Ramsar Information Sheet

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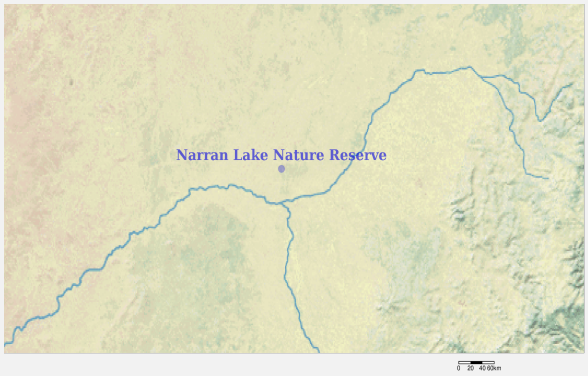
Australia

Narran Lake Nature Reserve



Designation date	14 June 1999
Site number	995
Coordinates	29°43'53"S 147°25'54"E
Area	8 447,00 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

Narran Lake Nature Reserve Ramsar site is located in the central north of New South Wales approximately 70 kilometres south west of Lightning Ridge, within the Murray-Darling Basin. The Ramsar site is part of the Narran Lakes system, a terminal wetland located on a distributary of the Balonne River. This region is characterised by highly variable rainfall and ephemeral river flows. Flows to the Narran Lakes typically occur as a result of heavy rainfall in elevated headwater areas, with no flow experienced at least 60% of the time (Thoms, 2007).

The lower Balonne system, which feeds the Narran Lakes is subject to significant water extraction for irrigated crops. There has been some water set aside to provide environmental outcomes in these catchments and environmental flows are periodically provided to support Narran Lakes values.
The Narran Lake Ramsar site is 8447 ha in area and is listed under three of the nine Ramsar criteria; 1, 2 and 4.

The site supports a range of intermittent wetland types which are geographically significant in NSW, exemplifying a relatively undisturbed terminal lake system. The terminal wetland is listed as a Key Biodiversity Area by Birdlife Australia and has been identified as a drought refugia habitat in a semi-arid environment, exhibiting the classic boom and bust ecology of arid and semi-arid intermittent floodplains and wetlands.

The site contains a diversity of habitats, including some of the largest expanses of Lignum (Muehlenbeckia florulenta) in NSW, as well as riparian forest and woodlands, which provide critical habitat for large colonial waterbird breeding events. Nine colonial species breed at the site, with the site being particularly important for straw-necked ibis (Threskiornis spinicollis), Australian pelican (Pelecanus conspicillatus), Australian white ibis (Threskiornis molucca), glossy ibis (Plegadis falcinellus), and royal spoonbill (Platalea regia). Narran Lake Nature Reserve supports 40 migratory bird species, including 19 species listed under international agreements.

Narran Lake Nature Reserve Ramsar Site supports three wetland dependent threatened species, including Australasian Bittern, Murray Cod and Winged Peppercress.

The Narran Lake Ramsar site has the following critical components and processes: hydrology, vegetation extent and condition, diversity of fish, diversity and abundance of waterbirds breeding and productivity.

2 - Data & location

2.1 - Formal data

2.1.1 - Name and address of the compiler of this RIS

Responsible compiler

Institution/agency	New South Wales Department of Planning, Industry and Environment
Postal address	PO Box A290 Sydney South, NSW 1232 Australia

National Ramsar Administrative Authority

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

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

From year	2011
To year	2020

2.1.3 - Name of the Ramsar Site

Official name (in English, French or Spanish)	Narran Lake Nature Reserve

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) The boundary has been delineated more accurately	☑
(Update) The boundary has been extended	☑
(Update) The boundary has been restricted	☐
(Update) B. Changes to Site area	the area has increased
(Update) The Site area has been calculated more accurately	☐
(Update) The Site has been delineated more accurately	☐
(Update) The Site area has increased because of a boundary extension	☑
(Update) The Site area has decreased because of a boundary restriction	☐
(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?	Yes (likely)
(Update) Are the changes	Positive ○ Negative ○ Positive & Negative ◉
(Update) Positive %	100
(Update) Negative %	100
(Update) No information available	☐
(Update) Optional text box to provide further information	

The site is subject to a changing climate. Australia has warmed by just over 1 °C since 1910, with most warming occurring since 1950 (Bureau of Meteorology (BOM), State of Climate 2018). Australia is projected to experience further increases in temperature, with more extremely hot days and fewer extremely cool days over the coming decades. Warming over Australia is expected to be slightly higher than the global average (BOM, State of the Climate 2018).

According to the BOM Regional Weather and Climate Guide 2019 for North West (NSW) the region has, over the last 30 years, seen changes to the climate and weather including:

• Rainfall has decreased in the autumn and spring months in the region, although annual totals have been relatively stable
• Summer rainfall has been moderately reliable, winter has been unreliable
• Spring frosts have been more common and have been occurring later
• There have been more hot days, with more consecutive days above 38 °C
In the near future (2030) natural variability is projected to predominate over rainfall trends. However, later in the century as the global climate continues to warm, the region, is projected to experience further increases in average temperatures in all seasons, with more hot days and fewer frosts, and decreases in average rainfall in winter with the intensity of heavy rainfall projected to increase. Given the complexity of rain producing systems in the region the rainfall in summer and autumn has not been projected; this region could face a wetter or drier climate in these seasons. Severe fire weather is projected to increase across region (CCIA, Central Slopes Projection Summaries

These conditions will inherently affect the critical components, processes and service of the Ramsar site and the adaptive capacity and resilience of the site will be tested.

