

Information Sheet on Ramsar Wetlands (RIS)

— 2009-2012 version

Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX. 22 of the 9th Conference of the Contracting Parties (2005).

1. The RIS should be completed in accordance with the attached *Explanatory Notes and Guidelines for completing the Information Sheet on Ramsar Wetlands*. Compilers are strongly advised to read this guidance before filling in the RIS.
2. Further information and guidance in support of Ramsar site designations are provided in the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* (Ramsar Wise Use Handbook 14, 3rd edition). A 4th edition of the Handbook is in preparation and will be available in 2009.
3. Once completed, the RIS (and accompanying map(s)) should be submitted to the Ramsar Secretariat. Compilers should provide an electronic (MS Word) copy of the RIS and, where possible, digital copies of all maps.

1. Name and address of the compiler of this form:

SEWPAC
John Gorton Building
King Edward Terrace
Parkes ACT 2600
Australia
Phone: +61 2 6274 1111
Email: wetlandsmail@environment.gov.au

NSW Office of Environment and Heritage
PO Box A290
Sydney South NSW 1232
Australia
ramsar.program@environment.nsw.gov.au

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Designation date

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Site Reference Number

2. Date this sheet was completed/updated:

May 2012

3. Country:

Australia

4. Name of the Ramsar site:

The precise name of the designated site in one of the three official languages (English, French or Spanish) of the Convention. Alternative names, including in local language(s), should be given in parentheses after the precise name.

NSW Central Murray Forests

5. Designation of new Ramsar site or update of existing site:

This RIS is for (tick one box only):

- a) Designation of a new Ramsar site ; or
b) Updated information on an existing Ramsar site

6. For RIS updates only, changes to the site since its designation or earlier update:

a) Site boundary and area

The Ramsar site boundary and site area are unchanged:

or

If the site boundary has changed:

- i) the boundary has been delineated more accurately or
- ii) the boundary has been extended ; or
- iii) the boundary has been restricted**

and/or

If the site area has changed:

- i) the area has been measured more accurately ; or
- ii) the area has been extended ; or
- iii) the area has been reduced**

** **Important note:** If the boundary and/or area of the designated site is being restricted/reduced, the Contracting Party should have followed the procedures established by the Conference of the Parties in the Annex to COP9 Resolution IX.6 and provided a report in line with paragraph 28 of that Annex, prior to the submission of an updated RIS.

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

From 1 July 2010 the Millewa and Forest Group component of the Ramsar site (formally State forest) has been reserved as national park (about 90 percent of the area) and regional park (about 10 percent of the area) under the NSW National Park Estate (Riverina Red Gum Reservations) Act 2010. Also from 1 July 2010 the Werai Forest Group is no longer gazetted state forest but has been vested in the Minister for National Parks and Wildlife for transfer to traditional owners for conservation purposes. These alterations to land tenure have resulted in major land use changes in the Ramsar site including a reduction of logging activities in the area.

It has only been seven years since the designation of the Central Murray Forests Ramsar site and as such, there is little evidence of significant change to the ecological character of the site during this period. There is some evidence that tree health has declined in the forests in the period 2003 to 2010 (Cunningham et al. 2009). However, the site was listed during a period of significant drought and it cannot be known in the short to medium term whether this decline is indicative of variability with recovery expected after significant floodplain inundation, or the beginnings of a long term decline.

An assessment of current conditions with respect to Limits of Acceptable Change (LAC) indicates that the LAC for hydrology has been exceeded. This relates to the trends for small floods, moderate overbank flows and large scale floods and is described further below:

- There is evidence that there has been a decline in small floods in the past decade as a result of water use, prolonged drought and potential effects of climate change. The hydrology LAC for small, in-channel and low lying wetlands has been exceeded.
- There is evidence of a decline in moderate overbank flows in the past 20 years and although the LAC for maximum period between these flows has not been exceeded, the hydrology LAC based on average recurrence intervals of moderate overbank flows has been exceeded.
- Large scale flood events are predominantly driven by climatic factors and are less influenced by water resource use (Maheshwari et al. 1993). There has not been a significant change in the frequency of these events in recent times and the hydrology LAC for wide scale flooding has not been exceeded.

While there is little evidence that the site has changed in the past seven years; there is evidence that the site is on a trajectory of decline and it is thought that hydrological conditions at the time of listing were insufficient to maintain the ecological character of the site (data contained in NRC 2009; MDBA 2010).

7. Map of site:

Refer to Annex III of the *Explanatory Note and Guidelines*, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:

- i) a hard copy (required for inclusion of site in the Ramsar List): ;
- ii) an electronic format (e.g. a JPEG or ArcView image) ;
- iii) a GIS file providing geo-referenced site boundary vectors and attribute tables .

b) Describe briefly the type of boundary delineation applied:

e.g. the boundary is the same as an existing protected area (nature reserve, national park, etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

The site is comprised of three areas in south-central NSW that are delineated based on gazetted tenure boundaries as follows:

The Millewa Forest Group is comprised of those parts of Murray Valley National Park gazetted on 1 July 2010 which were previously dedicated as part of the former Gulpa Island State Forest (an area of about 4,372 hectares), part of the former Millewa State Forest (an area of about 18,925 hectares), part of the former Moira State Forest (an area of about 9,054 hectares), and part of the former Tuppal State Forest (an area of about 1,040 hectares); and those parts of Murray Valley Regional Park gazetted on 1 July 2010 which were previously dedicated as part of the former Gulpa Island State Forest (an area of about 771 hectares), part of the former Millewa State Forest (an area of about 1,532 hectares), and part of the former Moira State Forest (an area of about 1,006 hectares).

