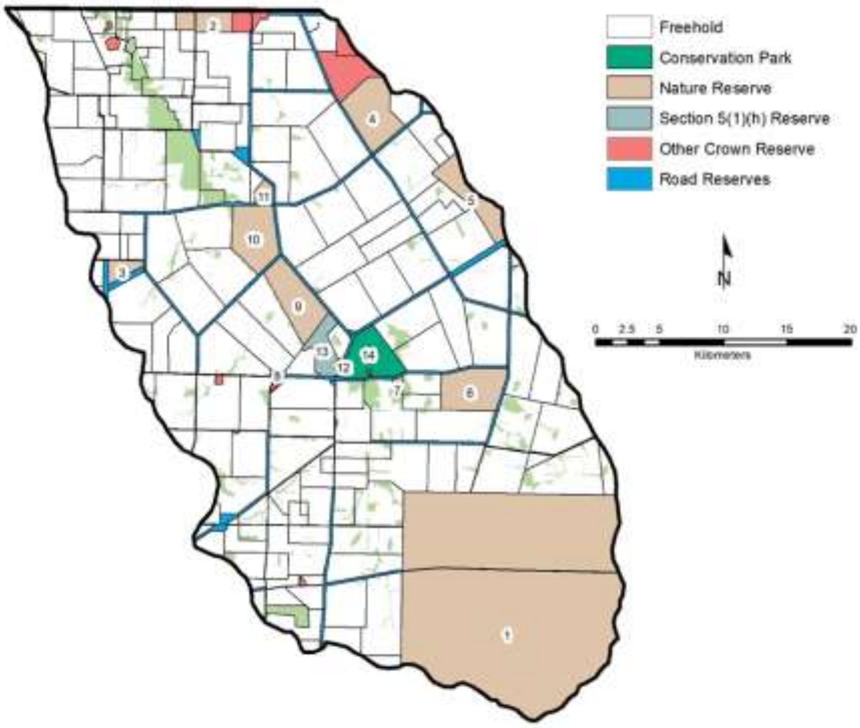

Figure 9: Current land tenure in the lake Bryde catchment (DBCA 2020).

Recreation

Lake Bryde is one of only a few freshwater wetlands remaining in the Wheatbelt. When filled the wetlands are large and deep enough to accommodate powered craft and water skiing. It is therefore a popular local recreation site during significant fill events and is widely utilised by the local community for recreational activities such as water-skiing and swimming (DBCA 2020). Activities linked with recreational use may be very detrimental to the ecological community if not managed.