Regarding 2.1.4: the boundary has been delineated more accurately

(Update) Changes resulting from causes operating within the existing boundaries?	☐
(Update) Changes resulting from causes operating beyond the site's boundaries?	☑
(Update) Changes consequent upon site boundary reduction alone (e.g., the exclusion of some wetland types formerly included within the site)?	☐
(Update) Changes consequent upon site boundary increase alone (e.g., the inclusion of different wetland types in the site)?	☐

(Update) Please describe any changes to the ecological character of the Ramsar Site, including in the application of the Criteria, since the previous RIS for the site.

Continued upstream water extraction post listing combined with another prolonged drought period and climatic changes have changed the hydrological regime of the site. Between 2013 and 2019 there were minimal inundation events into Narran Lakes, with one small inundation event recorded in the Narran Lakes in 2016-17 and consequently the ecological character of the site may have been impacted.

Water has been set aside to maintain the condition of the Narran Lakes Ramsar site. This "environmental water" is provided to the site when there is sufficient water available to trigger the environmental flow licences. Environmental water has been used in 2014, 2016, 2017 and 2020 and achieved positive environmental impacts in the Ramsar site.

As a boom and bust wetland, the ecological character of the site is resilient to dry periods. However, the extent of the recent dry periods saw significant impacts on the site's other critical components and processes, specifically the condition of the vegetation and the number of waterbird species visiting the site. A mid-sized inundation event over February and March 2020 has seen water return to the core rookery and important foraging habitat at the site and may, following further monitoring, demonstrate the site's resilience to such dry periods.

Vegetation surveys took place in Spring 2015, Autumn 2017 & Autumn 2018. The mean condition scores of flood-dependent lignum shrubland were intermediate in the first two years of surveys (2015-17) but had declined to intermediate/poor during recent the later surveys (2017-18).

Areas of tree dominated floodplain occur throughout the site with several key species: river red gum (Eucalyptus camaldulensis), coolibah (E. coolabahs), black box (E. largiflorens), river cooba (Acacia stenophylla) and bignonia emu-bush (Eremophila bignoniiflora). Thoms et al. (2007) noted low recent recruitment and high mortality in all commonly occurring tree species. A recent flyover of Narran Lakes showed trees still in poor condition (DPIE, 2020). However, early observations following the inundation event in early 2020 have found that vegetation in some areas is responding well. Monitoring will continue at the site to establish whether the vegetation is primed to support a future colonial waterbird breeding event.

The total number of waterbird species recorded in the Narran Lakes in recent surveys have been relatively low compared to available records, due to minimal inundation in the 2013-19 period. Ground counts in December 2016 have recorded resident shorebirds plus the migratory red-necked stint. Large flood events were recorded in many parts of the Murray-Darling Basin in 2016-17, and while small inflows in the Narran River reached Clear Lake in October 2016 and April 2017 these flows did not reach the area between Clear Lake and Back Lake which has traditionally supported large ibis breeding events. Colonial waterbird breeding activity has not been detected in the Narran Lakes since 2012.

A mid-sized inundation event over February and March 2020 has seen water return to the core rookery and important foraging habitat at the site and may, following further monitoring, demonstrate the site's resilience to such dry periods. Early observations have found that the lignum in some areas is responding well to the rainfall and inundation in early 2020. Monitoring will continue at the site to establish whether the vegetation is primed to support a future colonial waterbird breeding event.

Pigs, foxes and feral cats all pose a threat to waterbirds via increased predation particularly during breeding events.

Currently, and at listing, the site meets criteria 1, 2 and 4.

(Update) Is the change in ecological character negative, human-induced AND a significant change (above the limit of acceptable change)	Yes ○

2.2 - Site location

2.2.1 - Defining the Site boundaries

b) Digital map/image
<2 file(s) uploaded>

Former maps: 0

Boundaries description

The Ramsar boundary is made up from Nature Reserve boundary, floodplain boundary defined by the extent of hydric soils and floodplain vegetation using ADS40 imagery, and cadastre boundary. Since 2011 the Narran Lake Nature Reserve Ramsar site has encompassed the extent of floodplains and the majority of the floodplain dependent vegetation within the Narran Lake Nature Reserve.

The boundary description refers to points A, B, C, D, E, F, G, H and I, shown on the attached map. This attachment also shows approximate coordiantes for each of these points.

Commencing at the corner of DP765343 at Point A, the Ramsar boundary follows the Narran Lake Nature Reserve boundary west to Point B. The Ramsar boundary then follows the floodplain boundary in a generally northern direction to Point C where it again meets the Narran Lake Nature Reserve boundary. The Ramsar boundary follows the Nature Reserve boundary in a generally northern direction to Point D where it meets the floodplain boundary and then heads generally east along the floodplain boundary until it again meets the boundary of the cadastral parcel DP765343 at Point E.
From Point E to Point F, the Ramsar boundary follows the cadastral boundary of DP765343 to create the northern extent of the site. The road reserve at the northern edge of this lot is not included in the Ramsar site, isolating two small areas that are included in the Ramsar site, as shown on Attachment 1.

From Point F on the eastern boundary of DP765343, the Ramsar boundary heads in a generally easterly then southerly direction along the floodplain boundary meeting the cadastre again on the boundary of the western parcel of DP765344 at Point G.

From Point G, the Ramsar boundary proceeds southeast along a road reserve within DP765344 to Point H, where it heads in a generally easterly then southerly direction along the floodplain boundary, meeting the cadastre again on the boundary of the western parcel of DP765344 at Point I.