The Koondrook Forest Group is comprised of Koondrook SF (No. 625, dedicated 18 January 1918 and extensions thereto dedicated 25 January 1923, 13 June 1924, 25 November 1927, 26 January 1940, 25 October 1968, 13 November 1970 and 8 July 1983), Perricoota SF (No. 395, dedicated 13 April 1917) and Campbells Island SF (No. 615, dedicated 18 January 1918 and extension thereto dedicated 18 April 1980).

The Werai Forest Group is comprised of those parts of the land vested in the National Parks and Wildlife Minister on 1 July 2010 which were previously dedicated as part of the former Banangalite State Forest (an area of about 1,223 hectares), part of the former Barratta Creek State Forest (an area of about 221 hectares), part of the former Morago State Forest (an area of about 959 hectares), and part of the former Werai State Forest (an area of about 9,163 hectares).

8. Geographical coordinates (latitude/longitude, in degrees and minutes):

Provide the coordinates of the approximate centre of the site and/or the limits of the site. If the site is composed of more than one separate area, provide coordinates for each of these areas.

Ramsar sub-site	Latitude	Longitude
Millewa Forest Group	35° 49' S	144° 58'
Koondrook Forest Group	35° 43' S	144° 32'
Werai Forest Group	35° 44' S	144° 20'

9. General location:

Include in which part of the country and which large administrative region(s) the site lies and the location of the nearest large town.

The site is composed of three discrete but interrelated units in south-central New South Wales, Australia. The distance (and bearing) from the municipality of Deniliquin to the centres of each of these units is 33km (S) for the Millewa Forest Group, 46km (NW) for the Werai Forest Group, and 62km (WSW) for the Koondrook Forest Group. The municipality has an administrative area of 13,000 hectares and a population of 8,100.

10. Elevation: (in metres: average and/or maximum & minimum)

78 to 96 metres above mean sea level (Australian Height Datum)

11. Area: (in hectares)

Millewa Forest Group	38,058 hectares (GIS area)
Koondrook Forest Group	34,520 hectares (GIS area)
Werai Forest Group	11,414 hectares (GIS area)
Total:	83,992 hectares (GIS area)

12. General overview of the site:

Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

The NSW Central Murray Forests Ramsar site is dominated by river red gum forest and woodland, wet grasslands and marshes located on the floodplain of the Murray River. Riparian fringes of modern river channels and lower areas of the floodplain support river red gum (*Eucalyptus camaldulensis*) forest; which dominates the site. The most frequently inundated channels; drainage depressions and oxbow lagoons support reed beds, sedgeland and wet-grasslands. Wetland habitats at the site support nationally and internationally significant populations of wetland birds and fish (see Section 3). The wetlands also support at least three species of mammal, seven species of frog, three species of freshwater turtle and a number of reptile taxa closely associated with wetland and aquatic habitats.

13. Ramsar Criteria:

Tick the box under each Criterion applied to the designation of the Ramsar site. See Annex II of the *Explanatory Notes and Guidelines* for the Criteria and guidelines for their application (adopted by Resolution VII.11). All Criteria which apply should be ticked.

1 • 2 • 3 • 4 • 5 • 6 • 7 8 • 9

14. Justification for the application of each Criterion listed in 13 above:

Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region

There is strong evidence that the NSW Central Murray Forests Ramsar site contains both representative and rare wetland types in a bioregional context. The forests within the site are the largest complex of tree-dominated floodplain wetlands in southern Australia and are collectively the world's largest parcel of river red gum forests. The Millewa Forests along with the Barmah Forest are the world's largest continuous stand of river red gum forest (of which the Millewa Forests contribute over 50 percent) (MDBC 2007a and 2007b). They can be considered 'near natural' as, even though they have been harvested for timber for 150 years, they retain elements of pre-European aged trees and areas which are structurally equivalent to undisturbed forest.

Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

There are eight threatened species, listed at the national and / or international scale supported by the wetlands within the Ramsar site that contribute to the site meeting this criterion:

Common name	Scientific name	IUCN	National Status
Trout cod	<i>Maccullochella macquariensis</i>	EN	Endangered (EPBC Act, 1999)
Murray hardyhead	<i>Craterocephalus fluviatilis</i>	EN	Vulnerable (EPBC Act, 1999)
Silver perch	<i>Bidyanus bidyanus</i>	VU	Not listed
Murray cod	<i>Maccullochella peelii peelii</i>	-	Vulnerable (EPBC Act, 1999)
Australasian bittern	<i>Botaurus poiciloptilus</i>	EN	Endangered (EPBC Act, 1999)
Superb parrot	<i>Polytelis swainsonii</i>	VU	Vulnerable (EPBC Act, 1999)
Australian painted snipe	<i>Rostratula australis</i>	EN	Vulnerable (EPBC Act, 1999)
Swamp wallaby grass	<i>Amphibromus fluitans</i>	-	Vulnerable (EPBC Act, 1999)

Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

The site provides habitat for migratory birds with 11 species listed in migratory bird agreements between Australia and Japan (JAMBA), China (CAMBA) and the Republic of Korea (ROKAMBA) recorded from within the site. These species are Australian painted snipe (*Rostratula benghalensis australis*), eastern great egret (*Ardea modesta*), cattle egret (*Ardea ibis*), sharp-tailed sandpiper (*Calidris acuminata*), greenshank (*Tringa nebularia*), marsh sandpiper (*Tringa stagnatilis*), Latham's snipe (*Gallinago hardwickii*), glossy ibis (*Plegadis falcinellus*), Caspian tern (*Hydropogone caspia*), red-necked stint (*Calidris ruficollis*) and white-bellied sea-eagle (*Haliaeetus leucogaster*).

The site is also important in supporting breeding of colonial nesting waterbirds. Waterbird breeding in the Barmah-Millewa Forest was recorded 32 times during 1905 to 1997 (Leslie 2001). River regulation has dramatically reduced the frequency, duration and extent of natural flood events and has been implicated in the overall decline of wetland bird populations (Kingsford and Johnson 1998). Environmental water allocations provide some scope for waterbird breeding. In 1998, 2000, 2005, 2010 and 2012 environmental flows were used to extend the duration of natural floods. These managed floods triggered and maintained waterbird breeding events with successful nesting of thousands of birds (O'Connor et al. 2006). In the Koondrook Forests breeding events of hundreds of colonial nesting birds have been seen in 2000/01, 2003/4, 2004/05 and 2005/06, with over 200 chicks successfully fledged (MDBC 2007c). Large events comprising thousands of birds have not been seen in this Forest Group since a large natural flood in the mid 1970's (MDBC 2007b).

The site provides refuge for mobile and sedentary fauna during environmentally stressful periods. In southeast Australia such stressful periods usually coincide with drought. As it is an area of comparatively

high water availability and habitat productivity in a semi-arid rainfall zone, during these times the mosaic of aquatic, riparian and fringing river red gum forests and woodlands provide essential refuge habitat to a wide range of biota. It also provides sources of propagules (in the case of plants) or migrant individuals (in the case of animals) that allow dispersal into less productive areas during favourable conditions.

Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

The site provides migratory routes between habitats in the Murray River, anabranches and floodplains. Native fish of the Murray River main channel utilise anabranch and flood runner channels when they are available (Thoms et al. 2000). Native fish move into off-stream areas on rising flows, and make refuge movements into deeper waters during low flow periods. Many species spawn on the floodplains (Jones 2006). The site is known to support 17 native species of fish, although 22 species of native fish are predicted to occur within the streams and rivers of the Ramsar site (Davies et al. 2008). Native species of fish known to occur in the site include Australian smelt (*Retropinna semoni*), Murray cod (*Maccullochella peelii peelii*), golden perch (*Macquaria ambigua*), Murray hardhead (*Craterocephalus fluviatilis*), silver perch (*Bidyanus bidyanus*) and trout cod (*Maccullochella macquariensis*).

Several species of tagged fish – golden perch (*Macquaria ambigua*), Murray cod (*Maccullochella peelii peelii*) and silver perch (*Bidyanus bidyanus*) – have been recorded moving large distances from the site (up to 300 km upstream and 900 km downstream), which is indicative of pre- and post-spawning behaviour (McKinnon 1997). River red gum forests make a significant contribution to in stream nutrient accumulation and productivity through litter fall (Gawne et al. 2007) and provide important shelter in the form of coarse woody debris and shaded water (Jones and Stuart 2007).

15. Biogeography (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation):

Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region:

Murray Darling Drainage Division

b) biogeographic regionalisation scheme (include reference citation):

Australian Drainage Divisions

(Commonwealth of Australia (Bureau of Meteorology) 2011. Australian Hydrological Geospatial Fabric)

16. Physical features of the site:

Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

The site is composed of Quaternary alluvial sediments on the floodplain of the Murray River and associated anabranches. The general terrain of the site is extremely flat, with a regional east-west slope of some 0.2 metres per kilometre (Bacon et al. 1993). Alluvial formations are the dominant landscape features. Quaternary alluvial features include modern and ancestral river channels, floodplains, backplains, swamps, lakes and lunettes.

Historically the Murray River followed a course through what is now known as Green Gully, a depression which is approximately 20 kilometres north of Echuca. More recently, perhaps as early as approximately 550 years ago, it took a new course from Picnic Point in a southerly direction and into the ancestral course of the Goulburn River (Stone 2006). The section where the Murray cut through to the Goulburn channel is today known as the Barmah Choke because of its limited capacity to carry flows (Rutherford 1990). Arguably the most significant geomorphic feature of the site, the Barmah Choke has a capacity of approximately one third

of the channel upstream and acts like a partial dam, forcing floodwater to frequently back up onto the floodplain, thereby inundating the forests and resulting in the triangular shape of the floodplain supporting the Barmah-Millewa Forest (MDBC 2007a).

