

Water saving through wetland drying

Seven part test and ecological assessment – Euston Lakes

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A MDFRC Consultancy report for Department of Environment and
Climate Change

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October 2007

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A report prepared for Department of Environment and Climate Change by the Murray-Darling Freshwater Research Centre.

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October: 2007

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Cover Photograph: Clockwise: 1. Murray River and Taila Creek Junction; 2. Washpen Creek; 3. Freshwater catfish *Tandanus tandanus*; and 4. Lake Benanee. Photographs: Bernard McCarthy, MDFRC, September 2007.

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Executive summary

Murray-Darling Freshwater Research Centre (MDFRC) was contracted by the Department of Environment and Climate Change (NSW) to undertake an ecological assessment of flora and fauna of Euston Lakes. Euston Lakes have been identified as potential sites for water saving by the Murray Wetland Working Group (MWWG) and NSW Department of Environment and Climate Change (DECC), by either installing temporary regulators or block-banks to prevent the wetlands filling. Prior to works commencing there is a requirement to undertake a Review of Environmental Factors to identify any adverse effects of drying on either water quality or threatened flora and fauna.

The four wetlands at Euston Lakes identified for water saving are:

Wetland Name	Identifier*
Lake Benanee	1437
Dry Lake	1426
Washpen Creek	1455
Taila Creek	1445

* Murray Wetlands Working Group's
Wetland identification codes.

This report contains the following information:

- Flora and fauna assessments (including macrophytes, birds, amphibians and fish), with particular interest in threatened species, populations and/or ecological communities;
- 7-part test for all threatened species, populations and ecological communities identified; and
- Site assessment for potential adverse impacts (e.g. potential for acidification) and recommend options to ameliorate potential impacts.

Biodiversity legislation and policy

This report has addressed issues with reference to the provisions and requirements of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*, the New South Wales *Fisheries Management Act 1994 (FM Act)*, the *Environment Planning and Assessment Act 1979 (EP&A Act)* as amended by the *Threatened Species Conservation Act 1995 (TSC Act)* and *Threatened Species Legislation Amendment Act 2004*.

Under these Acts various factors need to be considered in deciding whether the proposed actions are likely to have a significant impact on threatened species, populations, ecological communities or their habitat. An assessment of significance, as outlined in the *EP&A Act*, otherwise known as the 7-part test, is required for all identified threatened species, populations and ecological communities as listed under the *FM Act* or the *TSC Act*. Only species listed as threatened identified within the study region have undertaken further assessment. Other species not listed as threatened, yet observed or with a known or predicted distribution within the study area have been included in the report to signify species diversity.

A range of migratory birds included in the *EPBC Act* are listed under international conventions. Many of these are often observed in the vicinity of inland waters within Australia, including the study region. International conventions discussed include:

- Chinese-Australian Migratory Bird Agreement (CAMBA);
- Japanese-Australian Migratory Bird Agreement (JAMBA);
- Republic of Korea-Australian Migratory Bird Agreement (ROKAMBA); and

- Convention on the Conservation of Migratory Species of Wild Animals – Bonn, 1979 (CMS), also known as the Bonn convention.

These agreements state each signatory will strive to protect birds listed, conserving or restoring habitat areas, mitigating obstacles and controlling other factors that might impede migration.

Methods

Assessment of the lake system was conducted via both desk top and field surveys, to identify threatened species, populations and ecological communities. Identification of species, populations and ecological conditions concentrated on records relating to confirmed sightings, species known to occur, former distribution or species predicted to occur within the region. This data has then been used to compile a list of species that could potentially occur in the area (Appendix A).

The desk top study methods employed consisted off reviewing:

- Information in the Atlas of NSW Wildlife and BioNet databases;
- The online database for the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (hereafter referred to as DEW database);
- The online database for the NSW *Threatened Species Conservation Act 1995* (hereafter referred to as DECC database);
- The online database for the NSW *Fisheries Management Act 1994* (hereafter referred to as DPI database); and
- Relevant literature relating to the study area.

The field survey methods employed during late August and mid September 2007 consisted of:

- Direct observation of any flora or fauna species within or adjacent to the site;
- Diurnal area searches for bird species were employed. This involved visually searching the study sites from multiple locations around each wetland, including both the aquatic and riparian zones. Search sites consisted of four around each lake and 1 km intervals along the creek lines. All birds observed (seen or heard) were identified to establish species diversity, abundance and general activity (e.g. nesting, perching or feeding);
- Fish surveys consisted of setting two large and two small fyke nets at each wetland. Boat-mounted electrofishing was also conducted at Lake Benanee, Washpen Creek and Taila Creek; and
- Amphibian survey consisted of recording male calls for 10 minutes at one main site on each wetland at least 20 minutes after dusk. Playback calls was used for the Southern bell frog *Litoria raniformis*, for 1 minute at each site. Spotlighting was undertaken for 10 minutes at each site (two observers) for visual identification. In addition to the main sites, male calls were recorded during a 2 minute period at additional sites on each wetland.

Limitations

This study by design was a brief and preliminary site assessment. Given the timing of the survey, late winter early spring and due to current drought conditions, it is possible species were overlooked. The data obtained from these surveys is not exhaustive in terms of sampling and should be viewed as an indication of species diversity, representing only a small percentage of what the total species pool could be present seasonally or permanently in the study region.

The weather during the time of the amphibian field survey consisted of a clear cloudless night with temperatures ranging from 8-15°C, although the weather is warming up after winter it possibly is not yet warm enough for frogs, as was evident with the lack of calling males recorded. Due to current drought conditions and lack of rain, optimal conditions for flora species may not have been reached, hence making identification of non-flowering, fruiting taxa difficult. The drought possibly may also influence the diversity and abundance of bird species visiting the lake system, due to favourable or unfavourable conditions else were.

Results

Based on the site assessment and desk top study:

- Eleven native fish species were recorded to be present during recent surveys, two listed as vulnerable under the *FM Act* or *EPBC Act* and one protected as listed under the *NSW Fisheries Management (General) Regulation 1995 (FM Regulation)*. An additional three threatened fish species (two vulnerable and one endangered) and two endangered populations, have a former or predicted distribution within the region.
- The proposal does have the potential to disturb, remove or modify habitat important to native fish and impact on the movements of native fish. However, due to current drought conditions and as long as water flows are managed to allow flow back into the wetland during surplus flows, the direct and indirect impact on the quality of habitat is unlikely to affect the presence of these species in the long term. Short term impacts will see fish species that have not managed to escape the drying wetland to become stranded.
- An endangered invertebrate specie has a former distribution in the region. This specie with limited dispersal abilities, previously has inhabited river systems as well as irrigation drain pipes in NSW.
- An endangered amphibian specie has a known distribution in the region. This specie is dependant on both aquatic and terrestrial habitat areas. The habitat surrounding these systems is classed as ideal habitat. Possibly due to cool weather on night of survey this specie was missed, further monitoring is recommended to determine if any populations do exist.
- Six vulnerable and one endangered waterbird have a known distribution or are predicted to occur within the region. These wetlands are already suffering forms of degradation due to drought conditions. Altering water levels has varying effects on waterbirds, four of these species potentially will benefit from shallow water levels, while three are dependant on large permanent deep water bodies. Due to the Euston Lakes historically being ephemeral the proposed action is likely in the long term to benefit waterbirds as long as other drought refuge areas remain within the region.
- 24 bird species listed in the international conventions either have been observed or potentially use the wetlands while migrating. Two migratory birds were observed during the recent survey. Each migratory bird species considered have extensive ranges within the region and each species has a wide distribution of potential habitat throughout the region. Therefore it could be considered no significant area of known habitat for migratory bird species is likely to be removed as a result of the proposed action.
- Distributions of six endangered and 17 vulnerable woodland birds have an extensive range and are predicted to occur within the region. Three threatened woodland birds were observed during recent surveys. Woodland birds can tolerate fluctuating water levels as long as food resources, suitable habitat and alternate water sources are not impacted on.
- One endangered and two vulnerable mammal species have been recorded in the region. Mammals may be considered dependant on wetlands as they require access to water, none of these threatened mammals recorded in the region spend their entire life cycle in wetland habitats.

- Two vulnerable and one endangered terrestrial plant species have a known distribution in the region. No threatened aquatic macrophytes are known to inhabit the region.
- The lower Murray River in which the Euston Lakes system occurs, is listed as an endangered ecological community. Modifications to hydrological regimes within these wetlands will lead to changes in the structure of the community and potentially result in the loss of species. However, this potentially can be balanced by re-instating a wetting cycle when surplus water is available, this may benefit some species.
- There is potential for the *Acacia loderi* Shrublands Endangered Ecological Community and the Buloke Woodlands Ecological Community of the Riverina and Murray-Darling Depression Bioregions to occur at these wetlands. These communities' are characterised by a number of plant species and are important habitat areas for many species. Modification to the hydrological regimes within these wetlands is unlikely to have adverse impacts on these communities.
- The landscape surrounding the wetlands is well represented with forests, nature reserves, rivers and creek systems. Due to widespread drought conditions across most of the State, these areas are suffering various forms of degradation. The drying of wetlands during these drought conditions is likely to add further stress to other wetlands, creeks and rivers, through an increase in abundance of species looking for alternative water sources and habitat.
- The risk of sulfidic sediments has been identified to possibly occur at Lake Benanee and to be a low risk at Dry Lake. Due to a low net acidity, Lake Benanee possibly will benefit from sulfidic sediment oxidation and a draw down of the lake potentially will be beneficial. Testing of Taila and Washpen Creeks for their identification of sulfidic sediments is currently still in process and results were not available in time for this report.

Recommendations

It is recommended the following points be considered to minimise disturbances on the ecological values of the study area:

- Regulators are installed in preference to block banks. This would allow future manipulation of water regimes with minimal impact on the surrounding environment;
- Re-wetting the wetlands when water flows become surplus or at least every two years. This will provide many benefits to the community's associated with the wetlands, potentially surpass impacts on species that will not benefit from a re-wetting cycle;
- During construction all woody debris required to be moved, from either within the creek or riparian zones, should be realigned within the channel so as not to decrease habitat areas;
- Care should be taken during construction not to remove any riparian vegetation. If riparian vegetation is removed or disturbed, consideration to revegetating the area should be made;
- These wetlands in size are relatively small in comparison to the catchment size. If the proposed action is to only occur to these wetlands, the impact on habitat areas for threatened species, populations and communities can be considered small and likely not to pose a risk of species extinction;
- A cautionary principle should be applied. There is potential for similar works to be undertaken on multiple wetlands throughout the region. Modification of the hydrology of many wetlands within the landscape will have the potential to have adverse impacts on the distribution and availability of wetland habitat with potential adverse effects on associated biota;
- An on going monitoring program to evaluate potential effects of the new or upgraded infrastructure should be considered, with specific interest in the impacts on protected and threatened native species and possible effects of sulfidic sediments.

List of Acronyms

CAMBA	Chinese-Australian Migratory Bird Agreement
CMS	Conservation of Migratory Species
DECC	Department of Environment and Climate Change (NSW)
DEH	Department of Environment and Heritage (Commonwealth)
DEW	Department of the Environment and Water Resources (Commonwealth) – former DEH
DPI	Department of Primary Industries (NSW)
EP&A Act	Environmental Planning and Assessment Act 1987 (NSW)
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth)
FM Act	Fisheries Management Act 1994 (NSW)
FM Regulation	Fisheries Management (General) Regulation 1995 (NSW)
JAMBA	Japanese-Australian Migratory Bird Agreement
KTP	Key Threatening Process
MDFRC	Murray-Darling Freshwater Research Centre
MWWG	Murray Wetlands Working Group
NPWS	National Parks and Wildlife Service (NSW)
NPWS Act	National Parks and Wildlife Act 1974 (NSW)
ROKAMBA	Republic of Korea-Australian Migratory Bird Agreement
TSC Act	Threatened Species and Conservation Act 1995 (NSW)

Acknowledgements

The study was funded by the Department of Environment and Climate Change (NSW) as part of the NSW Water Saving projects.

The results of fish surveys were provided by Bernard McCarthy (MDFRC), Prue McGuffie (MDFRC) and Rohan Rehwinkel (MDFRC), reproduced from the drought contingency monitoring of NSW Wetlands project for Euston Lakes. The authors acknowledge assistance of Bernard McCarthy (MDFRC) and Prue McGuffie (MDFRC) for conducting the amphibian surveys and providing invaluable knowledge on the system. Acknowledgment also goes to Rick Webster (Ecosurveys Pty Ltd) for conducting the waterbird and terrestrial bird surveys.

General assessment

Euston Lakes is situated approximately 10 km east of the township of Euston located on the New South Wales side of the Murray River. The lakes system consists of three lakes (Dry, Benanee and Caringay), three creeks (Washpen, Taila and Caringay), the floodplain area surrounding each lake and numerous wetlands and channels located between the lakes and the Murray River, totalling an area of over 1700 ha. For this proposed action of water saving through wetland drying only two lakes and two creeks are considered (Figure 1).

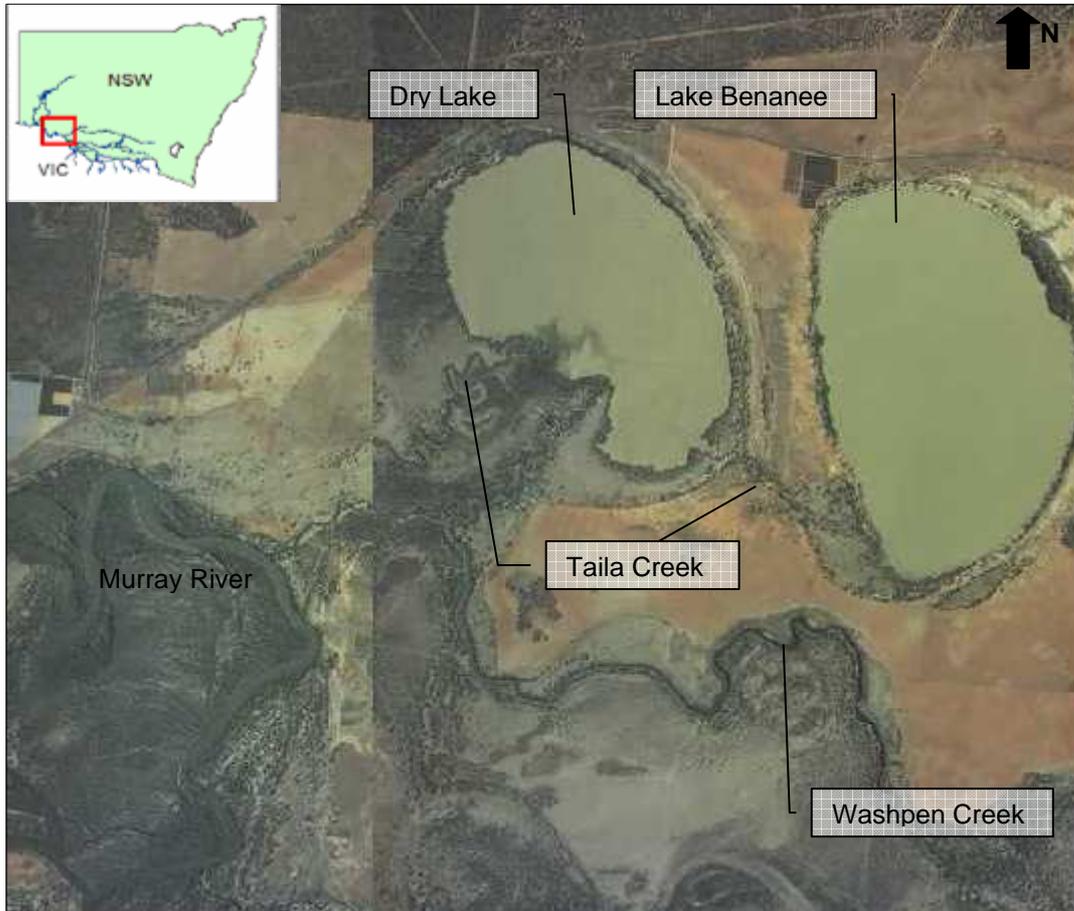


Figure 1. Euston Lakes.

Dry Lake and Lake Benanee, historically ephemeral lakes are connected to the Murray River via Washpen and Taila Creeks, these lakes have been permanently inundated since the establishment of the Euston Weir pool in 1937 (McCarthy et al 2004). Due to constructions of block banks on Caringay Creek and a branch of Washpen Creek, Lake Caringay has not received water flows since the 1960's and has since remained dry (McCarthy et al 2004).

Dry Lake

Dry lake is one of the three lakes that comprise the Euston lake system. The middle sized lake of the three, Dry Lake is approximately 611 hectares in surface area and connects to the Murray River via a 6.2 km section of Taila creek (McCarthy et al. 2004; Gippel & Roberts 2006). Flows from Dry Lake connect to Lake Benanee via an additional 2.6 km section of Taila creek, due to this channel connection Dry Lake responds rapidly to river water level changes compared to Lake Benanee (McCarthy et al. 2004).

The surrounding landscape consists of grazed and irrigated paddocks. The lake bed is dominated by red gum stags and fringed by emergent aquatic macrophytes (e.g. *Typha* spp.).

Lake Benanee

Lake Benanee is a 760 ha wetland connected to the Murray River via Taila and Washpen Creeks, as well as being connected to Dry Lake via a section of Taila Creek (McCarthy et al. 2004). Lake Benanee receives inflows largely west to east from Taila Creek and has a natural sill, which will prevent complete draining (McCarthy et al. 2004). This lake, approximately 2 m in depth near the centre, is the terminal lake for the system, constantly receiving water feeds which is then pumped for stock and domestic supplies.

This lake is located on freehold land with the adjacent land used for stock and irrigation purposes. Lake Benanee is known to be the only locality in NSW to have a community of endangered Swamp she-oak (*Casuarina obesa*) growing along the north-western shoreline (DECC 2005).

Washpen Creek

Washpen creek in surface area is approximately 72.9 ha (Gippel & Roberts 2006) is approximately 14.2 km in length and 40 m in width (McCarthy et al 2004). This creek is a lentic channel which begins at Dry Lake and links to Lake Caringay, although this link with Lake Caringay has been disconnected with a block bank. Due to the Euston Weir pool the creek is permanently inundated along most of its length.

The creek is fringed with River red gum (*Eucalyptus camaldulensis*) and Black box (*E. largiflorens*) communities, emergent aquatic vegetation (e.g. *Typha* sp.) occurs along the channel, with the submerged macrophyte *Vallisneria* sp. clearly dominate within the creek. Coarse woody debris is prevalent in the creek and fringing vegetation area, providing suitable habitat for a variety of fish, bird and amphibian species (e.g. Silver perch, Brown tree creeper., and Spotted marsh frog).

