

Information Sheet on Ramsar Wetlands (RIS) – 2009-2012 version

Available for download from http://www.ramsar.org/ris/key_ris_index.htm.

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. Name and address of the compiler of this form:

Roger Jaensch, Wetlands International - Oceania, on behalf of the Western Australian Department of Conservation & Land Management (DCLM), in 1998. Updated by DCLM staff in 2000 and 2003. Updated by Gareth Watkins, Department of Environment and Conservation (DEC) in 2009.

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Designation date

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Site Reference Number

All inquiries should be directed to Michael Coote, DEC, 17 Dick Perry Avenue, Technology Park, Kensington, Western Australia 6983, (Tel:+61-8-9219-8714; Fax:+61-8-9219-8750; email: Michael.Coote@dec.wa.gov.au).

2. Date this sheet was completed/updated:

June 2009

3. Country:

Australia

4. Name of the Ramsar site:

Lake Warden System

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:

- Based on recent analysis of waterbird data, the Lake Warden System Ramsar Site does not meet the current interpretation of Ramsar Criterion 5, under which the site was originally nominated (Criterion 3a at the time).
- The Lake Warden System Ramsar Site is considered to meet Ramsar Criterion 4.
- Increases in unseasonal, episodic rainfall events have exacerbated the affects of catchment clearing, resulting in an altered hydrological regime at the Ramsar site (i.e. increased extent and duration of inundation). It appears that changes to the hydrological regime have caused a reduction in exposed shore zone and wading habitat for waterbirds. The altered hydrological regime has also impacted on vegetation, where the extent and duration of inundation has exceeded natural thresholds resulting in the death of riparian vegetation.

7. Map of site:

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:

The boundary of the Ramsar site includes three Nature Reserves; the Lake Warden Nature Reserve 32257, the Woody Lake Nature Reserve 15231 and the Mullet Lake Nature Reserve 23825. These Reserves are vested in the Conservation Commission of Western Australia and managed by the Department of Environment and Conservation.

The boundary of the Ramsar site follows the southern boundary of the Lake Warden Nature Reserve starting at point A on the northern side of the South Coast Highway (Lat 33° 48' 54.54" Long 121° 51' 45.3234"), east to point B (Lat 33° 49' 8.3634" Long 121° 53' 15.4314") west of the Coolgardie Esperance Highway. The Ramsar boundary then follows the eastern boundary of the Lake Warden Nature Reserve north (west of the Coolgardie Esperance Highway) to point C (Lat 33° 48' 20.6274" Long 121° 52' 56.4234"). The Ramsar boundary then follows the northern boundary of the Lake Warden Nature Reserve in a westerly direction to point D (Lat 33° 48' 27.8994" Long 121° 51' 52.5594") and then heads south, following the western boundary of the Lake Warden Nature Reserve and passing over the South Coast Highway to point E (Lat 33° 49' 49.3674" Long 121° 51' 12.384"). From point E, the Ramsar boundary follows the remainder of the southern boundary of the Lake Warden Nature Reserve passing back over the South Coast Highway to point A on the northern side of the South Coast Highway (Lat 33° 48' 54.54" Long 121° 51' 45.3234"). The Ramsar boundary excludes the South Coast Highway.

The Ramsar boundary follows the Woody Lake Nature Reserve boundary starting at point A (Lat 33° 48' 49.86" Long 121° 53' 18.7794") east of South Coast Highway and follows the western boundary of the Nature Reserve boundary north to point B (Lat 33° 48' 9.252" Long 121° 53' 3.4794"). The Ramsar boundary then heads east following the northern boundary of the Woody Lake Nature Reserve which is adjacent to Lake Road, to point C (Lat 33° 48' 19.7634" Long 121° 56' 5.9634"). The Ramsar boundary changes south following the eastern boundary of the Woody Lake Nature Reserve on the western side of Fisheries Road to point D (Lat 33° 48' 47.124" Long 121° 55' 46.524") and then heads west following the southern boundary of the Woody Lake Nature Reserve to point E (Lat 33° 48' 46.872" Long 121° 55' 7.7874") and then changes south to point F (Lat 33° 49' 1.704" Long 121° 55' 3.5754"). From point F the Ramsar boundary deviates from the Woody Lake Nature Reserve boundary west to point G (Lat 33° 49' 1.7394" Long 121° 54' 44.7114") then south to point H (Lat 33° 49' 4.2594" Long 121° 54' 44.6754"). The Ramsar boundary then heads west to point I (Lat 33° 49' 4.2594" Long 121° 54' 44.6754") then north to point J (Lat 33° 48' 47.34" Long 121° 54' 29.34"). From point J the Ramsar boundary heads west to point K (Lat 33° 48' 47.016" Long 121° 54' 16.5234") then changes direction south to point L (Lat 33° 49' 4.764" Long 121° 54' 16.3074"). From point L the Ramsar boundary changes direction west following the southern boundary of the Woody Lake Nature Reserve to point A (Lat 33° 48' 49.86" Long 121° 53' 18.7794") east of South Coast Highway. The Ramsar boundary also includes a small separate area of the Woody Lake Nature Reserve which is east of Fisheries Road with centre coordinates (Lat 33° 48' 21.9954" Long 121° 56' 11.148").

