



Ramsar Information Sheet

Published on 1 July 2022

Update version, previously published on : 5 January 2001

Australia

Muir-Byenup System



Designation date	5 January 2001
Site number	1050
Coordinates	34°29'43"S 116°42'47"E
Area	10 631,00 ha

Color codes

Fields back-shaded in light blue relate to data and information required only for RIS updates.

Note that some fields concerning aspects of Part 3, the Ecological Character Description of the RIS (tinted in purple), are not expected to be completed as part of a standard RIS, but are included for completeness so as to provide the requested consistency between the RIS and the format of a 'full' Ecological Character Description, as adopted in Resolution X.15 (2008). If a Contracting Party does have information available that is relevant to these fields (for example from a national format Ecological Character Description) it may, if it wishes to, include information in these additional fields.

1 - Summary

Summary

The Muir-Byenup System Ramsar site is located 55 km east-south-east of Manjimup in the South-West Coast Australian Drainage Division of Western Australia, and covers an area of 10,631 hectares, of which approximately 7,000 hectares is wetland. Named wetlands in the site include; Lake Muir, Byenup Lagoon, Tordit-Gurru Lagoon, Poorginup Swamp, Neeranup Swamp, Coorinup Swamp and Wimbalup Swamp.

The Muir-Byenup System Ramsar site is composed of partly inter-connected wetlands, ranging in size, salinity (saline to fresh), water permanence (permanent to seasonal) and substrate (peat and inorganic), in an internally-draining catchment. Byenup Lagoon, Tordit-Gurru Lagoon, Poorginup Swamp, Geordinup Swamp and Neeranup Swamp are naturally freshwater wetlands, while Lake Muir and Coorinup Swamp are naturally occurring saline wetlands. Byenup Lagoon, Tordit-Gurru Lagoon and Poorginup Swamp are peat based wetlands, which are rare in Western Australia. These wetlands strongly influence water quality and provide important habitat for native plants and animals. The Muir-Byenup System Ramsar site is highly diverse with at least 600 indigenous flora species recorded. The Ramsar site provides significant waterbird habitat and refuge, and supports bird species listed under the EPBC Act and international migratory agreements. The Ramsar Site is considered a centre of endemism as it provides habitat for endemic freshwater fish fauna and supports a number of important endemic macroinvertebrate taxa.

The Muir-Byenup System Ramsar site meets Ramsar criteria 1, 2, 3, 4, 5 and 6:

1. The site is an excellent example of a wetland complex in relatively undisturbed condition in the South-West Coast Australian Drainage Division. Peat based wetlands in the site are rare in Western Australia.
2. The site supports 5 nationally listed threatened species - 4 orchids and 1 fish.
3. Peat and primary saline wetlands at the site support endemic species and populations of plant and animal species important for maintaining biodiversity.
4. The site provides drought refuge and habitat for moulting and breeding of waterbirds.
5. Up to 52,000 waterbirds have been counted at Lake Muir during periods of high water levels.
6. The Ramsar site supports at least five, and possibly up to 10, Australasian bitterns, which exceeds the 1% population thresholds for south-western Australia.

2 - Data & location

2.1 - Formal data

2.1.1 - Name and address of the compiler of this RIS

Responsible compiler

Institution/agency	Department of Biodiversity, Conservation and Attractions
Postal address	Department of Biodiversity, Conservation and Attractions Biodiversity and Conservation Science Locked Bag 104 BENTLEY DELIVERY CENTRE Western Australia 6983

National Ramsar Administrative Authority

Institution/agency	Department of Agriculture, Water and the Environment
Postal address	Department of Agriculture, Water and the Environment GPO Box 858 Canberra ACT 2601 Australia

2.1.2 - Period of collection of data and information used to compile the RIS

From year

To year

2.1.3 - Name of the Ramsar Site

Official name (in English, French or Spanish)

2.1.4 - Changes to the boundaries and area of the Site since its designation or earlier update

(Update) A. Changes to Site boundary Yes No

(Update) B. Changes to Site area No change to area

(Update) For secretariat only. This update is an extension

2.1.5 - Changes to the ecological character of the Site

(Update) 6b i. Has the ecological character of the Ramsar Site (including applicable Criteria) changed since the previous RIS? Uncertain

(Update) Optional text box to provide further information

Whilst there has been no notifiable change in ecological character, the site has been subject to a changing climate. Australia has warmed by just over 1°C since 1910, with most warming since 1950. It is projected to experience further increases in temperatures, with more extremely hot days and fewer extremely cool days over the coming decades under all emissions scenarios. Warming over Australia is projected to be slightly higher than the global average (BOM and CSIRO, State of the Climate 2018).

In south-west Western Australia autumn-winter rainfall has declined by 20% since 1970 (Bureau of Meteorology 2016).

These conditions will affect the critical components, processes and services of the site. The adaptive capacity and resilience of the site will be tested.

In 2016 the Ramsar Secretariat was advised that a preliminary assessment of evidence for potential change in ecological character for the site found that drying and resultant acidification of the Tordit-Gurrup Lagoon component of the Muir Byenup System Ramsar site was due to climate change. Further detail is provided at section 5.2.

2.2 - Site location

2.2.1 - Defining the Site boundaries

b) Digital map/image

<1 file(s) uploaded>

Former maps

Boundaries description

The boundary of the Ramsar site includes part of the Lake Muir Nature Reserve 31880, which is vested in the Conservation Commission of Western Australia and managed by the Department of Biodiversity, Conservation and Attractions. The Ramsar sites sits wholly within the Nature Reserve, but does not include all of the Nature Reserve.

The boundary of the Ramsar site includes the parts of Nature Reserve 31880 that is the part of lot 13201 of plan 240193 south of Muirs Highway's southern road reserve boundary and includes all of lots 12567, 12988, 13200, 13202 of plan 240193, lot 12561 of plan 208115, lots 12566 and 12568 of plan 211868, lot 12991 of plan 175123 and lot 13065 of plan 210271.

The parts of Nature Reserve 31880 excluded from the Ramsar site on the western shore are lot 2237 of plan 128508 and lot 9247 of plan 140779 and lot 12694 of plan 208995 on the northern boundary of Muirs Highway road reserve. Also excluded from the Ramsar site are road reserves PIN 11624987, 11585969, 11733346, 11624444, 11624443, 11733347 and 11733348.

2.2.2 - General location

a) In which large administrative region does the site lie?

b) What is the nearest town or population centre?

