

5.3 Fauna Surveys

5.3.1 Literature Review

5.3.1.1 Previous Reports

The Johnstone Centre carried out targeted surveys for threatened species, including Pink-tailed Legless Lizard (*Aprasia parapulchella*), Golden Sun Moth (*Synemon plana*), bats and birds (Johnstone Centre, 2004).

The reptile surveys found seventeen Pink-tailed Legless Lizards. These were recorded on the 'Talpa' property, which is to the north of the current study area, and on the McLean property, which is to the west of the current study area. The Reservoir Hill was also surveyed, but no Pink-tailed Legless Lizards were recorded (Johnstone Centre, 2004).

No targeted surveys for Grassland Earless Dragon (*Tympanocryptis pinguicolla*) or Striped Legless Lizard (*Delmar impar*) were carried out. The Golden Sun Moth was recorded on Crown land and on Robin Pty Ltd to the west of the current study area. Unconfirmed sightings of Golden Sun Moth were made on 'Talpa'. *Austrodanthonia carphoides* (preferred habitat for the Golden Sun Moth) was found on "Googong", but the Johnstone Centre (2004) considered that the level of grazing at this site as prohibitive for the species.

The Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) were recorded in the gully of Googong Creek. Brown Treecreeper (*Climacteris picumnus victoriae*) was recorded at a number of locations, but not within the current study area (Johnstone Centre, 2004).

5.3.1.2 Database Review

Fifteen threatened animal species listed on the TSC Act have previously been recorded within 10 km of the study area (DECC Atlas of NSW Wildlife and Biosis Research records).

These include Golden Sun Moth, Green and Golden Bell Frog (*Litoria aurea*), Southern Bell Frog (*Litoria raniformis*), Pink-tailed Legless Lizard, Rosenberg's Goanna (*Varanus rosenbergii*), Brown Treecreeper, Diamond Firetail (*Staggonopleura guttata*), Gang-gang Cockatoo (*Callocephalon fimbriatum*), Hooded Robin (*Melanodryas cucullata cucullata*), Speckled Warbler (*Pyrrholaemus sagittatus*), Large-footed Myotis (*Myotis macropus*), Eastern Bent-wing bat, Eastern False Pipistrelle, Koala (*Phascolarctos cinereus*) and Spotted-tailed Quoll (*Dasyurus maculatus maculatus*).

Twelve threatened animal species and twelve Migratory species (three of which are also threatened) listed on the EPBC Act, or their habitat, have been previously recorded within 10 km of the study area (DEWHA Online EPBC Database). All species listed as threatened under the EPBC Act and recorded in the locality are also listed under the TSC Act.

A total of 30 threatened fauna and/or Migratory species are considered in this report (**Table 8**). These species are mapped in **Figure 12 (Appendix 1)**.

Table 8. Terrestrial fauna listed on the TSC and/or EPBC Acts that may occur in the local area

Taxon	Common Name	EPBC Act ¹	TSC Act (NSW) ²	Habitat	Potential Habitat Present?
Invertebrates					
<i>Syneon plana</i>	Golden Sun Moth	E	E1	NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which ground layer is dominated by wallaby grasses of the genus <i>Austrodanthonia</i> (DECC, 2005b). It is believed that the females lay up to 200 eggs at the base of the <i>Austrodanthonia</i> tussocks. After hatching, the larvae tunnel underground where they remain feeding on the roots of <i>Austrodanthonia</i> (DEWHA, 2008e).	Yes
Amphibians					
<i>Litoria aurea</i>	Green and Golden Bell Frog	V	E1	Most existing locations for the species occur as small, coastal, or near coastal populations, with records occurring between south of Grafton and northern VIC (NSW Government 2008). Found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes (NPWS 1999b). Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks (NPWS 1999a; White and Pyke 1996).	No
<i>Litoria castanea</i>	Yellow-spotted Tree Frog	E	E1	Found in large permanent ponds, lakes and dams with an abundance of bullrushes and other emergent vegetation (Robinson, 1993).	No
<i>Litoria raniformis</i>	Southern Bell Frog	V	E1	Found in large permanent ponds, lakes and dams with an abundance of bullrushes and other emergent vegetation (Robinson, 1993).	No
Reptiles					
<i>Aprasia parapulchella</i>	Pink-tailed Legless Lizard	V	V	Fossorial species, which lives beneath surface rocks and occupies ant burrows. It feeds on ants, particularly their eggs and larvae (Osborne and Jones, 1995a). Thought to lay eggs within the ant nests under rocks that it uses as a source of food and shelter (DEC, 2005i). Key habitat features are a cover of native grasses, particularly Kangaroo Grass (<i>Themeda australis</i>), sparse or no tree cover, little or no leaf litter, and scattered small rock with shallow embedment in the soil surface (Osborne and Jones, 1995a).	Yes, recorded in study area
<i>Delma impar</i>	Striped Legless Lizard	V	V	Generally occurs in lowland native grasslands occurring on gently undulating plains having soils of basaltic origin (Coulson, 1990). Grasses are dominated by perennial, tussock-forming grasses such as <i>Themeda australis</i> , <i>Austrostipa</i> spp. and <i>Austrodanthonia</i> spp. Inhabits secondary grasslands only when they occur within 2 km of primary grassland (Hadden, 1995).	Yes, but limited by grazing

Table 8 (cont.). Terrestrial fauna listed on the TSC and/or EPBC Acts that may occur in the local area

Taxon	Common Name	EPBC Act ¹	TSC Act (NSW) ²	Habitat	Potential Habitat Present?
<i>Tympanocryptis pinguicolla</i>	Grassland Earless Dragon	E	E1	Occurs at sites dominated by wallaby grasses (<i>Austrodanthonia</i> spp.), spear grasses (<i>Austrostipa</i> spp.), Poa Tussock (<i>Poa sieberiana</i>), Red Grass (<i>Bothriochloa macra</i>), and occasionally Kangaroo Grass (<i>Themeda australis</i>). Introduced pasture grasses occur at many of the sites supporting this species. It apparently prefers areas with a more open structure, characterised by small patches of bare ground between the grasses and herbs. Partially embedded surface rocks, and spider and insect holes are used for shelter. Rocks and arthropod holes provide important thermal refuges during temperature extremes (DECC, 2005c).	Yes, but limited by grazing
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	-	V	This species is a Hawkesbury/Narrabeen sandstone outcrop specialist (Wellington and Wells, 1985). Occurs in coastal heaths, humid woodlands and both wet and dry sclerophyll forests (Cogger 1992).	Yes, in gully along Googong Creek
Birds					
<i>Anthochaera phrygia</i>	Regent Honeyeater	EM	E1	A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests (NPWS 1999c; Pizzey and Knight 1997).	Yes, along Googong Creek
<i>Apus pacificus</i>	Fork-tailed Swift	M	-	Almost exclusively aerial (foraging and roosting). Breed in Asia (Higgins 1999).	Only aerial habitat
<i>Ardea alba</i>	Great Egret	M	-	Terrestrial wetlands, estuarine and littoral habitats and moist grasslands. Inland, prefer permanent waterbodies on floodplains; shallows of deep permanent lakes (either open or vegetated), semi-permanent swamps with tall emergent vegetation and herb dominated seasonal swamps with abundant aquatic flora. Also, regularly use saline habitats including mangrove forests, estuarine mudflats, saltmarshes, bare saltpans, shallows of salt lakes, salt fields and offshore reefs. Breeding requires wetlands with fringing trees in which to build nests including mangrove forest, freshwater lakes or swamps and rivers (Marchant and Higgins 1990).	No
<i>Ardea ibis</i>	Cattle Egret	M	-	Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands (Marchant and Higgins 1990).	Yes

Table 8 (cont.). Terrestrial fauna listed on the TSC and/or EPBC Acts that may occur in the local area

Taxon	Common Name	EPBC Act ¹	TSC Act (NSW) ²	Habitat	Potential Habitat Present?
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	-	V	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests (Higgins, 1999). Also occurs in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest (Forshaw and Cooper, 1981; Cameron, 2007). In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas (Shields and Crome, 1992). It requires tree hollows in which to breed (Gibbons and Lindenmayer, 1997).	Yes
<i>Climacteris picumnus victorise</i>	Brown Treecreeper (eastern subspecies)	-	V	Lives in eucalypt woodlands, especially areas of relatively flat open woodland typically lacking a dense shrub layer, with short grass or bare ground and with fallen logs or dead trees present (Trail and Duncan, 2000).	Yes
<i>Gallinago hardwickii</i>	Latham's Snipe	M	-	Typically found on wet soft ground or shallow water with good cover of tussocks. Often found in wet paddocks, seepage areas below dams (Pizzey and Knight, 1997).	No
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	M	-	A Migratory species that is generally sedentary in Australia, although immature individuals and some adults are dispersive (Marchant and Higgins, 1993). Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes. It hunts over open terrestrial habitats. Feeds on birds, reptiles, fish, mammals, crustaceans and carrion. Roosts and makes nest in trees (Marchant and Higgins, 1993).	No
<i>Hirundapus caudacutus</i>	White-throated Needletail	M	-	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breed in Asia (Pizzey and Knight, 1997).	Only aerial habitat
<i>Lathamus discolor</i>	Swift Parrot	EM	E1	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects (Forshaw and Cooper, 1981). The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW (Shields and Crome, 1992). This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability (Pizzey and Knight, 1997).	Yes
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	-	V	This species lives in a wide range of temperate woodland habitats, and in a range of woodlands and shrublands in semi-arid areas (Trail and Duncan, 2000).	No

Table 8 (cont.). Terrestrial fauna listed on the TSC and/or EPBC Acts that may occur in the local area

Taxon	Common Name	EPBC Act ¹	TSC Act (NSW) ²	Habitat	Potential Habitat Present?
<i>Merops ornatus</i>	Rainbow Bee-eater	M	-	Usually occurs in open or lightly timbered areas, often near water. Nest in embankments, including banks of creeks and rivers, in sand dunes, in quarries and in roadside cuttings. Breeding occurs from November to January. It has complex migratory movements in Australia. NSW populations migrate north for winter (Higgins, 1999).	Yes
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	M	-	Migratory species that occurs in coastal forests, woodlands and scrubs during migration. The species breeds in heavily vegetated gullies (Pizzey and Knight, 1997).	No
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	Found mainly in open, tall riparian River Red Gum forest or woodland. Often found in farmland including grazing land with patches of remnant vegetation. It breeds in hollow branches of tall Eucalypt trees within 9 km of feeding areas (Higgins, 1999).	Yes
<i>Pyrholaemus sagittatus</i>	Speckled Warbler	-	V	This species occurs in eucalypt and cypress woodlands on the hills and tablelands of the Great Dividing Range. It prefers woodlands with a grassy understorey, often on ridges or gullies (Blakers <i>et al.</i> , 1984; NSW Scientific Committee, 2008b). The species is sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. It forages on the ground and in the understorey for arthropods and seeds (Blakers <i>et al.</i> 1984; NSW Scientific Committee 2008a). The home ranges vary from 6-12 ha (NSW Scientific Committee, 2008c).	No
<i>Rhipidura rufifrons</i>	Rufous Fantail	M	-	A migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. During migration it can stray into gardens and more open areas (Pizzey and Knight, 1997).	No
<i>Rostratula australis</i>	Australian Painted Snipe	VM	E1	The species is usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grassland. It prefers freshwater wetlands, ephemeral or permanent, although they have been recorded in brackish waters (Marchant and Higgins, 1993). The species requires tall vegetation and standing water for nesting and would often nest on a small island of tussocks or reeds within a wetland area.	No
<i>Stagonopleura guttata</i>	Diamond Firetail	-	V	The species is found in a range of habitat types including open eucalypt forest, mallee and acacia scrubs (Pizzey and Knight, 1997). Often occur in vegetation along watercourses (Higgins <i>et al.</i> , 2006).	No