The Ramsar boundary follows the northern boundary of the Mullet Lake Nature Reserve starting at point A (Lat 33° 47' 56.364" Long 121° 55' 46.02") east of Fisheries Road and heads east to point B (Lat 33° 47' 25.98" Long 121° 0' 10.98"). Merivale Road intersects the northern boundary and is excluded from the Ramsar site. From point B, the Ramsar boundary heads south following the eastern boundary of the Mullet Lake Nature Reserve to point C (Lat 33° 47' 57.084" Long 121° 0' 10.5834"). The eastern part of the Mullet Lake Nature Reserve is divided by an unnamed Road Reserve (PIN 11645714) which is excluded from the Ramsar boundary. From point C, the Ramsar boundary follows the southern boundary of the northern section of the Mullet Lake Nature Reserve west to point D (Lat 33° 48' 46.0434" Long 121° 56' 23.712"). The northern section of the Mullet Lake Nature Reserve is divided by an unnamed Road Reserve (PIN 11645715) which is excluded from the Ramsar site. The Ramsar boundary then heads north following the western boundary of the Mullet Lake Nature Reserve to point A (Lat 33° 47' 56.364" Long 121° 55' 46.02"), east of Fisheries Road.

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

Latitude (approximately) 33° 47' S to 33° 50' S

Longitude (approximately) 121° 51' E to 122° 01' E

9. General location:

The Lake Warden System Ramsar Site is located on the south coast of Western Australia (population 2,010,113 in 2005) (Australian Bureau of Statistics, 2007), approximately 730km south east of its capital Perth. The Ramsar site is within the local authority of the Shire of Esperance, approximately 5 km north of the Esperance townsite (population 13,265 in 2004) (Australian Bureau of Statistics, 2006).

10. Elevation:

Approximately 4-5 m AHD (metres Australian Height Datum)

11. Area: (in hectares)

1,999 ha

12. General overview of the site:

A system of saline lakes and marsh areas behind beach-front dunes. The Ramsar site provides significant waterbird habitat and drought refuge, and waterbird species listed under the international migratory agreements JAMBA, CAMBA, ROKAMBA and CMS have been observed at the site. The numbers of Chestnut Teal (*Anas castanea*) and Hooded Plover (*Thinornis rubricollis*) recorded at the site have been globally significant exceeding their respective 1% population thresholds.

13. Ramsar Criteria:

1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9

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

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.

Justification: The Ramsar site is considered to be unique in the South-West Coast Drainage Division. The wetlands within the site form a system of inter-connected lakes connected by channels. This system is distinctive as the lakes are highly variable in terms of their element and hydrochemical composition (Marimuthu et al., 2005).

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.

Justification: The Ramsar site is considered to be a major dry season refuge for waterbirds in south-western Australia (Australian Nature Conservation Agency, 1996). Twenty five “Migratory” waterbirds recognised under the international migratory bird agreements CAMBA (23), JAMBA (22), ROKAMBA (19) and CMS (20) use the site as part of their annual migration.

