

Appendix H

H1 Terrestrial flora and fauna impact assessment and addendum

H2 Surveys for pink-tailed worm lizard
Aprasia Parapulchella

H3 Burra Creek targeted survey for
Aprasia Parapulchella

Murrumbidgee River to
Googong Dam Water
Transfer Pipeline:
Terrestrial Flora &
Fauna Impact
Assessment

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Report for ACTEW Corporation Ltd.

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ABBREVIATIONS & TERMS

BGGW	Box Gum Grassy Woodland
COG	Canberra Ornithologists Group
DECC	NSW Department of Environment and Climate Change
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts
EEC	Endangered Ecological Community
EP&A Act	NSW <i>Environmental Planning and Assessment Act</i> 1979
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act</i> 1999
HLPS	High Lift Pump Station
LGA	Local Government Area
LLPS	Low Lift Pump Station
MNES	Matter of National Environmental Significance
NC Act	ACT <i>Nature Conservation Act</i> 1980
NPWS	National Parks and Wildlife Service (now part of DECC)
NTG	Natural Temperate Grassland
Locality	the area within 5km of the subject site
ROTAP	Rare or Threatened Australian Plant as listed by Briggs and Leigh (1995)
Study Area	Subject Site and any additional areas likely to be affected, either directly or indirectly, by the proposal - 200m wide corridor surrounding the Subject Site.
Subject Site	Area directly affected by the proposed construction
TSC Act	NSW <i>Threatened Species Conservation Act</i> 1995
SGGW	Snow Gum Grassy Woodland
sp.	Species (singular)
spp.	Species (plural)
ssp.	Subspecies
var.	Variety

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1.0 SUMMARY

Background and aims

ACTEW Corporation Limited is undertaking an environmental assessment of a proposed underground water transfer pipeline from the Murrumbidgee River to Burra Creek and other works (the project). This report focuses on the impacts to terrestrial flora and fauna as a result of the construction. In the context of this assessment the proposed works will be assessed in accordance with provisions of the ACT *Nature Conservation Act 1980* (NC Act); the NSW *Threatened Species Conservation Act 1995* (TSC Act); Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); and Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) as amended by the *Environmental Planning and Assessment Amendment (Infrastructure and Other Planning Reform) Act 2005*.

An ecological impact assessment was conducted to evaluate the potential terrestrial impacts of the project. The evaluation was based on extensive sampling surveys conducted from early September 2008 to the end of February 2009. Brief follow-up assessments were conducted during May 2009 in the central and western sections of the study area. Surveys included vegetation sampling (plot and transect), ground-truthing and vegetation mapping, targeted trapping and detection for fauna.

The main aims of the study were to:

- describe the vegetation and habitats of the study area;
- determine the likely presence and extent of occurrence of endangered ecological communities and threatened (or rare) plant and animal species; and,
- consider the extent of impact of the proposed development and make recommendations to avoid, mitigate or offset native vegetation and habitat loss.

Proposed Development

The proposed pipeline would extend from Angle Crossing on the Murrumbidgee River to Burra Creek, a distance of about 13 km. Clearing and grading would be minimised where practicable to the extent necessary for construction of the pipeline and would not exceed the 40 m construction corridor. The area that would be directly impacted upon by construction activities would range in width from 15 m to 40 m, depending on a range of factors considered that include occurrences of important habitats for threatened species and ecological communities, vegetation sensitivity and quality, constructability, construction

management and safety considerations, land form, slopes and anticipated sub-soil structures. Direct impacts would be reduced as far as practicable with narrower construction corridors proposed where feasible and in areas this may only require a 15 m wide corridor (possible only for short stretches). In areas of steep terrain (that impact on construction methodology's available and construction safety) and problematic sub-soil conditions, the impact area would be wider than 15 m, but would always be less than 40 m. The proponent has based the environmental assessment on an indicative corridor width that would be refined by the construction contractor.

Additional infrastructure works would include: an intake and discharge facility; low lift pump station (LLPS) and high lift pump stations (HLPS); power transmission line; pipe laydown areas, site compounds and vehicle parking areas. All plant and equipment would be stored within the subject site or within dedicated laydown areas.

A maximum of 100 ML/day of water would be extracted from the Murrumbidgee River and discharged into Burra Creek.

Flora and Vegetation

A total of 235 plant species were recorded from the study area, comprising of approximately 172 (73%) locally indigenous species and 63 (27 %) exotic and weed species.

Three threatened plant species occur within or near the study area; these are:

- *Swainsona recta* (listed as endangered under the NC Act, *Threatened Species Conservation Act 1995* (TSC Act) and EPBC Act (note: the species was also recorded at Burra Creek);
- *Leucochrysum albicans* var. *tricolor* (endangered under the EPBC Act); and,
- *Swainsona sericea* (vulnerable under the TSC Act).

Another ten uncommon plant species were recorded within remnant native vegetation, including: *Athropodium fibriatus*, *Cullen microcephalum*, *Discaria pubescens*, *Linum marginale*, *Lotus australis*, *Microceris lanceolata*, *Pterostylis* sp., *Thysanotis* spp., *Sorghum leiocladum* and *Zornia dyctiocarpa*.

Main vegetation types that occurred within or near the study area were:

- Emergent and fringing vegetation along the river edges and shallow backwaters of the Murrumbidgee River and shallow in-stream sections along Burra Creek and minor ephemeral drainage lines. These commonly

contained stands of *Typha orientalis* and *Juncus* sp. rushlands, *Carex apressa* sedgelands and/or *Phragmites australis* reedlands;

- *Kunzea ericoides*, *Acacia dealbata* and *Bursaria spinosa* shrubland along the drier riparian edges and lower slopes along the Murrumbidgee River corridor;
- Various associations of dry sclerophyll forest including Broad-leaved Peppermint *Eucalyptus dives*, Apple Box *E. bridgesiana* and Brittle Gum *E. mannifera* on rocky mid slopes and dry drainage gullies east of the Murrumbidgee River;
- *Eucalyptus mannifera*, Bundy *E. nortonii* and *E. dives* open forest occurs on the rockier and drier west facing slopes within the Murrumbidgee River corridor;
- Yellow Box *Eucalyptus melliodora*-Blakely's Red Gum *E. blakelyi*-Apple Box *E. bridgesiana* grassy woodland (Critically Endangered Ecological Community - CEEC), referred to as Box Gum Grassy Woodland (BGGW). This community extended from the Murrumbidgee River corridor to east of the Gibraltar 'saddle'. It occurred in various forms and conditions and has *high conservation value*;
- Secondary grasslands derived from BGGW (see bullet point above) conform to the BGGW CEEC. Secondary grasslands occurred in various forms and conditions and are of *high conservation value*;
- Natural Temperate Grassland (NTG) Endangered Ecological Community (EEC) was recorded within the Murrumbidgee River corridor in the western section of the study area (ACT) and are of *high conservation value*;
- Snow Gum *Eucalyptus pauciflora*-Candlebark *E. rubida*-*E. bridgesiana* grassy woodland and associated secondary grasslands occurred east of the Gibraltar 'saddle'. A nomination to list Snow Gum Grassy Woodland (SGGW) as an EEC under the TSC Act has been made (Crooks *et al.* 2009). This community has nominal *high conservation value*;
- Native pasture with generally low species diversity, and typically associated with increased agricultural activity i.e. pasture improvement and/or increased grazing pressure; and,
- Non-native pasture which is generally associated with productive farm activity and is either pasture improved or ploughed.

Fauna and Habitats

Fauna sampling surveys focused on threatened fauna including the Golden Sun Moth *Synemon plana*, Pink-tailed Worm Lizard *Aprasia parapulchella*, Striped Legless Lizard *Delma impar*, Grassland Earless Dragon *Tympanocryptis*

pinguicolla and Rosenberg's Goanna *Varanus rosenbergi*. Targeted surveys were also conducted for threatened birds, mammals (including bats) and frogs.

A total of 127 animal species were recorded within the study area during the current survey and comprised seven frog, 15 reptile, 79 (3 introduced) bird and 26 (11 introduced) mammal species.

Eight threatened animal species were recorded within or near the study area; these were:

- Pink-tailed Worm Lizard (NC Act, TSC Act and EPBC Act);
- Gang Gang Cockatoo *Callocephalon fimbriatum* (TSC Act);
- Speckled Warbler *Chthonicola sagittata* (TSC Act);
- Diamond Firetail *Stagonopleura guttata* (TSC Act)
- White-winged Triller *Lalage sueurii* (NC Act);
- Varied Sittella *Daphoenositta chrysoptera* (NC Act and proposed listing TSC Act);
- Large-footed Myotis *Myotis macropus* (TSC Act); and,
- Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis* (TSC Act).

Another seven species of interest were also recorded, these are: Scarlet Robin *Petroica boodang* (proposed vulnerable listing under the TSC Act), Rainbow Bee-eater *Merops ornatus* and Clamorous Reed-Warbler *Acrocephalus stentoreus* (listed as migratory species under the EPBC Act) and regionally uncommon species, such as Southern White-face *Aphelocephala leucopsis*, Restless Flycatcher *Myiagra inquieta*, Jacky winter *Microeca fascinans* and Double-barred Finch *Taeniopygia bichenovii*.

Main fauna habitats included grassland, woodland, open forest, rock outcrops, tree hollows and wet areas that ranged from major river systems to farm dams. Hollow-bearing trees occurred widely within many woodland and forest habitats, and occasionally as isolated paddock trees or stags. Extensive areas of rock outcrop were encountered in the Murrumbidgee River corridor, along Burra Creek and to a lesser extent on the Gibraltar 'saddle'. Smaller outcrops were associated with low hills and knolls, mainly in the western sections of the study area.

Potential Impacts of Construction

The proposed project would remove or modify a total of 16.7 ha of native vegetation (ranging from BGGW to native pasture) and 23.8 ha of non-native vegetation (essentially non-native pasture, plantations and weed affected areas).

The pipeline component of the project would affect a total 15.7 ha of native vegetation, with the additional infrastructure works affecting 0.9 ha of native vegetation.

The impact on each vegetation type in the ACT and NSW are as follows:

ACT

- 2.6 ha of BGGW in good to moderate condition;
- 1.8 ha of BGGW in poor condition;
- 1.7 ha of NTG in good condition;
- 0.3 ha of *Eucalyptus bridgesiana*-*E. dives*-*E. mannifera* woodlands;
- 0.5 ha of Kunzea/Acacia shrubland;
- 1.2 ha of native pasture; and,
- 2.2 ha of non-native and/or weed infested areas..

NSW

- 2.4 ha of BGGW in good to moderate condition;
- 4.3 ha of BGGW in poor condition;
- 0.3 ha of SGGW;
- 0.6 ha of *Eucalyptus dives* forest;
- 0.2 ha of *Eucalyptus bridgesiana*-*E. dives* forest
- 0.8 ha of native pasture; and,
- 21.6 ha of non-native vegetation.

Other impacts include disturbance of up to 2.31 ha of rocky outcrops (0.79 in the ACT and 1.52 ha in NSW) that is either known or suitable habitat for the Pink-tailed Worm Lizard, soil compaction and short-term effects of noise and vibration.

Recommendations

The following recommendations and recovery actions are proposed.

- Avoid impact to known and potential habitat for the Nationally endangered *Swainsona recta* within the Goulburn-Cooma Railway corridor.
- Avoid the removal of hollow-bearing trees and hollow limbs to the greatest extent possible.
- Reduce construction and scour widths in areas that contain EECs and/or threatened species habitat. The exact location and extent of corridor width

reduction would be determined in the Construction Environmental Plan of Management (EMP)

- Follow protocols for the management, storage and replacement of excavated soil, which are provided in Appendix 8.
- Determine if any nest sites for the Speckled Warbler occur within the construction corridor, particularly in the area between Monaro Highway and the Gouldburn-Cooma Railway corridor.
- Minimise the delay between construction and the commencement of rehabilitation. Consideration should be given to commencing pipeline construction in low conservation value areas (i.e. eastern sections).
- Collect and propagate a wide range of common and uncommon native varieties of plant within the catchment for future rehabilitation of moderate to good quality vegetation components that would be affected by construction.
- Prepare a monitoring strategy to record the progress of the rehabilitation effort. This should record, amongst other things, tube stock and/or seed used during rehalitation works; tube stock survival and germination of seed and/or natural recruitment; soil erosion; and, success of weed control measures. Monitoring should be undertaken for a minimum 2-year period after the commencement of rehabilitation work.
- Conduct regular inspections of the construction trench for trapped fauna.
- Minimise the introduction and transportation of weed species across the area by construction vehicles.
- Offsets for the loss and/or modification 16.7 ha of native vegetation (including 11 ha of BGGW that ranges from poor to good condition and 1.7 ha of NTG) should be considered and negotiated with the relevant Territory, State and Commonwealth agencies.
- Undertake targeted surveys for the Pink-tailed Worm Lizard within 152-754889 and 170-754889.

Works associated with the pipeline construction would have a short-term impact on some components of good quality BGGW EEC and probably longer-term impacts on small components of habitat for the Pink-tailed Worm Lizard. Other structures such as the intake and LLPS and HLPS and discharge facility would, however, have permanent but relatively small impacts on these habitats.

Provided that the recommendations (above) are agreed to and fully resourced it is considered unlikely that the project would have a significant impact on any matter of national environmental significance (MNES). Nevertheless, a Referral should be submitted to the Department of the Environment, Water, Heritage and

the Arts (DEWHA) for further consideration of the predicted impacts to BGGW EEC and Pink-tailed Worm Lizard habitat.

2.0 INTRODUCTION

2.1 Purpose of this Report

ACTEW Corporation Limited (ACTEW) proposes to undertake the Murrumbidgee to Googong Water Transfer Project (referred to in this report as ‘the project’). This report has been prepared to provide an assessment of the terrestrial flora and fauna impacts of the project as an input to the environmental impact assessment. The environmental impact assessment is being prepared in accordance with the requirements of Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and the ACT *Planning and Development Act 2007*.

The report addresses the requirements of the Director-General of the NSW Department of Planning (the Director-General’s Requirements) dated 7 October 2008 and the Final Scoping Document prepared by the ACT Planning & Land Authority (the Scoping Document) dated 16 December 2008.

Biosis Research Pty. Ltd. (Biosis Research) was commissioned by ACTEW to conduct a terrestrial flora and fauna assessment for the project. This report provides an overview of the current terrestrial ecological status of the study area, assessments of significance for threatened species and ecological communities and recommendations to avoid and/or minimise impacts to high conservation value vegetation/habitat and post-construction rehabilitation of the development footprint.

2.2 Project Overview

In recent years the Australian Capital Territory (ACT) region has been experiencing severe drought conditions coupled with increased demand for water. Canberra and Queanbeyan have been subject to level three water restrictions since 2006. The current drought, together with predicted climate change and population growth, is driving the search for a more reliable water supply for the ACT. In response to this need, the ACT Government developed the Water Security Program, which identified a range of new water supply projects.

The project is one of the preferred options for delivering improved security to the ACT’s water supply. It involves pumping water from the Murrumbidgee River (within the ACT) and transferring it via a pipeline to the Googong Reservoir via Burra Creek (in NSW). The Googong Reservoir supplies water treated to drinking quality standards to the ACT.

The project involves construction and operation of infrastructure required to transfer approximately 100 ML/day of water a distance of approximately 13 km from the Murrumbidgee River to Burra Creek.

The infrastructure required to transfer the water includes an intake/low lift pump station (LLPS); a high lift pump station (HLPS); an underground pipeline; a discharge structure and a power supply.

2.3 The Location of the Project

The intake/LLPS would be located on the east bank of the Murrumbidgee River, in the ACT, approximately 34 km south of Canberra (Figure 1). It would be located in an area known as Angle Crossing, approximately 4 km south-west of Williamsdale on the Monaro Highway (Figure 2).

The HLPS would be located within the ACT, approximately 290 m to the east of the intake/low lift pump station.

The pipeline would cross rural land in an east/north-east direction for approximately 13 km. It is located in the vicinity of Williamsdale and Burra Roads, within the districts of Williamsdale and Burra. The majority (approximately 10.2 km) of the pipeline would be located in NSW, with about 2.8 km situated in the ACT (Figure 3).

The pipeline would discharge to the discharge structure, located on the south bank of Burra Creek, downstream of an existing flow measuring station approximately 10 km south of Googong Reservoir. The discharge structure would be located within the Googong Foreshores, which is Commonwealth land within NSW.

2.4 Project Description

The following project components (Figure 3 and Figure 4) are being assessed in this report:

- Intake facility and Low Lift Pump Station (LLPS) at Angle Crossing;
- High Lift Pump Station (HLPS) above Angle Crossing;
- Electrical easement between the LLPS and HLPS;
- Construction of a 13 km underground pipeline;
- Site offices and pipe laydown areas; and,
- Construction of a discharge facility and site compound on the banks of Burra Creek.

The proposed pipeline trench would have an:

- average depth of cover to top of pipe is around 800 mm (range 0.6 to 3 m);
- average depth to pipe invert is around 2000 mm (1.8 to 4m); and,
- average width of 2 - 4 m depending on ground conditions and OHS requirements.

Clearing and grading would be minimised where practicable to the extent necessary for construction of the pipeline and would not exceed the 40 m construction corridor. The area that would be directly impacted upon by construction activities would range in width from 15 m to 40 m, depending on a range of factors considered that include occurrences of important habitats for threatened species and ecological communities, vegetation sensitivity and quality, constructability, construction management and safety considerations, land form, slopes and anticipated sub-soil structures. Direct impacts would be reduced as far as practicable with narrower construction corridors proposed where feasible and in areas this may only require a 15 m wide corridor (possible only for short stretches). In areas of steep terrain (that impact on construction methodology's available and construction safety) and problematic sub-soil conditions, the impact area would be wider than 15 m, but would always be less than 40 m. The proponent has based the environmental assessment on an indicative corridor width that would be refined by the construction contractor.

The proposed pipeline construction corridor would, in addition to trenching, be used as a transport corridor; to store plant and equipment; bedding sand and excavated soil stockpiles, and would have a total footprint of about 40 ha. Approximately 16.7 ha of native vegetation would be removed or modified by the proposed project.

The proposed pipeline alignment would traverse 39 separate paddocks (or blocks), seven transport easements - Angle Crossing Road, Monaro Highway, Goulburn-Cooma Railway corridor, Williamsdale Road (on at least four occasions), MacDairmid Road, Lagoon Road and Burra Road - and Burra Creek. Table 1 provides the sequence of lands, from West to East, through which the pipeline would pass.

Table 1: Sequence of land titles (from West to East) through which the proposed pipeline would pass.

Sequence West to East	Section and DA No. or property name
	ACT - Murrumbidgee River to western edge of Goulburn-Cooma Railway corridor
1	1611 Tuggeranong
2	1572 Tuggeranong

Sequence West to East	Section and DA No. or property name
3	<i>Angle Crossing Road</i>
4	1674 Tuggeranong
5	1653 Tuggeranong
6	<i>Monaro Highway</i>
7	119 Tuggeranong
	NSW - Goulburn-Cooma Railway corridor to Burra Creek
8	<i>Goulburn-Cooma Railway corridor</i>
9	1-126283
10	201-754889
11	152-754889
12	170-754889
13	141-754889
14	84-754889
15	222-754889 and/or 1-114174
16	91-754889 and/or 2 -114174
17	16-846996
18	1-1065746
19	1-875569
20	2-875569
21	<i>Williamsdale Road</i>
22	3-1111074
23	<i>Williamsdale Road</i>
24	1-1056284
25	3-114174
26	56-754889
27	201-1037637
28	<i>Williamsdale Road</i>
29	24-754889
30	1-246137
31	1-880873
32	4-246137
33	5-246137
34	<i>Williamsdale Road</i>
35	2-246930
36	3-246930
37	1-843907
38	<i>MacDiarmid Road</i>
39	1-854164
40	3-843907
41	7004-96235
42	<i>Burra Creek</i>
43	<i>Lagoon Road</i>
44	2-1038845
45	1-821774
46	7005-96325

Sequence West to East	Section and DA No. or property name
47	7003-96235
48	3-1097402
49	28-54913
Commonwealth - Googong Foreshores	
50	7-592796

A full description of the proposed works is provided in the Murrumbidgee to Googong Bulk Water Alliance Project Construction Methodology Revision A February 2009.

2.5 Aims

The general aim of this report is to undertake a terrestrial flora and fauna impact assessment for the proposed development in both the ACT and NSW sections.

The specific aims are to:

- Conduct a literature review and database search for the area surrounding the study site;
- Undertake targeted field surveys for habitat of threatened terrestrial species, populations and ecological communities that are listed on the ACT NC Act, the NSW TSC Act and the Commonwealth EPBC Act that potentially occur in the area;
- Consider the potential occurrence of subject species (see Table 1 in the Director General's Requirements for the evaluation of impacts on threatened species for the Murrumbidgee to Googong Water Transfer Project);
- Conduct targeted species searches, trapping and observational studies for those subject species with a high probability of occurrence within the study area;
- Evaluate the habitat values of the subject site; and,
- Provide recommendations to minimise the environmental impacts of the proposed development.

2.6 Definitions

The following terms are used frequently throughout the report:

- ***The proposal*** is the development, activity or action proposed. In this case the proposal is the below ground installation of a 1 m diameter water pipeline between Angle Crossing and Burra Creek.

- **Subject site** is defined as the area directly affected by the proposal. In this case, the subject site is the installation of facilities to extract, transfer and release water.
- **Study area** is defined as the subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly.
- **Regional** means the area defined within the applicable IBRA Bioregion (Thackway and Cresswell 1995), i.e. the ‘South-eastern Highlands’.
- **Landscape unit** this refers to planning units described in Fallding (2002). The study area falls into the Tharwa and Royalla Landscape Units.
- **Local population** is defined as the population of a species within the study area.
- **Local occurrence** is used in reference to endangered ecological communities and is defined as the community that occurs within the study area.
- **Locality** is the area within a 5 km radius of the study area.

2.7 Location Descriptions

2.7.1 Study Area

The study area is located about 34 km south of the Canberra CBD and is broadly defined as a 240 m wide corridor that extends from Angle Crossing on the Murrumbidgee River to Burra Creek, some 13 km to the east (Figure 2). The proposed pipeline corridor passes through the ACT, NSW and Commonwealth lands and falls within the Queanbeyan and Palerang Local Government Areas (LGAs).

The study area boundaries fall entirely within the Williamsdale (8726-4N) 1:25,000 Map Sheet.

2.7.2 Study Area Access

Access to large parts of the study area was generally unrestricted, except for a particular group of properties located between the Monaro Highway and Gibraltar Hill - 115 ‘Tuggeranong’; 134-650976; 201-754889; 152-754889 and 170-754889 1-126283 - in which access was limited during the formal survey period. Access to these properties was granted in February and May 2009 during which time vegetation sampling (20 m x 20 m plots) and general habitat assessments were conducted but no detailed or systematic fauna sampling were undertaken. Access was also denied to blocks 2/1040288 and 1/843907 (initial access to the later was granted but later denied), east of the Gibraltar ‘saddle’.

2.7.3 Landscape and Biogeographic Areas

The study area falls into two local Landscape Units as used by Fallding (2002), these are: Tharwa and Royalla units. Units are identified on the basis of similar ecological, social, economic and administrative characteristics (Fallding 2002) using a range of parameters including: topography; climate; vegetation type and cover; conservation values; land use; tenure; and, catchment and management issues.

At the biogeographic level the study area is within the South Eastern Highlands Bioregion (Thackway and Cresswell 1995) and the Monaro sub-region within the Murrumbidgee Catchment.

2.7.4 Landform

Elevation ranges from about 600 m on the Murrumbidgee River at Angle Crossing to over 1,100 m at Gibraltar Hill and Mount Burra. The proposed pipeline corridor would pass through the 'saddle' that connects these two peaks at about 860 m. The topography east and west of the saddle consists of mostly gently undulating hills and flats, which to the west gradually decline into the deeply incised Murrumbidgee River gorge.

2.7.5 Geology and Soils

The study area is situated within the Murrumbidgee Valley, on the Williamsdale Soil Landscape. The A1 horizon of this landscape is typically a brownish black massive loam; the A2 is a dull yellowish brown massive sandy clay loam or a bleached dull brown massive sandy loam; and the B2 horizon is a bright brown moderately pedal clay or a bright yellowish brown strongly pedal sandy clay. The soils overly Silurian volcanics; rhyodacitic and lithic tuff with minor siltstone, sandstone and limestone. Minor gully erosion is common, as is alluvial material (Jenkins 1993).

To the north, east, south and west of Williamsdale, within approximately 500 m, is the Burra Soil Landscape, the line of which runs roughly north-south and is approximately followed by the Monaro Highway in this area. The soils overlie Silurian volcanics; various tuffs with minor siltstone, shale, sandstone and limestone. Minor sheet erosion is common and widespread (Jenkins 1993).

To the east, approximately 2.5 km from Williamsdale, and to the west, approximately 1.5 km away, is the Campbell Soil Landscape. The soils again overlie Silurian volcanics; including various tuffs, siltstones, sandstones, rhyolites, dacites and limestones. Minor and moderate sheet erosion is

widespread, mass movement is evident on steep slopes, and gully erosion is common along drainage lines (Jenkins 1993).

2.7.6 Climate: ACT and Surrounds

Climate in the ACT and surrounds is influenced by landform. In the ranges to the west the average annual rainfall ranges from 800-1000 mm whereas on the lowlands the average range falls to 600-700 mm and even lower in areas exposed to enhanced rain shadow effects.

January is the hottest month with a mean daily maximum temperature of 27.7°C and the mean daily minimum temperature in January is 13.0°C. By contrast, winters are cool to cold with mean daily maximum temperatures for July of 11.2°C while the mean daily minimum is -0.2°C.

The highest recorded maximum temperature was 42.2°C in February 1968. The lowest recorded minimum temperature was -10.0°C during July 1971

<http://www.bom.gov.au/weather/nsw/canberra/climate.shtml>.

Appendix 4 contains monthly weather data during the main survey study period.

2.7.7 Land Use

Local land uses include farming (mostly sheep and cattle grazing and small scale cropping) and rural residential properties. Utilities include road, power, water and communications easements; mining (e.g. Williamsdale Quarry); and, conservation (e.g. Murrumbidgee River Corridor and Gigerline Nature Reserve in the ACT and Burra Creek Nature Reserve, Tinderry Nature Reserve and Googong Foreshore in NSW, although the latter is on Commonwealth Land).

A number of smaller conservation areas listed on the Register of the National Estate are scattered throughout the local area, and include:

- the Goulburn-Bombala Railway corridor (listed on the Register of the National Estate – Williamsdale Small Purple-pea *Swainsona recta* population); and,
- Braidwood Rural Lands Protection Board Travelling Stock Reserve and various other parks and road reserves.

2.7.8 Drainage

Broad drainage patterns can be divided generally into flows east and west of about 698000 E, which equates to the Gibraltar Hill and Mount Burra divide.

Drainage west of this divide flows into Deep Creek and Waterhole Creek system

to the south and, Lobb's Hole Creek north of Williamsdale Road and ultimately, the Murrumbidgee River, while runoff to the east enters Burra Creek and the Queanbeyan River system (including Googong Reservoir). A large array of unnamed drainage channels (including numerous farm dams) add to this drainage pattern.

2.7.9 Vegetation Overview

Remnant native vegetation across the study area ranges from non-native pasture to native grasslands and grassy woodlands on the undulating lowlying hills and flats. Dry grassy/shrubby sclerophyll forest occurs on the rockier slopes of Gibraltar Hill and Mount Burra including parts of the Gibraltar 'saddle' that link the two. The condition of vegetation west of the 'saddle' ranges from poor to good with some smaller components in very good condition. The 'saddle' area contains mostly intact dry grassy/shrubby sclerophyll forest, which grades into grassy forest/woodland on the intermediate and lower slopes.

Vegetation on the lower flats east of the 'saddle' contains small components of variable quality grassy woodland/forest. However, most of the paddocks along Williamsdale Road contain highly modified vegetation, such as low diversity native pasture and/or non-native pasture. Road-side vegetation in this area is mostly exotic and in poor condition as were the nearby drainage channels. In contrast, good quality vegetation was noted along some sections of Burra Road and at Burra Creek, east of Burra Road.

2.8 Legislative Context

The study area traverses several government jurisdictions and initiates a number of statutes and policies.

2.8.1 Commonwealth Legislation

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2.8.2 NSW Legislation

- *Animal Research Act 1985* (AR Act);
- *Environmental Planning and Assessment Act 1979* (EP&A Act) - Part 3A;
- *Fisheries Management Act 1994* (FM Act);
- *Local Government Act 1993* (LG Act);

- *Noxious Weeds Act 1993 (NW Act)*;
- *National Parks and Wildlife Act 1974 (NPW Act)*;
- *Threatened Species Conservation Act 1995 (TSC Act)*;
- *Threatened Species Conservation Amendment Act 2002 (TSCA Act)*; and,
- *Water Management Act 2000 (WM Act)* and the *Controlled Activity Provisions of the WM Act (previously the Rivers and Foreshores Improvement Act 1948)*.

2.8.3 ACT Legislation and Plans

- *Land (Planning and Environment) Act 1991 (LPE Act)*;
- *Nature Conservation Act (NC Act) 1980*;
- *Pest Plants and Animals Act (PPA Act) 2005*;
- *Tree Protection (Interim Scheme) Act (TP Act) 2001*; and,
- Murrumbidgee River Corridor Plan of Management 1997.

2.8.4 NSW Local Government Environmental Planning Instruments

- Yarrowlumla Development Control Plan: 7(E) Environmental Protection Zone September 2004;
- Yarrowlumla Development Control Plan: Rural and Rural Residential Zones September 2004;
- Yarrowlumla Local Environmental Plan 2002;
- Queanbeyan Local Environmental Plan 1991 – applies to the city limits;
- Queanbeyan Local Environmental Plan 1998; and,
- Draft Queanbeyan Local Environmental Plan (Googong) 2007 - currently on exhibition

2.8.5 ACT and NSW Regional Planning Framework

The *Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands* (Fallding 2002) provides a strategic framework that addresses the uncertainties of the planning process and provides an effective mechanism for habitat conservation for the region. Section 5 in Fallding outlines a framework for natural ecosystems planning for the region and presents a ‘modelled’ strategic approach for prioritising land use and management according to four planning settings:

- Planning setting A – Areas of known conservation importance;
- Planning setting B - Areas of predicted conservation importance;
- Planning setting C - Areas of uncertain importance for biodiversity conservation – more investigation required; and,

- Planning setting D - Areas likely to have limited conservation values.

Habitats within the study area range from very good to poor in condition and thus fall, to varying degrees, within all four of these planning settings.

3.0 METHODS

3.1 Approach

The study comprised three key stages: a literature and database review; field surveys; and, vegetation and constraints mapping. The desktop study involved gathering and reviewing existing ecological information of the study area. Field surveys were undertaken for the purpose of ground-truthing information obtained during the desktop examination and to gather any additional data from the study area. The combined information from field and desktop studies was then used to describe the ecological features of the study area and assess impacts to threatened flora and fauna.

3.2 Literature and Database Review

Existing information regarding the flora and fauna of the study area was obtained from a range of sources, including: databases; aerial photographs and maps; previous studies carried out in the vicinity of the study area; and, consultation with experts, government agencies, local conservation organisations and natural heritage groups. A list of documents cited in this report is located in the *References* section.

Local and sub-regional vegetation data, threatened species and EEC records were obtained from the following web-based databases:

- Integrated Nature Conservation Plan (INCP) mapping website, <<http://incp.environment.act.gov.au/>>;
- NSW Department of Environment and Climate Change (DECC) threatened species webpage <<http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>>;
- Atlas of NSW Wildlife, <<http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp>>
- BioNet <<http://www.bionet.nsw.gov.au/Area.cfm>>;
- Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) *Protected Matters Search Tool* in September 2008 <<http://www.environment.gov.au/erin/ert/epbc/index.html>>; and,
- Canberra Ornithologists Group Inc. (COG) bird records from the Williamsdale area, obtained December 2008;

A number of specialist and technical reports and spatial information relating to the local area were examined, these included:

- Comprehensive Regional Assessment vegetation mapping;

- *The native grasslands of the Monaro region: Southern Tablelands of NSW* (Benson 1994a);
- *The reptile, amphibian and mammal fauna of the Gigerline Nature Reserve, Australian Capital Territory, August 1995* (Rauhala 1995);
- *A Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands* (Fallding 2002);
- *National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands (NSW and ACT): an endangered ecological* (ACT Environment 2002);
- *Wildfires in the ACT 2003: Report on initial impacts on natural ecosystems. Technical Report 17*(Carey et al. 2003) ;
- *Woodland for Wildlife: ACT Lowland Woodland Conservation Strategy. Action Plan No. 27* (ACT Government 2004);
- *The recovery and ecology of Pomaderris pallida* (Moore 2005);
- Preliminary Vegetation Assessment: Angle Crossing to Burra Creek (Biosis Research Pty.Ltd. 2005);
- *A Vision Splendid of the Grassy Plains Extended: ACT Lowland Native Grassland Conservation Strategy. Action Plan No. 28* (ACT Government 2005);
- *Burra Creek Nature Reserve Draft Plan of Management. NSW National Parks and Wildlife Service* (DEC 2006);
- Overview of Ecological Constraints: Murrumbidgee River to Googong Dam Raw Water Transfer – Preliminary Design Project (Biosis Research Pty.Ltd. 2007);
- *Ribbons of Life Draft Aquatic Species and Riparian Zone Conservation Strategy. Acton Plan No. 29* (ACT Government 2007b);
- Googong Foreshores Draft Plan of Management. Territory and Municipal Services (ACT Government 2007a);
- *A Method to Assess Grassy Ecosystem Sites: Using floristic information to assess a sites' quality* (Rehwinkel 2007);
- *Proposed 132Kv Subtransmission Line from Williamsdale to Theodore. Preliminary Assessment* (Purdon Associates 2008);
- aerial photographs of the study area and surrounds, supplied by BWA; and,
- Williamsdale 8762-4N 1:25,000 Topographic and Orthophoto Map Sheet.

An overview of broad vegetation types and distributions was assessed across the study area. This included an examination of vegetation mapping layers presented on the ACT Government's INCP website

<<http://www.gim.act.gov.au/website/incp/viewer.htm>> and modelled extant native vegetation and regional ecological planning settings by Fallding (2002).

The location and extent of high conservation value vegetation, specifically BGGW, derived secondary grasslands and possibly NTG was estimated from the INCP vegetation mapping for the ACT and modelled vegetation provided in Fallding (2002).

3.3 Taxonomy

The plant taxonomy (method of classification) used in this report follows (Harden 1990; Harden 1992; Harden 1993; Harden 2002), although information from other electronic sources such as PlantNet (BGT 2007) and Weed CRC Management (CRC Weed Management 2008) were drawn from. In the body of this report non-woody plants are referred to by their scientific name only, with the exception of where the common name of a species is descriptive i.e. ‘Kangaroo Grass *Themeda australis* dominated grassland’. Trees and shrubs are referred to by their common names and scientific names when first mentioned. Subsequent references to these species cite the scientific name only. Common names for all plant species are included in the Appendices, where available.

Names of animals are taken from the Australian Faunal Directory maintained by DEWHA and names of vertebrates follow the Census of Australian Vertebrates Species (CAVS), at the same web site (Australian Biological Resources Study 2006). CAVS use the common name Pink-tailed Legless Lizard although in this report Pink-tailed Worm Lizard is used to follow the EPBC Act profile. In the body of this report vertebrates are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only.

3.4 Site Selection

The location of each sample site was selected on the basis of vegetation type and condition (in the case of vegetation quadrats its representativeness to the surrounding vegetation), habitat features (i.e. rock outcrops), the potential for threatened species to occur and, ultimately, accessibility.

The survey effort was not consistent across all sites or the entire study area; rather, survey effort was guided by initial site assessments, with greater emphasis and effort directed towards areas of better quality habitat and lower effort in areas with low botanical diversity, high weediness and/or high levels of modification, i.e. cropping.

Flora samples sites are presented in Figure 7 and fauna sample sites in Figure 8.

3.5 Flora Survey

Preliminary vegetation assessments were undertaken in December 2006 and again in October and November 2007. Formal flora surveys commenced on 3 September 2008 and continued at various intervals to mid January 2009.

Surveys were conducted in accordance with the *Draft Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004). A description of each of the survey methods is provided below.

3.5.1 Plot-based surveys (quadrats)

Fifteen sample plots (20 x 20 m quadrats) were placed across the study area (Figure 7) to provide a quantitative and comparable sample of the different vegetation components across the study area. Plot-based surveys also provide an additional method to search for inconspicuous plant species that may be overlooked during random or less detailed surveys.

A modified Braun-Blanquet, assessment of cover abundance was used (Rehwinkel 2007), see Table 2. The relative conservation value of each site was determined through the application of a regionally based assessment criteria (Rehwinkel 2007) for grassland and grassy woodland ecosystems of the Southern Tablelands of NSW.

Table 2: Modified Braun-Blanquet cover abundance scale as per Rehwinkel (2007).