2.2.3 - For wetlands on national boundaries only

a) Does the wetland extend onto the territory of one or more other countries? Yes No

b) Is the site adjacent to another designated Ramsar Site on the territory of another Contracting Party? Yes No

2.2.4 - Area of the Site

Official area, in hectares (ha):

Area, in hectares (ha) as calculated from GIS boundaries

2.2.5 - Biogeography

Biogeographic regions

Regionalisation scheme(s)	Biogeographic region
Other scheme (provide name below)	Frankland-Deep Rivers Region; South West Coast Drainage Division

Other biogeographic regionalisation scheme

Australian Hydrological Geospatial Fabric (Geofabric): Topographic Drainage Divisions and River Regions (BOM 2012). The Muir Byenup System Ramsar site is within the Frankland - Deep Rivers river region, South West Coast Drainage Division.

3 - Why is the Site important?

3.1 - Ramsar Criteria and their justification

- Criterion 1: Representative, rare or unique natural or near-natural wetland types

Hydrological services provided	The peat based wetlands of Byenup Lagoon, Tordit-Gurrup Lagoon, Poorginup Swamp are rare in Australia and Western Australia. These wetlands strongly influence water quality and provide an effective filter and buffering capacity and an important habitat for native plants and animals (Department of Environment and Conservation, 2012).
Other ecosystem services provided	Ecosystem services include: Biodiversity (supporting service) * Supporting a wide range of ecological communities; * Supporting a number of regionally, nationally and internationally threatened species; * Supporting a high diversity of species (flora and fauna); * Supporting an important representative of a rare habitat (peat wetlands); and, * Supporting numerous short range endemic species. Habitat (supporting service) * Open water – key biota: fish, macroinvertebrates, waterbirds (foraging); * Mudflats – key biota: macroinvertebrates, waders; * Peat wetlands – key biota: macroinvertebrates, waterbirds (foraging); * Baumea sedgeland – key biota: fish, macroinvertebrates, waterbirds (nesting, foraging and protection from predators); * Gahnia sedgeland – key biota: waterbirds; * Samphire – key biota: waterbirds (foraging, nesting, roosting and protection from predators); * Melaleuca communities – key biota: waterbirds (nesting and roosting); * Eucalyptus woodlands – key biota: waterbirds (nesting and roosting). Scientific (cultural services) The Muir-Byenup System Ramsar site has been monitored for several decades. Peat wetlands, rare in Western Australia, and primary saline wetlands are found within the Ramsar site and support scientifically important flora and fauna. The Ramsar site is also of interest for scientific research of past climatic regimes (peat record). Pollen and charcoal fossil records from Byenup Lagoon peat profiles have provided insights into Holocene vegetation and fire history (Dodson and Lu 2000). Analysis of lignite obtained during drilling investigations have also contributed to understanding late Eocene history of the area (Milne 2003). Farrell and Cook, (2009)
Other reasons	The Ramsar site is an excellent example of a wetland complex in a relatively undisturbed condition in the South-West Coast Australian Drainage Division. The peat based wetlands within the site are rare in Western Australia (Department of Environment and Conservation 2008; Environment Australia 2001) and they are also recognised as the most outstanding example in south-western Australia (Wetland Research and Management 2005).

- Criterion 2 : Rare species and threatened ecological communities

- Criterion 3 : Biological diversity

Justification	Peat and primary saline wetlands at the Muir Byenup System site support endemic species and populations of plant and animal species important for maintaining the biodiversity of the South-West Coast Australian Drainage Division. The site includes 21 priority taxa listed by the Western Australian Department of Environment and Conservation, including endemic plant taxa <i>Eryngium</i> sp. Lake Muir and <i>Tribonanthes</i> sp. Lake Muir. <i>Astartea</i> sp. Lake Muir is also endemic to the site. The majority of the population of <i>Wurmbea</i> sp. Cranbrook also occurs at the Ramsar site. The Muir-Byenup System Ramsar site supports 6 of the 8 endemic south-western Australian freshwater fish species including the western pygmy perch (<i>Nannoperca vittata</i>), Balston's pygmy perch (<i>Nannatherina balstoni</i>), nightfish (<i>Bostockia porosa</i>), western minnow (<i>Galaxias occidentalis</i>), black-striped minnow (<i>Galaxiella nigrostriata</i>) and mud minnow (<i>Galaxiella munda</i>). The Ramsar site also supports a number of important macroinvertebrate taxa, including 32 endemic taxa (Storey 1998).
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Criterion 4 : Support during critical life cycle stage or in adverse conditions

Criterion 5 : >20,000 waterbirds

Overall waterbird numbers

Start year

Source of data:

Criterion 6 : >1% waterbird population

3.2 - Plant species whose presence relates to the international importance of the site

Phylum	Scientific name	Criterion 2	Criterion 3	Criterion 4	IUCN Red List	CITES Appendix I	Other status	Justification
Plantae								
TRACHEOPHYTA / LILIOPSIDA	<i>Caladenia christineae</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	Nationally vulnerable under EPBC Act; Threatened under the WA Biodiversity Conservation Act	Rare at national and state level.
TRACHEOPHYTA / LILIOPSIDA	<i>Caladenia harringtoniae</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	Nationally vulnerable under EPBC Act; Threatened under the WA Biodiversity Conservation Act	Rare at national and state level.
TRACHEOPHYTA / LILIOPSIDA	<i>Caladenia lodgeana</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	Nationally critically endangered under EPBC Act. Threatened under the WA Biodiversity Conservation Act	Rare at national and state level.
TRACHEOPHYTA / LILIOPSIDA	<i>Diuris drummondii</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	Nationally vulnerable under EPBC Act; Threatened under the WA Biodiversity Conservation Act	Rare at national and state level.

Caladenia christineae (Christine’s Spider Orchid), also listed as Threatened under the WA Biodiversity Conservation Act (BC Act), is currently known from 28 populations within Western Australia, found between Yornup and Mt Barker in the state’s south-west. The orchid grows on winterwet flats (on the margins as well as in standing water) in heath and tall scrub communities, within *Eucalyptus marginata* (Jarrah)–*Eucalyptus calophylla* (Marri) forest and sometimes under *Melaleuca* sp. (Paperbarks). This species occurs within the South West and South Coast (Western Australia) Natural Resource Management Regions. The main identified threats to Christine’s Spider Orchid include fire between May, when the above-ground parts emerge, and November. Other threats include weeds, salinity, clearing, road maintenance and grazing. Source: Australian Government (2008b).

Caladenia harringtoniae (Harrington’s Spider-orchid), also listed as Threatened under the WA BC Act, has a restricted distribution, and is known from 37 populations between Nannup and Albany in Western Australia. It usually inhabits Paperbark (*Melaleuca* sp.) and Flooded gum (*Eucalyptus rudis*) swamps and flats, which are inundated for several months of the year, but may also be found along creeklines in Jarrah (*E. marginata*) and Karri (*E. diversicolor*) forest (Hoffman & Brown, 1992). The species occurs within the South West and South Coast (Western Australia) Natural Resource Management Regions. The main identified threat to Harrington’s Spider-orchid is fire during the active growth period (May–November). Other identified threats include grazing by feral pigs (*Sus scrofa*) and road maintenance activities, which disturb plants and habitat. Source: Australian Government (2008c).