White Bellied Sea Eagle (*Haliaeetus leucogaster*), Cattle Egret (*Ardea ibis*), Great Egret (*Egretta alba*), Grey Plover (*Pluvialis squatarola*), White-winged Black Tern (*Chlidonias leucopterus*), Ruddy Turnstone (*Arenaria interpres*), Sharp-tailed Sandpiper (*Calidris acuminata*), Sanderling (*Calidris alba*), Red Knot (*Calidris canutus*), Curlew Sandpiper (*Calidris ferruginea*), Pectoral Sandpiper (*Calidris melanotos*), Red-necked Stint (*Calidris ruficollis*), Long-toed Stint (*Calidris subminuta*), Great Knot (*Calidris tenuirostris*), Broad-billed Sandpiper (*Limicola falcinellus*), Bar-tailed Godwit (*Limosa lapponica*), Black-tailed Godwit (*Limosa limosa*), Whimbrel (*Numenius phaeopus*), Common Sandpiper (*Tringa glareola*), Common Greenshank (*Tringa nebularia*), Marsh Sandpiper (*Tringa stagnatilis*), Terek Sandpiper (*Xenus cinereus*), Caspian Tern (*Sterna caspia*), Clamorous Reed-Warbler (*Acrocephalus stentoreus*), Glossy Ibis (*Plegadis falcinellus*).

Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Justification: The Lake Warden Ramsar Site until relatively recently, supported more than 1% of the global population of Hooded Plover (*Thinornis rubricollis* [1% last recorded in 2003]). The available data suggests that these population thresholds may again be met in the future.

The 1% population threshold is also met for the Chestnut Teal (*Anas castanea*). Regular counts exceeding population estimates (see: Wetlands International, 2006) have occurred at the site.

- Hooded Plover 1% of the Western Australian population = 60 birds.
 Years exceeded with maximum count:
 1982 = 65; 1983 = 72; 1984 = 99; 1985 = 240; 1986 = 77; 1987 = 75; 1988 = 539;
 1995 = 146; 1996 = 272; 1997 = 230; 1998 = 607; 2003 = 60.

2. Chestnut Teal 1% of the South-west Australian population = 50 birds.
Years exceeded with maximum count:
1981 = 300; 1982 = 100; 1985 = 153; 1991 = 948; 1992 = 1269; 1997 = 429; 1999 = 76;
2001 = 250; 2003 = 200; 2006 = 409; 2007 = 196; 2008 = 763.

15. Biogeography

a) biogeographic region:

South-West Coast Australian Drainage Division

b) biogeographic regionalisation scheme:

Australian Natural Resources Atlas - Drainage Divisions (Australian Government, 2007).

16. Physical features of the site:

The Ramsar site is situated in the Albany - Fraser Orogen and is made up of Proterozoic rocks, consisting of granite and gneisses formed approximately 2,300 – 1,800 million years ago (CALM, 1999; Short, 2000). This bedrock was overlain by Tertiary sediments of the Plantagenet Group during periods of sea level change approximately 40 million years ago (CALM, 1999; Short, 2000). The site lies between prominent sand dunes to the south, the sediments of which were deposited during the Quaternary period and a granite escarpment to the north.

The bathymetry of each wetland within the Ramsar site in general, does not usually vary by more than 2 m. The majority of the wetlands within the Ramsar site can be described as a series of broad shallow basins. Water in the wetlands ranges from saline to hypersaline; water regimes range from permanent (only drying out occasionally at the end of summer) to ephemeral. There are also some springs which give rise to small, shallow, brackish wetlands such as that at the eastern end of the wetland area. The wetlands contain either completely open water or dead trees around the periphery: there is no emergent vegetation, although trees and rushes grow on the shorelines. The wetlands are supplied by a mixture of groundwater and surface run-off. Mullet Lake and wetlands to the east of it are located in a large samphire marsh. Lake Wheatfield and wetlands westward, occur in stabilised sand-dunes that support low woodland on the higher ground between the wetlands.

17. Physical features of the catchment area:

The Lake Warden Catchment originates north of the Ramsar site and is the major source of water for the site, covering an area of approximately 212,408 ha (CALM, 2006). Approximately 80 - 90% of the catchment has been cleared, with less than 5% of remnant vegetation remaining (Gee & Simons, 2002; Government of Western Australia, 1996; Pen, 1999).