Taila Creek

Taila Creek connects the Murray River to Dry Lake and with an additional section connecting Dry Lake to Lake Benanee. The creek has an approximate surface area of 24.5 ha, a 9 km length and a width ranging from 25-40 m (McCarthy et al 2004). The connection to the Murray River is approximately 14 km upstream of the Euston Weir pool.

A large number of emergent macrophytes (*Typha* sp.) occur along the creek line, with submerged macrophytes (*Vallisneria* sp.) appearing periodically throughout the creek. The riparian vegetation is dominated by River red gums, with woody debris prevalent.

Fauna assessment

Fish and Invertebrates

Fish surveys have been conducted of the Euston lakes system in spring 2006, autumn 2007 (McCarthy et al 2007) and again in spring 2007. From recent surveys conducted by MDFRC in spring 2007, two threatened species, Silver perch *Bidyanus bidyanus* and Murray cod *Maccullochella peelii peelii*, as listed under the FM and EPBC Act were recorded (Table 1).

Significant numbers of Freshwater catfish (*Tandanus tandanus*) were also recorded in Washpen Creek during both surveys, although not listed as threatened in NSW the species is protected from angling in western flowing waters and unlisted dams under the *FM* Regulations, with all catches needing to be returned immediately to the water (DPI 2007a). Due to the reduced distribution and abundance of the Freshwater catfish throughout the Murray River, Morris et al (2001) suggests the conservation status of this specie should be graded as vulnerable under the *FM* Act. As Freshwater catfish are currently not listed under the *FM* Act it is not considered within the 7-part test for threatened fish, however due to Euston Lakes located within the endangered ecological community of the Lower Murray River, it receives a listing as threatened, and therefore any impact the proposed action may have to this specie as apart of the community, needs to be considered.

Table 1. Fish species known or predicted to occur in the Euston Lakes system

Scientific name	Common name	Status
<i>Ambassis agassizii</i>	Olive perchlet (Western population)	EP
<i>Bidyanus bidyanus</i>*	Silver perch	V
<i>Carassius auratus</i> *	Goldfish	I
<i>Craterocephalus fluviatilis</i>	Murray hardyhead	E
<i>Craterocephalus stercusmuscarum fulvus</i>*	Flyspecked hardyhead	N
<i>Cyprinus carpio</i> *	Common carp	I
<i>Gambusia holbrooki</i> *	Gambusia	I
<i>Hypseleotris spp.</i>*	Carp gudgeon	N
<i>Maccullochella peelii peelii</i>*	Murray cod	v
<i>Macquaria australasica</i>	Maquarie perch	V
<i>Macquaria ambigua ambigua</i>*	Golden perch	N
<i>Malanotaenia fluviatilis</i>*	Murray-Darling Rainbow fish	N
<i>Mogurnda adspersa</i>	Purple spotted gudgeon - (Western population)	EP
<i>Nannoperca australis</i>	Southern pygmy perch	V
<i>Nematalosa erebi</i>*	Bony bream	N
<i>Perca fluviatilis</i> *	Redfin perch	I
<i>Philypnodon grandiceps</i>*	Flathead gudgeon	N
<i>Philypnodon sp.</i>*	Dwarf flathead gudgeon	N
<i>Retropinna semoni</i>*	Australian smelt	N
<i>Tandanus tandanus</i>*	Freshwater Catfish	P

* indicate species observed during field survey 2007; Those in bold indicate native species present during recent surveys. (*FM* Act - E = Endangered; EP = Endangered population; V = Vulnerable); (*EBPC* Act - v = vulnerable); N = Native; I = Introduced; P = Protected. Source: DPI 2007b; McCarthy et al 2007.

The former distribution of an endangered invertebrate *Notopala sublineata* (River snail) occurs in the region and potentially may inhabit the Euston Lake system (DPI 2007b).

Amphibians

Five frog species were recorded within the Euston Lakes system, all frogs recorded are common to the region (Table 2). It was observed that most frogs at these lakes appeared to be calling from the connecting Taila Creek system. The endangered Southern bell frog (*Litoria raniformis*) distribution range covers Euston Lakes, although was not observed during recent surveys.

The cool weather on the night of the survey likely resulted in an underestimation of frog abundances. Frogs in the area are known to call in September, however this month is early in

the calling period and due to the cool weather may have influenced calls heard. Few frogs were observed with spotlighting, again likely due to the cool weather.

Table 2. Amphibian species known or predicted to occur in the Euston Lakes system

Scientific name	Common name	Status
<i>Litoria raniformis</i>	Southern bell frog	E/v
<i>Litoria peronii</i> *	Peron's tree frog	P
<i>Limnodynastes tasmaniensis</i> *	Spotted marsh frog	P
<i>Limnodynastes fletcheri</i> *	Barking marsh frog	P
<i>Limnodynastes dumerili</i> *	Eastern banjo frog	P
<i>Crinia parinsignifera</i> *	Eastern sign-bearing froglet	P

* indicate species observed during field survey 2007; TSC Act - E = Endangered; EBPC Act - v = vulnerable; NPWS Act – P = Protected. Source: Atlas of NSW Wildlife 2007; McCarthy et al 2007.

Birds

The presence or absence of waterbirds is not always directly related to the condition of the wetland. If conditions in other wetlands hundreds of kilometres away are favourable, waterbirds may not look for more favourable conditions at other wetlands. Woodland birds, although not dependant on wetlands for their entire life cycle, access to water sources and the condition of suitable habitat, which may be affected by the status of wetlands, is required.

During spring 2007, 62 birds were recorded (Appendix A), of these birds five are listed on either the TSC Act or one of the migratory agreements (Table 3). The region has a distribution range for 30 threatened bird species, and 24 migratory birds have been recorded to visit the wetlands throughout the region (Val et al 2001; DECC 2005; McCarthy et al 2005; Atlas of NSW Wildlife 2007).

Table 3. Bird species known or predicted to occur in the Euston Lakes system

Scientific name	Common name	Status
Waterbirds		
<i>Anseranas semipalmata</i>	Magpie goose	V
<i>Ardea abla</i> *	Great egret	C/J
<i>Ardea ibis</i>	Cattle egret	C/J
<i>Arenaria interpres</i>	Ruddy turnstone	C/J/R
<i>Botaurus poiciloptilus</i>	Australasian bittern	V
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	C/J/R
<i>Calidris canutus</i>	Red knot	C/J/R
<i>Calidris ferruginea</i>	Curlew sandpiper	C/J/R
<i>Calidris melanotos</i>	Pectoral sandpiper	J/R
<i>Calidris subminuta</i>	Long-toed stint	C/J/R
<i>Calidris ruficollis</i>	Red-necked stint	C/J/R
<i>Gallinago hardwickii</i>	Latham's snipe	C/J/R
<i>Grus rubicunda</i>	Brolga	V
<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	C
<i>Hydroprogne capsia</i> *	Caspian tern	C
<i>Limosa lapponica</i>	Bar-tailed godwit	C/J/R
<i>Limosa limosa</i>	Black-tailed godwit	C/J/R V
<i>Oxyura australis</i>	Blue-billed duck	V
<i>Plegadis flectinellus</i>	Glossy ibis	C/M
<i>Pluvialis dominica</i>	Lesser golden plover	C/J
<i>Rostratula benghalensis</i>	Painted snipe (Australian subspecies)	E/v/C
<i>Stictonetta naevosa</i>	Freckled duck	V
<i>Tringa glareola</i>	Wood sandpiper	C/J/R
<i>Tringa hypoleucos</i>	Common sandpiper	C/J/R
<i>Tringa nebularia</i>	Greenshank	C/J/R
<i>Tringa stagnatilis</i>	Marsh sandpiper	C/J/R
Woodland birds		
<i>Apus pacificus</i>	Fork-tailed swift	C/J/R
<i>Ardeotis australis</i>	Australian bustard	E
<i>Burhinus grallarius</i>	Bush stone-curlew	E
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	V
<i>Calyptorhynchus banksii</i>	Red-tailed black cockatoo	V/e
<i>Certhionyx variegatus</i>	Pied honeyeater	V
<i>Chlidonias leucoptera</i>	White-winged black tern	C/J
<i>Cinclosoma castanotus</i>	Chestnut quail-thrush	V
<i>Climacteris picumnus</i> *	Brown treecreeper	V
<i>Drymodes brunneopygia</i>	Southern scrub robin	V
<i>Falco hypoleucos</i>	Grey falcon	V
<i>Glossopsitta porphyrocephala</i>	Purple-crowned lorikeet	V
<i>Hamirostra melanosternon</i>	Black-breasted buzzard	V
<i>Hirundapus caudacutus</i>	White-throated needletail	C/R
<i>Lathamus discolor</i>	Swift parrot	E/ e
<i>Leipoa ocellata</i>	Mallee fowl	E
<i>Lophoictinia isura</i>	Square tailed kite	V
<i>Melanodryas cucullata cucullata</i> *	Hooded robin (south-eastern form)	V
<i>Melithreptus gularis gularis</i>	Black-chinned honeyeater (eastern subspecies)	V
<i>Ninox connivens</i>	Barking owl	V
<i>Pachycephala inornata</i>	Gilbert's whistler	V
<i>Pedionomus torquatus</i>	Plains wanderer	E/v
<i>Polytelis anthopeplus monarchoides</i> *	Regent parrot (eastern subspecies)	E
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned babbler (eastern subspecies)	V
<i>Pyrrholaemus brunneus</i>	Redthroat	V
<i>Stagonopleura guttata</i>	Diamond firetail	V

* indicate species observed during field survey 2007. TSC Act - E = Endangered, V = Vulnerable; EPBC Act - e = endangered, v = vulnerable; C = CAMBA; J = JAMBA; R = ROKAMBA; M = CMS. Source: Val et al 2001; DECC 2005; McCarthy et al 2005; Atlas of NSW Wildlife 2007.

Mammals

Mammals may be considered wetland dependent in the need to access water. With the exception of the water-rat (*Hydromys chrysogaster*), which was observed at Washpen Creek during recent surveys, no mammals known or predicted to occur at Euston Lakes, spend their entire life cycle in wetlands (Table 4).

Table 4. Mammal species known or predicted to occur in the Euston Lakes system

Scientific name	Common name	Status
<i>Cercartetus concinnus</i>	Western pygmy possum	E
<i>Hydromys chrysogaster</i> *	Water-rat	P
<i>Ningauai yvonneae</i>	Southern ningauai	V
<i>Vespadelus baverstocki</i>	Inland forest bat	V

* indicate species observed during field survey 2007. TSC Act - E = Endangered, V = Vulnerable; NPWS Act - P = Protected. Source: Atlas of NSW Wildlife 2007; DEW 2007.

Reptiles

Numerous reptile species occur in the region surrounding Euston Lakes, including three threatened species (Table 5). In recent field visits an Eastern long-necked turtle (*Chelodina longicollis*) was recorded at Washpen Creek, although no threatened species were observed.

Table 5. Reptile species known or predicted to occur in the Euston Lakes system

Scientific name	Common name	Status
<i>Aprasia inaurita</i>	Mallee worm-lizard	E
<i>Chelodina longicollis</i> *	Eastern long-necked turtle	P
<i>Cyclodomorphus melanops elongatus</i>	Mallee slender blue tongue	E
<i>Tiliqua occipitalis</i>	Western blue tongue lizard	V

* indicate species observed during field survey 2007. TSC Act - E = Endangered, V = Vulnerable; NPWS Act – P = Protected. Source: Atlas of NSW Wildlife 2007.

Flora assessment

Over 100 different flora species, terrestrial and aquatic, occur in the Euston Lakes system. Of these only three species are listed as threatened under the TSC Act. An extensive list, but in no terms exhaustive, of flora species recorded to occur within the Euston Lakes region is listed in Appendix A. Although, many of these species are native to Australia they are not listed as protected under the NPWS Act.

Terrestrial vegetation

The riparian area fringing the lakes and creeks are dominated by River red gum and Black box, dead, living and regenerating. The endangered Swamp she-oak (*Casuarina obesa*) and the vulnerable A spear-grass (*Austrostipa metatoris*) as listed under the TSC Act, have been recorded to occur in the fringing vegetation of Lake Benanee (Table 6; DECC 2005; Atlas of NSW Wildlife 2007). Yellow gum has not been recorded directly at Euston Lakes, although historical records indicates it in the region (BioNet 2005; DECC 2005).

Table 6. Terrestrial vegetation known or predicted to occur in the Euston Lakes system

Scientific name	Common Name	Status
<i>Austrostipa metatoris</i>	A spear-grass	V
<i>Casuarina obesa</i>	Swamp she-oak	E
<i>Eucalyptus camaldulensis</i> *	River red gum	N
<i>Eucalyptus largiflorens</i> *	Black box	N
<i>Eucalyptus leucoxylon subsp. pruinosa</i>	Yellow gum	V
<i>Muehlenbeckia sp.</i> *	Lignum	N
<i>Onopordum acanthium</i> *	Scotch thistle	U

* indicate species observed during field survey 2007. TSC Act - E = Endangered, V = Vulnerable; NPWS Act - U = Unprotected; N = Native. Source: BioNet 2005; DECC 2005; Atlas of NSW Wildlife 2007.

Aquatic vegetation

Emerged and submerged macrophytes have been observed and recorded to occur in the channels of the Euston Lake system, with *Typha* sp. and *Vallisneria* sp. dominate (Table 7). No threatened aquatic vegetation species are known to occur within the region.

Table 7. An example of aquatic vegetation observed to occur in the Euston Lakes system

Scientific name	Common name
<i>Azolla sp.</i>	Azolla
<i>Cyperus gymnocaulos</i>	Spiny sedge
<i>Juncus spp.</i>	Rush species
<i>Typha spp.</i>	Cumbungi
<i>Vallisneria spp.</i>	Vallisneria
Filamentous green algae	

Ecological communities

Euston Lakes lie within the distribution range of three endangered ecological communities as listed under the TSC Act, FM Act or EPBC Act (Table 8). The two endangered woodland communities consist of a variety of flora species, although these flora species are not listed as threatened under either the Act. The endangered aquatic community incorporates all native fish and aquatic invertebrates within all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray River below Lake Hume, thus giving these species the protected status of endangered (DPI 2007b).

Table 8. Endangered ecological communities known or predicted to occur at the Euston Lakes system

Ecological community
<i>Acacia loderi</i> Shrublands (TSC Act)
Aquatic ecological community in the natural drainage system of the lower Murray River catchment (FM Act)
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (EPBC Act)

Source: DECC 2005; DEW 2007; DPIb 2007.

Water quality

Water quality parameters were measured at all four sites (Table 9). The electrical conductivity (EC) at Lake Benanee is relatively high but not unusual for this terminal wetland.

Table 9. Water Quality & Levels

	pH	EC (µs/cm)	Temp °C	Dissolved oxygen (mg/L)	Turbidity (NTU)	Water level (m)
Dry Lake	8.25	303	18.7	10.99	393	0.215
L. Benanee	8.5	1120	16.5	9.35	117	0.39
Washpen Ck	7.89	256	16.6	10.46	26	0.28
Taila Creek	8.46	103	17.5	10.9	32	0.23

Sulfidic sediment assessment

The occurrence of sulfidic sediments in inland wetlands is not uncommon. Acid sulfate soils are formed after the soils naturally occurring iron sulfides become exposed to air and oxidise, thus forming sulfuric acid. Sulfidic sediments have potential to cause significant acidification after re-instating a drying and re-wetting phase (Gippel & Roberts 2006). Sulfides in sediments are potentially harmful to aquatic ecosystems and too many aquatic species are toxic (Hall et al. 2006), they can cause the deoxygenation of the water column following sediment resuspension and also pose aesthetic concerns (Lamontagne et al 2006).

Based on findings by Hall et al (2006), Lake Benanee was identified to have a probable risk of containing sulfidic sediments, while Dry Lake was identified at a low risk. The assessment of Washpen and Taila Creeks for sulfidic sediment is still being conducted, due to the permanent inundation of these creeks and preliminary studies the results are not expected to differ from Lake Benanee or Dry Lake.

Lake Benanee after a more detailed assessment, was determined that the lake probably would not undergo acidification if it experienced a draw down. Due to a relatively low net acidity the lake possibly would benefit from a draw down and from sulfidic sediment oxidation.

7-part test

(Environment Planning and Assessment Act 1979 203 Part 1, Section 5A (2))

A 7-part test was conducted for all threatened species, populations and ecological communities listed under the *TSC Act* or *FM Act*, known to either occur in the region, have a known distribution within the region or directly observed within the study area. A total of 43 threatened fauna species and/or populations, three threatened flora species and three ecological communities potentially occur in the region.

Threatened fauna

Forty-three threatened fauna, as listed under the *FM Act*, *TSC Act* and/or *EPBC Act*, have a known, former or predicted distribution range occurring in the region of Euston Lakes. Of these threatened species, populations and/or communities, five have been recorded recently at Euston Lakes.

Fish and Invertebrates

The following factors must be taken into account in making a determination under this section:

- (a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,**

Euston Lakes falls into the former distribution range of five threatened fish species and one endangered invertebrate species (DPI 2007b). Of these threatened fish species, one is listed as endangered (Murray hardyhead), three are listed as vulnerable (Macquarie perch, Southern pygmy perch and Silver perch) under the *FM* Act and two listed as vulnerable (Murray hardyhead and Murray cod) and one as endangered (Macquarie perch) under the *EPBC* Act. During recent surveys two Silver perch species were recorded at Washpen Creek and a Murray Cod at Taila Creek.

Silver perch (*Bidyanus bidyanus*)

Silver perch is a moderate to large freshwater native fish that prefers fast-flowing, open-waters although it will inhabit warm, sluggish water as long as cover is provided by large woody debris and weeds. Distribution occurs in the central Murray River area, downstream of the Yarrowonga weir, on the Edward River and the Murrumbidgee River, however the central Murray population is considered secure and self-sustaining (DPI 2007b). Silver perch have distinct migratory movements, migrating upstream to spawn in spring and summer, this behaviour is believed to be related to providing suitable area for eggs and larvae to float downstream (Morris et al 2001; DECC 2005). Establishing barriers impede the passage of this species into and out of the wetlands and creeks. The management of barriers to allow reconnection between the main river and its tributaries during increased water flows, through opening of regulator gates, will provide opportunities for Silver perch to inhabit the wetland areas. As this species was recorded in the system (Washpen Creek), further monitoring is recommended and the proposed action has the potential to have an adverse effect on this species life cycle.