References

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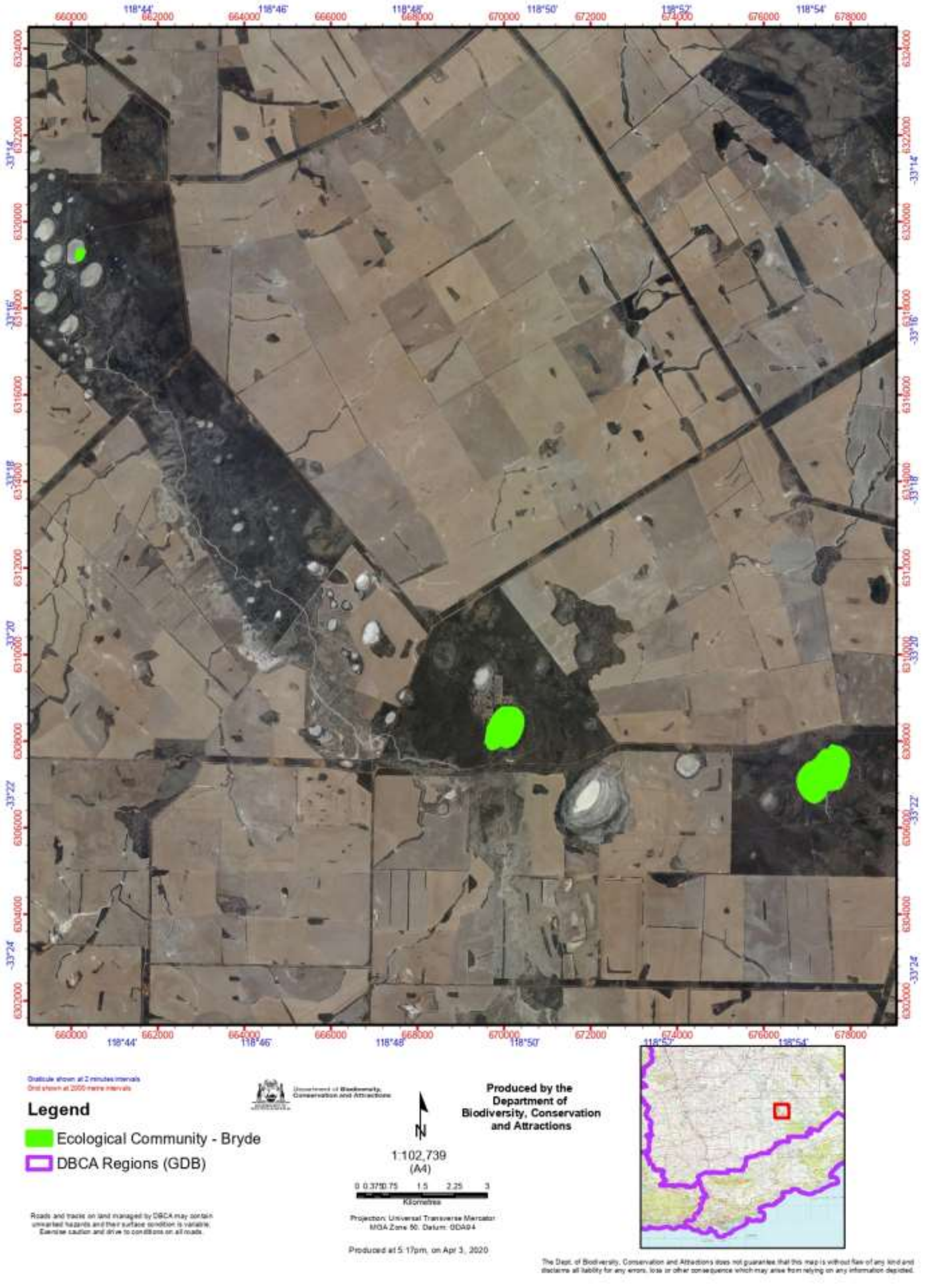
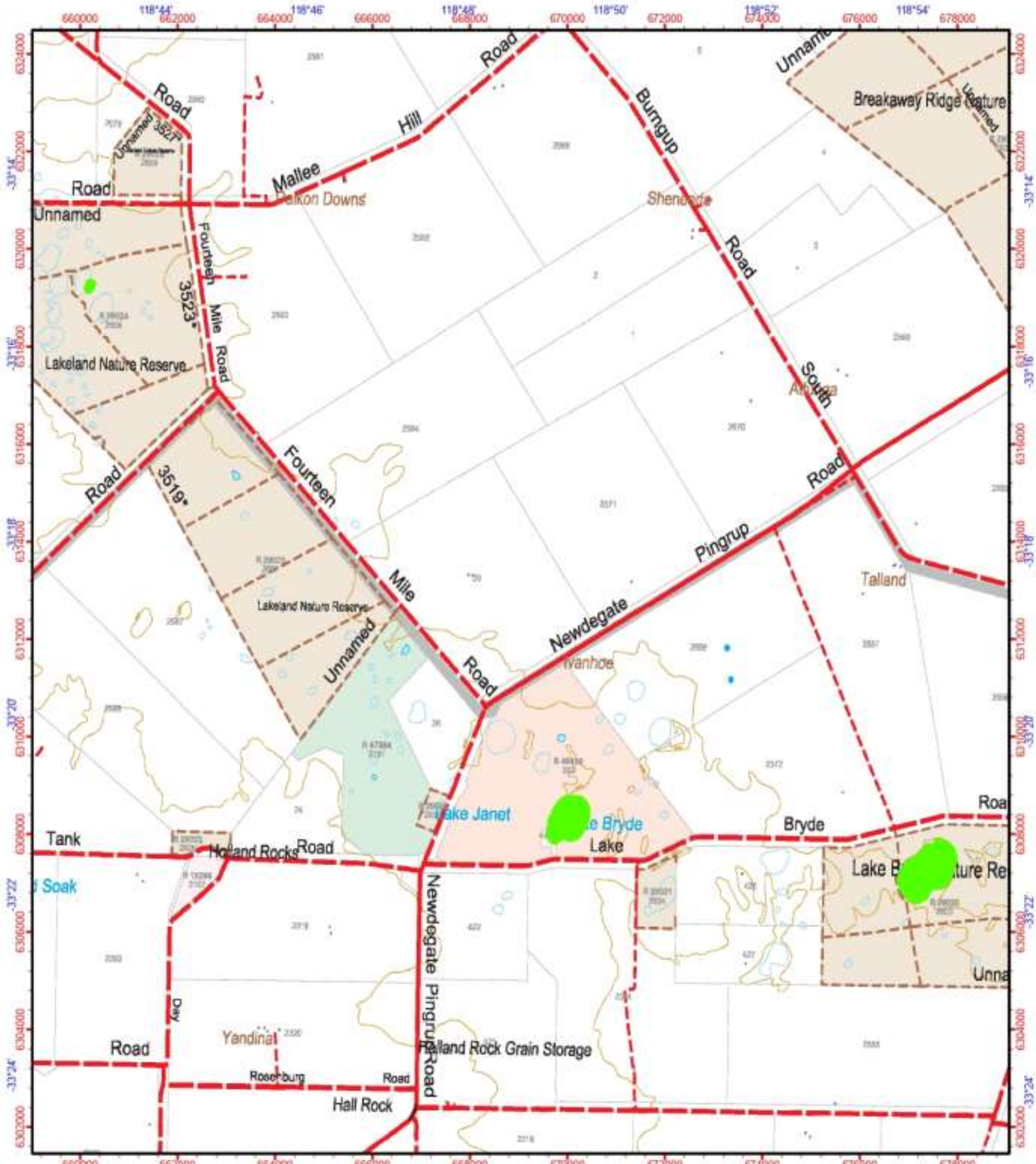
APPENDIX 2 Lake Bryde Ecological Community (Green)