COVER ABUNDANCE	COVER ABUNDANCE ESTIMATE
r	< 5 % cover and solitary (<4 individuals)
+	< 5 % cover and few (4-15 individuals)
1	< 5 % cover and numerous/scattered (>15 individuals)
2	5 % - 25 % cover
3	26 % - 50 % cover
4	51 % - 75 % cover
5	>75 % cover

3.5.2 Transects and targeted searches

Flora searches were carried out within the proposed pipeline route and a 200 m buffer area. Additional searches were made in adjacent vegetation where appropriate. Random meander surveys (Cropper 1993) were carried out over accessible parts of the study area in order to determine the extent and location of vegetation types, and to carry out searches for threatened plant species. A general survey (DEC 2004) was then carried out within the proposed alignment in order

to compile a list of plant species occurring within the approximate areas of disturbance.

Threatened plant locations were recorded using a hand-held non-differential Global Positioning Systems (GPS) (Figure 9).

Subject species identified in the Director General's Requirements included:

- *Calotis glandulosa*
- *Dillwynia glaucula*
- *Discaria pubesens*
- *Diuris* spp.
- *Dodonea procumbens*
- *Gentiana bredboensis*
- *Gentiana baeuerlenii*
- *Pomaderris pallida*
- *Prasophyllum petilum*
- *Rutidosia leptorhynchoides*
- *Swainsona recta*
- *Swainsona sericea*
- *Thesium australe*

Plant material of taxonomic uncertainty was collected and preserved for later identification.

3.5.3 Vegetation Condition Assessment

Vegetation condition was assessed according to the degree to which it resembles relatively natural, undisturbed vegetation. Vegetation was assessed as being in Good, Moderate, Poor or Disturbed condition according to the following criteria:

- Species composition (species richness, degree of weed invasion) - see Section 3.5.1 'Plot-based surveys', above;
- Vegetation structure (representation of each of the original layers of vegetation); and,
- Resilience - the capacity of a site for natural regeneration. This is primarily linked to the degree to which the natural soil profile of the area has been disturbed).

Plant community condition was categorised as follows:

Good: containing a high number of indigenous species; no weeds present or restricted to a few species in very low densities. Vegetation contains intact

structural layers (eg. ground, shrub, canopy) consistent with the community, or if modified, natural soil profile remains intact;

Moderate: containing a moderate number of indigenous species; moderate level of weed invasion; weeds occurring in isolated patches or scattered throughout. Vegetation contains largely intact structural layers or if modified, natural soil profile remains intact. Able to be regenerated to Good condition with minimal level of management;

Poor: containing a low number of indigenous species; high level of weed invasion, occurring in dense patches or dominating entire area. Structure may present but is highly modified and natural soil profile intact. Able to be regenerated to Moderate or Good condition with substantial management; and,

Disturbed: highly modified landscape containing few or no indigenous species; exotic species dominant and/or original native vegetation layers removed. Natural soil profile disturbed. Regeneration to near natural condition would not be possible without intensive efforts.

3.5.4 Vegetation Mapping

Initial investigations of vegetation type and distribution were undertaken by viewing aerial photography, local vegetation mapping, including the ACT Government mapping <<http://www.gim.act.gov.au/website/incp/viewer.htm>> and regional vegetation modelling (Fallding 2002). Vegetation was then ground truthed and the following data collected from within each property or vegetation unit:

- Location i.e. property number and location marked on map;
- Vegetation type, structure and condition; and,
- Habitat description: land uses, fauna habitat features such as tree hollows and species, fire history and other disturbances.

Vegetation boundaries were determined and hand-drawn onto aerial photographs in the field. These maps were later digitised and updated during the course of the project (Figures 11-14).

3.5.5 Flora survey effort

Survey efforts (see Table 3) were greatest within areas containing: native vegetation; known or potential habitat for threatened plant species and/or EECs.

Table 3: Flora survey effort

TASK	DETAILS
Quadrats 20 x 20 m (400 m ²) & transects	15 sample plots in total and one formal 1km transect (Figure 7)
Size, orientation and dimensions of transects	Random meanders were carried out within all accessible patches of native vegetation to opportunistically document species. Estimated walked distance was in excess of 20 km
Time invested in flora surveys	156 person hours
Dates of surveys	Initial scoping study was undertaken in December 2006 with subsequent options assessments conducted during late 2007. Detailed sampling along the proposed route were conducted between 1 September 2008 and January 2009.
Survey start times and finish times	Generally between 08:00 and 18:00
Vegetation mapping	80 person hrs – inc. aerial photo interpretation and GIS

3.6 Fauna Survey

Preliminary observations of habitat type within the local area were conducted in December 2006 and October/November 2007. Detailed habitat assessments commenced on 3 September 2008 and species sampling and monitoring were conducted between September 2008 and February 2009. Reptile sampling continued up to the end of February 2009.

The following describes the techniques applied during fauna surveys. The location of each sample site is provided in Figure 8.

3.6.1 Targeted Surveys

Targeted searches for threatened animals involved direct observation, detection and trapping in known and/or potential habitats within all accessible parts of the study area. Species locations were recorded using a hand-held non-differential GPS (Figure 10).

Targeted surveys were undertaken for the following threatened animal species or species groups:

- Golden Sun Moth *Synemon plana*;
- Pink-tailed Worm Lizard *Aprasia parapulchella*;
- Little Whip Snake *Suta flagellum*;
- Grassland Earless Dragon *Tympanocryptis pinuicolla*;
- Striped Legless Lizard *Delma impar*;

- Rosenberg's Monitor *Varanus rosenbergi*;
- Woodland birds;
- Nocturnal birds; and
- Micro-bats.

Invertebrate Surveys (e.g. Golden Sun Moth, Perunga Grasshopper, Keys Matchstick Grasshopper)

The Golden Sun Moth flight season can occur anytime between mid October and January and regular visits to known Golden Sun Moth sites during mid to late October are necessary to determine when flying has commenced. Visual surveys (either fixed observation points or walked transects through areas of potential habitat) were conducted within areas of potential habitat on warm days with little or no wind between 10:00 and 14:00 hours. Primary areas of habitat were considered to be native grasslands.

Golden Sun Moth Control Sites

Golden Sun Moths were observed flying on 29 October at the Belconnen Naval Station (Alison Rowell, *pers. comm.*) and 10 November at Letchworth Nature Reserve (authors note). Formal surveys for Golden Sun Moth commenced within the study area soon after the former date and continued until mid December 2008.

Surveys for Golden Sun Moth are best conducted when adult males are active (flying), usually between late spring and summer. The Golden Sun Moth has been recorded in native grasslands and grassy woodlands containing wallaby grass (*Austrodanthonia* spp.), speargrass (*Austrostipa* spp.) and *Bothriochloa macra*, as well as in degraded grasslands dominated by the exotic chilean needlegrass (*Nassella nessiana*), a weed of national significance. Bare or sparsely covered ground between grass tussocks (inter-tussock space) are thought to be important in helping males locate females. Golden Sun Moth surveys were carried out in accordance with the draft policy statement for the species (DEWHA 2009b), which includes recommended survey effort.

Other threatened and/or uncommon grassland invertebrates (i.e. Perunga Grasshopper *Perunga ochracea* - listed as vulnerable under the NC Act - and Keys Matchstick Grasshopper *Keyacris scurra*) were randomly searched for with grassland habitat.

Pit-fall Trapping

To date five pit-fall arrays have been placed across the study area (Figure 8) to target Striped Legless Lizard and Grassland Earless Dragon and other small ground-dwelling animals such as frogs and small mammals (eg. species of

Antechinus and *Sminthopsis*). The location chosen for pit-fall arrays was based on areas of potential habitat (primarily areas containing native grassland and grassland/woodland mosaic, but also in non-native grassland).

Each pit-fall array consisted of two 10 L buckets (pits) set 45 cm into the ground and placed approximately 10 m apart. A 20 m long x 30 cm high drift fence (plastic coated aluminium damp course) was placed vertically into the ground over the centre line of each bucket to direct fauna to the pits. A small amount of leaf litter and cotton wool was placed at the base of each pit to provide refuge and to retain moisture within the pit. A small amount (about 200 ml) of water was added to each pit daily and any excess water was able to drain through small holes set at the base of each bucket. A cover was placed over each pit to provide shade. Pit-falls were checked every day in the morning for three weeks and all captures and observations recorded, including location and number of individuals.

Pit fall transects were left in place at each site for at least 14 nights with one transect left for 30 nights.

Artificial Arthropod Tubes

A total of 140 artificial arthropod tubes were placed at twelve separate locations across the study area (Figure 8) to target Grassland Earless Dragon and, to a lesser extent, Striped Legless Lizard. The tubes mimic invertebrate burrows that are known to be used by small reptiles (ACT Government 2005). Tubes were arranged in linear transects within various grassland types and on the margins of woodland habitat.

Burrows are made from PVC piping (electrical conduit and pumping pipe and fittings) and consist of an outer tube (inner diameter of 32 mm and length of 15 cm) and an inner tube. The lining of the inner tube was coated with brown acrylic paint over which a fine grained soil/sand mix was spread before the paint dried. The lower end of the inner tube was capped and a small hole drilled into the base to permit drainage. A plastic 'connector' ring was fitted over the open end of the inner tube so that there was a minimal gap between the two tubes.

Holes were drilled into the soil (using a 34 mm diameter hand-held auger) in linear arrays approximately 10 m apart. An arthropod-tube was placed into each hole and a 20 x 20 cm shelter was positioned over each burrow.

Rock Turning

Rock turning is the most appropriate method to survey for Pink-tailed Worm Lizard and Little Whip Snake. Surface or 'floating' rocks between 10 and 55 cm (occasionally larger) in diameter were turned over and inspected for Pink-tailed Worm Lizard or their sloughs and Little Whip Snake. The approach to the surveys was as follows: Firstly, where rock outcrops were extensive or linear, searches were confined to a series of 10 m wide transects. Secondly, random searches were undertaken in smaller or isolated areas of outcropping rock, such as knolls. Thirdly, where evidence of either species was encountered a wider search was undertaken in the immediate area. Fourthly, the number of rocks turned was tallied against the number of specimens found. All rocks were immediately returned to position in which they were found. Targeted surveys were conducted between early September 2008 and early December 2008, although incidental searches were conducted during other field activities.

Cage Trapping

Cage trap transects were established at three locations: Murrumbidgee River corridor, within shrubby woodland within the Gibraltar 'saddle' area and at Burra Creek. Traps were set for a minimum of four (up to ten) consecutive nights to target Rosenberg's Goanna. Traps were baited with chicken and checked each morning.

Frog Surveys

Diurnal and nocturnal searches were conducted for frogs in and near dams and water ways. This included hand searches, pitfall trapping (which also enables capture of some myobatrachid species) and aural detection. Aural surveys involved quietly listening for calling frogs for a period of five to ten minutes at each site. Where possible surveys were conducted after rain. Listening for calls of the Green and Golden Bell Frog *Litoria aurea* was also undertaken at sites where it was considered they might occur.

Diurnal Bird Point Surveys

Diurnal woodland birds were surveyed for 30 minutes at five sites within the study area: Murrumbidgee River; ACT woodlands; Gibraltar ‘saddle’; Burra rural lands; and Burra Creek. Each point was approximately 1 ha in size. Surveys were conducted during periods of relatively high bird activity (i.e. early morning or late afternoon) and all bird species seen or heard were recorded.

Large tree hollows were monitored during the course of other field work for any evidence of threatened owl (eg. *Ninox* sp.) or cockatoo (eg. Glossy-black Cockatoo or Gang Gang Cockatoo) nesting.

Birds were also recorded opportunistically at all other times and locations.

Nocturnal Call Playback

Call playback techniques were used at four sites on ten occasions to survey for two owl species: Barking Owl *Ninox connivens* and Powerful Owl *Ninox strenua*. Call playback involved repeating recorded calls of owls through a megaphone for a period of at least three minutes, followed by a 10 minute listening period and a minimum 10 min spotlighting session.

Anabat Detection

Anabat detectors were used to survey microchiropteran bats within the study area at five sites. The detectors were set before dusk at a number of sites and left to record overnight. Detectors were set along woodland edges, farm dams, within river gullies, near hollow-bearing trees in paddocks and in roadside vegetation along Williamsdale Road. These positions were designed to cover the foraging areas of all targeted bat species.

3.6.2 Fauna Habitat Assessment

The three categories used to evaluate fauna habitat value were Good, Moderate or Poor, as described below:

Good: ground flora containing a high number of indigenous species; vegetation community structure, ground, log and litter layer intact and undisturbed; a high level of breeding, nesting, feeding and roosting resources available; a high richness and diversity of native fauna species.

Moderate: ground flora containing a moderate number of indigenous species; vegetation community structure, ground log and litter layer moderately intact and undisturbed; a moderate level of breeding, nesting, feeding and roosting resources available; a moderate richness and diversity of native fauna species.

Poor: ground flora containing a low number of indigenous species, vegetation community structure, ground log and litter layer disturbed and modified; a low level of breeding, nesting, feeding and roosting resources available; a low richness and diversity of native fauna species.

Other habitat features such the value of the study area as a habitat corridor, the presence of remnant communities or unusual ecological vegetation community structure where also used to assess habitat quality.

3.6.3 Fauna Survey Effort

The total combined survey effort for each survey method is given in Table 4.

Table 4: Fauna survey effort for each technique and survey period.

PERIOD	METHOD	TARGET SPECIES	NO. OF TRANSECTS OR SITES	TOTAL NO. OF TRAPS, TRANSECT LENGTH or HOURS	NO. OF PERSON HOURS OR TRAP NIGHTS	STAFF
Sept 08 – Jan 09	Rock turning	<i>Aprasia / Suta</i>	Target areas: from Murrumbidgee Corridor to Monaro Hwy. NSW very limited searches east of Monaro Hwy to Williamsdale Road extensive survey along Burra Creek 12 primary areas examined	In excess of 1,000 rocks turned along an estimated cumulative transect length of 3 km.	14 person hrs	TO, DE, TE
Sept - Dec 2008	Targeted diurnal bird observations (includes tree/stag hollow watching)	Woodland birds	5	30 mins/site	2.5 hrs**	TO, KC
Sept - Dec 2008	Tree/stag hollow watching	Woodland/forest and individual paddock trees	5	10-20 mins/site	Approx 1.3 hrs**	TO, KC
Dec 08	Nocturnal Bird Surveys	Forest owls <i>Ninox</i> sp.	4	A total of 10 call play-back sessions	5 hrs	KC, LB
Sept 2008 – May 2009	Opportunised bird observations	All avifauna guilds	All areas	Entire length of study area	In excess of 50 hrs	TO, KC
2 Dec 2008 – 29 Jan 2009	Cage traps	Rosenberg's Goanna	4 sites	Five traps/site. Set between 4 and 10 nights per site 300 m transects	170 trap nights	TO, AR, LB, TE
2 Dec 2008 24 Feb 2009	Pit fall trapping	<i>Delma</i> , <i>Typmpanocryptis</i> and <i>Aprasia</i>	6 pit lines	2 pits/line	100 trap nights	TO, AR, LB, JD, TE
2 Dec 08 to 24 Feb 09	Artificial arthropod tubes	<i>Delma</i> and <i>Typmpanocryptis</i>	12	140	11,480 tube nights	TO, AR, LB, KC, TE
Late Oct 08 to mid-Dec 08	Targeted visual searches within native grasslands	Golden Sun Moth surveys	Multiple	Each transect ranged between 100m - 1,000 m in length	5 hrs	TO
Dec 08	Spotlight transect – from vehicle and walking	Nocturnal fauna	2	500 m	4 hrs	AR, LB, MS, KC
1 Dec 2008 - 17 Dec 2008	Anabat ultrasonic detector	Micro-bats	5	10 hrs/night	8 nights or 80 hrs	AR, LB, MS, KC, TO

*Pit-fall and cage traps were closed between 12th and 15th December and again between 23rd December 2008 and 5th January 2009

** Opportunistic bird observations were undertaken throughout the course of all other field work

3.7 Weather Conditions

Maximum temperatures during the study period ranged from 26 °C (September 2008) to 39.9 °C (February 2009). The lowest recorded temperature was -4.4 °C in September 2008 (Appendix 4).

Total rainfall between September 2008 and February 2009 was 300.6 mm. The highest rainfall was in December, which produced 105.2 mm and the lowest in February (to 16th) with 1.6 mm (Appendix 4).

3.8 Limitations

Given that some fauna species occurrences are influenced by factors such as seasonal movements, available and changing habitat resources, peak activity times (i.e. diurnal or nocturnal activity) and random or periodic movements, it is unlikely that the field surveys would have detected all species likely to occur within the study area. In addition, the sampling effort during the study was extensive rather than intensive, and as a consequence some sample sites received more survey effort than others.

Generally, most locations were sufficiently accessed throughout the course of the investigation, although surveys and trapping were restricted in some locations because of the presence of stock and/or landowner concerns, but for the most part this caused minimal disruption. One exception, however, related to a relatively large portion of land situated between the Monaro Highway and Gibraltar Hill. Access to this area was limited to two cursory site visits in October 2008 and January 2009.

4.0 RESULTS

A list of the flora and fauna species recorded during this survey appears in Appendix 1 and Appendix 2, respectively.

4.1 Literature and Database Review

4.1.1 Literature

Relatively few terrestrial ecological studies have been conducted within or near the study area. Those of which Biosis Research is aware include a preliminary assessment for the proposed transmission line from Williamsdale to Theodore by Geoff Butler & Associates for Purdon Associates (Purdon Associates 2008), previous pipeline options assessments by Biosis Research Pty Ltd (2007) and a fauna census of the Gigerline Nature Reserve (Rauhala 1995). Other studies and reports from surrounding areas include initial vegetation study for the eastern gas pipeline south to Michelago (Crawford 1999), a brief overview of roadside vegetation along Williamsdale Road (Crawford 2002) and the Royalla Estate development 'Statement of Environmental Effects' (Don Fox Planning 2005). The following management plans and planning documents provided additional background: the 'Googong Foreshore Draft Plan of Management' (ACT Government 2007a); 'Burra Creek Nature Reserve Draft Plan of Management' (DEC 2006); and the regionally focused 'Planning Framework for the ACT and NSW Southern Tablelands' (Fallding 2002).

The study by (Rauhala 1995) identified eight species of frog, 23 species of reptile and 26 species of mammal within the Gigerline Nature Reserve, several of which have conservation significance, i.e. Rosenberg's Monitor, Pink-tailed Worm Lizard, Grey's Skink *Menetia greyii*, Black headed Snake *Suta spectabilis*, Eastern Falsistrelle *Fasistrellus tasmaniensis* and the Common Dunnart *Sminthopsis murina*. A preliminary assessment by Purdon Associates (2008) identified areas of significant vegetation (BGGW EEC) within the Williamsdale area west of the Monaro Highway. Their study also identified three species of threatened woodland bird (Brown Treecreeper *Climacteris picumnus*, Hooded Robin *Melanodryas cucullata* and White-winged Triller *Lalage sueurii*) as likely to occur in bushland in the general vicinity. Other rare and threatened woodland birds, such as Varied Sittella *Daphoenositta chrysoptera*, Regent Honeyeater *Xanthomyza phrygia* and Swift Parrot *Lathamus discolor*, were also expected to occur, although sporadically (Purdon Associates 2008).

Information on the local occurrence and distribution of threatened plants is apparently limited. Previous studies by (Benson 1994b) identified a number of fragmented populations of the endangered *Swainsona recta* along the

Goulburn-Cooma Railway corridor, and the vulnerable *Pomaderris pallida* has been recorded on the west bank of the Murrumbidgee River at Angle Crossing (CSIRO Herbarium data; (ACT Government 2007b).

Pre-1750 vegetation modelling (Fallding 2002) identified five broad vegetation types within the Royalla, Williamsdale and Burra areas; these are: dry forest; box gum woodland; grassland-woodland mosaic; and, small patches of grassland and wet forests east of Burra Creek. The ACT Government online vegetation map (see <http://www.gim.act.gov.au/website/incp/viewer.htm>) shows remnant patches of lowland woodland, including poor to good quality Yellow Box – Red Gum Grassy Woodland (BGGW EEC) within the Williamsdale area, although native grasslands (natural or secondary) are not identified. Draft vegetation mapping of the Googong Foreshores (ACT Government 2007a) was also examined.

4.1.2 Database Results

Threatened Flora

At least seventeen threatened plant species and/or their habitats have been recorded previously within the Monaro CMA Sub-region (BioNet, DECC threatened species online database, DEWHA EPBC Online Database and other sources, including the ACT Government INCP online data and CSIRO herbarium database). Figure 5 shows the approximate locations of three of these species (*Swainsona recta*, *Swainsona sericea* and *Dillwynia glaucula*) obtained from the 'Atlas of NSW Wildlife'¹. Both *Swainsona* species have been reported in the vicinity of the study area and the nearest known record of *Dillwynia glaucula* is located to the south near Michelago. Note: *Pomaderris pallida* was recorded on the west bank of the Murrumbidgee River within the ACT (ACT Government 2007b) and has not been registered on the 'Atlas of NSW Wildlife'.

Of the seventeen threatened plant species in Table 5, ten species are either extant or have potential habitat within the wider locality. Eight of these species (marked with an asterisk*) have a low probability of occurrence within the study area due to local rarity (restricted to a few sites outside the study area), absent local records and/or poorly represented habitat components within the proposed development corridor. Six species are listed under the NC Act and fourteen each under the TSC Act and EPBC Act, although not necessarily the same species (Table 5).

¹ Note: the 'atlas' does not provide a complete representation of all species actual or potential occurrence or distribution within any given area, it merely provides a point record of species based on field observations submitted to DECC.

Table 5: Rare and Threatened plant species that have known or potential habitat within the locality.

SPECIES	NC ACT	TSC ACT	EPBC ACT	ROTAP	KNOWN OCCURENCES	HABITAT WITHIN STUDY AREA
<i>Caladenia tessellata</i>	-	V	V		Difficult to predict occurrence	Possible
<i>Calotis glandulosa</i>	-	V	V		No known records within the locality	Possible but unlikely
<i>Dillwynia glauca</i> *	-	E	-		Only known from Windellama, Michelago and Numeralla areas	Possible but unlikely
<i>Discaria pubescens</i>	-	-	-	3RCa	Murrumbidgee & Molonglo River Corridors. Recorded during this study east of Angle Crossing and at Burra Creek.	Yes
<i>Diuris aequalis</i>	-	E	V		Not previous known from the locality	Possible
<i>Dodonaea procumbens</i> *	-	V	V		Only known to south between Michellago and Dalgety	Possible, but unlikely. No known local record
<i>Gentiana bredboensis</i> *	-	E (PCE)	V		Only known from a single population on the Monaro	Very restricted, unlikely
<i>Gentiana baeuerlenii</i> *	E	E	E		Only known from the Orroral Valley in Namadgi National Park	Very restricted, unlikely
<i>Lepidium pseudopapillosum</i> (syn. <i>ginninderrense</i>) *	E	E	V		Belconnen Naval Base	No
<i>Leucochrysum ablicans</i> var. <i>tricolor</i> ²	-	-	E		Common on roadside reserves and lightly grazed paddocks within study area. Previously recorded in locality	Yes
<i>Muehlenbeckia tuggeranong</i> *	E	-	E		Only known from three sites north of Point Hutt Crossing	Unlikely
<i>Pomaderris pallida</i>	-	V	V		Previously recorded on the west bank of Murrumbidgee River at Angle Crossing	Yes, but limited to the Murrumbidgee River Corridor
<i>Prasophyllum petilum</i> *	E	E	E		Known from 3 locations – Hall (ACT), Boorowa and Captains Flat in NSW	Possible but unlikely. No known local record
<i>Rutidosia leptorhynchoides</i>	E	E	E		Queanbeyan LGA – ‘The Poplars’	Possible. No known local record
<i>Swainsona recta</i>	E	E	E		Known within the Goulburn-Cooma Railway corridor between Royalla and Williamsdale. Also at Mt Taylor in the ACT. Also recorded at Burra Creek during this survey, which is assumed to be a new record.	Yes
<i>Swainsona sericea</i>	-	V	-		Previously recorded in locality. Widely recorded within the study area west of Gibraltar Hill and Burra Creek.	Yes
<i>Thesium australe</i> *	-	V	V		Unconfirmed record to south between Burra and Michelago on western side of Burra Road	Possible but unlikely. No confirmed local record

Key: V = vulnerable; E = Endangered; PCE = Proposed Critically Endangered listing

Muehlenbeckia tuggeranong is known only from three locations along the Murrumbidgee River north of Point Hut Crossing and is unlikely to occur within the study area. *Pomaderris pallida* is associated with rocky gullies and gorges along the Murrumbidgee, Molonglo and Queanbeyan River corridors and has been recorded on the western bank of the Murrubidgee River near Angle Crossing. No other local records are known. *Thesium australe*, a root parasite associated with Kangaroo Grass *Themeda australis*, is usually found in damp

² *Leucochrysum ablicans* var. *tricolor* is listed as Nationally endangered (EPBC Act), however, its nomination relates to the Victoria and Tasmanian populations (the species is not listed under the NC Act or TSC Act and is not listed as a ROTAP in any other state except Tasmania). Nevertheless, the species must be considered under the provisions of the EPBC Act.

areas though it is rarely recorded due to its cryptic habit. There are no known local records of this species in the locality. *Dillwynia glaucula* is only known from three locations south of the study area near Michellago and is unlikely to occur. Neither *Gentiana* species is known locally. *Prasophyllum petilum* is known only from three locations within the region with no known local records. *Rutidosia leptorrhynchoides* has been recorded to the north near Queanbeyan, but there are no known records within the locality. While there is suitable habitat for *Diuris* species within the study area, there are no known local records of *Diuris aequalis*.

Threatened Fauna

Approximately 40 threatened and/or migratory animal species and/or their habitats have been recorded previously within the Monaro CMA Sub-region (BioNet, DECC 'Atlas of NSW Wildlife', DEWHA EPBC Online Database and COG bird data), see Table 6 below. Sixteen of these species are listed under the NC Act, 24 under the TSC Act and 22 under the EPBC Act. Records of 15 threatened species have been recorded on 'Atlas of NSW Wildlife' within 10 km of the study area (Figure 6). Eight of these species (marked with an asterisk*) have a low probability of occurrence within the study area due to local rarity, absent local records and/or poorly represented habitat components within the proposed development corridor.

The COG data identified 144 species of bird within the Williamsdale 1:25,000 map sheet, which included ten threatened and three migratory species (Appendix 5).

Summaries of species habitat requirements and their potential occurrences within the study area are provided in Table 6.

Table 6: Terrestrial fauna listed on the NC, TSC and/or EPBC Acts that are extant or previously recorded the region

SCIENTIFIC NAME	COMMON NAME	NC ACT	TSC ACT	EPBC ACT	HABITAT	RECORDED or PRESENCE OF HABITAT WITHIN THE STUDY AREA
Invertebrates						
<i>Synemon plana</i>	Golden Sun Moth	E	E	CE	Possibly favours <i>Danthonia</i> grasslands but is also found in grassland that contain few <i>Danthonia</i> sp. One known site is dominated by the noxious weed Chilean Needle Grass <i>Nassella nessiana</i> (DEWHA 2009b).	Possible though not previously recorded in the locality
<i>Perunga ochracea</i>	Perunga Grasshopper	V	-	-	Found in Natural Temperate Grassland dominated by <i>Austrodanthonia</i> spp., <i>Austrostipa</i> spp. and <i>Themeda triandra</i> , native pasture and grassy woodlands. May use grass tussocks for shelter (ACT Government 1999).	Possible though not previously recorded in the locality
Amphibians						
<i>Litoria aurea</i> *	Green and Golden Bell Frog	-	E	V	Found in large permanent and ephemeral ponds, lakes and dams with an abundance of bulrushes and other emergent vegetation (Robinson 1993).	Possible but no known extant local population. There is very little available habitat.
<i>Litoria castanea</i> *	Yellow-spotted Tree Frog	-	E	E	Require large permanent ponds or slow flowing streams with plenty of emergent vegetation such as bulrushes. The Yellow-spotted Bell Frog has not been recorded in the wild since the 1970s. It has two separate highland ranges, on the New England Tableland and on the southern highlands from Lake George to Bombala. There are unconfirmed reports from near Bathurst and Orange (DECC 2005f).	Unlikely
<i>Litoria raniformis</i> *	Southern Bell Frog	-	E	V	Found in large permanent ponds, lakes and dams with an abundance of bulrushes and other emergent vegetation (Robinson 1993).	Unlikely
<i>Litoria verreauxii alpina</i> *	Alpine Tree Frog	-	E	V	This species is a high altitude frog species, occurring in the Snowy Mountains in upland bogs and rivers (Barker <i>et al.</i> 1995; Lintermans and Osborne 2002; NSW Scientific Committee 2002). Breeding habitats include streamside pools, bog pools, wet grassland and in deep artificial ponds (Lintermans and Osborne 2002).	No

SCIENTIFIC NAME	COMMON NAME	NC ACT	TSC ACT	EPBC ACT	HABITAT	RECORDED or PRESENCE OF HABITAT WITHIN THE STUDY AREA
Reptiles						
<i>Aprasia parapulchella</i>	Pink-tailed Worm Lizard	V	V	V	Fossorial species, which lives beneath surface rocks and occupies ant burrows. It feed 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 2005a). Key habitat features are a cover of native grasses, particularly Kangaroo Grass (<i>Themeda australis</i>), sparse or no tree cover, and little or no leaf litter (Osborne and Jones 1995a).	Yes previously recorded within ACT portion of the study area. Recorded during this study Likely to occur elsewhere within suitable rock habitats (see Figure 16)
<i>Delma impar</i>	Striped Legless Lizard	V	V	V	Generally occurs in lowland native grasslands occurring on gently undulating plains having soils of basaltic origin (Coulson 1990) Grasses are dominated b perennial, tussock-forming grasses such as <i>Themeda triandra</i> , <i>Stipa</i> spp. and <i>Danthonia</i> spp. Inhabits secondary grasslands only when they occur within 2km of primary grassland (Hadden 1995).	Not previously recorded in locality, habitat is most likely limited in this area..
<i>Suta flagellum</i>	Little Whip Snake	-	V	-	Occurs in Natural Temperate Grassland, grassy woodland, and secondary grasslands derived from clearing of woodland. Found on well-drained hillsides, mostly associated with scattered loose rocks (DECC 2005d).	Possible, rock outcrops Not recorded
<i>Tympanocryptis pinguicolla</i>	Grassland Earless Dragon	E	E	E	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).	Not previously recorded in locality, habitat is most likely limited in this area.
<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, along Murrumbidgee River corridor and Burra Creek
Birds						

SCIENTIFIC NAME	COMMON NAME	NC ACT	TSC ACT	EPBC ACT	HABITAT	RECORDED or PRESENCE OF HABITAT WITHIN THE STUDY AREA
<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).	Not previously recorded in locality Not recorded during this study.
<i>Ardea ibis</i>	Cattle Egret	-	-	M	Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands (Marchant and Higgins 1990).	Previously recorded in locality (COG data Appendix 2).
<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). 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 previously recorded in locality (COG data Appendix 2). Recorded during this study in the ACT and Burra Creek sections.
<i>Climacteris picumnus victorïae</i>	Brown Treecreeper (eastern subspecies)	V	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 (Traill and Duncan 2000).	Previously recorded north of study area. Suitable woodland habitat within ACT and parts of NSW section of the study area
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	PV	-	Inhabit a wide variety of dry Eucalypt forests and woodlands, usually with either shrubby understorey or grassy ground cover or both, in all climatic zones of Australia. Usually inhabit areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows.	Yes previously recorded (COG bird data) Recorded during this study in ACT and Burra areas.

SCIENTIFIC NAME	COMMON NAME	NC ACT	TSC ACT	EPBC ACT	HABITAT	RECORDED or PRESENCE OF HABITAT WITHIN THE STUDY AREA
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	-	V	-	Inhabits forest with low nutrients, characteristically with key <i>Allocasuarina</i> species. Tends to prefer drier forest types (NPWS 1999a). Often confined to remnant patches in hills and gullies. Breed in hollows, stumps or limbs, either living or dead (Higgins 1999).	Yes previously recorded (COG bird data) Not recorded during this study
<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).	Possible Not recorded previously (COG data Appendix 2) or during this study
<i>Grantiella picta</i>	Painted honeyeater	V	V	-	Found mainly in dry open woodlands and forests, where it is strongly associated with mistletoe(Higgins <i>et al.</i> 2001). Often found on plains with scattered eucalypts and remnant trees on farmlands.	Possible, very rarely recorded (one record COG data Appendix 2) Not recorded during this study
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	-	-	M	A migratory species that is generally sedentary in Australia, although immatures 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 (English and Predavec 2001). 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).	One previous record (COG data Appendix 2) Not recorded during this study
<i>Hieraaetus morphnoides</i>	Little Eagle	V	PV	-	Found in most woodland types with a preference for wooded hill slopes near open woodland and/or tree lined watercourses. Species has declined dramatically in the ACT and surrounds in recent years. Previously breeding territories in the Murrumbidgee and Molonglo River corridors.	Yes. Previously recorded (COG data Appendix 2)
<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).	Yes. Previously recorded (COG data Appendix 2). Aerial habit only
<i>Lalage sueurii</i>	White-winged Triller	V	-	-	During migration it occurs in open country with trees, from inland plains to coastal farmland. Breeds in open woodlands and scrublands, riparian woodlands, native pine and other scrub (Pizzey and Knight 1997) .	Previously recorded (COG data Appendix 2). Recorded during this study at Angle Crossing and Burra Creek

SCIENTIFIC NAME	COMMON NAME	NC ACT	TSC ACT	EPBC ACT	HABITAT	RECORDED or PRESENCE OF HABITAT WITHIN THE STUDY AREA
<i>Lathamus discolor</i>	Swift Parrot	V	E	EM	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).	No previous record. Highly variable and could occur on rare occasions
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	V	-	This species lives in a wide range of temperate woodland habitats, and a range of woodlands and shrublands in semi-arid areas (Traill and Duncan 2000).	Previously recorded (COG data Appendix 2).
<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).	Previously recorded (COG data Appendix 2). Recorded during this study at Angle Crossing and Burra Creek
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	-	M	Migratory species that occurs in coastal forests, woodlands and scrubs during migration. Breeds in heavily vegetated gullies (Pizzey and Knight 1997).	Possible along Burra Creek and woodland areas. Not previously recorded in the locality (COG bird data)
<i>Neophema pulchella</i>	Turquoise Parrot	-	V	-	Uses edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually in pairs or small family groups. Forages on ground. Nests in tree-hollows, log or post. Range from southern Queensland to northern Victoria from coast to western plains.	Not previously recorded (COG data Appendix 2). Possible occurrence, but considered a rare vagrant (COG)
<i>Petroica boodang</i>	Scarlet Robin	-	PV	-	The Scarlet Robin's range includes all state capitals. It occurs in forests, woodlands; and heavier vegetation during the breeding season. During autumn and winter it occurs in more open and cleared areas. It has a dispersive or locally migratory seasonal movement. Is conspicuous in open and suburban habitats	Previously recorded (COG data Appendix 2). Recorded during this study near the ACT/NSW border and western NSW section of the study area.

SCIENTIFIC NAME	COMMON NAME	NC ACT	TSC ACT	EPBC ACT	HABITAT	RECORDED or PRESENCE OF HABITAT WITHIN THE STUDY AREA
<i>Petroica phoenicea</i>	Flame Robin	-	PV	-	Flame Robins are found in a broad coastal band from southern Queensland to just west of the South Australian border. The species is also found in Tasmania. The preferred habitat in summer includes eucalyptus forests and woodland, whilst in winter prefers open woodlands and farmlands. It is considered migratory. The Flame Robin breeds from about August to January.	Previously recorded (COG data Appendix 2).
<i>Polytelis swainsonii</i> *	Superb Parrot	V	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. Breeds in hollow branches of tall Eucalypt trees within 9 km of feeding areas (Higgins 1999).	Not previously recorded (COG data Appendix 2). Unlikely, known from northern parts of the ACT
<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	-	V	-	This species occurs in eucalypt and cypress woodlands on the hills and tablelands of the Great Dividing Range. They prefer woodlands with a grassy understorey, often on ridges or gullies (Blakers <i>et al.</i> 1984; NSW Scientific Committee 2008). The species is sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. They forage on the ground and in the understorey for arthropods and seeds (Blakers <i>et al.</i> 1984; NSW Scientific Committee 2008). Home ranges vary from 6-12 hectares (NSW Scientific Committee 2008).	Previously recorded (COG data Appendix 2). Recorded during this study near the ACT/NSW border
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	-	M	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).	Possible along Burra Creek and woodland areas. Not previously recorded in the locality (COG data Appendix 2)
<i>Rostratula australis</i> *	Australian Painted Snipe	-	E	VM	Usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grassland. They prefer freshwater wetlands, ephemeral or permanent, although they have been recorded in brackish waters (Marchant and Higgins 1993). Requires tall vegetation and standing water for nesting, it would often nest on a small island of tussocks or reeds within a wetland area (DECC 2005a).	Unlikely. Very limited habitat No previous records (COG data Appendix 2).