Murray hardyhead (*Craterocephalus fluviatilis*)

The Murray hardyhead is endemic to the lowland floodplains of the Murray and Murrumbidgee River systems. The species is a highly mobile schooling fish that inhabits open-water, often foraging over very shallow sand and will tolerate temporary or permanently elevated salinity (Ebner et al 2003). The construction of weirs, dams and other infrastructure designed to regulate rivers has been identified as a threat to the species, as it causes fragmented populations and prevents the re-colonisation of areas, possibly impeding spawning migrations and upstream migrations of juveniles (DECC 2005). The Euston Lakes system is not considered an important habitat for this species, therefore the proposed action is unlikely to place this species at risk of extinction.

Macquarie perch (*Macquaria australasica*)

Macquarie perch former distribution was widespread throughout the Murray-Darling Basin, the species natural distribution is now fragmented and consists generally of small discrete populations with the largest natural population occurring in Lake Dartmouth and the Mitta Mitta River (Appleford et al 1998; DECC 2005). This species occurs in a range of habitats, from small upland streams to larger deeper rivers also including lake habitats (Ingram et al 2000; DECC 2005). The Macquarie perch generally migrates from lakes upstream to spawn, with spawning occurring between October and November amongst stones and gravel in riffle areas (DPI 2007b). Therefore any population of Macquarie perch located within the Euston Lakes system may be impacted by any alteration in the flow regime as proposed by this action. Although as the Euston Lake system is not considered significant habitat area for this species, the proposed action is unlikely to have an adverse effect on the status of the Macquarie perch.

Murray cod (*Maccullochella peelii peelii*)

The Murray cod is a large freshwater fish with similar life history strategies as the Trout cod (Koehn & Harrington 2006). The Murray cod diet relies on a few large aquatic prey species (e.g. Silver perch), since regulation of rivers shifts in prey abundance has resulted and a limited diversity and abundance is now available (Ebner 2006). There is little evidence Murray cod use temporary floodplain habits during their life cycle and flooding does not appear to trigger spawning with spawning occurring in a wide range of flow conditions (Koehn & Harrington 2006). A Murray cod was recorded during recent surveys in Taila Creek, the proposed action of disconnecting this creek from the Murray River and manipulating water levels is likely to fragment populations, resulting in an adverse effect on this specie life cycle.

Southern pygmy perch (*Nannoperca australis*)

The decline in populations of Southern pygmy perch is regarded to be an influence of habitat degradation and introduced predatory fish (Ebner et al 2003). Southern pygmy perch is a small fish (~65 – 85 mm) that feeds on epiphytic macroinvertebrates occurring in patches of dense macrophyte growth (Warfe & Barmuta 2004) and is absent from much of the Murrumbidgee and Murray River systems (Ebner et al 2003). The species is now restricted to a number of billabongs and small creeks in the Albury area and also the Murray River near Mildura (Morris et al 2001). It is reasonable to suggest the proposed action is unlikely to have an adverse impact, as long as management of the constructed barriers considers a re-wetting phase when water availability excides a predetermined capacity.

River snail (*Notopala sublineata*)

A freshwater snail once commonly widespread, the River snail is now restricted to the Murray, Murrumbidgee and Darling River drainage systems, often being recorded in artificial environments (e.g. irrigation drain pipes; DPI 2007b). With limited dispersal abilities, fragmentation of habitat through altering flow regimes may have a significant effect on populations (DECC 2005). The River snail is able to avoid dehydration by tightly sealing the aperture with the operculum, however it is unlikely to be able to survive prolonged periods of exposure (Carini et al 2006). As the Euston Lakes system is regarded as an area of former distribution for this specie and as previous surveys have identified the specie to occur more regularly in artificial environments (DPI 2007b), it is reasonable to suggest that the proposal is unlikely to adversely risk local extinction to the species (if present). Management of the barrier to enable the creek to be re-wetted when flows are optimal should be considered, in the event that this specie does inhabit the system.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

The endangered Purple spotted gudgeon – western population (*Mogurnda adspersa*) and Olive perchlet – western population (*Ambassis agassizii*) distribution range covers the area of the Euston Lakes system (DPI 2007b).

Olive perchlet – Western population (*Ambassis agassizii*)

Olive perchlet has reduced in abundance and distribution within its southern range in the Murray-Darling Basin (DPI 2007b). This species is usually found in water with little or no flow, approximately 1 m in depth and near overhanging vegetation, inhabiting creeks, rivers, ponds and swamps (Morris et al 2001; DPI 2007b). The removal of woody debris, thermal pollution, predation by introduced fish and the loss of natural flow regimes appears to be the reason this species is declining (DPI 2007b). The proposed action potentially may have an impact on any populations (if present) in the system, although a wetting/drying cycle in the long term possibly will provide benefits in habitat health and abundance of prey.

Purple spotted gudgeon - Western population (*Mogurnda adspersa*)

Formerly distributed throughout the entire Murray-Darling drainage system, western populations of the Purple spotted gudgeon are now extremely rare in inland NSW (Morris et al 2001; DECC 2005). The decline of this specie has been correlated with the invasion of Mosquito fish, habitat destruction and loss of macrophytes (Morris et al 2001). The species prefers slow-moving or still waters of rivers, creeks and billabongs, often areas with weeds, rocks or snags (DPI 2007b). Euston Lakes is not considered an important habitat for this species, therefore the proposed action is unlikely to place this species at risk of extinction. Management of the barrier to enable the creek to be re-wetted when flows are optimal should be considered, in the event that this specie does inhabit the system.

- (c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
 - (ii) is likely too substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

Aquatic ecological community in the natural drainage system of the Lower Murray River Catchment

This community includes all native fish and aquatic invertebrates within all natural creeks, rivers, and associated lagoons, billabongs and lakes of the regulated Murray River below Lake Hume. The area of this endangered ecological community which would be affected by this proposal is small, this area suffers degradation already due to the alteration in natural flow regimes as a result of river regulation and drought conditions. The management of the proposed barrier to allow for drying and wetting phases has the potential to benefit many aquatic organisms within the system, however as the system is one wetland out of many being assessed for similar proposals, any alteration to the hydrological cycle is likely to have an adverse impact on the local occurrence of this community. As long as barriers are managed to allow the creek to re-wet, improvement to the wetland area is expected to offset any initial impact on the creek, it is reasonable to suggest this proposed action is unlikely to have an adverse effect on the community and may potentially in the long-term benefit habitat that requires a drying and wetting phase.

The protected Freshwater Catfish has been recorded to occur in Washpen Creek during recent surveys, even though this species is not listed on the *FM Act*, it is classed as endangered as part of the ecological community. Further monitoring to determine the impacts this proposed action may have on this specie is recommended.

- (d) in relation to the habitat of a threatened species, population or ecological community:**
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,**

Disturbance is a defining factor of many wetlands, the development of barriers (e.g. regulators and block-banks) across permanent or intermittent water ways obstructs fish migrations, fragment populations and prevents access to spawning and feeding habitats, altering the structure of the wetland. The proposed action is likely to remove and modify exiting habitats, fragmenting and isolating these habitats from other areas. Water level fluctuations,

specifically drying out of a wetland, can have an impact on the abundance and structure of fish communities, causing high mortality as fish become stranded in drying wetlands. After a dry down period, there is a risk of exotic fish, e.g. Mosquito fish, dominating the wetland as this species is quick to recover following a drought and is better suited to surviving poor water quality conditions than most native fish.

Current drought conditions potentially may impact on habitat conditions naturally, the installation of a barrier provides an opportunity for the creek to be managed to allow drying and wetting phases, regimes that mimic natural and/or seasonal cycles. The wetting phase will also provide opportunities for habitat areas to be reconnected to other areas providing passage way for migration and dispersal patterns.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No areas of critical habitat occur in the area.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Recovery plans have been established for two threatened species, Silver perch and the endangered invertebrate River snail.

Silver perch – Further research is required to determine the ecological needs of the Silver perch's life cycle and levels of flow required. The action proposed needs to consider the improvement of fish passage through appropriate designs of new structures and construction of fishways to allow for Silver perch to migrate, as barriers limit or prevent access to upstream habitats. It can be considered the proposal to be consistent with the objectives of the recovery plan, as long as a managed regulator is constructed allowing wetting phases during important migration periods.

River snail – Further research is required to locate and protect populations of the species in natural habitats and to increase the understanding of the species habitat requirements, ecology and key threats. If management of the proposed action considers a re-wetting phase, the works can be considered consistent with the objectives of the recovery plan.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

From the seven KTP determined under the *FM* Act, four are considered to be the most relevant to the current proposal.

Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams

Prior to regulation the Murray River experienced periods of high and low water flows, these flows have important ecological functions that native flora and fauna have adapted to. Regulation has altered these flows, resulting in changes in size of flows, seasonality of flow patterns, timing, variability, frequency and duration of floods. Altered natural flow regimes may also affect the availability and quality of suitable habitat for many species. Allowing wetlands to experience a wetting and drying regime has the potential to improve the quality of habitat areas and trigger spawning for many aquatic species. As long as management in the removal or opening of barriers allowing the creek to re-wet, improvement to the wetland area is expected to offset any initial impact on the creek, therefore providing opportunities for native fish to migrate into newly established habitat areas.

Degradation of native riparian vegetation along New South Wales water courses

The need to clear any native vegetation on this site is considered small. The proposed action is unlikely to have a significant impact in this respect because of the small area to be affected.

If the clearing of vegetation is required consideration to revegetating disturbed areas is recommended.

Removal of large woody debris from New South Wales Rivers and streams

Any removal of woody debris will reduce the availability of shelter and foraging habitat for populations of threatened species. It is not expected that removal of large woody debris will have an affect as a result of the proposal, as any removal will be small and would only be removed to allow suitable access to the site for any construction purposes. The removal of woody debris can be elevated by realigning within the lagoon or fringing vegetation therefore maintaining these important habitat areas. Due to the small area that would be affected the proposed action is unlikely to have a significant threat.

Predation by *Gambusia holbrooki* Girard, 1859 (Plague Minnow or Mosquito Fish)

Mosquito fish have been recorded at two of the four sites during the recent survey. Mosquito fish are thought to have adverse impacts on frog larvae and eggs (NPWS 2003) and have been linked to the possible decline of some native fish (e.g. Murray hardyhead and Purple spotted gudgeon; Morris et al 2001; NPWS 2003). Due to the species ability to tolerate a range of conditions and a short generation time compared to native fish, on removal or opening of the barrier and re-wetting the creek there may incur an increase in numbers of Mosquito fish that may impact on the ability of native fish species to recolonise.

Amphibians

The following factors must be taken into account in making a determination under this section:

- (a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,**

One endangered amphibian species has a known distribution range that incorporates the Euston Lake system (Atlas of NSW Wildlife 2007), this specie was not recorded during recent surveys.

Southern bell frog (*Litoria raniformis*)

The southern bell frog *Litoria raniformis*, a species known to the region, was not sampled at the Euston Lakes system during spring 2007. This species is listed as Endangered under the NSW TSC Act and Vulnerable nationally under the EPBC Act. At the Euston Lakes system, the abundant vegetation cover including the emergent cumbungi *Typha orientalis*, still/slow-flowing water and habitat of shallow water provide ideal habitat for the southern bell frog (DEW 2007). This specie prefers low-lying temperate inundated areas or natural temporary floodplain channels (Conallin et al 2003). Predation from fish (e.g. Mosquito fish) is a major threat to this specie, other threats include the regulation of rivers causing reduced flooding frequency, loss and degradation of wetlands from over-grazing and permanent inundation (Conallin et al 2003). Flooding or a significant rise in water levels triggers breeding in the warmer months for this species, with breeding occurring in still or slow moving water, while outside breeding periods the animals have been known to disperse away from water, using ground debris (e.g. fallen timber, rocks, bark etc) to shelter beneath (DECC 2005). Altering natural flooding regimes, degradation of aquatic and/or terrestrial habitat are considered threatening processes for this species. Therefore the proposed action is likely to have an effect on the life cycle of this specie (if present), although can be managed if a re-wetting phase is initiated when surplus water becomes available and monitoring of habitat health surrounding the wetlands is undertaken.

- (b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the**

endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

No endangered populations of amphibians have been recorded within the region.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

No amphibians are listed as an ecological community in the region.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

The draining of wetlands, altered flow regimes and prolonged periods of drought causing the loss or fragmentation of habitats is considered a threat to the survival of this endangered frog species (DECC 2005). The proposed action is likely to fragment and isolate habitat areas as is the current drought conditions. This species is able to traverse across terrestrial zones to alternate aquatic zones, therefore as long as alternate wetlands continue to exist in the vicinity of the lake system and a re-wetting phase is initiated when appropriate, the long-term survival of these species is unlikely to be posed at risk of extinction.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No designated areas of critical habitat occur in the area.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Southern bell frog

An objective of the recovery plan is to alleviate any current threats to the Southern bell frog (DECC 2005). The draining of wetlands has been identified as a threat to this species, therefore the proposed action can be considered not consistent with the objectives of the recovery plan.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Of the 30 KTP listed under the TSC Act and seven under the FM Act, four need to be considered. The main KTP is the alteration to natural flow regimes and to a lesser extent the removal of dead wood and trees, the clearing of native vegetation and predation by Mosquito fish.

Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams

The proposed actions will alter current flow regimes however, as the creeks are connected to the Murray River, which is a regulated river, these current flow regimes are not considered the natural flow. Periods of high flow are just as important as a drying phase, although the failure of an adequate inflow of water into a wetland after a drying process may fail to provide connectivity between rivers, floodplains and other wetlands, preventing the drought-recovery process of aquatic organisms. This failure of adequate inflow of water can effect the re-establishment of aquatic vegetation and macroinvertebrates, which are important in the life cycle of amphibians. Therefore, as long as in times when surplus water flows are available the wetlands are provided with an opportunity to re-wet, the impact of this process is unlikely to increase and potentially may benefit the wetlands and amphibian species.

Removal of dead wood and dead trees

It is not expected the requirement for removal of dead wood or trees will occur as a result of gaining access to the lake system. Any dead wood that requires removal can be realigned within the creek or riparian zones to maintain habitat areas. This realignment is considered to be small and is therefore unlikely to increase the impact of this process.

Clearing of native vegetation

The clearing of native vegetation understorey and groundcover can remove the availability of shelter and refuge area for amphibians. The area of native vegetation that is likely to be removed due to any construction and access requirements on this site is very small. The proposed action is unlikely to have a significant impact in respect to the small area being disturbed and revegetating disturbed areas should be considered.

Predation by *Gambusia holbrooki* Girard, 1859 (Mosquito Fish)

Mosquito fish are known to prey on amphibian populations (Conallin et al 2003; DECC 2005) and have been recorded in the lake system. An increased threat of predation by these species possibly could result during the re-wetting phase, as Mosquito fish are able to establish populations in areas of poor water quality and tolerate a range of conditions. Monitoring the establishment of this predatory fish is recommended to elevate any threat to amphibian populations.

Waterbirds

The following factors must be taken into account in making a determination under this section:

- (a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,**

Seven threatened water birds have a known distribution range that incorporates the Euston Lake system. Of these threatened water birds none were observed during recent field trips.

Magpie goose (*Anseranas semipalmata*)

The breeding season for the vulnerable Magpie goose is dependant on the depth of water and density and height of aquatic vegetation, breeding is stimulated by rainfall and flooding (Firth & Davies 1961) and is unlikely to occur in south-eastern Australia (DECC 2005). Habitat preference is for shallow wetlands with dense growth of rushes and sedges although can be found grazing on land in terrestrial habitats (DECC 2005). Magpie geese nests on floating or attached to macrophytes (Leslie 2001) and will travel hundreds of kilometres during dry seasons to perennial swamps (Garnett & Cowley 2000). The drainage of wetlands appears to

be a major threat to the survival of this species as is modification and degradation of habitat areas, including the invasion of environmental weeds (Garnett & Cowley 2000; DECC 2005). The Euston Lakes system is not considered a significant habitat area and the species is unlikely to breed in the area, it is reasonable to suggest no adverse impact from the proposal will occur.

Australasian bittern (*Botaurus poiciloptilus*)

The vulnerable Australasian bittern is a large stocky highly nomadic bird that favours permanent freshwater wetlands dominated with tall, dense vegetation. Distribution occurs from south Queensland to Tasmania and south eastern South Australia including most of NSW and Victoria (DECC 2005). This species hides during the day amongst dense reeds or rushes, building nests in secluded places of densely vegetated wetlands (Recher et al 1983; DECC 2005). Threats to this species have been identified to include the drainage of wetlands, reduced water quality due to siltation, pollution and salinity, grazing and associated frequent burning of wetland areas (DECC 2005). Due to this species nomadic tendency and as long as other drought refuge areas continue to exist within the region, this species is unlikely to be adversely effected by the proposed action.

Brolga (*Grus rubicunda*)

The Brolga is one of Australia's largest flying birds with a sparse distribution across the southern part of Australia, listed as vulnerable in NSW yet still abundant in the northern tropics (DECC 2005). This species is dependant on wetlands, nesting on islands or in the water, although often feeds in dry grassland or ploughed paddocks, nesting on mounds in shallow waters (Leslie 2001; DECC 2005). Euston Lakes is not considered significant habitat area for the Brolga, it is therefore reasonable to suggest the proposed action is unlikely to have an adverse impact.

Black-tailed godwit (*Limosa limosa*)

Distribution for Black-tailed godwits includes coastal and inland wetlands, spending non-breeding seasons (August-February) in the region between Thailand and Australia (Watkins 1993; Barter 2002). This migratory wading bird breeds in Asia and Europe and is primarily a coastal species (Watkins 1993; Barter 2002; DECC 2005; DEW 2007). Preferred habitat is coastal sandy shores, mudflats and marshes, although is often found inland in small numbers on mudflats and in water less than 10 cm deep (Val et al 2001; DECC 2005; DEW 2007). Threats to the Black-tailed godwit include clearing of habitat and hydrological changes to inland lakes and estuaries, as these changes may modify or remove important areas of suitable habitat (DECC 2005). The lowering of water levels revealing mudflats around Euston Lakes, potentially may provide suitable habitat area for Black-tailed godwits, therefore the proposed action is unlikely to have an adverse effect on the species and maybe beneficial.

Blue-billed duck (*Oxyura australis*)

The Blue-billed duck regionally and seasonally is nomadic outside of the breeding season, is endemic to south-eastern and south-western Australia favouring deep, permanent well vegetated freshwater swamps especially those with beds of cumbungi (DECC 2005). This vulnerable species is completely aquatic and feeds in permanent freshwater zones in clear water, where there is an absence of turbulence and the substrate is firmer, while breeding occurs in the secluded dense vegetation structure, generally over water, between September and February (DECC 2005). Loss of habitat associated with changes in flow regimes has been identified to be a threat to the survival of this species. The proposed action of lowering water levels is likely to have an adverse effect on this species life cycle, due to its aquatic life cycle and habitat preference of large permanent wetlands and swamps with dense macrophytes. Establishment of drought refuge areas and management of re-wetting or increasing flows to the wetlands (when surplus water is available) may decrease any initial impact.

