

Information Sheet on Ramsar Wetlands

Categories approved by Recommendation 4.7 of the Conference of the Contracting Parties.

1. Date this sheet was completed/updated:

October 2002

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DD MM YY
Designation date

Site Reference Number

2. Country:

Australia

3. Name of wetland:

Fivebough and Tuckerbil Swamps

4. Geographical coordinates:

Fivebough Swamp Lat 34° 32' S Long 146° 25'E

Tuckerbil Swamp Lat 34° 29' S Long 146° 21'E

5. Elevation:

Approximately 135 metres above sea level

6. Area:

Total – 689ha

(Fivebough Swamp – 400ha; Tuckerbil Swamp – 289ha)

7. Overview:

Fivebough Swamp is a permanent, but fluctuating, fresh-brackish, shallow wetland and Tuckerbil Swamp is a seasonal, shallow, brackish-saline wetland. Both are of national and international importance because of the presence, abundance and diversity of waterbirds that have been recorded there, including migratory shorebirds and threatened species. Both wetlands operate as important waterbird habitat and refuge within an agricultural landscape and in fact gain some of these habitat values from the human uses of the areas such as grazing, flood mitigation and sewage treatment. As such, the site is a good demonstration of Ramsar's wise use principle which also has considerable potential for the development of waterbird-related eco-tourism.

8. Wetland Types

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)		

Q = Permanent saline/brackish/alkaline lakes, **Ss** = Seasonal/intermittent saline/brackish/alkaline marshes/pools

Ranking from the most to the least dominant types:

Fivebough Swamp: Q, Ss

Tuckerbil Swamp: Ss

9. Ramsar Criteria:

Fivebough and Tuckerbil Swamps qualify as a Wetland of International Importance against the following criteria.

1 2 3 4 5 6 7 8

These criteria are:

- Criterion 2:** “A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.”
- Criterion 3:** “A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.”
- 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.”
- Criterion 5:** “A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.”

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.”

The most significant criterion applicable to the site: 3

10. Maps of site included? Please tick *yes* -or- *no* ? (see Maps 1 and 2 for general locality. Maps 3 and 4 show the site boundary, Management Zones and hydrological flows and are provided in Category 20)

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12. Justification of the criteria selected under point 9.

Criterion 2:

The site supports Australasian Bittern (*Botaurus poiciloptilus*) which is listed as ‘Vulnerable’ globally (IUCN 2000). The site is important for this species, supporting more than 1% of the estimated population in south-eastern Australia (Rose and Scott 1997). Bittern were recorded at only six other sites during the 1994-97 Murray-Darling Waterbird Project (Hutchinson *in* Glazebrook and Taylor 1998). Stevens *et al.* (1994-2002) recorded numerous sightings of Bittern from 1994-2001. Taylor and Richardson (2000) recorded Bittern five times during surveys from October 1999 to January 2000.

Much of the habitat needed to maintain Bittern in the Riverina bioregion has been lost (Mike Schultz pers comm.). Bittern favour wetlands, such as Fivebough Swamp, with large areas (>5ha) of tall, dense vegetation (eg *Typha* spp. and *Phragmites australis*) (DLWC 2002).

Criterion 3:

The site is important for maintaining a high diversity of species of waterbirds within the Riverina bioregion, an area with few other non-riparian wetlands. The number of species listed under international treaties, or as threatened species and the abundances of some bird species are amongst the highest recorded in the Murray-Darling Basin.

Fivebough Swamp had the highest, and Tuckerbil Swamp the second highest number of waterbird species recorded (65 and 64 species respectively) in the 1994-97 Murray - Darling Waterbird Project (Hutchinson *in* Glazebrook and Taylor 1998). Fivebough Swamp ranked number two of the 360 sites for the maximum number of species recorded in a single survey (43 species); Tuckerbil Swamp ranked seven (33 species).

A total of 83 species of waterbirds have been identified at Fivebough Swamp and 69 species at Tuckerbil Swamp (Appendix 1).

Criterion 4:

Twenty-two species of waterbird have been recorded breeding at Fivebough Swamp and 11 species at Tuckerbil Swamp (Appendix 1). At least 12 of these species are known to breed regularly at the site. Tuckerbil Swamp is a flocking area for Brolga (*Grus rubicunda*).