Flow in the Murray River defines the hydrology of the NSW Central Murray Forests via flow into effluent streams across the site and overbank flow onto the floodplain during flood events. The hydrology of the Murray River and its tributaries is managed for water supply, flood mitigation, navigation and hydroelectricity production. Flows into the NSW Central Murray Forests occur as two main types of flow pattern:

- Channel flow, which features inundation of effluent streams, channels, depressions or leads. This occurs primarily as through-flows with limited overbank flow and ponding in depressions during moderate increases in flow; and
- Broad-area flooding, which features inundation of broad areas across the floodplain. These events occur as lateral, overbank flow from channels, which spread over broader areas and ponds in depressions or returns to channels when flow recedes (MDBC 2005; Maunsell 1992).

Inundation of low lying areas, occurs on average every 2 to 3 years, while broad scale inundation of approximately 50 percent of the floodplain forests occurs once every four years in Koondrook, every 6.6 years in Werai and every 5.5 years in Millewa (Natural Resources Commission 2009; MDBA 2010).

17. Physical features of the catchment area:

Describe the surface area, general geology and geomorphological features, general soil types, and climate (including climate type).

The NSW Central Murray Forests Ramsar site is within the Murray Darling Basin catchment on the floodplain of the Murray River. The Murray Darling Basin covers over one million square kilometres and comprises 14 percent of the continent. Much of the catchment is flat, with extensive aeolian and alluvial deposits of sands, silts and clays. An outcrop of folded metamorphic rocks provides slightly-elevated relief in the north-west, and the high metamorphic and igneous rock outcrops of the Great Dividing Range form the eastern and southern borders (MDBC 2007a).

NSW Central Murray Forests are situated within the semi-arid / grassland climatic zone of south-eastern Australia. The general climatic pattern is hot dry summers and cold winters. Annual average rainfall at Deniliquin is in the order of 400 millimetres per year, with the highest monthly average rainfall in June (35 millimetres) and lowest in February (16 millimetres). Temperatures range from cool to hot, with average summer maximum temperatures around 32 degrees Celsius and average minimum temperatures around 15 degrees Celsius. During winter average maximum temperatures are considerably cooler (14 to 15 degrees Celsius) as are average minimum temperatures (3 to 4 degrees Celsius). Average monthly evaporation exceeds rainfall, year round.

18. Hydrological values:

Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

Floods mobilise river red gum litter in the form of particulate and dissolved organic carbon into the riverine food web (Glazebrook and Robertson 1999). Linkages between the site and adjacent river channels during flood also provide a storage capacity of between 400 to 550 GL. The heavy clay soils of the floodplain are largely impermeable, and soil saturation during flood is largely achieved through extensive deep cracks that develop in upper soil profile in summer. Groundwater, where present within nine metres of the surface, is generally restricted to confined aquifer systems that are believed to be connected to the main river systems. Localised groundwater recharge also occurs during floods from exposed lens surfaces (FCNSW 1987). The modern rate of floodplain sedimentation is in the order of 7 mm/10 years compared to the assumed long-term background rate of 3 mm/10 years (Kenyon 2001).

19. Wetland Types

a) presence:

Circle or underline the applicable codes for the wetland types of the Ramsar “Classification System for Wetland Type” present in the Ramsar site. Descriptions of each wetland type code are provided in Annex I of the *Explanatory Notes & Guidelines*.

Marine/coastal: A • B • C • D • E • F • G • H • I • J • K • Zk(a)

Inland: L • M • N • O • P • Q • R • Sp • Ss • Tp Ts • U • Va •
Vt • W • Xf • Xp • Y • Zg • Zk(b)

Human-made: 1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9 • Zk(c)

b) dominance:

List the wetland types identified in a) above in order of their dominance (by area) in the Ramsar site, starting with the wetland type with the largest area.

Xf, Ts, P, N, M and 9.

20. General ecological features:

Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

There are 320 native species of plant that have been recorded within the Ramsar site including a range of aquatic, floodplain and terrestrial species. The two distinct types of wetland vegetation that characterise the site are:

- River red gum forests and woodlands, which comprise the majority of the site and occupy the large areas of floodplain; and
- Floodplain marshes, which comprise a number of different communities all of which occur in the low lying areas of the site that are subjected to more frequent inundation.

River red gum dominated forest and woodland communities are the characteristic feature of the Ramsar site and occupy 94 percent of its total area. River red gum is a fast growing, highly competitive species in areas with sufficient soil moisture. It is the canopy dominant in all vegetation associations in which it occurs, and in many areas forms monospecific communities. Co-occurring species include river cooba (*Acacia stenophylla*) as a sub-canopy species, and black box and, less commonly grey box (*Eucalyptus microcarpa*), where river red gum forest intergrades with box woodland (Benson et al. 2006).

Community structure and understorey composition vary with flood regime, which in turn is a product of geomorphic setting. The driest portions of the floodplain support black box woodland which grades into a river red gum woodland at its wetter end, with a sparse, shrubby understorey and groundcover of grasses and herbs with increasing soil moisture. Better-watered locations support a taller river red gum forest with an understorey of moisture-loving grasses, herbs and sedges (Benson et al. 2006; Roberts and Marston 2000).