Table 8 (cont.). Terrestrial fauna listed on the TSC and/or EPBC Acts that may occur in the local area

Taxon	Common Name	EPBC Act ¹	TSC Act (NSW) ²	Habitat	Potential Habitat Present?
Mammals					
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll	E	V	Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests (Dickman and Read, 1992). Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage (Edgar and Belcher, 1995).	Minimal, mainly along Googong Creek
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	-	V	The species inhabits sclerophyll forests, preferring wet habitats where trees are more than 20 m high (Churchill, 1998). Two observations have been made of roosts in stem holes of living eucalypts (Phillips, 1995). There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor (Menkhorst and Lumsden 1995). This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites (Menkhorst and Lumsden, 1995).	Yes
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat	-	V	Broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Roost in caves and man made habitats and under road culverts (Strahan, 1995).	Yes
<i>Myotis macropus (adversus)</i>	Large-footed Myotis	-	V	Occurs in most habitat types as long as they are near permanent water bodies, including streams, lakes and reservoirs. Commonly roost in caves, but can also roost in tree hollows, under bridges and in mines (Richards, 1995; Churchill, 1998).	Yes

**Key: 1) Listed on the EPBC Act as Endangered (E) or Vulnerable (V) or covered under migratory provisions (M) on the EPBC Act
2) Listed on the TSC Act as Endangered (E1) or Vulnerable (V)**

5.3.2 Fauna Survey Results

5.3.2.1 Fauna Habitats

Grassland with Scattered Trees

The majority of the study area is grazing land with little surface rock cover and occasional isolated paddock trees (mostly Eucalypts) or windbreaks of Radiata Pine (*Pinus radiata*). In most paddocks, there is very little cover of native grasses (**Plate 13**).

The main animal species seen in these areas were Australian Magpies (*Gymnorhina tibicen*), Australian Ravens (*Corvus coronoides*), and Magpie-larks (*Grallina cyanoleuca*). Red-rumped Parrots (*Psephotus haematonotus*) were observed in the paddock trees. Common Starlings (*Sternus vulgaris*) and House Sparrows (*Passer domesticus*) were also common.

Some native groundcover was present. *Austrodanthonia carphoides*, potential habitat for the threatened Golden Sun Moth, was present in patches in the study area, particularly near the Reservoir Hill and near the proposed SPS sites.

These areas also had a range of other groundcover and outcropping surface rock, which could provide habitat for threatened grassland lizards such as Grassland Earless Dragon, Striped Legless Lizard and Pink-tailed Legless Lizard. The Pink-tailed Legless Lizard was recorded near the proposed SPS to the east of NH1A.

Woodlands

The main area of woodland in the study area is associated with the Googong Creek gully (**Plate 14**). This area consists of *Eucalyptus* trees with Burgan (*Kunzea ericoides*) as the main understorey species, dominant in many areas.

A range of small woodland birds were recorded in the area, including Grey Fantails (*Rhipidura fuliginosa*) and White-eared Honeyeaters (*Lichenostomus leucotis*). This area is likely to provide habitat for a number of threatened birds, including the Brown Treecreepers. Termite mounds were recorded in the area and could provide habitat for Rosenberg's Goanna.



Plate 13. Paddock with scattered trees

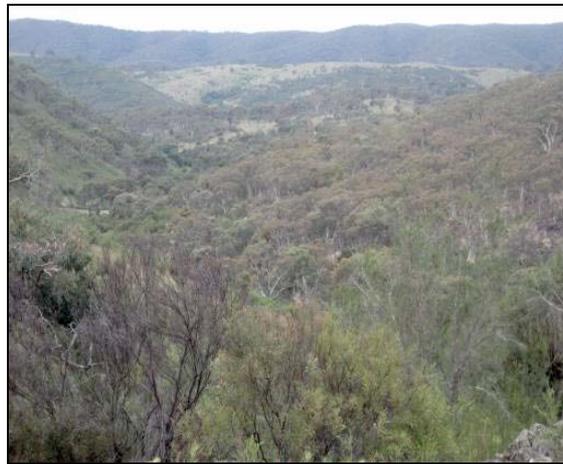


Plate 14. Googong Creek Gully

Other woodland within the study area is restricted to narrow strips of roadside vegetation. In general, this is less than approximately 5 m in width. Species recorded included Crimson Rosellas (*Platycercus elegans*), White-throated Gerygones (*Gerygone olivacea*) and Yellow-rumped Thornbills (*Acanthiza chrysorrhoa*).

Hollow-bearing trees are abundant in the Googong Creek vegetation, and in the roadside vegetation. These are likely to provide nesting habitat for parrots, possums and bats.

Rocky Slopes and Outcrops

Rocky slopes and outcrops are present at a number of locations in the study area (**Plate 15**). In particular, rocky outcrops are common in areas associated with the Montgomery Creek and Reservoir Hill.

Some surface rock is also present in paddocks within the study area. In some areas, the rock outcrops are at an almost vertical angle, while in other places it occurs as plates sitting on the surface. The latter provides habitat for a range of invertebrates, such as ants, scorpions and centipedes. The threatened Pink-tailed Legless Lizard uses the rock habitat for shelter, foraging and breeding.

Farm Dams

A number of farm dams (**Plate 16**) are present on the subject site. These have very little or no emergent vegetation, and are heavily used by sheep. Australian Wood Ducks (*Chenonetta jubata*) and Grey Teal (*Anas gracilis*) were recorded at these dams, as well as Welcome Swallows (*Hirundo neoxema*). The Spotted Grass Frog (*Limnodynastes tasmaniensis*) was recorded at the dam near the Reservoir Hill.



Plate 15. Habitat of Pink-tailed Legless Lizard in study area



Plate 16. A typical farm dam

Googong Creek

The Googong Creek was not flowing at the time of surveys. This creek followed a steep vegetated gully down to the Queanbeyan River. Obstructions (e.g. a raised track) had led to the formation of a number of pools. These had emergent vegetation and are likely to form habitat for a number of common frog species such as Spotted Grass Frog, Haswell's Frog (*Paracrinia haswellii*) and the Common Eastern Froglet (*Crinia signifera*).

5.3.2.2 Fauna

Fauna recorded in the study area during current surveys are listed in **Appendix 11- Table A20** and include 47 bird species (four introduced), fifteen mammals (three introduced), three amphibians and four reptiles. Two threatened species: the Eastern Bent-wing Bat and the Pink-tailed Legless Lizard were recorded in the study area.

The Eastern False Pipistrelle has previously been recorded in the study area (Johnstone Centre, 2004). A range of other threatened species have previously been recorded in the locality, including the Golden Sun Moth and Brown Treecreeper.

The Pink-tailed Legless Lizard was recorded at two locations within the study area, both associated with habitats of the Montgomery Creek. One live individual and one skin were recorded near where the SPS is proposed, and two live individuals were recorded to the south-east in the same gully system of the Montgomery Creek.

6. Impact Assessment

The guidelines for assessing the significance of impacts (DEC, DPI, 2005) advises the following matters to be considered in determining the nature and magnitude of an impact of works, such as proposed:

- The total impact which can be attributed to that action over the entire geographic area affected, and over time;

- Pre-construction, construction and occupation/maintenance phases;

- All on-site and off-site impacts, including location, installation, operation and maintenance of infrastructure and fire management zones;

- All direct and indirect impacts;

- The frequency and duration of each known or likely impact/action;

- The sensitivity of the receiving environment; and

- The degree of confidence with which the impacts of the action are known and understood.

The threatened species assessment of significance is not to be considered a 'pass or fail' test of potential impacts. Instead, a due consideration of the operating factors is expected to inform the decision-making process of the likelihood of significant effects.

All factors should be considered, as well as any other information deemed relevant to the assessment. The assessment of significance should not be used as a substitute for a species impact statement. Application of the 'precautionary principle' requires that a lack of scientific certainty about the potential impacts of an action does not itself justify a decision that the action is not likely to have a significant impact.

If information is not available to conclusively determine that there will not be a significant impact on a threatened species, population or ecological community, or its habitat, then it should be assumed that a significant impact is likely.

Proposed measures that mitigate, improve or compensate for the action, development or activity are not to be considered in determining the degree of the effect on threatened species, populations or ecological communities, unless the measures have been used successfully, for that species in a similar situation.

In many cases where complex mitigating, ameliorative or compensatory measures are required, such as translocation, bush restoration or purchase of land, further assessment is likely to be required.

Recovery and threat abatement plans, priorities action statements, threatened species profiles and other fact sheets prepared by DECC and DPI provide further guidance on whether an action, or an activity, is likely to be significant.

6.1 Impacts of the Proposal

The majority of the study area was assessed based on required infrastructure for the the Googong Water Cycle Project, located within the proposed Googong New Township development site. The subject sites also included areas which would be impacted along Old Cooma Road, and part of the Googong Foreshores (Googong Dam Road, Googong WTP Site and access road corridor and some sections of the Montgomery Creek). The Googong Creek, which is north of Googong Dam Road, would also be impacted by the proposal.

The study assessed the likely potential impacts of the construction phase of the proposed works on existing flora and fauna within the subject sites, based on:

- Findings of the review of existing information;

- Consideration of the Key Threatening Processes (KTPs) identified by the TSC Act and EPBC Act;

- Results of extensive field surveys of the study area; and

- Consideration of the development footprint, provided by the scope of works.

The report includes the basis and rationale of the assessed potential impacts on flora and fauna, the results of which are discussed in terms of significance, magnitude, reversibility and other suitable parameters.

Where potential adverse impacts of the proposed works on existing flora and fauna are identified, safeguards and appropriate mitigation measures are recommended to reduce those impacts (**Section 7**).

The major environmental impacts arising from the proposal include the following:

- Ground disturbances associated with the construction of potable and wastewater infrastructure, including buildings, and the operation of the water reservoirs, the water cycle infrastructure and delivery mains;

- Ground disturbances associated with the construction of wastewater infrastructure, including buildings, and operations of WRP, SPSs and underground connections;

- Ground disturbances during the installation of the stormwater channeling and management system, including riparian corridors; and

- Discharge of stormwater down Googong Creek.

It is noted that the Water Cycle Project is proposed in order to support the subdivision of NH1A of the Googong New Town, the first stages of which are being assessed under Part 4 of the EP&A Act.

These assessments should be read with the assumption that the subdivision of NH1A has been separately assessed and determined, and that impacts arising from the Water Cycle Project are additional to the impacts from the development of the township.

As such, this report assumes that much of the study area, although currently grazing land, will be developed and is lacking in potential habitat for many of the species discussed.

6.2 Key Threatening Processes

This section provides a discussion of the impacts of the proposed works, addressing the key threatening processes (KTPs) identified by the TSC Act and EPBC Act. The KTPs provide specific contextual information regarding potential impacts, which need to be considered in assessing the proposal. It should be noted that the extent of the impacts on each species and community would vary. Assessments of the likely impacts on each species are provided in **Appendices 12-15**.

The following KTPs, listed under the TSC Act, are likely to result from the proposal:

- (a) Clearing of native vegetation;
- (b) Alteration to natural flow regimes of rivers, streams, floodplains and wetlands;
- (c) Invasion of native plant communities by exotic perennial grasses;
- (d) Bushrock removal; and
- (e) Loss of hollow-bearing trees and removal of dead wood and dead trees.

Each KTP is discussed below, as they relate to the proposed works.

Clearing of native vegetation

Schedule 3 of the TSC Act lists 'clearing of native vegetation' as a KTP (NSW Scientific Committee, 2001). 'Land clearance' is listed as a KTP under the EPBC Act and clearing of native vegetation is also subject to the *Native Vegetation Act* (2003).