Diuris drummondii (Tall Donkey Orchid), also listed as listed as Threatened under the WA BC Act, is known from 12 populations between Perth and Walpole, south-west Western Australia. Recently, two populations have been identified within the city of Bunbury, one on council-managed land, and the other on private land (South-West Catchments Council, 2007). The species occurs within the Swan, South West and South Coast (Western Australia) Natural Resource Management Regions (Australian Government, 2008d).

Caladenia lodgeana (Lodges spider orchid), also listed as threatened under the WA BC Act, is endemic to Western Australia, with a total number of 137 mature individuals known from four populations in 2008 – one near Augusta, and three south-east of Collie. Australian Government, 2013.

3.3 - Animal species whose presence relates to the international importance of the site

Phylum	Scientific name	Species qualifies under criterion				Species contributes under criterion				Pop. Size	Period of pop. Est.	% occurrence 1)	IUCN Red List	CITES Appendix I	CMS Appendix I	Other Status	Justification
		2	4	6	9	3	5	7	8								
Fish, Mollusc and Crustacea																	
CHORDATA/ ACTINOPTERYGII	<i>Bostockia porosa</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				NT	<input type="checkbox"/>	<input type="checkbox"/>		Species is endemic to south-west Western Australia
CHORDATA/ ACTINOPTERYGII	<i>Galaxias occidentalis</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				LC	<input type="checkbox"/>	<input type="checkbox"/>		Species is endemic to south-west Western Australia
CHORDATA/ ACTINOPTERYGII	<i>Galaxiella munda</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				EN	<input type="checkbox"/>	<input type="checkbox"/>		Internationally listed threatened species (IUCN). Species is endemic to south-west Western Australia
CHORDATA/ ACTINOPTERYGII	<i>Galaxiella nigrostriata</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				EN	<input type="checkbox"/>	<input type="checkbox"/>		Internationally listed threatened species (IUCN). Species is endemic to south-west Western Australia
CHORDATA/ ACTINOPTERYGII	<i>Nannatherina balstoni</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				EN	<input type="checkbox"/>	<input type="checkbox"/>	Listed as vulnerable under the EPBC; vulnerable, WA Biodiversity Conservation Act.	Internationally listed threatened species (IUCN). Species is endemic to south-west Western Australia
CHORDATA/ ACTINOPTERYGII	<i>Nannoperca vittata</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				VU	<input type="checkbox"/>	<input type="checkbox"/>		Internationally listed threatened species (IUCN). Species is endemic to south-west Western Australia
Birds																	
CHORDATA/ AVES	<i>Actitis hypoleucos</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				LC	<input type="checkbox"/>	<input type="checkbox"/>	Listed as migratory under the EPBC Act	Internationally migratory species that uses the site for non-breeding habitat or as a stop-over on their northward and/or southward migrations.

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Phylum	Scientific name	Species qualifies under criterion				Species contributes under criterion				Pop. Size	Period of pop. Est.	% occurrence 1)	IUCN Red List	CITES Appendix I	CMS Appendix I	Other Status	Justification
		2	4	6	9	3	5	7	8								
CHORDATA/AVES	<i>Anas gracilis</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16000			LC	<input type="checkbox"/>	<input type="checkbox"/>		The site provides a drought refuge for this species.
CHORDATA/AVES	<i>Anas superciliosa</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	18450			LC	<input type="checkbox"/>	<input type="checkbox"/>		The site provides a drought refuge for this species
CHORDATA/AVES	<i>Aythya australis</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	550	1989		LC	<input type="checkbox"/>	<input type="checkbox"/>		The site provides a drought refuge for this species.
CHORDATA/AVES	<i>Botaurus poiciloptilus</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10		3	EN	<input type="checkbox"/>	<input type="checkbox"/>	Nationally listed as endangered under the EPBC Act Listed as endangered under the WA Biodiversity Conservation Act.	Nationally listed threatened species (EPBC Act) and internationally listed threatened species (IUCN). The site supports this species during breeding
CHORDATA/AVES	<i>Calidris acuminata</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				LC	<input type="checkbox"/>	<input type="checkbox"/>	Listed as migratory under the EPBC Act	Internationally migratory species that uses the site for non-breeding habitat or as a stop-over on their northward and/or southward migrations.
CHORDATA/AVES	<i>Calidris ferruginea</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				NT	<input type="checkbox"/>	<input type="checkbox"/>	Nationally listed as critically endangered and migratory under the EPBC Act	Nationally listed threatened species (EPBC Act). Internationally migratory species that uses the site for non-breeding habitat or as a stop-over on their northward and/or southward migrations.
CHORDATA/AVES	<i>Calidris ruficollis</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	517	1985		NT	<input type="checkbox"/>	<input type="checkbox"/>	Listed as migratory under the EPBC Act (and under CMS, JAMBA, CAMBA, ROKAMBA)	Internationally migratory species that uses the site for non-breeding habitat or as a stop-over on their northward and/or southward migrations.
CHORDATA/AVES	<i>Calidris subminuta</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				LC	<input type="checkbox"/>	<input type="checkbox"/>	Listed as migratory under the EPBC Act	Internationally migratory species that uses the site for non-breeding habitat or as a stop-over on their northward and/or southward migrations.
CHORDATA/AVES	<i>Chroicocephalus novaehollandiae</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	40				<input type="checkbox"/>	<input type="checkbox"/>		The site supports this species during breeding. Breeding population: 40 pairs.
CHORDATA/AVES	<i>Cygnus atratus</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				LC	<input type="checkbox"/>	<input type="checkbox"/>		The site supports this species during breeding.
CHORDATA/AVES	<i>Fulica atra</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9630			LC	<input type="checkbox"/>	<input type="checkbox"/>		The site supports this species during breeding and provides a drought refuge.
CHORDATA/AVES	<i>Ixobrychus minutus</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				LC	<input type="checkbox"/>	<input type="checkbox"/>		The site supports this species during breeding.
CHORDATA/AVES	<i>Pluvialis squatarola</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				LC	<input type="checkbox"/>	<input type="checkbox"/>	Listed as migratory under the EPBC Act	Internationally migratory species that uses the site for non-breeding habitat or as a stop-over on their northward and/or southward migrations.
CHORDATA/AVES	<i>Porzana tabuensis</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					<input type="checkbox"/>	<input type="checkbox"/>		The site supports this species during breeding.
CHORDATA/AVES	<i>Tadorna tadornoides</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12000	1982		LC	<input type="checkbox"/>	<input type="checkbox"/>		The site supports this species during moulting.
CHORDATA/AVES	<i>Tringa nebularia</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				LC	<input type="checkbox"/>	<input type="checkbox"/>	Listed as migratory under the EPBC Act	Internationally migratory species that uses the site for non-breeding habitat or as a stop-over on their northward and/or southward migrations.