SCIENTIFIC NAME	COMMON NAME	NC ACT	TSC ACT	EPBC ACT	HABITAT	RECORDED or PRESENCE OF HABITAT WITHIN THE STUDY AREA
<i>Stagonopleura guttata</i>	Diamond Firetail	V	V	-	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).	Previously recorded (COG data Appendix 2). Recorded during this study in the western NSW and Burra Creek sections.
<i>Xanthomyza phrygia</i>	Regent Honeyeater	E	E	EM	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 1999b; Pizzey and Knight 1997).	Possible in woodland. Not previously recorded in the locality (COG data Appendix 2)
Mammals						
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll (southeastern mainland)	V	V	E	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).	Possible, but likely to be in low densities. More likely in the Burra Creek Murrumbidgee River corridor areas
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	-	V	-	Inhabit 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, previously recorded
<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).	Previously recorded Recorded during this study
<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).	Previously recorded. Recorded during this study

SCIENTIFIC NAME	COMMON NAME	NC ACT	TSC ACT	EPBC ACT	HABITAT	RECORDED or PRESENCE OF HABITAT WITHIN THE STUDY AREA
<i>Pteropus poliocephalus</i> *	Grey-headed Flying-fox	-	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost (Tidemann 1995) although some individuals may travel up to 70 km (Augee and Ford 1999).	No

Key: E = Endangered; V = Vulnerable; M = Migratory; CE = Critically Endangered; PV = Proposed Vulnerable listing

4.2 Survey Results

4.2.1 Flora - General

A total of 235 plant species were recorded within the study area, comprising 172 (73%) locally indigenous species and 63 (27 %) exotic and weed species.

Quadrat data are provided in Table A1.1 in Appendix 1 and a cumulative list of plant species recorded within the study area is presented in Table A1.2 in Appendix 1.

4.2.2 Vegetation Communities – General Description

Vegetation varied according to aspect, soil, topography, drainage and disturbance. Fourteen broad native vegetation types were identified within or near to the study area (Figure 11), including the Box Gum Grassy Woodland (BGGW) and associated secondary grasslands EEC³ and possibly Natural Temperate Grassland (NTG) EEC (Figure 12 and 13). Snow Gum Grassy Woodland (SGGW) occurred within the NSW portion of the study area (Figure 13) and has been nominated for endangered listing under the TSC Act. Further discussion on BGGW, NTG and SGGW is provided in Section 4.2.2.4.

The main vegetation types recorded within or near the study area are:

Native vegetation

- Riparian and fringing vegetation along the river flats and sand wash areas of the Murrumbidgee River, within shallow in-stream sections of Burra Creek and along minor waterways and drainage lines. Vegetation ranged from *Poa*, *Carex apressa* and *Juncus* grass and sedgeland in more ephemeral settings to rank stands of *Typha orientalis* rushlands and *Phragmites australis* reedlands in standing water;
- *Kunzea ericoides*, *Acacia dealbata* and *Bursaria spinosa* shrubland along the lower slopes along the Murrumbidgee River;
- Various associations of Black Cypress Pine *Callitris endlicheri*-Brittle Gum *Eucalyptus mannifera* on steep rocky gully slopes of the Murrumbidgee River Corridor up river of Angle Crossing. These occurred outside the study area;

³ This community is listed as ‘endangered’ under the NC and TSC Acts and ‘critically endangered’ under EPBC Act. Note that the name and community definitions differ slightly in each jurisdiction. See section 4.2.2.4.

- Various associations of dry sclerophyll forest including Broad-leaved Peppermint *Eucalyptus dives*, Apple Box *E. bridgesiana* and *E. mannifera* on rocky mid slopes and dry drainage gullies east of the Murrumbidgee River;
- *Eucalyptus mannifera*, Bundy *E. nortonii* and *E. dives* open forest on the drier west facing slopes within the Murrumbidgee River corridor;
- Variable combinations of Snow Gum *Eucalyptus pauciflora*, *E. bridgesiana*, *E. mannifera*, *E. dives*-*E. nortonii*, Candlebark *E. rubida* and *E. melliodora*-woodland (occasionally as open forest) occur as small patches around the Gibraltar ‘saddle’ and variably along the northern sections of Williamsdale Road east of the ‘saddle’ and along Burra Road north of the Williamsdale/Burra Roads intersection;
- Yellow Box *Eucalyptus melliodora*-Blakely’s Red Gum *E. blakelyi*-*E. bridgesiana* grassy woodland (BGGW EEC) typically occurred west of Gibraltar ‘saddle’ although in various forms and conditions. Smaller components also occurred east of the ‘saddle’ (discussed further in Section 4.2.2.4);
- Secondary grasslands occurred as variably sized patches among BGGW EEC and which may also be defined as grassland/woodland mosaic (discussed further in Section 4.2.2.4);
- NTG EEC was observed within the Murrumbidgee River corridor portions of the study area (discussed further in Section 4.2.2.4);
- *Eucalyptus pauciflora*-Candlebark *E. rubida*-*E. bridgesiana* Grassy Woodland associations (SGGW) occurred in small patches along Williamsdale Road and more extensively along Burra Creek east from Burra Road (this community is also discussed further in Section 4.2.2.4); and,
- Native pasture with generally low species diversity, which is typically associated with paddocks exposed to fertilization and/or higher levels of grazing pressure.

Exotic Vegetation

- Planted exotic trees Monterey Pine *Pinus radiata* at Burra village along minor roads, paddock edges and a small plantation along Williamsdale Road and in Burra and various *Eucalypts* sp. plantings of uncertain origin along Williamsdale Road and near Burra;
- Degraded riparian vegetation – Willows *Salix* sp. and Poplar *Populus* sp. along Burra Creek between Williamsdale Road and Burra Road. In-stream weeds included Curly Pondweed *Potamogeton crispus*.

- Non-native pasture and weed affected areas occur widely across the study area and are associated with agricultural activity, poor weed management practices and other disturbances.

The following section provides an outline of the vegetation types and conditions that were observed across the study area. Additional discussion of surrounding vegetation is occasionally provided for contextual and comparative purposes. Descriptions have been divided according to State, Territory and Commonwealth boundaries and reference to property identification numbers is provided.

4.2.2.1 ACT Section

Riparian vegetation along the lower sections at Angle Crossing contained a variable mix of native and non-native species, including Willow *Salix* sp.; Silver Wattle *Acacia dealbata* and Green Wattle *A. mearnsii* shrubland with a generally disturbed understorey structure, which included the noxious grass *Eragrostis curvula*. On the drier mid slopes above Angle Crossing vegetation graded into *Eucalyptus bridgesiana* - *E. rubida* woodland with diverse grassy/low shrub understories. Monotypic stands of *Kunzea ericoides* shrubland (a post-fire coloniser) extended southward from Angle Bend along the steeper mid slopes. A depression between Angle Bend and Angle Crossing Road was highly modified and contained a suite of introduced shrubs and herbaceous weeds. The upper slopes and low lying hills above the crossing contained open areas of good quality *Themeda australis* grassland, particularly on properties 1572 and 1654 'Tuggeranong' (Figure 12), with smaller components (about 0.25ha) in the western corner of 1471 'Tuggeranong'. It is not entirely clear if these grasslands are representative of NTG EEC or 'secondary grasslands' derived from BGGW EEC, either way these grasslands have high conservation value.

Groundcover diversity was greatest in lightly or rotationally grazed properties, such as 1653, 1654 and 1572 'Tuggeranong'. These areas also contained a greater number of rare or uncommon plants species including *Discaria pubescens* (1654 'Tuggeranong') and *Swainsona sericea* (1470, 1653, 1654 and 1572 'Tuggeranong' as well as road side vegetation along Angle Crossing Road). Note: although *Swainsona sericea* is listed as threatened in NSW it has a wide distribution and is moderately common on the Monaro and ACT.

Remnant BGGW EEC (Figure 12) and secondary grassy components extended from the Murrumbidgee River corridor to the ACT/NSW border. There were apparent differences in vegetation quality across the surrounding properties, a likely indication of different land use practices. Examples of good quality BGGW and associated secondary grasslands were noted on 36, 115, 119, 1572, 1653 and 1654 'Tuggeranong'.

Woodlands within 1471 ‘Tuggeranong’ were indicative of BGGW, however, associated groundcovers were demonstrably less diverse (see Appendix 1) than those observed on 1653, 1654 and 1572 ‘Tuggeranong’, and were either highly modified or not consistent with the community. Groundcovers in the southern portion of 1470 ‘Tuggeranong’ were similarly modified. Consequently, most of 1471 and the southern portion of 1470 ‘Tuggeranong’ contain modified and relatively low value vegetation (Appendix 1) compared to vegetation on surrounding properties, i.e. 1572, 1653 and 1654 ‘Tuggeranong’.

Despite the generally low quality understorey within 1471 ‘Tuggeranong’ the property contained a relatively healthy stand of eucalypt trees (mostly *Eucalyptus melliodora*, *E. bridgesiana* and *E. dives*), which extended through the central section and linked woodland to the north and south. A significant proportion of the pipeline would pass through 1471 and 1653 ‘Tuggeranong’.

Vegetation between the Monaro Highway and the Goulburn-Cooma Railway corridor (36, 115 and 119 ‘Tuggeranong’) was consistent with BGGW EEC of high structural and floristic diversity (Figure 13). Noxious weeds such as *Eragrostis curvula*, *Hypericum perforatum* and *Rubus fruticosus* were more common in this section and correlated to previous infrastructure works, such as roads, power lines and drainage channels. The current level of weed invasion did not, however, detract significantly from the overall high conservation value of the community. The adjacent railway corridor to the east contained regenerating BGGW and secondary grassland of high floristic diversity, which included a population of the endangered *Swainsona recta*, see discussion in Section 4.2.2.2, below. The proposed pipeline would traverse property 119 ‘Tuggeranong’ and the railway corridor, see Section 4.2.2.2 below.

4.2.2.2 NSW Section

*Goulburn-Cooma Railway corridor to the Gibraltar ‘saddle’*⁴

Vegetation within the Goulburn-Cooma railway corridor ranged from highly modified non-native habitat to high quality BGGW (trees regenerating) and secondary grasslands.

Better quality patches were typically associated with railway cuttings and contained a high diversity of groundcover species, which often included a range

⁴ For the purpose of this assessment the area defined as the Gibraltar ‘saddle’ essentially lies between properties 1-1065746 to the west and 1-1056284 to the east.

of less common forb, such as *Microseris lanceolata*, *Podolepis jaceoides*, *Calocephalus citreus* and occasionally the Nationally endangered *Swainsona recta* (Figure 9). These areas have high conservation value.

Blocks east of the railway corridor (1-126283; 201-754889; 152-754889 and 170-754889) contained remnant BGGW EEC that contained groundcovers that ranged from low floristic diversity with low cover abundance to moderate diversity. Paddocks were subject to varying grazing intensities and interestingly with relatively few weeds were recorded.

Moderate to good groundcover vegetation was observed in the western section of 1-126283, the eastern portion of 170-754889 and the western section of 141-754889, which conformed to BGGW and/or secondary grassland EEC. *Swainsona sericea* (vulnerable on the TSC Act) and *Zornia dyctiocarpa* (uncommon) were occasionally recorded on these properties (Appendix 1). A number of large healthy mature hollow-bearing trees, mostly *Eucalyptus melliodora* and *E. mannifera* were recorded on 1-126283; 201-754889; 152-754889 and 170-754889.

Properties east of 141-754889 to the Gibraltar ‘saddle’ on the south side of Williamsdale Road have been cleared and/or pasture improved and presented as mostly modified pasture. Vegetation on the northern side of Williamsdale Road contained BGGW of variable quality and secondary grassland of moderate to high conservation value.

Gibraltar ‘saddle’

The eastern and western lower slopes of the ‘saddle’ contained BGGW and/or secondary grasslands of moderate to high conservation value. Conditions ranged from poor to good depending upon the extent of clearing and past land uses. Rockier sections contained much of the original vegetation with many mature hollow-bearing trees and a diverse understory (i.e. blocks 1-1065746, 1-875569, 2-875569 and 3-1111074). The community continued into 2-1111074 and 3-1111074 but was virtually non-existent east of 3-1111074 (Figure 13).

The central ‘saddle’ area (1-1065746 and 1-875569) contained *Eucalyptus dives*, *E. bridgesiana* and occasional *E. melliodora* Dry Sclerophyll Woodland/Open Forest. Understories contained a greater abundance of woody shrubs, *Melichrus urceolatus*, *Bursaria spinosa*, *Acacia dealbata*, *Bossiaea buxifolia*, *Cassinia longifolia*, *Daviesia mimosoides*, *Exocarpus cupressiformis* and *Cryptandra amara*. *Joycea pallida* was the dominant grass with *Vittadinia* spp., *Stackhousia monogyna*, *Solenogyne* spp., and occasionally *Microseris lanceolata* and *Calotis scabiosifolia*. Weeds were generally sparse and were concentrated along disturbance edges.

East of the Gibraltar ‘saddle’ to Burra

The majority of this section has been cleared for crop production and commercial grazing and most of the vegetation presents as low quality native pasture and non-native pasture. Trees, both native and exotic, have been planted at various locations along road side, within paddocks and around private dwellings. Small patches of remnant SGGW and derived secondary grassland were noted on the northern side of Williamsdale Road on 3-1141174, 56-754889, 2-1040788 and 1-843907.

Burra Creek vegetation is discussed in Section 4.2.2.3, below.

4.2.2.3 Commonwealth Land – Burra Creek (Googong Foreshore)

Assessments were undertaken along the main channel and upper slopes of Burra Creek from Burra Road to approximately 1.5 km down stream. Vegetation included rank reed beds within the main channel, high quality SGGW and secondary grasslands on the slopes that bordered Burra Creek and native and non-native pastures on adjacent paddocks to the north and south (Figure 14).

In-stream vegetation comprised rank stands of *Typha orientalis* and *Phragmites australis*. Sedges and grasses occupied the narrow alluvial benches along Burra Creek and included *Carex* sp., *Juncus* sp., *Poa labillardieri*, *Themeda australis*, and occasionally the uncommon grass *Sorghum leiocladum*. Weeds were generally restricted to the sandy alluvial benches and included *Verbasum thapsis*, *Vulpia* sp., *Phalaris* sp. and the noxious grass *Egargostis curvula*.

Good quality SGGW and secondary grasslands were distributed within much of the lower and mid slopes along Burra Creek.

A single *Swainsona recta* (Nationally endangered) plant was recorded on the eastern slopes of Burra Creek, approximately 350 m downstream of the proposed discharge structure (Figure 9). Additional searches were made but no other specimens were found in the area. More than 200 *Swainsona sericea* (vulnerable) specimens were recorded down stream of the proposed discharge structure along the slopes above Burra Creek. Scattered individuals were also recorded within the adjoining property (28-754913) located to the south (Figure 9).

Paddocks immediately north and south of the Burra Creek gauging station were generally consistent with low-moderate diversity native pasture and non-native pasture.

4.2.2.4 Endangered Ecological Communities

Box Gum Grassy Woodlands and Secondary Grasslands

Box Gum Grassy Woodland communities are characterised by a diverse understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of either White Box *Eucalyptus albens* (not known from the ACT or NSW Southern Tablelands), *E. melliodora* or *E. blakelyi* trees. Depending upon aspect, soil and surrounding vegetation the community may be variably dominated by either of these three species or contain other sub-dominant eucalypts, such as *E. bridgesiana*, Red Box *E. polyanthemos* and *E. mannifera*. Various forms of BGGW occur throughout south-eastern Australia, within a broad band that extends from south-eastern Queensland through NSW into central and western Victoria.

Box Gum Grassy Woodland EEC is identified under Commonwealth, NSW and ACT legislation in the following ways:

- Commonwealth (EPBC Act) - *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC*.
- NSW (TSC Act) - *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland EEC*.
- ACT (NC Act) - *Yellow Box-Red Gum Grassy Woodland EEC*.

The criteria which are used to determine this community differ slightly at the Commonwealth, NSW and ACT levels. Under the Commonwealth listing the EEC must meet the following minimum thresholds:

- Is or did have an overstorey of request tree species;
- Have a predominately native understorey;
- Patch greater than 0.1ha; and,
- Contain twelve or more native understorey species (excluding grasses).

In NSW lower thresholds or categories apply. For example, modified sites composed of one main tree species (i.e. *Eucalyptus melliodora*) in various forms, or even treeless, with groundlayers that are predominantly composed of exotic species with remnant grassy groundlayer and some forbs may be sufficient.

According to the ACT Action Plan No. 27 (ACT Government 2004) the Box Gum Grassy Woodland community may be partially or moderately modified and still meet the definition, whereas remnants substantially or severely modified forms of the community would not.

Within the study area BGGW extends from the upper slopes of the

Murrumbidgee River corridor to the western slopes of the Gibraltar ‘saddle’ and again on the lower eastern slopes of the ‘saddle’ (Figure 13). The community’s extent and condition varied according to the level of vegetation clearing, pasture improvement and grazing.

Potential impacts on this community are discussed in Section 5.0, below.

Natural Temperate Grassland

The community is dominated by moderately tall (25-50 cm in) to tall (50 cm-1 m in height) (Figure 12), dense to open tussock grasses with up to 70% of species being forbs. The community may be treeless or contain up to 10% cover of trees, shrubs or sedges. In the Southern Tablelands, NTGs are located at altitudes between 560 and 1,200 m in valleys influenced by cold air drainage and in broad plains. The community occurs within the geographical region of the Southern Tablelands of NSW and ACT, which extends southwards from the Abercrombie River to the Victorian Border, from Boorowa and Jindabyne to the west and Goulburn to Braidwood and Bombala to the east (DEWHA 2009a).

Natural Temperate Grasslands are described under Commonwealth and ACT legislation as follows (*note: the community is not listed as an EEC in NSW*):

- Commonwealth (EPBC Act) - *Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory* EEC; and,
- ACT (NC Act) - *Natural Temperate Grasslands* EEC.

Small patches of NTG (possibly part of BGGW/grassland mosaic) occur on the lower slopes in the western portion of the study area, within the ACT (Figure 12). Its historic distribution within the locality is difficult to determine, but it is likely to have been irregular and not as extensive it is in other situations, such as in Canberra and the Monaro. Minor components of NTG may occur south of Williamsdale Road (Fallding 2002), though it is possible that these areas were once treed and formed part of a woodland/grassland mosaic. The potential impacts on this community are discussed in Section 5.0, below.

Key defining characteristics to identify NTG of the NSW Southern Tablelands and ACT are (Environment ACT 2005):

- Occurrence within the temperate lowland zone of the Southern Tablelands where tree growth is climatically limited (elevation up to approximately 600 m in the central and northern areas and up to 1200 m in the south);

- Treeless or containing up to 10% projective cover of trees, shrubs or sedges;
- Dominated by native grasses and/or native forbs (more than 50% total vegetative cover, excluding introduced annuals); and
- A diversity of native forbs present, or if disturbed, having components of the indigenous native species (including both existing plants and reproductive propagules in the soil e.g. soil seed banks) sufficient to re-establish the characteristic native groundcover.

Snow Gum Grassy Woodland

SGGW communities of the southern tablelands are characterised by a diverse understorey of native grasses, herbs and scattered shrubs, and is recognized by the dominance, or prior dominance, of Snow Gum *Eucalyptus pauciflora*, Candlebark *E. rubida* and/or Black Sally *E. stellulata* trees. At lower elevation this community intergrades with BGGW and NTG.

This community is located in small patches on the northern side of Williamsdale Road on properties 3-1141174, 56-754889, 2-1040788, 1-843907 and along Burra Creek (7592796). The community intergrades with Yellow Box Grassy Woodland on 3-1111074 and with Broad-leaved Peppermint *E. dives* located on the upper slopes of 2-849360. Larger and better quality examples of SGGW (dominated by *E. pauciflora*, *E. rubida* and *E. bridgesiana*) occur along Burra Creek (property 7-592796) from Burra Road to about 1.5 km down stream. Threatened plants *Swainsona recta* and *S. sericea* were also recorded in this woodland type at Burra Creek. The distribution of the community is shown in (Figure 14). Potential impacts on this community are discussed in Section 5.0, below.

A nomination to list *Snow Gum, Black Sally, Candlebark, Ribbon Gum Grassy Woodlands of south-eastern NSW* as an EEC has been made to the NSW Scientific Committee (Crooks *et al.* 2009).

4.2.2.5 Significant Plant Species

Plants were recorded during formal transects, plot assessments and during the course of other work across the study area. The following assessment is based on database records, previous reports (Biosis Research Pty.Ltd. 2005), broad site interpretations and the authors' own local knowledge.

Three threatened plant species were recorded: *Swainsona recta*, *Swainsona sericea* and *Leucochrysum albicans* var. *tricolor*. A number of regionally uncommon species including *Sorghum leiocladum*, *Lotus australis*, *Zornia*

dyctiocarpa, *Podolepis jaceoides*, *Microseris lanceolata* and the ROTAP *Discaria pubescens* were also recorded. These species are discussed further in the sub-sections below (Figure 9).

It is conceivable that one or more additional threatened or rare species occurs in or around the boundaries of the study area even though they were not identified during the survey. For instance some species of orchid are not always easy to locate and may, for many reasons, have escaped detection. However, the level of survey effort across the study area is considered appropriate for this type of assessment.

If any new species is subsequently found, an appropriate assessment of its status and local distribution should be undertaken and management strategies incorporated where necessary.

ACT

Swainsona sericea was widespread and common on some properties, particularly 1470, 1653, 1654 and 1572 ‘Tuggeranong’, where in excess of 300 plants were observed. The species was also recorded on property 1471 but at much lower densities, which might reflect higher grazing pressures and previous application of fertiliser. Another 650 plants were recorded within Angle Crossing Road reserve during previous surveys (Figure 9). The species is not listed as threatened under the NC Act or EPBC Act, but is listed as vulnerable under the TSC Act. The species is considered to be moderately common on the Monaro and ACT.

Pomaderris pallida, previously recorded on western bank of the Murrumbidgee River near Angle Crossing (CSIRO Herbarium data), was not recorded at any other location within the study area.

Leucochrysum albicans var. *tricolor* was limited in its occurrence to relatively minor occurrences within Angle Crossing Road and Monaro Highway reserves. The species was not observed within the ACT section of the study area.

A number of uncommon plants were recorded in mostly better quality vegetation in the ACT, these include *Discaria pubescens*, *Podolepis jaceoides* and *Microseris lanceolata*.

There was no evidence of the *Muehlenbeckia tuggeranong*, which is only known from three locations on the Murrumbidgee River to the north of Point Hut Crossing, approximately 19 km north of Angle Crossing.

NSW

A significant population of the endangered *Swainsona recta* (in excess of 70 plants) occurs within the Goulburn-Cooma Railway Corridor approximately 80 m north of the proposed pipeline alignment (Figure 9). Additional four plants were recorded a further north of the main population. A single specimen was also recorded on the mid-slope above Burra Creek, which is believed to be a new location record for the species (Figure 9).

Swainsona sericea and *Zornia dyctiocarpa* were recorded in low numbers within 201-754889 and 170-754889. The former species was also recorded in significant numbers at Burra Creek and more than 300 individuals were recorded within the Williamsdale Road reserve (east of 5-551657, north of the study area) during previous assessments (Figure 9).

Leucochrysum albicans var. *tricolor* was recorded within the Goulburn-Cooma Railway corridor and at Burra Creek (see plot data Appendix 1 and Figure 9). Additional populations were also recorded along Williamsdale Road and Burra Roads, outside the study area.

A number of uncommon plants have also been recorded within or near the study, including *Lotus australis*, *Zornia dyctiocarpa*, *Einadia hastata* and *Discaria pubescens* (Figure 9).

Commonwealth

Species listed under the EPBC Act that were recorded within the study area are *Swainsona recta* and *Leucochrysum albicans* var. *tricolor* (Figure 9). Refer to comments on these species above.

4.2.2.6 Noxious Weeds

Infestations can range from just a few individuals affecting small areas to almost complete dominance over a large expanse, particularly in areas that are highly disturbed and/or poorly managed. In some cases weeds pose significant problems by spreading rapidly and outcompeting native plants or result in considerable costs to agricultural activities. Some of the more serious weeds recorded within the study area and surrounds are declared in the ACT *Draft Weeds Strategy 2007-2017* and also under the NSW *Noxious Weeds Act 1993*; these include *Eragrostis curvula*, *Rosa rubiginosa*, *Rubus fruticosus*, *Echium plantaginum*, *E. vulgare*, *Hypericum perforatum*, and *Marrubium vulgare*. Some of these species were locally abundant in some locations within the study area.

Localised infestations of *Eragrostis curvula* were noted at Angle Crossing 'beach' on the Murrumbidgee River, 36 'Tuggeranong' (between the Monaro

Highway and the Goulburn-Cooma Railway corridor) and the lower banks of Burra Creek below the gauging station and roadsides. *Hypericum perforatum*, and *Rubus fruticosus* were recorded in some sections of the Murrumbidgee River corridor particularly on the slopes above Angle Bend, 36 and 119 ‘Tuggeranong’ and the southern extent of 1470 ‘Tuggeranong’.

Willow *Salix* sp. and black poplar *Populus nigra* were noted at various locations along Burra Creek above Burra Road and also within an unnamed ephemeral channel, east of the Gibraltar ‘saddle’. A number of *Salix* sp. seedlings had become established in Burra Creek below the gauging station.

A list of noxious weeds within the Queanbeyan and Palerang control areas and the ACT is provided in Appendix 3.

4.2.3 Fauna

A total of 127 vertebrate animal species were recorded in the study area during the current surveys and include seven frog, 15 reptile, 79 bird, 26 mammal (including 11 microbat species), which represent a total of 50 families (Appendix 2). In addition, one uncommon invertebrate - Keys Matchstick Grasshopper *Keyacris scura* – was also recorded. Introduced species accounted for about 8 % of the total number of animals recorded, which included three bird and eleven mammal species.

Fauna surveys generally focused on habitats that were likely to contain native species, eg. woodland, forest, riparian vegetation, rocky outcrops, grasslands and water bodies. Highly modified areas such as non-native pasture and/or sown paddocks were routinely observed throughout the course of the field work but were not specially targeted.

While the survey results indicate a moderate level of vertebrate fauna diversity (112 native species) the number of recorded species would increase with longer duration surveys conducted across a range of seasons. Species were not observed uniformly across study area and greater diversity was noted in better quality habitats. In other words, habitats that exhibit a wider range of structural features and floristic diversity tend to yield higher faunal diversities than did monotypic or homogenous habitats. Typically, higher animal diversity (particularly bird diversity) was observed in the more complex habitats along the Murrumbidgee River, woodland and forest habitats within the ACT, Gibraltar ‘saddle’ and Burra Creek than in the highly modified rural landscapes, that were prevalent in the eastern sections of the study area.

4.2.4 Fauna Habitats

Fauna habitats of the study area and surrounds correlated broadly to the vegetation structure and composition of the natural and modified landscapes discussed in the flora section above. Within this broad vegetation setting there were a range of micro-habitat features that included: rocky gorges; rock outcrops and knolls; tree hollows; riparian and wetland habitats (including reservoirs, rivers and creeks and wet depressions) and rural lands modified for cropping and grazing.

Grassy woodland and grassland (native and non-native) were the dominant form of vegetation within the western and central parts of the study area, which graded into dry sclerophyll open forest at the top of the Gibraltar ‘saddle’. Open forest reverted back to grassy woodland on the east side of the ‘saddle’, which extended to property 3-114174. Beyond this point most habitats along Williamsdale Road comprised highly modified low quality grasslands.

The fauna habitats within the eastern section of the study area have been negatively influenced by past vegetation clearing for cultivation and commercial grazing purposes, in which habitat opportunities were, albeit with a few exceptions (i.e. east of Burra Road and Burra Creek area), mostly limited. These highly modified and fragmented landscapes would advantage disturbance tolerant native animals and non-native species at the expense of disturbance sensitive and habitat specialist species.

Habitats west of the ‘saddle’ were generally in better condition but were influenced by tree clearing, variable grazing pressures and weed invasions and some cultivation, but not to the same extent as properties to the east. Woodland and grassland habitats were generally in better condition in the ACT than those in NSW, with the notable exceptions of the Gibraltar ‘saddle’ and Burra Creek.

A description of the main fauna habitats and associated species is provided in the sub-sections below.

Grasslands

Good quality native grasslands were more common in the western sections of the study area as well as along the Goulburn-Cooma Railway corridor, Angle Crossing Road, Williamsdale Road reserves and at Burra Creek. Other areas of grassland ranged from low to moderate quality grasslands. Better quality grasslands were identified as potential habitat of the threatened Golden Sun Moth, Grassland Earless Dragon and Striped Legless Lizard, and targeted searches and trapping was conducted to search for these species. None of these species were recorded during the survey period.

A range of other common species were observed or trapped in grassland habitats including: Richards Pipit *Anthus novaeseelandiae*, Spotted Marsh Frog *Limnodynastes tasmaniensis* and Haswells Frog *Paracrinia haswelli*.

Modified Paddock with Scattered Trees

Some sections of the study area provide little more than modified pastures with occasional isolated paddock trees (generally eucalypts) or windbreaks of Monterey Pine *Pinus radiata*. Examples of this type of habitat are found on 223-754889 and 201-1037637, east of the Gibraltar ‘saddle’. These areas generally provide poor cover of native grasses and may have been pasture improved and sown. Typical species seen in these areas were Australian Magpie *Gymnorhina tibicen*, Australian Raven *Corvus coronoides*, Magpie-lark *Grallina cyanoleuca*, and Red-rumped Parrot *Psephotus haematonotus*, and Black-shouldered Kite *Elanus axillaris* was occasionally observed. The introduced Common Starling *Sternus vulgaris* and House Sparrow *Passer domesticus* were also common.

Woodland

Woodlands were widespread throughout the study area, but varied considerably in floristic and structural condition. Better quality woodlands occurred within the ACT (properties 36, 115, 119, 1653 and 1654 ‘Tuggeranong’), either side of the Gibraltar ‘saddle’ and along Burra Creek. Functional woodlands with mature hollow-bearing trees in good health (generally with low groundcover diversity) occurred on 1471 ‘Tuggeranong’ and in the central parts of the study area at 134-650976; 201-754889; 152-754889; 170-54889 and 141-754889, west of the Gibraltar ‘saddle’.

Woodlands generally provided semi-continuous tree and grassy groundcovers that would be used by a range of native avifauna from passerines such as White-throated Gerygone *Gerygone olivacea*, Yellow-rumped Thornbill *Acanthiza chrysorrhoa*, Double-barred Finch *Taeniopygia bichenovii* and Red-browed Finch *Neochima temporalis* to non-passerines such as Dollarbird *Eurystomus orientalis*, Laughing Kookaburra *Dacelo novaeguineae*, Rainbow Bee-eater *Merops ornatus* and various raptors - eagles, kites and falcons.

Woodland habitats, particularly in the ACT, western sections in NSW and Burra Creek east of Burra Road, provided good habitat opportunities for threatened woodland birds including Hooded Robin, Diamond Firetail *Stagonopleura guttata*, Speckled Warbler *Chthonicola sagittata*, White-winged Triller, Brown Treecreeper and Varied Sittella.

Speckled Warbler, Diamond Firetail, Varied Sittella, White-winged Triller and Scarlet Robin *Petroica boodang* (proposed listing as a vulnerable species in NSW) were all recorded within woodland habitats during this study (Figure 10).

Other common species known or likely to occupy these habitats include Short-beaked Echidna *Tachyglossus aculeatus*, Common Brush-tail Possum *Trichosurus vulpecula*, Sugar Glider *Petaurus breviceps*, *Rattus* spp., *Antechinus* spp., Common Dunnart *Sminthopsis murina* and microbats such as the Eastern False Pipistrelle *Falsistrellus tasmaniensis*, Gould's Wattled Bat *Chalinolobus gouldii* and White-striped Freetail Bat *Tadarida australis*. Larger ground-dwelling mammals include Common Wombat *Vombatus ursinus*, Eastern Grey Kangaroo *Macropus giganteus* and Wallaroo *M. robustus* were observed.

Termite mounds recorded in woodlands within the Murrumbidgee River corridor and at Burra Creek could provide opportunities for egg incubation for the threatened Rosenberg's Goanna, although very few termite mounds were observed within the construction easement or site compounds.

Rock Outcrops

Rocky outcrops occur throughout the study area but in different forms depending upon the landscape (Figure 15). Upper parts of gorge and gully areas along the Murrumbidgee River corridor and Burra Creek contained extensive areas of exposed rock habitat, which provide suitable habitat for a range of reptiles, including Stone Gecko *Diplodactylus vittatus*, Cunningham's Skink, *Egernia cunninghami*, Four-fingered Skink *Carlia tetradactyla*, Striped Skink *Ctenotus robustus*, Blind Snake *Ramphotyphlops nigrescens* and the threatened Pink-tailed Worm Lizard and possibly the Little Whip Snake *Suta flagellum*. Most of these species have been recorded north of the study area within the Gigerline Nature Reserve (Rauhala 1995).

Reptiles observed during this study included Pink-tailed Worm Lizard, Stone Gecko, Cunningham's Skink, Four-fingered Skink, Copper-tailed Skink *Ctenotus taeniolatus*, Common Blue-tongue Lizard *Tiliqua scincoides* and Delicate Skink *Lampropholis delicata* (see Appendix 2).

Extensive searches for the Pink-tailed Worm Lizard and Little Whip Snake were conducted in many rock outcrops across the study area (with the exception of some NSW properties west of the Gibraltar 'saddle' were targeted reptile surveys were not conducted). Pink-tailed Worm Lizard was recorded on 1654 'Tuggeranong', 1653 'Tuggeranong' and at one location in 1471 'Tuggeranong' within the ACT (Figure 10). Searches were also conducted in other areas, such as 1572 'Tuggeranong' and along Burra Creek, but surprisingly found no evidence of the species.

Hollow-bearing Trees

Tree hollows provide critical shelter and nesting habitat for a range of hollow-dependent fauna, including threatened species of microbat and bird. Mature hollow-bearing trees were recorded across the study area, particularly within woodland habitats in the ACT and west of and within the Gibraltar 'saddle' and along Burra Creek. Mature and senescent paddock trees in other locations would provide similar but restricted nesting opportunities.

Threatened hollow-dependent species that may nest locally include Glossy Black-cockatoo *Calyptorhynchus lathami*, Gang Gang Cockatoo *Callocephalon fimbriatum* (relatively common in the ACT area) and Brown Treecreeper. Gang Gang Cockatoo was recorded in the ACT and NSW (Burra Creek) sections of the study area, although no active nesting sites were observed during this study.

Riparian Zones

Riparian habitats within the study areas ranged from simple ephemeral drainage lines to structurally complex and dynamic systems along the Murrumbidgee River and Burra Creek.

Fauna recorded within these habitats varied according to structural feature of the habitat in question. Quiet areas such as backwaters or where flow was impeded on major rivers provided suitable shelter and food resources for a wide range of waterfowl, including Pacific Black Duck *Anas superciliosa*, Australasian Grebe *Tachybaptus neahollandiae* and waders. Fishing birds such as Great Cormorant *Phalacrocorax carbo* and Little Pied Cormorant *P. melanoleucos* were also observed in a wide variety of situations. Rainbow Bee-eater and Sacred Kingfisher *Todiramphus sanctus* occurred along deeper gullies often with fringing woodland and shrub habitats.

Frogs including Spotted Marsh Frog *Lymnodynastes tasmaniensis*, Lesueur's Tree Frog *Litoria lesueuri* and Peron's Tree Frog *L. peronii*, were either observed or recorded from their advertising calls. The Long-necked Tortoise *Chelodina longicollis* and Eastern Water Dragon *Physignathus lesueurii* were found at various locations along Burra Creek.

Numerous wombat diggings and burrows observed within the riparian zones along the Murrumbidgee River and Burra Creek. Although the Water Rat *Hydromys chrysogaster* and Platypus *Ornithorhynchus anatinus* were not observed, they would be expected to occur within permanent river systems (ACT Government 2007b; ACT Government 2007a).

Farm Dams

Farm dams were widely distributed throughout the local area. Generally, these had very little or no emergent vegetation, and were regularly used by stock. Native animals in and around dams included Pacific Black Duck, Australian Grebe, Australian Wood Ducks *Chenonetta jubata*, Grey Teal *Anas gracilis* and Welcome Swallow *Hirundo neoxema*.

Reptiles recorded in or near dams included Red-bellied Black Snake *Pseudechis porphyriacus*, Eastern Water Dragon and Long-necked Tortoise. Frogs including Spotted Marsh Frog *Limnodynastes tasmaniensis*, Plains Froglet *Paracrinia parinsignifera*, Haswell's Frog *Paracrinia haswelli* and Common Eastern Froglet *Crinia signifera* were either captured in pit traps or recorded from their advertising calls.

Ground vegetation and litter

Ground cover grassy vegetation provides important foraging habitat for granivorous birds including robins, finches and parrots. Ground litter including fallen branches and limbs provide cover and refuge for a wide range of ground based fauna and perching and nesting opportunities for some species of bird such as the threatened ground nesting Speckled Warbler.

4.2.5 Critical Habitat

Critical habitat can be declared under the TSC Act and EPBC Act. To date no areas of critical habitat have been declared under either Act within or near the study area.

The only listed critical habitat in the region is for *Lepidium ginninderrense* which is located on the Belconnen Naval Transmission Station in the ACT. The proposed development would have no direct or indirect impact upon this habitat.

4.2.6 Register of the National Estate

A number of natural and historical sites listed on the 'Register of the National Estate' occur within region. One natural site of relevance to the study area is the:

- Tralee - Williamsdale Railway *Swainsona recta* sites, Monaro Hwy, Williamsdale, NSW – Place ID. 13347.