For the purposes of the legislation, 'native vegetation' is defined as made up of plant communities, comprising primarily indigenous species, including canopy trees (where present), understorey, ground cover and below ground biomass (roots, bulbs and the seed bank).

'Clearing', as defined by the legislation, refers to the destruction of a sufficient proportion of one or more strata (layers) within a stand or stands of native vegetation.

Impacts of the clearing of native vegetation on biological diversity include:

- Destruction of habitat, causing a loss of biological diversity, which may result in total extinction of species or loss of local genotypes;
- Fragmentation of populations, resulting in limited gene flow between small isolated populations, reduced potential to adapt to environmental change and loss or severe modification of the interactions between species;
- Riparian zone degradation, such as bank erosion leading to sedimentation that affects aquatic communities;
- Disturbance of habitat, which may increase habitat for the establishment and spread of exotic species, displacing native species;
- Loss of leaf litter, removing or modifying habitat for a wide variety of vertebrates and invertebrates and soil biota; and
- Loss or disruption of ecological functions at ecosystem, population and community levels.

Given the nature of the development proposal, clearing of some native vegetation is unavoidable. However, adverse impacts are largely dependent on the quality of the vegetation that is being cleared, the magnitude of the clearing and the way clearing is conducted, and possibly the level and quality of post-clearing rehabilitation. In its current state, the study areas are mostly heavily grazed, comprising degraded pasture with scattered trees.

The proposal for construction of infrastructure for the Water Cycle Project will result in the clearing of approximately 10 hectares of degraded pasture and already disturbed, poor quality roadside vegetation, which is largely of no conservation value, except for:

Potential loss of populations and seed banks of some Australian native grasses (i.e. *Themeda australis*);

Potential loss of some Gum trees, of species that are very common in the region.

The proposed works intends no large-scale clearing of native vegetation. There would be removal of some trees, partly due to low quality or being partially or fully dead (JEA, 2009).

The majority of trees, which are of value as part of the landscape's biodiversity, and for their fauna habitat values are likely to be retained, as elements of the Googong New Township's biodiversity attractions.

There is some recognition that roadside vegetation has important biodiversity values, particularly in rural and peri-urban areas, because such vegetation comprises important biodiversity links and corridors, allowing consolidation of existing remnant corridors (HCCREMS, 2007; DEC, 2005n; DEH, 2009).

Road verges also allow for the occurrence of rare or threatened species, populations or communities. However, the roadside vegetation of Old Cooma Road and Googong Dam Road (part of Googong Foreshores) is not part of a wildlife corridor in the area or region. Nevertheless, the Yarrowlumla LEP (Yarrowlumla DCP, 2002) does recognise the importance of roadside vegetation, throughout the municipality.

Relatively small areas of degraded pasture and roadside vegetation and a selection of woodland trees would be cleared as part of the Water Cycle Project. As previously discussed, the majority of the subject site is currently heavily grazed and does not form good quality habitat for many native species.

The study areas, including the already fragmented part of the Googong Foreshores (Googong Dam Road, WTP Site and corridor and Googong Creek), are also not part of a wildlife corridor. However, given that the study areas include the areas that were historically part of 'White Box-Yellow Box-Blakely's Red Gum Woodlands' (i.e. Googong Creek area) and the 'Natural Temperate Grasslands of the Southern Tablelands of NSW and the ACT (i.e. the broad development site, NH1A), the existence of potential habitat is recognised for these EECs, as well as for a number of threatened species.

Therefore, in undertaking the proposed vegetation clearing activities, given in the description of works (Section 3.4), consideration needs to be given to potential loss of habitat for the EECs, and threatened species. As a consequence, mitigating the adverse impacts on potential flora

and fauna habitat and managing some of the issues identified by the KTPs, discussed in **Section 7**, are of high importance.

The main adverse fauna impact that could result from the proposal is the clearing of grassland that is potential habitat for native species, such as the Golden Sun Moth, Grassland Earless Dragon, and Striped Legless Lizard. The Pink-tailed Legless Lizard, which has been recorded in the study area, could also be impacted by the removal of rocky grassland habitat.

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

'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands' is a KTP listed under the TSC Act Schedule 3 (NSW Scientific Committee, 2002b).

Alteration to natural flow regimes can occur through the reduction or increasing of flows, altering the seasonality of flows, changing the frequency, duration, magnitude, timing, predictability and variability of flow events, altering surface and sub-surface water levels and by changing the rate of rise or fall of water levels. These are major factors contributing to loss of biological diversity and ecological function in aquatic ecosystems, including floodplains.

Major alteration to natural flow regimes could cause a large number of species, populations or ecological communities that rely on water flows for their short term and long-term survival to become threatened. Impacts associated with altering natural flow regimes relevant for this impact assessment, include:

- Changes that could lead to reduced flows, leading to a lower distribution of organic matter on which invertebrates and vertebrates depend on;

- Increased flows and the permanent flooding of wetlands and depressions, which kills vegetation depending on the frequency of intermittent flooding, decreasing habitat for invertebrates and waterbirds as a result;

- Riparian zone degradation, where changes to flows increases erosion, leading to sedimentation impacts upon aquatic communities;

- Creation of deeper and more permanent standing water pools, which permits the establishment and spread of exotic species; and

- Changes to the physical, chemical and biological conditions of streams, which alters their existing biota.

Additionally, the proposed stormwater management system involves discharging stormwater down Googong Creek to the Queanbeyan River. Given that there is hardly any flow in the Googong Creek during much of the year, future discharges of stormwater may increase the level of flow above the normal flows in the creek.

Unless the flows are managed, geomorphological changes like increased sedimentation, possible changes in routes of flow and collapsing of bank sections, which are already eroding, could occur with detrimental effects at downstream locations and the receiving water (Queanbeyan River).

In addition, the stormwater from the development is likely to be different in water quality (for instance, the stormwater is likely to be richer in nutrients, such as nitrogen and phosphorus) above the typical levels from degraded pasture, conditions in the creek are likely to be modified. It is however noted that implementing elements of water sensitive urban design (WSUD) within the development would largely reduce the inflow of additional nutrients into the Googong Creek and its receiving waters.

However, additional discharges could also lead to further downstream spread of invasive species like Blackberry and Serrated Tussock, which are currently limited in spread. These weeds could not only spread along the entire length of the creek, but also across its banks on to terrestrial environments, which are habitat for the species assemblages of the adjacent Box-Gum Woodlands. Flushes of water from the pooled areas may flush tadpoles and other animals downstream.

Invasion of native plant communities by exotic perennial grasses

Schedule 3 of the TSC Act lists invasion of native plant communities by exotic perennial grasses as a KTP (NSW Scientific Committee, 2003a).

Exotic perennial grasses are those that are not native to NSW and have a life-span of more than one growing season. More than a hundred species of such grasses occur in NSW. A relatively small number of these perennial grasses threaten native plant communities, and it is these species, which are of concern. The listing recognises the increasing evidence that some of the exotic perennial grass species have significant adverse impacts on biodiversity.

Two exotic perennial grasses stated in the Schedule, namely, Serrated Tussock (*Nassella trichotoma*) and African Lovegrass (*Eragrostis curvula*) are relevant to this impact assessment, as they are abundant, mainly in the road verges and Googong Creek habitat.

Serrated Tussock already infests more than a million hectares in southern Australia, but has the potential to spread over a much larger area. It invades native grasslands, grassy woodlands, dry forests and rocky shrublands. Its large tussocks, formed by clusters of individual plants, are capable of producing more than 10,000 seeds annually. Some seeds remain viable in the soil for more than 10 years. Mature plants often droop across the ground, smothering other species.

Similarly, African Lovegrass is a fast growing species, which had been introduced in Australia, mainly to stabilise sand dunes. It grows vigorously, often replacing native grass and other ground covers. It tolerates drought and is known to have invaded large areas of grassy woodlands and native pastures in NSW and is spreading rapidly in other regions.

Perennial grasses are also recognised for producing large amounts of plant matter, which dry quickly and contribute increased fuel loads. This fuel results in fire regimes that favour the spread of the same perennial grasses. Hotter and more frequent fires often lead to changes in the structure of resident vegetation, and in some cases, cause local extinctions of some plant and animal species.

Examples of EECs threatened by exotic perennial grasses, listed in the Schedule 3 include both the 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodlands and Derived Native Grassland' and the 'Natural Temperate Grasslands of the Southern Tablelands of NSW and the ACT', which are assessed in this report, because of potential habitat for their constituent species within the subject site.

It is apparent from the above discussion that the construction activities related to the Water Cycle Project need to be undertaken and environmental impacts managed well, to avoid causing further spread of both Serrated Tussock and African Lovegrass populations at the disturbed sites.

Loss of hollow-bearing trees and removal of dead wood and dead trees

Schedule 3 of the TSC Act lists the 'Loss of hollow-bearing trees and removal of dead wood and dead trees' as a KTP (NSW Scientific Committee, 2003b; 2007a).

In NSW, terrestrial vertebrate species that are reliant on tree hollows for shelter and/or nests include at least 46 mammals, 81 birds, 31 reptiles and 16 frogs (Gibbons and Lindenmayer, 1997; 2002). Of these, 40 species are listed as threatened under the TSC Act.

The study area has many hollow-bearing paddock trees. In addition, there are hollow-bearing trees in the roadside vegetation. These provide suitable den and nesting habitat for a range of common birds, such as parrots, and possibly for arboreal mammal species, such as Common Brush-tailed Possums (*Trichosurus vulpecula*). Locally recorded threatened species requiring tree-hollows for roosting include Brown Treecreepers, Gang-gang Cockatoos and Eastern False Pipistrelles.

The removal of standing dead wood reduces the availability of hollows over time, and the input of material to the litter layer. Fallen branches and bark, which are scattered throughout wooded areas, provide refuge and nesting habitat for a range of terrestrial animals. Many invertebrates and amphibians rely on these 'moisture-retaining' microhabitats to over-winter or as refuge during periods of drought. Similarly, many reptiles rely on ground litter and debris for shelter and foraging. Larger hollow logs could provide potential dens and nesting habitat for small animals, the threatened Spotted-tailed Quoll and its prey.

Removal of Bushrock

Schedule 3 of the TSC Act lists 'Removal of Bushrock' as a KTP (NSW Scientific Committee, 1999a). Bushrock removal is the removal of natural surface deposits of rock from rock outcrops or from areas of native vegetation. However, it does not include: the removal of rock from approved quarrying activities; the salvage of rock where the removal of the rock is necessary for carrying out an approved development or the removal of rock from paddocks when it constitutes a necessary part of a routine agricultural activity (NSW Scientific Committee, 2007).

As previously discussed, surface rocks are very much a part of the landscape of the study area, and are an important habitat feature for the Pink-tailed Legless Lizard.

Some removal of rock may occur as part of the Water Cycle Project, but this must be minimal. Also, removal of rock should be discouraged following construction of the Googong New Township, in order to protect habitat for grassland reptiles and other fauna.

6.3 Part 3A Assessment of Impacts

6.3.1 Introduction

The impacts of the proposal on threatened biota, listed under the TSC Act were undertaken following the Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act (DEC, 2004; DEC, DPI, 2005; DECC, 2007a). Where threatened biota is recorded within a study area, an impact assessment is required under the EP&A Act.

When threatened biota is not recorded during a survey, the presence of potential habitat for this species is used to determine the need to undertake an impact assessment under the EP&A Act.

Where there is no potential habitat in the study area for threatened biota, there is unlikely to be any impact on these species and these species do not require further consideration.