Floodplain marshes occur on low-lying, more frequently flooded portions of the floodplain. They are highly variable, in both time and space, and may comprise moist or dry grasslands, rushlands, reed beds or semi-permanent marshes. This category includes the regionally significant vegetation community moira grass plains (MDBC 2007a, 2007c). They feature a moist, low mat grassland dominated by moira grass (*Pseudoraphis spinescens*). This community occurs on elevated rises and river banks on red to brown clay or loamy soils on the floodplains (Benson et al. 2006).

The site supports a diverse assemblage of wetland birds with 68 species dependent on wetlands recorded from within the site. Fifty four wetland bird species have been recorded breeding in the NSW Central Murray Forests including 25 colonial nesting species (Leslie 2001). The distribution and abundance of nesting waterbirds varies both spatially as well as temporally in response to flooding. The greatest concentration of important waterbird breeding colonies at the site are in the Millewa Forests associated with the Moira Lake and the Gulpa Creek group of floodplain marshes, where there are records of breeding of thousands of colonial nesting wetland birds. Koondrook and Weraï Forests are also considered significant for supporting water bird breeding during times of flood.

The site supports 17 species of native inland fish, such as Australian smelt (*Retropinna semoni*), Murray cod (*Maccullochella peelii peelii*), golden perch (*Macquaria ambigua*), Murray hardyhead (*Craterocephalus fluviatilis*) and trout cod (*Maccullochella macquariensis*). Stream habitats provide migratory pathways between the Murray River and floodplain wetlands, which provide important fish spawning habitat during flood events.

21. Noteworthy flora:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14, Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

The site supports a nationally threatened flora species: swamp wallaby grass (*Amphibromus fluitans*).

Significant weed species in the site identified as requiring management include willows (*Salix* spp.), sweet briar (*Rosa rubiginosa*), blackberry (*Rubus fruticosus*), African boxthorn (*Lycium ferocissimum*), bridal creeper (*Myrsiphyllum asparagoides*), golden dodder (*Cuscuta campestris*), thistles (*Carduus* spp.; *Carthamus* spp.), St John's wort (*Hypericum perforatum*), noogoora burr (*Xanthium occidentale*), Bathurst burr (*Xanthium spinosum*), horehound (*Marrubium vulgare*), and the aquatic weed salvinia (*Salvinia molesta*) (Thompson M. personal communication; Harrington B. personal observation.).

22. Noteworthy fauna:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14, Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

There are nine threatened species supported by the wetland (see section 14 above). Of note is the provision of important breeding habitat for two of these threatened species, Australasian bittern and superb parrot. The Australasian bittern breeds in the riparian herblands when favourable spring floods occur. During 2000/01 flood, the site supported internationally significant numbers of this cryptic species (12 adult breeding birds, plus young). The superb parrot has an estimated breeding population of 55–65 pairs (data collected from mid 1980s to mid 1990s), and breeds annually within the Millewa Forest Group (Rick Webster, pers. comm., 2012).

Eleven species listed under international migratory bird agreements have been recorded from the site (see section 14 above). The site supports an estimated six breeding pairs of white-bellied sea-eagles (*Haliaeetus leucogaster*), and this species is known to breed in all three forest groups of the Ramsar site (Rick Webster, pers. comm., 2012).

Introduced animal pests in the Ramsar site include deer species, pigs (*Sus scrofa*), rabbits (*Oryctolagus cuniculus*), foxes (*Vulpes vulpes*), European honey-bees (*Apis mellifera*) and European carp (*Cyprinus carpio*).

23. Social and cultural values:

a) Describe if the site has any general social and/or cultural values e.g., fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values:

The site is a major factor in the social and economic profiles of the rural townships of Koondrook (Victoria), Barham (NSW) and Mathoura (NSW). Current Aboriginal custodians are the Yota Yota Local Aboriginal Land Council (covering the Millewa Forest Group and the eastern portion of the Koondrook Forest Group) and the Deniliquin Local Aboriginal Land Council (covering the Werai Forest Group and the western portion of the Koondrook Forest Group). Evidence of Aboriginal occupation includes scarred trees, burials, shell middens and oven mounds (Craib 1990, Lyons undated). Places of European significance that illustrate the phases of pastoral settlement, timber getting and river navigation are also located within the site.

The Koondrook-Perricoota forest is important for sustainable forestry while the Millewa and Werai forests are reserved to protect biodiversity and promote recreation and education. Overall, the site is currently used for timber harvesting, apiculture, fishing, bird watching and scientific study.

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning?

If Yes, tick the box and describe this importance under one or more of the following categories:

- i) sites which provide 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) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:
- iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:
- iv) sites where 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:

24. Land tenure/ownership:

a) within the Ramsar site:

The site is Crown land, with Koondrook Forest Group (34,562 hectares) designated as State forest under the New South Wales *Forestry Act 1916* for the purposes of timber production and other matters in the public interest. Millewa Forests comprises areas of National Park and Regional Park and Werai Forests is vested in the NSW Minister for National Parks and Wildlife for transfer to the traditional owners as an Indigenous Protected Area.

b) in the surrounding area:

The surrounding area comprises predominantly freehold land. The southern boundaries of the Millewa and Koondrook units form part of the State border, and mostly adjoin public land managed by the Victorian Department of Natural Resources and Environment.