Fivebough Swamp provides important feeding habitat for four species of Egret (Appendix 1) during their breeding season between September and February. An Egret breeding colony with around 500-700 nests located 600m south of the Swamp is regularly used each year (Richardson 1999).

Fivebough Swamp may be a drought refuge as part of it (Management Zone 2, see Map 3) retains water year round and provides habitat during dry periods (Glazebrook and Taylor 1998).

The site is important for migratory waterbirds: 24 species recorded at Fivebough Swamp and 13 at Tuckerbil Swamp are listed under the Japan-Australia and/or the China-Australia Migratory Bird Agreements (JAMBA and CAMBA) (Appendix 1).

Criterion 5:

Surveys of the abundance of waterbirds have not been undertaken for the entire site however the Swamps have regularly been recorded supporting over 20,000 waterbirds. At Fivebough Swamp counts of 20,000 Whiskered Terns (*Chlidonias hybridus*) and 20,000 Glossy Ibis (*Plegadis falcinellus*) are the highest recorded for Australia (Hutchison *in* Glazebrook and Taylor 1998). In December 1995 approximately 50,000 birds were counted at Fivebough Swamp by local naturalists and verified by the Royal Australasian Ornithologists Union (RAOU) (Glazebrook and Taylor 1998). Taylor and Richardson (2000) recorded in excess of 20,000 waterbirds across the eastern half of Fivebough Swamp in November and December 1999.

Criterion 6:

The site has recorded five species of waterbird at numbers estimated to represent greater than 1% of their population (see Appendix 1):

Glossy Ibis - 20,000 recorded at Fivebough Swamp and 500 at Tuckerbil.

Sharp-tailed Sandpiper (*Calidris acuminata*) - 2015 at Fivebough and 2253 at Tuckerbil.

Whiskered Tern - 20,000 at Fivebough and 900 at Tuckerbil.

Australasian Bittern - 17 at Fivebough and 6 at Tuckerbil.

Brolga - Nine at Fivebough and 81 at Tuckerbil. Tuckerbil Swamp is particularly important as a regular flocking area for Brolga.

13. General location:

See Maps 1 and 2. Fivebough and Tuckerbil Swamps are located near Leeton in the Riverina region of New South Wales. Fivebough Swamp is 2 km north-east of Leeton, and Tuckerbil Swamp, less than 10 km from Fivebough, is approximately 12 km north-west of Leeton.

14. Physical features:

(For further details see Glazebrook and Taylor 1998)

Regional setting and microrelief

Fivebough and Tuckerbil Swamps are located in shallow, circular depressions on the eastern margin of the Riverine Plain of NSW (Riverina bioregion) (Glazebrook and Taylor 1998).

Microrelief is provided in the northern section of Fivebough and the north-eastern section of Tuckerbil by Gilgai (Glazebrook and Taylor *in* Environment Australia 2001). Gilgai can form a series of small pools when flooded, enhancing the diversity of habitats found in the Swamps.

Climate

Climate is characterised by hot summers and cool winters. Mean annual rainfall is 433mm and is evenly distributed throughout the year. Total evaporation from October to March is 1547mm and between April and September only 490mm (Glazebrook and Taylor 1998).

Soils and groundwater

Soils in the Fivebough Swamp basin are cracking grey clays with varying degrees of self-mulching properties. The basin is underlain by at least 10m of extensive, impermeable clays (Glazebrook and

Taylor *in* Environment Australia 2001). Before irrigation began, regional shallow groundwater levels were generally about 20m below the surface. Groundwater data collected by the NSW Department of Land and Water Conservation (DLWC) 1969-96, suggests the watertable is now within 2.5m of the Swamp basin.

The surface of Tuckerbil Swamp is predominantly grey/dark grey clay to an average depth of 7.2m. A lens of sandy soils intersects beneath the clay and extends to a depth of 11.6m (Glazebrook and Taylor *in* Environment Australia 2001). Data indicate the watertable is now within 2m of the surface and there is a general rising groundwater trend in the area (Glazebrook and Taylor 1998). Some areas within the Swamp show signs of being salt affected.