Painted snip – Australian subspecies (*Rostratula benghalensis*)

The Painted snipe is a small freshwater wader, preferring the fringes of swamps, dams and marshy areas, areas where there is a cover of grasses, lignums, low scrub or open timber (DECC 2005). This specie distribution is most common in the Murray-Darling Basin although was not observed during this assessment. Threats to this specie include the drainage of wetlands or diversion of water from rivers, resulting in wetlands not becoming shallow (Garnett & Crowley 2000). It is likely any drying of the wetland may have an impact on the Painted snipe. The impact from fluctuating water levels possibly may be beneficial, exposing foraging mudflat and shallow water areas. Monitoring of the system to maintain adequate water levels is recommended, as is the management of alternate drought refuge areas in the region.

Freckled duck (*Stictonetta naevosa*)

Freckled duck is a vulnerable waterbird that prefers to inhabit permanent freshwater swamps and creeks with heavy growth of cumbungi species (DECC 2005). The species breeds in large temporary swamps and is forced to disperse during extensive inland droughts to more permanent waters such as lakes and reservoirs (DECC 2005). The species is dependant on water as part of its life cycle, nesting usually in dense vegetation at or near the water level (DECC 2005). The proposed action of drying wetlands and altering flood patterns is considered a threat to populations of Freckled ducks. Therefore the proposed action is likely to impact the life cycle of any present populations of this specie.

- (b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,**

No endangered populations of waterbirds have been recorded at Euston Lakes.

- (c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
 - (ii) is likely too substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

No waterbirds recorded at Euston Lakes are listed as part of an ecological community.

- (d) in relation to the habitat of a threatened species, population or ecological community:**
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,**

The proposed action potentially may cause destruction or degradation of suitable breeding habitat through the drying of the lake system, resulting in loss of aquatic vegetation structure, in particular the loss of tall dense wetland vegetation that is used for nesting, foraging and shelter. Fragmentation or isolation of habitat from other areas can be caused during the drying phase, this may also alter the physicochemical conditions of the wetland with organic matter and sediments accumulating in pools as flows have ceased and organic matter

transport has stopped. The lowering of water levels has the potential to benefit species that rely on shallow water and mud flats for feeding. As the lake system historically is an ephemeral wetland, drying and re-wetting (when water surplus becomes available) the system in the long term is likely to be beneficial for water bird populations in the region, as long as for the short term drought refuge sites are retained in the region.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

There is no critical habitat recorded in the designated area.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Recovery plans have not been prepared for these threatened waterbirds.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The alteration to the natural flow regime of the system is the main KTP considered in relation to waterbirds and the action proposed. The clearing of native vegetation and woody debris is less relevant to the proposed action although still requires consideration.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

The process of drying Euston Lakes as part of water saving will alter current flow regimes however, as the system is historically an ephemeral system and flows are controlled by the Euston Weir, the current flow regimes are not considered natural flows. Periods of high flow are just as important as a drying phase, although the failure of an adequate inflow of water into a wetland after a drying process may fail to provide connectivity between rivers, floodplains and other wetlands, preventing the drought-recovery process of aquatic organisms.

Clearing of native vegetation

In undertaking the upgrade, construction and maintenance of barriers to prevent water flowing into the system, care needs to be taken if clearing of native vegetation is required. It is predicted that a relatively small amount of vegetation may need to be cleared in order to install the barriers, however it is important to consider avoiding removal or destruction of any native vegetation and revegetating any disturbed areas.

Removal of dead wood and dead trees

It is not expected that removal of large woody debris will have an affect as a result of the proposal, as any removal is considered to be small and would only need to be removed to allow suitable access to the site for construction and maintenance purposes. Any dead wood that requires removal can be realigned within the creek or riparian zones to maintain habitat areas. The need for this realignment is considered to cover a small area and therefore the proposed action is unlikely to increase the impact of this key threatening process.

Woodland birds

The following factors must be taken into account in making a determination under this section:

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Within the region a diversity of woodland birds occur, it is reasonable to suggest that not all of these birds inhabit in the vegetation directly fringing the Euston Lakes system, additionally within the total landscape an extensive area of suitable habitat for woodland birds does exist. Twenty three threatened woodland birds have a known distribution range within the Euston Lakes region, six endangered and 17 vulnerable. Three threatened woodland birds were observed during recent surveys.

Australian bustard (*Ardeotis australis*)

A very large, heavy bodied ground dwelling bird, the Australian bustard mainly occurs inland and is still observed on the Riverina plains (DECC 2005). This specie forages on insects, young birds, lizards, seeds and fruits, mainly inhabiting tussocks and hummock grasslands, occasionally found in pastoral and cropping areas (DECC 2005). As this specie is not directly dependant on wetlands for parts of its life cycle and as other water sources are in the near vicinity, the proposed action is unlikely to place this specie at risk of extinction.

Bush stone-curlew (*Burhinus grallarius*)

This endangered woodland bird inhabits open forests and woodlands with sparse grassy ground layer and woody debris (DECC 2005). Bush stone-curlews are largely a nocturnal bird who feed on insects and small vertebrates (DECC 2005). The Bush stone-curlew is not dependant on wetlands for parts of its life cycle and it is therefore reasonable to consider the proposed action is unlikely to pose a risk of extinction for this specie, as long as other water sources remain in the vicinity.

Major Mitchell's cockatoo (*Cacatua leadbeateri*)

Major Mitchell's cockatoos nest in shallow high tree hollows, feed mostly on the ground and inhabit a wide range of inland habitats, always within easy reach of water (Rowley & Chapman 1991; DECC 2005). This specie survives dry times by enduring, perhaps foregoing breeding and depending on a wide knowledge of specialised foods and watering places (Rowley & Chapman 1991). As long as drought refuge areas remain in the region the proposed action is unlikely to pose a risk.

Red-tailed black cockatoo (*Calyptorhynchus banksii*)

Red-tailed black cockatoo is the most widespread of all black-cockatoos and inhabits a variety of habitats, including riparian vegetation (DECC 2005). This specie is highly selective with its diet with a main food of seeds from stringybark trees and in summer the fruits of Buloke trees (Maron & Lill 2004). The loss of Buloke woodlands is thought to be a major factor threatening the decline of this species, as is the removal of hollow-bearing trees and clearing of riparian areas (Maron & Lill 2004; DECC 2005). As clearing and removal of vegetation is not a requirement of this proposal, it is unlikely to have an adverse impact on the species life cycle.

Pied honeyeater (*Certhionyx variegatus*)

The Pied honeyeater is a nomadic species that inhabits wattle shrub, mallee, spinifex and eucalypt woodlands, following the erratic flowering of shrubs (DECC 2005; Burbidge & Fuller 2007). Due to this species mobility, the close proximity of other water sources and as the specie is not dependant on wetlands for parts of its life cycle, the proposed action is unlikely to pose a risk.

Chestnut quail-thrush (*Cinlosoma castanotus*)

This vulnerable species has a scattered distribution throughout NSW, which includes Euston, occurring in a wide range of arid and semi-arid habitats (DECC 2005). Chestnut quail-thrush's forage on the ground on invertebrates, seeds and some berries, preferring mallee and Acacia scrub vegetation (Garnett & Crowley 2000; DECC 2005). Fragmentation and degradation of habitat as a result from inappropriate grazing or fire regimes and clearing of vegetation are threats to this specie (DECC 2005). As this specie is not directly dependant on wetlands for parts of its life cycle and as long as other watering sources remain in the region and the

proposed action does not degrade surrounding habitat areas, it is unlikely to have an adverse impact.

Brown treecreeper (*Climacteris picumnus*)

Brown treecreepers prefer woodlands with an open understorey and generally require an area of at least 200 ha of suitable habitat (Doerr et al 2006). Specialising in foraging on fallen timber and tree trunks for insects and nesting in tree hollows, this species requires connectivity between terrestrial habitat remnants for its ability to disperse (MacNally 2006). This species was recorded at all four wetland sites during recent surveys. Due to the species large home range and the provision of alternative watering points in the vicinity of the Euston Lakes system, and as long as surrounding habitat is maintained, the proposed action is unlikely to adversely affect the Brown treecreepers life cycle.

Southern scrub robin (*Drymodes brunneopygia*)

A ground-dwelling bird, the Southern scrub robin inhabits mallee and acacia scrub, particular areas with a dense understorey of shrubs (Brooker et al 2001; DECC 2005). This species forages at the base of mallee trees and on ground beneath shrubs for litter and ground dwelling invertebrates, with a major diet component being the arthropod communities (Garnett & Crowley 2000; Brooker et al 2001; DECC 2005). Southern scrub robins build their cup-shaped nests of twigs, bark and grass usually concealed in the shelter of a tree, shrub or fallen branch (Brooker et al 2001; DECC 2005). Threats include grazing and an increase in weeds that may disturb the litter and soil layer, altering the composition of the arthropod communities (Garnett & Crowley 2000; Brooker et al 2001). It is unlikely the proposed action will pose a threat to the life cycle of the Southern scrub robin.

Grey falcon (*Falco hypoleucos*)

This species is sparsely distributed throughout NSW and is predominantly found in the Murray-Darling Basin (DECC 2005). The Grey falcon usually is restricted to shrublands, grasslands and wooded watercourses of arid and semi-arid regions, although has been recorded to occur near wetlands (DECC 2005). As this species usually nests near water there is the potential the proposed action will pose a risk to this species life cycle, however as other water courses occur locally, the proposed action is unlikely to pose a risk of extinction.

Purple crowned lorikeet (*Glossopsitta porphyrocephala*)

This species is most often seen in grey box and white box woodlands in the Riverina region and occasionally along the Murray valley (DECC 2005). This species has a nomadic pattern of distribution, according to eucalypt flowering conditions, influencing breeding where there is a good supply of nectar and tree hollows (Hopper & Burbidge 1979; DECC 2005). Threats to this species includes the loss of hollows, that are used for nesting and loss of large flowering eucalypts (DECC 2005). It is unlikely the proposed action will pose a threat to populations of the Purple crowned lorikeet (if present).

Black breasted buzzard (*Hamirostra melanosternon*)

Black breasted buzzards are one of Australia's largest birds of prey with a sparse distribution in areas of less than 500 mm rainfall in a range of inland habitats, especially timbered watercourse, while avoiding desert areas (DECC 2005). This species hunts over grasslands and sparsely timbered woodlands with a diet mostly of reptiles, small mammals and birds, specialising in large eggs (Aumann 1990; DECC 2005). It is unlikely the proposed action will pose a risk to this species life cycle.

Swift parrot (*Lathamus discolor*)

This small parrot breeds in Tasmania during spring and summer then migrates to the Australian mainland for the cooler months (Hingston et al 2004; DECC 2005). Swift parrots are specialist nectar and pollen-feeders, who return to foraging sites on a cyclic basis (Hingston et al 2004; DECC 2005). Due to this species mobility and as long as other habitat

and water sources are retained in the vicinity, the species is unlikely to be adversely impacted by this proposed action.

Mallee fowl (*Leipoa ocellata*)

Malleefowl is a ground dwelling bird, found predominantly in mallee shrubland, inhabiting areas with light sandy soil, dense mallee canopy, with a dense and diverse shrub layer and in rainfall areas with 300-450 mm mean annual (Garnett & Crowley 2000; DECC 2005). Home range may vary from 50 to 500 ha, preferring areas within five or more years of fire (DECC 2005). The major effects threatening this species life cycle includes clearing of vegetation resulting in fragmentation and isolation of populations and too frequent burns, as the species requires areas of mallee that have not been burnt for long periods of time (Garnett & Crowley 2000; Val et al 2001). It is unlikely the proposed action will adversely effect this specie life cycle.

Square-tailed kite (*Lophoictinia isura*)

Square-tailed kites have a scattered distribution which includes areas along major west-flowing river systems. The specie inhabits a variety of timbered habitats with a preference for timbered watercourses (DECC 2005). Square-tailed kite is a specialist hunter, taking small birds and their eggs and nestlings from the canopy, with a hunting range of more than 100km² (Garnett & Crowley 2000; DECC 2005). The long-term impact of health to vegetation fringing the creeks possibly may have an impact on suitable habitat for this specie, although due to this species mobility and the availability of alternate water sources, the proposed action is unlikely to have an adverse impact.

Hooded robin - south-eastern form (*Melanodryas cucullata cucullata*)

The Hooded robin is considered a sedentary specie although has been known to have local seasonal movements, with a home range varying from 10 to 30 ha during breeding and non-breeding seasons (DECC 2005). This specie prefers lightly wooded areas featuring mature eucalypts, saplings, some small shrubs and a ground layer of native grasses (DECC 2005). This specie was recorded to occur at Taila Creek, as long as disturbance to habitat area surrounding the creek is monitored and reduced, it is reasonable to suggest the proposed action will not pose an adverse risk to this specie.

Black-chinned honeyeater – eastern subspecies (*Melithreptus gularis*)

This largely nomadic bird prefers to inhabit drier open forests or woodlands dominated by Box and Ironbark Eucalypt species (Garnett & Crowley 2000; DECC 2005). The specie appears to be susceptible to fragmentation of terrestrial vegetation, being rarely discovered in small remnants. Due to the mobility of this species and as the proposed action is not designed to remove vegetation, fragmentation should not occur. It is therefore unlikely the proposed action will place the specie at a risk of extinction.

Barking owl (*Ninox connivens*)

A nocturnal bird, Barking owls roost in tree hollows during the day, generally along creek lines with a dense understorey or in the canopy of trees with dense foliage, having a large home range (DECC 2005). Barking owls occur primarily in dry sclerophyll woodlands, particularly areas associated with riparian vegetation (Garnett & Crowley 2000). Given the mobility of this species and the extent of suitable habitat within the region, the action proposed is considered unlikely to adversely affect the life cycle of the specie.

Gilbert's whistler (*Pachycephala inornata*)

Gilbert's whistler inhabits a variety of areas occurring in ranges, plains, foothills, arid and semi-arid timbered habitats, mostly found in mallee shrubland and occasionally in Belah woodlands and River red gum forests that have a dense understorey of shrubs (DECC 2005). Prickly plants, such as acacias that are taller then 2 m, are required for this specie to build its nest (DECC 2005). Gilbert's whistler do not make any regular large-scale movements, a pair will hold and defend a territory all year round and after fledging, young disperse beyond this

defended territory (DECC 2005). Threats to the status of this specie includes grazing, high fire frequency, clearing and fragmentation of suitable habitat areas (DECC 2005). As long as surrounding habitat is not degraded by this proposed action, it is unlikely to pose a risk to this specie.

Plains-wanderer (*Pedionomus torquatus*)

The Lower Murray-Darling region is not considered a core distribution area for this specie, although the specie may occur here (Val et al 2001). Preferred habitat areas are sparse native grasslands where structure is more important than species composition, with cover of plant heights ranging from 2-10 cm (Val et al 2001; DECC 2005). This ground dwelling specie has a home range of 12-18 ha (DECC 2005). Threats include grazing, drought, cultivation and pasture improvement, predation by foxes, use of pesticides and fire (DECC 2005). It is unlikely the proposed action will impede any populations of this specie, if present.

Regent parrot - eastern subspecies (*Polytelis anthopeplus monarchoides*)

River red gum forests with suitable hollow-bearing trees are significant habitat areas for Regent parrots along the Murray River, as long as mallee foraging habitat is within 20 km (Law & Dickman 1998; Garnett & Crowley 2000). Disturbances to either of these habitats can affect the species life cycle, with the major threats relating to clearing of either mallee or suitable River red gum nest trees, including preventing regeneration of these habitats through logging, increased salinity and water logging (Garnett & Crowley 2000). Two sightings of Regent parrots occurred at Taila Creek during recent surveys. This proposed action is unlikely to affect the Regent parrots lifecycle, although continuous monitoring of the health of riparian areas where red gums exist is recommended.

Grey-crowned babbler - eastern subspecies (*Pomatostomus temporalis temporalis*)

The Grey-crowned babbler is the largest Australian babbler and inhabits open Box-Gum woodlands on the western slopes of the Great Dividing Range and Box-Cypress pine and Open Box woodlands on the western plains (DECC 2005). This specie has a home range of approximately 10 ha and requires connectivity between remnants, due to an inability to cross large open areas (DECC 2005). The proposed action is unlikely to affect this species life cycle.

Redthroat (*Pyrrholaemus brunneus*)

A sedentary bird specie with no known large scale seasonal movements, Redthroats inhabit acacia and chenopod shrublands, especially along watercourses or drainage lines (Garnett & Crowley 2001; DEC 2005). Threats include the clearing of suitable habitat areas and overgrazing by herbivores, which degrades and prevents regeneration of habitat areas (Garnett & Crowley 2001; DEC 2005). It is unlikely the proposed action will impede this specie lifestyle as long as suitable habitat is maintained along alternative watercourses or drainage lines within the region.

Diamond firetail (*Stagonopleura guttata*)

Diamond firetails are usually found in grassy woodlands although they will also inhabit open forests, riparian areas and sometimes in lightly wooded farmland areas with a grassy groundcover (DECC 2005). The species has been known to nest in mistletoe although, more commonly nesting in the dense foliage of a tree or shrub, yet they feed mostly on grass species exclusively on the ground (Cooney & Watson 2005; DECC 2005). As the proposed action does not directly anticipate clearing or fragmenting any native terrestrial vegetation, also as other suitable habitat occurs in the nearby area, it is unlikely any populations of Diamond firetails will be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

There are no endangered woodland bird populations known to occur at Euston Lakes.

- (c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
 - (ii) is likely too substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

No woodland birds at Euston Lakes are listed as an endangered or critically endangered ecological community.

- (d) in relation to the habitat of a threatened species, population or ecological community:**
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,**

The habitat which is expected to be removed, modified, isolated or fragmented by this proposed action relates to aquatic habitats rather than terrestrial habitats. As woodland birds inhabit terrestrial habitats and have not been recorded to directly be dependant on wetlands for all parts of their life cycles and as long as alternative watering points are in the near vicinity, it is not expected that the proposed action will impact on the habitat of these threatened woodland birds. Providing when surplus water flows become available, barriers are removed or open to allow the wetlands to refill.

- (e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),**

No critical habitat is designated at Euston Lakes for woodland birds.

- (f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,**

Currently to date there are three woodland birds listed within the Euston Lakes system that have a recovery or draft recovery plan, Bush stone-curlew, Barking owl and Plains-wanderer.

Bush stone-curlew - The proposed action does not include the requirement to clear native vegetation and any removal of dead wood can be realigned within the landscape. Therefore the action proposed can be considered consistent with the objectives of the recovery plan.