25. Current land (including water) use:

a) within the Ramsar site:

Koondrook Forest – timber harvesting and production, livestock grazing, bee keeping, recreational activities, firewood collection. The newly dedicated National Park, Regional Park and land vested in the Minister for National Parks and Wildlife, will be used predominantly for passive recreation activities.

b) in the surroundings/catchment:

Irrigated and dryland cereal cropping and pastures are the main land uses surrounding the site. Other adjacent land uses include horticulture, private native forestry and residential development.

26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:

a) within the Ramsar site:

Threats to ecological character within the Ramsar site include:

Forestry activities – the harvesting of mature river red gums for timber has the potential to affect the ecological character of the site in a number of ways. Arguably the most significant is the loss of large hollow-bearing trees which are important habitat for a range of fauna including the Superb Parrot.

Altered fire regimes – increased intensity and frequency of fires has the potential to negatively affect the river red gum forests that characterise the site. Although mature river red gum trees can survive low intensity fires (MacNally and Parkinson 2005) saplings are fire-sensitive (Dexter 1978) with even fires of moderate intensity sufficient to damage the cambium leaving the stem susceptible to secondary attack by fungal pests. As this species lacks a lignotuber high intensity fires will generally result in significant mortality.

Invasive species – The NSW National Parks and Wildlife Service and Forests NSW has joined with local government, other agencies and stakeholders to develop regional strategies to manage weeds and other plants of concern (FNSW 2008a; NPWS 2012). Within Millewa and Werai National Parks manages pests and weeds according to the Significant weed species that are present at the site that have been identified as requiring management as part of this process include: woody weeds (willows, sweet briar, blackberry, African boxthorn), climbers and creepers (bridal creeper, golden dodder) broad-leaved weeds (thistles, St John's wort, noogoora burr, Bathurst burr and horehound), perennial grasses (spiny burr grass), annual grasses (quaking-grass, wild oats and *Bromus* spp.) and aquatic weeds (arrowhead and salvinia) (Thompson M. pers. comm.; Harrington B. pers. obs.). Most of those weeds have arrived in the Ramsar site through accidental introduction e.g. blown or carried via vehicles and animals into the site from nearby agricultural lands (sweet briar, blackberry, African boxthorn, broad-leaved weeds, perennial grasses and annual grasses), or transported to the site from upstream (willows, aquatic weeds). The distribution of these weed species varies with habitat type and inundation frequency. However, the effects are similar and include displacement of native vegetation species and loss of physical habitat and food sources for animals.

Carp (*Cyprinus carpio*) are a significant threat to native fish species within the site. The Barmah-Millewa forest has been identified as a potential recruitment zone for carp (Stuart and Jones 2006) and they comprised 80 percent of the fish biomass in 1999 to 2001 (Stuart and Jones 2002). Carp compete with native fish and may contribute to water quality deterioration by increasing turbidity and bank erosion. The extraction of carp from Moira Lake has occurred whenever conditions allow since 2001 and was last implemented by NPWS in 2011. Carp extraction is an activity listed in the NPWS Western Rivers Regional Pest Management Strategy 2012-2015. This program is licensed by NSW DPI (Fisheries) and managed by the NPWS. NPWS is developing a research program with NSW DPI (Fisheries) and the Murray CMA to identify possible impacts to carp populations [from carp extraction] in the central Murray River region.

b) in the surrounding area:

The most significant threat to the ecological character of the site is altered water regimes as a result of water resource development and exacerbated by the predicted effects of climate change. The hydrology of the NSW Central Murray Forests has altered significantly over the past 100 years mostly as a result of flow regulation and water extraction (Gippel and Blackham 2002). These changes have led to a reduction in the frequency and duration of spring wetland inundation in all three forests and an alteration to the seasonality of inundation in the Millewa forest. There is evidence to suggest that the current water regimes are insufficient to maintain the ecological character of the site impacting on the community composition and health of vegetation communities. In 2009, only five percent of the forest in Koondrook and 17 percent of the forest in Millewa were considered in "good" condition (Cunningham et al. 2009).

The reduced frequency, extent and duration of spring floods have resulted in a dramatic decrease in the number of species and individuals breeding in both Millewa and Koondrook (Leslie 2001; Ecological Associates 2004). The interval between breeding episodes during extended drought periods may be the most critical factor affecting colonially nesting waterbirds in the forests. Given that the average life span of a waterbird is five to seven years, the current flooding frequency may result in many waterbirds dying without breeding, thus affecting the long-term viability of populations (Leslie 2001).

River regulation and altered hydrology have also had negative effects on native fish populations as unseasonal flooding favours carp breeding (Norris et al. 2001). This is supported by the low proportion of native fish (versus introduced species) in the Murray River adjacent to the Millewa forest in comparable unregulated streams (Gerhke 1995). In addition, although there is little direct evidence, it is likely that reduced floodplain inundation and consequent reduced connectivity between wetlands and river habitats has (and continues to) result in decreased habitat for breeding and juvenile native fish.