1) Percentage of the total biogeographic population at the site

Australasian bittern - threats

The major factor in the decline of the Australasian Bittern population in Australia is the reduction in extent of available habitat due to the long-term diversion of water away from wetlands and floodplains to support irrigated agriculture and urban water supplies; and the permanent loss of wetlands through conversion to other purposes, such as agricultural and urban development (Marchant & Higgins 1990; Kingsford & Thomas 1995; Garnett et al. 2011; Kingsford 2000). Frequent or intense burning of wetland areas may reduce the dense vegetation that forms the core habitat of the Australasian Bittern, potentially resulting in reduced nesting success. There is strong evidence that rising temperatures caused by increased greenhouse gases is leading to reduced rainfall across southeast and southwest Australia, and to increased evaporation, leading to large declines in surface water runoff. This will impact on Australasian Bittern habitat. All natural habitat in which the Australasian Bittern is known or likely to occur should be considered critical to the survival of the species (Australian Government, 2019).

3.4 - Ecological communities whose presence relates to the international importance of the site

<no data available>

4 - What is the Site like? (Ecological character description)

4.1 - Ecological character

Due to the complexity of the site, details for Lake Muir and the Byenup Lagoon System parts of the site are discussed separately below:

The critical components and processes of the Muir-Byenup System Ramsar Site are:

Hydrology:

Regionally, Lake Muir is a sink for groundwater and surface water flows and is mostly internally draining. Inflows are from artificial channels and the Mulgarnup Swamp complex. Lake Muir is seasonal and is naturally saline, acting as a shallow evaporating basin. Surface water area and depth varies seasonally.

The Byenup Lagoon System is fresh to saline with seasonal cycles. A complex process of overflow and filling occurs between connected wetlands. Surface water area, depth and salinity vary seasonally. Byenup Lagoon is permanent. Other wetlands in this system are permanent or near permanent. Minor swamps are inundated or waterlogged only in winter-spring. Areas of peat in Byenup, Tordit-Gurru and Poorginup dry out seasonally.

Wetland vegetation:

Lake Muir comprises salt tolerant macrophytes, sedgeland, low shrublands (samphires) and scrub dominate. Woodlands occur at higher elevations.

In Byenup Lagoon System macrophytes occur. Fringing vegetation includes Baumea and shrublands. Woodlands occur at higher elevations.

Fish:

Byenup Lagoon System has 7 fish species, including 6 endemic to south-west WA. Data is not available for Lake Muir

Aquatic invertebrates:

Byenup Lagoon System fauna is highly endemic but depauperate in richness. Macroinvertebrates in the system are able to tolerate a broad range of environmental conditions. Data is not available for Lake Muir.

Waterbirds:

49 waterbird species have been recorded within the Muir-Byenup System. 10 of these are listed under international migratory bird agreements. The site is an important drought refuge and the number of waterbirds inhabiting these wetlands is strongly influenced by local and regional water availability and varies from year to year. Muir-Byenup System is one of the most important moulting sites for Australian Shelducks in south-west WA. Baumea communities in freshwater lakes, including Tordit-Gurru and Byenup Lagoons and Poorginup Swamp, provide habitat for breeding pairs of little bittern and spotless crane. Australasian Bitterns are likely to breed at the site.

Non-critical ecosystem benefits and services include regulating services, cultural services and supporting services.

Regulating services: include pollution control and detoxification, and flood control. The wetlands act as a sink for sediment and nutrients from the catchment and the site acts a receiver of water from the surrounding floodplain.

Cultural services: include recreation and tourism (bird watching, photography) and spiritual and inspirational (the wetlands are spiritually significant for the Noongar people and at least one Aboriginal site occurs within the Muir-Byenup System Ramsar site). Scientific and educational services are provided. Peat wetlands, rare in Western Australia, and primary saline wetlands are found within the Ramsar site and support scientifically important flora and fauna.

Supporting services: include biodiversity - supporting ecological communities, threatened species, high species diversity a high level of endemism and rare habitat. Nutrient cycling is also important.

Natural variability:

The system is characterised by high natural variability in water depth, salinity and other factors in response to climate.

Current changes:

Aquatic invertebrate community composition, distribution of some fish species and condition of fringing vegetation has undergone changes. These may be due to increased salinity levels. However as mean annual salinity has not been statistically significantly different over the long term (1978- 2008) the changes may be within natural variation.

Reductions in water levels, lake drying and acidification were reported in 2016 and have been attributed to a significant drying trend due to climate change.

4.2 - What wetland type(s) are in the site?

Inland wetlands

Wetland types (code and name)	Local name	Ranking of extent (1: greatest - 4: least)	Area (ha) of wetland type	Justification of Criterion 1
Fresh water > Lakes and pools >> O: Permanent freshwater lakes				
Saline, brackish or alkaline water > Lakes >> R: Seasonal/ intermittent saline/ brackish/ alkaline lakes and flats	Lake Muir	1	4600	Representative
Fresh water > Lakes and pools >> Tp: Permanent freshwater marshes/ pools	Byenup Lagoon System	0		Rare
Fresh water > Marshes on inorganic soils >> Ts: Seasonal/ intermittent freshwater marshes/ pools on inorganic soils	Byenup Lagoon System	0		Rare
Fresh water > Marshes on peat soils >> U: Permanent Non-forested peatlands	Byenup Lagoon, Tordit-Gurrup Lagoon, Poorginup Lagoon	0		Rare
Fresh water > Marshes on inorganic soils >> W: Shrub-dominated wetlands	Byenup Lagoon System	0		Rare
Fresh water > Marshes on inorganic soils >> Xf: Freshwater, tree-dominated wetlands	Byenup Lagoon System	0		Rare

(ECD) Habitat connectivity

The Muir-Byenup System Ramsar site contains an unusual complex of natural wetlands, composed of partly inter-connected lakes and swamps, ranging in size (up to 4,600 ha), salinity (saline to fresh), water permanence (permanent to seasonal) and substrate.