Water regime

The water regime was originally determined by the balance between rainfall and evaporation. Only after exceptionally heavy and prolonged rainfall was water likely to flow out of the Swamps (Glazebrook and Taylor 1998). In 1939 an earthen contour drain was constructed to intercept the original drainage line and redirect natural drainage around the Swamps (see Category 15).

The main sources of water to the Swamps today are: rainfall; stormwater and irrigation runoff; automatic overflow of drainage water from the contour drain; release of excess drainage water by Murrumbidgee Irrigation; and escape water from the irrigation supply. Fivebough Swamp also receives water from treated sewage effluent discharges (Glazebrook and Taylor 1998).

Water levels in Fivebough Swamp fluctuate considerably from season to season. After heavy rainfall, water levels can rise rapidly. Waterlogging following excessive wet periods is common. Water levels gradually recede, exposing mudflats and providing a shallow water habitat (Glazebrook and Taylor 1998). Treated effluent is constantly released into the Swamp basin and as a consequence, a series of ponds in the central-west of the Swamp (previously the formal effluent containment area) contain water all year round (Glazebrook and Taylor 1998).

The north-western section of Tuckerbil Swamp receives water from surrounding farms via the Stony Point Main Drain. Tuckerbil Swamp fills swiftly after heavy rain and the entire basin becomes submerged. The Swamp can hold a maximum depth of approximately 30-40 cm of water. As water levels recede, the central and south-western parts of the Swamp dry first, with the 'basin' near and extending beyond the far south-eastern boundary of the Swamp generally remaining full of water all year round. The Swamp usually dries out completely during late spring/early summer with the exception of a small flow of drainage water in the north-western section. As the Swamp dries out there may be groundwater discharge via evaporation, and subsequent salt concentration (Glazebrook and Taylor 1998).

15. Hydrological values:

The natural hydrological patterns of both Swamps have been highly modified by the surrounding landuses and regulation of water flows, affecting both the volume of water entering the wetlands and its seasonal timing.

Originally, Fivebough Swamp was a natural drainage depression with a water regime determined by the balance between rainfall and evaporation. In 1939, a contour drain was constructed to intercept and redirect the natural drainage around the Swamp, permanently altering its natural flooding regime. Fivebough now plays an important role in alleviating flooding in the irrigation and urban drainage system that surrounds the Swamp. During prolonged or heavy rainfall, excess water in the drainage system is directed into Fivebough Swamp. In circumstances of extreme storm conditions (1 in 10 year events), Murrumbidgee Irrigation can release water into the Swamp via several regulatory structures. The volume and frequency of excess water entering the Swamp from the drainage system has not been quantified. The contour drain does not completely encircle the Swamp and consequently a considerable volume of stormwater runoff enters the Swamp from the southern end of the basin. Treated sewage from Leeton Sewage Treatment System is also discharged into the Swamp for disposal by evaporation.

On the western edge of Fivebough Swamp, a prior stream was thought to act as an intake area for regional groundwaters, but further investigations found that the aquifer associated with this prior

stream is shallow and of limited extent. It is uncertain what the relationship is between this aquifer and the perched watertables of the Swamp (Glazebrook and Taylor 1998).

As with Fivebough, Tuckerbil Swamp was once a natural drainage depression which filled from local rainfall in winter and dried out via evaporation/percolation by spring/summer. Following the establishment of the contour drain at Fivebough Swamp, a drainage network was constructed to carry water via the south-western boundary of Tuckerbil Swamp and north-west to Barren Box Swamp 35 km west of Griffith. This network of drains captured water that would previously have flowed directly into Tuckerbil. The Swamp is now used for flood control, receiving excess water from the local supply/drainage channel system and the drainage channel from Fivebough Swamp, water released by Murrumbidgee Irrigation and irrigation runoff. Large volumes of water can be diverted into the Swamp during prolonged or heavy rain and the basin can fill within 24 hours, often encroaching onto higher ground. Tuckerbil Swamp is too low for floodwaters to drain out naturally and Murrumbidgee Irrigation has only a limited ability to drain the Swamp.

16. Ecological features:

The dominant vegetation at Fivebough Swamp was once a Black Box (*Eucalyptus largiflorens*) – Lignum (*Muehlenbeckia cunninghamii*) association. During the 1930s, the Swamp filled with water for a prolonged period following the rupture of a drainage pipe. Most of the Black Box trees died and the remainder were killed by fire. The Swamp became extensively covered with a thick growth of Cumbungi (*Typha spp*). By the 1980s, heavy grazing of livestock (cattle), together with drought, resulted in loss of vegetation in the central part of the Swamp, which became open mud flats (Taylor and Richardson 2000).