In addition, reduced frequency of inundation, coupled with unseasonal inundation (during warmer months) can increase the risk of “blackwater events”. Although floodplains are natural sources and sinks of organic matter and inundation should initiate a pulse of productivity, under certain conditions, this boom in productivity can result in low dissolved oxygen, a decrease in pH and a release of salt from the floodplain (McCarthy et al. 2006).

Modelled scenarios of climate change predict an increase in the intervals between flooding of the forests. This reduction in floodplain and wetland inundation is likely to exacerbate the effects of river regulation already observed at the sites with an increase in stress to vegetation and fauna communities.

27. Conservation measures taken:

a) List national and/or international category and legal status of protected areas, including boundary relationships with the Ramsar site:

In particular, if the site is partly or wholly a World Heritage Site and/or a UNESCO Biosphere Reserve, please give the names of the site under these designations.

Recent initiatives have resulted in a change in the tenure and land use within parts of the site. The Millewa Forest Group now comprises National Park and Regional Park that are protected for the conservation of natural values. The Werai Forest Group has been vested in the NSW Minister for the Environment to be transferred to the Traditional Owners as an Indigenous Protected Area, to be managed to maintain ecological character and the significant cultural values within the forest.

b) If appropriate, list the IUCN (1994) protected areas category/ies which apply to the site (tick the box or boxes as appropriate):

Ia ; Ib ; II ; III ; IV ; V ; VI

c) Does an officially approved management plan exist; and is it being implemented?:

The management plan for the site (FNSW, 2008, Ecologically Sustainable Forest Management Plan Riverina NSW) applies only to the remaining area of State forest in the site (Koondrook Forest Group). Draft Statements of Interim Management Intent (SIMI) for the Millewa Group - Murray Valley National Park and Murray Valley Regional Park (NPWS 2011) and Werai Group have been prepared to guide management of the Millewa Forest Group and Werai Forest Group until a plan of management is prepared.

There are also management plans for the site under different programs, for example Koondrook Forests and Millewa Forests are part of recognised icon sites under the Living Murray program and are covered by environmental water management plans and condition management plans (MDBC 2007a and d). Water management for the Werai Forest Group is included in the environmental water management plan for the Edward-Wakool river system that has been developed by the Commonwealth Environmental Water Office (Hale and SKM 2011).

There is no current management plan for the entire Ramsar site, and the site will continue to be managed under the existing management plans for each forest group.

d) Describe any other current management practices:

The site has experienced environmental water allocations to help maintain the ecological character of the wetlands. Site managers may access and utilise environmental water from a range of sources. These include:

- The Living Murray program (TLM). TLM aims to recover an average of up to 500 gigalitres/year of water to improve environmental flows and achieve ecological objectives at six Icon sites along the Murray River. These include the Barmah-Millewa Forest (containing the Millewa Forests) and Gunbower-Koondrook-Perricoota Forest (containing the Koondrook Forests). Use of the water is governed by the Environmental Watering Group who consider a range of factors including ecological need and water availability to collectively determine where and for what purpose water should be used in any given year.
- The Barmah-Millewa Environmental Water Allocation. This allocation places up to 100 gigalitres/year from Victoria and NSW into water account for use at the site. Use of the water is governed by a steering committee comprised of land managers, water managers and environmental experts from Victoria and New South Wales in accord with a set of operational rules. In 2005/2006, the Barmah-Millewa Icon site achieved a water delivery of 513 gigalitres. This water allocation was timed with a natural peak in flows to achieve a flood event resulting in successful breeding of native fish (Jones 2006), frogs (Ward 2006) and waterbirds (O'Connor and Ward 2003). Similar amounts of water were also delivered in 2010/2011 and 2011/2012.
- Commonwealth Environmental Water Office: The Commonwealth Environmental Water Holder is required to use its holdings to protect and restore environmental assets of the Murray-Darling Basin. From 2009 – 31 August 2012, the Commonwealth Environmental Water Holder delivered 1500 ML to Barmah-Millewa Forests which contributed to watering parts of the Central Murray Forests Ramsar site. In the future, environmental water management in the Murray-Darling Basin will be guided by the Murray-Darling Basin Plan. The Plan will provide a framework for both setting environmentally sustainable limits on water and for the management of water to protect and restore key environmental assets, which include for Ramsar listed wetlands.
- NSW OEH – Waters, Wetlands and Coast Division.

28. Conservation measures proposed but not yet implemented:

e.g. management plan in preparation; official proposal as a legally protected area, etc.

Construction in Koondrook Forests for the “Koondrook-Perricoota Flood Enhancement Project” commenced in 2010 and is due for completion in 2012. The project aims to improve the condition of river red gum forest and re-establish colonial waterbird breeding by providing broad scale floodplain inundation every two to four years. The project involves the construction of (GHD 2010):

- Downstream structures to divert water into the forest from Torrumbarry Weir pool (including an inlet channel, an inlet regulator and associated infrastructure, as well as regulators at Swan Lagoon to control flows returning to the Murray River); and
- Upstream structures to control the release of water from the forest and to maximise return flows back to the river (including a levee to retain water within the forest, as well as regulators and a return channel).