6.3.2 Assessment of Key Thresholds

The Part 3A Guidelines of the EP&A Act (DEC, 2004; DEC, DPI, 2005; DECC, 2007a) set out a number of key thresholds, which need to be addressed to justify the impacts of the proposal on threatened species, populations or ecological communities. The key thresholds are:

- Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts, will maintain or improve biodiversity values;
- Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community;
- Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction; and
- Whether or not the proposal will adversely affect critical habitat.

Table 9 below provides a brief discussion for each of the key thresholds that relate to the EECs. **Table 10** provides a similar discussion on threatened flora and fauna in the study area.

Based on the impact assessments (**Appendices 12 and 13**), the proposal is unlikely to reduce the long-term viability of and habitat availability for the EECs. Nor will the proposal accelerate the extinction of the constituent species that characterise the EECs.

Moreover, the proposal is not likely to have a significant impact on any of the listed threatened flora whose habitat is likely to occur, within the study area.

Of threatened fauna species found in the study area, the Golden Sun Moth and Pink-tailed Legless Lizard may be significantly impacted by the proposal. Other fauna species and/or populations, either found in the surveys, or whose habitat is likely to occur, are not likely to be adversely affected by the proposal.

Table 9. Key Thresholds for Endangered Ecological Communities - Flora

EEC	Will the proposal have an adverse effect on the extent of the EEC, or adversely modify the composition of the EEC, or its habitat, such that its local occurrence or species assemblages are likely to be placed at risk of extinction?	Will the habitat to be removed, modified, fragmented or isolated adversely affect the long-term survival of the species, population or EEC in the locality?	Will the proposal adversely affect critical habitat?
<p>Natural Temperate Grasslands of the Southern Tablelands of NSW and ACT (TSC Act, EPBC Act)</p>	<p>The EEC and its species assemblage have been recorded in close proximity to the study area, and potential habitat is present in the study area (albeit heavily grazed). The heavily grazed pasturelands that have been degraded over a very long period are not considered as representative of the grasslands of this EEC.</p> <p>Some clearing is inevitable in the proposal, but this is not regarded as large scale clearing of good quality habitat that might be suitable for some constituent species of the EEC. The total area affected by the proposed works is relatively small.</p> <p>Therefore, the proposal will not further reduce the long-term viability of the EEC in the local area or in the region; or place the constituent native grassland and forb species at risk of extinction.</p>	<p>Unlikely</p>	<p>No</p>
<p>White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act)</p>	<p>The EEC and its species assemblage have been recorded in close proximity to the study area, and potential habitat is present in the study area, particularly the Goongong Creek habitat for the overstorey canopy trees, middle storey small-to-medium trees and the understorey shrublands and native grasslands.</p> <p>The Goongong Creek will receive stormwater from the subdivision, after implementation of WSUD elements. The volume of stormwater discharges is likely to be relatively small. The water quality of the discharges is also not likely to be significantly different to that from a typical agricultural catchment. Some effects of the discharges (more frequent water flow) would be felt by the species occupying the aquatic habitat and lower riparian zones.</p> <p>Given the above, the creek environment is not likely to be modified to an extent that would place at risk the constituent species of the EEC. Therefore, the proposal could further reduce the long-term viability of the EEC.</p>	<p>Unlikely</p>	<p>No</p>

Table 10. Key Thresholds for Threatened (Endangered/Vulnerable) Flora and Fauna

Threatened Species	Will the proposal reduce the long-term viability of a local population of the species?	Will the proposal accelerate the extinction of the species or place it at risk of extinction?	Will the proposal adversely affect critical habitat?
Flora			
Button Wrinklewort (<i>Rutidosia leptorrhyncooides</i>)	The species has been recorded in proximity to the study area, and potential habitat is considered to present in the study area, although much of it is poor quality, heavily grazed, degraded pasture. Some clearing is inevitable in the proposal, but this is not regarded as large scale clearing of habitat that might be suitable for the species. The total area affected by the proposed works is relatively small. Therefore, the proposal will not further reduce the long-term viability of the EEC in the local area or in the region; or place the constituent native grassland and forb species at risk of extinction.	Unlikely	No
Mountain Swainson Pea (<i>Swainsona recta</i>)	The species has not been recorded from the study area. However, potential habitat is present in the study area, possibly along road verges and relatively ungrazed areas at the top end of Googong Creek and in other habitat along Googong Creek. Some clearing is inevitable in the proposal, but this is not regarded as large scale clearing of habitat that might be suitable for the species. The total area affected by the proposed works is relatively small. Therefore, the proposal will not further reduce the long-term viability of a local population or the occurrence of the species in the local area or in the region.	Unlikely	No
Silky Swainson Pea- (<i>Swainsona sericea</i>)	The species has been recorded in an area several kilometres to the south of the study area, and potential habitat is present in the study area, possibly along road verges and relatively ungrazed areas at the top end of Googong Creek and in other habitat along Googong Creek. Some clearing is inevitable in the proposal, but this is not regarded as large scale clearing of habitat that might be suitable for the species. The total area affected by the proposed works is relatively small. Therefore, the proposal will not further reduce the long-term viability of a local population or the occurrence of the species in the local area or in the region.	Unlikely	No
Pale Pomaderris (<i>Pomaderris pallida</i>)	The species has not been recorded from the study area. However, potential habitat exists in the Googong Creek area. The excess stormwater discharges are relatively small, and not likely to remove or significantly modify habitat associated with the creek. As a terrestrial shrub species occupying the middle-storey of Box-Gum Woodlands, potential habitat of Pale Pomaderris is not likely to be greatly modified by the discharges of stormwater down Googong Creek.	Unlikely	No

Table 10 (cont.). Key Thresholds for Threatened (Endangered/Vulnerable) Flora and Fauna

Threatened Species	Will the proposal reduce the long-term viability of a local population of the species?	Will the proposal accelerate the extinction of the species or place it at risk of extinction?	Will the proposal adversely affect critical habitat?
Tessellated Spider Orchid (<i>Caledinia tessellata</i>)	The species has not been recorded from the study area. However, potential habitat exists in the Googong Creek area. The excess stormwater discharges are relatively small, and not likely to remove or significantly modify habitat associated with the creek. As a terrestrial species that can occur in the understorey of Box-Gum Woodlands and grasslands, potential habitat of the Tessellated Orchid is not likely to be greatly modified by the discharges of stormwater down Googong Creek.	Unlikely	No
Hoary Sunray (<i>Leucocorysum albicans</i> var. <i>tricolor</i>)	This species has been recorded at a property some distance away from the study area to the north-west of the Googong development. Suitable habitat also exists, possibly along road verges and in relatively ungrazed areas at the top end of Googong Creek and in other habitat along Googong Creek. Some clearing is inevitable in the proposal, but this is not regarded as large scale clearing of habitat that might be suitable for the species. The total area affected by the proposed works is relatively small. Therefore, the proposal will not further reduce the long-term viability of a local population or the occurrence of Hoary Sunray in the local area or in the region.	Unlikely	No
Mauve Burr-daisy (<i>Calotis glandulosa</i>)	This species has not been recorded from the study areas; however, suitable habitat exists, possibly along road verges and in relatively ungrazed areas at the top end of Googong Creek and in other habitat along Googong Creek. Other study areas- much of the subdivision and Neighbourhood 1 are heavily grazed, degraded pasture, are not suitable habitat for the species. Some clearing is inevitable in the proposal, but this is not regarded as large scale clearing of habitat that might be suitable for the species. The total area affected by the proposed works is relatively small. Therefore, the proposal will not further reduce the long-term viability of a local population or the occurrence of the species in the local area or in the region.	Unlikely	No
Austral Toadflax (<i>Thesium australe</i>)	The species has not been recorded from the study area. However, potential habitat exists in the Googong Creek area. The excess stormwater discharges are relatively small, and not likely to remove or significantly modify habitat associated with the creek. As a terrestrial species that shares habitat with wet grasslands occupying the understorey of Box-Gum Woodlands, potential habitat of Austral Toadflax is not likely to be greatly modified by the discharges of stormwater down Googong Creek.	Unlikely	No

Table 10 (cont.). Key Thresholds for Threatened (Endangered/Vulnerable) Flora and Fauna

Threatened Species	Will the proposal reduce the long-term viability of a local population of the species?	Will the proposal accelerate the extinction of the species or place it at risk of extinction?	Will the proposal adversely affect critical habitat?
Fauna			
Golden Sun Moth	Possible. The species has been recorded in close proximity to the study area, and potential habitat is present in the study area (albeit heavily grazed). Given the sensitive ecology of the species, and the difficulty of detection, it is possible that a local population could occur in the study area and that the proposal could reduce its long-term viability.	Possible	No
Grassland Earless Dragon	Unlikely. Potential habitat in the study area has been heavily grazed, making the area marginal at best for this species.	Unlikely	No
Pink-tailed Legless Lizard	Possible. This species has been recorded in the vicinity of the proposed recycled water Pumping station. Its area of habitat is very restricted in this area, and the population present on the hillside is likely to be isolated from other nearby populations. Any disturbance to the area could reduce the long-term viability of the population.	Unlikely	No
Striped Legless Lizard	Unlikely. Potential habitat in the study area has been heavily grazed, making the area marginal at best for this species.	Unlikely	No
Rosenberg's Goanna	Unlikely. Very little predicted impact on Googong Creek. Habitat for this species (e.g. termite mounds) unlikely to be affected.	Unlikely	No
Brown Treecreeper (eastern subspecies)	Unlikely. Very little predicted impact on Googong Creek. Woodland habitats unlikely to be impacted.	Unlikely	No
Diamond Firetail	Unlikely. Very little predicted impact on Googong Creek. Woodland habitats unlikely to be impacted.	Unlikely	No
Hooded Robin (south-eastern form)	Unlikely. Very little predicted impact on Googong Creek. Woodland habitats unlikely to be impacted.	Unlikely	No
Gang-gang Cockatoo	Unlikely. Very little predicted impact on Googong Creek. Woodland habitats unlikely to be impacted.	Unlikely	No
Regent Honeyeater	Unlikely. Very little predicted impact on Googong Creek. Woodland habitats unlikely to be impacted.	Unlikely	No
Superb Parrot	Unlikely. Very little predicted impact on Googong Creek. Woodland habitats unlikely to be impacted.	Unlikely	No

Table 10 (cont.). Key Thresholds for Threatened (Endangered/Vulnerable) Flora and Fauna

Threatened Species	Will the proposal reduce the long-term viability of a local population of the species?	Will the proposal accelerate the extinction of the species or place it at risk of extinction?	Will the proposal adversely affect critical habitat?
Fauna			
Speckled Warbler	Unlikely. Very little predicted impact on Googong Creek. Woodland habitats unlikely to be impacted.	Unlikely	No
Swift Parrot	Unlikely. Very little predicted impact on Googong Creek. Woodland habitats unlikely to be impacted.	Unlikely	No
Eastern False Pipistrelle	Unlikely. Very little predicted impact on Googong Creek. Woodland habitats unlikely to be impacted.	Unlikely	No
Eastern Bentwing Bat	Unlikely. Very little predicted impact on Googong Creek. Woodland habitats unlikely to be impacted.	Unlikely	No
Large-footed Myotis	Unlikely. Some water bodies will be retained in the proposal.	Unlikely	No
Grey-headed Flying-fox	Unlikely. Very little predicted impact on woodlands along Googong Creek. Scattered trees would be retained in the proposed water reticulation works area.	Unlikely	No
Spotted-tailed Quoll (south-eastern mainland)	Unlikely. Very little predicted impact on Googong Creek. Woodland habitats unlikely to be impacted.	Unlikely	No

Maintenance of Biodiversity Values

The majority of the study area is pastoral agricultural land, which has been grazed by domestic stock for many decades. Some parts of the grazing land have native groundcover and paddock trees, which provide habitat for native fauna. Small patches of woodland are present along roadsides in the study area, as well as along Googong Creek.