Grazing temporarily ceased in parts of the Swamp in 1997 followed by rapid regeneration of Cumbungi and Water Couch (*Paspalum disticum*). This produced a vegetation structure in parts of the Swamp preferred by cryptic waterbird species and significantly reduced the amount of mudflat available to shorebirds. Common Couch (*Cynodon dactylon*) and Barley Grass (*Hordeum leporinum*) are found on drier areas and Seabligh (*Suaeda baccifera*) is present on some Gilgai puffs indicating saline conditions.

Taylor and Richardson (2000) estimated that 42-46% of Fivebough Swamp was a bare mud substrate. There was very little vegetation less than 20cm or over 50cm tall. Modal vegetation heights were 21 to 40cm. Vegetation taller than 100cm was mostly Cumbungi which occurred mainly in the south and western central sections of the Swamp. Vegetation up to 2m occurred in the north but mostly consisted of introduced weeds. Most vegetation of 50cm and less was Water Couch which formed dense deep mats. Cumbungi and Water Couch were spreading rapidly following the removal of livestock.

Fivebough Swamp provides habitat for many resident waterbirds and migratory shorebirds during the annual wetting-drying cycle. There is a succession of species, each reaching their maximum numbers at different stages of the cycle. The pattern of wetting and drying maintains the productivity and diversity of waterbird species using the site.

The dominant vegetation at Tuckerbil Swamp was once a Black Box-Lignum association. Following the establishment of irrigated farming, the Swamp served as a drainage basin and held irrigation water for extended periods. The Black Box died and were replaced by a thick growth of Cumbungi and Water Couch. Fire reduced the extent of Cumbungi in the 1960s.

Today, Tuckerbil Swamp has localised areas of saline flats covered by salt-tolerant species such as Samphire (*Sclerostegia tenuis*). Seablite increases in abundance towards the margins of these flats and in areas inundated for considerable periods. Sea Barley Grass (*Hordeum marinum*) and Samphire dominate the Gilgai country in the north east of the Swamp. Drier areas of the Swamp are dominated by Sea Barley Grass and introduced 'grazing' species. Remnants of the original vegetation remain on and near the northern, eastern and southern margins of the Swamp including Black Box, Belah (*Casuarina cristata*) and Lignum. Cumbungi grows along the central western part of the Swamp and along the Stony Point Main Drain to the north. Water couch is restricted to the wetter north-western end of the Swamp and is sustained by water from the drainage outflow.

Fivebough and Tuckerbil Swamps are less than 10km apart (see Maps 1 and 2) and are considered to be key parts of the wetland (and surrounding rice field) habitats of the local region. Waterbirds can

move between the Swamps and use the habitat variations advantageously. Tuckerbil Swamp is generally shallower throughout and tends to dry out before Fivebough, offering more shallow water and wet mud habitat for smaller shorebirds when water depths in Fivebough Swamp are higher. A variety of other wetland habitats, including ricefields which are filled with shallow open water in October, are available in the immediate area. Further studies are required to demonstrate the importance of each habitat and its use by waterbirds at each site.

17. Noteworthy flora:

As noted above, the dominant vegetation at Fivebough Swamp was once a Black Box (*Eucalyptus largiflorens*) - Lignum (*Muehlenbeckia cunninghamii*) association, but little of this remains today. Vegetation data collected to date consists of species presence/absence and most surveys have been carried out during the drier months (see Appendix 3). There have been no formal surveys of vegetation structure, species abundance or the seasonal/spatial distribution of vegetation. It is not known whether any threatened species, populations or communities exist at Fivebough Swamp (Glazebrook and Taylor 1998).

The vegetation at Tuckerbil Swamp was also originally a Black Box (*Eucalyptus largiflorens*), Belah (*Casuarina cristata*) and Lignum (*Muehlenbeckia cunninghamii*) association (see above) but only small remnants of these communities now remain on higher ground in the north-eastern corner of the Swamp. As with Fivebough, no formal vegetation surveys have been conducted at Tuckerbil Swamp.