'The railway corridor between Tralee and Williamsdale contains the largest known population(s) of the nationally endangered plant species, *Swainsona recta*. Approximately 1,000 plants have been found in this area, principally

among the natural grassland communities which have survived in ribbon strips along the railway easement. Small populations of this species have been recorded at a number of other sites in NSW and the ACT; however, the numbers of individuals found at these sites is decreasing. The railway corridor also supports some good examples of native grassland communities which are now very rare.’

4.2.7 Conservation Values across the Study Area

The conservation significance (value) of threatened flora and fauna species and communities within the study area was primarily assessed according to their listings under the NC Act, TSC Act and EPBC Act and any other relevant policy or plan (Table 7).

Areas known or likely to contain habitat for threatened and/or migratory species were also considered to have high conservation value. Vegetation and landform features that were considered to be part of a regional or local habitat corridor were also considered have at least local conservation value.

Declared conservation areas in the locality include: Gigerline Nature Reserve, Googong Foreshores Area and conservation zones within the Goulburn-Cooma Railway corridor and the woodland between the Monaro Highway and Goulburn-Cooma Railway corridor.

Table 7: Conservation values across the study area.

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
WESTERN SECTION (ACT) - between Murrumbidgee River corridor to western boundary of Goulburn-Cooma Railway corridor.				
Important Habitats:	Habitat for threatened species:	High Constraint	Specific site surveys	Mature trees with variably sized tree hollows
Rock outcrops Tree hollows				Rock outcrops widely distributed within the ACT and possibly in the area between the Goulburn – Cooma Railway corridor and the Gibraltar ‘saddle’ and at Burra Creek.
Box Gum Grassy Woodland & secondary grasslands	NC Act TSC Act EPBC Act	High Constraint	Quadrats and transects	Moderate to good quality in 36, 115, 119, 1653 and 1654 ‘Tuggeranong’
Natural Temperate Grassland	NC Act EPBC Act	High Constraint	Quadrats and transects	Low to moderate quality in 1471 ‘Tuggeranong’ Relatively small patches of moderate to good quality grassland within 1572, 1654 and possibly 1653 ‘Tuggeranong’

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
<i>Swainsona recta</i>	NC Act TSC Act EPBC Act	High constraint if occurs	Targeted surveys	Not recorded in ACT - See Central Section
<i>Swainsona sericea</i>	TSC Act	Moderate to Low constraint Plants are also scattered through the western section and between 50 - 100 plants would be removed. Impacts are unlikely to reduce the long term viability of the local population.	Targeted surveys	Confirmed and widespread 1471 Tuggeranong 1572 Tuggeranong 1653 Tuggeranong 1654 Tuggeranong Angle Crossing Road
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	EPBC Act	Moderate to high constraint Locally uncommon but widespread. Unlikely to be affected. Occurs within better quality vegetation and in areas of low intensity grazing.	Targeted surveys	Few occurrences in the ACT section. Angle Crossing Road
<i>Pomaderris pallida</i>	EPBC Act	Moderate to high constraint Restricted to western bank of Murrumbidgee unlikely to be affected	Targeted surveys	Previously recorded western bank of Murrumbidgee River 148 Tennent (CSIRO Herbarium records) Not observed within construction easement
<i>Discaria pubescens</i>	ROTAP - 3RCa	Low constraint Plants located within a drainage gully south of the study area	Targeted surveys	Confirmed within small feeder gully east of Angle Crossing (1654 Tuggeranong) Recorded within small gully

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
Pink-tailed worm Lizard	NC Act TSC Act EPBC Act	<p>Moderate to high constraint Avoidance of rocky areas is preferable though small scale impacts might be acceptable. Post-development rehabilitation of rock outcrops (for this sp.) is unlikely to succeed</p>	Extensive Rock turning	Previously recorded in Gigerline Nature Reserve (Rahuala 1995) Confirmed 1654, 1653 and 1471 Tuggeranong Not confirmed but probable occurrence in 1572 Tuggeranong
Rosenberg's Monitor	TSC Act	<p>Moderate constraint Unlikely to be significantly affected</p>	Targeted cage trapping conducted	Previously recorded in Gigerline Nature Reserve (Rahuala 1995) Unconfirmed though potential presence within 1611 Tuggeranong 148 Tennent 1471 Tuggeranong 1572 Tuggeranong 1654 Tuggeranong 1638 Tuggeranong and 1641 Tuggeranong
Striped Legless Lizard	NC Act TSC Act EPBC Act	<p>High constraint Unlikely to be significantly affected</p>	Targeted trapping conducted (pit-fall traps and arthropod tubes)	No previous record Not confirmed Low likelihood of occurrence

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
Grassland Earless Dragon	NC Act TSC Act EPBC Act	High constraint Unlikely to be significantly affected	Targeted trapping conducted (pit-fall traps and arthropod tubes)	No previous record Not confirmed Low likelihood of occurrence
Rare, threatened and migratory woodland birds, including: Brown Treecreeper Diamond Firetail Hooded Robin Regent Honeyeater Painted Honeyeater Speckled Warbler Varied Sittella White-winged Triller Southern White-face (uncommon) Rainbow Bee-eater (migratory EPBC Act)	NC Act TSC Act EPBC Act	High Constraint Woodland habitats within the study area provides good habitat opportunities for threatened woodland birds. Provided trees losses are minimised the impacts are not expected to be significant Mitigation could be achieved by limiting tree removal and habitat offsets and tree replanting	Surveys for habitat and occurrences of rare & threatened woodland birds	Records from the COG bird data identify these species within the locality. Potential occurrences within the study area at: 36 Tuggeranong 115 Tuggeranong 119 Tuggeranong 1471 Tuggeranong 1572 Tuggeranong 1653 Tuggeranong 1654 Tuggeranong Speckled Warbler confirmed this survey at 36 Tuggeranong 115 Tuggeranong 119 Tuggeranong Southern White-face confirmed this survey at 36 Tuggeranong) Rainbow Bee-eater confirmed along the Murrumbidgee River corridor

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
Box Gum Grassy Woodland (including secondary grasslands) and/or Natural Temperate Grassland	NC Act TSC Act EPBC Act	High constraint Avoid impact to moderate and good quality remnants	Quadrat and transects	Confirmed 36 Tuggeranong 115 Tuggeranong 119 Tuggeranong 1470 Tuggeranong (Low quality in part) 1471 Tuggeranong (Low quality) 1572 Tuggeranong 1653 Tuggeranong 1654 Tuggeranong
Hollow-dependent microbats	Listed under the TSC Act Eastern Bent-wing Bat - Conservation dependant under the NC Act	Low constraint Loss of hollow-bearing trees Mitigation - minimise hollow-bearing tree loss.	Ultrasonic detection (Anabat) surveys	Likely throughout
Spotted-tailed Quoll	NC Act TSC Act EPBC Act	High constraint Minimal impact likely	Habitat assessment cage trapping	Not previously recorded Occurrence not confirmed. Mostly unlikely or limited habitat opportunities within study area

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
Perunga Grasshopper	Perunga Grasshopper NC Act	Low to moderate constraint	Searches included during grassland assessment,	Not confirmed
Keys Matchstick Grasshopper	Keys Matchstick not listed but considered locally uncommon in ACT and surrounds	Impact depends on degree of disturbance to native grasslands and subsequent recovery	particularly in areas not previously surveyed	Potential habitat at 36 Tuggeranong 115 Tuggeranong 119 Tuggeranong 1471 Tuggeranong 1572 Tuggeranong 1653 Tuggeranong 1654 Tuggeranong
CENTRAL SECTION: Goulburn-Cooma Railway Corridor to the Gibraltar 'saddle'				
Important habitats: Rock outcrops Tree hollows	Important habitat for threatened species:	High Constraint	Specific site surveys	Mature trees with variably sized tree hollows Rock outcrops widely distributed within 152-754889, 170-754889 and 141754889

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
<p>Box Gum Grassy Woodland and secondary grasslands -</p>	<p>NC Act (EEC) TSC Act (EEC) EPBC Act (CCEC)</p>	<p>High constraint</p>	<p>Limited surveys west of Giralta 'saddle' Plot data recorded.</p>	<p>Confirmed within Railway Corridor and adjacent NSW properties to east</p> <p>1-126283 (low to moderate diversity) 134-650976 (low diversity) 201-7548889 (low diversity) 152-754889 (low diversity) 170-754889 (moderate diversity) 141-754889 (ranged from high to mostly low occasionally moderate diversity)</p>
<p>Rare, threatened and migratory woodland birds, including:</p> <p>Brown Treecreeper Diamond Firetail Hooded Robin Scarlet Robin Regent Honeyeater Painted Honeyeater Speckled Warbler Varied Sittella White-winged triller Southern White-face (uncommon) Restless Flycatcher (uncommon) Rainbow Bee-eater (migratory EPBC Act)</p>	<p>NC Act TSC Act EPBC Act</p>	<p>High constraint</p> <p>Woodland habitat within study area provides good habitat opportunities for woodland birds.</p> <p>Provided that the pipeline corridor avoids excessive disturbance to habitat then the impacts are not expected to be significant</p> <p>Mitigation could be achieved by limiting tree removal and recovery replanting</p>	<p>Conducted surveys for habitat and occurrence of rare & threatened woodland birds</p>	<p>Speckled Warbler and Southern White-face recorded in central area and western NSW section of study area</p> <p>Diamond Firetail, Scarlet Robin & Restless Flycatcher recorded in Western NSW Section</p> <p>Other species unconfirmed though potential presence within adjacent properties</p> <p>36 Tuggeranong 115 Tuggeranong 119 Tuggeranong 1471 Tuggeranong 1572 Tuggeranong 1653 Tuggeranong 1654 Tuggeranong 201-754889 152-754889</p>

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
<i>Swainsona recta</i>	NC Act (E) TSC Act (E) EPBC Act (E)	High constraint Avoid	Targeted surveys	One large population known (fenced) within Goulburn-Cooma Railway corridor, and 4 plants occurred 100 m to the north. A remote possibility that the individual plants could occur within adjacent properties
<i>Swainsona sericea</i>	TSC Act (V)	Moderate constraint Plants are also scattered through the western section and between 50 -100 plants would be removed. Impacts are unlikely to reduce the long term viability of the local population. Minimise disturbance where possible.	Limited targeted searches	Confirmed at 134-650976 (low density) 201-7548889 (numerous) 152-754889 (low density) 170-754889 (low density) 141-754889 (?)
Pink-tailed worm Lizard	NC Act TSC Act EPBC Act	Moderate to high constraint Avoidance of rocky outcrops where species is confirmed is preferable though small scale impacts might be acceptable. Post-development rehabilitation of rock outcrops (for this sp.) is not seen as a viable mitigation measure	Limited access to properties east of railway corridor	Potential habitat within 152-754889 170-754889

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
Striped Legless Lizard	NC Act TSC Act EPBC Act	High constraint Unlikely to be significantly impacted.	Limited access to properties east of railway corridor	Not primary grassland, heavily grazed with little apparent shelter habitat. Low likelihood of occurrence
Grassland Earless Dragon	NC Act TSC Act EPBC Act	High constraint Unlikely to be significantly impacted.	Limited access to properties east of railway corridor	Not primary grasslands, heavily grazed little apparent shelter habitat. Low likelihood of occurrence
EASTERN SECTION: east of the Gibraltar 'saddle' to Burra Creek				
Important habitats: Rock outcrops Tree hollows	Important habitat for threatened species:	High Constraint	Specific site surveys	Mature trees with variably sized tree hollows Rock outcrops widely distributed along Burra Creek
Snow Gum Grassy Woodland and Natural Temperate Grassland mosaic	A nomination for Snow Gum Grassy Woodland is being prepared for listing as an EEC under the TSC Act	Moderate to high constraint Route mostly along Williamsdale Road, minor impact expected	Sampling surveys Quadrats and transects	Confirmed Lower and mid slopes along Burra Creek 7-592796 Smaller modified components on 3-114174 2-1040788
Box Gum Grassy Woodland and secondary grasslands -	NC Act (EEC) TSC Act (EEC) EPBC Act (CEECC)	High constraint Route mostly along Williamsdale Road, though some impact expected Avoid were possible	Quadrats and transects	Confirmed on western and eastern side of the 'saddle'. Contained high diversity of native groundcover species.

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
<i>Swainsona recta</i>	NC Act TSC Act EPBC Act	High constraint Not within construction area impact unlikely	Targeted surveys	Confirmed at one location on the mid slopes of Burra Creek 7-592796 Coordinates 0702185 6064729
<i>Swainsona sericea</i>	TSC Act	Moderate constraint Approximately 200 plants recorded in the Burra Creek area. Construction likely to affect about 15 individuals.	Targeted surveys	Confirmed in a range of locations on mid and upper eastern slopes of Burra Creek 7-592796
<i>Leucochrysum albicans var. tricolor</i>	EPBC Act	Moderate to high constraint Locally uncommon but widespread. Unlikely to be affected. Occurs within better quality vegetation and in areas of low intensity grazing.	Targeted surveys	Confirmed in a range of locations on mid and upper eastern slopes of Burra Creek 7-592796 Also recorded outside the study area along Burra Road and Williamsdale Road reserves.
<i>Discaria pubescens</i>	ROTAP - 3RCa	Low constraint Located on northern bank of Burra Creek unlikely to be impacted by construction	Targeted surveys	Confirmed on northern bank of Burra Creek near gauging station 7-592796
Other threatened plants e.g. Orchids <i>Diuris</i> spp.	NC Act TSC Act EPBC Act	High constraint if present	Targeted surveys	Not confirmed 7-592796 Could occur virtually anywhere containing remnant grassland, secondary grassland or grassy woodland and where grazing pressures are low

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
<i>Pomaderris pallida</i>	TSC Act EPBC Act	High constraint Based on known distribution is unlikely to be affected	Targeted surveys	7-592796 (not confirmed) Known along Queanbeyan River below Googong Dam No known records along Burrra Creek
<i>Rutidosia leptorhynchoides</i>	NC Act TSC Act EPBC Act	High constraint Possible constraint within Googong Foreshore, though preliminary pipeline route suggests that any population would be avoided	Targeted surveys	7-592796 (not confirmed) Suitable vegetation within study area. Recorded south of Queanbeyan and along the Goulburn-Cooma Railway corridor south of Michelago.
Rosenberg's Monitor	TSC Act	Moderate constraint Unlikely to be significantly affected but should be considered	Survey for evidence of presence	(not confirmed) Widely recorded in the region though at low densities Likely to occur within dry sclerophyll woodland/scrub within Googong Foreshore Reserve
Rare & Threatened woodland birds Brown Treecreeper Diamond Firetail Hooded Robin Scarlet Robin Gang Gang Cockatoo Glossy Black-cockatoo Varied Sittella White-winged Triller Southern White-face (uncommon)	NC Act TSC Act EPBC Act	High constraint Provided that the pipeline corridor avoids excessive habitat loss the impacts are likely to be low Mitigation could be achieved by selective off set tree replanting	Surveys for habitat and occurrence of woodland birds	Gang Gang Cockatoo, Diamond Firetail, White-winged Triller and Southern White-face confirmed at 7-592796
Migratory Birds	EPBC Act	Low constraint	Surveys for habitat and occurrence of woodland birds	Rainbow Bee-eater confirmed at 7-592796

CONSERVATION ISSUE	LEGISLATION & STATUS	RELEVANCE / POSSIBLE MITIGATION MEASURE	ASSESSMENTS	PROPERTY ID OR COORDINATES
Hollow-dwelling microbats	TSC Act	Moderate constraint Low level impact Mitigation - minimise hollow-bearing tree loss.	Echolocation recording	Micobat species confirmed.
Threatened mammals Spotted-tailed Quoll	All spp. TSC Act EPBC Act (V) - Spotted-tailed Quoll only	High constraint Minimal impact likely	Cage trapping	Spotted-tailed Quoll previously recorded in the locality south of Burra. Potential occurrence within in the Googong Foreshore 7-592796
Golden Sun Moth	NC Act TSC Act EPBC Act	High constraint Low level impact	Targeted surveys	7-592796 (not confirmed)
Perunga Grasshopper	NC Act	Low constraint Low level impact	Searches conducted during vegetation assessment	7-592796 (not confirmed)
Keys Matchstick Grasshopper	Not listed but considered locally uncommon in ACT and surrounds	Low constraint Low level impact	Searches conducted during vegetation assessment	Confirmed 7-592796

5.0 IMPACT ASSESSMENT

The criteria used to determine the condition and therefore conservation significance of remnant BGGW differs at the Territory, State and Commonwealth levels. A map showing the extent of vegetation communities that would need to be considered under each jurisdiction is provided in Figure 17. Total vegetation loss across the proposed construction area comprises 16.7 ha of native vegetation (Table 8) and 23.8 ha of non-native vegetation.

Vegetation loss associated with other infrastructure works (i.e. LLPS, HLPS and site compounds) were assessed separately from the pipeline construction corridor.

Table 8: Estimated total native vegetation disturbance across the entire study area from both the proposed pipeline and other infrastructure.

Vegetation type	ACT		NSW			Totals
	EEC - EPBC Act	Non-EEC	EEC - EPBC Act)	EEC - TSC Act	Non-EEC	
Box Gum Grassy Woodland	2.6	1.8*	2.4	4.3	0	11.1*
Natural Temperate Grassland	1.7	0	0	0	0	1.7
Snow Gum Grassy Woodland	0	0	0.3	0	0	0.3
Other native vegetation	-	2	-	-	1.6	3.6
Total	4.3	3.8	2.7	4.3	1.6	16.7

NB: precise offset requirements will be determined in consultation with relevant conservation authorities.

* 1.8 ha of BGGW in the ACT does not meet the EPBC requirement, due to poor condition and low species diversity.

Vegetation and rock outcrops losses within the ACT and NSW are discussed separately in Sections 5.1 and 5.2, respectively.

5.1 ACT Section

Vegetation

The proposed development (pipeline and other infrastructure works) would remove or modify approximately 8.1 ha of native vegetation within the ACT. This includes 4.4 ha of BGGW (comprising 2.6 ha that is in good condition and meets the EPBC criteria). Approximately 1.7 ha of what is considered to be NTG would also be affected (Table 9a and 9b). Other affected native vegetation total about 2 ha and include *Eucalyptus bridgesiana*-*E. dives*-*E. mannifera* woodlands, Kunzea/Acacia shrubland and native pasture. About 2.2 ha of non-native and/or weed infested areas would also be removed (Figure 12).

Good quality BGGW occurred extensively across blocks 1653, 36 and 119 'Tuggeranong' (Figure 12), and is identified as 'partially' and/or 'moderately' modified by the ACT Government INCP vegetation mapping (TAMS 2009). Approximately 2.6 ha of BGGW that conforms to the EPBC criteria for this community would be removed (DEH 2006b) (see Figure 17).

Approximately 65 mature native trees and up to 140 juvenile trees (between 2 – 6 m in height) would be removed within the ACT, with most occurring on blocks 1653, 36 and 119 'Tuggeranong'. The removal of mature and juvenile native trees from this section, however, means that restoration to original structure would be a long-term process. Provided that proposed rehabilitation is well funded and resourced, the impacts to the community are unlikely to be significant.

Most of the vegetation within 1471 'Tuggeranong' comprise degraded remnant BGGW and, apart for a small component in the western section, was in poor floristic condition. The property was classified as 'moderately', 'substantially' or 'serverly' modified by the ACT Government INCP vegetation mapping. For the most part this vegetation within 1471 'Tuggeranong' was not consistent with the DEWHA definition of BGGW.

Small patches of NTG occurred within 1572 and 1653 'Tuggeranong' and up to 1.7 ha would be affected by the proposed development (Figure 12). These grasslands conformed to the definition in the National Recovery Plan for NTG in NSW and the ACT (Environment ACT 2005), although the community is not acknowledged on the INCP website for this area (TAMS 2009). See discussion on NTG in Section 4.2.2.4.

Flora losses would include the removal of some rare and uncommon ground cover plants including *Swainsona sericea*, *Podolepis jaceoides* and *Microseris lanceolata* in some sections of good to moderate condition vegetation.

The removal or modification of good condition groundcover vegetation will have a localised and most likely short-term impact. Provided that proposed rehabilitation (see Appendix 8 'Recommendation for the Reinstatement of Grassy Vegetation') is well funded and resourced, the impacts to these vegetation communities are unlikely to be significant.

Table 9: Estimated removal/modification of all vegetation types according to variable pipeline construction corridor widths (Table 9a) and other infrastructure and compounds (Table 9b) within the ACT.

Table 9a: Pipeline

Vegetation	Area (ha)	Totals
EECs		
Apple Box/Yellow Box Woodland & part of BGGW	0.8	
BGGW	1.8	
Sub-total BGGW		2.6
NTG	1.1	
Sub-total NTG		1.1
Other native veg		
BGGW (not EPBC criteria)	1.8	
Apple Box/Peppermint Forest	0.3	
Shrubland	0.5	
Native Pasture	1.2	
Sub-total other native veg		3.8
Non-native Pasture	0.6	
Sub-total other non-native veg		0.6
Total pipeline	8.1	8.1

Table 9b: Other infrastructure and compounds

Vegetation	Type of Ancillary Work	Area (ha)	Totals
NTG or Secondary Grassland (EEC)	Electricity easement	0.31	
NTG or Secondary Grassland (EEC)	Site office and crib facilities	0.27	
Sub-total NTG (EPBC/NC)			0.6
Shrubland - Acacia	Electricity easement	0.03	
Sub-total Shrubland			0.03
Non-native	Electricity easement	0.07	
Non-native	Pipe lay down (Angle Crossing)	0.08	
Non-native	Site office and crib facilities	0.05	
Non-native trees - poplar/pine/willow	Construction compound	0.013	
Non-native trees - poplar/pine/willow	Pump station & pipeline laydown & storage facility	0.1	
Non-native vegetation - exotic/weed dominated	Pump station & pipeline laydown & storage facility	0.01	
Non-native vegetation - exotic/weed dominated	Pump station & pipeline laydown & storage facility	0.26	
Non-native – heavily modified and grazed	Main office, storage facility & pipe lay down	1	
Sub-total non-native			1.6
Total ancillary works			2.2

Rock Habitat

Rock removal would impact known and potential habitat for the threatened Pink-tailed Worm Lizard, which was recorded at a number of locations within or adjacent to the proposed pipeline alignment (Figure 16). While the number of individual lizards that would be affected was not determined, the area of suitable rock outcrop that would be removed has been calculated at 0.79 ha (Table 10). In addition, 0.16 ha of mostly consolidated rock that was considered unsuitable for Pink-tailed Worm Lizard would also be affected.

The Pink-tailed Worm Lizard is thought to be reasonably common in the ACT and Queanbeyan region where it has a patchy distribution along hilly slopes, with large populations in the Lower Molonglo and Murrumbidgee River corridors, Mount Taylor, Googong Hill and Queanbeyan (Barrer 1992; Osborne and Jones 1995b; Osborne and Coghlan 2004; ACT Government 2007b). Although the proposal would result in the direct loss of some habitat components (0.79 ha) and may incur partial and temporary fragmentation of the local population, the disturbance is unlikely to have a significant affect on the species' local population or its regional distribution.

Table 10: Known and potential habitat (rock outcrop) for the Pink-tailed Worm Lizard that would be removed by the proposed development in the ACT.

Rock classes	Area (ha)	Total
Suitable habitat for PTWL	0.23	
Suitable habitat for PTWL	0.06	
Suitable habitat for PTWL	0.01	
Suitable habitat for PTWL	0.04	
Suitable habitat for PTWL	0.01	
Suitable habitat for PTWL	0.08	
Suitable habitat for PTWL	0.22	
Suitable habitat for PTWL	0.06	
Suitable habitat for PTWL	0.03	
Suitable habitat for PTWL	0.01	
Suitable habitat for PTWL	0.05	
Sub-Total suitable		0.79
Not suitable for PTWL	0.08	
Not suitable for PTWL	0.08	
Total not suitable		0.16
Total ACT		0.95

EPBC Referral Recommendation

The impact of the proposed development on the Pink-tailed Worm Lizard and its habitat is unlikely to be significant. The proposed development should, however, be referred to DEWHA for further consideration.

5.2 NSW Section

Vegetation

The proposed development (pipeline and infrastructure works) would remove or modify approximately 8.6 ha of native vegetation. This includes 6.7 ha of variable quality BGGW (comprising 2.4 ha that is in good to moderate condition and about 4.3 ha in mostly poor condition) (Table 11a and 11b). Good quality BGGW and secondary grassland remnants occurred within the Goulburn-Cooma Railway corridor, small patches within the western portion of 201-754889 and the eastern portion of 170-754889, a narrow strip within the adjoining property (141-754889) and the Gibraltar ‘saddle’ (Figure 13 and Figure 14).

All 6.7 ha of BGGW within NSW would conform to the DECC definition of the EEC, whereas about a third (2.4 ha) corresponded to the Commonwealth (DEWHA) criteria. See Section 4.2.2.4 for DECC and DEWHA definitions (Figure 17).

The proposed pipeline alignment would cross the Goulburn-Cooma Railway corridor through a degraded and weed infested culvert that is approximately 15 - 20 m wide. Vegetation immediately north of the culvert comprises secondary grassland of high species diversity and high conservation value. A number of regionally uncommon species, *Podolepis jaceoides* and *Microseris lanceolata*, occur and the site also has the potential to contain the endangered plant *Swainsona recta*, which is known within the railway corridor approximately 80 m to the north. While the proposed alignment has the potential to disturb a small proportion of this habitat, the alignment, if restricted to the drainage culvert, would have negligible impact on this habitat and population of *S. recta*.

Approximately 4 ha of good to poor quality BGGW (including secondary grassland) that occurs within blocks 1-126283, 201-754889, 170-754889, 141-754889 and the Gibraltar ‘saddle’ would be affected. Between 120-130 mature native trees and up to 150 juvenile trees (between 2 – 6 m in height) could also be removed within the NSW sections of the proposal development. Most tree loss would occur in 1-126283 and through the Gibraltar ‘saddle’. The removal of mature and juvenile native trees from this section, however, means that restoration to original structure would be a long-term process. Provided that proposed rehabilitation is well funded and resourced, the impacts to the community are unlikely to be significant.

A minor component (0.3 ha) of poor to moderate quality SGGW and associated secondary grassland would be affected within 3-114174, 56-754889 and possibly on the disturbed southern bank of Burra Creek. This vegetation type did not

occur extensively within the construction corridor and the proposal is unlikely to affect good quality components of this community (Table 11).

The removal and or modification to groundcover vegetation will have a localised and most likely short-term effect (provided that that post-construction rehabilitation is fully funded and resourced). Flora losses would include the removal of some rare and uncommon ground cover plants including *Swainsona sericea*, *Podolepis jaceoides* and *Microseris lanceolata* and *Zornia dyctiocarpa*, in some sections between the Goulburn-Cooma Railway corridor and the Gibraltar ‘saddle’.

Table 11: Estimated removal/modification of all vegetation types according to variable pipeline construction widths as determined by vegetation condition (Table 11a) and infrastructure and compounds (Table 11b) within NSW.

Table 11a: Pipeline

Vegetation	Area (ha)	Totals
EECs		
BGGW good to moderate condition	2.4	
BGGW poor condition	4.2	
Sub-total BGGW		6.6
SGGW nominal EEC	0.3	
Sub-total SGGW		0.3
Other native		
Peppermint Forests	0.6	
Intermediate Forests	0.0	
Native Pasture	0.8	
Sub-total other native		1.4
Non-native		
non-native (i.e. cropped pasture, plantations)	21.3	
Sub-total non-native		21.3
Total pipeline		29.6

Table 11b: Other Infrastructure and compounds

Vegetation	Type of Ancillary Work	Area (ha)	Totals
EECs			
Box Gum Grassy Woodland EEC (poor-moderate condition)	Pipe lay down	0.13	
Sub-total BGGW (TSC)			0.13
Snow Gum Grassy Woodland (proposed EEC)	Discharge structure lay down	0.04	
Sub-total SGGW (TSC)			0.04
Other native			
Apple Box/Broad-leaved Peppermint Open Forest/Woodland	Spoil & pipe storage	0.13	
Total Apple Box/Peppermint			0.13
Non-native			

Non-native - exotic/weed dominated	Discharge structure lay down	0.06
Non-native - exotic/weed dominated	Pipe lay down & material storage	0.16
Total non-native		0.22
Total ancillary works		0.5

Rock Habitat

Approximately 1.52 ha of rock habitats that are considered suitable for the Pink-tailed Worm Lizard would be affected. A further 0.04 ha within the Gibraltar ‘saddle’ would also be affected but was considered less suitable for the species due greater tree canopy cover. About 0.09 ha of rock outcrop was considered unsuitable for the species (Table 12).

The Pink-tailed Worm Lizard was not recorded in the NSW sections of the study area, although it was recorded at a number of locations within the ACT (Figure 10). Locations of rock outcrops recorded during the study are provided in Figure 16.

The Pink-tailed Worm Lizard is thought to be reasonably common in the ACT and Queanbeyan region where it has a patchy distribution on hilly slopes and rises. Large populations occur within the Lower Molonglo and Murrumbidgee River corridors and smaller isolated populations at Mount Taylor, Googong Hill, ‘The Poplars’ and Googong foreshore (Barrer 1992; Osborne and Jones 1995b; Osborne and Coghlan 2004; ACT Government 2007b). The proposal would result in the direct loss of approximately 1.52 ha of potential habitat for the species. Surveys were conducted in block 141-754889 but the presence of the species was not confirmed. Due to reasons beyond Biosis’ control, targeted surveys were not conducted for the species in blocks 152-754889 and 170-754889. However, careful micro-alignment and a narrow construction corridor would help to reduce the total impact to rock habitats. Further surveys for the species are suggested within 152-754889 and 170-754889.

Table 12: Potential habitat (rock outcrop) for the Pink-tailed Worm Lizard that would be removed by the proposed development in NSW.

Rock classes	Area (ha)	Total
Suitable habitat for PTWL	0.34	
Suitable habitat for PTWL	0.12	
Suitable habitat for PTWL	0.05	
Suitable habitat for PTWL	0.05	
Suitable habitat for PTWL	0.21	
Suitable habitat for PTWL	0.26	
Suitable habitat for PTWL	0.05	
Suitable habitat for PTWL	0.08	
Suitable habitat for PTWL	0.32	
Suitable habitat for PTWL	0.05	

Total suitable habitat	1.52
Not suitable for PTWL	0.09
Total not suitable	0.09
Undetermined PTWL habitat	0.03
Undetermined PTWL habitat	0.01
Total undetermined	0.04
Total NSW	1.66

EPBC Referral Recommendation

Impacts to potential habitat for the Pink-tailed Worm Lizard have not been fully determined and a referral to DEWHA for the NSW section of the proposed development should be considered on a precautionary basis, particularly given the lack of survey data from blocks 152-754889 and 170-754889.

5.2.1 Key Threatening Processes (NSW)

This section of the report provides contextual information that relates to the potential impacts of construction within the NSW section for the proposed pipeline. The extent of the following impacts on each species and community would vary. An assessment of the likely impacts on each species is provided in Appendix 6. A range of key threatening processes (KTPs), listed under Schedule 3 of the TSC Act, could result from the proposed development, include: ‘clearing of vegetation’ (NSW Scientific Committee 2001), ‘loss of hollow-bearing trees’ (NSW Scientific Committee 2007b), ‘removal of dead wood and dead trees’ (NSW Scientific Committee 2003), and ‘bushrock removal’ (NSW Scientific Committee 2007a). These are discussed in more detail below.

Clearing of vegetation and associated habitat loss

Clearing of native vegetation is also subject to the *Native Vegetation Act 2003*. Impacts of the clearing of native vegetation on biological diversity include:

Destruction of habitat resulting in the loss of local populations;

- Fragmentation;
- Expansion of dryland salinity;
- Riparian zone degradation;
- Increased habitat for invasive species;
- Loss of leaf litter layer;
- Loss or disruption of ecological function; and,
- Changes to soil biota.

The NSW component of the proposed pipeline would affect up to 8.84 ha of native vegetation, ranging from good quality BGGW EEC to poor quality native pasture, and almost 20 ha of highly modified or non-native vegetation.

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

In NSW, there are a wide range of terrestrial vertebrate species (including many threatened species) that are reliant on tree hollows for their survival (Gibbons and Lindenmayer 1997; Gibbons and Lindenmayer 2002) and are therefore threatened by the ‘loss of hollow-bearing trees’.

Many trees within the study area contain hollows and occur as part of a woodland/forest structure and as isolated paddock trees. Hollow-bearing trees in the study area would provide suitable den and nesting habitat for a range of woodland/forest birds, microbats and arboreal mammal species (such as Brush-tailed Possums). Locally recorded threatened species requiring tree-hollows for roosting include Brown Treecreeper, Glossy Black-cockatoo, Gang-gang Cockatoo and Eastern False Pipistrelle.

The ‘removal of dead wood and dead trees’ reduces the availability of hollows over time and the input of material to the litter layer. Fallen branches and bark (scattered throughout wooded areas) provided refuge and nesting habitat for many terrestrial animals, e.g. Speckled Warbler. 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 refuge habitat for larger terrestrial fauna including the threatened Spotted-tailed Quoll *Dasyurus maculatus*.

Trees would be removed in the Gibraltar ‘saddle’ and it is likely that some will be hollow-bearing.

Removal of Bushrock

Bushrock removal is the removal of natural surface deposits of rock from rock outcrops or from areas of native vegetation. Bushrock removal 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 2007a).

The total extent of rock removal within the NSW section of the study area was estimated at 1.8 ha, including 1.27 ha of potential Pink-tailed Worm Lizard habitat.

Surface rock within the study area provides important habitat features for a range of reptiles, including possibly Pink-tailed Worm Lizard and Little Whip Snake, should they occur. The former species was recorded within some rock outcrops within the ACT section of the study area but not within the NSW sections.

5.2.2 Key Thresholds for Threatened Species and Communities (Part 3A)

The Part 3A Guidelines of the EP&A Act (DEC & DPI 2005) 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. Table 13 below provides a summary for each of the key thresholds that relate to threatened species and communities in the locality. 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 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.

The proposal is unlikely to reduce the long-term viability of and/or accelerate the extinction of and/or adversely affect critical habitat for threatened species, populations or communities within the study area. The proposed development could, however, reduce the long-term viability of small components of the *Swainsona sericea* populations within NSW sections of the study area and possibly the Pink-tailed Worm Lizard should the species occur (Table 13), however, these impacts are not considered to be significant.

Table 13: Key Thresholds for Threatened species and communities

THREATENED SPECIES and COMMUNITIES	WILL THE PROPOSAL REDUCE THE LONG-TERM VIABILITY OF A LOCAL POPULATION OF THE SPECIES or COMMUNITY?	WILL THE PROPOSAL ACCELERATE THE EXTINCTION OF THE SPECIES/COMMUNITY OR PLACE IT AT RISK OF EXTINCTION?	WILL THE PROPOSAL ADVERSELY AFFECT CRITICAL HABITAT?
BGGW and secondary grassland	The proposal will remove approximately 6.55 ha of this community within NSW. Patch conditions ranged from poor to good. Whether or not long-term recovery is achieved in patches containing good quality vegetation will depend upon post construction rehabilitation efforts.	Unlikely	No
SGGW (nomination is being prepared for listing as an EEC)	Minimal impact to this community. Approximately 0.38 ha of modified habitat would be removed.	Unlikely	No
<i>Swainsona recta</i>	Unlikely to reduce the long-term viability of the majority of the local population, although 3-4 plants (and a small component of the soil seed bank) within the Goulburn-Cooma railway corridor are at risk. A single plant recorded in the Burra Creek area.	Unlikely. Although strict controls over the pipeline alignment, construction width and work activity within the Goulburn-Cooma railway corridor will be required.	No
<i>Swainsona sericea</i>	Occurred at low-moderate densities within 201-754889, 170-754889 and possibly 141-754889. Estimated that between 50-100 individuals would be affected. Approximately 200 plants were recorded in the Burra Creek area. Construction is likely to affect about 15 individuals.	Despite some losses there would be no perceptible increase in the extinction rate.	No
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	Limited loss, would not reduce long-term viability	No	No
Golden Sun Moth	Unlikely. Habitat within the study area has been modified, making the area marginal at best for this species. Surveys conducted during the current study failed to locate the species.	No	No
Green & Golden Bell Frog	Unlikely. Very little predicted impact on area of preferred habitat.	No	No
Southern Bell Frog	Unlikely to occur. Very little predicted impact on area of preferred habitat.	No	No
Grassland Earless Dragon	Not recorded during trapping studies	Unlikely	No
Pink-tailed Worm Lizard	This species was not recorded with the NSW section of the study area although it was recorded within the ACT sections. Primary rock outcrop habitat for this species occurred within the following properties in the NSW section of the study area: <ul style="list-style-type: none"> > 201-754889 > 152-754889 > 170-754889 	Unlikely	No

THREATENED SPECIES and COMMUNITIES	WILL THE PROPOSAL REDUCE THE LONG-TERM VIABILITY OF A LOCAL POPULATION OF THE SPECIES or COMMUNITY?	WILL THE PROPOSAL ACCELERATE THE EXTINCTION OF THE SPECIES/COMMUNITY OR PLACE IT AT RISK OF EXTINCTION?	WILL THE PROPOSAL ADVERSELY AFFECT CRITICAL HABITAT?
	<ul style="list-style-type: none"> ➤ 141-754889 ➤ 7-592796 (Burra Creek) 		
Striped Legless Lizard	Not recorded during trapping studies.	Unlikely	No
Rosenberg's Goanna	Not recorded during trapping studies, although likely to occur locally.	Unlikely	No
Australian Painted Snipe	Unlikely. Favoured habitat would not be affected.	Unlikely	No
Brown Treecreeper	Unlikely. Although not recorded during this study it is expected to occur locally.	Unlikely	No
Diamond Firetail	Unlikely. Although not recorded during this study it is expected to occur locally.	Unlikely	No
Hooded Robin (south-eastern form)	Unlikely. Although not recorded during this study it is expected to occur locally.	Unlikely	No
Gang-gang Cockatoo	Unlikely. Recorded at Burra and widely recorded in the ACT and surrounds.	Unlikely	No
Regent Honeyeater	Unlikely. Although not recorded during this study the species could occur locally. Sporadic local occurrence and in low densities (COG bird data Appendix 5)	Unlikely	No
Superb Parrot	Unlikely. Not regularly recorded in this area. Most regional records are from the northern parts of the ACT. Woodland habitats not likely to be impacted.	Unlikely	No
Speckled Warbler	Possible low to moderate impact on this sedentary species. Individuals were recorded within woodland habitats within the ACT between the Goulburn-Cooma railway corridor and the Monaro Highway. Likely to occur in surrounding woodland/forest habitats.	Unlikely	No
Swift Parrot	Unlikely. Timing for surveys not appropriate for this species. Could occur locally although it would be sporadically and in low densities. Recorded Mt Majura area, north Canberra.	Unlikely	No
Eastern False Pipistrelle	Unlikely. Very little predicted impact on this species habitat. Woodland habitats unlikely to be impacted.	Unlikely	No
Eastern Bent-wing Bat	Unlikely. No impact on roost habitats. Foraging woodland habitats unlikely to be impacted.	Unlikely	No
Large-footed Myotis	Unlikely. Foraging habitats (i.e. farm dams) will not be affected by the proposed development.	Unlikely	No
Spotted-tailed Quoll (south-eastern mainland)	Unlikely. Very little predicted impact on this species preferred habitat. No disturbance to den habitat (i.e. complex rock outcrops or hollow-logs).	Unlikely	No

5.2.3 Impact Assessments (Part 3A)

The proposal may impact threatened species by causing any of the following situations to arise:

- 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 restricted distributions.