The paddock areas are depauperate in native fauna, with mainly common species, such as Australian Magpies and Australian Ravens being present, although the threatened Pink-tailed Legless Lizard was detected within two grazed paddocks in the study area. Woodland areas have a higher diversity of native species.

When the area is subdivided for residential purposes, the diversity of fauna in the paddock areas is likely to remain, or increase when residential gardens are put in. Some biodiversity would be lost from clearing of vegetation along roadsides and clearing of paddock trees. However, planting of locally occurring native trees and shrubs would encourage and improve the biodiversity in the area.

Woodland biodiversity along the Googong Creek is not likely to alter due to relative minor and intermittent discharges, particularly after implementation of WSUD elements within the subdivision.

6.3.3 Impact Assessments

This section summarises the highlights of the impact assessments undertaken under the Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act (DEC, 2004; DEC, DPI 2005).

6.3.3.1 Impacts on Flora and Flora Habitat

Under the TSC Act, the impacts of the proposal on one EEC - *White Box- Yellow Box- Blakely's Red Gum Grassy Woodland and Derived Native Grassland*, or its habitat, and seven threatened plant species, or their habitat, need to be considered (**Table 3**).

The proposal may significantly impact on habitat that might support constituent species of the EEC by causing further fragmentation, and/or clearing that might reduce the availability of suitable habitat for the species to grow and complete their life cycles .

Constant pressure from human activities is known to operate in the area, creating disturbances and conditions for opportunistic, invasive species ('colonisers') to invade and flourish in the fragmented habitats. Weed invasion inevitably leads to further reduction of the integrity, species compositions and biodiversity values of the EEC. Loss or decline of suitable habitat, over time, could lead to gradual decline in the quality of the EEC and the variety and abundance of their constituent species assemblages.

The seven flora species listed as threatened under the TSC Act that have potential habitat in the study area and could occur on the study site are:

- Button Wrinklewort (*Rutidosis leptorrhynchoides*);
- Mountain Swainson Pea (*Swainsona recta*);
- Silky Swainson Pea (*Swainsona sericea*);
- Pale Pomaderris (*Pomaderris pallida*);
- Tessellated Spider Orchid (*Caladenia tessellata*);
- Mauve Burr-daisy (*Calotis glandulosa*); and
- Austral Toadflax (*Thesium Australe*).

The proposal envisages removal of some *Eucalyptus* trees and clearing areas for development of Water Cycle Project infrastructure. Although the areas to be cleared are not that extensive, the works for the Water Cycle Project and the subdivision are likely to contribute to further habitat fragmentation, which would be significant in the case of the Googong Foreshores vegetation, particularly the Googong Creek.

The works would further disturb an already degraded environment and clearing is likely to increase edge effects on the existing vegetation in the area. The overall modifications of the currently degraded pastureland habitat are unlikely to be of major consequence.

Assessment of the impacts of the proposal on the *Natural Temperate Grasslands of the Southern Tablelands of NSW and the ACT*; and the seven threatened species listed by the TSC Act were considered, according to the Guidelines (DEC, DPI, 2005). Details of the assessments are provided in **Appendix 12**.

The assessments took into account the existence of potential habitat, although no populations of the threatened flora species (given above) were found to occur in the study areas.

The assessments concluded that while the proposal involves clearing of some native vegetation, this activity is not of a magnitude that would cause significant habitat modifications, putting at risk the natural temperate grassland EEC or the species that characterise the EEC.

Furthermore, the assessments of impacts on potential habitat of the individual threatened species also concluded that albeit some habitat would be lost through the works in the proposal, these would not cause a risk of extinction of any of the threatened species.

6.3.3.2 Impacts on Fauna and Fauna Habitat

The proposal may significantly impact threatened species by causing death or injury of individuals, loss or disturbance of limiting foraging resources; and loss or disturbance of limiting breeding resources.

Limiting resources are specialised habitat components that species are dependent on for their ongoing survival. Such limiting resources are predominantly associated with specialised breeding habitats (such as tree hollows or suitable nest/maternity roost sites) that occur at low densities, with high levels of competition from a range of species. However, for some species, limiting resources include specialised foraging habitats that have a restricted distribution (such as Koalas feeding only on specific tree species).

Threatened species recorded during recent surveys included the Pink-tailed Legless Lizard (*Aprasia parapulchella*) and the Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*). In addition, Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) had also been recorded within the study area during previous surveys (Johnstone Centre, 2004).

Impact assessments have been prepared for the Pink-tailed Legless Lizard and the Eastern False Pipistrelle due to impacts of limiting resources (see **Appendix 13**). No limiting resources for the Eastern Bent-wing Bat would be impacted; thus no assessment of significance is provided for this species.

Where there is potential habitat (for foraging or breeding) for a threatened species in the study area, further consideration must be given to the potential impact of the proposal on these species. Grasslands habitat will be the most affected by the proposal.

Impact assessments have been provided in **Appendix 13** for grassland species with potential habitat in the study area as limiting breeding and feeding resources. These species assessed for potential grassland habitat are:

- Golden Sun Moth (*Synemon plana*);
- Grassland Earless Dragon (*Tympanocryptis pinguicollis*); and
- Striped Legless Lizard (*Delmar impar*).

Woodland habitat, consisting of narrow bands of vegetation, dominated by eucalypts, exists alongside Old Cooma Road and Googong Dam Road. This vegetation has hollow-bearing trees, but little understorey vegetation. In addition, paddock trees are scattered throughout the study area, many with hollows. These provide habitat for hollow-nesting birds, such as the following:

- Brown Treecreeper (*Climacteris picumnus victoriae*);
- Regent Honeyeater (*Anthochaera phrygia*);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Superb Parrot (*Polytelis swainsonii*); and
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*).

Detailed impact assessments are provided in **Appendix 13** for these species, which rely on paddock tree hollows for nesting.

Limiting foraging resources for the Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Anthochaera phrygia*) may also be impacted. Impact assessments were also conducted for these species and the details are provided in **Appendix 13**.

Habitat for the Diamond Firetail, Hooded Robin, and the Speckled Warbler is not present, given the lack of understorey in the area.

Woodland habitat exists along the Googong Creek gully. Excess stormwater from the subdivision will be discharged down Googong Creek. This is not likely to impact Rosenberg's Goanna or any of the woodland birds or bats with potential habitat in the study area. No individuals are likely to be injured or killed, and no limiting breeding or feeding resources will be impacted. No impact assessments are provided for these species.

Googong Creek does not currently contain habitat for the Green and Golden Bell Frog, Southern Bell Frog, or Yellow-spotted Tree Frog (*Litoria castanea*). Impact assessments are not provided for these species.

6.4 EPBC Act Assessments of Significance

6.4.1 Flora - Threatened Species and Ecological Communities

Two EECs and seven threatened plant species listed on the EPBC Act, or their habitat, have been previously recorded within 10 km of the study area (DEWHA Online EPBC Database).

The EECs and their potential habitat that could occur in the study area are:

Natural Temperate Grasslands of the Southern Tablelands of NSW and the ACT; and
White Box- Yellow Box- Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Species listed as endangered under the EPBC Act that have potential habitat in the study area and could occur on the study site are:

Button Wrinklewort (*Rutidosis leptorrhynchoides*);
Mountain Swainson Pea (*Swainsona recta*);
Pale Pomaderris (*Pomaderris pallida*);
Hoary Sunray (*Leucochrysum albicans* var. *tricolor*);
Tessellated Spider Orchid (*Caladenia tessellata*);
Mauve Burr-daisy (*Calotis glandulosa*); and
Austral Toadflax (*Thesium australe*).

The potential impacts of the proposed works on the above EECs and threatened species were considered, according to the Significant Impact Criteria (DEH, 2006a). Details of the assessments are provided in **Appendix 15**.

Based on past history of disturbance and the current surveys, it was evident that habitat that might have been occupied by species of both EECs exists within the study areas. However, as previously discussed, the flora habitat assessment (**Table 6**) indicated how poor the areas are, in terms of integrity of the vegetation, species richness and weed invasion.

The assessments concluded that extent of the proposed works is relatively small; and hence, will not lead to a significant reduction of the habitat areas available for the EEC, locally or in the region. Nor will it lead to any extinction of species that characterise the EEC, despite the fact that some habitat may be lost for some of the constituent species. Therefore, the proposal will not significantly affect the availability of habitat for the EECs or its species assemblage.

None of the seven threatened species were found in the current surveys in the study areas. However, a population of Button Wrinklewort has been previously located at a nearby property- The 'Poplars', and Hoary Sunray was found at Mueller's Property, which is also nearby (Johnstone Centre, 2004).

The assessments for significance of impact of the proposal on the potential habitat of the threatened species concluded that the proposal might remove some habitat, which might be available for four of them: Button Wrinklewort, Mountain Swainson Pea, Hoary Sunray and Mauve Burr-daisy. However, these species were not been found by this survey or previous surveys in the study area or in the larger 'Googong' development area.

Given this, and the fact that the extent of the works is relatively small; the proposal will not lead to a significant reduction of the habitat areas available for the species, locally or in the region. Nor will it lead to any extinction of species and its populations. Referrals under the EPBC Act are therefore not required for these species.

Potential habitat for Pale Pomaderris, Tessellated Spider Orchid and Austral Toadflax exists within the Googong Creek habitat. However, the proposed works will not remove or significantly modify habitat, which might be available for any local populations of these species. All three species could occupy upper riparian to higher terrestrial habitat associated with the creek.

The discharges of stormwater after WSUD has been implemented in the subdivision are likely to be relatively small; and hence, will not lead to significant modifications of the conditions in the creek, or reductions of the habitat available for the three species, locally or in the region.

Therefore, the proposal will not have a significant impact on the habitat of Pale Pomaderris, Tessellated Spider Orchid and Austral Toadflax. Referrals under the EPBC Act are therefore not required for these species.

6.4.2 Fauna - Threatened Species

Twelve threatened animal species listed on the EPBC Act, or their habitat, have been previously recorded within 10 km of the study area (DEWHA Online EPBC Database).

Species listed as endangered under the EPBC Act that have potential habitat in the study area and could occur on the site include the following:

- Golden Sun Moth (*Synemon plana*);
- Grassland Earless Dragon (*Tympanocryptis pinguicolla*);
- Regent Honeyeater (*Anthochaera phrygia*); and
- Swift Parrot (*Lathamus discolor*).

Potential impacts on the above species have been assessed according to the Significant Impact Criteria (DEH, 2006a) and details are provided in **Appendix 15**.

The Spotted-tailed Quoll was considered, however, no impact is expected on it's habitat and an Assessment of Significance is not provided for this species.

Species listed as vulnerable under the EPBC Act that have known and/or potential habitat in the study area and could occur on the site include:

- Pink-tailed Legless Lizard (*Aprasia parapulchella*);
- Striped Legless Lizard (*Delmar impar*); and
- Superb Parrot (*Polytelis swainsonii*).

Potential impacts on the above species have also been considered and assessed according to the Significant Impact Criteria (DEH, 2006a) and the details provided in **Appendix 15**.

Based on the precautionary principle, a significant impact is considered possible for the Golden Sun Moth and the Pink-tailed Legless Lizard, and a Referral to the Commonwealth Minister for the Environment is recommended.

6.4.3 Migratory Species

The list of Migratory species under the EPBC Act is a compilation of species listed under four international conventions: China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA), Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA), and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Twelve species listed under the 'migratory' provisions of the EPBC Act were listed in **Table 8** for investigation. Of these, the following have potential habitat in the study area: Regent Honeyeater, Swift Parrot, Cattle Egret (*Ardea ibis*), Rainbow Bee-eater (*Merops ornatus*) and Satin Flycatcher (*Myiagra cyanoleuca*).