The Ramsar boundary then goes south along the edge of the western parcel of DP765344 to the Nature Reserve boundary. The Ramsar boundary follows the Nature Reserve boundary west and northwest to Point A.

2.2.2 - General location

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

b) What is the nearest town or population centre? Brewarrina (population approximately 1,143) is located 50km south west

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): 8447

Area, in hectares (ha) as calculated from GIS boundaries: 8453.957

2.2.5 - Biogeography

Biogeographic regions

Regionalisation scheme(s)	Biogeographic region
Other scheme (provide name below)	Australian Drainage Divisions
Marine Ecoregions of the World (MEOW)	Murray-Darling Basin Drainage Division: Condamine Balonne

Other biogeographic regionalisation scheme

Australian Hydrological Geospatial Fabric (Geofabric): Topographic Drainage Divisions and River Regions (BOM 2012) – Murray-Darling Basin: Condamine-Balonne

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 site is unique within the Murray-Darling Drainage Division bioregion for its juxtaposition of highly channelised floodplain with open water wetland habitat. As a terminal wetland system, it plays an important hydrological role in the natural functioning of the Narran River. The vast lignum (Muehlenbeckia florulenta) (Ramsar wetland type W) dominated floodplain represents one of the largest expanses of relatively intact lignum in NSW (Aldis 1987). The site is part of a largely intact, unmodified terminal wetland ecosystem in good condition.

☑ Criterion 2 : Rare species and threatened ecological communities

☑ Criterion 4 : Support during critical life cycle stage or in adverse conditions

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 / MAGNOLIOPSIDA	*Duma florulenta*	☐	☐	☑		☐		Also known as Muehlenbeckia florulenta., Lignum provides key habitat for colonial bird breeding events.
TRACHEOPHYTA / MAGNOLIOPSIDA	*Eucalyptus largiflorens*	☑	☐	☐	VU	☐		Internationally listed threatened species (IUCN).
TRACHEOPHYTA / MAGNOLIOPSIDA	*Lepidium monoplocoides*	☑	☐	☐		☐	Nationally listed (EPBC Act) - endangered	Nationally listed threatened species (EPBC Act). Found in the shrubland surrounding the ephemeral herbfields

The site is important in maintaining the geographic range of the winged peppercress plant species/community and an outstanding example of this plant community.

Lignum shrublands are dominated by the shrub Muehlenbeckia florulenta (also known as Duma florulenta) but may also support scattered trees in varying abundance. Lignum provides key habitat for colonial bird breeding events.

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								
Others																	
CHORDATA / MAMMALIA	*Phascolarctos cinereus*	☑	☐	☐	☐	☐	☐	☐	☐				VU	☐	☐	Listed as threatened at state level (BC Act) - vulnerable	Internationally listed threatened species (IUCN). Listed as threatened under NSW legislation.

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	*Maccullochella peelii*	☑	☐	☐	☐	☐	☐	☐	☐				LC	☐	☐	Nationally listed (EPBC Act) - vulnerable	Nationally listed threatened species (EPBC Act).
Birds																	
CHORDATA / AVES	*Anas gracilis*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Anas rhynchotis rhynchotis*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Anas superciliosa*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Anhinga novaehollandiae*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Anseranas semipalmata*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐	Listed as threatened at state level (BC Act) - vulnerable	This species breeds at the site. Listed as threatened under NSW legislation.
CHORDATA / AVES	*Ardea modesta*	☐	☑	☐	☐	☐	☐	☐	☐					☐	☐		This species breeds at the site.
CHORDATA / AVES	*Ardea pacifica*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Aythya australis*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Biziura lobata*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Botaurus poiciloptilus*	☑	☐	☐	☐	☐	☐	☐	☐				EN	☐	☐	Nationally listed (EPBC Act) - endangered	Nationally listed threatened species (EPBC Act).
CHORDATA / AVES	*Chenonetta jubata*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Cygnus atratus*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Dendrocygna eytoni*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Limosa limosa*	☐	☑	☐	☐	☐	☐	☐	☐				NT	☐	☐	Nationally listed (EPBC Act) – migratory	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	*Malacorhynchus membranaceus*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Microcarbo melanoleucos*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Oxyura australis*	☐	☑	☐	☐	☐	☐	☐	☐				NT	☐	☐	Listed as threatened at state level (BC Act) - vulnerable	This species breeds at the site.
CHORDATA / AVES	*Pelecanus conspicillatus*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Phalacrocorax carbo*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Phalacrocorax sulcirostris*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Phalacrocorax varius*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Platalea regia*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at 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								
CHORDATA / AVES	*Plegadis falcinellus*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Poliocephalus poliocephalus*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Stictonetta naevosa*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐	Listed as threatened at state level (BC Act) - vulnerable	This species breeds at the site.
CHORDATA / AVES	*Tachybaptus novaehollandiae*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Threskiornis molucca*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.
CHORDATA / AVES	*Threskiornis spinicollis*	☐	☑	☐	☐	☐	☐	☐	☐				LC	☐	☐		This species breeds at the site.

1) Percentage of the total biogeographic population at the site

The Australasian bittern, Botaurus poiciloptilus, has been recorded at the site (DECCW 2010a) in the vicinity of Clear Lake in 2008 and upstream of the Ramsar site in 1994. There have been no more recent sightings. This species is cryptic and difficult to locate without targeted ground surveys.

Murray cod (Maccullochella peelii peelii) has been recorded in the Ramsar site in the Narran River (Thoms et al. 2007) and lower the reaches of the Condamine system (Davies et al. 26 2008). However, Murray cod are rare in the system with records being sporadic. Fish resilience surveys are being proposed across the Northern Murray Darling Basin which may provide up-to-date information on the species in the system.