Graticule shown at 2 minutes intervals
Grid shown at 2000 metre intervals

Legend

Ecological Community - Bryde

DBCA Regions (GDB)

Department of Biodiversity, Conservation and Attractions

1:102,739
(A4)

0 0.375 0.75 1.5 2.25 3
Kilometres

Produced by the Department of Biodiversity, Conservation and Attractions

Roads and tracks on land managed by DBCA may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.

Projection: Universal Transverse Mercator
MGA Zone 50. Datum: GDA94

Produced at 5:17pm, on Apr 3, 2020

The Dept. of Biodiversity, Conservation and Attractions does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.

APPENDIX 3 IUCN Red List Criteria for ecosystems (version 2.2) (IUCN 2017)

A. Reduction in geographic distribution over ANY of the following time periods:

		CR	EN	VU
A1	Present (over the past 50 years).	≥ 80%	≥ 50%	≥ 30%
A2a	Future (over the next 50 years).	≥ 80%	≥ 50%	≥ 30%
A2b	Future (over any 50-year period including the present and future).	≥ 80%	≥ 50%	≥ 30%
A3	Historic (since 1750).	≥ 90%	≥ 70%	≥ 50%

B. Restricted geographic distribution indicated by EITHER B1, B2 or B3:

		CR	EN	VU
B1	Extent of a minimum convex polygon enclosing all occurrences (Extent of Occurrence)	≤ 2,000 km^2	≤ 20,000 km^2	≤ 50,000 km^2
	AND at least one of the following (a-c):			
	(a) An observed or inferred continuing decline in **EITHER**:			
	i. a measure of spatial extent appropriate to the ecosystem; **OR**			
	ii. a measure of environmental quality appropriate to characteristic biota of the ecosystem; **OR**			
	iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem.			
	(b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years.			
	(c) Ecosystem exists at …	1 location	≤ 5 locations	≤ 10 locations
B2	The number of 10 × 10 km grid cells occupied (Area of Occupancy)	≤ 2	≤ 20	≤ 50
	AND at least one of a-c above (same sub-criteria as for B1).			
B3	A very small number of locations (generally fewer than 5) **AND** prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and thus capable of collapse or becoming Critically Endangered within a very short time period (B3 can only lead to a listing as VU).			VU

C. Environmental degradation over ANY of the following time periods:

			Relative severity (%)		
		Extent (%)	≥ 80	≥ 50	≥ 30
C1	The past 50 years based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 80	≥ 50	≥ 30
C2	The next 50 years, or any 50-year period including the present and future, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 90	≥ 70	≥ 50
C3	Since 1750 based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 90	CR	EN	VU
		≥ 70	EN	VU	
		≥ 50	VU		

D. Disruption of biotic processes or interactions over ANY of the following time periods:

			Relative severity (%)		
		Extent (%)	≥ 80	≥ 50	≥ 30
D1	The past 50 years based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
D2			≥ 80	≥ 50	≥ 30

	(D2a) The next 50 years, or (D2b) any 50-year period including the present and future, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table: OR	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 90	≥ 70	≥ 50
D3	Since 1750, based on a change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 90	CR	EN	VU
		≥ 70	EN	VU	
		≥ 50	VU		
E. Quantitative analysis					
			CR	EN	VU
… that estimates the probability of ecosystem collapse to be:			≥ 50% within 50 years	≥ 20% within 50 years	≥ 10% within 100 years