Individuals of these species that have been or may be recorded in the study area are not considered likely to be an ecologically significant proportion of the population. Potential habitat in the study area is not considered important for the migratory species.

Minimal impact is expected on the potential habitat for these species in the study area. As such, no assessments have been carried out for these species, in accordance with the Significant Impact Criteria (DEH, 2006a).

6.5 Commonwealth Land

Under the EPBC Act, approval is required for an action taken by any person outside of Commonwealth land that is likely to have a significant impact on the environment on Commonwealth land. 'Environment' is defined in the EPBC Act as:

- (a) Ecosystems and their constituent parts, including people and communities ('ecosystem' is defined in the EPBC Act as 'a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functioning unit');
- (b) Natural and physical resources;
- (c) Qualities and characteristics of locations, places and areas;
- (d) Heritage values of places; and
- (e) Social, economic and cultural aspects of a thing mentioned in paragraphs (a), (b) or (c).

Part of the study area is located within and adjacent to the western side of the Googong Foreshores, an area of Commonwealth Land. The relevant sections are the following:

- Googong Dam Road and its road verges;
- Access road linking the Googong WTP and the Googong Dam Road and road verges;
- Land within the Googong WTP; and
- A section of Montgomery Creek and its riparian zone.

Impacts upon Commonwealth Land due to the Googong Water Cycle Project that relate to endangered ecological communities and threatened flora and fauna species were assessed, in accordance with EPBC Act Policy Statement 1.2 (DEH, 2006b). Details of the assessment are given in **Appendix 16**.

6.5.1 Flora - Threatened Species and Ecological Communities

Within the Googong Foreshores, two particular EECs could occur (GHD, 2007). They are: Natural Temperate Grasslands of the Southern Tablelands of NSW and the ACT; and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

However, these EECs do not occur in the sections of Commonwealth Land (given above), which are likely to be impacted by the proposal.

Within the western section of the Googong Foreshores area, plant species listed as threatened under the EPBC Act include:

- Button Wrinklewort (*Rutidosis leptorrhynchoides*) - listed as nationally endangered;
- Hoary Sunray (*Leucochrysum albicans* var. *tricolor*) - listed as endangered; and
- Pale Pomaderris (*Pomaderris pallida*)- listed as vulnerable.

In the surveys conducted, these species were not detected in the areas that are likely to be affected by the proposal. However, some potential habitat could be present for the Button Wrinklewort and Hoary Sunray, along the Googong Dam Road corridor.

As has been assessed in this report (see **Appendices 12 and 14**), the likelihood of occurrence of these species on the sections of Commonwealth Land is low, due to the poor quality of the habitat and on-going high levels of disturbances.

Habitat for Pale Pomaderris does not exist in the areas of Commonwealth Land likely to be affected by the works (see **Appendices 12 and 14**).

6.5.2 Fauna - Threatened Species

Potential habitat does exist for the vulnerable Pink-tailed Legless Lizard in sections associated with rocky areas along Montgomery Creek, which runs from the study area into the Googong Foreshores.

The Eastern Bent-wing Bat and Eastern False Pipistrelle have also been recorded within the study area. The Eastern Bent-wing Bat may forage aerially for insects, but is unlikely to breed in the study area, as it requires caves (which are absent).

The Eastern False Pipistrelle may also forage aerially for insects within the study area, and/or roost within tree hollows. However, the species prefers wet habitats and is therefore, unlikely to breed within the study area. All hollow-bearing trees in the area are in dry habitat, which are not usually favoured by this species.

No other threatened fauna species were detected in the study area, although potential habitat does exist for a number of species, extending into the sections of Commonwealth Land, likely to be affected by the proposal.

As assessed in this report, potential habitat for the following species may exist on Commonwealth Land, likely to be impacted by the proposal:

- Golden Sun Moth;
- Grassland Earless Dragon;
- Striped Legless Lizard;
- Brown Treecreeper;
- Gang-gang Cockatoo;
- Regent Honeyeater;
- Swift Parrot; and
- Superb Parrot.

The impacts to the potential habitat of these species in the western part of the Googong Foreshores are likely to be minimal, if impacted at all. Therefore, no significant effects to any of the above species are likely by the proposed work in Commonwealth Land.

7. Impact Amelioration

A general principle of environmental management is to, in order of preference:

- Avoid** environmental impacts;
- Minimise** impacts; and
- Mitigate** the impacts.

As a last resort, once the above options have been investigated, it is necessary to consider **compensating** for the residual impacts.

In general, environmental impacts have been avoided by restricting development to areas that have been subject to extensive disturbances through historical agricultural practices. However, there will be some impacts on the terrestrial flora and fauna and their habitat, which can be minimised to ensure the sustainability of the existing native biodiversity and landscapes.

For minimising and managing the potential impacts of the proposal on flora and fauna, consideration needs to be given to the EPBC Act, TSC Act and the Queanbeyan DCP No. 38 (Queanbeyan CC, 2006 - incorporating requirements of Queanbeyan LEP, 1998 and Yarrolumla DCP, 2002).

The sections below provide some discussion and recommendations to avoid, minimise and manage the environmental impacts on the terrestrial flora and fauna arising from the proposal.

Flora and Fauna Management Plan

It is recommended that a *Flora and Fauna Management Plan* (FFMP) be prepared, based on best practice guidelines, and implemented during the pre-construction, construction and post-construction phases.

This Plan should detail the impact avoidance and mitigation measures that would be implemented to reduce adverse impacts on flora and fauna, during tree removal and clearing, excavation of trenches, rehabilitation of disturbed areas after disturbances and activities, such as weed management and re-establishment of native vegetation by revegetation.

It should also include a monitoring and review program.

Key elements of the FFMP are discussed below.

Removal of significant trees

Removal of some *Eucalyptus* trees and specimens of some introduced tree species (Chinese Elms, Radiata Pines, Poplars and Willows) is required in the construction work associated with the Water Cycle Project. The trees to be removed include those that are dead or partially dead or are in a poor state, and some live specimens as well.

A tree survey has been conducted for the proposal (JEA, 2009). The report tabulates the trees/groves that may be affected, their current condition, whether significant or not, and proposed actions. It is recommended that this tree survey be updated in the FFMP, in accordance with the final development plans and with consideration of the Queanbeyan Council's Significant Tree Policy (Queanbeyan CC, 2006).

The FFMP should address all impact avoidance and mitigation measures that would be implemented during tree removal and clearing, including flora and fauna management and sediment/erosion control measures, as discussed further in this section.

The FFMP also needs to consider the phases of the development, including how the large specimens of remnant trees should be managed with minimal disturbance, during construction, consolidation and during the life of the project.

Habitat protection and flora management

Although threatened flora species, listed under the TSC Act or the EPBC Act were not found in the study area, the flora and fauna management objectives for the Water Cycle Project (and the subdivision) should recognise the existence of potential habitat for some of the listed species and the constituent species of the two EECs.

The proposal is not likely to have a significant impact on the habitat availability of the constituent species of the EECs or the threatened flora (not detected) locally or in the region. Also, the available habitat is poor in quality. However, given that potential habitat does exist, habitat loss or modification should be minimised, as follows:

- Identify and clearly map areas that should be left undisturbed during excavation and construction works associated with the Water Cycle Project. Exclusion fencing should be installed around areas of vegetation to be retained. This can help many native forbs and grasses to continue surviving in the area;

- Rehabilitate and regenerate modified habitat, as soon as practicable, during and post-construction, to protect and enhance biodiversity values and minimise weed incursions. This action requires enhancement planting of local native plants, to provide food, shelter and roosting sites for fauna, or regenerating native communities, where appropriate and possible, through the application of rehabilitation and regeneration techniques;

- Prepare lists of local, indigenous tree, shrub, herb, creeper and ground cover species and local provenances, which are suitable for rehabilitation of the disturbed sites, and initiate action to secure the numbers of plants (likely to be large) from local sources;

- Alignment of routes for the water cycle infrastructure to avoid patches of native shrubs, trees or grasslands, where practicable, so as to minimise the destruction of such vegetation during the excavation of the trenches. For instance, along Old Cooma Road, it is possible to minimise impacts on the roadside vegetation by directing the route of the trenches to the east of the current fence line, where the vegetation is degraded pasture;

- Planning and landscape designs to retain the remaining native vegetation, although sparse, such as the aquatic species- rushes and sedges, associated with the dams and waterlines. There are considerable seed banks of these species that could be expected to survive in the soil. Where practicable, these elements should be conserved and possibly enhanced; and

- In the integrated design of the landscape in the proposal, retain, as much as possible, existing landforms, such as the natural drainage lines, farm dams, hills and troughs and native vegetation, including the remaining large *Eucalyptus* trees. These elements, some of which are man-made (i.e. dams), not only add to the visual amenity of the locality, but are ecologically significant for both flora and fauna. Hence, where possible, preserve and enhance these features.

Managing invasive species

The FFMP should develop a weed management strategy that aims to remove the major weeds identified in the study, prior to disturbances, so as to not cause further spread, and to manage the threat posed by new incursions during the construction phase.

Weed management will also be an essential part of the post-construction and consolidation phases, associated with the removal of existing vegetation cover and disturbance of soil.

It would be important to implement a program of long-term monitoring and control of weed incursions that could potentially occur shortly following the construction phase of the development. The strategy should address the following:

- Provide a framework for pre-construction mapping of weed distributions, and a weed control program;

- Provide a framework for effectively managing weeds during construction and post-construction; this includes long-term monitoring of weed incursions and strategies for their on-going monitoring and management;

Undertake invasive plant control in accordance with relevant legislation and strategies and in co-operation with adjacent land managers;

Take a preventative and pragmatic approach to address the issues; this would require coordinating any planned local control work with that of other landholders and responsible authorities, such as the Googong Foreshores Management;

Develop a pre-construction weed control program;

Give particular attention to the species that are likely to spread most by the works in the proposal at specific locations, sites and routes; this would include giving priority to St. John's Wort (*Hypericum perforatum*), African Love Grass (*Eragrostis curvula*), Chilean Needle Grass (*Nasella neesiana*), Serrated Tussock (*Nasella trichotoma*), Patterson's Curse (*Echium plantagineum*), so as to prevent their proliferation and spread;

Where applicable, manage invasive scrub, to the extent required, to mitigate environmental impacts of the proposal; this would require controlling the extensive Blackberry (*Rubus fruticosus*) infestations, large bushes of Sweet Briar (*Rosa rubiginosa*) and African Boxthorn (*Lycium ferocissimum*), which are spread through the Googong Creek habitat;

Where necessary, manage the excessive growth and spread of native shrub - Burgan (*Kunzea ericoides*) at particular sites, so as to allow regeneration and establishment of a diversity of native scrub;

Plan to avoid the introduction and transportation of weeds by implementing strict vehicle hygiene controls, such as cleaning of tyres, wheel guards and bases of machinery, as appropriate, before entry into the development site;

Ensure that an integrated weed management approach is implemented and all weed management actions are 'best practice' and with appropriate technologies; this will ensure that herbicides will be used where necessary, but with precautions, to minimise adverse impacts on the non-target biota; and

Nominate performance indicators and undertake monitoring and maintenance of the sites where weed control has been implemented, to monitor success and undertake any remedial action, including additional planting to discourage re-establishment of the invasive species from seed banks.

Managing Roadside Vegetation

During the excavation of trenches along the roadsides for the water and wastewater infrastructure, removal of some grassy vegetation and the lopping or removal of some trees and shrubs will occur. The FFMP should assist ongoing planning, ensuring that the total extent of the grubbing is minimised and the impacts of the clearing are reduced to the minimum extent that is reasonable and practicable.