Part 3A impact assessments have been prepared for the following threatened NSW species and communities: BGGW, *Swainsona recta*, *Swainsona sericea*, *Rutidosia leptorrhyncoides*, *Dillwynia glaucula*, *Pomaderris pallida*, Golden Sun Moth, Pink-tailed Worm Lizard, Grassland Earless Dragon, Striped Legless Lizard, Rosenberg's Goanna and Speckled Warbler (see Appendix 6).

5.3 Commonwealth EPBC ACT Assessments of Significance

5.3.1 Endangered Ecological Communities

Communities listed as EECs under the EPBC Act that are known or are likely to occur within the study area are: 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Grassy Woodland)' (BGGW) and 'Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory' (NTG). These communities have been assessed according to the Significant Impact Criteria (DEH 2006a) and appear in Appendix 7. Table 14 provides an estimate of the amount of BGGW and NTG, that meet the EPBC criteria, in NSW and the ACT.

Table 14: Estimated total amount of BGGW and NTG that would be affected in NSW and the ACT.

NTG & BGGW / condition	ACT (ha)	NSW (ha)	Total (ha)
BGGW - good to moderate	2.6	2.4	5
NTG - good	1.7	0	1.7

5.3.2 Threatened Species

Flora

Species listed under the EPBC Act that have known or potential habitat within the study area are: *Swainsona recta*, *Rutidosia leptorrhyncooides*, *Leucochrysum albicans* var. *tricolor* and *Pomaderris pallida* and impact assessments have been prepared according to the Significant Impact Criteria (DEH 2006a), see Appendix 7.

Fauna

Species listed under the EPBC Act that have known or potential habitat within the study area are: Golden Sun Moth, Grassland Earless Dragon, Striped-legless Lizard and Pink-tailed Worm Lizard and impact assessments have been prepared according to the Significant Impact Criteria (DEH 2006a), see Appendix 7.

There would be virtually no impact on habitats for Green and Golden Bell Frog, Southern Bell Frog *Litoria raniformis*, Regent Honeyeater, Swift Parrot, Superb Parrot, Grey-headed Flying-fox and Spotted-tailed Quoll and assessments of significance have not been provided for these species.

5.3.3 Migratory Species

Migratory listed species under the EPBC Act are a compilation of 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 migratory species listed under the ‘migratory’ provisions of the EPBC Act were considered in this investigation. Of these, the following have potential or known habitat in the study area: Regent Honeyeater, Swift Parrot, Cattle Egret, Rainbow Bee-eater and Satin Flycatcher. Individuals of these species that have been recorded or may occur in the study area are not considered to be an ecologically significant proportion of their respective populations. Furthermore, potential habitat within the study area is not considered critical to any of these migratory species. The impacts of the proposal would have minor effect on the

habitats for these species. As such, no assessments have been carried out for these species, in accordance with the Significant Impact Criteria (DEH 2006a).

5.3.4 Commonwealth Land

Under the EPBC Act approval is required for an action taken by any person on Commonwealth land that is likely to have a significant impact on the environment on that land. ‘Environment’ is defined under the EPBC Act as follows:

- (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 (‘heritage value’ is defined in the EPBC Act as including ‘the place’s natural and cultural environment having aesthetic, historic, scientific or social significance, or other significance, for current and future generations of Australians.’ ‘Indigenous heritage value’ is defined as meaning ‘a heritage value of the place that is of significance to Indigenous persons in accordance with their practices, observances, customs, traditions, beliefs or history’); and
- (e) the social, economic and cultural aspects of a thing mentioned in paragraphs (a), (b) or (c).

5.3.5 Referral

For general impact assessments for each jurisdictions see Section 5.1 and 5.2, above. Specific impact assessments are provided in Appendix 7.

EPBC Referral Recommendation ACT

Provided that sufficient vegetation offsets are negotiated and a fully funded and resourced rehabilitation program is implemented, the proposed development is not expected to have a significant impact on either BGGW and NTG EECs. However, the proposed development should be referred to DEWHA for further consideration.

EPBC Referral Recommendation NSW

Provided that sufficient vegetation offsets are negotiated and a fully funded and resourced rehabilitation program is implemented, the proposed development is not expected to have a significant impact on BGGW EEC. Nevertheless, the proposed development should be referred to DEWHA for further consideration.

There is a remote chance that a small component of habitat for Swainsona recta could be indirectly affected during the pipeline construction, but provided that strict controls are placed on the alignment and construction methods (i.e. construction width is limited to 15 m, the pipeline alignment traverses disturbed habitat within an identified drainage culvert and that vehicles, plant and equipment are excluded from the rest of the railway corridor) the impact would be negligible. Referral to DEWHA for this component is not recommended.

5.4 Non-physical Impacts

5.4.1 Disturbance

Disturbance is a non-physical form of habitat alteration associated with human activities, and may include the following forms of impact: visual and noise disturbance from people, machinery and vehicle traffic. Sources of disturbance associated with construction of the pipeline include:

- possible effects of tunnelling noise and/or vibration on fauna, especially terrestrial species;
- disturbance of fauna due to percussive noise, such as construction noise; and,
- disturbance of fauna due to increased numbers of people in proximity to fauna habitats during the construction period.

Evidence from Australia and overseas has shown that most noise does not disturb most species of animal unless they are associated with actual danger. Given this, there is likely to be little effect on native fauna as result of such stimuli.

However, a small number of species are particularly sensitive to disturbance and might be affected (water birds for instance). The effects of noise are likely to be greatest in habitat areas where current levels are relatively low. Increased noise and movement resulting from construction works may also cause some disturbance to wildlife in adjacent habitat areas. In general this effect is likely to be low.

Sudden loud noises are likely to disturb fauna; however the effects on most fauna species tend to be short-lived.

The construction of the pipeline facility would involve noise and vibration that may cause minor short-term (approximately 12 months) disturbance to vertebrate fauna that occupy adjacent habitats. The primary causes of noise and vibration would come from traffic and equipment operation and movement, clearing and excavation, rock breaking (drilling and blasting) and construction.

Minor levels of background noise and vibration would be experienced during the operation phase of the LLPS and HLPS at Angle Crossing. The design of the LLPS and HLPS facilities should incorporate measures to minimise operational noise and vibration.

It would seem likely that the topography of the Murrumbidgee River gorge would confine any noise emanating from the LLPS and HLPS. It is also assumed that these noise levels would be low and have negligible effects on local fauna.

The impacts of noise and vibration will be mostly confined to the construction period and no long-term population-level effects on any species of vertebrate fauna is considered likely to result from the operation period as long as project controls include isolation/monitoring of vibration and noise control measures.

If the recommendations to avoid and/or minimise impacts outlined in Section 6.1 are adopted, the overall risk to fauna resulting from disturbance is considered to be low.

6.0 RECOMMENDATIONS

The following recommendations have been made to reduce the impact of the proposal on native vegetation, flora and fauna within the study area:

6.1 General Recommendations

6.1.1 Avoidance

- High quality secondary grassland habitat within the Goulburn-Cooma Railway corridor that contains the Nationally endangered *Swainsona recta* must be avoided.
- ACTEW should consider micro-alignment modifications of the proposed pipeline to avoid important habitat features such as rock outcrop (Pink-tailed Worm Lizard) and hollow-bearing trees (potential shelter/nest sites for hollow-dependent threatened fauna).

6.1.2 Mitigation

- Reduce construction and scour widths in areas that contain EECs and/or threatened species habitat. The exact location and extent of corridor width reduction would be determined in the Construction Environmental Plan of Management (EMP).
- Follow protocols for the management, storage and replacement of excavated soil, as outlined in Appendix 8;
- Minimise the introduction and transportation of weeds (particularly noxious species such as St John's Wort *Hypericum perforatum*, African Lovegrass *Eragrostis curvula* and Serrated Tussock *Nassella trichotoma*) into surrounding areas that are relatively free of weeds, including both good quality native vegetation and grazing paddocks. Measures that should be implemented to minimise the transportation of weeds include: the development of a weed distribution map that identifies problem areas; undertake a pre-construction weed control program in areas likely to pose potential weed dispersal problems; and, implement strict vehicle hygiene controls, such as providing vehicle wash down areas and not manoeuvring vehicles through problem weed areas;
- Determine if any nest sites for the Speckled Warbler occur within the construction corridor, particularly in the area between Monaro Highway and the Goulburn-Cooma Railway corridor 36 'Tuggeranong and 119 'Tuggeranong';

- Where practicable avoid the removal of hollow-bearing trees and branches to the greatest extent possible. Where the removal of hollow-bearing trees and/or hollow limbs is unavoidable, the work should be undertaken by an appropriately qualified arborist. Tree-hollows should be inspected for resident fauna by a qualified ecologist/zoologist 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. Any trees or limbs that are felled or cut should be retained on site for ground based habitat;
- Rehabilitation of the construction corridor would not commence until after the completion of the construction phase, which in some sections could be up to 12 months after construction. This poses considerable constraints on the successful rehabilitation of the pipeline construction scar. Consideration should therefore be given to initiating pipeline construction within areas that contain low conservation value vegetation (i.e. eastern sections) so that the time delay between vegetation removal and subsequent rehabilitation, particularly within areas containing higher conservation value vegetation, particularly within and west of the Gibraltar ‘saddle’, are minimised;
- Collect and propagate a wide range of common and uncommon native varieties of plant within the catchment for future rehabilitation of the construction footprint. Plant material should preferably include endemic grass seeds/tube stock (particularly *Themeda australis*) and native legumes (e.g. *Glycine* sp., *Desmodium* sp., *Swainsona sericea*). Collection of native grass seed (eg. *Themeda australis*) should be undertaken during the December and January period (see Appendix 8). Other native grasses such as *Austrodanthonia* spp. and *Austrostipa* spp. occur in many surrounding paddocks and are likely to reestablish naturally in some sections of the pipeline corridor. The minimum rehabilitation aim should be to return the vegetation to at least the state (and level of species diversity) that existed prior to construction, essentially ‘like for like’. Furthermore, the situation and future use of each parcel of land needs to be taken into account when considering the level of rehabilitation that is required. In the case of farming properties that will continue to be managed as such should be rehabilitated to the level that benefits the continued agricultural use of that land but at the same time does not diminish its ecological value;
- Prepare a vegetation monitoring strategy to record the progress of the rehabilitation effort. This should record, amongst other things, tube stock and/seed used during rehabilitation works; tube stock survival rates and germination of seed and/or natural recruitment; soil erosion; and, success

of weed control measures. Monitoring should be undertaken for a minimum 2-year period after the commencement of rehabilitation work;

- The construction trench should be regularly inspected for trapped fauna, particularly if the trench is left open for periods greater than one or two nights. Escape routes i.e. wooden planks, could be placed into trenches overnight to provide a possible means of escape for trapped fauna;
- Site buildings and other infrastructure where people will congregate should be located as far from areas of good quality habitat (e.g. native grasslands and waterbodies) as practicable;
- Minimise numbers of personnel and vehicles in areas of native vegetation and other fauna habitat e.g. watercourses;
- Ensure compliance with all regulations relevant to minimising noise generated from construction of the pipeline;
- Ensure that design of the LLPS and HLPS minimises the generation and/or propagation of noise and vibration from the facility when in operation; and,
- Monitoring of vibration and noise must be carried out in order to assess the effectiveness of noise and vibration mitigation measures.

6.1.3 Offsets

- The proponent should provide offsets for the removal and/or modification of up to 16.7 ha of native vegetation, including 11.1 ha of BGGW (and secondary grasslands) that ranges from poor to good condition, 1.7 ha of NTG and 0.3 ha of SGGW that occurs within the construction footprint. The offset amount should be negotiated with the relevant Territory, State and Commonwealth agencies. Offsets are discussed further in Section 6.2, below.

6.2 Offsets

6.2.1 General

The ACT Government currently has no offsets policy.

In NSW, the TSC Act has recently been modified to include provision for an environmental impact offsetting strategy known as BioBanking. BioBanking provides an alternative and systematic (and at this stage voluntary) approach for the development of offsets with the intent of maintaining or improving biodiversity values in lieu of habitat modification or removal as a result of development in NSW. The implementation of BioBanking within the planning process is imminent.

Victoria has a ‘net gain’ process in which offsets are based on ratios that relate to the quality and quantity (habitat/hectares) of the vegetation that would be removed.

The Australian Government ‘*Draft Policy Statement: Use of environmental offsets under the EPBC Act*’ (DEWR 2007), defines an environmental offset as ‘actions taken *outside a development site* that compensates for the impact of that development – including direct and indirect or consequential impacts’. The policy also states that ‘Environmental offsets provide an opportunity to achieve long-term conservation outcomes’and that.... ‘offsets are not intended to make proposals with unacceptable impacts acceptable.’

Offsets can be delivered in a number of ways, as follows:

Direct offsets – aimed at on-ground maintenance and improvement of habitat or landscape values, and may include:

- Acquisition of and inclusion of land in the conservation estate, and covenanting arrangements on private land;
- Restoration or rehabilitation of existing degraded habitat; or
- Re-establishment of habitat.

Indirect offsets – include options that aim to improve knowledge, understanding and management leading to improved conservation outcomes, and may include:

- Implementation of recovery plan actions – including surveys;
- Contributions to relevant research or education programs;
- Removal of threatening processes;

- Contribution to appropriate funds or banking schemes that can deliver direct offsets; or,
- On-going management activities, such as monitoring, maintenance, preparation and implementation of management plans.

6.2.2 Proposed Offsets: ACT

Offsets should be considered for the loss or modification of good quality native vegetation and habitats within the ACT. Negotiations in this regard should be conducted between ACTEW and the ACT Government, Commonwealth or any other appropriate land manager. Any offsets for vegetation loss should not be used as a surrogate offset for energy use during the construction or operation phases of the project or as a form of carbon trading, which, if included, should be considered independently. Furthermore, offsets should be considered independently of any existing or planned revegetation and/or rehabilitation works within the ACT either by ACTEW or any other party.

In consultation with land managers, ACTEW would provide funding and resources to offset the loss and/or modification of 8 ha of native vegetation within the ACT (including 2.6 ha of good condition BGGW and 1.7 ha of NTG).

6.2.3 Proposed Offsets NSW

Offset requirements within NSW are pursued then these would need to be calculated by the DECC or an accredited BioBanking assessor.

The BioBanking Scheme aims to provide for the protection of biodiversity through the 'maintain or improve' test and the establishment of BioBank sites. The BioBanking Scheme also provides an alternative to traditional development application and assessment pathways under Parts 4 and 5 of the EP&A Act (e.g. Assessments of Significance, Species Impact Statements and Part 3A assessments). BioBanking is a system that enables a consistent approach for determining the amount of offsets a development will require for modifying or clearing vegetation (habitat). The offsets required will be measured as Biodiversity Credits and a development would be required to purchase Biodiversity Credits of equal or greater value to those calculated for the development. DECC will maintain a register of BioBanking properties from which Biodiversity Credits can be purchased. The BioBanking methodology is used to both calculate Biodiversity Credits required for a development and to determine the Credits that are generated at a BioBank site. It should be noted that the ratio of credits required to offset a development are not fixed and will vary depending on the site.

6.3 Future Surveys

Future targeted surveys should be conducted for Pink-tailed Worm Lizard within the rock outcrops on 152-754889 and 170-754889 that were not adequately surveyed during the study period. Additional surveys should be undertaken for *Swainsona recta* within the section of Goulburn-Cooma Railway corridor that would be traversed by the proposed pipeline.

Surveys for both species should be conducted between early Spring and early Summer 2009.

7.0 CONCLUSION

The study area contained a wide range of vegetation and habitat types which varied from non-native pasture to high conservation value native grassland and woodland. Highly modified vegetation typically occurred east of the Gibraltar ‘saddle’ and provided minimal opportunities for native flora and fauna. Native vegetation ranged from poor to good quality and was most common in the area between the Gibraltar ‘saddle’ and the Murrumbidgee River corridor, and included Box Gum Grassy Woodland (BGGW) EEC and Natural Temperate Grassland (NTG) EEC on the elevated slopes above the Murrumbidgee River corridor. Vegetation along Burra Creek to the east contained good quality Snow Gum Grassy Woodland (SGGW) (recently nominated for listing as an EEC in NSW). Habitat opportunities for threatened species broadly correlated with good quality woodland and forest habitats, native grassland and exposed rock outcrops. Some of these habitats have additional conservation value as regional wildlife movement corridors i.e. the Murrumbidgee River corridor.

Three threatened plant species were recorded: *Swainsona recta*, *Swainsona sericea* and *Leucochrysum albicans* var. *tricolor*, and one ROTAP species, *Discaria pubescens*. Eight threatened animal species were also recorded during the surveys: Pink-tailed Worm Lizard, Gang Gang Cockatoo, Speckled Warbler, Diamond Firetail, White-winged Triller, Varied Sittella, Eastern Bent-wing Bat and Large-footed Myotis.

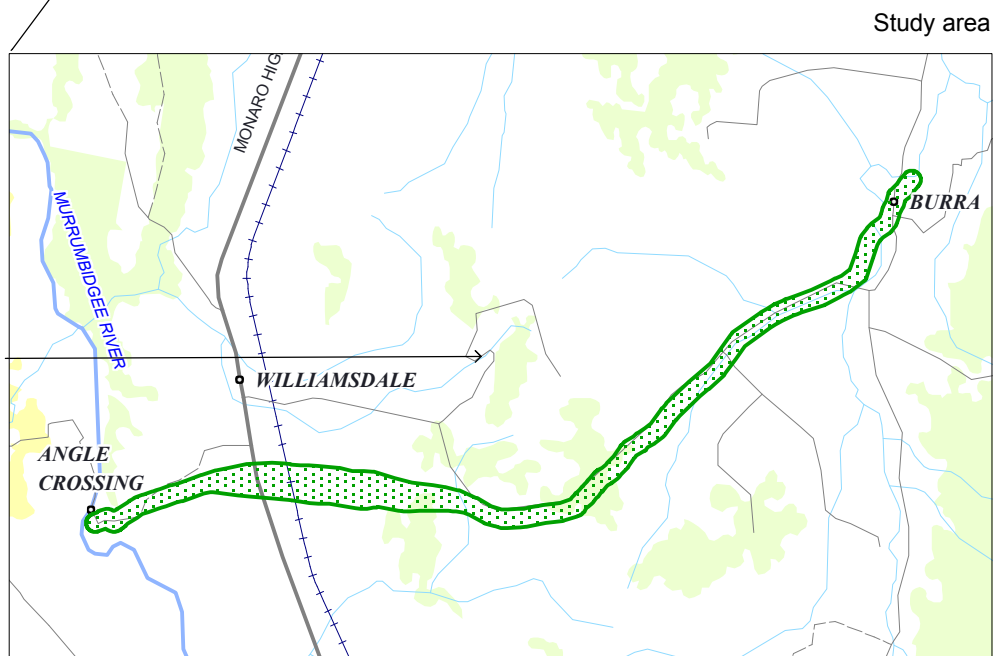
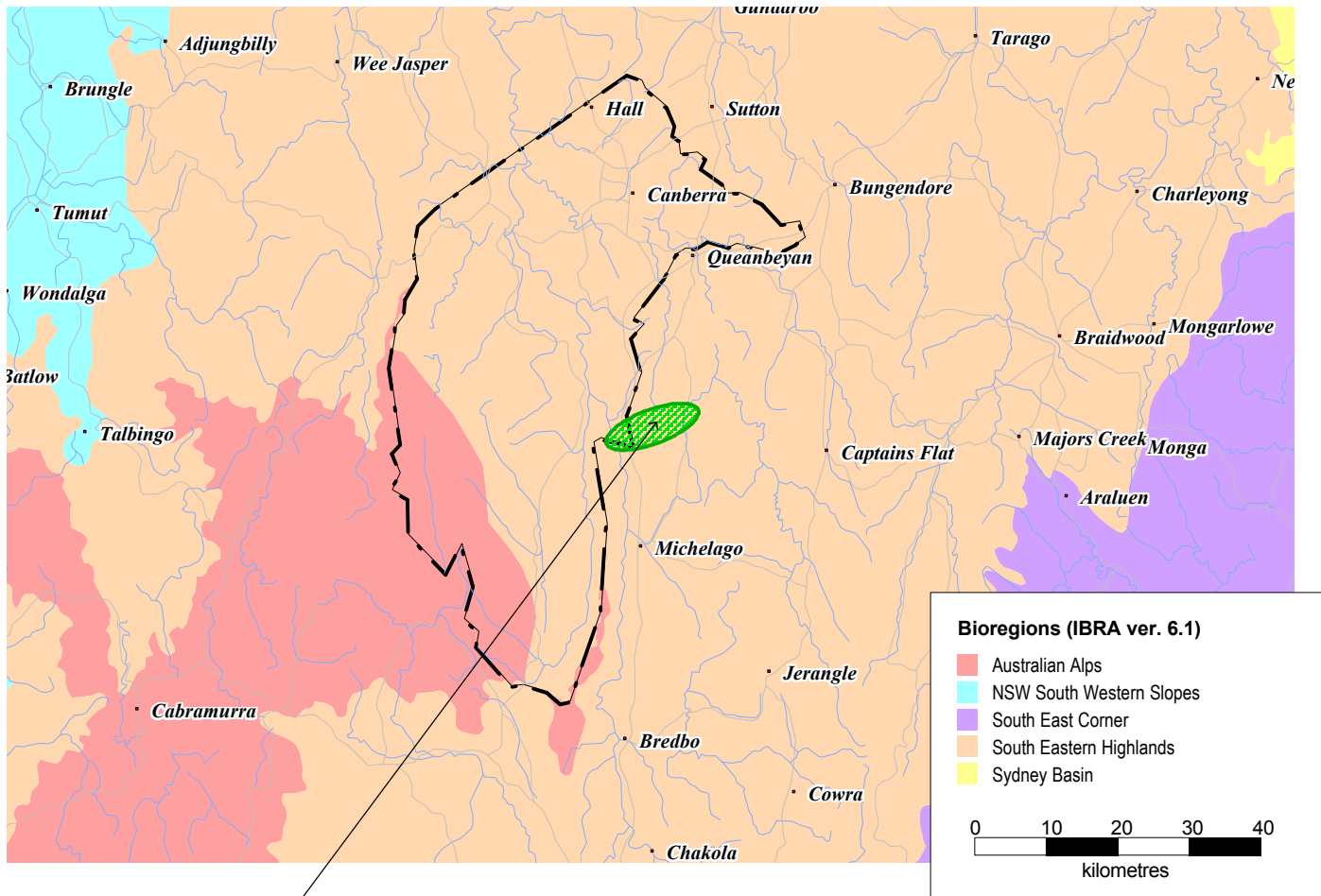
Generally, work associated with pipeline construction would have short-term impacts on some components of good quality BGGW and NTG EECs and probably longer-term impacts on some components of Pink-tailed Worm Lizard habitat. Permanent structures such as the intake, LLPS, HLPS and discharge facilities would, however, have permanent but relatively small impacts on terrestrial habitats.

The overall impact of the proposal on threatened species is likely to manifest in different and unequal ways and will be dependant upon the species local occurrence and their habitat preference, but for most these impacts would be trivial. Some impact would, however, occur to threatened species and endangered ecological communities found within the proposed construction footprint; this includes: approximately 5 ha of good to moderate condition BGGW; 6 ha of poor condition BGGW; 1.7 ha of NTG; 0.3 ha of SGGW and a little over 2.3 ha of known or suitable habitat for the Pink-tailed Worm Lizard. A small proportion of potential *Swainsona recta* habitat, within the Goulburn-Cooma Railway corridor, may also be affected, though ACTEW is content that the pipeline would be sufficiently micro-aligned to avoid this area.

The provision of offsets for vegetation loss and/or modification and restoration of grassland and woodland habitats within the pipeline corridor should be a condition of development approval. Failure of the proponent to fully commit to the funding and resourcing of rehabilitation could result in an inadequate recovery of high conservation value areas. Controls on construction methods and corridor widths at selective locations would reduce these construction footprint and overall impact on threatened species and vegetation.

ACTEW should invest significant resources to ensure the effective post-construction rehabilitation of the construction corridor. ACTEW should also provide sufficient offsets for the loss or modification of high conservation value vegetation and habitat. Provided that the recommendations (Section 6.0) are followed it is considered unlikely that the project would have a significant impact on any matter of national environmental significance. Nevertheless, a Referral should be submitted to the Department of the Environment, Water, Heritage and the Arts (DEWHA) for further consideration of the predicted impacts to BGGW and NTG EECs and Pink-tailed Worm Lizard habitat.

FIGURES



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Figure 1: Location of the Study Area in a regional context.

Date: 24 July 2009

Checked by: TO

File number: S5561

Location: P:\5000\5500s\5561\Mapping\S5561 F1_region.WOR

Scale:



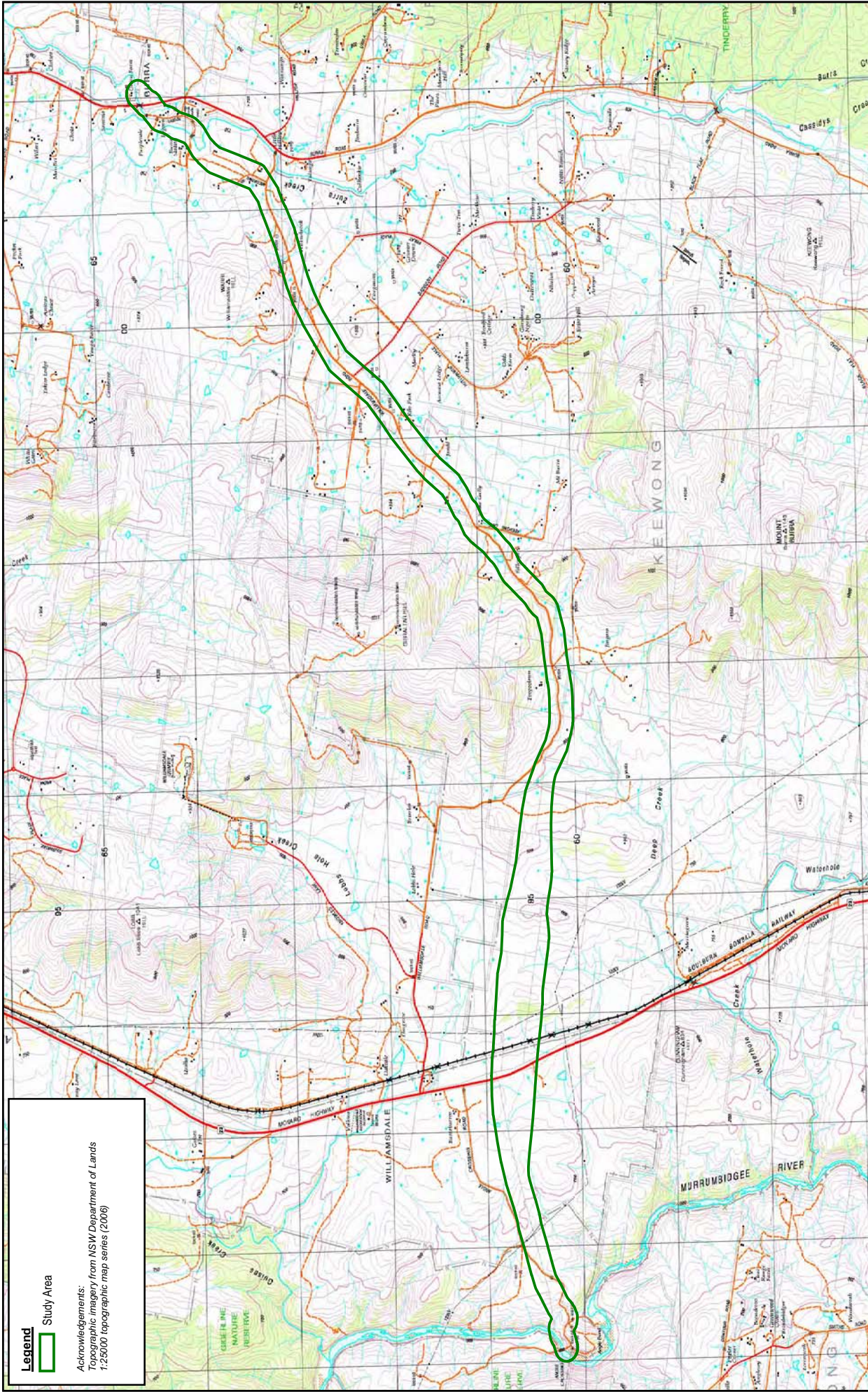


Figure 2: The study area in detail

Figure 2: The study area in detail

Date: 24 July 2009

Checked by: TO

File number: S5561

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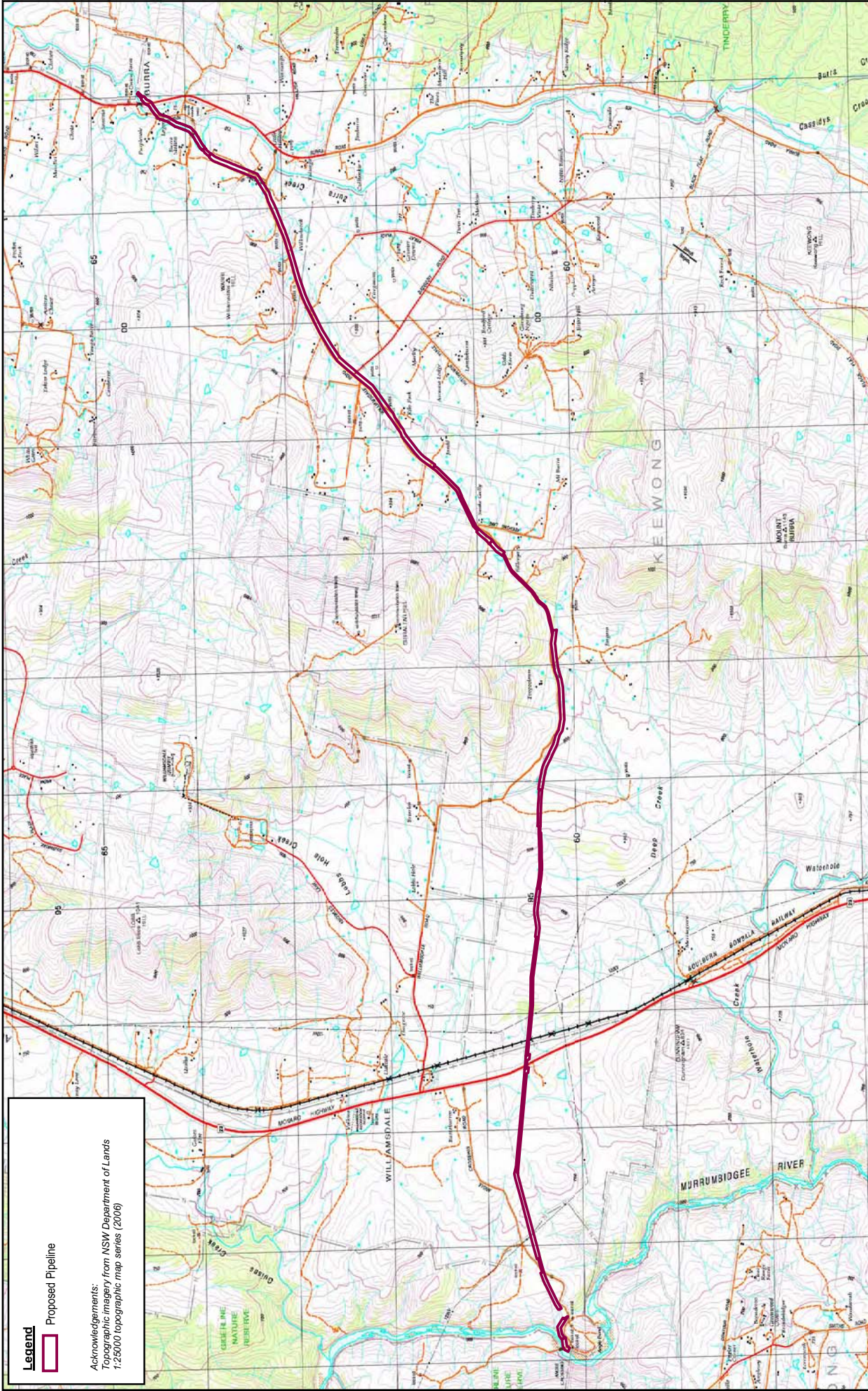
Kilometres



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Legend

Proposed Pipeline

Acknowledgements:
Topographic imagery from NSW Department of Lands
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Figure 3: Proposed pipeline route

Figure 3: Proposed pipeline route

Date: 29 July 2009
Checked by: TO

Scale: 0 0.3 0.6 0.9 1.2 1.5 Kilometres

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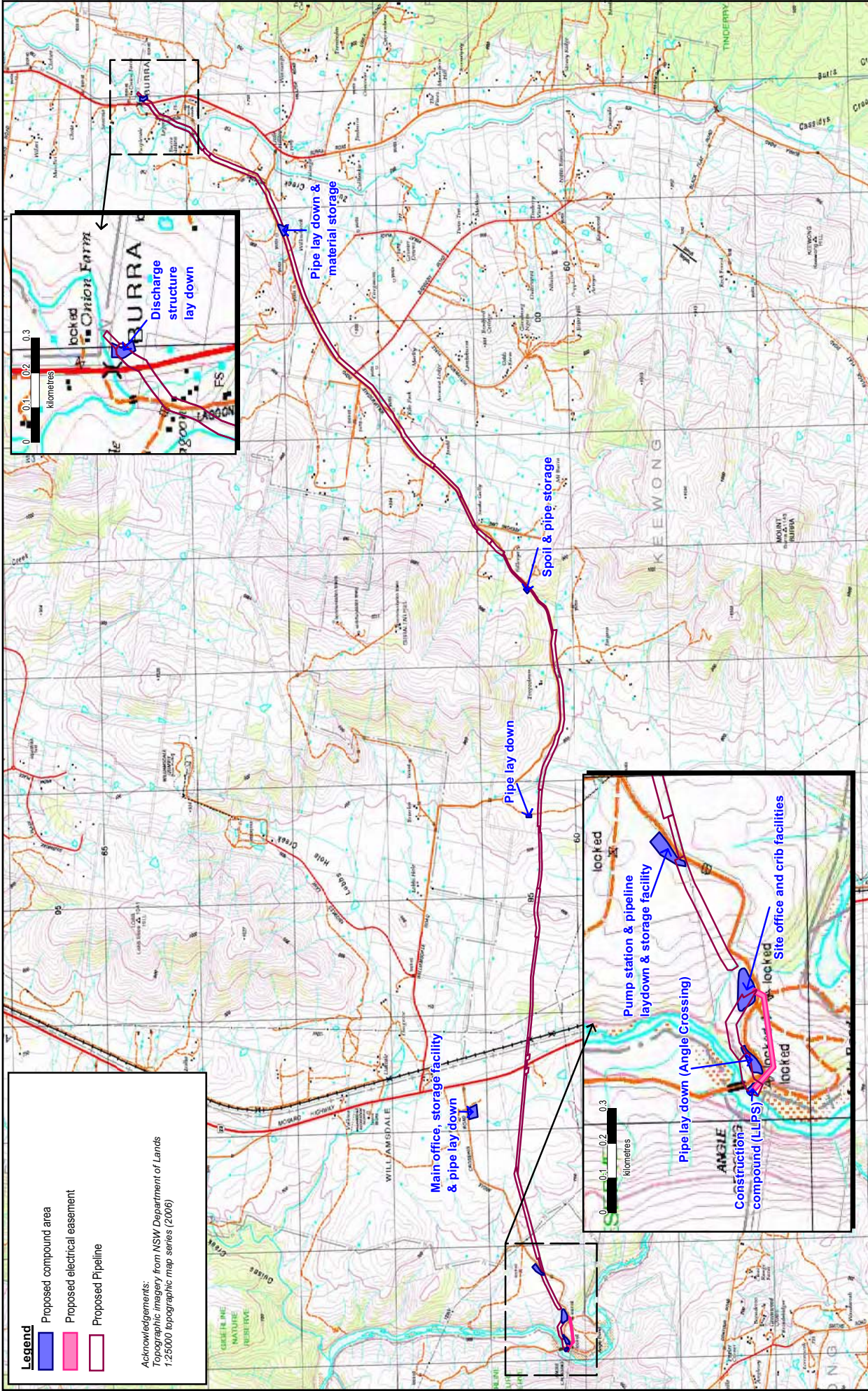