4.3 - Biological components

4.3.1 - Plant species

Other noteworthy plant species

Phylum	Scientific name	Position in range / endemism / other
TRACHEOPHYTA/MAGNOLIOPSIDA	<i>Euphrasia scabra</i>	rare in WA
TRACHEOPHYTA/MAGNOLIOPSIDA	<i>Lilaeopsis polyantha</i>	rare in WA
TRACHEOPHYTA/MAGNOLIOPSIDA	<i>Stylidium rhipidium</i>	endemic

Invasive alien plant species

Phylum	Scientific name	Impacts	Changes at RIS update
OOMYCOTA/PERONOSPOREA	<i>Phytophthora cinnamomi</i>	Potential	No change
TRACHEOPHYTA/LILIOPSIDA	<i>Typha orientalis</i>	Actual (minor impacts)	No change

Optional text box to provide further information

Invasive species:
 Exotic weeds, including *Watsonia* sp., Cape Tulip, east coast wattles, exotic grasses, blue gums and various clovers, are found within the Ramsar site. The impacts of these species are not known. *Typha orientalis* populations have been found in Tordit-Gurrup Lagoon and Geordinup Swamp, and have been managed by spraying programs (since 2006) and seed removal.

Noteworthy flora:
 The Muir-Byenup System Ramsar site is highly diverse; with at least 600 flora species within the Ramsar site (Gibson and Keighery 1999). This diversity is probably due to complexes of soil types and hydrological patterns, which are found over short distances and are reflected in vegetation patterning. In particular, vegetation patterning at the site is related to inundation, groundwater and fire history. Structural vegetation mapping at the site has defined a complex mosaic of over 30 vegetation types (see Ecological Character Description attached at section 6.1.2).

Noteworthy flora at the site includes three species of wetland dependent orchids, *Caladenia christineae*, *Caladenia harringtoniae* and *Diuris drummondii*, which occur on the margins of Lake Muir and elsewhere in the site (Gibson and Keighery 1999). These orchids are listed as vulnerable under the EPBC Act. *Caladenia lodgeana*, a species found in wet creek flats, swamps and granite outcrops is listed as critically endangered under the EPBC Act.

21 other State listed priority taxa (under the WA Biodiversity Conservation Act) are also found within site, including:

- * *Stylidium rhipidium* and *Wurmbea* sp. Cranbrook, found in winter-wet swamps.
- * *Eryngium* sp. Lake Muir, which appears to be endemic to winter-wet clay flats of Lake Muir and is currently known only from the Ramsar site.
- * *Euphrasia scabra* has two populations at the site which are the only known extant populations in Western Australia.
- * *Lilaeopsis polyantha*, with the State's only known population found in fringing vegetation surrounding Lake Muir
- * *Tribonanthes* sp. Lake Muir, a previously unrecognised taxon, endemic to winter- wet clay flats of the Ramsar site and nearby Nature Reserves.

4.3.2 - Animal species

Invasive alien animal species

Phylum	Scientific name	Impacts	Changes at RIS update
ARTHROPODA/INSECTA	<i>Apis mellifera</i>	Potential	No change
CHORDATA/MAMMALIA	<i>Canis lupus familiaris</i>	Potential	No change
CHORDATA/MAMMALIA	<i>Cervus elaphus</i>	Actual (minor impacts)	No change
CHORDATA/MAMMALIA	<i>Dama dama</i>	Actual (minor impacts)	No change
CHORDATA/MAMMALIA	<i>Equus caballus</i>	Actual (minor impacts)	No change
CHORDATA/MAMMALIA	<i>Felis catus</i>	Potential	No change
CHORDATA/ACTINOPTERYGII	<i>Gambusia holbrooki</i>	Potential	No change
CHORDATA/MAMMALIA	<i>Mus musculus</i>	Potential	No change
CHORDATA/MAMMALIA	<i>Oryctolagus cuniculus</i>	Potential	No change
CHORDATA/MAMMALIA	<i>Rattus rattus</i>	Potential	No change
CHORDATA/MAMMALIA	<i>Sus scrofa</i>	Actual (minor impacts)	No change
CHORDATA/MAMMALIA	<i>Vulpes vulpes</i>	Actual (minor impacts)	No change

Optional text box to provide further information

Invasive species
 Foxes pose direct threats to waterbirds through predation. Horses, deer and pigs also pose a direct threat to waterbirds through habitat destruction. Horses and pigs can also spread Phytophthora. Deer may exacerbate acid sulfate soils in Baumea sedgeland by oxygenating peat and mobilising acid groundwater. They may cause tree death through ringbarking.

Noteworthy fauna - Aquatic invertebrates
 A survey of macroinvertebrates by DeHaan (1987) recorded 103 invertebrate taxa in the suite comprising Tordit-Gurrup Lagoon, Byenup Lagoon and Poorginup Swamp. These included 11 watermites, Hydracarina, six of which (found at Poorginup Swamp) have restricted distributions (e.g. Pseudohydryphantes doegi, Acercella poorginup) and are of considerable zoogeographic interest. One species, Huitfeldtia sp. nov., is the second known species in its genus, the other species occurs in northern Europe and Canada. The crustaceans Cherax preissii and C. quinquecarinatus also occur at the site.

Storey (1998) surveyed the macroinvertebrate communities of eight wetlands within the Ramsar site in 1996/97 and recorded 32 taxa endemic to south-western Australia. Poorginup Swamp had the greatest number (16) of south-western Australian endemics. Two new species of dytiscid water beetle Sternopriscus sp. nov. and Antiporus pennifolidae (Antiporus Sp. 1 of Storey, 1998) were recorded.

Preliminary identification of macroinvertebrates collected during the 1996/97 survey has revealed a rich and diverse fauna (Storey 1998). At least 78 species of ostracods and copepods were recorded. Of these, six ostracods and one cyclopoid copepod are, to date, only known from the Muir-Unicup area, with two of the ostracods and the cyclopoid being found within the Ramsar site (S. Halse pers. com.). Within the Rotifera there were 11 new records for Western Australia, one new record for Australia and one new species, yet to be described. Within the Cladocera there were two new species and the second record of new, undescribed genus. Hygrobia watsii sp. n (Coleoptera: Hygrobiidae) found in Byenup Lagoon appears to be restricted to peatland swamps and lakes and is the sixth species in the world in this genus and the fourth in Australia (Hendrich 2001). Hygrobia watsii sp. n is a relict species which is likely to be endangered by swamp drainage and increased salinity (Hendrich 2001).

See Ecological Character Description attached at section 6.1.2 for further information and references.

4.4 - Physical components

4.4.1 - Climate

Climatic region	Subregion
C: Moist Mid-Latitude climate with mild winters	Csb: Mediterranean (Mild with dry, warm summer)

The Muir-Byenup System Ramsar site experiences a moderate Mediterranean climate of warm to hot, dry summers and cold, wet winters. During the last 30 years the weather and climate in south-west Western Australia have changed including:

- * Annual rainfall has decreased by 6%;
- * Rainfall has decreased in the autumn and early winter months;
- * There have been fewer spring frosts;
- * Daytime temperatures have remained relatively stable while night-time temperatures have increased.