Barking owl - A draft recovery plan has been prepared for the Barking owl identifying the major threats include the loss of hollow-bearing trees through clearing and degradation of habitat and too frequent fires (DECC 2005). As the proposed action does not aim to clear or remove any potential suitable habitat and due to the mobility of the specie, being able to exploit resources from both local and distant water bodies, the proposed action is considered consistent with the objectives of this draft recovery plan.

Plains-wanderer – Objectives of the draft recovery plan include maintaining and enhancing the extent of suitable habitat and controlling threatening processes. The proposed action does not have a requirement to clear large areas of native vegetation and as the area is not

considered significant habitat area for the Plains-wanderer the proposal can be considered consistent with the objectives of the recovery plan.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are 30 KTP currently listed under the TSC Act, one of these processes (alteration to the natural flow regimes) is considered in relation to the proposed action, while another two processes (clearing native vegetation and removal of woody debris) are mentioned as a possibility of having an impact.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

Alteration to the natural flow regimes can occur through reducing or increasing water flows, alternating seasonal flow patterns, changing the frequency, timing, magnitude, variability and duration of flow, these flows have important ecological functions that native flora and fauna have adapted to. Altered natural flow regimes may also affect the availability and quality of suitable habitat for many species. Woodland birds are able to tolerate fluctuating water levels, as long as this fluctuation does not affect food abundance, degrade habitat availability and alternate water sources are nearby.

Clearing of native vegetation

The clearing of any native vegetation on this site is considered small, the only need to clear would be to allow for suitable access to the creek or lake for any construction or maintenance work. The proposed action is unlikely to have a significant impact in this respect, because of the small area to be affected and as long as avoiding disturbing hollow bearing trees is considered and revegetating disturbed areas with native indigenous flora species is undertaken.

Removal of dead wood and dead trees

It is not expected that removal of dead wood or trees will have an affect as a result of the proposal, as any removal is considered to be small and would only need to be removed to allow suitable access to the site for construction or maintenance purposes. Therefore, due to similar habitat occurring in the vicinity and the small area that would be affected by any removal of woody debris and that woody debris can be realigned within either the riparian or aquatic zones, the proposed action is unlikely to have a significant threat, again as long as disturbance to hollow bearing trees (dead or alive) is avoided.

Mammals

The following factors must be taken into account in making a determination under this section:

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Two vulnerable and one endangered mammal species have a known distribution range in the region (Val et al 2001; DECC 2005; Atlas of NSW Wildlife 2007).

Western pygmy possum (*Cercartetus concinnus*)

A small nocturnal marsupial, Western pygmy possums inhabit mallee shrublands and open forests, nesting in hollows for shelter (Ward 1990; Val et al 2001; DECC 2005). This specie forages on the ground and in shrubs for nectar, pollen and insects (DECC 2005). Threats

include clearing, overgrazing and too frequent burns of habitat areas (DECC 2005). The proposed action is unlikely to have an adverse impact on this species life cycle.

Southern ningai (*Ningai yvonneae*)

Southern ningai are a tiny, nocturnal carnivorous marsupial with a distribution that roughly corresponds with mallee woodland, although has been recorded in low heathlands (Bos et al 2002; DECC 2005). Any action that disturbs the shrub layer within suitable habitat areas appears to be a threat to this specie (Val et al 2001; DECC 2005). It is unlikely the proposed action will have an adverse impact on this specie as long as suitable shrub layer habitat remains undisturbed.

Inland forest bat (*Vespadelus baverstocki*)

Inland forest bats, largely an arid-adapted species, have been recorded in a variety of woodland habitats, including mallee, mulga and river red gum, preferring open drier habitats rather than Riverine woodlands (Lumsden & Bennett 1995; DECC 2005). This species fly rapidly covering an extensive foraging area, roosting in tree hollows and abandoned buildings (DECC 2005). Removal of old hollow trees, predation by cats and degradation of vegetation are threatening the status of this specie (DECC 2005). It is unlikely the proposed action will affect any populations of Inland forest bats, if present, in the study area.

- (b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,**

There are no endangered mammal populations known to occur in the study region.

- (c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
 - (ii) is likely too substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

No mammals in the study region are listed as an ecological community.

- (d) in relation to the habitat of a threatened species, population or ecological community:**
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,**

As mammals inhabit terrestrial habitats and have not been recorded to directly be dependant on wetlands for all parts of their life cycles and as long as alternative watering points are in the near vicinity, it is not expected that the proposed action will directly impact on the habitat of these threatened mammals. In the event that a re-wetting phase is not initiated there is the potential for habitat areas surrounding the wetlands to change in species composition and structure to species characteristic of un-flooded areas. Monitoring of health of surrounding vegetation is recommended to elevate any possible impacts.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No critical habitat is designated in the area.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

A Recovery plan has been prepared for the Western pygmy possum.

Western pygmy possum – Objectives of the recovery plan include improving knowledge of distribution and habitat requirements, and identifying threats. The proposed action can be considered consistent with these objectives.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are 30 KTP currently listed under the *TSC Act*, one of these processes (alteration to the natural flow regimes) is considered in relation to the proposed action, while another two processes (clearing native vegetation and removal of woody debris) are mentioned as a possibility of having an impact.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

Alteration to the natural flow regimes can occur through reducing or increasing water flows, alternating seasonal flow patterns, changing the frequency, timing, magnitude, variability and duration of flow. Mammals are able to tolerate fluctuating water levels, as long as this fluctuation does not affect food abundance, degrade habitat availability and alternate water sources are nearby.

Clearing of native vegetation

The clearing of any native vegetation on this site is considered small, the only need to clear would be to allow for suitable access to the wetland for any construction purposes. The proposed action is unlikely to have a significant impact in this respect, because of the small area to be affected. If clearing of vegetation is required, consideration to rehabilitating the area is recommended.

Removal of dead wood and dead trees

Any removal of woody debris will reduce the availability of shelter and foraging habitat for populations of the threatened species. Given that any removal of woody debris should be relatively small, can be realigned within the creek or riparian zones and should only occur to allow suitable access and construction if needed, it is not expected to have an adverse affect on any populations.

Reptiles

The following factors must be taken into account in making a determination under this section:

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The region surrounding Euston Lakes covers the distribution range of three threatened reptiles, two endangered (Mallee worm lizard and Mallee slender blue tongue) and one vulnerable (Western blue tongue lizard) species (Atlas of NSW Wildlife 2007).

Mallee worm lizard (*Aprasia inaurita*)

The Mallee worm lizard requires a mature habitat with a well developed leaf litter and surface debris layer, inhabiting semi-arid mallee woodlands (Val et al 2001; DECC 2005). Threats to the status of this specie includes clearing of habitat, inappropriate fire frequency, heavy grazing and loss of leaf litter and ground cover (DECC 2005). It is unlikely the proposed action will pose an adverse effect on this specie.

Mallee slender blue tongue (*Cyclodomorphus melanops elongatus*)

A medium sized nocturnal, solitary skink, Mallee slender blue tongues are dependant on mallee habitats with a spinifex understorey (Val et al 2001; DECC 2005). Rock slaps, leaf litter, fallen timber and other ground cover provides shelter and hunting opportunities for insects, flowers, fleshy leaves and fruit (DECC 2005). Threats include the loss of ground cover, habitat clearance, heavy grazing and trampling of habitat and food resources (DECC 2005). The proposed action is unlikely to pose an adverse effect to this specie.

Western blue tongue lizard (*Tiliqua occipitalis*)

Western blue tongue lizards prefer mallee shrublands, heaths or hummock grasslands with a spinifex understorey and dense shrub layer (Val et al 2001; DECC 2005). This terrestrial specie is a diurnal forager, feeding on insects, snail and native vegetation (DECC 2005). Possible threats include habitat fragmentation as a result of clearing and heavy grazing causing degradation of fragments (Val et al 2001; DECC 2005). As this specie is not dependant on water for all parts of its life cycle it is reasonable to suggest the proposed action is unlikely to pose a threat to any viable local populations.

- (b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,**

No reptiles are listed as an endangered population.

- (c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

No reptiles are listed as an ecological community.

- (d) in relation to the habitat of a threatened species, population or ecological community:**

- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,**

Habitat removal, modification and fragmentation are threats that effect reptile populations (DECC 2005). The area and habitat that will be affected by this proposal relate to aquatic

habitats, the fragmentation caused by drying the wetland is not expected to adversely affect any significant habitat areas for these reptile species. There is potential in the long-term a dry period will affect the health of aquatic organisms and vegetation surrounding the lagoon and may encroach on significant habitat areas for the threatened species. Therefore, further monitoring of surrounding habitat health is recommended.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No critical habitat is designated in the area.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

No recovery plans have been established for these species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are 30 KTP currently listed under the TSC Act, one of these processes (alteration to the natural flow regimes) is considered in relation to the proposed action, while another two processes (clearing native vegetation and removal of woody debris) are mentioned as a possibility of having an impact.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

Altered natural flow regimes may affect the availability and quality of suitable habitat for many species. All wetland communities to some degree are associated with terrestrial habitats, during a prolonged dry period the species composition of these terrestrial zones fringing wetlands potentially could change to species more characteristic of un-flooded areas. Therefore as long as wetlands, when water flows become surplus are re-wetted, there is unlikely to be a long-term impact.

Clearing of native vegetation

The clearing of any native vegetation on this site is considered small, the only need to clear would be to allow for suitable access to the wetland for construction purposes and installation of the barrier. The proposed action is unlikely to have a significant impact in this respect, because of the small area to be affected, as long as revegetation of any disturbed areas is considered.

Removal of dead wood and dead trees

It is not expected that removal of dead wood or trees will have an affect as a result of the proposal, as any removal is considered to be small and would only need to be removed to allow suitable access to the site for construction purposes. The need for removal can be elevated by realigning any dead wood in the riparian and aquatic zones to maintain these habitat and foraging areas. Therefore, due to the small area that would be affected by any realigning of woody debris, the proposed action is unlikely to have a significant threat.

Threatened flora

Three threatened terrestrial flora species were recorded to occur in the region. No threatened aquatic species are known to occur in the region.

Native Vegetation

The following factors must be taken into account in making a determination under this section:

- (a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,**

Three threatened native vegetation species have a known distribution range within the study region (DECC 2005; Atlas of NSW Wildlife 2007). These threatened species include two vulnerable (A spear-grass and Yellow gum) and one endangered (Swamp she-oak) species as listed on the TSC Act.

A spear grass (*Austrostipa metatoris*)

Austrostipa metatoris is a perennial spear grass that grows in tussocks to 1 m tall, occurring in the Murray Valley in sandy areas (DECC 2005). Habitats include sand hills, sand ridges, undulating plains and flat open mallee country (DECC 2005). Drought is a major threat to this species as it flowers in response to rain, grazing and habitat degradation are other threats (DECC 2005). This species has historically been recorded to occur at Lake Benanee (Atlas of NSW Wildlife 2007), as this is a terrestrial species any drying then re-wetting of the lake is unlikely to affect this species lifecycle.

Swamp she-oak (*Casuarina obesa*)

The only known locality of this species in south-western NSW occurs at Lake Benanee (DECC 2005). This species commonly is found in wetlands on the edges of salt lakes, mud flats and other water courses (DECC 2005). The species has been identified to be tolerant of many environmental conditions, including salinity, water-logging, dieback due to nitrogen fixing and drought tolerance and will grow on heavy soils, however there are doubts about its low-water using potential (Hearn 2001; Safstrom 2002; Carter 2006). Grazing is considered a threat to the survival of this species, due to its palatability, ground compaction from stock, increase in soil nutrients and introduction of weeds (DECC 2005). As this species can inhabit permanent or ephemeral lake systems, and as prolonged high water levels at Lake Benanee have caused waterlogging and/or root undermining (DECC 2005) the proposed action potentially may benefit this species life cycle, continual monitoring of any existing stands and exclusion of stock is recommended.

Yellow gum (*Eucalyptus leucoxylon subsp. pruinosa*)

The vulnerable Yellow gum is known or predicted to occur in the area surrounding Euston Lakes (DECC 2005). This small to medium sized tree occurs in grassy woodlands on moderately fertile to loamy or alluvial soils, at the bases of sandy rises on the Murray River floodplains, flowering from May to December (DECC 2007; PlantNET 2007). Threats to this species include lack of regeneration, clearing and salinity (DECC 2005). It is unlikely the proposed action will pose an adverse effect on the life cycle of this species.

- (b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,**

No vegetation species listed as an endangered population have been recorded in the study area.

- (c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

- (ii) is likely too substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

The vegetation community's of the *Acacia Ioderi* Shrublands Community as listed under the TSC Act and Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions as listed under the *EBPC* Act are predicted to occur in the region. These communities are characterised by a diversity of plant species and provide suitable habitat for many animals. The proposed action potentially may alter the structure of these communities in the short-term through stress of species adapted to regular flooding or wetting regimes. Due to the process of these wetlands naturally drying down as a result of current drought conditions, it is likely the proposed action may further impact on this stress, although as long as a wetting phase is initiated when water surplus becomes available the long-term impact can be reduced.

- (d) in relation to the habitat of a threatened species, population or ecological community:**
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,**

The habitat which is expected to be removed, modified, isolated or fragmented by this proposed action relates to aquatic habitats rather than terrestrial habitats. The proposed action does not intend to impact on existing links between any communities associated with the creek system and neighbouring remnants. Although the proposal potentially may alter the structure of these communities through stress of species adapted to regular flooding or wetting regimes. It is not expected that the proposed works will impact on the habitat of these threatened plants.

- (e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),**

No critical habitat is recorded in the area for these species.

- (f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,**

No recovery plans have been established for these species.

- (g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

The major key threatening process to be impacted by this proposed action is altering the natural flow of rivers, stream and their floodplains and wetlands, two other potential key threatening processes that may also be impacted and require consideration are the removal of dead trees and wood, and the clearing of native vegetation.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

The regulating of rivers has altered the natural flow regimes of wetlands, wetlands that are now permanently inundated once experienced extended dry periods. Native fauna and flora over time have adapted to these changes with some species now reliant on these wetlands remaining as a permanent wetland. Altered natural flow regimes may also affect the availability and quality of suitable habitat for many species. As these plant species are not

directly reliant on wetlands, the proposed action should not adversely impact on their life cycles.

Clearing of native vegetation

Any clearing of native vegetation proposed by this action is considered to be minimal. As it is predicted that such a disturbance would affect a relatively small area and any area disturbed, consideration should be made to revegetate the area, the proposed action is therefore unlikely to increase this impact.

Removal of dead wood and dead trees

It is reasonable to expect any removal of dead wood and trees will be a direct result of any construction or maintenance on the barriers, any such removal would consider being minimal. The need to remove woody debris can be prevented by realigning wood within the creek or fringing vegetation to maintain important habitat areas. Therefore the proposed action is unlikely to increase the impact of this threatening process.

Endangered Ecological communities

Three Ecological Communities as listed under the *FM Act*, *TSC Act* or *EPBC Act* are known or predicted to occur in the Euston Lakes region.

Aquatic Ecological Community of the Lower Murray Catchment.

The following factors must be taken into account in making a determination under this section:

- (a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,**

The Lower Murray River Catchment is not a threatened species.

- (b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,**

The Lower Murray River Catchment is not an endangered population.

- (c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Euston Lakes occurs in the Lower Murray River Catchment area which is classified as an endangered aquatic ecological community. Listing of this ecological community gives all native fish and invertebrate species within its boundaries the protected status of endangered species, therefore any potential impacts on these communities must be considered during any development process.

In a natural state the area would experience variable water regimes, wetting and drying cycles. Since regulation of flows within the Murray River many wetlands in the catchment have become more permanent and rarely undergo a drying phase. Re-imposing a natural wetting and drying cycle has the potential to benefit many components of the ecological community of Euston Lakes providing wetting is undertaken at (i) the appropriate time of year (ii) water is held within the wetland for sufficient duration to allow flora and fauna to complete life cycles, and (iii) allowed to naturally draw down.

The native protected Freshwater catfish has been recorded recently to inhabit Washpen Creek. This specie has a reduced distribution throughout the Murray River, although not listed as threatened, Morris et al (2001) suggests conservation status in NSW should be vulnerable. Under *FM* regulations the specie is protected from commercial fishing and recently this protection has been changed to include recreational angling, therefore Freshwater catfish are totally protected in all western flowing rivers and unlisted dams, all catfish caught must be returned to the water immediately (DPI 2007a). The proposed action is likely to impact on the life cycle of populations of Freshwater catfish located in Washpen Creek, resulting in the population becoming isolated and stranded during the dry down period.

- (d) in relation to the habitat of a threatened species, population or ecological community:**
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,**

Due to the permanent inundation of the lakes system, many species have adapted to the altered habitat since regulation was introduced. In altering the current hydrological system there is the potential for impacts to occur on species established in the area. Alternatively, altering regulation practises to allow sections of the system to dry down and then re-wet at optimal times, will benefit other aquatic species that rely on wetting and drying cycles.

The area to be impacted by this proposed action is relatively small in comparison to the catchment size, due to long term benefits, it is unlikely this proposed action will have an adverse effect on the local ecological community, but maybe of benefit if an appropriate wetting and drying regime is considered and re-imposed. As Euston Lakes is potentially one of many wetlands being assessed for this action, the size of the catchment area that potentially may be affected could result in a considerably large area of the catchment. Therefore, an approach to the number of wetlands and cumulative size of the catchment to be impacted by this change in flow regimes needs to be considered in regards to the effect on this community.

- (e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),**

No known critical habitat occurs in the region for this community.

- (f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,**

No recovery plan has been prepared for the aquatic community of the Lower Murray River Catchment.

- (g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

Of the 30 KTP listed under the *TSC Act* and seven under the *FM Act*, four need to be considered. The main KTP is the alteration to natural flow regimes and to a lesser extent the removal of dead wood and trees, the clearing of native vegetation and predation by Mosquito fish.

Installation and operation of in stream structures and other mechanisms that alter natural flow regimes of rivers and streams

As the impact from this proposed action is restricted to a small area of the catchment it is considered not to pose a risk to the ecological community. As long as the existing regulators and block banks are managed to allow sections of the system to re-wet, improvement to the wetland area is expected to offset any initial impact on the creek. As Euston Lakes is potentially one of many wetlands being assessed for this action, the size of the catchment area that potentially may be affected could result in a considerably large area. Therefore an approach to the number of wetlands and cumulative size of the catchment to be impacted by this change in flow regimes needs to be considered and may increase this threat.

Removal of dead wood and dead trees

It is not expected the requirement for removal of dead wood or trees will occur as a result of this proposed action. Any dead wood that requires removal can be realigned within the creek or riparian zones to maintain habitat areas. This realignment therefore, is considered to be small and is unlikely to increase the impact of this process.