As part of the recent management and tenure change, a number of management actions are proposed by the NSW NPWS. This includes:

- Water management delivery works that include the removal of existing structures that currently impede flow and fish passage. Also, the upgrade or installation of structures to improve flow-fish passage and delivery of water into areas presently isolated by earthen block banks. For example, the Aratula Creek system in eastern Millewa is currently blocked from the Murray River by earthen banks. The replacement of these banks with water delivery infrastructure is likely to improve the ecological and hydrological function of approximately 6,000 ha of River Red Gum forest, which provides critical habitat for Superb Parrots and Squirrel Gliders. All works will be designed to provide optimal ecological outcomes for the Ramsar sites and assist in the mitigation of hypoxic blackwater events.

- Ecological thinning trials within the Millewa forests with the objectives of creating space between trees in densely stocked stands to allow crowns to spread and to ultimately develop hollows; and to remove competition within stressed stands to allow the remainder of the stand to survive.
- Removal of sawlog harvesting, cattle grazing and apiary from the Millewa and Werai forests.
- Implementation of hazard reduction and ecological burning into areas of the forests in order to reduce fine fuel loads and control Giant Rush encroachment in to Moira Grass plains and open water wetland habitat.
- Pests and weed control programs will be implemented in the Millewa and Werai forests from 1 July 2010.
- Implementation of a domestic firewood collection program for the Millewa forests that ensures that a minimum of 45 tonnes per hectare is retained in areas of the forest. Domestic firewood collectors will be directed to Firewood Collection Areas and must obtain a permit from NPWS.
- The revegetation and rehabilitation of native cypress pine sandhills within Millewa forests by direct seeding and removing introduced tree species is likely to improve habitat linkages with the River Red Gum vegetation communities and restrict the spread of weeds.

29. Current scientific research and facilities:

e.g., details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

There have been significant scientific investigations conducted in the NSW Central Murray Forests and adjacent Ramsar site on the southern side of the River (Barmah Forest and Gunbower Forest). Recent examples include:

- Importance of floodplain to native fish (King et al. 2007);
- Responses of vegetation, waterbirds and fish to environmental watering (Ecological Associates 2003; Kingsford et al. 2009; MDBC 2007c; Ward 2006)
- Condition of river red gum forests (Cunningham et al. 2009).

30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:

e.g. visitors' centre, observation hides and nature trails, information booklets, facilities for school visits, etc.

The site provides a focal point for environmental flow and wetland research and management issues in the Murray-Darling Basin. Publicly available information on these and other conservation-related topics is provided by agencies and community groups using various media, including posters, pamphlets, reports, CDroms, internet, radio and television. The site is regularly used for education purposes by school groups, and in 2002 was included in a youth forum on managing the Barmah-Millewa Forest. Interpretive walkways and a waterbird observatory established in the Millewa Forest Group also have significant conservation education components.

The NSW NPWS is planning to construct and upgrade new and existing camping areas, day-use areas, boat ramps and eco-tourism areas (eg. walking tracks, bird hides, etc) within the Millewa forests, which is likely to allow for monitoring and management of public awareness and behaviour. Also, wildfire mitigation activities such as hazard reduction burning, fire trail maintenance, and provision of contemporary fire suppression training and equipment will be implemented for the Millewa and Werai reserves. NPWS will work closely with NSW Maritime and NSW Fisheries to minimise threats from recreational boating and fishing activities.

31. Current recreation and tourism:

State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

A camping holiday on the shaded banks of a lowland river is a quintessential Australian experience, as it combines four icons of Australian folklore—the Murray River, river red gums, bush camping and Murray cod (*Maccullochella peelii*). The high recreational and tourism values of the site largely stem from these associations, which are realised through the availability of public access to the Murray River. The forests provide an important backdrop to the river setting by establishing a sense of isolation in a semi-natural bushland environment. Nature study, Aboriginal and European cultural heritage, are also important tourism attractions.

Befitting the values for which the site is esteemed, there are no formal camping areas and few structured tourist attractions within the site.

In order to address the management of recreation and other issues in the Ramsar site, NPWS has prepared a Statement of Interim Management Intent (SIMI) for Murray Valley National Park and Regional Park, which include the Millewa Forests. The SIMI proposes that areas with existing impacts from visitors (e.g. on riverbanks) be rehabilitated, and that additional day use and camping facilities be provided in some areas (e.g. in Murray Valley Regional Park).

32. Jurisdiction:

Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept of Agriculture/Dept. of Environment, etc.

Territorial: Government of New South Wales

Functional: Forests NSW (for Koondrook Forests)

NSW Office of Environment and Heritage (OEH) (for Millewa Forests and Werai Forests)

33. Management authority:

Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

Forests NSW

Address: District Forester
PO Box 610
Deniliquin NSW 2710

Phone: 03 5881 9999

NSW National Parks and Wildlife Service (part of OEH)

Address: Area Manager
Murray Area
PO Box 952
Moama NSW 2731

Phone: 03 5483 9100

34. Bibliographical references:

Scientific/technical references only. If biogeographic regionalisation scheme applied (see 15 above), list full reference citation for the scheme.

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Please return to: **Ramsar Convention Secretariat, Rue Mauverney 28, CH-1196 Gland, Switzerland**
Telephone: +41 22 999 0170 • Fax: +41 22 999 0169 • e-mail: ramsar@ramsar.org