Figure 4: Proposed additional infrastructure works

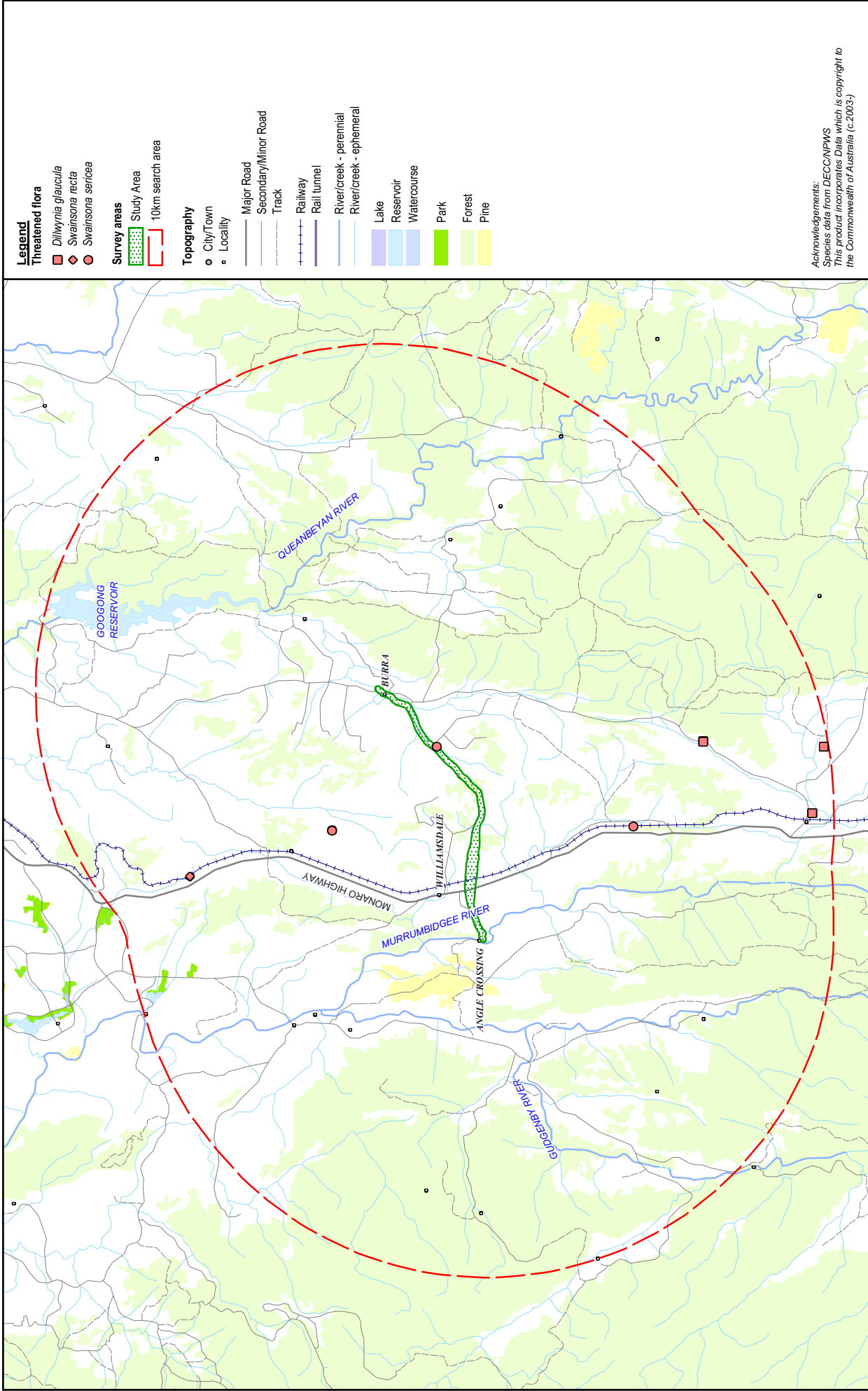
Figure 4: Proposed additional infrastructure works

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Scale: 0 0.3 0.6 0.9 1.2 1.5
Kilometres

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Legend
Threatened flora
 ■ *Dillwynia glauca*
 ◆ *Swainsona recta*
 ● *Swainsona sericea*
Survey areas
 Study Area
 10km search area
Topography
 ○ City/Town
 □ Locality
 — Major Road
 - - - Secondary/Minor Road
 — Track
 —+— Railway
 —+— Rail tunnel
 — River/creek - perennial
 — River/creek - ephemeral
 Lake
 Reservoir
 Watercourse
 Park
 Forest
 Pine

Acknowledgements:
 Species data from DECC/NPWS
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Figure 5: Threatened flora, listed on the TSC Act,
 recorded within 10km of the Study Area

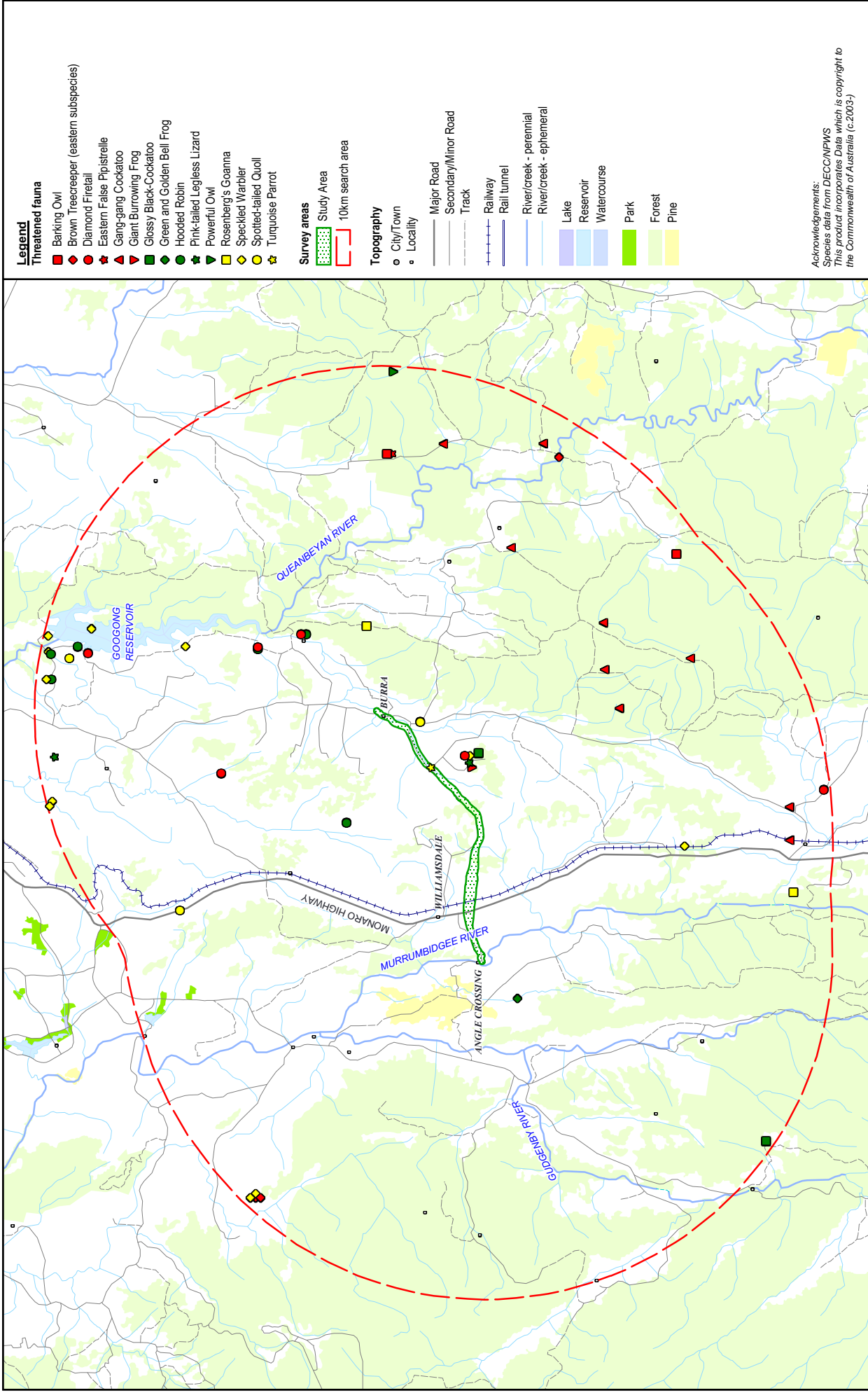
Date: 24 July 2009
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Scale: 0 1.5 3 4.5 6 7.5
 Kilometres

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Figure 5: Threatened flora, listed on the TSC Act,
 recorded within 10km of the Study Area





- Legend**
- Threatened fauna**
- Barking Owl
 - ◆ Brown Treecreeper (eastern subspecies)
 - ★ Diamond Firetail
 - ▲ Eastern False Pheasant
 - Gang-gang Cockatoo
 - Giant Burrowing Frog
 - ◆ Glossy Black-Cockatoo
 - ▲ Green and Golden Bell Frog
 - Hooded Robin
 - ★ Pink-tailed Legless Lizard
 - Powerful Owl
 - Rosenberg's Goanna
 - Speckled Warbler
 - ◆ Spotted-tailed Quoll
 - ★ Turquoise Parrot
- Survey areas**
- ▨ Study Area
 - ▭ 10km search area
- Topography**
- City/Town
 - Locality
 - Major Road
 - - - Secondary/Minor Road
 - Track
 - +—+—+ Railway
 - +—+—+ Rail tunnel
 - River/creek - perennial
 - River/creek - ephemeral
 - Lake
 - Reservoir
 - Watercourse
 - Park
 - Forest
 - Pine

Acknowledgements:
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Figure 6: Threatened fauna, listed on the TSC Act,
 recorded within 10km of the Study Area

Date: 24 July 2009
 Checked by: TO
 Location: P:\90005650\55611\Mapping\55611\FB_threatened_fauna.WOR

Scale: 0 1.5 3 4.5 6 7.5
 Kilometres

Figure 6: Threatened fauna, listed on the TSC Act,
 recorded within 10km of the Study Area



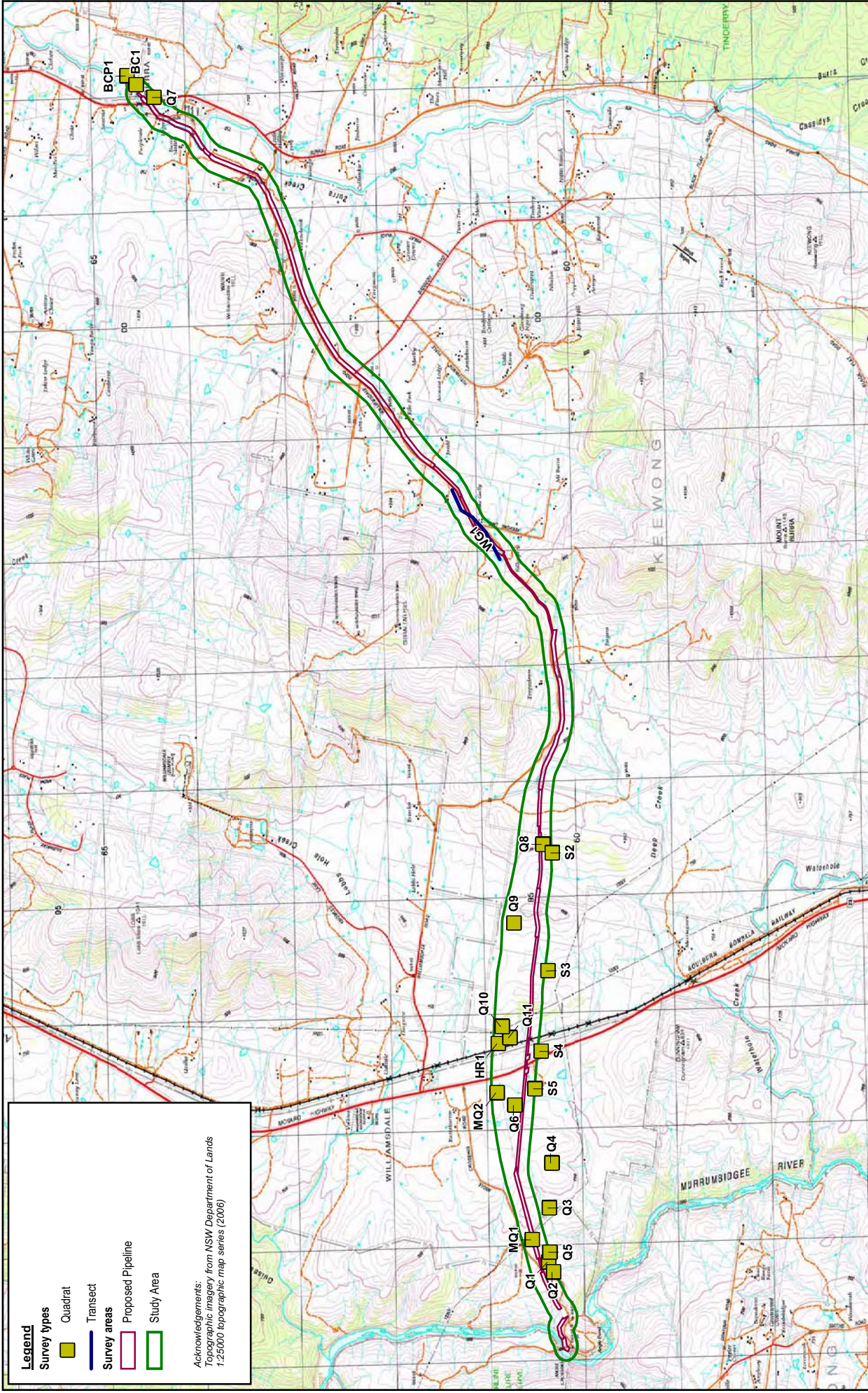



Figure 7: Location of flora sampling sites

Figure 7: Location of flora sampling sites

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 Location: P:\5000\5050s\5651\Mapping\S5651\F7_surveys flora.WOR

Scale: 0 0.3 0.6 0.9 1.2 1.5
 Kilometres

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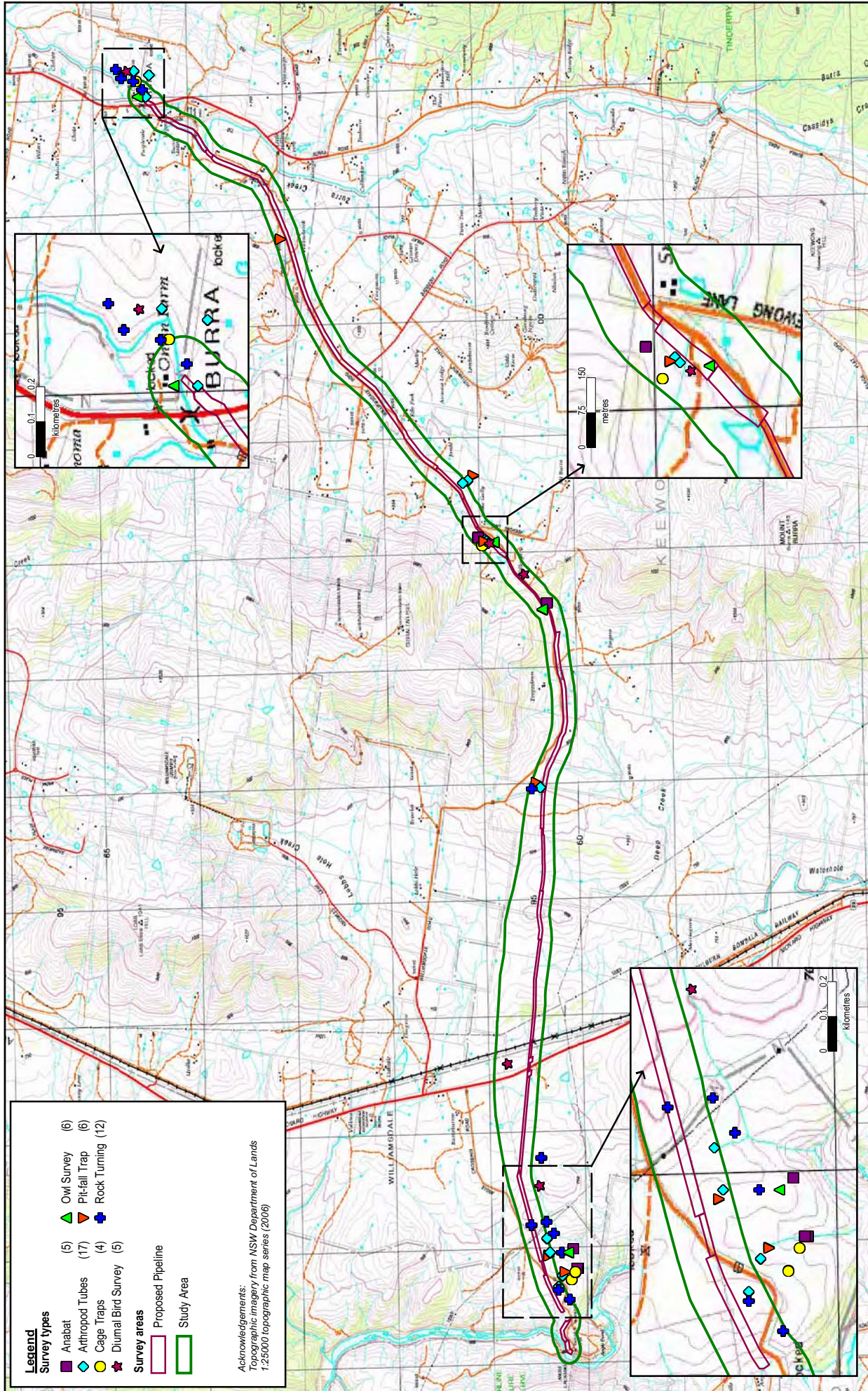



Figure 8: Location of fauna sampling sites

Figure 8: Location of fauna sampling sites



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File number: S5561

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Kilometres



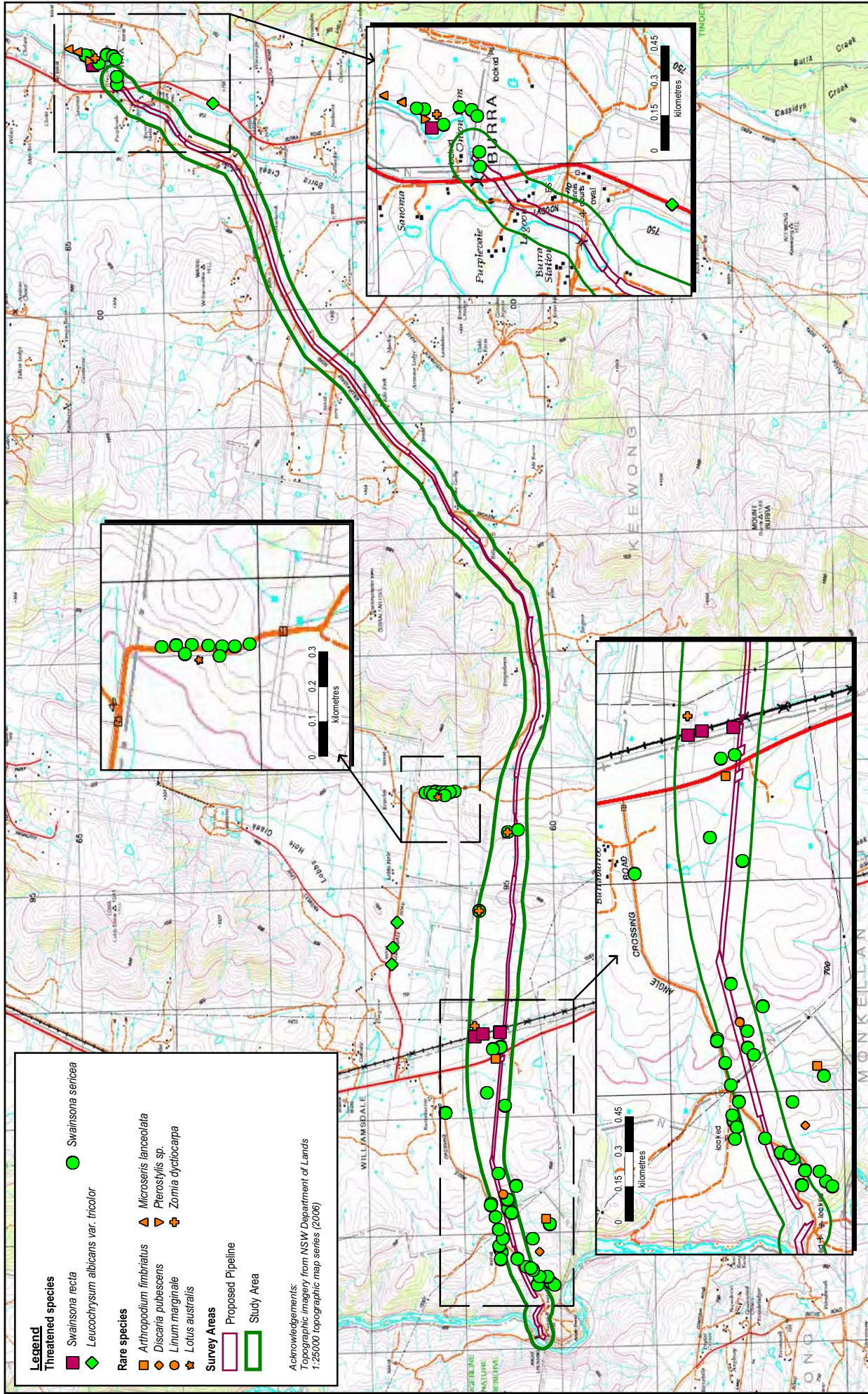


Figure 9: Location of threatened flora recorded during this study

Figure 9: Location of threatened flora recorded during this study

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 Location: P:\5000\5050s\5561\Mapping\SS561 F9 flora records.WOR

Scale: 0 0.3 0.6 0.9 1.2 1.5
 kilometres

File number: SS561

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 kilometres



Acknowledgements:
 Topographic imagery from NSW Department of Lands
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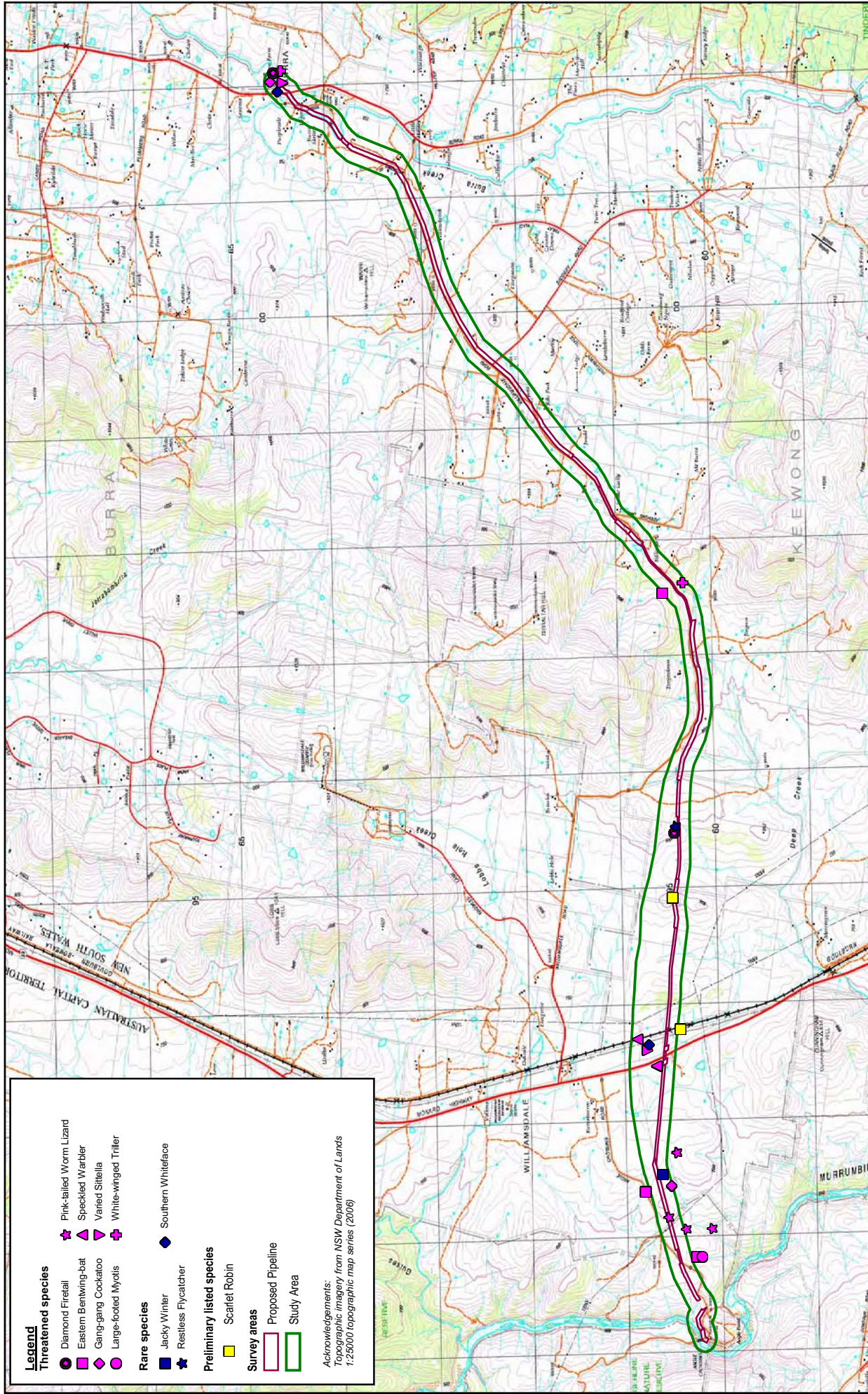



Figure 10: Location of threatened fauna recorded during this study

Figure 10: Location of threatened fauna recorded during this study

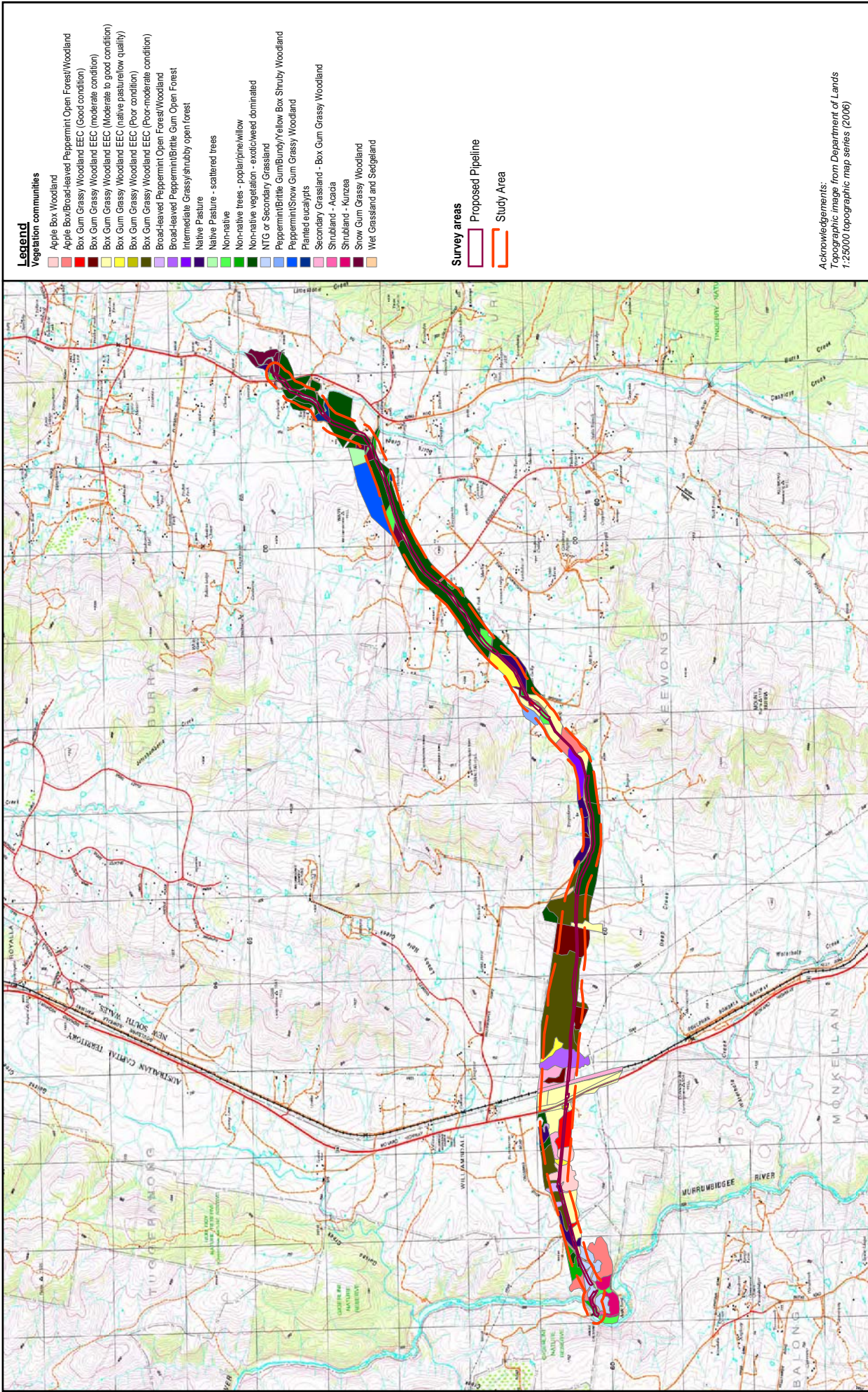


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Date: 29 July 2009
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 Location: P:\5000\5500s\5561\Mapping\5561 F10: fauna records.WOR

Scale: 0 0.3 0.6 0.9 1.2 1.5
 Kilometres

Legend
Threatened species
 Diamond Firetail
 Eastern Bentwing-bat
 Gang-gang Cockatoo
 Large-footed Myotis
 White-winged Triller
 Pink-tailed Worm Lizard
 Speckled Warbler
 Varied Sittella
 White-winged Triller
Rare species
 Jacky Winter
 Restless Flycatcher
 Southern Whiteface
Preliminary listed species
 Scarlet Robin
Survey areas
 Proposed Pipeline
 Study Area
 Acknowledgements:
 Topographic imagery from NSW Department of Lands
 1:25000 topographic map series (2006)



Legend

- Vegetation communities**
- Apple Box Woodland
 - Apple Box/Broad-leaved Peppermint Open Forest/Woodland
 - Box Gum Grassy Woodland EEC (Good condition)
 - Box Gum Grassy Woodland EEC (moderate condition)
 - Box Gum Grassy Woodland EEC (moderate to good condition)
 - Box Gum Grassy Woodland EEC (native pasture/low quality)
 - Box Gum Grassy Woodland EEC (Poor condition)
 - Box Gum Grassy Woodland EEC (Poor-moderate condition)
 - Broad-leaved Peppermint Open Forest/Woodland
 - Broad-leaved Peppermint/Bottle Gum Open Forest
 - Intermediate Grassy/shrubby open forest
 - Native Pasture
 - Native Pasture - scattered trees
 - Non-native
 - Non-native trees - poplar/riple/willow
 - Non-native vegetation - exotic/weed dominated
 - NTG or Secondary Grassland
 - Peppermint/Bottle Gum/Bundy/ellow Box Shrubby Woodland
 - Peppermint/Snow Gum Grassy Woodland
 - Planted eucalypts
 - Secondary Grassland - Box Gum Grassy Woodland
 - Shrubland - Acacia
 - Shrubland - Kurraea
 - Snow Gum Grassy Woodland
 - Wet Grassland and Segetal

- Survey areas**
- Proposed Pipeline
 - Study Area

Acknowledgements:
Topographic image from Department of Lands
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Figure 11: Overview of vegetation identified during surveys

Date: 29 July 2009
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Location: P:\5000\5500s\5561\Mapping\SS561_F11_14_veg.WOR

Scale: 0 0.4 0.8 1.2 1.6 2.0 Kilometres




Figure 11: Overview of vegetation identified during surveys

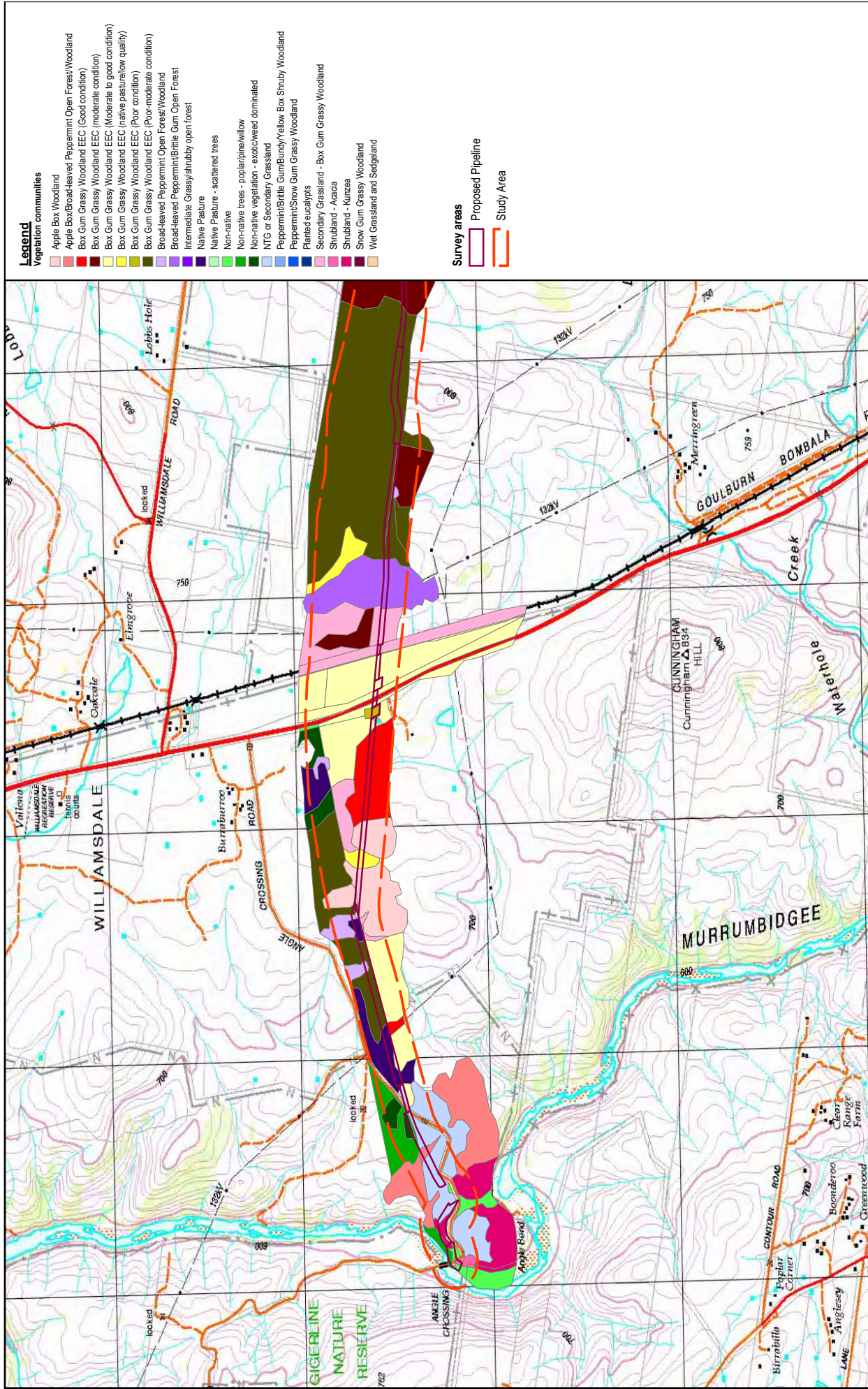


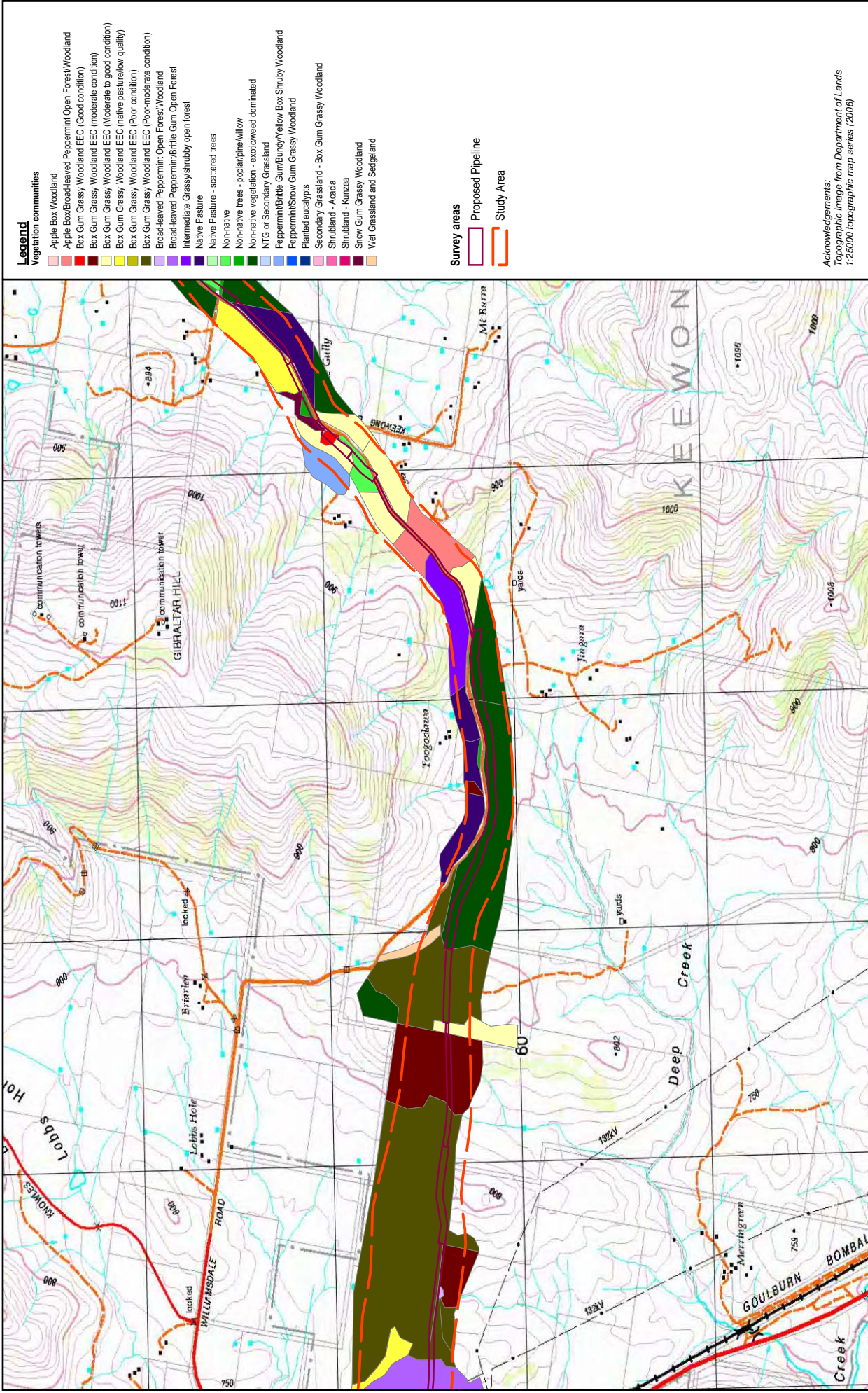
Figure 12: Close up of vegetation identified during surveys - Western section