Clearing of native vegetation

In the event native vegetation is removed, consideration should be made to revegetate the affected areas. The proposed action is unlikely to have a significant impact in respect to the small area being disturbed.

Predation by *Gambusia holbrooki* Girard, 1859 (Mosquito Fish)

An increased threat of predation by Mosquito fish possibly could result during the re-wetting phase. Mosquito fish are able to establish populations in areas of poor water quality and tolerate a range of conditions. Monitoring of fish populations during a re-wetting phase is recommended to evaluate any impact.

Woodland Ecological Communities of the Riverina and NSW South Western Slopes

The following factors must be taken into account in making a determination under this section:

- (a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,**

These woodland communities are not a threatened species.

- (b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,**

These woodland communities are not an endangered population.

- (c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- (ii) is likely too substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

Acacia loderi shrublands

This community is dominated by *Nelia Acacia loderei*, with an open structure of individual shrubs to small trees and a low diverse understorey dominated by chenopod shrubs, herbs and grasses (DECC 2005). Threats include clearing and lack of regeneration as a result of heavy grazing, and invasion of exotic weeds into the understorey (DECC 2005). Flooding appears to also be a threat, as discovered at Menindee lakes where the destruction of several stands of the community resulted after a period when the lake was over filled (DECC 2005). Therefore, if this community is present at the wetland during a re-wetting phase, if the wetland is over filled there is a possibility the community will be placed at risk, it is recommended to allow for a gradual inflow of water (if possible) so monitoring can occur.

Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions Ecological Community

This community is listed as an endangered ecological community under the *EPBC Act*. The community is generally dominated by Buloke (*Allocasuarina luehmannii*), Slender cypress pine (*Callitris gracilis*) and Grey box (*Eucalyptus microcarpa*) with an open and grassy understorey (DEW 2007). Threats to this community include clearing, grazing, weedicide application, fertiliser drift and inappropriate fire regimes. A prolonged dry period potentially may change species composition within the wetland areas which may impact on this Woodland Community. Appropriate management and monitoring of these areas, including a re-wetting phase potentially will reduce any substantial changes in species composition.

- (d) in relation to the habitat of a threatened species, population or ecological community:**
 - (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,**

The habitat area which is expected to be fragmented by this proposed action relates to aquatic habitats rather than terrestrial habitats. Terrestrial habitats to some degree are associated with wetland communities, maintaining the integrity of these habitats is important to many species that are dependant on both terrestrial and aquatic habitats for parts of their life cycles. A prolonged dry period potentially could change the species composition of these terrestrial and aquatic areas to species more characteristic of dry or un-flooded conditions and increase fragmentation between remnants. This proposed action potentially will benefit some species, during a re-wetting phase providing wetting is undertaken at (i) the appropriate time of year, (ii) water is held within the creek system for sufficient duration to allow species to complete life cycles, and (iii) creeks are allowed a natural draw down. Continuing monitoring of the sites to maintain the integrity and quality of the community, including combating invasive species is recommended.

- (e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),**

No designated areas of critical habitat occur in the area.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

No recovery plans have been prepared for these communities.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are 30 KTP currently listed under the TSC Act, there are three processes considered in relation to the proposed action as a possibility of having an impact.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

Altered flow regimes may affect the availability and quality of suitable habitat for many species. As this community is not directly dependant on wetlands, the proposed action is unlikely to have an adverse impact. Alteration of water drainage patterns potentially can affect the availability and quality of suitable habitat for many species, including this community. As long as the proposed actions are managed to allow opportunities of wetting and drying phases, it is unlikely to have an impact on this community's survival.

Clearing of native vegetation

It is not expected removal of native vegetation is required for this proposed action. Any clearing or disturbance that may occur is considered to be small and therefore is reasonable to suggest the proposed action is unlikely to impact further on this KTP. In the event clearing is required, disturbed areas should be rehabilitated with native indigenous species, this will aim towards reducing any long term impacts.

Removal of dead wood and dead trees

It is not expected that removal of dead wood or trees will have an affect as a result of the proposal, as any removal is considered to be small and would only need to be removed to allow suitable access to the site for construction purposes. The need for removal can be elevated by realigning any dead wood in the riparian and/or aquatic zones to maintain these habitat and foraging areas. Therefore, due to the small area that would be affected by any realigning of woody debris the proposed action is unlikely to have a significant threat.

Significant impact criteria

Migratory Species Criteria

The study area contains potential habitat for 24 migratory bird species listed on the Chinese-Australian Migratory Bird Agreement (CAMBA), Japanese-Australian Migratory Bird Agreement (JAMBA), Republic of Korea-Australian Migratory Bird Agreement and/or the Conservation of Migratory Species (CMS). Two species were observed during recent field surveys.

Waterbirds react differently to changes to hydrology. The proposed action potentially may affect habitat for species that use permanent water, while habitat for species which rely on wetting and drying cycles of ephemeral wetlands benefit. Waterbirds that rely on wetting/drying cycles include Ibis, egrets and waders, while waterbirds that prefer more permanent water bodies include fish-eating species (Scott & Grant 1997).

An assessment as per the Administrative Guidelines on Significance has been completed for the species listed below (Table 10).

Table 10. Migratory birds with a distribution range that includes the Euston Lakes system

Scientific name	Common name	Treaty
<i>Apus pacificus</i>	Fork-tailed swift	C / J / R
<i>Ardea alba</i> *	Great egret	C
<i>Ardea ibis</i>	Cattle egret	C / J
<i>Arenaria interpres</i>	Ruddy turnstone	C / J / R
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	C/J/R
<i>Calidris canutus</i>	Red knot	C / J / R
<i>Calidris ferruginea</i>	Curlew sandpiper	C / J / R
<i>Calidris melanotos</i>	Pectoral sandpiper	J / R
<i>Calidris ruficollis</i>	Red-necked stint	C / R
<i>Calidris subminuta</i>	Long-toed stint	C / J / R
<i>Chlidonias leucopterus</i>	White-winged black tern	C / J
<i>Gallinago hardwickii</i>	Latham's snipe	C / R
<i>Haliaeetus leucogaster</i>	White-bellied sea eagle	C
<i>Hirundapus caudacutus</i>	White-throated needletail	C / R
<i>Hydroprogne caspia</i> *	Caspian tern	C
<i>Limosa lapponica</i>	Bar-tailed godwit	C / J / R
<i>Limosa limosa</i>	Black-tailed godwit	C / J / R
<i>Pluvialis dominica</i>	Lesser golden plover	C / J
<i>Plegadis falcinellus</i>	Glossy ibis	C / M
<i>Rostratula benghalensis</i>	Painted snipe	C
<i>Tringa glareola</i>	Wood sandpiper	C / J / R
<i>Tringa hypoleucos</i>	Common sandpiper	C / J / R
<i>Tringa nebularia</i>	Greenshank	C / J / R
<i>Tringa stagnatilis</i>	Marsh sandpiper	C / J / R

* species observed during 2007 survey. C = CAMBA; J = JAMBA; R = ROKAMBA; M = CMS. Source: Val et al 2001; McCarthy et al 2005; Atlas of NSW Wildlife 2007.

Administrative Guidelines on Significance, Environment Protection and Biodiversity Conservation Act 1999

An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is likely to:

- **Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat¹ of the migratory species:**

The wetlands along the Murray River are relatively extensive and likely to support many migratory species in the region. Impacts that would result from the proposed action at Euston Lakes would be limited in extent compared with the number of wetlands, rivers and creeks occurring within the region. There is potential for similar works to be undertaken on multiple wetlands throughout the region, this would therefore increase the affected area and may impact on suitable habitat areas for migratory birds, including reducing or modifying drought refuge areas.

- (i) **Fragmentation:** Euston Lakes is connected to the Murray River via the Euston Weir pool. Fragmentation of aquatic habitat is likely to occur when water flows are modified. The impact of this fragmentation is not likely to affect these migratory bird species due to alternate habitat within the region and the mobility of these species. As long as consideration is taken into account for maintaining significant drought refuge sites within the study area.
- (ii) **Alteration of fire regimes:** The proposed action will not alter fire regimes.
- (iii) **Alteration of nutrient cycles:** Flooding of wetlands after a drying phase provides a pulse of nutrients to wetlands driving secondary productivity and benefits the

ecological community in the long term (Reid & Brooks 2000). This pulse of nutrients during re-wetting or flooding determines vegetation patterns and health. Vegetation structure then determines the suitability of habitat for birds to breed and forage in. Returning the wetlands to a more natural wetting and drying cycle is likely to benefit the system and in turn benefit the migratory bird species that visit the area.

(iv) Alteration of hydrological cycles: The hydrological cycle of a wetland is responsible for the composition structure and function of wetland communities. Regulation of rivers has significantly altered the hydrology of many wetlands with many wetlands either more permanently inundated or more permanently dry. Appropriate management of the structures should allow a more natural wetting and drying cycle to occur enhancing the secondary productivity of these wetlands therefore, providing food resources and habitat for migratory birds.

- **Result in invasive species that is harmful to the migratory species becoming established in an area of important habitat¹ of the migratory species:**

During dry periods wetland vegetation dies off, grasses and other dry land vegetation are then provided with an opportunity to grow in the wetland. During the dry down phase it is advisable that stock be restricted from the areas fringing the creek. This will prevent the effects of trampling and pugging the creek edges which can lead to destruction of vegetation and soil profile and the introduction of weeds and nutrients. Continuing a monitoring program on the study sites is recommended to evaluate any potential of invasive species becoming established.

- **Seriously disrupt the lifecycle (breeding, feeding, migration or nesting behaviour) of an ecologically significant proportion of the population of the species:**

Euston Lakes is not considered significant habitat area for all these listed migratory bird species. Due to these species mobility and similar vegetation is well represented in the area it is reasonable to consider that it is unlikely that impacts from the action will seriously disrupt the lifecycle of these migratory species.

Fork-tailed swift (*Apus pacificus*)

The Fork-tailed swift breeds in north-east and mid-east Asia, a summer migrant bird to Australia visiting from November to April each year (Emison et al 1987). This specie is almost totally aerial, feeding during flight (Emison et al 1987).

Great egret (*Ardea alba*)

Great egrets breed in Australia in a variety of habitats around the edges of wetlands and are considered common and widespread (Baxter 1994). The specie nests in trees and is a territorial feeder foraging in the water for mollusc, amphibians and aquatic insects (Baxter 1994). Estuarine mudflats have also been used as a summer-autumn or drought refuge site (Emison et al 1987). This specie was observed roosting at Taila Creek during recent surveys.

Cattle egret (*Ardea ibis*)

Cattle egrets are colony tree nesting species that breed in Australia, in a variety of vegetation types around edges of wetlands, and colonies have been known to remain at the one site for up to 18 years (Baxter 1994). Nests are predominantly located in living River red gums (Leslie 2001). Cattle egrets are only partially migrant, some individuals stay close to their natal breeding ground from one nesting season to another, although majority of individuals will leave in autumn and then return in spring to the same natal breeding ground (McKilligan 2005).

Ruddy turnstone (*Arenaria interpres*)

Habitat plays a significant role in nest site selection for this species, with a habitat preference for rocky shorelines, avoiding dry heaths and gravel ridges with breeding occurring in Northern Siberia and Alaska (Watkins 1993; Barter 2002; Smith et al 2007). A monogamous, territorial migratory shorebird species, Ruddy turnstones migrate to both coastal and inland wetlands in Australia during the non-breeding periods (Barter 2002; Smith et al 2007). This species is an opportunistic feeder, preferring to feed near the waters edge of tidal coastal areas, shifting prey types and foraging modes as distribution of food changes (Fleischer 1983).

Sharp-tailed sandpiper (*Calidris acuminata*)

This migratory bird species prefers to forage along the muddy shores of open swamps occurring in areas with scattered, low emergent vegetation (Emison et al 1987; Barter 2002). Temporary floodwaters, including flooded salt marshes have also been used as habitat refuge (Emison et al 1987). This species breeds across northern Europe and Asia, is generally common and widespread in China, while considered scarce in South Korea (Barter 2002). This species does not breed in Australia, although it will inhabit both salt and freshwater wetlands.

Red knot (*Calidris canutus*)

Breeding occurs in Asia, Northern Siberia and Alaska with migration to Australia occurring in late August early September (Watkins 1993; Barker 2002; DEH 2005). Preferred habitat for this species includes inter-tidal mudflats, sand flats, estuaries and sandy beaches of sheltered coasts (Watkins 1993; DEH 2005).

Curlew sandpiper (*Calidris ferruginea*)

The Curlew sandpiper breeds in Northern Siberia and Asia, migrating to Australia in late August early September, departing in February/March the following year (Paton et al 1980; Watkins 1993; Barker 2002). During this non-breeding time in Australia the species feeds on a variety of prey in inter-tidal zones and shallow wetlands (Dann 1999). Habitat preference is for inter-tidal mudflats of sheltered coastal areas, coastal lakes, estuaries and occasionally inland wetlands (Barker 2002; DEH 2005).

Pectoral sandpiper (*Calidris melanotos*)

Pectoral sandpipers breed in northern America and northern Russia (DEH 2005; Steiger et al 2006). Preferred habitats include shallow fresh to saline wetlands usually coastal regions but also occurring inland (DEH 2005). In Australia no habitat sites have been identified as internationally important and the species occurs in small numbers spread over a large number of sites (Watkins 1993; DEH 2005).

Long-toed stint (*Calidris subminuta*)

Long-toed stints have a habitat preference for terrestrial wetlands with shallow freshwater or brackish wetlands with muddy or vegetated shorelines (Watkins 1993; DEH 2005). The species breeds across northern Asia migrating to Australia during Australia's summer months, nesting on the ground and foraging on mudflats. No sites in Australia are identified as internationally important habitat areas (DEH 2005).

Red-necked stint (*Calidris ruficollis*)

A summer migrant species to Australia, preferring mudflats, salt marshes, brackish and saltwater habitats, this species breeds in northern Europe (Barter 2002). The Red-necked stint has also been known to inhabit temporary floodwaters. Red-necked stints feed on the exposed mudflats on the tidal flats, feeding in, or from the surface of the sediment while standing in or out of the water (Dann 1999).

White-winged black tern (*Chlidonias leucopterus*)

White-winged black terns breed in northern Europe and Asia, migrate to inland waters in Australia in October and then depart in April each year (Bargiel & Banbura 2003; van der Winden & Nesterenko 2003; Chan & Dening 2006). White-winged terns prefer marshland habitats and predominantly feed in terrestrial habitats including very shallow brackish water and fresh water marshlands (van der Winden & Nesterenko 2003).

Latham's snipe (*Gallinago hardwickii*)

Latham's snipe breeds in Japan, migrating in summer to the Australian swamps along drainage lines and water courses (Saunders 2006). A nocturnal feeder, feeding on soft soils or mud, this species shelters by day in dense vegetation (Todd 2000; Saunders 2006). The overgrazing of wetland areas, predation by foxes and modification to flow regimes are considered risks in the survival of this species.

White-bellied sea eagle (*Haliaeetus leucogaster*)

Distribution of the White-bellied sea eagle extends from the western coast of India throughout the Indo-Malaysian region, Papua New Guinea and Australia (Shephard et al 2004). This species prefers major rivers and large estuaries or large inland water bodies, hunting over deep water, terrestrial wetlands and lakes and also inland terrestrial areas (Shephard 2003). Nest sites are selected in relation to the accessibility to water, with this distance varying from 100 m to kilometres depending on food resources (Shephard 2003).

White-throated needletail (*Hirundapus caudacutus*)

White-throated needletails are a summer migrant to Australia with a preference for a range of habitats including forests, woodlands, urban areas, grasslands and water bodies (Emison et al 1987). This species forages in flight, is rarely reported roosting and breeds in Siberia, the Himalayas and Japan (Emison et al 1987).

Caspian tern (*Hydroprogne caspia*)

The Caspian tern is a partially migrant bird that inhabits coastal areas and sometimes can be found at inland watercourses and saline or brackish lakes (Emison et al 1987). This species breeds in Australia in small colonies or individually on beaches near salt water, rarely seen in large colonies (Emison et al 1987; Wires & Cuthbert 2000). This bird appears to exploit human modified habitats and responds quickly to habitat changes, although habitat changes that result in large numbers at single sites may place populations of this species vulnerable to stochastic events (Wires & Cuthbert 2000). This species was observed foraging at Dry lake.

Bar-tailed godwit (*Limosa lapponica*)

Bar-tailed godwits breed from Scandinavia across Northern Russia to Alaska (Watkins 1993). Preferred habitat is for coastal areas, usually sheltered bays, estuaries and lagoons (DEH 2005). No international important areas have been identified within the study region. This species is rarely recorded using wetlands or in areas of short grasslands such as paddocks (Higgins & Davies 1996).

Black-tailed godwit (*Limosa limosa*)

Distribution for Black-tailed godwits includes coastal and inland wetlands, spending non-breeding seasons (August-February) in the region between Thailand and Australia (Watkins 1993; Barker 2002). Breeding occurs in Asia and Europe (Watkins 1993; Barker 2002; DEH 2005). Preferred habitat is coastal sandy shores, mudflats and marshes, although is often found inland in small numbers (Val et al 2001; DEH 2005).

Glossy ibis (*Plegadis falcinellus*)

Glossy ibis breed in Australia, do not use regular breeding sites and appear to wander nomadically in search of feeding grounds (Lowe 1983). The species generally feeds in small flocks in shallow freshwater swamps and mudflats, with nests located in emergent macrophytes, e.g. lignum (Kingsford & Johnson 1998; Leslie 2001).

Lesser golden plover (*Pluvialis dominica*)

Lesser golden plovers breed in North America and Northern Siberia, migrating to Australia during the winter months (Johnson et al 2001). This species can adopt territorial or non-territorial tendencies, with territorial individuals reoccupying the same territory from previous seasons and non-territorial individuals reappearing at the same feeding sites (Johnson et al 2001).

Painted snipe (*Rostratula benghalensis*)

The Painted snipe is a small freshwater wader, preferring the fringes of swamps, dams and marshy areas, areas where there is a cover of grasses, lignums, low scrub or open timber including shallow vegetated, temporary or infrequently filled wetlands (Garnett & Crowley 2000; DECC 2005). This species feeds at the water's edge and on the mudflats with threats including the drainage of wetlands or diversion of water from rivers, resulting in wetlands not becoming shallow (Garnett & Crowley 2000). This species' distribution is most common in the Murray-Darling Basin although was not observed during this assessment.

Wood sandpiper (*Tringa glareola*)

Wood sandpiper on summer visits to Australia prefers fresh inland water ways including brackish swamps, mangrove lakes and flooded pastures (Emison et al 1987). Artificial wetlands, such as a large farm dam have also been used as a refuge site (Emison et al 1987).