18. Noteworthy fauna:

Both Fivebough and Tuckerbil Swamps have long been recognised as important sites for birdlife (Glazebrook and Taylor 1998). Waterbird records for both sites date back to the period 1900-1930 (Hindwood 1940). However, clearing for agriculture, urban development and changes to the water regime of the Swamps have favoured some species of waterbirds over others. It is only recently, following surveys undertaken for the RAOU Murray-Darling Basin Waterbird Project (Hutchison 1998) and long-term observations by local naturalists, that these sites have been recognised as important habitat for migratory shorebirds. Count information of waterbird species is given in Appendix 1.

Of 360 wetlands surveyed during the RAOU Murray-Darling Basin Waterbird Project, Fivebough Swamp recorded the highest number of waterbird species and it ranked second within the Murray-Darling Basin for the maximum number of species recorded in a single survey. Eighty-three waterbird species have been recorded at Fivebough Swamp of which 24 species are listed under the Japan-Australia Migratory Bird Agreement (JAMBA) and/or the China-Australia Migratory Bird Agreement (CAMBA), and protected under Commonwealth legislation. During the RAOU Waterbird Project, Tuckerbil Swamp recorded the second highest number of waterbird species and it ranked seventh for the maximum number of species recorded in a single survey. Sixty-nine species of waterbird have been recorded at Tuckerbil Swamp, thirteen of which are JAMBA and/or CAMBA species.

Seven species listed under the NSW Threatened species legislation have been recorded at Fivebough Swamp; namely Australasian Bittern (*Botaurus poiciloptilus*), Magpie Goose (*Anseranas semipalmata*), Freckled Duck (*Stictonetta naevosa*), Blue-billed Duck (*Oxyura australis*), Brolga (*Grus rubicunda*), Painted Snipe (*Rostratula benghalensis*) and Black-tailed Godwit (*Limosa limosa*) (see Appendix 1) and at Tuckerbil Swamp, four species; namely, Australasian Bittern, Painted Snipe, Freckled Duck and Brolga. Australasian Bittern is also listed as 'Vulnerable' globally by the World Conservation Union (IUCN 2000).

Fivebough and Tuckerbil Swamps have also recorded a number of waterbird species at numbers considered to represent greater than 1% of their population estimate. This includes Glossy Ibis, Sharp-tailed Sandpiper, Whiskered Tern, Australasian Bittern and Brolga.

There have been no surveys of mammals, reptiles, amphibians or fish at the Swamps, however those species observed at Fivebough Swamp are listed in Appendix 2.

19. Social and cultural values:

The area surrounding Fivebough Swamp is likely to contain Aboriginal relics (possibly including Aboriginal burial sites in the lunette on the eastern side) (Robson 1997).

Tuckerbil Swamp is a traditional hunting/fishing area for the Wiradjuri Aboriginal people. The Koonadan Historic Site is nearby to the south-east of Tuckerbil Swamp and is of cultural heritage significance to the Aboriginal people of the area. Aboriginal skeletal remains have been found in the dunes and the local Aboriginal community believes that Koonadan is an ancestral Wiradjuri burial ground (NPWS 1996).

Currently, Fivebough Swamp is used by a small number of local, Australian and international visitors, who are attracted by the waterbirds at the site. Visitors are aware of the site by 'word of mouth' and there is little promotion of the site. There is no commercial tourism at either Fivebough or Tuckerbil Swamps at present.

The wetland has excellent potential as an educational resource, as well as a regionally, nationally and internationally important tourist destination for nature-based recreation focusing on the rich birdlife that is attracted to the Swamp.

Murrumbidgee Field Naturalists have obtained funding to set up a field study centre at Fivebough Swamp, which will cater for passive recreational activities centred on the natural values of the wetland and the waterbirds it supports. Since some species of waterbird may be little tolerant of human intrusion (such as Brolgas), a study of waterbird fright distances was incorporated into research on the ecology and management of waterbirds at Fivebough Swamp (Taylor and Richardson 2000). The results of this study will influence visitor management at this site. There are few visitors to Tuckerbil Swamp because of difficulties of access, so this site will primarily be managed for conservation rather than recreation and eco-tourism.