Date: 29 July 2009
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 Location: P:\5000\550s\5561\Mapping\SS561_F11_14_veg.WOR

Scale: 0 0.15 0.3 0.45 0.6 0.75 Kilometres

Figure 12: Close up of vegetation identified during surveys - Western section

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Topographic image from Department of Lands
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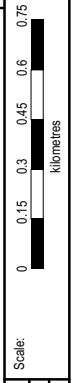
Figure 13: Close up of vegetation identified during surveys - Centre section

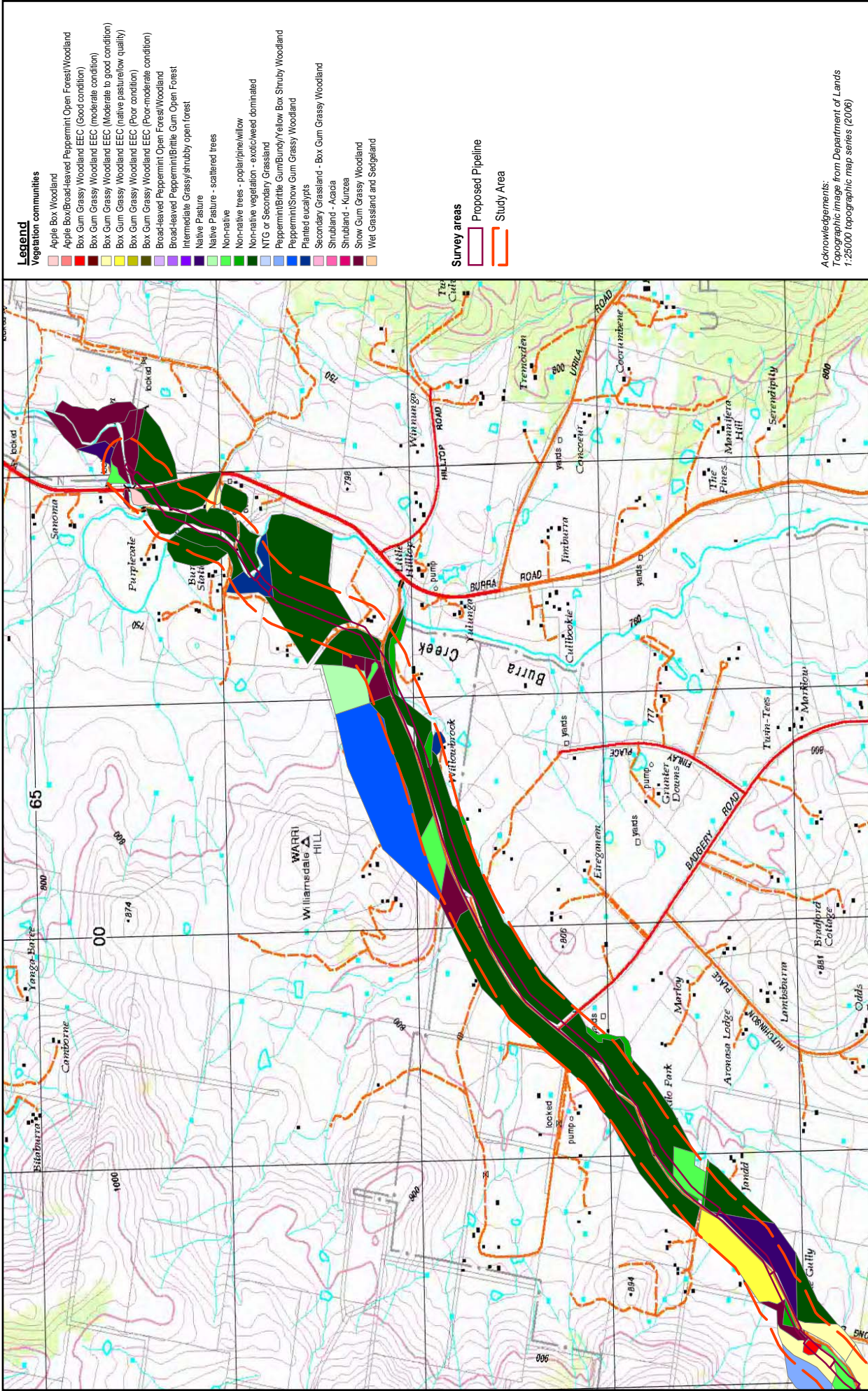
Figure 13: Close up of vegetation identified during surveys - Centre section

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File number: SS581





Legend

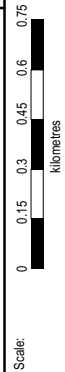
- Vegetation communities**
- Apple Box Woodland
 - Apple Box/Broad-leaved Peppermint Open Forest/Woodland
 - Box Gum Grassy Woodland EEC (Good condition)
 - Box Gum Grassy Woodland EEC (moderate condition)
 - Box Gum Grassy Woodland EEC (moderate to good condition)
 - Box Gum Grassy Woodland EEC (native pasture/low quality)
 - Box Gum Grassy Woodland EEC (Poor condition)
 - Box Gum Grassy Woodland EEC (Poor-moderate condition)
 - Broad-leaved Peppermint Open Forest/Woodland
 - Broad-leaved Peppermint/Bottle Gum Open Forest
 - Intermediate Grassy/shrubby open forest
 - Native Pasture
 - Native Pasture - scattered trees
 - Non-native
 - Non-native trees - poplar/riple/willow
 - Non-native vegetation - exotic/weed dominated
 - NTG or Secondary Grassland
 - Peppermint/Bottle Gum/Bundy/ellow Box Shrubly Woodland
 - Peppermint/Snow Gum Grassy Woodland
 - Planted eucalypts
 - Secondary Grassland - Box Gum Grassy Woodland
 - Shrubland - Acacia
 - Shrubland - Kurraea
 - Snow Gum Grassy Woodland
 - Wet Grassland and Seigeland

- Survey areas**
- Proposed Pipeline
 - Study Area

Acknowledgements:
Topographic image from Department of Lands
1:25000 topographic map series (2006)

Figure 14: Close up of vegetation identified during surveys - Eastern section

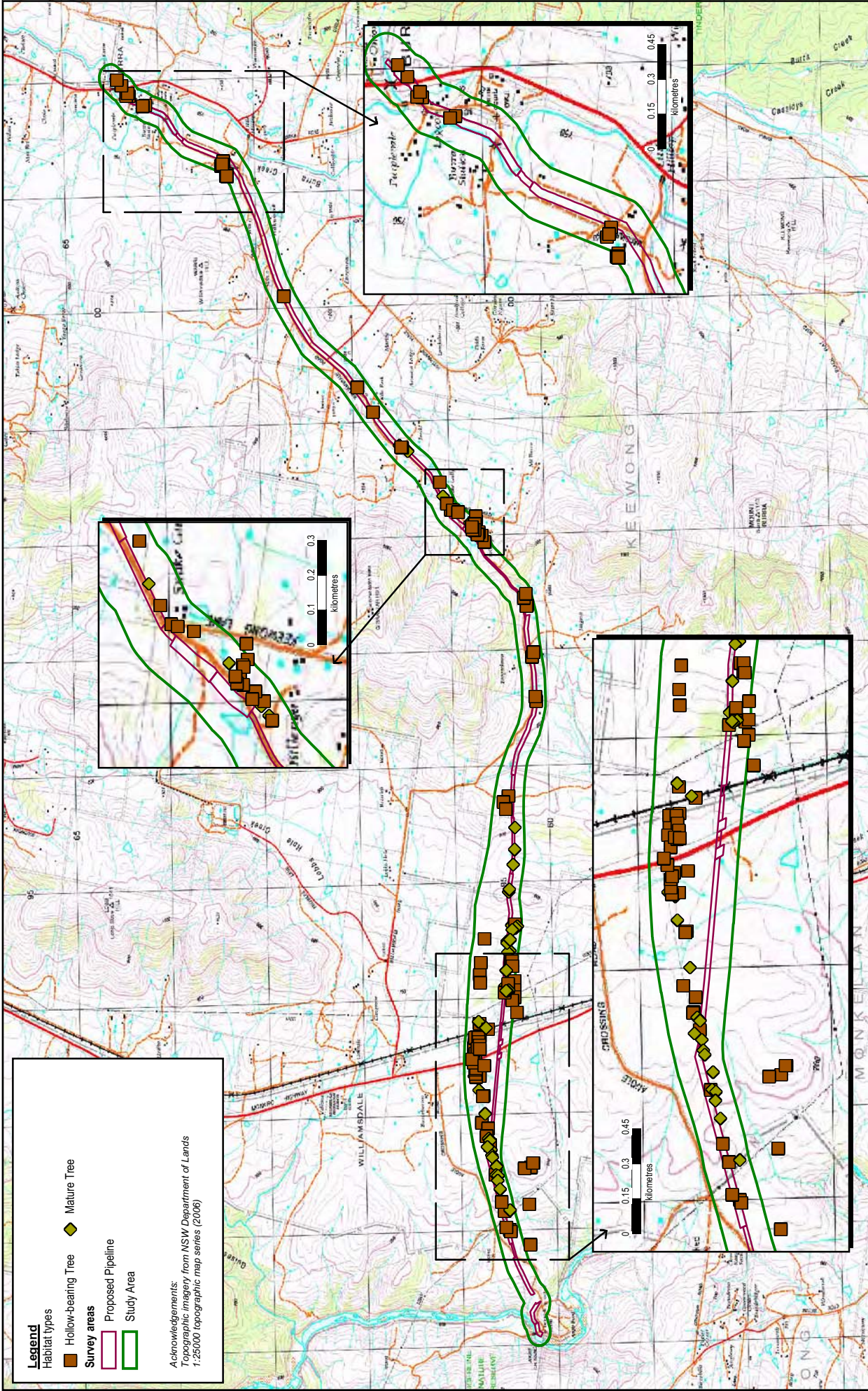
Figure 14: Close up of vegetation identified during surveys - Eastern section



Date: 29 July 2009
Checked by: TO
File number: S5561
Location: P:\5000550s\5561\Mapping\S5561_F11_14_veg_WOR

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Legend

Habitat types
 Hollow-bearing Tree ■ Mature Tree ◆

Survey areas
 Proposed Pipeline
 Study Area

Acknowledgements:
 Topographic imagery from NSW Department of Lands
 1:25000 topographic map series (2006)

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Figure 15: Locations of trees identified as potential habitat

Date: 29 July 2009
 Checked by: TO
 Location: P:\5000\5509\5561\Mapping\5561 F15: trees.WOR

File number: S5561

Scale: 0 0.3 0.6 0.9 1.2 1.5
 kilometres



Figure 15: Locations of trees identified as potential habitat

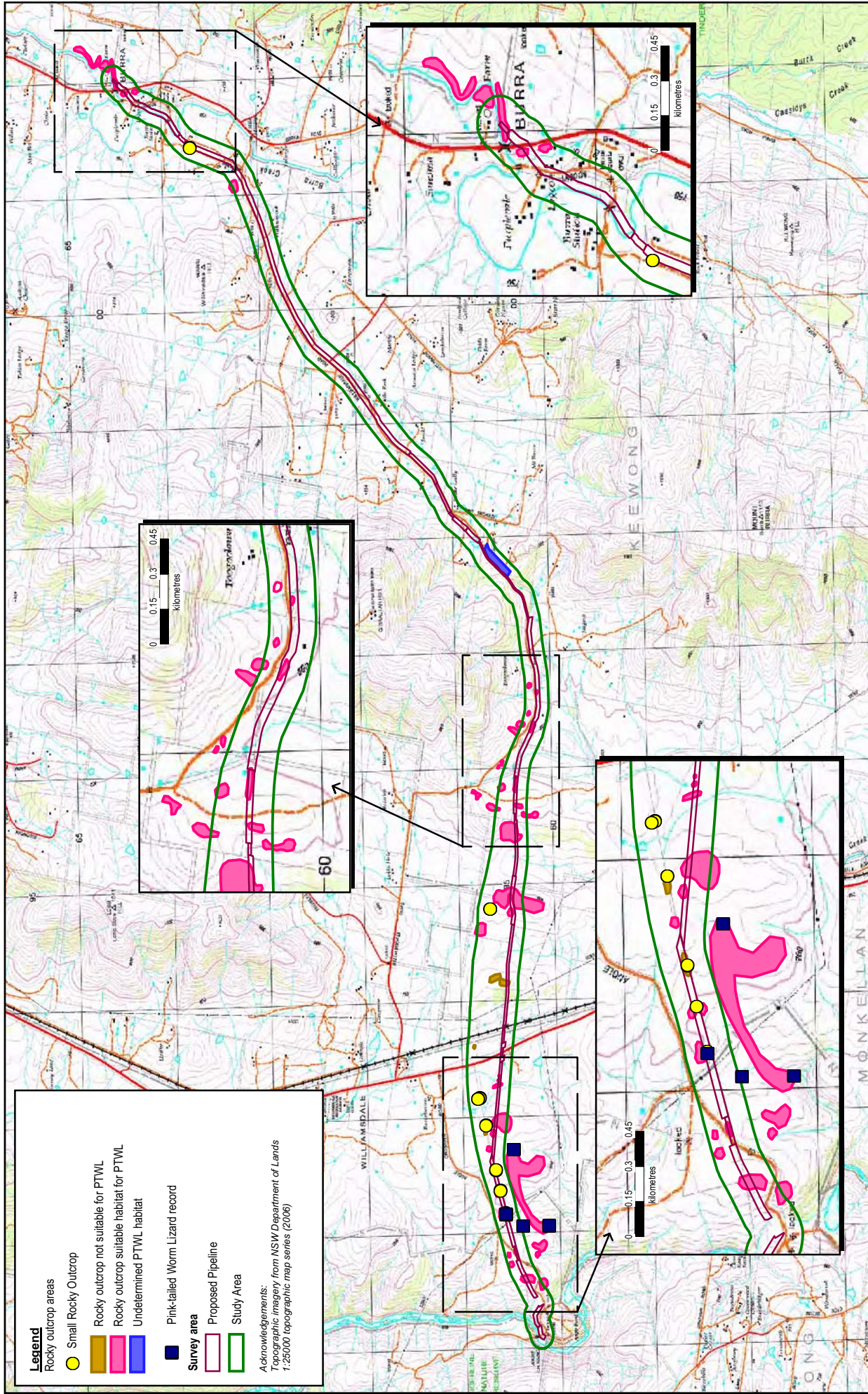


Figure 16: Locations of rocky outcrops and potential habitat for Pink-tailed Worm Lizard

Figure 16: Locations of rocky outcrops and potential habitat for Pink-tailed Worm Lizard

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Date: 29 July 2009

Checked by: TO

File number: S5561

Location: P:\5000\5000\5561\Mapping\S5561_F16_rocky_outcrops.WOR

Scale: 0 0.3 0.6 0.9 1.2 1.5
 kilometres



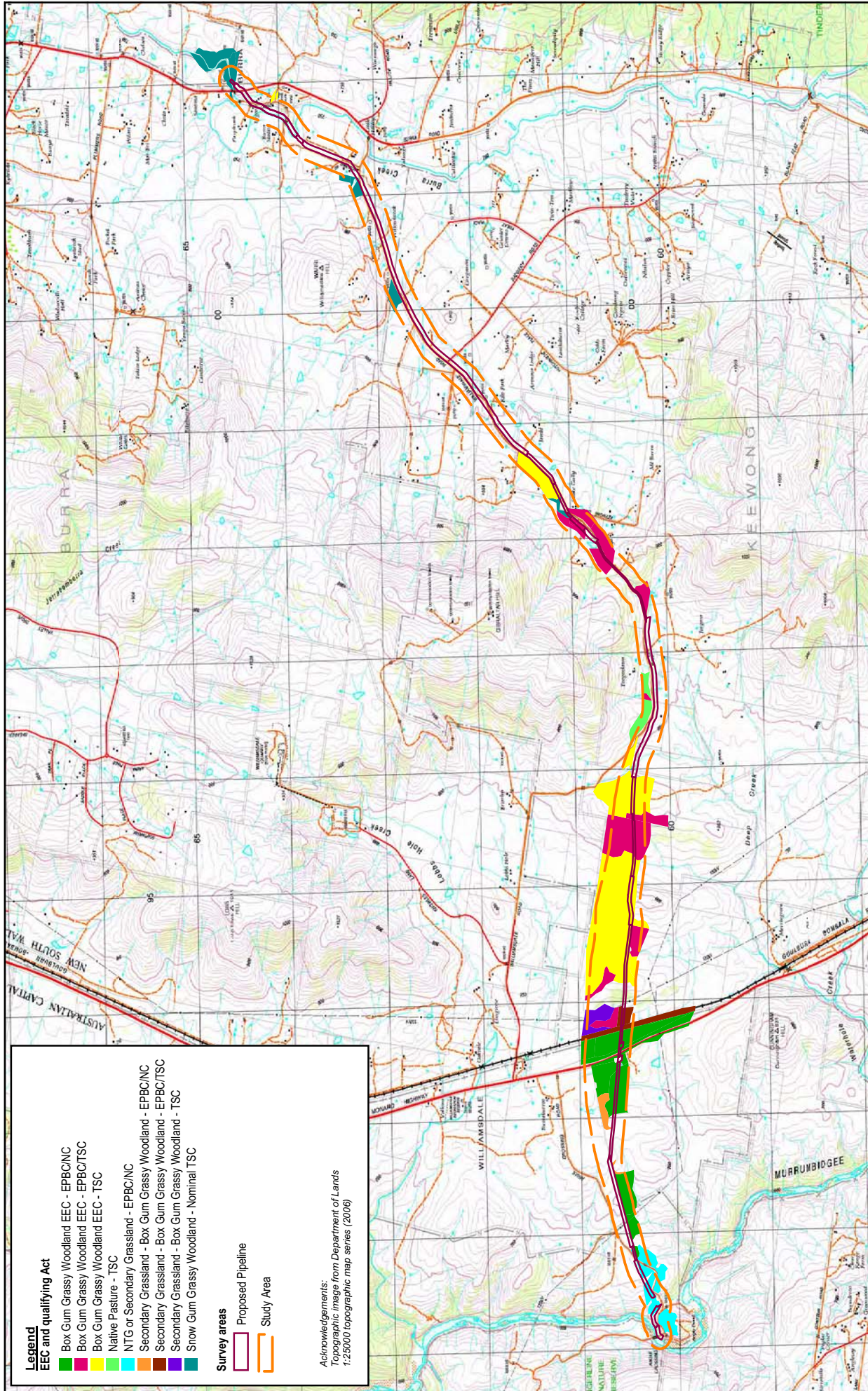


Figure 17: Endangered Ecological Community categories according to the EPBC Act, TSC Act or NC Act

Date: 29 July 2009
 Checked by: TO
 Location: P:\5000\505\505\5561\Mapping\5561_F17_EEC.WOR
 File number: 5561

Scale: 0 0.3 0.6 0.9 1.2 1.5 Kilometres

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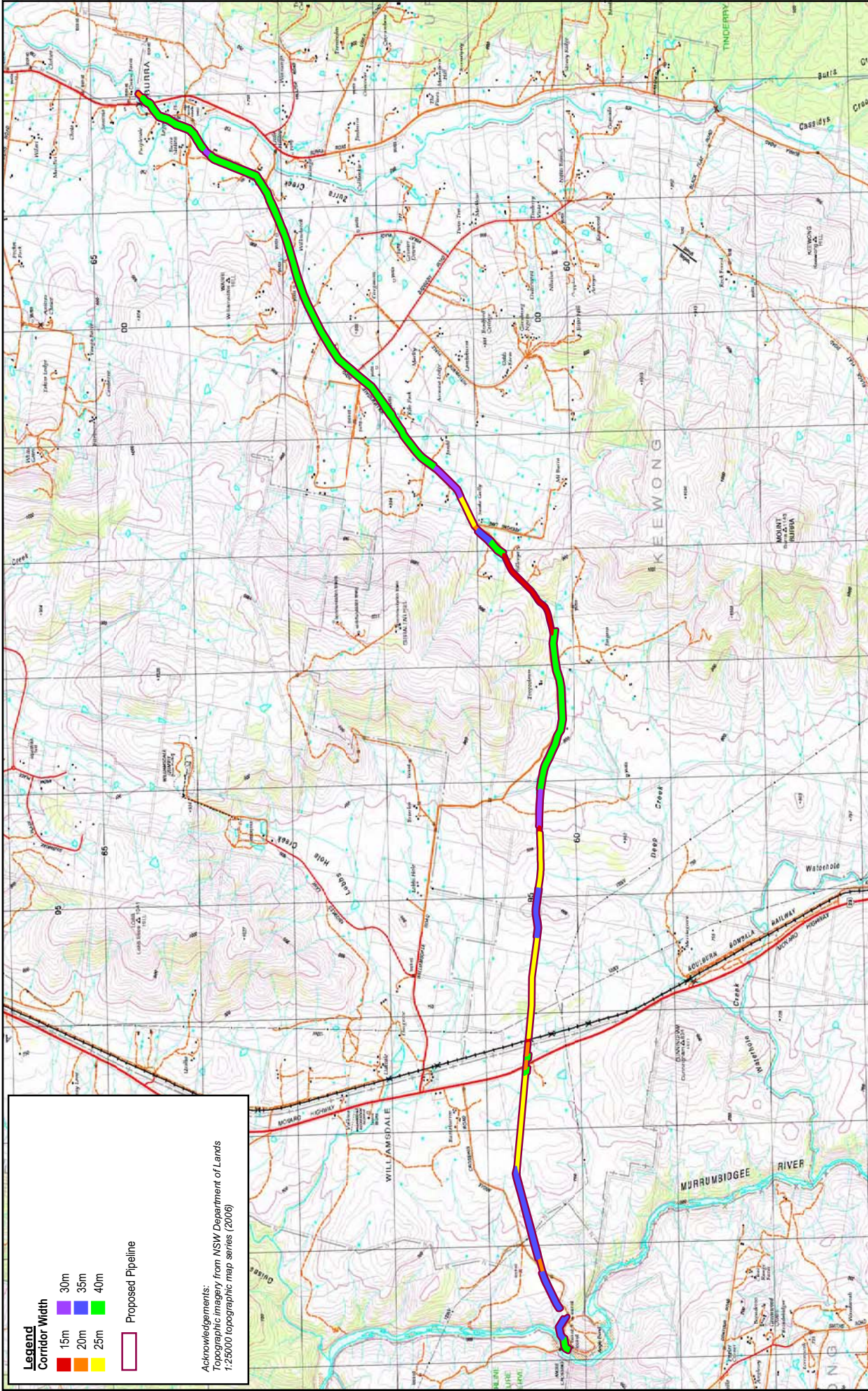
Legend EEC and qualifying Act

- Box Gum Grassy Woodland EEC - EPBC/INC
- Box Gum Grassy Woodland EEC - EPBC/TSC
- Box Gum Grassy Woodland EEC - TSC
- Native Pasture - TSC
- NTG or Secondary Grassland - EPBC/INC
- Secondary Grassland - Box Gum Grassy Woodland - EPBC/INC
- Secondary Grassland - Box Gum Grassy Woodland - EPBC/TSC
- Secondary Grassland - Box Gum Grassy Woodland - TSC
- Snow Gum Grassy Woodland - Nominal TSC

Survey areas

- Proposed Pipeline
- Study Area

*Acknowledgements:
Topographic image from Department of Lands
1:25000 topographic map series (2006)*



Legend

Corridor Width

- 15m
- 20m
- 25m
- 30m
- 35m
- 40m
- Proposed Pipeline

Acknowledgements:
 Topographic imagery from NSW Department of Lands
 1:25000 topographic map series (2006)

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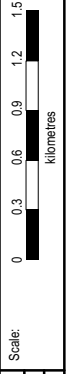


Figure 18: Proposed construction corridors widths.

Figure 18: Proposed construction corridors widths.

Date: 29 July 2009
 Checked by: TO
 Location: P:\5000\5500s\5561\Mapping\5561 F18_pipeline width.WOR

File number: S561



APPENDICES

APPENDIX 1

Flora Results

Table A1.1: Quadrat Data

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species	level 2	level 2s	level 1+2	level 1+2	value	Status		
Q1 E	691730	Native								
.....N	6060313									
		<i>Acaena ovina</i>	1							
		<i>Austrodanthonia</i> spp.	1							
		<i>Brachyoloma daphnoides</i>	r	r						
		<i>Carex breviculmis</i>	+							
		<i>Chrysocephalum apiculatum</i>	r		r					
		<i>Dianella revoluta</i>	r		r					
		<i>Dichondra repens</i>	+							
		<i>Elymus scaber</i>	1							
		<i>Epilobium billardierianum</i>	+							
		<i>Euchiton</i> sp.	1							
		<i>Geranium solanderi</i>	+							
		<i>Geranium retrorsum</i>	+							
		<i>Gonocarpus tetragynus</i>	+		+	+				
		<i>Hydrocotyle laxiflora</i>	1		1	1				
		<i>Hypericum gramineum</i>	r		r					
		<i>Leptorhynchos squamatus</i>	1		1	1				
		<i>Lomandra</i> sp.	1		1	1				
		<i>Oxalis perennans</i>	+							
		<i>Poa sieberiana</i>	1							
		<i>Ranunculus leppaceus</i>	r	r						
		<i>Themeda australis</i>	5	5	5	5				
		<i>Wahlenbergia</i> sp.	r							
		Floristic Score	3	1	5	9		EEC		
		Exotic								
		<i>Acetosella vulgaris</i>	r							

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Centaureum</i> sp.	+							
		<i>Hypericum perforatum</i>	1							
		<i>Hypochoeris radicata</i>	r							
		<i>Petrorhagia nanteuilii</i>	r							
		<i>Plantago lanceolata</i>	r							
		<i>Rosa rubiginosa</i>	+							
		<i>Trifolium</i> sp.	r							
		<i>Verbascum thapsus</i>	r							
		Native								
Q2	E 691644	<i>Acaena ovina</i>	+	C						
	N 6060266	<i>Asperula conferta</i>	+	1			+			
		<i>Austrodanthonia</i> spp.	+	C						
		<i>Carex breviculmis</i>	+	C						
		<i>Cheilanthes australis</i>	r	2	r			r		
		<i>Chrysocephalum apiculatum</i>	1	1			1			
		<i>Cymbonotus lawsonianus</i>	+	C						
		<i>Daucus glochidiatus</i>	r	C						
		<i>Dichopogon fimbriatus</i>	1	2	1	1	1	1		
		<i>Elymus scaber</i>	+	C						
		<i>Euchiton</i> sp.	1	C						
		<i>Geranium retrorsum</i>	1	C						
		<i>Gonocarpus tetragynus</i>	1	1			1	1		
		<i>Haloragis heterophylla</i>	r	1			r			
		<i>Hydrocotyle laxiflora</i>	+	1			+			
		<i>Leptorhynchus squamatus</i>	1	1			1	1		
		<i>Lomandra filiformis</i>	+	1			+			
		<i>Lomandra multiflora</i>	+	1			+			
		<i>Ophioglossum lusitanicum</i>	+	2	+		+			
		<i>Oxalis perennans</i>	+	C						

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Panicum effusum</i>	+	C						
		<i>Poa sieberiana</i>	+	C						
		<i>Ranunculus leppaceus</i>	r	2	r		r			
		<i>Rumex brownii</i>	+	C						
		<i>Senecio quadridentatus</i>	+	C						
		<i>Solenogyne dominii</i>	1	C						
		<i>Stackhousia monogyna</i>	+	2	+	+	+	+		
		Swainsona sericea	1	2	1	1	1	1		
		<i>Themeda australis</i>	5	2	5	5	5	5		
		<i>Vittadinia muelleri</i>	1	C						
		<i>Wahlenbergia</i> sp.	+	C						
		Floristic Score			7	5	12	24	EEC	
		Exotic								
		<i>Acetosella vulgaris</i>	r							
		<i>Bromus</i> sp.	r							
		<i>Centaureum</i> sp.	1							
		<i>Eragrostis curvula</i>	r							
		<i>Hypericum perforatum</i>	1							
		<i>Hypochoeris radicata</i>	+							
		<i>Linaria arvensis</i>	1							
		<i>Petrorhagia nanteuilii</i>	+							
		<i>Plantago lanceolata</i>	r							
		<i>Trifolium</i> sp.	+							
		<i>Verbascum thapsus</i>	+							
		Native								
Q3	E	692198								
	N	6060296								
		<i>Acaena ovina</i>	1	C						
		<i>Aristida ramosa</i>	1	C						
		<i>Asperula conferta</i>	+	1			+	+		

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Austrodanthonia</i> spp.	1	C						
		<i>Austrostipa scabra</i>	1	C						
		<i>Bothriochloa macra</i>	1	C						
		<i>Brachyoloma daphnoides</i>	r	2	r		r			
		<i>Carex breviculmis</i>	1	C						
		<i>Cheilanthes australis</i>	+	2	+	+	+	+		
		<i>Chrysocephalum apiculatum</i>	1	1			1	1		
		<i>Convolvulus erubescens</i>	r	C						
		<i>Cymbonotus lawsonianus</i>	r	C						
		<i>Daucus glochidiatus</i>	r	C						
		<i>Dichelachne</i> sp.	+	C						
		<i>Elymus scaber</i>	+	C						
		<i>Euchiton</i> sp.	+	C						
		<i>Geranium retrorsum</i>	+	C						
		<i>Gonocarpus tetragynus</i>	+	1			+	+		
		<i>Hypericum gramineum</i>	r	1			r			
		<i>Leptorhynchus squamatus</i>	1	1			1	1		
		<i>Lomandra filiformis</i>	r	1			r			
		<i>Lomandra multiflora</i>	+	1			+	+		
		<i>Ophioglossum lusitanicum</i>	1	2	1	1	1	1		
		<i>Oxalis perennans</i>	r	C						
		<i>Panicum effusum</i>	+	C						
		<i>Poa sieberiana</i>	1	C						
		<i>Senecio quadridentatus</i>	r	C						
		<i>Solenogyne dominii</i>	1	C						
		Swainsona sericea	1	2	1	1	1	1		
		<i>Themeda australis</i>	4	2	4	4	4	4		
		<i>Vittadinia muelleri</i>	1	C						
		<i>Wahlenbergia</i> sp.	1	C						
		<i>Wurmbea dioica</i>	1	2	1	1	1	1		

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		Floristic Score			6	5	10	21		EEC
		Exotic								
		<i>Centaureum</i> sp.	r							
		<i>Hypericum perforatum</i>	+							
		<i>Hypochaeris radicata</i>	r							
		<i>Linaria arvensis</i>	r							
		<i>Petrorhagia nanteuilii</i>	+							
		<i>Rosa rubiginosa</i>	r							
		<i>Salvia verbenaca</i>	r							
		<i>Trifolium</i> sp.	r							
Q4	E 692585	Native								
	N 6060260									
		<i>Acaena ovina</i>	1	C						
		<i>Aristida ramosa</i>	1	C						
		<i>Asperula conferta</i>	+	1			+			
		<i>Austrodanthonia</i> spp.	2	C						
		<i>Austrostipa scabra</i>	2	C						
		<i>Bothriochloa macra</i>	3	C						
		<i>Bursaria spinosa</i>	r	C						
		<i>Carex breviculmis</i>	1	C						
		<i>Cheilanthes australis</i>	+	2	+		+			
		<i>Chrysocephalum apiculatum</i>	+	1			+			
		<i>Convolvulus erubescens</i>	+	C						
		<i>Crassula sieberiana</i>	r	C						
		<i>Cymbonotus lawsonianus</i>	+	C						
		<i>Daucus glochidiatus</i>	+	C						
		<i>Elymus scaber</i>	1	C						
		<i>Erneapogon nigricans</i>	+	C						
		<i>Eucalyptus mannifera</i>	r	C						

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Euchiton</i> sp.	+	C						
		<i>Geranium antrorsum</i>	1	2	1	1	1	1		
		<i>Geranium solanderi</i>	1	C						
		<i>Gonocarpus tetragynus</i>	+	1			+	+		
		<i>Hydrocotyle laxiflora</i>	+	1			+	+		
		<i>Lomandra</i> sp. 1	r	1			r			
		<i>Lomandra</i> sp. 2	1	1			1	1		
		<i>Ophioglossum lusitanicum</i>	1	2	1	1	1	1		
		<i>Panicum effusum</i>	2	C						
		<i>Rumex brownii</i>	+	C						
		<i>Schoenus apogon</i>	r	C						
		<i>Themeda australis</i>	1	C						
		<i>Vittadinia cuneata</i>	r	C						
		<i>Vittadinia muelleri</i>	1	C						
		<i>Wahlenbergia</i> sp. 1	1	C						
		<i>Wahlenbergia</i> sp. 2	r	C						
		<i>Wurmbea dioica</i>	+	2	+	+	+	+		
		Floristic Score			4	4		9	17	EEC
		Exotic								
		<i>Acetosella vulgaris</i>	1							
		<i>Hypochoeris radicata</i>	+							
		<i>Linaria arvensis</i>	r							
		<i>Petrorhagia nanteuilii</i>	1							
		<i>Rosa rubiginosa</i>	+							
		<i>Tragopogon dubius</i>	r							
		<i>Trifolium</i> sp.	1							
MQ1	E	691928	Native							
	N	6060483	<i>Acaena ovina</i>	C						
			<i>Aphanes australiana</i>	C						