The majority of the land use surrounding the Ramsar site is dedicated to agriculture of some form or another. Crops such as oats, wheat, barley, canola and lupins are the major crop types grown. Grazing for lamb, beef and wool production also takes place in the surrounding catchments. Some farm forestry and hobby farming also exists. Mining and mineral exploration occurs on Pink Lake with a mining lease for the production of salt over the north east section of the lake. Residential, commercial and recreational purposes also form part of the surrounding land use.

The majority of the site lies within the Gore land system which is characterised by alkaline grey sandy duplex soils, pale deep sands and saline wet soils, usually with ironstone gravels within the sandy topsoil and pale deep sands (CALM, 1999; Short, 2000).

The climate of Esperance is Mediterranean, with warm dry summers (December to February) and cool, wet winters (June to August). Annual average rainfall at Esperance is approximately 620 mm and the

average annual evaporation rate is approximately 1,657 mm (Bureau of Meteorology, 2008). The annual rainfall varies from 350 mm in the upper catchments that surround the Ramsar site to 650 mm in the lower part of the catchments at the coast.

There has been an increase of unseasonal (during summer) episodic rainfall events, experienced in 1999, 2000, 2007 and 2009.

18. Hydrological values:

The Ramsar site extends over the majority of the Lake Warden Wetland System (LWWS) which encompasses 90 overflow satellite wetlands and the major lakes: Lake Warden, Pink Lake (excluded from the Ramsar site), Windabout Lake, Woody Lake, Lake Wheatfield, Ewans Lake, Station Lake and Mullet Lake.

Four major catchments north of the site comprise the Lake Warden Catchment; Neridup Creek Catchment, Bandy Creek Catchment, Coramup Creek Catchment and the Western Lakes Catchments which includes Melijinup, Buckenerup and Monjingup Creeks. Coramup and Bandy Creek are perennial systems and deliver approximately 90% of the surface water that is received by the LWWS. There are three main hydrogeological units within the Lake Warden Catchment, which form a two layer aquifer system: the Precambrian bedrock; the Tertiary sediments and the Quaternary sand and dunes (Short et al., 2000).

The wetlands of the LWWS act as a sink for the majority of the groundwater and surface water flow in the Lake Warden Catchment and are a form of flood mitigation for the Esperance Townsite. There is seasonal variability in the relationship between the wetlands of the LWWS and the local aquifers. In general, winter lake levels rise ahead of groundwater and recharge the surrounding aquifers (Marimuthu et al., submitted). Conversely, during summer the lakes dry ahead of groundwater and the groundwater discharges into the lakes (Marimuthu et al., submitted).

The wetlands within the LWWS initially appear to be part of a single homogenous system as they form an organisation interconnected by a series of channels, however, they show large variations in terms of isotopic composition and hydrochemistry (Marimuthu et al., 2005). The LWWS contains three distinct hydrological suites: the Western hydrological suite (Lake Warden), the Eastern hydrological suite (Ewans Lake, Station Lake and Mullet Lake) and the Central hydrological suite (Windabout Lake, Woody Lake, Lake Wheatfield), which are distinguishable due to a lack of groundwater connection between them and their relationships with the surrounding aquifers.

19. Wetland Types

a) presence:

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:

Q, R, J

20. General ecological features:

The Lake Warden System Ramsar Site is located in the South-West Botanical Province within the Fanny's Cove Vegetation System. *Melaleuca cuticularis* trees grow to the water's edge in all the wetlands, although in some places there are narrow zones of rushes, principally *Baumea juncea*. Other rushes and sedges, including *Juncus kraussii*, *Ficinia nodosa* and *Gabnia trifida*, also grow around the shoreline. At the western end, *Acacia cyclops* frequently grows behind *M. cuticularis* as the land rises, before it is replaced by low woodland of *Banksia speciosa* or by mallee and scrub. In some of the eastern wetlands, *Melaleuca preissiana* grows in the fringing tree zone as well as *M. cuticularis*. Also at the eastern end of the system, the fringing tree vegetation gives way to samphire species, especially *Halosarcia pterygosperma*, *H. pergranulata* and *Sarcocornia blackiana*, as the ground drops away from the embankment around the wetland. In higher parts of the marsh, the grass *Stipa luncifolia* grows profusely, and in areas fed by springs *Suaeda australis* occurs.