(BOM Regional Weather and Climate Guide 2019).

4.4.2 - Geomorphic setting

a) Minimum elevation above sea level (in metres)

a) Maximum elevation above sea level (in metres)

- Entire river basin
- Upper part of river basin
- Middle part of river basin
- Lower part of river basin
- More than one river basin
- Not in river basin
- Coastal

Please name the river basin or basins. If the site lies in a sub-basin, please also name the larger river basin. For a coastal/marine site, please name the sea or ocean.

The Lake Muir-Unicup catchment is approximately 694 km² and shares imprecise boundaries with the south-flowing drainages of the Tone, Deep and Frankland rivers (Smith 2003). Lake Muir, at approximately 41 km² is the largest surface waterbody in the catchment, and is almost exclusively internally draining (Smith 2003). Other wetlands overflow to downstream wetlands or waterways such as the Tone or Frankland rivers (Smith 2003). Water is derived from minor seasonal streams of up to 5 km long within a surface catchment that covers about 38,500 ha (Department of Conservation and Land Management 2003). See ecological character description at section 6.1.2 for references details.

4.4.3 - Soil

Mineral

(Update) Changes at RIS update No change Increase Decrease Unknown

Organic

(Update) Changes at RIS update No change Increase Decrease Unknown

No available information

Are soil types subject to change as a result of changing hydrological conditions (e.g., increased salinity or acidification)? Yes No

Please provide further information on the soil (optional)

The Ramsar site overlies the Proterozoic Albany-Fraser Orogen, in alluvial/lacustrine deposits and peat (peat to 4m thick) overlying granite and gneiss, in broadly undulating country. The broad plain on which most of the wetlands occur has had a complex geological history. The area has been subject to several marine incursions while most of the soils are of Tertiary or Quaternary age and represent infilling of blocked paleodrainage systems (Chakravartula and Street, 1999). Acid sulfate soils are present.

4.4.4 - Water regime

Water permanence

Presence?	Changes at RIS update
Usually seasonal, ephemeral or intermittent water present	unknown
Usually permanent water present	decrease

Source of water that maintains character of the site

Presence?	Predominant water source	Changes at RIS update
Water inputs from surface water	<input checked="" type="checkbox"/>	unknown
Water inputs from groundwater	<input type="checkbox"/>	unknown
Water inputs from precipitation	<input type="checkbox"/>	decrease

Water destination

Presence?	Changes at RIS update
Unknown	No change

Stability of water regime

Presence?	Changes at RIS update
Water levels fluctuating (including tidal)	No change

Please add any comments on the water regime and its determinants (if relevant). Use this box to explain sites with complex hydrology:

Lake Muir is the largest surface waterbody in the catchment, and is almost exclusively internally draining (Smith 2003). Other wetlands overflow to downstream wetlands or waterways such as the Tone or Frankland rivers (Smith 2003). Water is derived from minor seasonal streams. There are also a number of constructed channels that drain adjacent farming land and divert runoff into wetlands or directly into the Tone River (Smith 2003).

Depending on rainfall, evaporation and groundwater connectivity, wetlands in the Muir - Unicup catchments are either permanent or ephemeral, naturally fresh, naturally saline or seasonally alternating (Smith 2003). These wetlands can belong to groundwater systems overlying poorly conductive clays or they may be windows to deeper regional aquifers, depending on their position in the landscape (Smith 2003).

Surface water area and depth of wetlands in south-west Western Australia varies seasonally, with water levels rising in winter and spring and falling in summer and autumn (Lane and Munro 1982).

The Lake Muir-Unicup catchment has been divided informally into a number of sub- catchments, including: Lake Muir, Unicup and Yarnup (Smith 2003).

See ecological character description attached at section 6.1.2 for further detail and references.

(ECD) Connectivity of surface waters and of groundwater

The Muir-Byenup System Ramsar site possibly contributes to the maintenance of groundwater in surrounding areas. Little is known on the interactions between shallow and deep groundwater systems and groundwater interactions with surface water systems.

4.4.5 - Sediment regime

Sediment regime unknown

4.4.6 - Water pH

Acid (pH<5.5)

(Update) Changes at RIS update No change Increase Decrease Unknown

Circumneutral (pH: 5.5-7.4)

(Update) Changes at RIS update No change Increase Decrease Unknown

Alkaline (pH>7.4)

(Update) Changes at RIS update No change Increase Decrease Unknown

Unknown

Please provide further information on pH (optional):

The pH of Lake Muir is 6.2-9.9. Lower pH is associated with low water levels.
 The pH of the Byenup Lagoon system is 7-9, with the exception of Pooringup Swamp, which is acidic with a pH of 5-6.6.

An acidification event within part of Tordit-Gurrup Lagoon was first observed in the winter of 2013. Water quality data collected through the monitoring program conducted by Parks indicated that the pH in surface water within Tordit-Gurrup Lagoon declined to below 3 (2.99 in July 2013; 2.94 in June 2014).

Tordit-Gurrup Lagoon has historically been a permanently inundated wetland, however, the lake bed dried during the summer/autumn of 2013. The dry conditions are likely to be the result of a trend of declining rainfall observed in the area since the 1970s. As the wetland dried, the soils and sediments that contain sulfides were exposed - these sulfides then oxidised and during rewetting, acid was mobilised within the water body.

4.4.7 - Water salinity

Fresh (<0.5 g/l)

(Update) Changes at RIS update No change Increase Decrease Unknown

Mixohaline (brackish)/Mixosaline (0.5-30 g/l)

(Update) Changes at RIS update No change Increase Decrease Unknown

Euhaline/Eusaline (30-40 g/l)

(Update) Changes at RIS update No change Increase Decrease Unknown

Unknown

Please provide further information on salinity (optional):

Mean annual salinity are presented for Byenup Lagoon, Tordit-Gurrup Lagoon and Pooringup Swamp, 1979 to 2008 (unpublished data from J. Lane, DEC 2008). Salinity (ppt) ranged from 1.38-42.2 at Byenup Lagoon, 0.65-15.2 at Tordit- Gurrup Lagoon and 0.1-1.6 at Pooringup Swamp. Salinity levels between years were only significantly different in Pooringup Swamp (P<0.001) and were associated with lower water depths in 1987 and 2007.

For all three wetlands, mean annual salinity data is highly variable and there has been no significant change since the time of listing (2001). Due to the high natural variability in these wetlands the ANZECC guidelines were not considered appropriate.

Note: ANZECC is the Australian New Zealand Environment and Conservation Council.