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

Name of ecological community	Community qualifies under Criterion 2?	Description	Justification
Chenopod shrubs	☑	Overall, plant community composition of herbfields within the extent of historic inundation in the Narran Lakes ecosystem tend to be quite distinct from that of the understoreys of adjacent terrestrial communities (Thoms et al. 2007; Capon 2010).	Lepidium monoploides (winged peppercress) a nationally listed species is found in the shrubland surrounding the ephemeral herbfields.

Optional text box to provide further information

Winged peppercress (Lepidium monoplocoides) is a small annual herb found in a range of habitats including floodplain wetlands on seasonally damp or waterlogged soils. It is considered to be widespread in western New South Wales but locally rare. Within the Ramsar site it is found as isolated individuals within Chenopod shrub communities (Thoms et al. 2002).

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

4.1 - Ecological character

Central to a description of the ecological character of a Ramsar site is the identification and description of critical components, processes and services, benchmarked to the time of listing. The Narran Lake Ramsar site has the following critical components and processes: hydrology, vegetation extent and condition, diversity of fish, diversity and abundance of waterbird breeding and productivity. The services for the site include supporting services for waterbirds and fish and threatened plant and animal species and cultural services.

Hydrology

Surface water hydrology tends to be the primary driver of vegetation dynamics in dryland floodplain and wetland ecosystems (Brock et al. 2006). Species inhabiting these systems typically exhibit morphological and physiological traits as well as life histories which enable plants to persist under unpredictable regimes of flooding and drying, either as adult plants or as dormant propagules that enable escape from these stressors in time and space. Variations in the tolerances and responses of different species to flooding and drought have a major influence on temporal and spatial patterns of vegetation composition and structure.

Productivity

The site is a boom and bust wetland in a semi-arid environment (meaning the system is characterised by flood and drought) and as such it was considered that productivity is a critical process for the site, with high primary production underpinning the support of fish and waterbird populations. However, whilst no site specific data exists, the loss of reactive/productive floodplains upstream (from expansion of irrigated crops and water storage) of the Ramsar site may influence productivity in the Ramsar site.

Vegetation

Wetland vegetation in the Ramsar site is characterised by three main community types: i) riparian open forest and woodland, ii) lignum shrubland and iii) ephemeral herbfields. Vegetation associations within the Ramsar site are spatially and temporally heterogeneous and reflect historical inundation patterns and dryland topography and geology. The lignum shrublands, in particular, provide critical breeding habitat for the colonial waterbirds. The 2011 boundary extension to the Ramsar site captures more breeding habitat as well as key feeding areas. Condition and characteristics of the lignum shrubland are driven by flood inundation history. Frequently flooded areas are typically dominated by large, dense, continuous clumps while infrequently flooded areas support many small lignum clumps, and the most frequently flooded habitats lack lignum all together.

Waterbirds

The site is significant for supporting waterbird breeding with 44 species recorded breeding at the site; the colonial breeding species form the most spectacular breeding colonies. Data on breeding events from 1971 to 2012 indicate that Clear and Back Lake are important areas for waterbird breeding (Thoms et al. 2002, DPIE, 2018). Narran Lake to the south of the Ramsar site is also important as a waterbird breeding site and in providing resources for nesting species within the Ramsar site. Waterbirds which occur within the site and are listed at the state level include freckled duck (Stictonetta naevosa), blue-billed duck (Oxyura australis), brolga (Grus rubicunda), Australasian bittern (Botaurus poiciloptilus) (also listed under the EPBC Act), magpie goose (Anseranas semipalmata), black-necked stork (Ephippiorhynchus asiaticus), and black-tailed godwit (Limosa limosa). When all of the waterbodies in the Narran Lakes system fill with floodwaters, the lakes within and outside the Ramsar site become important breeding sites for colonial nesting waterbirds. Over 130,000 nests were observed in March 2012 (Spencer et al. , 2015).

Fish

Fish surveys have collected 11 native and four introduced species including the Murray cod (Maccullochella peelii peelii) listed under the EPBC Act. Fish are also a critical food source for waterbirds.

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 > Flowing water >> N: Seasonal/ intermittent/ irregular rivers/ streams/ creeks		3	167	
Fresh water > Lakes and pools >> P: Seasonal/ intermittent freshwater lakes		2	300	
Saline, brackish or alkaline water > Lakes >> R: Seasonal/ intermittent saline/ brackish/ alkaline lakes and flats		4	20	
Fresh water > Marshes on inorganic soils >> Ts: Seasonal/ intermittent freshwater marshes/ pools on inorganic soils		4	20	
Fresh water > Marshes on inorganic soils >> W: Shrub-dominated wetlands	Narran Lakes	1	7926	Unique
Fresh water > Marshes on inorganic soils >> Xf: Freshwater, tree-dominated wetlands		4	20	

(ECD) Habitat connectivity	The extent of each wetland type is not known. The ranking of wetland type (above) is judged the order of likely dominance and the area of each wetland type is estimated.