Common sandpiper (*Tringa hypoleucos*)

Common sandpipers have habitat preferences for a range of wetlands, including muddy edges, river pools and mangroves perching on branches and posts, and are a summer migrant to Australia (Emison et al 1987). This species is considered to be widespread and scattered throughout Australia but generally regarded as uncommon (Emison et al 1987).

Greenshank (*Tringa nebularia*)

Greenshanks breed in northern Europe and Asia migrating to Australia for the Australian summer months (Barter 2002). The species' main prey is for small invertebrates including molluscs and small fish (Thompson et al 1986). This species occupies a variety of habitats both inland and coastal. Inland habitats both permanent and temporary wetlands, include billabongs, swamps, lakes, farm dams and even flooded irrigated crops.

Marsh sandpiper (*Tringa stagnatilis*)

The Marsh sandpiper breeding area extends from Eastern Europe to Eastern Siberia, migrating to Australia for the summer months (Barter 2002). This species in Australia will be found at both coastal and inland wetlands, both salt and freshwater, including estuaries, mangrove mudflats, lakes, billabongs and temporary floodwaters (Barter 2002).

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Appendix A.

Fauna species known or predicted to occur in the study region

Status codes V = Vulnerable (*TSC Act / FM Act*)
v = vulnerable (EPBC Act)
 E = Endangered (*TSC Act / FM Act*)
e = endangered (EPBC Act)
 EP = Endangered population (*TSC Act / FM Act*)
 P = Protected (*NPWS Act*)
 U = Unprotected (*NPWS Act*)
 N = Native
 I = Introduced
 C = Chinese-Australian Migratory Bird Agreement (CAMBA)
 R = Republic of Korea-Australian Migratory Bird Agreement (ROKAMBA)
 J = Japanese-Australian Migratory Bird Agreement (JAMBA)
 M = Conservation of Migratory Species (CMS)

	Scientific name	Common name	Status	Regional occurrence	Taila creek	Washpen creek	Lake Benanee	Dry Lake
Fish	<i>Ambassis agassizii</i>	Olive perchlet (Western population)	EP	X				
	<i>Bidyanus bidyanus</i>	Silver perch	V		X	X	X	X
	<i>Carassius auratus</i>	Goldfish	I		X	X		
	<i>Craterocephalus fluviatilis</i>	Murray hardyhead	E/v	X				
	<i>Craterocephalus stercusmuscarum fulvus</i>	Flyspecked hardyhead	N		X	X		
	<i>Cyprinus carpio</i>	Common carp	I		X	X	X	X
	<i>Gambusia holbrooki</i>	Mosquito fish	I			X		X

	<i>Hypseleotris spp.</i>	Carp gudgeon	N		X	X		X
	<i>Maccullochella peelii peelii</i>	Murray cod	v		X	X	X	X
	<i>Macquaria ambigua ambigua</i>	Golden perch	N			X		
	<i>Macquaria australasica</i>	Maquarie perch	V/e	X				
	<i>Malanotaenia fluviatilis</i>	Murray-Darling Rainbow fish	N		X			
	<i>Mogurnda adspersa</i>	Purple spotted gudgeon - (Western population)	EP	X				
	<i>Nannoperca australis</i>	Southern pygmy perch	V	X				
	<i>Nematalosa erebi</i>	Bony bream	N		X	X	X	X
	<i>Perca fluviatilis</i>	Redfin perch	I		X		X	
	<i>Philypnodon grandiceps</i>	Flathead gudgeon	N		X	X	X	X
	<i>Philypnodon sp.</i>	Dwarf flathead gudgeon	N			X		
	<i>Retropinna semoni</i>	Australian smelt	N			X	X	X
	<i>Tandanus tandanus</i>	Freshwater catfish	P			X		
Invertebrate	<i>Notopala sublineata</i>	River snail	E		X	X	X	X
		unidentified yabby			X			X
		unidentified shrimp			X			X
Birds	<i>Acanthagenys rufogularis</i>	Spiny-cheeked honeyeater	P	X			X	X
	<i>Acrocephalus australis</i>	Australian Reed warbler	P					X
	<i>Acrocephalus stentoreus</i>	Clamours reed warbler	P		X	X	X	X
	<i>Aegotheles cristatus</i>	Australian owlet-nightjar	P	X				
	<i>Anas casatarea</i>	Chestnut teal	P	X				
	<i>Anas gracilis</i>	Grey teal	P		X		X	X
	<i>Anas superciliosa</i>	Pacific black duck	P		X	X	X	X
	<i>Anhinga melanogaster</i>	Darter	P		X	X	X	X
	<i>Anseranas semipalmata</i>	Magpie goose	V	X				
	<i>Anthochaera carunculata</i>	Red wattlebird	P	X		X		
	<i>Anthus australis</i>	Australian pipit	P	X				
	<i>Apus pacificus</i>	Fork-tailed swift	C/J/R	X				

	<i>Ardea abla</i>	Great egret	C/J	X	X		X	X
	<i>Ardea ibis</i>	Cattle egret	C/J	X				
	<i>Ardea intermedia</i>	Intermediate egret	P				X	
	<i>Ardea pacifica</i>	White-necked heron	P	X		X		
	<i>Ardeotis australis</i>	Australian bustard	E	X				
	<i>Arenaria interpres</i>	Ruddy turnstone	C/J/R	X				
	<i>Artamus cinereus</i>	Black-faced woodswallow	P	X				
	<i>Artamus cyanopterus</i>	Dusky woodswallow	P	X				
	<i>Artamus leucorhynchus</i>	White-breasted wood swallow	P	X	X		X	X
	<i>Artamus personatus</i>	Masked woodswallow	P	X				
	<i>Artamus superciliosus</i>	White browed wood swallow	P	X				
	<i>Arthya australis</i>	Australian wood duck	P		X	X	X	X
	<i>Barnardius zonarius barnardi</i>	Australian ringneck	P	X				
	<i>Biziura lobata</i>	Musk duck	P	X				
	<i>Botaurus poiciloptilus</i>	Australasian bittern	V	X				
	<i>Burhinus grallarius</i>	Bush stone-curlew	E	X				
	<i>Cacatua galerita</i>	Sulphur-crested cockatoo	P	X	X			
	<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	V	X				
	<i>Cacatua roseicapilla</i>	Galah	P	X	X	X	X	X
	<i>Cacatua sanguinea</i>	Little corella	P	X	X			
	<i>Calidris acuminata</i>	Sharp-tailed sandpiper	C/J/R	X				
	<i>Calidris canutus</i>	Red knot	C/J/R	X				
	<i>Calidris ferruginea</i>	Curlew sandpiper	C/J/R	X				
	<i>Calidris melanotos</i>	Pectoral sandpiper	J/R	X				
	<i>Calidris subminuta</i>	Long-toed stint	C/J/R	X				
	<i>Calyptorhynchus banksii</i>	Red-tailed black cockatoo	V/e	X				
	<i>Certhionyx niger</i>	Black honeyeater	P	X				
	<i>Certhionyx variegatus</i>	Pied honeyeater	V	X				
	<i>Chlidonias hybrida</i>	Whiskered tern	P				X	
	<i>Chlidonias leucoptera</i>	White-winged black tern	C/J	X				
	<i>Cincloramphus cruralis</i>	Brown songlark	P	X				

	<i>Cinclorhamphus mathewski</i>	Rufous songlark	P	X				
	<i>Cinclosoma castanotus</i>	Chestnut quail-thrush	V	X				
	<i>Circus approximans</i>	Swamp harrier	P		X		X	
	<i>Claidris ruficollis</i>	Red-necked stint	C/J/R	X				
	<i>Climacteris affinis</i>	White-browed treecreeper	P	X				
	<i>Climacteris picumnus</i>	Brown treecreeper	V	X	X	X	X	X
	<i>Colluricincla harmonica</i>	Grey-shrike thrush	P		X	X	X	
	<i>Columba livia</i>	Rock dove	U	X				
	<i>Coracina maxima</i>	Ground cuckoo-shrike	P	X				
	<i>Coracina novaehollandiae</i>	Black-faced cuckoo shrike	P				X	
	<i>Corcorax melanorhamphos</i>	White-winged chough	P	X				
	<i>Corvus coronoides</i>	Australian raven	P	X	X	X	X	
	<i>Cracticus nigrogularis</i>	Pied butcherbird	P	X				
	<i>Cracticus torquatus</i>	Grey butcherbird	P	X				
	<i>Cuculus pallidus</i>	Pallid cuckoo	P	X				
	<i>Cygnus atratus</i>	Black swan	P			X	X	X
	<i>Dacelo novaeguineae</i>	Laughing kookaburra	P	X	X	X	X	
	<i>Daphoenositta chrysoptera</i>	Varied sittella	P	X				
	<i>Dicaeum hirundinaceum</i>	Mistletoe bird	P	X	X			
	<i>Dromaius novaehollandiae</i>	Emu	P	X				
	<i>Drymodes brunneopygia</i>	Southern Scrub-robin	V	X				
	<i>Egretta garzetta</i>	Little egret	P	X				
	<i>Egretta novaehollandiae</i>	White-faced heron	P	X		X		
	<i>Euseyornis melanops</i>	Black-fronted dotterel	P					X
	<i>Entomyson cyanotis</i>	Blue faced honeyeater	P	X				
	<i>Epthianura albifrons</i>	White fronted chat	P	X				
	<i>Epthianura aurifrons</i>	Orange chat	P	X				
	<i>Erythronyctes alba</i>	Red-necked dotterel	P				X	
	<i>Eurostopodus argus</i>	Spotted nightjar	P	X				
	<i>Falco berigora</i>	Brown falcon	P	X				
	<i>Falco cencroides</i>	Nankeen kestrel	P	X				

	<i>Falco hypoleucos</i>	Grey falcon	V	X				
	<i>Falco peregrinus</i>	Peregrine falcon	P				X	
	<i>Fulica atra</i>	Eurasian coot	P	X	X			
	<i>Gallinago hardwickii</i>	Latham's snipe	C/J/R	X				
	<i>Gallinago ventralis</i>	Black-tailed native hen	P		X		X	
	<i>Gallinula tenebrosa</i>	Dusky moorhen	P	X	X			
	<i>Geopelia cuneata</i>	Diamond dove	P	X				
	<i>Glossopsitta porphyrocephala</i>	Purple-crowned lorikeet	V	X				
	<i>Grallina cyanoleuca</i>	Magpie lark	P		X	X	X	X
	<i>Grus rubicunda</i>	Brolga	V	X				
	<i>Gymnorhina tibicen</i>	Australian Magpie	P	X	X		X	
	<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	C				X	X
	<i>Haliastur sphenurus</i>	Whistling kite	P		X			X
	<i>Hamirostra melanosternon</i>	Black-breasted buzzard	V	X				
	<i>Himantopus himantopus</i>	Black winged stilt	P	X			X	
	<i>Hirundapus caudacutus</i>	White-throated needletail	C/R	X				
	<i>Hirundo neoxena</i>	Welcome swallow	P	X	X	X		X
	<i>Hydroprogne capsia</i>	Caspian tern	C	X				X
	<i>Lalage sueuni</i>	White winged triller	P	X				
	<i>Larus novaehollandiae</i>	Silvergull	P	X			X	X
	<i>Lathamus discolor</i>	Swift parrot	E/ e	X				
	<i>Leipoa ocellata</i>	Malleefowl	E/v	X				
	<i>Lichenostomus leucotis</i>	White-eared honeyeater	P	X				
	<i>Lichenostomus ornatus</i>	Yellow-plumed honeyeater	P	X				
	<i>Lichenostomus penicillatus</i>	White-plumed honeyeater	P	X	X	X	X	X
	<i>Lichenostomus virescens</i>	Singing honeyeater	P	X				
	<i>Limosa lapponica</i>	Bar-tailed godwit	C/J/R	X				
	<i>Limosa limosa</i>	Black-tailed godwit	C/J/R V	X				
	<i>Lophoictinia isura</i>	Square tailed kite	V	X				
	<i>Malacorhynchus membrancaus</i>	Pink-eared duck	P	X				

<i>Malurus cyaneus</i>	Superb fairy wren	P	X	X			
<i>Malurus lamberti</i>	Variiegated fairy wren	P	X	X			
<i>Malurus splendens</i>	Splendid fairy wren	P	X				
<i>Manorina flavigula</i>	Yellow throated minor	P				X	
<i>Manorina melanocephala</i>	Noisy minor	P	X	X		X	X
<i>Megalurus gramineus</i>	Little grass bird	P		X			X
<i>Melanodryas cucullata cucullata</i>	Hooded robin (south-eastern form)	V	X	X			
<i>Melithreptus brevirostirs</i>	Brown-headed honeyeater	P	X				
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V	X				
<i>Melopsittacus undulatus</i>	Budgerigar	P	X				
<i>Merops ornatus</i>	Rainbow bee-eater	P	X	X		X	
<i>Microeca fascinans</i>	Jacky winter	P	X				
<i>Milvus migrans</i>	Black kite	P		X			
<i>Myiagra inquieta</i>	Restless flycatcher	P				X	
<i>Ninox connivens</i>	Barking owl	V	X				
<i>Ninox novaeseelandiae</i>	Southern boobook	P	X				
<i>Northiella haematogaster</i>	Blue bonnet	P	X				
<i>Nycticorax caledonicus</i>	Nankeen night heron	P	X				
<i>Nymphicus hollandicus</i>	Cockatiel	P	X				
<i>Ocyphaps lophotes</i>	Crested pigeon	P		X	X	X	
<i>Oreoica gutturalis</i>	Crested bellbird	P	X				
<i>Oxyura australis</i>	Blue-billed duck	V	X				
<i>Pachycephala inornata</i>	Gilbert's whistler	V	X				
<i>Pachycephala rufiventris</i>	Rufous whistler	P	X				
<i>Pardalotus punctatus xanthopyge</i>	Yellow rumped pardalote	P	X				
<i>Pardalotus striatus</i>	Striated pardalote	P		X	X	X	X
<i>Passer domesticus</i>	House Sparrow	U	X				
<i>Pedionomus torquatus</i>	Plains-wanderer	E/v	X				
<i>Pelecanus conspicillatus</i>	Australian Pelican	P	X	X	X	X	X
<i>Petrochelidon ariel</i>	Fairy martin	P	X	X			X

	<i>Petrochelidon nigricans</i>	Tree martin	P		X	X	X	X
	<i>Petroica goodenovii</i>	Red-capped robin	P	X				
	<i>Phalacrocorax carbo</i>	Great cormorant	P		X		X	X
	<i>Phalacrocorax melanoleucos</i>	Little pied cormorant	P		X	X	X	X
	<i>Phalacrocorax sulcirostris</i>	Little black cormorant	P	X	X	X	X	X
	<i>Phalacrocorax varius</i>	Pied cormorant	P	X	X	X	X	
	<i>Phaps chalcoptera</i>	Common bronzewing	P	X				
	<i>Philemon citreogularis</i>	Little friarbird	P	X				
	<i>Philemon corniculatus</i>	Noisy friarbird	P	X				
	<i>Phylidonyris albifrons</i>	White fronted honeyeater	P	X				
	<i>Phylidonyris melanops</i>	Tawny-crowned honeyeater	P	X				
	<i>Platalea flavipes</i>	Yellow-billed spoonbill	P	X				X
	<i>Platalea regia</i>	Royal spoonbill	P	X				X
	<i>Platycercus elegans flaveolus</i>	Yellow rosella	P	X	X	X	X	X
	<i>Platycercus eximius</i>	Eastern rosella	P	X				
	<i>Plegadis flectinellus</i>	Glossy ibis	C/M	X				
	<i>Pluvialis dominica</i>	Lesser golden plover	C/J	X				
	<i>Podargus strigoides</i>	Tawny frogmouth	P	X				
	<i>Podiceps cristatus</i>	Great crested grebe	P				X	
	<i>Polytelis anthopeplus monarchoides</i>	Regent parrot (eastern subspecies)	E	X	X			
	<i>Pomatostomus superciliosus</i>	White-browed babbler	P	X				
	<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V	X				
	<i>Popliocephalus poliocephalus</i>	Hoary-headed grebe	P	X				
	<i>Porphyrio porphyrio</i>	Purple swamphen	P	X	X	X	X	X
	<i>Psephotus haematontus</i>	Red-rumped parrot	P	X	X	X	X	X
	<i>Psephotus varius</i>	Mulga parrot	P	X				
	<i>Pyrrholaemus brunneus</i>	Redthroat	V	X				
	<i>Rhipidura fuliginosa</i>	Grey fantail	P	X				
	<i>Rhipidura leucophrys</i>	Willie wagtail	P		X	X	X	
	<i>Rostratula benghalensis</i>	Painted snipe (Australian subspecies)	E/v/C	X				

	<i>Stagonopleura guttata</i>	Diamond firetail	V	X				
	<i>Stictonetta naevosa</i>	Freckled duck	V	X				
	<i>Strepera versicolor</i>	Grey currawong	P	X				
	<i>Struthidea cinerea</i>	Apostlebird	P	X				
	<i>Sturnus vulgaris</i>	Common starling	I				X	X
	<i>Tachybaptus novaehollandiae</i>	Australiasian grebe	P	X				
	<i>Tadorna tadornoides</i>	Australian Shelduck	P					X
	<i>Taeniopygia guttata</i>	Zebra finch	P	X				
	<i>Threskiomis molucca</i>	Australian White ibis	P			X	X	X
	<i>Threskiornis spinicollis</i>	Straw-necked ibis	P	X				X
	<i>Todiramphus sanctus</i>	Sacred kingfisher	P	X	X	X		
	<i>Tringa glareola</i>	Wood sandpiper	C/J/R	X				
	<i>Tringa hypoleucos</i>	Common sandpiper	C/J/R	X				
	<i>Tringa nebularia</i>	Greenshank	C/J/R	X				
	<i>Tringa stagnatilis</i>	Marsh sandpiper	C/J/R	X				
	<i>Turdus merula</i>	Eurasian blackbird	U	X				
	<i>Tyto alba</i>	Barn owl	P	X				
	<i>Vanellus miles</i>	Masked lapwing	P				X	
	<i>Vanellus tricolor</i>	Banded lapwing	P	X				
	<i>Zosterops lateralis</i>	Silvereye	P	X				
Amphibians	<i>Crinia parinsignifera</i>	Eastern sign-bearing froglet	P			X		
	<i>Limnodynastes dumerili</i>	Eastern banjo frog	P		X	X		
	<i>Limnodynastes fletcheri</i>	Barking marsh frog	P			X	X	X
	<i>Limnodynastes tasmaniensis</i>	Spotted marsh frog	P		X	X	X	X
	<i>Litoria peroni</i>	Peron's tree frog	P		X	X	X	X
	<i>Litoria raniformis</i>	Southern bell frog	E/v	X				
Mammals	<i>Canis lupus</i>	Dingo	U	X				
	<i>Cercartetus concinnus</i>	Western pygmy possum	E	X				
	<i>Chalinolobus gouldii</i>	Gould's wattle bat	P	X				