4.4.8 - Dissolved or suspended nutrients in water

Unknown

Please provide further information on dissolved or suspended nutrients (optional):

Based on data (1979-2008) presented in the ecological character description (see section 6.1.2):

Lake Muir:
 Total N and soluble N ranged from 0.58-5.8 and 0.4-4.7 mg/L , respectively. Total P and soluble P ranged from 0.005-0.65 and 0.005-0.1 mg/L respectively.
 Mean annual total and soluble N and P were not significantly different between years for Lake Muir and there are no apparent trends.

Byenup Lagoon System:
 Seasonal patterns for surface water total nitrogen and total phosphorous were similar between the 1996/97 and 2003/04 sampling periods. In 1996/97, total nitrogen concentrations were found to be consistently high at most sites and seasons, except for Geordinup Swamp in spring and Pooringup Swamp in autumn. In 2003/04, total N concentrations were high in all seasons and at all sites, except Tordit-Gurrup in autumn and Pooringup Swamp in spring. Phosphorous was limited at all sampling times in all wetlands (Wetland Research and Management 2005).

4.4.9 - Features of the surrounding area which may affect the Site

Please describe whether, and if so how, the landscape and ecological characteristics in the area surrounding the Ramsar Site differ from the i) broadly similar ii) significantly different site itself:

Surrounding area has greater urbanisation or development

Surrounding area has higher human population density

Surrounding area has more intensive agricultural use

Surrounding area has significantly different land cover or habitat types

Please describe other ways in which the surrounding area is different:

Surrounding land uses include agriculture, predominantly grazing and tree plantations on freehold land, and peat mining north of Lake Muir. The southern boundary of the Ramsar site adjoins the Lake Muir National Park. Previously, timber was also extracted from surrounding State Forest areas. Within the Ramsar site, land use is restricted to nature conservation, in line with the land tenure and purpose.

4.5 - Ecosystem services

4.5.1 - Ecosystem services/benefits

Regulating Services

Ecosystem service	Examples	Importance/Extent/Significance
Maintenance of hydrological regimes	Groundwater recharge and discharge	Medium
Pollution control and detoxification	Water purification/waste treatment or dilution	Medium

Cultural Services

Ecosystem service	Examples	Importance/Extent/Significance
Recreation and tourism	Nature observation and nature-based tourism	Low
Spiritual and inspirational	Contemporary cultural significance, including for arts and creative inspiration, and including existence values	Medium
Spiritual and inspirational	Spiritual and religious values	Medium
Scientific and educational	Important knowledge systems, importance for research (scientific reference area or site)	Medium
Scientific and educational	Long-term monitoring site	Medium

Supporting Services

Ecosystem service	Examples	Importance/Extent/Significance
Biodiversity	Supports a variety of all life forms including plants, animals and microorganisms, the genes they contain, and the ecosystems of which they form a part	High

Optional text box to provide further information

Further detail about ecosystem services not captured above:

Spiritual and inspirational
 The wetlands are spiritually significant for the Noongar people and at least one Aboriginal site occurs within the Muir-Byenup System Ramsar site. The Mulgarnup Swamp complex is known to be an important site for Aboriginal women (R. Hearn pers. com.)

Scientific and educational
 The Muir-Byenup System Ramsar site has been monitored for several decades. Peat wetlands, rare in Western Australia, and primary saline wetlands are found within the Ramsar site and support scientifically important flora and fauna. The Ramsar site is also of interest for scientific research of past climatic regimes (peat record). Pollen and charcoal fossil records from Byenup Lagoon peat profiles have provided insights into Holocene vegetation and fire history (Dodson and Lu 2000). Analysis of lignite obtained during drilling investigations have also contributed to understanding late Eocene history of the area (Milne 2003).

Habitat
 Habitat types that are important for the ecological character of the Ramsar site include:
 * Open water – key biota: fish, macroinvertebrates, waterbirds (foraging);
 * Mudflats – key biota: macroinvertebrates, waders;
 * Peat wetlands – key biota: macroinvertebrates, waterbirds (foraging);
 * Baumea sedgeland – key biota: fish, macroinvertebrates, waterbirds (nesting, foraging and protection from predators);
 * Gahnia sedgeland – key biota: waterbirds;
 * Samphire – key biota: waterbirds (foraging, nesting, roosting and protection from predators);
 * Melaleuca communities – key biota: waterbirds (nesting and roosting); and
 * Eucalyptus woodlands – key biota: waterbirds (nesting and roosting).

Biodiversity
 Biodiversity values include:
 * Supporting a wide range of ecological communities;
 * Supporting a number of regionally, nationally and internationally threatened species;
 * Supporting a high diversity of species (flora and fauna); and,
 * Supporting an important representative of a rare habitat (peat wetlands) Supporting short range endemic species.

Within the site:

Outside the site:

Have studies or assessments been made of the economic valuation of ecosystem services provided by this Ramsar Site? Yes No Unknown

4.5.2 - Social and cultural values

- i) the site provides a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland
- ii) the site has exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland
- iii) the ecological character of the wetland depends on its interaction with local communities or indigenous peoples
- iv) relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland

<no data available>

4.6 - Ecological processes

(ECD) Nutrient cycling	The Ramsar site plays a role in the recycling of nutrients from the surrounding catchment.
(ECD) Animal reproductive productivity	The site supports waterbird breeding and in particular, provides habitat to support breeding of the Australasian bittern, a listed threatened species. Little bittern, spotless crane, black swans and Eurasian coots also breed at the site.
(ECD) Notable aspects concerning migration	The site is used by migratory birds including 6 species listed on international migratory agreements

5 - How is the Site managed? (Conservation and management)

5.1 - Land tenure and responsibilities (Managers)

5.1.1 - Land tenure/ownership

Public ownership

Category	Within the Ramsar Site	In the surrounding area
Provincial/region/state government	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Private ownership

Category	Within the Ramsar Site	In the surrounding area
Other types of private/individual owner(s)	<input type="checkbox"/>	<input checked="" type="checkbox"/>

5.1.2 - Management authority

Please list the local office / offices of any agency or organization responsible for managing the site:

The Parks and Wildlife Service, Warren Region, Western Australian Department of Biodiversity Conservation & Attractions.

Provide the name and/or title of the person or people with responsibility for the wetland:

Department of Biodiversity, Conservation and Attractions

Postal address:

Department of Biodiversity, Conservation and Attractions
Parks and Wildlife Service
Locked Bag 104
BENTLEY DELIVERY CENTRE
Western Australia 6983.