4.3 - Biological components

4.3.1 - Plant species

Other noteworthy plant species

Phylum	Scientific name	Position in range / endemism / other
TRACHEOPHYTA/MAGNOLIOPSIDA	*Acacia stenophylla*	Important part of ecosystem - currently exhibiting very high levels of mortality and stress
TRACHEOPHYTA/MAGNOLIOPSIDA	*Atriplex holocarpa*	Important part of ephemeral herb field ecosystem
TRACHEOPHYTA/MAGNOLIOPSIDA	*Atriplex nummularia*	important part of ecosystem
TRACHEOPHYTA/MAGNOLIOPSIDA	*Eremophila bignoniiflora*	Important part of ecosystem - currently exhibiting very high levels of mortality and stress
TRACHEOPHYTA/MAGNOLIOPSIDA	*Eucalyptus camaldulensis*	Important part of ecosystem - currently exhibiting very high levels of mortality and stress
TRACHEOPHYTA/MAGNOLIOPSIDA	*Haloragis glauca*	important species within t the riparian open forests and woodlands
TRACHEOPHYTA/MAGNOLIOPSIDA	*Maireana appressa*	Important part of ephemeral herb field ecosystem
TRACHEOPHYTA/POLYPODIOPSIDA	*Marsilea drummondii*	Important part of ephemeral herb field ecosystem
TRACHEOPHYTA/MAGNOLIOPSIDA	*Sclerolaena decurrens*	important part of ecosystem
TRACHEOPHYTA/LILIOPSIDA	*Sporobolus mitchellii*	important part of ecosystems

Invasive alien plant species

Phylum	Scientific name	Impacts	Changes at RIS update
TRACHEOPHYTA/MAGNOLIOPSIDA	*Cuscuta pentagona*	- Please select a value -	unknown
TRACHEOPHYTA/MAGNOLIOPSIDA	*Lycium ferocissimum*	- Please select a value -	unknown
TRACHEOPHYTA/MAGNOLIOPSIDA	*Myriophyllum spicatum*	- Please select a value -	unknown
TRACHEOPHYTA/MAGNOLIOPSIDA	*Phyla nodiflora minor*	Potential	unknown
TRACHEOPHYTA/MAGNOLIOPSIDA	*Xanthium spinosum*	- Please select a value -	unknown

Optional text box to provide further information

Hunter (1999) recorded 325 plant species within the Nature Reserve, of which 11 percent were introduced species, with the flora of the Ramsar Site being characterised by arid and semi-arid zone species.

River cooba (Acacia stenophylla) is particularly abundant in areas fringing Clear Lake and on the floodplain west of Clear Lake while Eucalyptus camaldulensis is relatively frequent in shrublands on the eastern edge of Clear and Back lakes (Hunter 1999). Areas of tree dominated floodplain occur throughout the site with several key species: river red gum (Eucalyptus camaldulensis), coolibah (E. coolabahs), black box (E. largiflorens), river cooba (Acacia stenophylla) and bignonia emu-bush (Eremophila bignoniiflora). Thoms et al. (2007) noted low recent recruitment and high mortality in all commonly occurring tree species. In 2004, seedlings and saplings of river red gum, river coolibah and river cooba were all exhibiting very high levels of mortality and stress (Thoms et al. 2007).

Overall, plant community composition of herbfields within the extent of historic inundation in the Narran Lakes ecosystem tend to be quite distinct from that of the understoreys of adjacent terrestrial communities (Thoms et al. 2007; Capon 2010). Within these herb fields chenopods may be present and even locally abundant, particularly during dry periods (Hunter 1999, Capon 2010).

Samphire is known to occur on patches of red earths, lunettes and playas to the east of Clear Lake most of the time (McGann et al. 2001).

Noogoora burr is considered a riparian weed, infesting riparian and floodplain habitats. Golden dodder is frequently found amongst the lignum shrublands, occurring in shallow areas of the site. As propagules of all three species are transported from upstream they are not able to be eradicated from the Ramsar site. Lippia (Phyla canescens) has also been identified as an invasive species within the Ramsar site. Lippia is a fast-growing groundcover which causes degradation of soil and water, displacement of native species and can lead to bank erosion. There are programs in place to manage these species.

4.3.2 - Animal species

Other noteworthy animal species

Phylum	Scientific name	Pop. size	Period of pop. est.	% occurrence	Position in range /endemism/other
CHORDATA/AVES	*Ardeotis australis*				Listed as threatened at state level (BC Act) - endangered
CHORDATA/REPTILIA	*Chelodina longicollis*				Listed as threatened at state level (BC Act) - vulnerable
CHORDATA/AVES	*Climacteris picumnus*				Listed as threatened at state level (BC Act) - vulnerable
CHORDATA/AVES	*Ephippiorhynchus asiaticus*				Listed as threatened at state level (BC Act) - endangered
CHORDATA/AVES	*Epthianura albifrons*				Listed as threatened at state level (BC Act) - vulnerable
CHORDATA/AVES	*Grus rubicunda*				Listed as threatened at state level (BC Act) - vulnerable
CHORDATA/AVES	*Hamirostra melanosternon*				Listed as threatened at state level (BC Act) - vulnerable
CHORDATA/AVES	*Hieraaetus morphnoides*				Listed as threatened at state level (BC Act) - vulnerable
CHORDATA/MAMMALIA	*Hydromys chrysogaster*				Listed as threatened at state level (BC Act) - vulnerable
CHORDATA/AVES	*Melanodryas cucullata*				Listed as threatened at state level (BC Act) - vulnerable
CHORDATA/AVES	*Ninox connivens*				Listed as threatened at state level (BC Act) - vulnerable
CHORDATA/AVES	*Pomatostomus temporalis temporalis*				Listed as threatened at state level (BC Act) - vulnerable
CHORDATA/MAMMALIA	*Saccolaimus flaviventris*				Listed as threatened at state level (BC Act) - vulnerable