20. Land tenure/ownership of:

(a) site

The site is Crown Land administered by Land New South Wales, a business unit of DLWC under the *Crown Lands Act 1989* and the *Crown Lands (Continued Tenures) Act 1989*. Maps showing the boundaries are provided below (Maps 3 and 4).

Zones 3 and 4b of Fivebough Swamp are not part of the wetland proper but are part of the Ramsar site. The entire area of Tuckerbil Swamp is wetland and is included in the Ramsar site.

Leeton Council leases 6.5ha on the southern end of Fivebough Swamp for the Leeton Sewage Treatment Plant (STP) tertiary treatment ponds. Management Zone 1 is currently leased for grazing.

In 1967, Tuckerbil Swamp was divided into three blocks and leased on a four-yearly basis for dry grazing. In the late 1970s, the northern block was subdivided and added to adjoining farms for the purpose of mixed farming. The remaining two blocks continue to be leased for dry grazing and make up the entire area of Tuckerbil Swamp today.

The Fivebough and Tuckerbil Wetlands Management Trust Inc. provides advice to Land NSW on the management of the site and undertakes a range of the day-to-day management actions.

(b) surrounding area

The area immediately outside the contour drain of Fivebough Swamp consists of freehold blocks. Several parcels of land on the eastern edge of the Swamp are held either under permissible occupancy agreements or perpetual licence by adjoining landholders. Approximately 2ha of perpetual leasehold land adjoining the north-eastern part of the site are inundated with water at times. Three blocks of privately owned land impinge on the Swamp.

Irrigation farms surrounding Tuckerbil Swamp are freehold land mainly used for growing rice, winter cereals and grazing. Tuckerbil Swamp, and the surrounding land, was a traditional hunting/fishing area for the Wiradjuri Aboriginal people. Koonadan Historic Site lies to the south-east of Tuckerbil Swamp and is considered to have significant cultural heritage value to the Aboriginal people of the area.

21. Current land use:

(a) Site

Both Swamps are zoned Rural 1(a) in the Leeton Local Environmental Plan (LEP) 35 which means that they can be used for any rural activity. The Swamps are used for flood mitigation during periods of heavy rainfall (see Category 15).

Fivebough Swamp is currently being managed for conservation, education and research, with part of the area leased for grazing purposes. Tuckerbil Swamp, while leased for grazing purposes, is also managed with waterbird conservation outcomes in mind.

Leeton Shire Council uses Fivebough Swamp to dispose of tertiary treated effluent by evaporation. The Leeton STP has been operating since 1937 and is located at the southern end of Fivebough Swamp. The STP has been augmented over the years to service unsewered subdivisions in Leeton. See Category 22 following for further details.

(b) surroundings/catchment

The area immediately west of the contour drain consists of allotments varying in size from 0.4 to approximately 15ha. This privately owned land is zoned 2. Living and 7(a) Fivebough Environmental Buffer under Leeton LEP No. 35.

The 2. Living zone permits land to be subdivided into 1200m² residential allotments subject to the provision of reticulated sewerage. Where sewerage is not available, the minimum lot size for a dwelling is 4000m². The buffer zone is 500 metres wide and while development is permitted, Council can control inappropriate development and require revegetation of land.

Land to the north and east of Fivebough Swamp is zoned Rural 1(a) under Leeton LEP No. 4 and No. 27. LEP No. 27, gazetted on 9 January 1998, increased the minimum lot size for a dwelling from 2 to 20ha for horticultural land and 150ha for broad acre crops. The effect of LEP No. 27 is to retain land for agricultural purposes and prevent rural residential subdivisions. Rural Industries are provided for in LEP No. 27 with no minimum lot size.

Large area farms surround Tuckerbil Swamp and are mainly used for rice, winter cereals and grazing.

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

(a) at the site

Fivebough and Tuckerbil Swamps have been used for agricultural production, including grazing and cultivation, as well as flood mitigation and sewage effluent disposal, which have resulted in significant changes to the ecological character of the sites. The water regime and hydrology of both Fivebough and Tuckerbil Swamps have also changed markedly since the development of irrigation.