Waterbird surveys at the Ramsar site have resulted in a total of 73 species being recorded. This includes 42 species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); 40 are listed as "Marine" species and 25 species are listed as "Migratory" and are included under the international migratory bird agreements CAMBA (23), JAMBA (22), ROKAMBA (19) and CMS (20).

Lake Warden retains important habitat to waterbirds, with the *M. cuticularis* along the northern shore providing cover and roosting habitat for cormorants, ducks, grebes, herons and egrets (Clarke & Lane, 2003). The vegetation also provides ideal habitat for the Rufous Night Heron (Clarke & Lane, 2003). The dead stands of *Melaleuca* spp. surrounding Lake Wheatfield provides important habitat including roosting and nesting for cormorants, egrets, ibis, spoonbills and herons (Bennelongia, 2008b; Cale et al., 2004; Clarke & Lane, 2003). The open water and the overhanging vegetation around the lake also provides important loafing and roosting sites for large numbers of ducks such as Musk Ducks and Blue Billed Ducks (Clarke & Lane, 2003; Jaensch et al., 1988).

Lake Wheatfield has provided important waterbird breeding habitat with the colonial waterbirds such as Yellow-billed Spoonbill and Little Black Cormorant using the extensive stands of *Melaleuca* spp. in the south of the lake for nesting sites (Cale et al., 2004; Halse, 2007). Other species that have utilised Lake Wheatfield for breeding include the Australian Shoveler, Darter, Great Crested Grebe, Grey Teal, Pacific Black Duck, Pink-eared Duck, Straw-necked Ibis and the White-faced Heron (Department of Environment and Conservation, 2006; Jaensch et al., 1988). White-faced Herons have also been recorded breeding in the fringing trees of Woody Lake and Windabout Lake (Jaensch et al., 1988). Additionally, Pacific Black Ducks have also been recorded breeding at Woody Lake (Jaensch et al., 1988). The north-east section of Lake Warden has been used as a loafing site for large numbers of Hooded Plover when not inundated (Jaensch et al., 1988). The exposed shoreline and bed of Station Lake have also been considered to be important feeding, loafing and possibly breeding areas for large numbers of Hooded Plover (Jaensch et al., 1988).

21. Noteworthy flora:

There are no rare, threatened or endemic plants known at the site.

22. Noteworthy fauna:

The Ramsar site is amongst the most important sites in south-western Australia for Chestnut Teal *Anas castanea*. The highest count of Chestnut Teal at the Ramsar site was in March 1992 (1,269) where Mullet Lake, Lake Wheatfield, Lake Warden and Woody Lake were surveyed at the same time (see: Halse et al., 1995). The most significant wetlands for Chestnut Teal within the Ramsar site (in order) have been Lake Wheatfield, Lake Warden, Windabout Lake and Mullet Lake (see: Bennelongia, 2008a; Bennelongia, 2008b; Birds Australia, 2008; Cale, 2008; Cale et al., 2004; Halse, 2007; Halse et al., 1992; Halse et al., 1990; Halse et al., 1995; Halse et al., 1994; Jaensch et al., 1988).

The site is also important for Hooded Plover where the highest count occurred at Lake Warden in March 1998 where 607 individuals were recorded (Singor, 1999). Lake Warden has long been considered one of the most important sites along with Lake Gore (within the Lake Gore Ramsar Site) for Hooded Plover in the Esperance region (Newbey, 1996; Singor, 1999). The most important wetlands within the Ramsar site for Hooded Plover have been (in order of greatest abundance) Lake Warden, Station Lake and to a lesser extent Ewans Lake. The Hooded Plover is considered “Near Threatened” under the IUCN Red List and in some regions it has become locally extinct (BirdLife International, 2006; Raines, 2002). The Hooded Plover is listed under the EPBC Act as “Marine” and is listed as a Priority Four species (taxa in need of monitoring) by DEC.

The counts of Hooded Plover and Chestnut Teal at the site, in comparison with the latest waterbird population estimates (see: Wetlands International, 2006), indicate that both species have exceeded their respective 1% population thresholds “regularly”, as defined by the Ramsar Convention (Ramsar Convention, 2005).