Invasive alien animal species

Phylum	Scientific name	Impacts	Changes at RIS update
CHORDATA/ACTINOPTERYGII	*Cyprinus carpio*	- Please select a value -	No change
CHORDATA/MAMMALIA	*Felis catus*	- Please select a value -	No change
CHORDATA/ACTINOPTERYGII	*Gambusia holbrooki*	- Please select a value -	No change
CHORDATA/MAMMALIA	*Lepus capensis*	- Please select a value -	No change
CHORDATA/MAMMALIA	*Oryctolagus cuniculus*	- Please select a value -	No change
CHORDATA/MAMMALIA	*Sus scrofa*	- Please select a value -	No change
CHORDATA/MAMMALIA	*Vulpes vulpes*	- Please select a value -	No change

Optional text box to provide further information

Over 100 species of land birds have been recorded in the area with many showing a preference for the floodplain woodlands (Thoms et al. 2002); including eight vulnerable and one endangered species under the NSW Biodiversity Conservation Act 2016. The Pink Cockatoo (lephochroa leadbeateri) is also known to occur within the Ramsar site.

Twenty four species of reptiles have been recorded within the site (NSW Atlas). The only wetland dependent mammal present is the water rat (Hydromys chrysogaster).

Pest control programs have been in place on the Narran Lakes Nature Reserve from 2012 to 2020. This are undertaken by National Parks and Wildlife Service and target rabbits, goats, pigs, foxes and cats. The operations are successful in shooting a number of these species each year (NPWS, 2020).

4.4 - Physical components

4.4.1 - Climate

Climatic region	Subregion
B: Dry climate	BSh: Subtropical steppe (Low-latitude dry)

Please refer to section 2.1.5

4.4.2 - Geomorphic setting

a) Minimum elevation above sea level (in metres): 120

a) Maximum elevation above sea level (in metres): 140

- 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.

Narran Lakes and the Narran River are within the Condamine-Balonne catchment of the northern Murray-Darling Basin. The Narran system is a terminal portion of the Balonne River.

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 geology of the site consists primarily of Quaternary sediments which include floodplain, outwash areas and drainage flats of black, red and white sandy to silty clay and clayey sand, and silt with areas of black and grey clayey silt and sand deposited in claypans and lakes. The soils of the Ramsar site are generally very fine in texture, with on average over 65 percent silts and clays and are classified as being clayey mud soils according to the standard soil nomenclature (Thoms et al. 2007). Rayburg et al. (2006) identified eight geomorphic units in the Narran Lakes terminal ecosystem, five of which occur within the bounds of the Ramsar site: northern lakes, red soil, north eastern floodplain, north western floodplain and a small area of central western floodplain.

4.4.4 - Water regime

Water permanence

Presence?	Changes at RIS update
Usually seasonal, ephemeral or intermittent water present	No change
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	☑	No change

Water destination

Presence?	Changes at RIS update
Feeds groundwater	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:

The local catchment area of the Ramsar site is relatively small, with the wetlands rarely filling from local rainfall events. Floods are generated in the upper catchment areas (Thoms 2003 and mainly occur in summer and autumn. Annual inflows to the site are highly variable and tend to be relatively high magnitude for short duration, or little or no flow (Thoms et al. 2002). The high inter-annual variability of flows in the Narran River ensures that the site has a complex flood history with periodic wet/dry cycles (Thoms 2003) supporting a classic boom and bust ecology. In Narran Lake the average time to dry, in the absence of top up events, is about 15 months. In the Ramsar site, the average time to dry is about ten months, although the shallower parts of this lake may dry much more quickly (for example Long Arm dries in about two months while Back Lake dries in about three months on average) (Thoms et al. 2007).

Flows at Wilby Wilby, the nearest upstream gauge to the site, show a systematic decline in the occurrence of medium-sized floods since 1992 and an overall decrease in discharge volumes when compared to the earlier part of the record (Thoms et al. 2007). This has resulted in an increase in the recurrence intervals for all flood magnitudes since 1992 (Thoms et al. 2007). Cease to flow conditions occur approximately 60% of the time in the Narran River immediately upstream of the Ramsar site.

The Lower Balonne region has been subject to large water resource developments particularly since the advent of irrigated agriculture in the 1960s. There are three main irrigation developments within the Condamine-Balonne catchment and four significant public water storages in the catchment, which service irrigation, agricultural and domestic supply. There are also numerous private off-stream water storages on the Lower Balonne Floodplain that have an estimated combined storage volume in excess of 500 000 Ml (Thoms, 2003).

Narran Lakes is a terminal lake system.

(ECD) Connectivity of surface waters and of groundwater	Groundwater – surface water interactions are considered to be negligible.
(ECD) Stratification and mixing regime	No information available

4.4.5 - Sediment regime

Sediment regime unknown ☑

Please provide further information on sediment (optional):

No information available

(ECD) Water turbidity and colour	No information available
(ECD) Light - reaching wetland	No information available
(ECD) Water temperature	No information available

4.4.6 - Water pH

Unknown ☑

4.4.7 - Water salinity

Fresh (<0.5 g/l) ☑

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

Unknown ☐

Please provide further information on salinity (optional):

No information available

(ECD) Dissolved gases in water

No information available

4.4.8 - Dissolved or suspended nutrients in water

Unknown ☑

(ECD) Dissolved organic carbon	No information available

(ECD) Redox potential of water and sediments	No information available
(ECD) Water conductivity	No information available

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 site itself: i) broadly similar ○ ii) significantly different ◉

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:

The majority of land surrounding the Nature Reserve that contains the Ramsar Site is held under Western Lands Leases granted under the Western Lands Act 1901, one of the oldest pieces of natural resource management legislation in Australia. The immediate area surrounding the Nature Reserve and Ramsar site is part of the semi-arid pastoral zone and is used primarily for sheep and cattle grazing (NSW NPWS 2000). There is considerable water extraction in the catchment with 1,500,000 megalitres of water storages on the Lower Balonne floodplain, predominantly in Queensland.