The drainage system

The effect of excess water on the ecology of the Swamps is unknown (Glazebrook and Taylor 1998). Little is known about the quality of the diverted drainage water (see Categories 14 and 15) that spills into the Swamps. Stormwater can contain high levels of nutrients (phosphorus and nitrogen), micro-organisms and organic matter which can impact on biological oxygen demand in the receiving water (Pygram 1977). Murrumbidgee Irrigation recently began sampling drainage water entering the Swamp during periods of heavy rain.

The use of pesticides and herbicides for rice farming and horticulture in surrounding areas could impact on the Swamps. A drainage strategy stipulates that rice cannot be drained within 21-28 days of using chemicals (Glazebrook and Taylor 1998).

Groundwater levels have risen to within 2m of the surface over approximately 85% of Fivebough Swamp. This is a critical zone for salinisation of soils, waterlogging and associated problems. Patches of bare ground and the presence of salt tolerant species such as Seablite and Sea Barley

Grass indicate that areas may be salt affected. Samphire has also regenerated on some Gilgai puffs since stock removal.

The disposal of treated sewage effluent

Leeton Shire Council uses Fivebough Swamp to dispose of tertiary treated effluent by evaporation. The STP treats both domestic sewage and industrial waste. Leeton Shire Council and DLWC monitor effluent regularly. The provision of nutrient removal is being considered to further improve the quality of the effluent.

Increased sewage loads are expected with new and expanding citrus, rice, cheese and wine industries (DPWS 1999). The volume of effluent produced by the Leeton STP in 1996 required an evaporation area of 75ha. This will increase to approximately 120ha for projected effluent volumes by the year 2021 (DPWS 1996). While the quantity of waste treated is expected to double over the next 20 years, discharges from individual industries are expected to fall with the introduction of trade waste charges and penalties for discharging above licence conditions. Leeton STP was upgraded (\$2.50 million) during 1999/2000 to increase the capacity of the plant and improve the level of treatment.

Weeds

Several species of weed (see Appendix 3) have been identified at Fivebough Swamp which occur on the Leeton Council's noxious weeds list (Pluis *in* Glazebrook and Taylor 1998). Bathurst Burr (*Xanthium spinosum*) has been a problem in sections of Fivebough for many decades. Introduced vegetation will compete with native aquatic, emergent and grass species growing in the Swamp basin.

Grazing

No long-term studies have been conducted to quantify the effect of domestic livestock grazing on the ecology of the Swamps. It is clear that poorly regulated grazing in the past has had an impact, especially on Fivebough Swamp where the extent of Cumbungi has been greatly reduced (Taylor and Richardson 2000). The direct impact of stock on wetlands can include alterations to soil structure and nutrient levels, reduction in vegetation biomass and changes to water quality.

(b) around the site

Urban and industrial development

In the future, careful planning and development controls will be needed to ensure Fivebough Swamp is not affected by possible nearby urban and industrial developments. It has been estimated that over the next 20 years a further 200 allotments will be required in the Petersham Road area to the south-west of Fivebough Swamp. Consideration is also being given to the development of a fruit juice plant and a pectin processing plant nearby.

23. Conservation measures taken:

The site is administered by Land NSW, a business unit of DLWC. The Fivebough and Tuckerbil Wetlands Management Trust, an incorporated body comprising representatives from local naturalist groups, government agencies, local council, local land council and industry, has been established to provide advice to Land NSW and DLWC with respect to management, and to undertake some of the actions set down in the Management Plan. The Trust also liaises with the lessees of the two sites in terms of their management activities, as specified in the respective conditions of lease.

The Trust has developed a Management Plan designed to maintain the 'ecological character' of the wetlands, while also undertaking some management actions to address threats and some degradation caused by past activities. While the Plan has been under development the Trust has begun to implement some of the actions outlined in this framework, including:

- Construction of internal fencing for zoned management of the wetland;
- Reconstruction and repair of levees to contain and manage treated sewage effluent;

- Installing water management structures to control treated effluent water;
- Constructing walkways for access around the permanent wetland, Management Zone 2;
- Viewing mounds have been placed along walking trails;
- Design and planting of endemic plants as part of a field study area, in Management Zone 3;
- Construction of the Budyaaan Baamirra Interpretive Centre;
- Revegetating Management Zones 3 and 4 with 10,000 local native plants;
- Development of two car parking areas and a wetland observation site;
- Management of weeds, by spraying, chipping, and mowing;
- Removal of all rubbish from the basin; and
- Construction of a bird hide.