	<i>Chalinolobus morio</i>	Chocolate wattled bat	P	X				
	<i>Hydromys chrysogaster</i>	Water-rat	P			X		
	<i>Macropus giganteus</i>	Eastern grey kangaroo	P	X				
	<i>Ningauai yvonneae</i>	Southern ningauai	V	X				
	<i>Scotorepens balstoni</i>	Inland broad-nosed bat	P	X				
	<i>Sminthopsis crassicaudata</i>	Fat-tailed dunnart	P	X				
	<i>Sminthopsis murina</i>	Common dunnart	P	X				
	<i>Tachyglossus aculeatus</i>	Short-beaked echidna	P	X				
	<i>Tadarida australis</i>	White-striped freetail bat	P	X				
	<i>Trichosurus vulpecula</i>	Common brushtail possum	P	X				
	<i>Vespadelus baverstocki</i>	Inland forest bat	V	X				
	<i>Vespadelus vulturnus</i>	Little forest bat	P	X				
Reptiles	<i>Aprasia inaurita</i>	Mallee worm-lizard	E	X				
	<i>Chelodina longicollis</i>	Eastern long necked turtle	P			X		
	<i>Chelodina longicollis</i>	Eastern snake-necked turtle	P	X				
	<i>Cryptoblepharus carnabyi</i>	Shiny-palmed shinning-skink	P	X				
	<i>Ctenotus schomburgkii</i>	Barred wedge-snout ctenotus	P	X				
	<i>Cyclodomorphus melanops elongatus</i>	Mallee slender blue tongue	E	X				
	<i>Demansia psammophis</i>	Yellow-faced whipsnake	P	X				
	<i>Diplodactylus tessellatus</i>	Tessellated gecko	P	X				
	<i>Diplodactylus vittatus</i>	Eastern stone gecko	P	X				
	<i>Gehyra variegata</i>	Varied dtella	P	X				
	<i>Heteronotia binoei</i>	Prickly gecko	P	X				
	<i>Lerista muelleri</i>	Wood mulch-slider	P	X				
	<i>Lerista punctatovittata</i>	Eastern robust slider	P	X				
	<i>Lialis burtonis</i>	Burton's snake lizard	P	X				
	<i>Lucasium damaeum</i>	Beaded gecko	P	X				
	<i>Menetia greyii</i>	Common dwarf skink	P	X				
	<i>Morethia adelaidensis</i>	Saltbush morethia skink	P	X				
	<i>Morethia boulengeri</i>	South-eastern morethia skink	P	X				

	<i>Pogona vitticeps</i>	Central beared dragon	P	X				
	<i>Pseudonaja textilis</i>	Eastern brown snake	P	X				
	<i>Tiliqua occipitalis</i>	Western blue tongue lizard	V	X				
	<i>Tiliqua rugosa</i>	Shingle back lizard	P	X				
	<i>Underwoodisaurus milii</i>	Thick-tailed gecko	P	X				
	<i>Varanus gouldii</i>	Sand monitor	P	X				

Flora species known or predicted to occur in the study region

Scientific name	Common name	Status	Regional occurrence	Taila creek	Washpen creek	Lake Benanee	Dry Lake
<i>Acacia ligulata</i>	Umbrella Bush	U	X		X		
<i>Acacia oswaldii</i>	Miljee	U	X				
<i>Acacia sclerophylla</i> var. <i>sclerophylla</i>	Hard-leaved Wattle	U	X				
<i>Acacia stenophylla</i>	River coobah	U			X		
<i>Acacia stenophylla</i>	River Cooba	U	X				
<i>Actinobole uliginosum</i>	Flannel Cudweed	U	X				
<i>Alectryon oleifolius</i> subsp. <i>canescens</i>		U	X				
<i>Alternanthera denticulata</i>	Lesser joyweed	U	X				
<i>Alternanthera nodiflora</i>	Common joyweed	U	X				
<i>Alternanthera</i> spp.	Joyweed	U	X				
<i>Althernanthera denticulata</i>	Lesser joyweed	U			X		
<i>Alyssum linifolium</i>	Flax-leaf Alyssum	U	X				
<i>Angianthus tomentosus</i>	Hairy Cup-flower	U	X				
<i>Asphodelus fistulosus</i>	Onion Weed	U	X				
<i>Atriplex eardleyae</i>		U	X				
<i>Atriplex leptocarpa</i>	Slender-fruit Saltbush	U	X				
<i>Atriplex lindleyi</i>		U	X				

<i>Atriplex nummularia</i>	Old Man Saltbush	U	X				
<i>Atriplex pseudocampanulata</i>		U	X				
<i>Atriplex pumilio</i>		U	X				
<i>Atriplex stipitata</i>	Mallee Saltbush	U	X				
<i>Atriplex vesicaria</i>	Bladder Saltbush	U	X				
<i>Austrodanthonia caespitosa</i>	Ringed Wallaby Grass	U	X				
<i>Austrodanthonia setacea</i>		U	X				
<i>Austrostipa eremophila</i>		U	X				
<i>Austrostipa metatoris</i>	A spear-grass	V		X	X	X	X
<i>Austrostipa metatoris</i>	A spear-grass	V				X	
<i>Austrostipa nitida</i>		U	X				
<i>Austrostipa scabra</i>	Speargrass	U	X				
<i>Austrostipa spp.</i>		U	X				
<i>Austrostipa tuckeri</i>		U	X				
<i>Azolla filiculoides</i>		U	X				
<i>Azolla spp.</i>	Azolla	U			X		
<i>Boerhavia dominii</i>	Tarvine	U	X		X		
<i>Bossiaea walkeri</i>	Cactus Pea	U	X				
<i>Brachyscome lineariloba</i>	Hard-headed Daisy	U	X				
<i>Brassica tournefortii</i>	Mediterranean Turnip	U	X				
<i>Bromus diandrus</i>	Great Brome	I	X				
<i>Bromus rubens</i>	Red Brome	I	X	X	X		
<i>Calandrinia eremaea</i>		U	X				
<i>Callitris glaucophylla</i>	White Cypress Pine	U	X				
<i>Calocephalus sonderi</i>	Pale Beauty-heads	U	X				
<i>Calotis hispidula</i>	Bogan Flea	U	X				
<i>Carrichtera annua</i>	Ward's Weed	U	X				
<i>Carthamus lanatus</i>	Saffron Thistle	I	X				
<i>Cassythra melantha</i>		U	X				
<i>Casuarina obesa</i>	Swamp she-oak	E				X	

<i>Casuarina pauper</i>	Belah	U	X				
<i>Centaurea melitensis</i>	Maltese Cockspur	U	X				
<i>Centipeda cunninghamii</i>	sneezeweed	U			X		
<i>Centipeda cunninghamii</i>	Common Sneezeweed	U	X	X			X
<i>Chamaesyce drummondii</i>	Caustic Weed	U	X		X		
<i>Chenopodium curvispicatum</i>		U	X				
<i>Chenopodium nitrariaceum</i>	Nitre goosefoot	U			X		
<i>Chenopodium nitrariaceum</i>	Nitre Goosefoot	U	X		X		
<i>Chloris truncata</i>	Windmill Grass	U	X				
<i>Citrullus lanatus var. lanatus</i>	Wild Melon, Camel Melon, Bitter	I	X		X		X
<i>Crassula colorata</i>		U	X				
<i>Cynodon dactylon</i>	Common Couch	U	X	X	X		
<i>Cyperus difformis</i>	Dirty Dora	U	X		X		
<i>Cyperus eragrostis</i>	Umbrella sedge	U			X		
<i>Cyperus exaltatus</i>		U	X				
<i>Cyperus gymnocaulos</i>	Spiny sedge	U	X	X	X	X	X
<i>Cyperus pygmaeus</i>		U	X				
<i>Damasonium minus</i>	Starfruit	U	X				
<i>Danthonia spp.</i>	Wallaby grass	U			X		
<i>Daucus glochidiatus</i>	Native Carrot	U	X				
<i>Dianella revoluta</i>		U	X				
<i>Dissocarpus biflorus</i>		U	X				
<i>Dissocarpus paradoxus</i>	Cannonball Burr	U	X				
<i>Dodonaea viscosa subsp. angustissima</i>		U	X				
<i>Eclipta platyglossa</i>		U	X				
<i>Einadia nutans</i>	Climbing Saltbush	U	X				
<i>Eleocharis acuta</i>	Common spike rush	U	X	X	X	X	X
<i>Eleocharis pusilla</i>		U	X				
<i>Elymus scaber</i>		U	X				
<i>Enchylaena tomentosa</i>	Ruby Saltbush	U	X		X		

<i>Epaltes australis</i>	Spreading Nut-heads	U	X				X
<i>Eragrostis australasica</i>	Canegrass	U	X				
<i>Eragrostis cilianensis</i>	Stinkgrass	U	X	X			
<i>Eragrostis dielsii</i>	Mallee Lovegrass	U	X				
<i>Eragrostis lacunaria</i>	Purple Lovegrass	U	X	X			
<i>Eremophila divaricata</i>	Spreading Emubush	U	X				
<i>Eremophila longifolia</i>	Emubush	U	X				
<i>Eucalyptus camaldulensis</i>	River Red Gum	U	X	X	X	X	X
<i>Eucalyptus dumosa</i>	White Mallee	U	X				
<i>Eucalyptus gracilis</i>	Snap and Rattle	U	X				
<i>Eucalyptus largiflorens</i>	Black Box	U	X		X		
<i>Eucalyptus leucoxylon subsp. pruinosa</i>	Yellow gum	V	X				
<i>Eucalyptus oleosa subsp. oleosa</i>	Red Mallee	U	X				
<i>Eucalyptus socialis</i>	Red Mallee	U	X				
<i>Euchiton sphaericus</i>		U	X				
<i>Exocarpos aphyllus</i>	Leafless Ballart	U	X				
<i>Fescue spp.</i>	fescue	U			X		
<i>Goodenia fascicularis</i>		U	X				
<i>Goodenia glauca</i>		U	X		X		
<i>Goodenia varia</i>		U	X				
<i>Goodinea spp.</i>	Goodinea spp.	U			X		
<i>Grevillea huegelii</i>		U	X				
<i>Hakea tephrosperma</i>	Hooked Needlewood	U	X				
<i>Halgania cyanea</i>	Rough Halgania	U	X				
<i>Haloragis glauca f. glauca</i>		U	X	X			
<i>Heliotropium supinum</i>	Prostrate Heliotrope	I	X	X		X	X
<i>Hordeum leporinum</i>	Barley Grass	I	X		X		
<i>Isoetopsis graminifolia</i>	Grass Cushion	U	X				
<i>Juncus amabilis</i>		U	X	X			
<i>Juncus flavidus</i>		U	X				

<i>Juncus ustitadis</i>	Common rush	U			X		
<i>Lachnagrostis filiformis</i>		U	X	X			
<i>Lepidium pseudohyssopifolium</i>	Peppercress	U	X				
<i>Lomandra effusa</i>	Scented Mat-rush	U	X				
<i>Ludwigia peploides</i>	Water primrose	U			X		
<i>Ludwigia peploides subsp. montevidensis</i>	Water Primrose	U	X				
<i>Maireana appressa</i>		U	X				
<i>Maireana brevifolia</i>	Yanga Bush	U	X		X		
<i>Maireana erioclada</i>		U	X				
<i>Maireana georgei</i>		U	X				
<i>Maireana pentatropis</i>		U	X				
<i>Maireana pyramidata</i>	Black Bluebush	U	X				
<i>Maireana radiata</i>		U	X				
<i>Maireana sclerolaenoides</i>		U	X				
<i>Maireana triptera</i>	Three-wing Bluebush	U	X				
<i>Marsilea drummondii</i>	Common Nardoo	U	X		X		
<i>Medicago laciniata</i>	Cut-leaved Medic	I	X				
<i>Medicago minima</i>	Woolly Burr Medic	I	X		X		
<i>Melaleuca lanceolata</i>		U	X				
<i>Muehlenbeckia florulenta</i>	Lignum	U	X		X		
<i>Myriocephalus rhizocephalus</i>	Woolly-heads	U	X				
<i>Myriophyllum crispatum</i>		U	X	X			
<i>Myriophyllum papillosum</i>	Common watermilfoil	U	X		X		
<i>Nymphoides crenata</i>	Wavy Marshwort	U	X				
<i>Olearia magniflora</i>		U	X				
<i>Olearia muel</i>		U	X				
<i>Olearia pimeleoides</i>		U	X				
<i>Onopordum acanthium</i>	Scotch thistle	UU			X		
<i>Opercularia turpis</i>	Twiggy Stinkweed	U	X				
<i>Opuntia spp.</i>		U	X				

<i>Osteocarpum acropterum</i>		U	X				
<i>Ottelia ovalifolia subsp. ovalifolia</i>	Swamp Lily	U	X				
<i>Oxalis corniculata</i>		I	X				
<i>Oxalis perennans</i>		U	X			X	
<i>Panicum spp.</i>	Panic grass	U				X	
<i>Paspalidium jubiflorum</i>	Warrego summer grass	N	X	X		X	
<i>Pentaschistis airoides</i>	False Hairgrass	I	X				
<i>Persicaria decipiens</i>	Slender Knotweed	U	X				
<i>Persicaria prostrata</i>	Creeping Knotweed	U	X				
<i>Phyla nodiflora</i>	Carpet Weed	I	X				
<i>Phyllanthus lacunarius</i>		U	X			X	X
<i>Pittosporum angustifolium</i>		U	X				
<i>Plantago cunninghamii</i>		U	X			X	
<i>Plantago turrifera</i>		U	X				
<i>Pogonolepis muelleriana</i>		U	X				
<i>Polypogon monnspeliensis</i>	Annual beardgrass	U				X	
<i>Potamogeton sulcatus</i>	Potamogeton	U				X	
<i>Pseudognaphalium luteo-album</i>	Jersey cudweed	U				X	
<i>Pseudoraphis spinescens</i>	Spiny Mudgrass	U	X	X			
<i>Ptilotus spathulatus f. spathulatus</i>		U	X				
<i>Rhagodia spinescens</i>	Thorny Saltbush	U	X			X	
<i>Rhodanthe corymbiflora</i>	Small White Sunray	U	X				
<i>Rhodanthe stuartiana</i>		U	X				
<i>Rorippa palustris</i>	Yellow Cress	U	X				
<i>Rumex brownii</i>	Swamp Dock	U	X			X	
<i>Salsola kali var. kali</i>		U	X				
<i>Salvia verbenaca</i>	Wild Sage	U	X				
<i>Schismus barbatus</i>	Arabian Grass	I	X				
<i>Scleranthus minusculus</i>		U	X				
<i>Sclerolaena brachyptera</i>		U	X				

<i>Sclerolaena diacantha</i>	Grey Copperburr	U	X				
<i>Sclerolaena muricata</i> var. <i>muricata</i>		U	X		X		
<i>Sclerolaena obliquicuspis</i>		U	X				
<i>Sclerolaena patenticuspis</i>		U	X				
<i>Sclerolaena stelligera</i>		U	X				
<i>Sclerolaena tricuspis</i>	Giant Redburr	U	X				
<i>Senecio glossanthus</i>		U	X				
<i>Senna form taxon 'coriacea'</i>		U	X				
<i>Senna form taxon 'petiolaris'</i>	Woody Cassia	U	X				
<i>Sida fibulifera</i>		U	X				
<i>Sida trichopoda</i>		U	X				
<i>Silene apetala</i>		I	X				
<i>Silene gallica</i>		I	X				
<i>Sisymbrium erysimoides</i>	Smooth Mustard	U	X				
<i>Sisymbrium irio</i>	London Rocket	I	X				
<i>Solanum esuriale</i>	Quena	U	X				
<i>Solanum nigrum</i>	Black-berry Nightshade	I	X				
<i>Sonchus asper</i> subsp. <i>glaucescens</i>	Prickly Sowthistle	I	X			X	X
<i>Sonchus</i> spp.	Sowthistle	I			X		
<i>Spergularia rubra</i>	Sandspurry	U	X				
<i>Sporobolus mitchellii</i>	Rat's Tail Couch	U	X	X	X		
<i>Stemodia florulenta</i>	Bluerod	U	X	X			
<i>Stenopetalum lineare</i>		U	X				
<i>Stipa</i> spp.	Stipa	U			X		
<i>Swainsona</i> spp.		U	X				
<i>Thysanotus baueri</i>		U	X				
<i>Trifolium arvense</i>	Haresfoot Clover	I	X				
<i>Triodia scariosa</i>	Porcupine Grass	U	X				
<i>Triodia scariosa</i> subsp. <i>scariosa</i>		U	X				
<i>Tripogon loliiformis</i>	Fiveminute Grass	U	X				

<i>Typa orientalis</i>	Broad-leafed cumbungi	U			X		
<i>Vallisneria spiralis</i>	Vallisneria	U			X		
<i>Vittadinia cervicularis</i> var. <i>cervicularis</i>		U	X				
<i>Vittadinia cuneata</i>	Fuzzweed	U	X				
<i>Vittadinia dissecta</i>		U	X				
<i>Vittadinia</i> spp.	Fuzzweed	U			X		
<i>Vulpia bromoides</i>	Squirrel Tail Fesque	I	X				
<i>Vulpia myuros</i> f. <i>megalura</i>		I	X	X	X		
<i>Wahlenbergia fluminalis</i>	River Bluebell	U	X		X		
<i>Wahlenbergia stricta</i> subsp. <i>alterna</i>		U	X				
<i>Westringia rigida</i>	Stiff Westringia	U	X				
<i>Xanthium occidentale</i>	Noogoora Burr, Cockle Burr	I	X				
<i>Xanthium spinosum</i>	Bathurst Burr	I	X			X	X
<i>Zygophyllum ammophilum</i>	Sand Twinleaf	U	X				
<i>Zygophyllum apiculatum</i>	Gallweed, Pointed or Common Twinleaf	U	X				
<i>Zygophyllum aurantiacum</i>	Shrubby Twinleaf	U	X				
<i>Zygophyllum crenatum</i>	Lobed Twinleaf	U	X				
<i>Zygophyllum eremaeum</i>	Climbing Twinleaf	U	X				

Source: Val et al 2001; BioNET 2005; DECC 2005; McCarthy et al 2005; Atlas of NSW Wildlife 2007; DPI 2007b; DEW 2007; McCarthy et al 2007.