Other notable waterbird species recorded at the Ramsar site are the Cape Barren Goose (*Cereopsis novaehollandiae grisea*) and the Fairy Tern (*Sterna nereis*). The Cape Barren Goose recorded at the site is a rare subspecies and occurs largely on the islands of the Recherche Archipelago, however, it is occasionally recorded on the mainland. The Cape Barren Goose is listed as “Vulnerable” under the EPBC Act with approximately 650 individuals in the population (Wetlands International, 2006). The Fairy Tern is listed as “Vulnerable” under the IUCN Red List. The Ramsar site is not considered important in supporting populations of Cape Barren Goose or Fairy Tern as the numbers recorded to date suggest that both are only occasional visitors.

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 provides cultural services in the form of recreation; science and education; cultural heritage and identity; spiritual and inspirational and aesthetic amenity.

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 Ramsar site is comprised of the Lake Warden Nature Reserve (32257), Woody Lake Nature Reserve (15231) and part of Mullet Lake Nature Reserve (23825), which are vested in the Conservation Commission of Western Australia and managed by the Department of Environment and Conservation.

b) in the surrounding area: The land tenure surrounding the Ramsar site includes Nature Reserve, Crown Land and freehold land.

25. Current land (including water) use:

a) within the Ramsar site: The principal land use within the Ramsar Site is nature conservation. In addition, low level passive recreational use occurs such as bird watching. Some active recreation occurs within the Ramsar boundary i.e. Windabout and Woody Lakes are used for water-skiing and sailing.

b) in the surroundings/catchment: Much of the surrounding land is used for agriculture, primarily cereal cropping and grazing. The urban area of the Esperance townsite lies to the south of the site, and a golf course is located immediately south of Lake Warden Nature Reserve.

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: The extensive vehicular use around the wetlands are leading to degradation of the environment and efforts are being made to restrict access. Water-skiing and, to a lesser extent, sailing may have an adverse effect on the use of the lakes by birds.

An altered hydrological regime at the Ramsar site is the largest threat to the ecological character of the site. Optimal waterbird habitats have been reduced and the riparian zone has been impacted resulting in vegetation death (mainly *Melaleuca cuticularis*) and condition decline.

Studies on the rates of sedimentation conducted at the site concluded that sedimentation rates have increased 5 to 10 times in Lake Wheatfield and Lake Warden, and at Station Lake they have increased 10 to 20 times since clearing of the Lake Warden Catchment occurred (Wilson, 2004). Sedimentation can impact on the bathymetry of the wetlands and therefore alter the hydrological regime by making the basins shallower, displacing water and increasing the extent of inundation.

Some other potential threats include non-native and alien species, eutrophication (resulting in algal blooms) and plant diseases such as Dieback caused by *Phytophthora cinnamomi*.

b) in the surrounding area:

The threats occurring within the Ramsar site have their origins in the surrounding areas. Clearing for agriculture, along with encroaching urbanisation, have resulted in altered catchment hydrology causing rising groundwater levels, increased surface water runoff and prolonged inundation of wetlands areas. Other threats associated with altered hydrology include secondary salinity, erosion, waterlogging, sedimentation and eutrophication. Approximately 8% of agricultural land in Esperance is affected by secondary salinity and under current recharge rates, approximately 27% of the Lake Warden Catchment will be at risk from salinity by 2020, increasing to approximately 45% by 2050 (Short et al., 2000). Agricultural production has been reduced or lost in lower areas due to waterlogging, salinity, eutrophication and siltation following clearing (Massenbauer, 2007). Another threat is climate change. The Indian Ocean Climate Initiative (2002) have indicated five major changes that have already occurred to the climate in the south west of Western Australia.

27. Conservation measures taken:

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

The Ramsar site contains Nature Reserves 32257, 15231 and 23825 vested under the Conservation Commission of Western Australia.

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?: Yes

d) Describe any other current management practices:

The Lake Warden System is listed as a “Natural Diversity Recovery Catchment” under the State Salinity Action Plan and its successor the Salinity Strategy (Government of Western Australia, 1996, 2000). The Department of Environment and Conservation (then Department of Conservation and Land Management) has prepared a “Recovery Farm Kit” to assist rural landholders within the catchment to implement strategies aimed at conserving and enhancing natural diversity and improving the quality of water entering the LWWS (Massenbauer, 2000). Other “Recovery Catchment” initiatives include: the establishment of over 1,000 ha of revegetation to act as biodiversity corridors, buffers and water quality filters; and over 350 km of fencing to protect revegetation and remnant vegetation.