The on-ground works have been carried out with the assistance of the Murrumbidgee Field Naturalists Inc. These works will be reviewed with the ongoing development of the Management Plan.

Leeton Local Environment Plan No. 35 has rezoned the area around the western side of Fivebough Swamp as an Environmental Buffer, with the aim of providing some protection for the Swamp.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* is relevant for both Fivebough and Tuckerbil Swamps due to the presence of migratory waterbirds (JAMBA, CAMBA and Bonn Convention-listed). The NSW *Threatened Species Conservation Act 1995* may protect species and communities considered at risk, and the NSW *Native Vegetation Conservation Act 1997* serves to provide for the conservation and management of native vegetation. These Acts have the potential to provide protection for both Swamps from inappropriate developments in the future.

24. Conservation measures proposed but not yet implemented:

The Fivebough and Tuckerbil Wetlands Management Trust Inc. has developed a Management Plan for both Swamps. Two particular studies, *Fivebough and Tuckerbil Swamps: A review of their history, conservation values and future managements options* (Glazebrook and Taylor 1998) and *The ecology and management of waterbirds on Fivebough Swamp* (Taylor and Richardson 2000), and other wetland reports have provided the basis for the development of the Management Plan for the Swamps.

Actions outlined in the Management Plan that are proposed but not yet implemented include:

- Developing a range of habitats for shorebirds and larger wading birds in the various compartments of Management Zone 2 in order to provide alternative habitats for these species when it is not available in Management Zone 1 for whatever reason;
- Erecting interpretative signs etc. along the walking tracks and in association with the proposed hides; and
- Providing internal protective fencing of walkways, embayments and other infrastructure to allow cattle grazing within compartments.

25. Current scientific research and facilities:

Current research and monitoring at the site includes:

- Baseline data collection and monitoring of grazing regarding provision and maintenance of waterbird habitats. This is ongoing and is being carried out by the Fivebough and Tuckerbil Wetlands Management Trust; and

- A study of Painted Snipe at Fivebough Swamp being carried out by Prof. Lew Oring at Charles Sturt University. This study is expected to be completed in December 2002.
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26. Current conservation education:

Murrumbidgee Field Naturalists were successful in obtaining Natural Heritage Trust funding in 1997 for a three year project which in part is to carry out on-ground works associated with setting up a field study centre at Fivebough Swamp. These works include the provision of interpretative signage, hides, walkways and facilities for school visits. Tuckerbil Swamp is relatively inaccessible, so this site will primarily be managed for conservation rather than education or eco-tourism, but results from research at the site will inform the management of both Swamps.

Fivebough Swamp is used by local schools as a study resource. One of the main Management objectives for the Swamps is to provide opportunities and facilities for wetland and environmental education.

27. Current recreation and tourism:

Currently, Fivebough Swamp is used by a small number of local, Australian and international visitors, who are attracted by the waterbirds at the site. Visitors are aware of the site by 'word of mouth' and there is little promotion of the site. There is no commercial tourism at either Fivebough or Tuckerbil Swamps.

Murrumbidgee Field Naturalists have obtained funding to set up a field study centre at Fivebough Swamp, which will cater for passive recreational activities centred around the natural values of the wetland and the waterbirds it supports.

28. Jurisdiction:

Territorial:	State of New South Wales Commonwealth of Australia
Functional:	NSW Department of Land and Water Conservation Leeton Shire Council Murrumbidgee Irrigation NSW National Parks and Wildlife Service The Department of Environment and Heritage (Environment Australia)

29. Management authority:

As Crown Land, the site is administered by Land NSW, a business unit of DLWC. The Fivebough and Tuckerbil Wetlands Management Trust provides advice to Land NSW and DLWC with respect to management, and to undertake some of the actions set down in the Management Plan. The Trust also liaises with the lessees of the two sites in terms of their management activities, as specified in the respective conditions of lease.

Officeholders of the Fivebough and Tuckerbil Wetlands Management Trust:

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 2. Secretary, Phil Green, PO Box 97, Leeton NSW 2705 Australia.
 3. Treasurer, Richard Faulder, PO Box 136, Yanco NSW 2703 Australia.
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