The trenching is likely to adversely impact on some dense populations of Kangaroo Grass (*Themeda australis*). Populations of this species are of conservation significance in the area, largely because other native grasses and their seed banks are likely to be depleted in the modified environments of the area.

Where practicable, trenches should be re-routed and aligned in a way that minimises impacts on Kangaroo Grass populations, which are found on both the eastern side of the Old Cooma Road and on both sides of the Googong Dam Road corridor. Also, after the trenching and associated works, these roadside areas need to be rehabilitated to their pre-construction state.

Managing impacts during construction

The FFMP should provide advice to minimise impacts on flora and fauna values of the sites, which are being excavated for trenches and also for other construction work.

Measures to avoid and reduce impacts may include:

Colour tape or 'para-webbing' be used to delineate the maximum work area permitted. This should be implemented prior to any work commencing on site. If any tape is disturbed, by humans or by inclement weather, then it should immediately be replaced along the appropriate alignment;

As previously discussed, an appropriate revegetation and rehabilitation plan should be prepared for implementation. This plan should include an integrated strategy of methods, such as the direct seeding of local native grasses, transplanting or translocating of native vegetation and maintenance weeding along constructed batter slopes and drainage lines;

Locally indigenous species be used in landscaping and revegetation works;

Topsoil brought in from outside for rehabilitation of the site needs to be certified as free of weed seeds. This requires monitoring and ongoing assessment;

A flora and fauna monitoring program should be prepared that will progressively monitor and assess the health and condition of vegetation communities and fauna habitats being disturbed, as the proposed construction and development work is undertaken. This monitoring will allow continuous assessment of the disturbances of the sites, as well as the success of rehabilitation programs.

Fauna Management

Managing impacts on fauna during and post-construction is clearly an important issue, to mitigate against further degradation of fauna habitat. Avoidance of large-scale adverse impacts would be necessary to protect and preserve the threatened fauna species, and to minimise the invasion of disturbed habitat by colonising species.

In addition to the recommendations on managing flora and habitat and impacts during the removal of trees, previously discussed, the following specific recommendations are made to reduce the impact of the proposal on native fauna occurring in the study area:

Prior to any construction, undertake further surveys for the Pink-tailed Legless Lizard and Golden Sun Moth in the study area.

With regard to mitigating impacts on Golden Sun Moth populations (which could exist, but not found) and its potential habitat, measures should include the following:

- Clearly mark out the potential Golden Sun Moth habitat prior to any construction; an experienced ecologist should do this.
- Retain, as much as possible, habitat patches, which are known or likely to contain the Golden Sun Moth.
- Before trenching in the areas of Golden Sun Moth potential habitat, carefully remove and stockpile the topsoil within this area, taking care to maintain the natural soil profile (i.e. keeping topsoil as topsoil). This topsoil needs to be subsequently re-installed over the disturbed area. The methodology for this procedure will be included in the FFMP.
- Reduce the impact of construction works by employing an appropriate buffer around potential Golden Sun Moth habitat (e.g. 100-200 m around breeding habitat, if the Golden Sun Moth is found), restricting vehicular movement during times of high soil moisture, and when adult moths are flying.
- Conduct temporary or discrete activities at a time when they will not have a negative impact on the Golden Sun Moth population (if found). e.g. staggered weed control measures, to avoid affecting the whole population at the same time.
- Avoid landscaping that would introduce weeds or non-indigenous plant species into the study area. Manage ground maintenance within potential Golden Sun Moth habitat, such as mowing and slashing, so that they are undertaken during appropriate time/seasons (i.e. outside of flying period) and mow/slash grass to maintain a height of approximately 6 cm.
- Place fencing around habitat (three sides) to limit the use of the Golden Sun Moth potential habitat as thoroughfare and place pathways outside such areas.
- Avoid planting trees in the vicinity of the potential habitat for the Golden Sun Moth, to avoid providing perch sites for the Moth's predators.

With regard to mitigating impacts on Pink-tailed Legless Lizard and its habitat, measures should include the following:

- If possible use trenchless installation of pipelines by subterranean tunnelling at a depth of >0.5 m and cabling, to avoid and minimise habitat disturbances.
- Undertake micro-alignment of the pipeline route, so that it avoids or reduces the need to remove rock outcrops, particularly in the areas where Pink-tailed Legless Lizards were recorded. Where practicable, the scouring of soil should be limited to no more than a few metres either side of proposed pipeline trenches.
- Inspect the construction trenches for trapped fauna, particularly if trenches are left open for more than one night during spring and prior to infilling. Escape routes (i.e. planks of wood), could be placed in the trenches overnight, as means of escape for trapped fauna.
- Avoid disturbance to the surface rocks in the vicinity of the proposed Pumping stations, to minimise disturbance to known habitat of the Pink-tailed Legless Lizard.
- Avoid planting trees in the vicinity of the proposed pumping stations and the nearby outcropping surface rocks, which may provide perch sites for the Lizard's predators.
- Remove livestock as soon as possible from the vicinity of the proposed pumping stations where known habitat for the Pink-tailed Legless Lizard is present.
- Manage the excessive growth of the native shrub Burgan (*Kunzea ericoides*) to retain open habitat for the Pink-tailed Legless Lizard.
- Avoid the over-use of herbicides in the area of known habitat for the Pink-tailed Legless Lizard. Methods should be limited to well-directed spot spraying, cut-stump and paint, dig-out and/or hand pulling of weeds.
- Educate the residents/stakeholders of the Googong area of the importance of the habitat of the Pink-tailed Legless Lizard. No collection of bush rock should be allowed.
- If possible, place additional surface rock in the area, to provide a link between areas of habitat on adjacent hill slopes, particularly to the east.

With regard to hollow-bearing trees, the removal of such trees and branches should be avoided, as much as possible, within the study area. Where the removal of hollow-bearing trees and branches is unavoidable, an appropriately qualified arborist, under the observation of a qualified ecologist/zoologist should undertake the work.

Inspection of tree hollows for resident fauna needs to be undertaken by a qualified ecologist prior to felling or trimming. If resident fauna are found, the appropriate action to follow should be determined, in consultation with the qualified ecologist/zoologist.

Exercise caution in undertaking tree removal. Combined with the inspections of tree hollows, the tree removal protocol should include the following:

- Shaking of the tree to be removed using a bulldozer;
- Slowly pushing the tree to the ground so that it largely remains intact;
- Having a trained fauna ecologist inspect hollows and removing any animals, if practical;
- Leaving the tree in place once felled for at least one day/night before removing to allow animals to relocate to nearby vegetation;
- Providing all contractors with the contact numbers of wildlife rescue groups should animals be injured during clearing;
- Undertaking vegetation clearing during September/October or in March/May to avoid summer breeding seasons and the winter hibernation for hollow dependent species.

Broadly, fauna habitat management also needs to incorporate managing erosion at the site. For this, stormwater and runoff controls, which are consistent with the ACT and NSW guidelines, will be required pre, during and post construction, to prevent sedimentation in major waterways. This may include the appropriate use of temporary sediment fencing or sediment control bunding. These structures will need to meet appropriate industry best practice standards and be well maintained throughout the construction phase.

Managing Impacts on Googong Creek environment and habitat

Discharges in the Googong Creek are not likely to be significant for the conservation and protection of the threatened species' potential habitat or lead to a decline in habitat availability of the species that characterise the Box-Gum Woodland EEC of NSW. However, if future work involves constructing mitigation wetlands and/or works to stabilise eroding sections of the creek, these may require further environmental assessment and possibly more rigorous surveys and assessments for some endangered species discussed in this report.

In general, the Googong Creek needs to be managed, so as to not cause any deterioration of the in-stream environment, particularly in relation to water quality and water flows. Protecting the biodiversity and ecological values of the lower and upper riparian environment, in relation to the diversity of the riparian vegetation and habitats and bank stability; would include management of invasive species affecting the creek habitat.

Restoring degraded and collapsing sections of the creek habitat, where possible, could include enhancing the in-stream and riparian environments with resilient, native aquatic species.

Managing impacts on Commonwealth Land

The Googong Dam Road (leading to Googong Foreshores) is Commonwealth land and is recognised by the Plan of Management (ACT Government, 2007a).

The Plan of Management makes a commitment to protecting, improving and maintaining vegetation communities, wildlife habitats and ecological connectivity by appropriate management and rehabilitation activities.

Actions in the proposal are not likely to cause any additional adverse impact on the Googong Dam Road corridor or the Googong WTP site and its access road, all of which are continually subject to heavy disturbances. However, after the construction work associated with the Water Cycle Project, these areas need to be rehabilitated to their pre-construction state.

The occurrence of a wide array of invasive weeds in these fragmented areas, discussed in the report, highlight the need for planning prior to construction and effective management action during and post construction.

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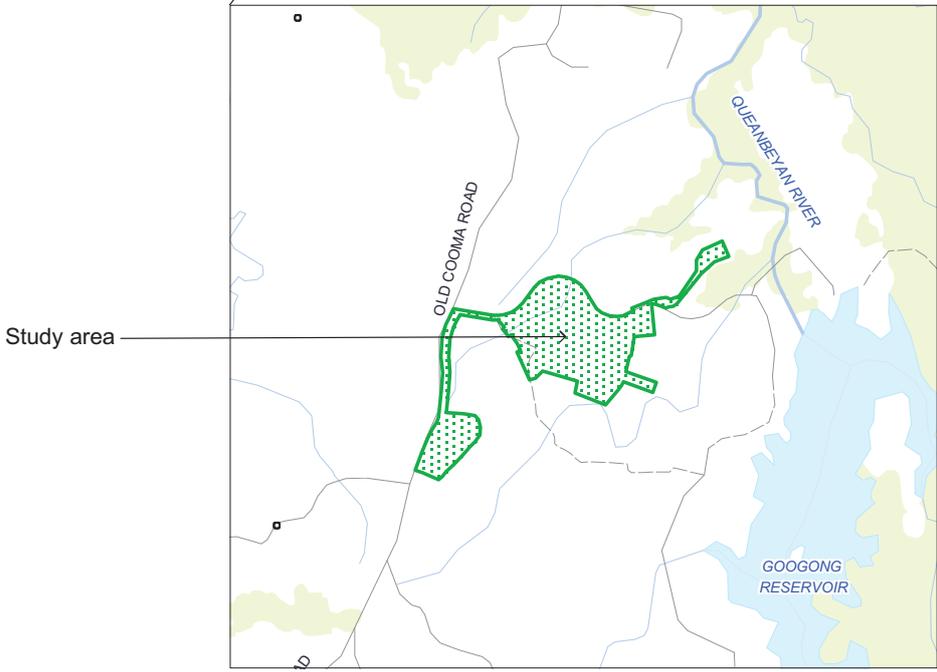
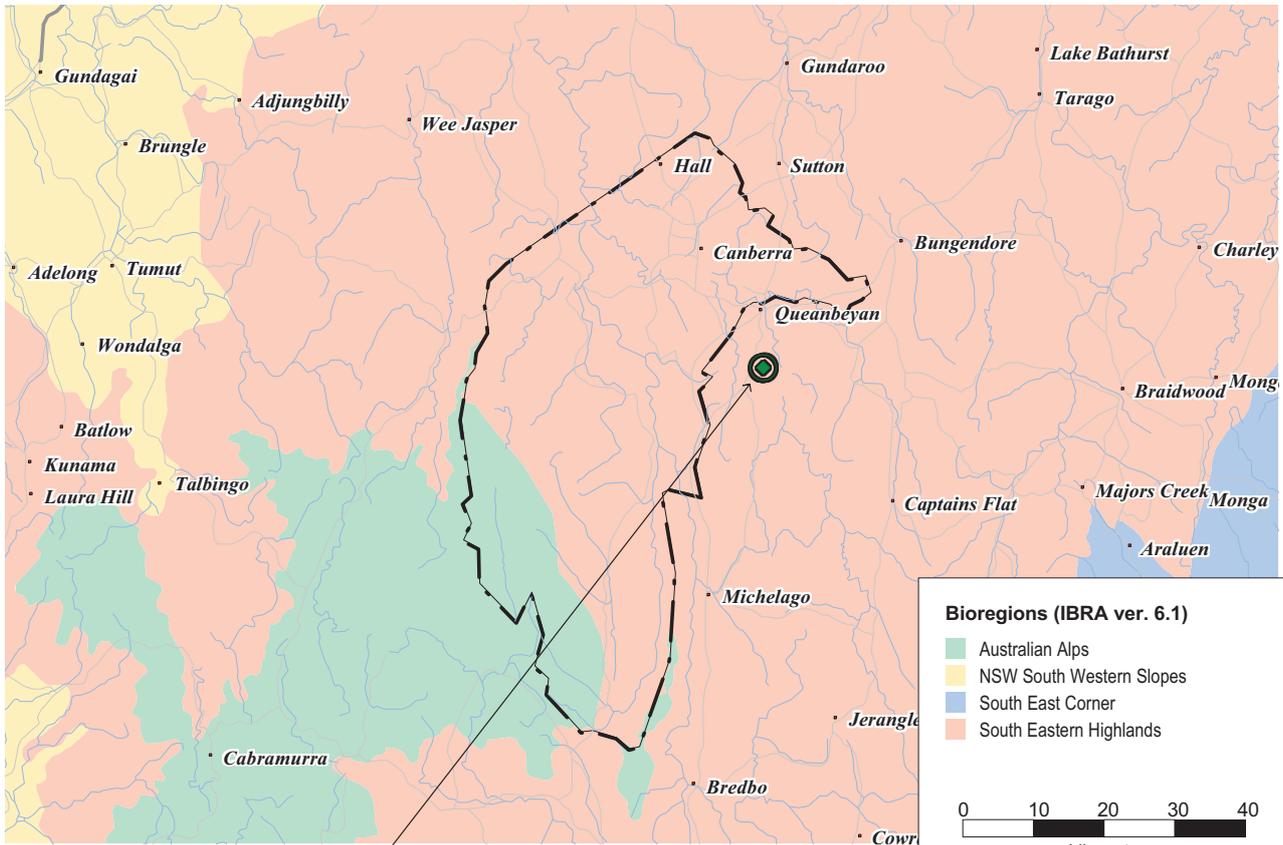
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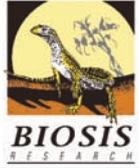
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Appendix 1 - Figures