Engineering dewatering of the LWWS to ameliorate the impacts of the altered hydrology within the catchment is currently in progress and is taking place in two stages:

Stage 1. Siphoning of water from Lake Wheatfield using gravity-fed pipe system and disposing the water into Bandy Creek 900 metres away.

Stage 2. Pumping water from Lake Warden and disposing via a pipeline into Bandy Creek 6.9 km away.

Volume ranges for Lake Warden, Lake Windabout, Woody Lake and Lake Wheatfield have been set in order to provide recovery of waterbird abundance and richness, and vegetation condition (see: Massenbauer, 2008; Robertson & Massenbauer, 2005).

Stage 1 aims to initially dewater between 1.2 and 2.4 GL of water from the central hydrological suite of the Ramsar site via Lake Wheatfield (see: Massenbauer, 2008; Robertson & Massenbauer, 2005). Stage 2 aims to initially dewater 6-9 GL of water from the western hydrological suite via Lake Warden (see: Massenbauer, 2008; Robertson & Massenbauer, 2005). These initial dewatering targets will reduce the volume of water to depth ranges appropriate for the recovery of waterbirds and vegetation condition. Ongoing dewatering to ensure that these depths are maintained will also need to occur.

DEC’s management objective for the LWWS is to “recover the existing (2003) waterbird species richness and abundance and its living assemblages to a near natural condition* by the year 2030” (Massenbauer & Vogwill, 2007). At the time of writing, Stage 1 dewatering of the central suite via Lake Wheatfield had commenced.

* Natural condition is benchmarked at early 1980’s waterbird survey counts and hydrology records.

28. Conservation measures proposed but not yet implemented:

Stage 2 of the engineering dewatering intervention.

29. Current scientific research and facilities:

- Depth, salinity and nutrient levels are currently being recorded by DEC. In addition to these, groundwater bores and piezometers are being measured at least quarterly for depth and salinity concentrations
- The Department of Water also measures a range of physico-chemical parameters (via gauging stations) in the Lake Warden Catchment
- Birds Australia and volunteers undertake waterbird surveys at the Ramsar site, including dedicated Hooded Plover surveys. Some aerial waterbird surveys have also been conducted in 2006, 2007 and 2008
- Vegetation floristics and structure, invertebrates, waterbirds and water quality were recorded in October 2008 at Ewans Lake. This is part of the Statewide Resource Condition Monitoring project (see: Department of Environment and Conservation, 2008)

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

Current CEPA for the Lake Warden System Ramsar Site includes:

- A 3.6 km long interpretive walking trail in the Woody Lake Nature Reserve, which consists of 1.5 km of raised timber boardwalks. The Kepwari Walk Trail has 20 information panels along the way and has been installed to educate visitors and to protect native vegetation from *Phytophthora* Dieback. As part of the trail, two bird hides have been installed at Lake Wheatfield where visitors can observe waterbirds. DEC have produced a brochure of the Kepwari Trail which is available at the Esperance District Office
- Signs indicating the system's Recovery Catchment and Ramsar Wetland status have been erected around the site.
- South Coast NRM Inc. have produced a fact sheet on the Lake Warden Catchment Project which summarises the aims of the project and achievements to date.
- DEC has prepared a Lake Warden student curriculum package for upper primary and lower secondary school students.
- Birds Australia has produced a Hooded Plover Management Plan, which includes the Esperance region. The plan itself details specific threats to wetlands and Hooded Plovers. It also includes specific strategies for the Esperance region for management and conservation
- Department of Agriculture and Food WA have a range of advisory services which provide education about a range of catchment management issues including salinity and weed/pest management. They are also able to aid in cost benefit analysis for fertiliser application rates to prevent over application.

31. Current recreation and tourism:

Low level and passive recreation including nature appreciation such as bird watching, bushwalking and some fishing. Some active recreation occurs such as water skiing and sailing on Windabout and Woody Lakes.

32. Jurisdiction:

Territorial: The State Government of Western Australia.

Functional: The Conservation Commission of Western Australia (vesting) and the Western Australian Department of Environment and Conservation (management on behalf of the Conservation Commission).

33. Management authority:

The Esperance District (based in Esperance) of the South Coast Region, Western Australian Department of Environment and Conservation.

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