4.5 - Ecosystem services

4.5.1 - Ecosystem services/benefits

Cultural Services

Ecosystem service	Examples	Importance/Extent/Significance
Spiritual and inspirational	Cultural heritage (historical and archaeological)	High
Spiritual and inspirational	Spiritual and religious values	Medium
Scientific and educational	Important knowledge systems, importance for research (scientific reference area or site)	Medium

Supporting Services

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

Optional text box to provide further information

The Ramsar site is part of an area which holds great significance for local Aboriginal people, with very high archaeological, traditional and contemporary social and spiritual significance (NSW NPWS 2000). The Narran Lake Nature Reserve is called Dhwarriwaa which means ‘Meeting Place’ and Narran Lake is called Burrul Guumin, meaning ‘Big Water’. The site covers the traditional lands of the Yuwaalaraay/Euahalia. A number of Aboriginal groups frequent the site. These groups include the Gomilaroi, Baranbinya, Murrawari, Ngyiimpaa/Wongiabon, Ngemba, Gwambiraay, Wielwan, and Cooma/Gwamu who would have visited the site on the invitation of the Yuwaalaraay to conduct cultural business that would have coincided with large bird breeding, wetting, and seasonal events.
The Narran Lake terminal ecosystem and neighbouring landscape have been a key focal point for Indigenous people for around 40,000 years, as a meeting place for ceremonial and economic purposes, and as a rich source of food and other materials (Thoms et al. 2002). There are numerous Aboriginal site complexes in the area including shell middens, shell mounds, hearth sites, significant silcrete quarries, artefact scatters and sacred trees. Sites within the Nature Reserve are relatively undisturbed (NSW NPWS 2000). The Murrawari have a burial ground on the western point on Narran Lake proper.

Within the site:	10s
Outside the site:	100s

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) Primary production	High productivity is associated with intermediate duration's (one to three months) of inundation followed by long periods of floodwater drawdown (three to six months).
(ECD) Nutrient cycling	Insufficient information available.
(ECD) Carbon cycling	Insufficient information available.
(ECD) Animal reproductive productivity	Colonial waterbird breeding events are considered critical to the ecological character of the site.
(ECD) Vegetational productivity, pollination, regeneration processes, succession, role of fire, etc.	Vegetational productivity and regeneration are considered critical to the ecological character of the site especially as successful colonial waterbird breeding events are dependent on an adequate feeding habitat.
(ECD) Notable species interactions, including grazing, predation, competition, diseases and pathogens	Insufficient information available.
(ECD) Notable aspects concerning animal and plant dispersal	Pigs, foxes and feral cats all pose a threat to waterbirds via increased predation particularly during breeding events.
(ECD) Notable aspects concerning migration	The site supports a significant number of migratory bird species including 14 species listed under international migratory species treaties and a further 26 species which are migratory within Australia.
(ECD) Pressures and trends concerning any of the above, and/or concerning ecosystem integrity	Climate change is expected to impact on the above ecological processes. Refer to section 2.1.5.

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	☑	☐

Private ownership

Category	Within the Ramsar Site	In the surrounding area
Other types of private/individual owner(s)	☐	☑

5.1.2 - Management authority

Please list the local office / offices of any agency or organization responsible for managing the site: NSW National Parks and Wildlife Service (part of NSW Department of Planning, Industry and Environment).

Provide the name and/or title of the person or people with responsibility for the wetland: Area Manager, Narrabri Area

Postal address: PO Box 72
Narrabri NSW 2390

E-mail address: npws.barwon@environment.nsw.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
Water abstraction	High impact	High impact	☐	No change	☑	No change

Agriculture and aquaculture

Factors adversely affecting site	Actual threat	Potential threat	Within the site	Changes	In the surrounding area	Changes
Livestock farming and ranching	Medium impact	Medium impact	☐	No change	☑	No change

Natural system modifications

Factors adversely affecting site	Actual threat	Potential threat	Within the site	Changes	In the surrounding area	Changes
Unspecified/others	Medium impact	Medium impact	☑	No change	☐	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	Low impact	Low impact	☑	No change	☐	No change
Problematic native species	Low impact	Low impact	☑	No change	☐	No change

Climate change and severe weather

Factors adversely affecting site	Actual threat	Potential threat	Within the site	Changes	In the surrounding area	Changes
Droughts	Medium impact	Medium impact	☐	No change	☑	No change
Temperature extremes	Medium impact	Medium impact	☐	No change	☑	No change

Please describe any other threats (optional):

Water abstraction: please refer to section 4.4.4
Invasive non-native/ alien species: please refer to section 4.3.2
Climate change and severe weather: please refer to section 2.1.5

5.2.2 - Legal conservation status

National legal designations

Designation type	Name of area	Online information url	Overlap with Ramsar Site
State Protected Area (NSW)	Narran Lake nature Reserve	http://www.nationalparks.nsw.gov.au/visit-a-park/parks/narran-la ke-nature-reserve	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

Species

Measures	Status
Control of invasive alien plants	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).

Species measures: Control of Noogoora burr (Xanthium occidentale) and Bathurst burr (Xanthium spinosum) along the river.