E-mail address:

wetlands@dbca.wa.gov.au

5.2 - Ecological character threats and responses (Management)

5.2.1 - Factors (actual or likely) adversely affecting the Site's ecological character

Water regulation

Factors adversely affecting site	Actual threat	Potential threat	Within the site	Changes	In the surrounding area	Changes
Salinisation	Medium impact	Medium impact	<input checked="" type="checkbox"/>	No change	<input checked="" type="checkbox"/>	No change
Drainage	Medium impact	Medium impact	<input checked="" type="checkbox"/>	No change	<input checked="" type="checkbox"/>	No change

Natural system modifications

Factors adversely affecting site	Actual threat	Potential threat	Within the site	Changes	In the surrounding area	Changes
Fire and fire suppression	Medium impact	Medium impact	<input checked="" type="checkbox"/>	No change	<input checked="" type="checkbox"/>	No change
Unspecified/others	Medium impact	Medium impact	<input checked="" type="checkbox"/>	No change	<input type="checkbox"/>	No change

Invasive and other problematic species and genes

Factors adversely affecting site	Actual threat	Potential threat	Within the site	Changes	In the surrounding area	Changes
Invasive non-native/ alien species	Medium impact	Medium impact	<input checked="" type="checkbox"/>	No change	<input type="checkbox"/>	No change

Climate change and severe weather

Factors adversely affecting site	Actual threat	Potential threat	Within the site	Changes	In the surrounding area	Changes
Storms and flooding	unknown impact	unknown impact	<input checked="" type="checkbox"/>	increase	<input checked="" type="checkbox"/>	increase
Habitat shifting and alteration	unknown impact	unknown impact	<input checked="" type="checkbox"/>	unknown	<input checked="" type="checkbox"/>	unknown
Droughts	unknown impact	unknown impact	<input checked="" type="checkbox"/>	increase	<input checked="" type="checkbox"/>	increase
Temperature extremes	unknown impact	unknown impact	<input checked="" type="checkbox"/>	increase	<input checked="" type="checkbox"/>	increase

Please describe any other threats (optional):

With continued global warming, projections for the Southern and south-western flatlands NRM region in which the Muir Byenup System Ramsar site is located, are for increased average temperatures in all seasons; more hot days and dry spells; a continuing trend of decreasing winter rainfall and possibly also decreasing in spring (changes in other seasons are unclear); increased intensity of extreme rainfall events; and a harsher fire weather (Climate Change in Australia, BOM and CSIRO, 2020).

An assessment was undertaken in response to an acidification event at Tordit-Gurrup Lagoon (component of Ramsar site) first observed in 2013 and reported to the Australian Government on 15 September 2014. Water quality data indicated that the pH in surface water within Tordit-Gurrup Lagoon had declined to below 3 (2.99 in July 2013; 2.94 in June 2014).

Tordit-Gurrup Lagoon has historically been a permanently inundated wetland, however, the lake bed dried during the summer/autumn of 2013. The dry conditions are likely to be the result of a trend of declining rainfall observed in the area since the 1970s. As the wetland dried, the soils and sediments that contain sulfides were exposed. The sulfides then oxidised and during rewetting, acid was mobilised within the water body.

A wildfire occurred along the western boundary of Tordit-Gurrup Lagoon during November 2013 and burnt across approximately 85 ha. The fire extended to a peat area of the wetland and exacerbated the acidification process by further cracking and exposing the peat.

The preliminary assessment indicated that the hydrology and pH had changed at Tordit-Gurrup Lagoon within the Muir-Byenup System Ramsar site.

The acidification of Tordit-Gurrup Lagoon is largely the result of climate change, particularly declining rainfall reducing both surface water and groundwater levels. Water supplementation to Tordit-Gurrup Lagoon has been considered but determined to not be feasible due to the lack of a sustainable water source.

Surface water level data collected in 2015-2016 show summer levels in all wetlands within the Muir-Byenup System Ramsar site are at a record long term low. Therefore under the current climate, all water bodies within wetlands with peat substrates are at risk of becoming acidic.

Potential solutions are being considered and a watching brief was implemented to monitor future change and trigger further consideration. Appropriate management measures will be considered if they become available and are feasible to implement.

5.2.2 - Legal conservation status

National legal designations

Designation type	Name of area	Online information url	Overlap with Ramsar Site
Nature Reserve	Lake Muir National Park	https://parks.dpaw.wa.gov.au/par k/lake-muir	whole

5.2.3 - IUCN protected areas categories (2008)

- Ia Strict Nature Reserve
- Ib Wilderness Area: protected area managed mainly for wilderness protection
- II National Park: protected area managed mainly for ecosystem protection and recreation
- III Natural Monument: protected area managed mainly for conservation of specific natural features
- IV Habitat/Species Management Area: protected area managed mainly for conservation through management intervention
- V Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation
- VI Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems

5.2.4 - Key conservation measures

Legal protection

Measures	Status
Legal protection	Implemented

Other:

In Australia, the ecological character of a designated Ramsar site is protected as a Matter of National Environmental Significance (MNES) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

5.2.5 - Management planning

Is there a site-specific management plan for the site? Yes

Has a management effectiveness assessment been undertaken for the site? Yes No

If the site is a formal transboundary site as indicated in section Data and location > Site location, are there shared management planning processes with another Contracting Party? Yes No

5.2.6 - Planning for restoration

Is there a site-specific restoration plan? No need identified

Further information

Actions to address acidification at Tordit-Gurru Lagoon, as reported in 2016, have been considered. However, addressing this climate change related process is complex and more information is needed.

5.2.7 - Monitoring implemented or proposed

Monitoring	Status
Water quality	Proposed
Water regime monitoring	Proposed
Birds	Proposed

Monitoring at Tordit-Gurru Lagoon includes:

- monthly surface water levels and basic water chemistry;
- biannual groundwater levels;
- monthly waterbird surveys;
- invasive species monitoring.

6 - Additional material

6.1 - Additional reports and documents

6.1.1 - Bibliographical references

A list of references is attached at 6.1.2 (vi)

6.1.2 - Additional reports and documents

i. taxonomic lists of plant and animal species occurring in the site (see section 4.3)

<no file available>

ii. a detailed Ecological Character Description (ECD) (in a national format)

<1 file(s) uploaded>

iii. a description of the site in a national or regional wetland inventory

<no file available>

iv. relevant Article 3.2 reports

<no file available>

v. site management plan

<no file available>

vi. other published literature

<1 file(s) uploaded>

6.1.3 - Photograph(s) of the Site

Please provide at least one photograph of the site:



Byenup Lagoon, Muir-Byenup System Ramsar site (G Partridge, 26-08-2019)



Lake Muir, Muir-Byenup Ramsar site (G Partridge, 26-08-2019)



Tordit-Gurrup Lagoon, Muir-Byenup Ramsar site (G Partridge, 26-08-2019)

6.1.4 - Designation letter and related data

Designation letter

<1 file(s) uploaded>

Date of Designation 2001-01-05