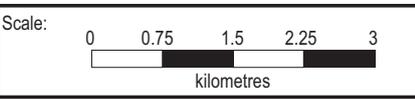
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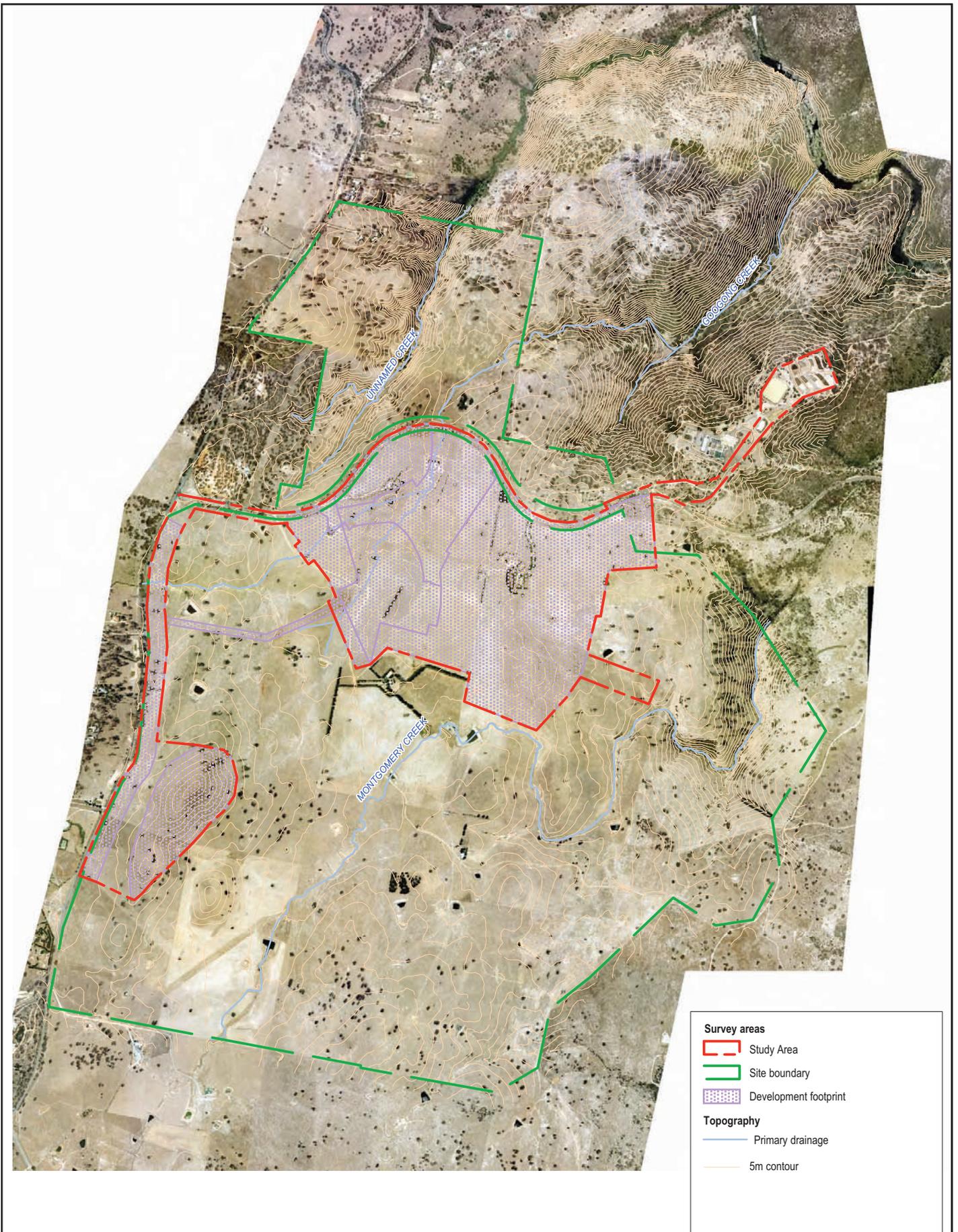


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Figure 1: Location of the study area in a regional context.

Date: 21 May 2009
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Figure 2 - Study sites - aerial

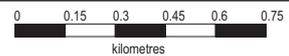
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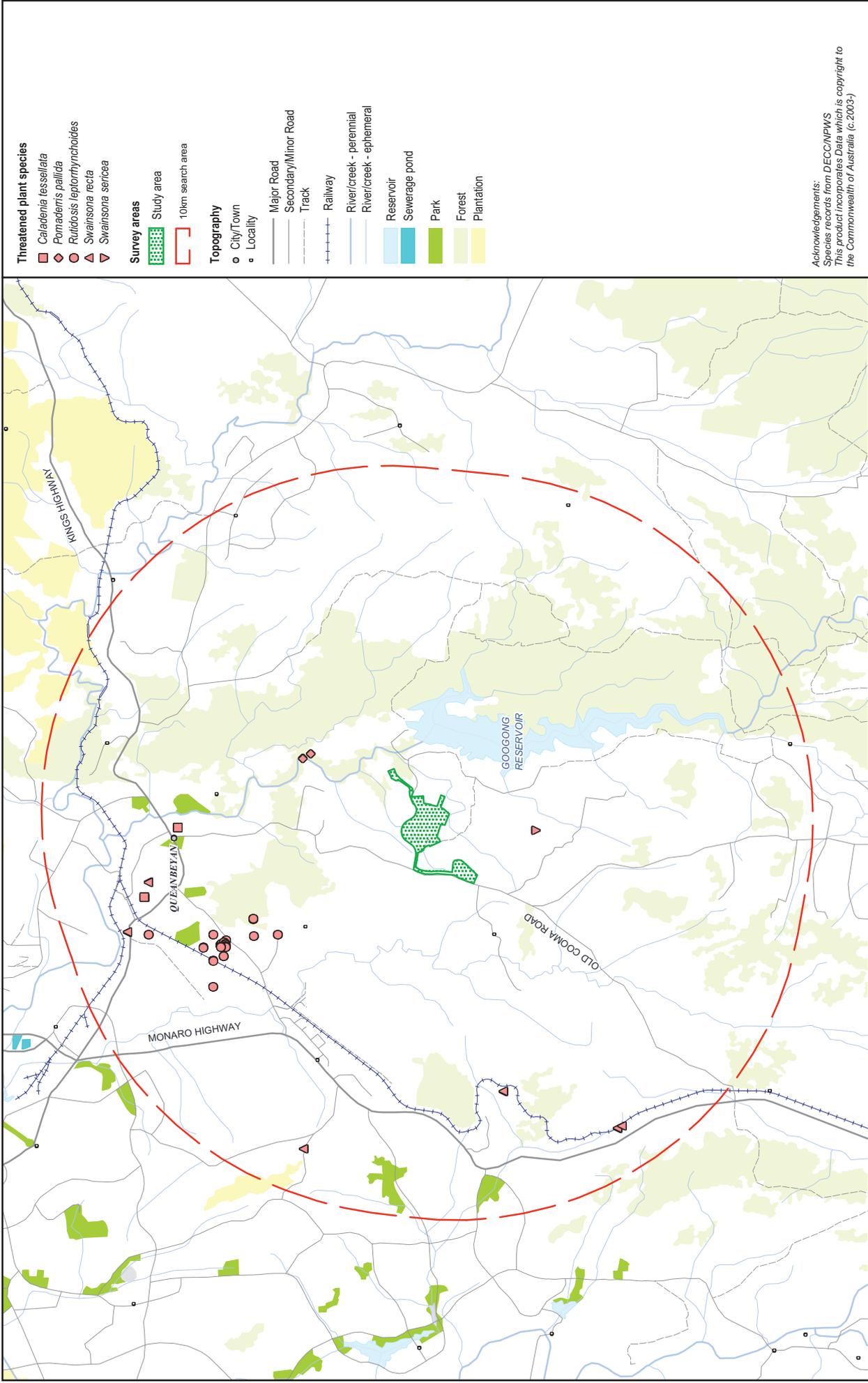
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Location: 5000\5200s\5233\Mapping\S5233 3a_F2 overview.WOR

Scale:





- Threatened plant species**
- ◊ *Caladenia tessellata*
 - *Pomaderris pallida*
 - ▲ *Ruitosis leptorhynchoites*
 - ▼ *Swainsona recta*
 - ◻ *Swainsona sericea*

- Survey areas**
- ▨ Study area
 - 10km search area

- Topography**
- City/Town
 - ◼ Locality

- Major Road
- - - Secondary/Minor Road
- - - Track
- +— Railway
- River/creek - perennial
- - - River/creek - ephemeral
- Reservoir
- Sewerage pond
- Park
- Forest
- Plantation

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Figure 3: Threatened plant species, listed on the TSC Act and EPBC Act, within 10km of the study area

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Date: 21 May 2009
 Checked by: KAC
 Location: ...50016520815233\Mapping\5223_3a_F3\ora.WOR

File number: 5223

Scale: 0 1 2 3 4 5 Kilometres

Figure 3: Threatened plant species, listed on the TSC Act and EPBC Act, within 10km of the study area