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

5.2.7 - Monitoring implemented or proposed

Monitoring	Status
Plant community	Implemented
Birds	Implemented
Animal species (please specify)	Implemented

The Murray-Darling Basin Environmental Water Knowledge and Research (MDB EWKR) project conducts annual surveys on floodplain vegetation diversity, survival, condition and recruitment, waterbird annual and breeding event surveys, inundation extent and duration and native fish survival condition and recruitment studies. Under EWKR only vegetation surveys have been conducted at Narran so far.

EWKR link: http://environment.gov.au/water/cewo/monitoring/ewkr

NSW Department for Planning, Industry and the Environment (DPIE) have regular spring ground count data for waterbirds collected by NSW National Parks and Wildlife Service. These are done each November to coincide with University of NSW (UNSW) aerial survey that is funded by Murray Darling Basin Authority as part of their asset based annual spring surveys. The NSW DPIE ground spring survey has been going each spring since 2012. UNSW aerial spring counts are available in 2008 (through their National Survey program) and 2010-2019 (through the MDBA funded program). Ad hoc data is also collected by local Birdlife Australia volunteers. All of the ground data is available through NSW Bionet.

In conjunction with a mid-sized inundation event over February and March 2020 the Commonwealth Environmental Water Office worked with NSW and Queensland government agencies, the University of New England and the Narran Lakes Joint Management Committee to develop a short term monitoring program to measure the ecosystem response. Satellite images will be used to analyse the areas that receive water. Vegetation and water bird responses will be photographed and assessed. Other animals, including frogs, will also be monitored.

6 - Additional material

6.1 - Additional reports and documents

6.1.1 - Bibliographical references

See Attachment 1 for full list of bibliographical references.

Key references used in this RIS update are as follows:

Bureau of Meterology (2012). Australian Hydrological Geospatial Fabric (Geofabric): Topographic Drainage Divisions and River Regions: http://www.bom.gov.au/water/geofabric/documents/BOM002_Map_Poster_A3_Web.pdf

Bureau of Meterology and CSIRO (2018). State of the Climate 2018 https://www.csiro.au/~/media/OnA/Files/State-of-the-Climate-2018-CSIRO-BOM-Dec2018.pdf

Bureau of Meterology (2019a). Regional Weather and Climate Guide – Border Rivers file:///C:/Users/A15446/Downloads/10-Border-Rivers-QLD-Climate-Guide.pdf

Bureau of Meterology (2019b). Regional Weather and Climate Guide – Border Rivers file:///C:/Users/A15446/Downloads/10-Border-Rivers-QLD-Climate-Guide.pdf

Bureau of Meterology (2019c). Regional Weather and Climate Guide – Western NSW file:///C:/Users/A15446/Downloads/016-Western-NSW-Climate-Guide.pdf

CSIRO (2008). Water availability in the Condamine-Balonne. A report to the Australian Government from the CSIRO Murray-Darling Basin Sustainable Yields Project. CSIRO, Australia. 169pp.

MDBA Basin environmental watering outlook for 2019–20 February (2019) https://www.mdba.gov.au/sites/default/files/pubs/Basin-environmental-watering-outlook-2019-2020.pdf< br>
Merritt, W., Spencer, J., Brandis, K., Bino, G., Harding, P., and Thomas, R. (2016). Review of the science behind the waterbird breeding indicator for the Narran Lakes. Final report to the Murray - Darling Basin Authority.

OEH, 2014. Far West Climate Change snapshot, https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-you r-region/Far-West-Climate-Change-Downloads

Spencer, et al (2015). Colony boundaries for waterbird breeding events in the Narran Lakes recorded during 2008–2012. Version1, NSW Office of Environment and Heritage. June 2015.

Spencer, J., at al. (2018). Monitoring Waterbird Outcomes in NSW: Summary Report 2016-17. Unpublished report. NSW Office of Environment and Heritage, Sydney.

State of Queensland, 2019. Climate Change in the Maranoa and District Region, https://www.qld.gov.au/__data/assets/pdf_file/0027/67914/maranoa-climate-change-impact-summary.pdf

Thoms et al, (2007) The Narran Ecosystem Project: the response of a terminal wetland system to variable wetting and drying. Final report to the Murray-Darling Basin Commission. https://www.researchgate.net/publication/268209599_The_Narran_ecosystem_project_the_response_of_a_terminal_wetland_system_to_variable_wetting_and_drying_Final_report_to_the_Murray-Darling_Basin_Commission_MDBC_publication_4008_200_300_400_500_600_700_

6.1.2 - Additional reports and documents

i. taxonomic lists of plant and animal species occurring in the site (see section 4.3)
<2 file(s) uploaded>

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
<7 file(s) uploaded>

6.1.3 - Photograph(s) of the Site

Please provide at least one photograph of the site:

Lignum at Long Arm, recovering after wetting by flows (*N. Foster, Department of Agriculture Water and the Environment, 10-03-2020*)

Crinum Flacidum at Narran Lake, note sea eagle nest (*N. Foster, Department of Agriculture Water and the Environment, 10-03-2020*)

Narran Lake from the air (*D. Love, Office of Environment and Heritage, 28-03-2008*)

Sunset and ripples over Narran Lake (*N. Foster, Office of Environment and Heritage, 21-10-2010*)

Clear Lake, in dry state (*N. Foster, Department of Agriculture Water and the Environment, 10-03-2020*)

6.1.4 - Designation letter and related data

Designation letter

<1 file(s) uploaded>

Date of Designation 1999-06-14