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Asperula conferta</i>	1	1			1	1		
		<i>Austrodanthonia</i> spp.	1	C						
		<i>Austrostipa bigeniculata</i>	1	C						
		<i>Austrostipa scabra</i>	2	C						
		<i>Bothriochloa macra</i>	2	C						
		<i>Chamaesyce drummondii</i>	r	C						
		<i>Chrysocephalum apiculatum</i>	1	1			1	1		
		<i>Craspedia</i> sp.	1	2	1	1	1	1		
		<i>Crassula sieberiana</i>	1	C						
		<i>Cymbonotus lawsonianus</i>	1	C						
		<i>Dichopogon fimbriatus</i>	+	2	+	+	+	+		
		<i>Elymus scaber</i>	1	C						
		<i>Enneapogon nigricans</i>	+	C						
		<i>Eragrostis</i> sp.	1	C						
		<i>Euchiton</i> sp.	1	C						
		<i>Geranium retrorsum</i>	1	C						
		<i>Halragis heterophylla</i>	1	1			1	1		
		<i>Juncus</i> sp.	+	C						
		<i>Leptorhynchos elongatus</i>	r	2	r		r			
		?								
		<i>Leptorhynchos squamatus</i>	+	1			+	+		
		<i>Lomandra bracteata</i>	+	1			+	+		
		<i>Lomandra</i> sp.	+	1			+	+		
		<i>Oxalis perennans</i>	1	C						
		<i>Panicum effusum</i>	2	C						
		<i>Poa</i> sp.	+	C						
		<i>Rumex brownii</i>	+	C						
		<i>Schoenus apogon</i>	+	C						
		<i>Senecio quadridentatus</i>	r	C						
		<i>Solenogyne dominii</i>	1	C						
		Swainsona sericea	r	2	r		r			

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Vittadinia muelleri</i>	+	C						
		<i>Wahlenbergia</i> sp. 1	+	C						
		<i>Wahlenbergia</i> sp. 2	r	C						
		<i>Wurmbea dioica</i>	+	2	+	+	+			
		Exotic			5	3	9	17	EEC	
		<i>Acetosella vulgaris</i>	1							
		<i>Bromus</i> sp.	1							
		<i>Centaureum</i> sp.	+							
		<i>Conyza</i> sp.	r							
		<i>Erodium cicutarium</i>	+							
		<i>Hypericum perforatum</i>	1							
		<i>Hypochoeris radicata</i>	+							
		<i>Onopordum acanthium</i>	r							
		<i>Paronychia brasiliensis</i>	r							
		<i>Petrorhagia nanteuilii</i>	+							
		<i>Trifolium</i> sp.	1							
		<i>Verbasum thapsus</i>	r							
		<i>Verbasum virgatum</i>	+							
		<i>Vulpia</i> sp.	+							
MQ2	E	693204								
	N	6060828								
		Native								
		<i>Acaena ovina</i>	r	C						
		<i>Aphanes australiana</i>	r	C						
		<i>Austrodanthonia</i> spp.	2	C						
		<i>Austrostipa bigeniculata</i>	1	C						
		<i>Austrostipa scabra</i>	2	C						
		<i>Bothriochloa macra</i>	2	C						
		<i>Carex appressa</i>	1	C						

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Chloris truncata</i>	r	C						
		<i>Chrysocephalum apiculatum</i>	+	1			+	+		
		<i>Crassula sieberiana</i>	+	C						
		<i>Elymus scaber</i>	1	C						
		<i>Euchiton</i> sp.	+	C						
		<i>Geranium retrorsum</i>	+	C						
		<i>Geranium solanderi</i>	+	C						
		<i>Juncus</i> sp. 1	r	C						
		<i>Juncus</i> sp. 2	r	C						
		<i>Leptorhynchos squamatus</i>	r	1			r			
		<i>Lomandra bracteata</i>	+	1			+	+		
		<i>Oxalis perennans</i>	1	C						
		<i>Panicum effusum</i>	1	C						
		<i>Plantago varia</i>	r	1			r			
		<i>Rumex brownii</i>	+	C						
		<i>Themeda australis</i>	+	C						
		Floristic Score			0	0	2	2	2	not EEC
		Exotic								
		<i>Acetosella vulgaris</i>	1							
		<i>Capsella bursapastoris</i>	r							
		<i>Cynodon dactylon</i>	r							
		<i>Eleusine tristachya</i>	r							
		<i>Eragrostis curvula</i>	r							
		<i>Erodium cicutarium</i>	1							
		<i>Lolium perenne</i>	r							
		<i>Phalaris aquatica</i>	2							
		<i>Poa bulbosa</i>	r							
		<i>Taraxacum officinale</i>	r							
		<i>Trifolium</i> sp.	1							

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species	level 2	level 2s	level 1+2	level 1+2	value	Status		
BCP1 E	702177	Native								
N	6064710	<i>Acaena ovina</i>	r							
		<i>Asperula conferta</i>	+		+					
		<i>Austrodanthonia</i> spp.	1							
		<i>Bossiaea buxifolia</i>	+	+	+					
		<i>Carex breviculmis</i>	+							
		<i>Cheilanthes austrotenuifolia</i>	r		r					
		<i>Chrysocephalum apiculatum</i>	1		1					
		<i>Convolvulus erubescens</i>	+							
		<i>Cryptandra amara</i>	1	1	1					
		<i>Cymbonotus lawsonianus</i>	+							
		<i>Daucus glochidiatus</i>	r							
		<i>Desmodium varians</i>	r		r					
		<i>Dianella longifolia</i>	+		+					
		<i>Elymus scaber</i>	1							
		<i>Eragrostis</i> sp.	1							
		<i>Eucalyptus pauciflora</i>	r							
		<i>Geranium retrosum</i>	r							
		<i>Glycine tabacina</i>	+	+	+					
		<i>Gonocarpus tetragynus</i>	1		1					
		<i>Isoetopsis graminifolia</i>	1	1	1					
		<i>Leptorhynchos squamatus</i>	1		1					
		Leucochrysum albicans	1	1	1					
		<i>Lomandra bracteata</i>	+		+					
		<i>Lomandra multiflora</i>	+		+					
		<i>Melichrus urceolatus</i>	+		+					
		<i>Microtis unifolia</i>	r		r					
		<i>Oxalis perennans</i>	r							
		<i>Pimelia curviflora</i>	+		+					
		<i>Plantago varia</i>	1		1					

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Poa sieberiana</i>	1	C						
		<i>Scleranthus fasciculatus</i>	+	1			+			
		<i>Solenogyne dominii</i>	r	C						
		<i>Stackhousia monogyna</i>	1	2	1	1	1	1		
		<i>Swainsona recta</i>	r	2	r	r	r	r		
		<i>Themeda australis</i>	4	2	4	4	4	4		
		<i>Triplodiscus pygmaeus</i>	1	1			1	1		
		<i>Velleia paradoxa</i>	+	2	+	+	+	+		
		<i>Vittadinia muelleri</i>	+	C						
		<i>Wahlenbergia</i> sp. 1	r	C						
		<i>Wahlenbergia</i> sp. 2	+	C						
		<i>Wurmbea dioica</i>	r	2	r	r	r	r		
		<i>Zornia dycliocarpa</i>	r	2	r	r	r	r		
		Floristic Score			14	8	20	42		EEC
		Exotic								
		<i>Briza minor</i>	r							
		<i>Coryza</i> sp.	r							
		<i>Hypericum perforatum</i>	+							
		<i>Hypochoeris radicata</i>	+							
		<i>Trifolium</i> sp.	r							
		<i>Vulpia</i> sp.	+							
WG1 E	697812	Native							score	
N	6060572	<i>Acacia dealbata</i>	r	C						
		<i>Acaena ovina</i>	+	C						
		<i>Ajuga australis</i>	+	2	+	+	+	+		
		<i>Aristida ramosa</i>	1	C						
		<i>Austrodanthonia</i> spp.	1	C						
		<i>Austrostipa scabra</i>	1	C						
		<i>Carex breviculmis</i>	1	C						

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Pimelia curviflora</i>	1	1			1	1		
		<i>Plantago gaudichaudii</i>	r	2	r		r			
		<i>Plantago varia</i>	1	1			1	1		
		<i>Poa sieberiana</i>	1	C						
		<i>Pterostylis cynrocephala</i>	r	2	r		r			
		<i>Scleranthus diander</i>	1	2	1	1	1	1		
		<i>Sorghum leiocladium</i>	1	2	1	1	1	1		
		<i>Stackhousia monogyna</i>	1	2	1	1	1	1		
		<i>Themeda australis</i>	3	2	3	3	3	3		
		<i>Triptilodiscus pygmaeus</i>	+	1			+	+		
		<i>Vittadinia muelleri</i>	1	C						
		<i>Vittadinia cuneata</i>	1	C						
		<i>Wahlenbergia</i> sp. 1	1	C						
		<i>Wahlenbergia</i> sp. 2	1	C						
		Floristic Score			17	14		26	57	EEC
		Exotic								
		<i>Centaurium</i> sp.	+							
		<i>Linaria arvensis</i>	+							
		<i>Rosa rubiginosa</i>	+							
		<i>Trifolium</i> sp.	+							
		<i>Verbascum thapsus</i>	r							
BC1	E	Native								
	N	701994								
		6064452	r	1			r			
		<i>Asperula conferta</i>	2	C						
		<i>Austrodanthonia</i> spp.	1	C						
		<i>Austrostipa scabra</i>	+	C						
		<i>Chamaesyce drummondii</i>	2	1			2	2		
		<i>Chrysocephalum apiculatum</i>	r	C						
		<i>Convolvulus erubescens</i>	1	C						
		<i>Crassula sieberiana</i>	1	C						

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Cymbonotus lawsonianus</i>	+	C						
		<i>Desmodium varians</i>	r	2	r		r			
		<i>Einadia nutans</i>	r	C						
		<i>Elymus scaber</i>	1	C						
		<i>Enneapogon nigricans</i>	1	C						
		<i>Eragrostis</i> sp.	1	C						
		<i>Gonocarpus tetragynus</i>	r	1			r			
		<i>Leptorhynchos elongates?</i>	1	2	1	1	1	1		
		<i>Lomandra</i> sp. 1	+	1			+	+		
		<i>Lomandra</i> sp. 2	+	1			+	+		
		<i>Panicum effusum</i>	1	C						
		<i>Pimelia curviflora</i>	r	1			r			
		<i>Plantago varia</i>	1	1			1	1		
		<i>Rumex brownii</i>	r	C						
		<i>Solenogyne dominii</i>	r	C						
		<i>Stackhousia monogyna</i>	+	2	+	+	+	+		
		Swainsona sericea	+	2	+	+	+	+		
		<i>Themeda australis</i>	2	C						
		<i>Triptilodiscus pygmaeus</i>	1	1			1	1		
		<i>Vittadinia muelleri</i>	r	C						
		<i>Vittadinia cuneata</i>	r	C						
		<i>Wahlenbergia</i> sp. 1	1	C						
		<i>Wurmbea dioica</i>	r	2	r		r			
		Floristic Score			5	3	8	16	EEC	
		Exotic								
		<i>Bromus</i> sp.	1							
		<i>Conyza</i> sp.	r							
		<i>Erodium cicutarium</i>	+							
		<i>Hirschfeldia incana</i>	r							
		<i>Hypericum perforatum</i>	r							

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Hypochoeris radicata</i>	+							
		<i>Linaria arvensis</i>	+							
		<i>Lolium perenne</i>	r							
		<i>Onopordium acanthium</i>	r							
		<i>Paronychia brasiliana</i>	1							
		<i>Phalaris aquatica</i>	+							
		<i>Salvia verbenaca</i>	r							
		<i>Sonchus sp.</i>	r							
		<i>Taraxacum officinale</i>	+							
		<i>Tragopogon dubius</i>	r							
		<i>Trifolium sp.</i>	1							
		<i>Verbascum thapsus</i>	r							
		<i>Verbascum virgatum</i>	r							
		<i>Vulpia sp.</i>	1							
HR1	E	Native								
		<i>Acaena ovina</i>	r	C						
	N	<i>Aphanes australiana</i>	+	C						
		<i>Asperula conferta</i>	+	1		+		+		
		<i>Austrodanthonia spp.</i>	1	C						
		<i>Austrostipa bigeniculata</i>	+	C						
		<i>Bothriochloa macra</i>	1	C						
		<i>Bulbine bulbosa</i>	+	2	+	+		+		
		<i>Chamaesyce drummondii</i>	r	C						
		<i>Chloris truncata</i>	r	C						
		<i>Chrysocephalum apiculatum</i>	2	1		2		2		
		<i>Craspedia sp.</i>	+	2	+	+		+		
		<i>Crassula sieberiana</i>	+	C						
		<i>Cymbonotus lawsonianus</i>	1	C						
		<i>Daucus glochidiatus</i>	+	C						

Biosis vegetation assessment for M2G pipeline										
Name	AMG coordinates	Species		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
		<i>Desmodium varians</i>	+	2	+	+	+	+		
		<i>Dichopogon fimbriatus</i>	1	2	1	1	1	1		
		<i>Elymus scaber</i>	1	C						
		<i>Eragrostis</i> sp.	1	C						
		<i>Eryngium ovinum</i>	r	2	r		r			
		<i>Eucalyptus blakeyi</i>	+	C						
		<i>Geranium retrorsum</i>	1	C						
		<i>Glycine tabacina</i>	+	2	+	+	+	+		
		<i>Goodenia pinnatifida?</i>	+	2	+	+	+	+		
		<i>Isoetopsis graminifolia</i>	+	2	+	+	+	+		
		<i>Leptorhynchos squamatus</i>	1	1			1	1		
		<i>Lomandra bracteata</i>	r	1			r			
		<i>Lomandra filiformis</i>	+	1			+	+		
		<i>Oxalis perennans</i>	+	C						
		<i>Panicum effusum</i>	1	C						
		<i>Plantago gaudichaudii</i>	r	2	r		r			
		<i>Plantago varia</i>	1	1			1	1		
		<i>Ranunculus pimpinellifolius</i>	+	2	+	+	+	+		
		<i>Rumex browii</i>	+	C						
		<i>Senecio quadridentatus</i>	r	C						
		<i>Solenogyne dominii</i>	1	C						
		<i>Themeda australis</i>	4	2	4	4	1	1		
		<i>Tricoryne elatior</i>	1	1			1	1		
		<i>Triplodiscus pygmaeus</i>	1	1			1	1		
		<i>Velleia paradoxa ?</i>	+							
		<i>Wahlenbergia</i> sp.	1	C						
		<i>Wurmbea dioica</i>	r	2	r		r			
		Floristic Score			12	9		16	37	EEC
		Exotic								
		<i>Aira</i> sp.	r							

Biosis vegetation assessment for M2G pipeline		sp. type	level 2	level 2s	level 1+2	level 1+2	value	Status
Name	AMG coordinates	Species						
		<i>Carex breviculmis</i>						
		<i>Cassinia longifolia</i>						
		<i>Cheilanthes australenuifolia</i>						
		<i>Chrysocephalum apiculatum</i>						
		<i>Clematis</i> sp.						
		<i>Convolvulus erubescens</i>						
		<i>Craspedia</i> sp.						
		<i>Crassula sieberiana</i>						
		<i>Cryptandra amara</i>						
		<i>Cullen microcephalum</i>						
		<i>Cymbonotus lawsonianus</i>						
		<i>Cymbopogon refractus</i>						
		<i>Daucus glochidiatus</i>						
		<i>Daviesia mimosoides</i>						
		<i>Desmodium varians</i>						
		<i>Dichelachne</i> sp. 1						
		<i>Dichelachne</i> sp. 2						
		<i>Dichondra repens</i>						
		<i>Elymus scaber</i>						
		<i>Eucalyptus bridgesiana</i>						
		<i>Eucalyptus dives</i>						
		<i>Eucalyptus melliodora</i>						
		<i>Euchiton</i> sp.						
		<i>Exocarpus cupressiformis</i>						
		<i>Galium gaudichaudii</i>						
		<i>Geranium solanderi</i>						
		<i>Glycine clandestina</i>						
		<i>Glycine tabacina</i>						
		<i>Gonocarpus tetragynus</i>						
		<i>Hardenbergia violacea</i>						

Biosis vegetation assessment for M2G pipeline		Species	level 2	level 2s	level 1+2	level 1+2	value	Status
Name	AMG coordinates							
		<i>Hibbertia obtusifolia</i>						
		<i>Hovea linearis</i>						
		<i>Hydrocotyle laxiflora</i>						
		<i>Hypericum gramineum</i>						
		<i>Indigofera australis</i>						
		<i>Joycea pallida</i>						
		<i>Juncus filicaulis</i>						
		<i>Kunzea ambigua</i>						
		<i>Leptorhynchos squamatus</i>						
		<i>Lomandra bracteata</i>						
		<i>Lomandra multiflora</i>						
		<i>Luzula sp.</i>						
		<i>Melichrus urceolatus</i>						
		<i>Microlaena stipoides</i>						
		<i>Microseris lanceolata</i>						
		<i>Microtis unifolia</i>						
		<i>Oxalis perennans</i>						
		<i>Panicum effusum</i>						
		<i>Pimelia curviflora</i>						
		<i>Plantago gaudichaudii</i>						
		<i>Plantago varia</i>						
		<i>Poa meionectes ?</i>						
		<i>Poa sieberiana</i>						
		<i>Pterostylis sp.</i>						
		<i>Pultenaea sp.</i>						
		<i>Ranunculus lappaceus</i>						
		<i>Rumex brownii</i>						
		<i>Schoenus apogon</i>						
		<i>Scleranthus diander</i>						
		<i>Scleranthus fasciculatus</i>						

The following four quadrats were recorded at DPs 201-754889; 152-754889 and 170-754889 during February 2009.

Quadrat Q8

Plant Name	1	2	3	4	5	6	Tally	Status
<i>Austrodanthonia</i> sp.	2	C						
<i>Austrostipa scabra</i>	2	C						
<i>Chrysocephalum apiculatum</i>	r	1			r			
<i>Hypoxis</i> sp.	1	2	1			1		
<i>Crassula sieberiana</i>	+	C						
<i>Eucalyptus blakelyi</i>	3							
<i>Themeda australis</i>	2	C						
<i>Leptorhynchos squamatus</i>	+	1			+	+		
<i>Zornia dyctiocarpa</i>	+	2	+	+	+	+		
<i>Wahlenbergia communis</i>	r	C						
<i>Hypericum gramineum</i>	+	2	+	+	+	+		
<i>Lomandra (?) bracteata</i>	r	2	+		+			
<i>Poa sieberiana</i>	1	C						
Florsitic Score			4	2		4	10	EEC
<i>Acetosella vulgaris</i>	+							
<i>Verbascum thapsus</i> .	r							
<i>Vulpia</i> sp.	+							

Quadrat Q9

Plant Name	1	2	3	4	5	6	Tally	Status
<i>Acaena novae-zelandiae</i>	+	C						
<i>Austrodanthonia (?) eriantha</i>	2	C						
<i>Austrostipa scabra</i>	3	C						
<i>Chamaesyce drummondii</i>	+	C						
<i>Chrysocephalum apiculatum</i>	r	1			+			
<i>Convolvulus erubescens</i>	+							
<i>Crassula sieberiana</i>	+	C						
<i>Einadia nutans</i>	+	C						
<i>Dichondra repens</i>	r	C						
<i>Calotis (?) lappulacea</i>	r	2	+		+			
<i>Zornia dyctiocarpa</i>	+	2	+	+	+	+		
<i>Swainsona sericea</i>	r	2	+		+			
<i>Wahlenbergia communis</i>	r	C						
<i>Hypericum gramineum</i>	+	2	+	+	+	+		
<i>Lomandra (?) bracteata</i>	r	2	+		+			
<i>Poa sieberiana</i>	1	C						
Floristic Score			5	2		2	9	EEC
<i>Acetosella vulgaris</i>	+							
<i>Bromus</i> sp.	+							
<i>Vulpia</i> sp.	+							

Quadrat Q10

Plant Name	1	2	3	4	5	6	Tally	Status
<i>Acaena ovina</i>	r	C						
<i>Austrodanthonia</i> sp.	2	C						
<i>Austrostipa scabra</i>	2	C						
<i>Cyperus</i> sp.	+	C						
<i>Crassula sieberiana</i>	+	C						
<i>Oxalis perennans</i>	r	C						
<i>Dichondra repens</i>	r	C						
<i>Eucalyptus melliodora</i>	3							
<i>Eucalyptus blakelyi</i>	3							
<i>Poa sieberiana</i>	2	C						

Floristic Score		0	0	0	0	Not EEC
<i>Acetosella vulgaris</i>	+					
<i>Hordeum leporinum</i>	+					
<i>Avena</i> sp.	r					
<i>Aira</i> sp.	r					

Quadrat Q11

Plant Name	1	2	3	4	5	6	Tally	Status
<i>Acaena novae-zelandiae</i>	+	C						
<i>Austrodanthonia (?) eriantha</i>	2	C						
<i>Austrostipa scabra</i>	3	C						
<i>Chamaesyce drummondii</i>	+	C						
<i>Chrysocephalum apiculatum</i>	r	1			+			
<i>Convolvulus erubescens</i>	+							
<i>Crassula sieberiana</i>	+	C						
<i>Desmodium varians</i>	+	2	+	+	+	+		
<i>Dichondra repens</i>	r	C						
<i>Eucalyptus dives</i>	3							
<i>Zornia dyctiocarpa</i>	+	2	+	+	+	+		
<i>Swainsona sericea</i>	r	2	+		+			
<i>Wahlenbergia communis</i>	r	C						
<i>Ranunculus pimpinellifolius</i>	+	2	+	+	+	+		
<i>Lomandra (?) bracteata</i>	r	2	+		+			
<i>Poa sieberiana</i>	1	C						
Floristic Score			5	3		3	11	EEC
<i>Acetosella vulgaris</i>	+							
<i>Oxalis</i> sp.	r							
<i>Cirsium vulgare</i>	+							
<i>Rosa rubiginosa</i>	+							

The following five quadrats were recorded within 170-754889; 1-126283; 36 'Tuggeranong' and 1653 'Tuggeranong' during May 2009.

Quadrat S1

Species	1	2	3	4	5	6	Tally	Status
<i>Acaena ovina</i>	2	c						
<i>Asplenium flabellifolium</i>	r	2	r		r			
<i>Asperula conferta</i>	1	2	1	1	1	1		
<i>Austrodanthonia</i> spp.	2	c						
<i>Austrostipa bigeniculata</i>	3	c						
<i>Bothriochloa macra</i>	r	c						
<i>Chamaesyce drummondii</i>	1	c						
<i>Cheilanthes austrotenuifolia</i>	1	2	1	1	1	1		
<i>Chrysocephalum apiculatum</i>	r	1						
<i>Cymbonotus lawsonianus</i>	1	c						
<i>Desmodium varians</i>	+	2	+	+		+		
<i>Dichondra repens</i>	r	c						
<i>Einadia nutans</i>	r	c						
<i>Elymus scaber</i>	2	c						
<i>Euchiton</i> sp.	r	c						

<i>Geranium solanderi</i>	1	c						
<i>Glycine tabacina</i>	+	2	+	+	+	+		
<i>Lomandra multiflora</i>	1	2	1	1	1	1		
<i>Oxalis perennans</i>	1	c						
<i>Panicum effusum</i>	2	c						
<i>Plantago varia</i>	2	2	2	2	2	2		
<i>Poa sieberiana</i>	2	c						
<i>Solenogyne dominii</i>	2	c						
<i>Swainsona sericea</i>	2	2	2	2	2	2		
<i>Themeda australis</i>	r	1						
<i>Vittadinia muelleri</i>	2	c						
<i>Wahlenbergia communis</i>	+	c						
Floristic Score			8	7		7	22	EEC High floristic value
Weeds								
<i>Rosa rubiginosa</i>								

Quadrat S2

Species	1	2	3	4	5	6	Tally	Status
<i>Acaena ovina</i>	1	c						
<i>Austrodanthonia</i> sp.	1	c						
<i>Austrostipa bigeniculata</i>	3	c						
<i>Bothriochloa macra</i>	1	c						
<i>Carex appressa</i>	1	c						
<i>Dichelachne</i> sp.	+	c						
<i>Elymus scaber</i>	1	c						
<i>Geranium solanderi</i>	1	c						
<i>Hydrocotyle laxiflora</i>	1	2	1	1	1	1		
<i>Juncus</i> sp.	+	c						
<i>Oxalis perennans</i>	1	c						
<i>Poa sieberiana</i>	+	c						
<i>Solenogyne dominii</i>	+	c						
<i>Themeda australis</i>	3	2	3	3	3	3		
Floristic Score			2	2		2	6	EEC moderate floristic value

Quadrat S3

Species	1	2	3	4	5	6	Tally	Status
<i>Aristida ramosa</i>	+	c						
<i>Austrodanthonia</i> sp.	1	c						

<i>Austrostipa bigeniculata</i>	2	c					
<i>Bothriochloa macra</i>	1	c					
<i>Carex appressa</i>	1	c					
<i>Dichondra repens</i>	+	c					
<i>Elymus scaber</i>	1	c					
<i>Hydrocotyle laxiflora</i>	+	2	+	+	+	+	
<i>Panicum effusum</i>	+	c					
<i>Solenogyne dominii</i>	r	c					
<i>Themeda australis</i>	1	c					
Floristic Score			1	1		1	3 Low floristic value
Trees							
<i>Eucalyptus melliodora</i>	+						
<i>Eucalyptus bridgesiana</i>	+						

Quadrat S4

Species	1	2	3	4	5	6	Tally	Status
<i>Acaena ovina</i>	+	c						
<i>Aristida ramosa</i>	2	c						
<i>Asperula conferta</i>	r	2	r		r			
<i>Austrodanthonia</i> spp.	1	c						
<i>Austrostipa</i> sp.	1	c						
<i>Bothriochloa macra</i>	3	c						
<i>Calocephalus citreus</i>	r	2	r		r			
<i>Cheilanthes austrotenuifolia</i>	1	2	1	1	1	1		
<i>Chrysocephalum apiculatum</i>	r	1			r			
<i>Cymbonotus lawsonianus</i>	r	c						
<i>Desmodium varians</i>	r	2	r		r			
<i>Dianella revoluta</i>	+	2	+	+	+	+		
<i>Dichelachne</i> sp.	+	c						
<i>Geranium solanderi</i>	1	c						
<i>Glycine clandestina</i>	+	2	+	+	+	+		
<i>Hydrocotyle laxiflora</i>	1	2	1	1	1	1		
<i>Juncus</i> sp.	+	c						
<i>Kunzea eriocoides</i>	+	c						
<i>Leptorhynchus squamatus</i>	r	2	r		r			
<i>Microlaena stipoides</i>	+	c						
<i>Panicum effusum</i>	1	c						
<i>Plantago varia</i>	+	2	+	+	+	+		
<i>Solenogyne dominii</i>	+	c						
<i>Tricoryne elatior</i>	1	2	1	1	1	1		
<i>Themeda australis</i>	2	c						

Floristic Score	10	6	6	22	EEC
					High floristic value
Trees					
<i>Eucalyptus blakelyi</i>	1				
Weeds					
<i>Centaurium erythraea</i>	r				
<i>Eragrostis curvula</i>	2				
<i>Hypericum perforatum</i>	3				
<i>Hypochaeris radicata</i>	r				
<i>Nassella trichotoma</i>	r				
<i>Plantago lanceolata</i>	+				
<i>Rosa rubiginosa</i>	+				

Quadrat S5

Species	1	2	3	4	5	6	Tally	Status
<i>Acaena ovina</i>	r	c						
<i>Asperula conferta</i>	r	2	r		r			
<i>Austrodanthonia</i> spp.	2	c						
<i>Austrostipa</i> sp.	1	c						
<i>Chamaesyce drummondii</i>	r	c						
<i>Cheilanthes austrotenuifolia</i>	r	2	r		r			
<i>Chrysocephalum apiculatum</i>	1	1			1	1		
<i>Convolvulus erubescens</i>	r	c						
<i>Cymbonotus lawsonianus</i>	r	c						
<i>Dichondra repens</i>	+	c						
<i>Euchiton</i> sp.	r	c						
<i>Geranium retrorsum</i>	r	c						
<i>Geranium solanderi</i>	1	c						
<i>Gonocarpus tetragynus</i>	r	1			r			
<i>Juncus</i> sp.	+	c						
<i>Leptorhynchus squamatus</i>	r	2	r		r			
<i>Lomandra filiformis</i>	+	2	+	+	+	+		
<i>Panicum effusum</i>	+	c						
<i>Poa sieberiana</i>	+	c						
<i>Solenogyne dominii</i>	1	c						
<i>Themeda australis</i>	2	c						
<i>Vittadinia cuneata</i>	2	c						
<i>Wahlenbergia</i> sp.	1	c						
Floristic Score	4	1				2	7	EEC
								moderate floristic value

Trees	
<i>Eucalyptus bridgesiana</i>	2
Weeds	
<i>Cirsium vulgare</i>	r
<i>Hypericum perforatum</i>	2
<i>Hypochaeris radicata</i>	r
<i>Rosa rubiginosa</i>	r

***Modified Braun-Blanquet cover abundance - as per Rehwinkel 2007**

Table A1.2: Cumulative Flora Species List

Species	Status	Species	Status
<i>Acacia dealbata</i>		<i>Hydrocotyle laxiflora</i>	
<i>Acacia decurrens</i> ?		<i>Hypericum gramineum</i>	
<i>Acacia mearnsii</i>		<i>Hypericum perforatum</i>	nw
<i>Acaena novae-zelandiae</i>		<i>Hypochaeris glabra</i>	i
<i>Acaena ovina</i>		<i>Hypochaeris radicata</i>	i
<i>Acetosella vulgaris</i>	i	<i>Indigofera australis</i>	
<i>Ajuga australis</i>		<i>Isoetopsis graminifolia</i>	
<i>Allocasuarina verticillata</i>		<i>Joycea pallida</i>	
<i>Anthoxanthum odoratum</i>	i	<i>Juncus filicaulis</i>	
<i>Aphanes australiana</i>		<i>Juncus</i> sp.	
<i>Arctotheca calendula</i>		<i>Juncus</i> sp. 1	
<i>Aristida ramosa</i>		<i>Juncus</i> sp. 2	
<i>Arthropodium minus</i>		<i>Kunzea ericoides</i>	
<i>Asperula conferta</i>		<i>Lactuca serriola</i>	i
<i>Asperula scoparia</i>		<i>Leptorhynchos elongatus</i> ?	
<i>Austrodanthonia carphoides</i>		<i>Leptorhynchos squamatus</i>	
<i>Austrodanthonia</i> spp.		<i>Leptospermum</i> sp.	
<i>Austrostipa bigeniculata</i>		<i>Leucochrysum albicans</i> var. <i>tricolor</i>	E
<i>Austrostipa scabra</i>		<i>Linaria pelisseriana</i>	i
<i>Austrostipa</i> sp.		<i>Linum marginale</i>	uncommon
<i>Avena</i> sp.		<i>Lolium perenne</i>	ipg
<i>Bossiaea buxifolia</i>		<i>Lomandra bracteata</i>	
<i>Bothriochloa macra</i>		<i>Lomandra filiformis</i>	
<i>Brachyloma daphnoides</i>		<i>Lomandra multiflora</i>	
<i>Brachyscome rigidula</i>		<i>Lomandra</i> sp.	
<i>Briza maxima</i>	i	<i>Lomandra</i> sp. 1	
<i>Briza minor</i>	i	<i>Lomandra</i> sp. 2	
<i>Bromus brevis</i>	ipg	<i>Lotus australis</i>	
<i>Bromus rubens</i>	i	<i>Luzula</i> sp.	i
<i>Bromus</i> sp.	i	<i>Malva neglecta</i>	i
<i>Bulbine bulbosa</i>		<i>Marrubium vulgare</i>	nw
<i>Bursaria spinosa</i> ssp. <i>lasiophylla</i>		<i>Medicago</i> sp.	i
<i>Callitris endlicheri</i>		<i>Melichrus urceolatus</i>	
<i>Calotis scabiosifolia</i>		<i>Microlaena stipoides</i>	
<i>Capsella Bursa-pastoris</i>	i	<i>Microseris lanceolata</i>	
<i>Carduus tenuiflorus</i>		<i>Microtis unifolia</i>	
<i>Carex appressa</i>		<i>Nassella trichotoma</i>	nw
<i>Carex breviculmis</i>		<i>Oenothera stricta</i>	i
<i>Cassinia longifolia</i>		<i>Onopordum acanthium</i>	i
<i>Cerastium fontanum</i>	i	<i>Ophioglossum lusitanicum</i>	
<i>Chamaesyce drummondii</i>		<i>Orobanche</i> spp.	nw
<i>Cheilanthes austrotenuifolia</i>		<i>Oxalis perennans</i>	
<i>Cheilanthes sieberi</i>		<i>Oxalis</i> sp.	i
<i>Cheilanthes</i> sp.		<i>Panicum effusum</i>	
<i>Chloris truncata</i>	i	<i>Parentucellia latifolia</i>	i

Species	Status	Species	Status
<i>Chrysocephalum apiculatum</i>		<i>Petrorhagia nanteuillii</i>	i
<i>Chrysocephalum semipapposum</i>		<i>Phalaris aquatica</i>	ipg
<i>Cichorium intybus</i>	i	<i>Phragmites australis</i>	
<i>Cirsium vulgare</i>	i	<i>Pimelea curviflora</i>	
<i>Clematis microphylla</i>		<i>Pimelea glauca</i>	
<i>Clematis sp.</i>	i	<i>Pinus sp.</i>	i
<i>Convolvulus erubescens</i>		<i>Plantago gaudichaudii</i>	
<i>Craspedia sp.</i>		<i>Plantago lanceolata</i>	i
<i>Craspedia variabilis</i>		<i>Plantago varia</i>	
<i>Crassula sieberiana</i>		<i>Poa labillardieri</i>	
<i>Cryptandra amara</i>		<i>Poa meionectes</i>	?
<i>Cullen microcephalum</i>	uncommon	<i>Poa sieberiana</i>	
<i>Cullen tenax</i>		<i>Poa sp.</i>	
<i>Cupressus sp.</i>		<i>Podolepis jaceoides</i>	
<i>Cymbonotus lawsonianus</i>		<i>Populus alba</i>	nw
<i>Cymbopogon refractus</i>		<i>Populus nigra</i>	nw
<i>Cyperus sp.</i>		<i>Pteridium esculentum</i>	
<i>Dactylis glomerata</i>	i	<i>Pterostylis cycnocephala</i>	
<i>Daucus glochidiatus</i>		<i>Pterostylis sp.</i>	
<i>Daviesia mimosoides</i>		<i>Pultenaea procumbens</i>	
<i>Desmodium varians</i>		<i>Pultenaea sp.</i>	
<i>Dianella longifolia</i>		<i>Ranunculus lappaceus</i>	
<i>Dianella revoluta</i>		<i>Ranunculus pimpinellifolius</i>	
<i>Dichelachne sp.</i>		<i>Rosa rubiginosa</i>	nw
<i>Dichelachne sp. 1</i>		<i>Rubus fruticosus aggregate</i>	nw
<i>Dichelachne sp. 2</i>		<i>Rumex brownii</i>	
<i>Dichondra repens</i>		<i>Rumex crispus</i>	i
<i>Dichopogon fimbriatus</i>		<i>Rumex sp.</i>	
<i>Discaria pubescens</i>	ROTAP	<i>Salix sp.</i>	nw
<i>Dillwynia sericea</i>		<i>Salvia verbenaca</i>	i
<i>Dodonaea viscosa</i>		<i>Sanguisorba minor</i>	i
<i>Drosera peltata</i>		<i>Schoenus apogon</i>	
<i>Echium plantagineum</i>	nw	<i>Scleranthus diander</i>	
<i>Echium vulgare</i>	nw	<i>Scleranthus fasciculatus</i>	
<i>Einadia nutans</i>		<i>Senecio quadridentatus</i>	
<i>Elymus scaber</i>		<i>Silybum marianum</i>	i
<i>Enneapogon nigricans</i>		<i>Solenogyne dominii</i>	
<i>Epilobium billardierianum</i>		<i>Solenogyne gunnii</i>	
<i>Eragrostis curvula</i>	nw	<i>Sonchus asper</i>	i
<i>Eragrostis sp.</i>		<i>Sorghum leiocladum</i>	uncommon
<i>Erodium crinitum</i>	i	<i>Stackhousia monogyne</i>	
<i>Eryngium ovinum</i>		<i>Stellaria pungens</i>	
<i>Eryngium rostratum</i>		<i>Swainsona recta</i>	E
<i>Eucalyptus blakelyi</i>		<i>Swainsona sericea</i>	V
<i>Eucalyptus bridgesiana</i>		<i>Taraxacum officinale</i>	i
<i>Eucalyptus dives</i>		<i>Themeda australis</i>	
<i>Eucalyptus goniocalyx</i>		<i>Thysanotus patersonii</i>	uncommon
<i>Eucalyptus mannifera</i>		<i>Thysanotus tuberosus</i>	uncommon
<i>Eucalyptus melliodora</i>		<i>Tolpis umbellata</i>	i

Species	Status	Species	Status
<i>Eucalyptus nortonii</i>		<i>Tragopogon porrifolius</i>	i
<i>Eucalyptus pauciflora</i>		<i>Tragopogon sp.</i>	i
<i>Eucalyptus rossii</i>		<i>Tricoryne elatior</i>	
<i>Eucalyptus rubida</i>		<i>Trifolium angustifolium</i>	i
<i>Euchiton involucratum</i>		<i>Trifolium arvense</i>	i
<i>Euchiton sp.</i>		<i>Trifolium campestre</i>	i
<i>Exocarpos cupressiformis</i>		<i>Trifolium repens</i>	i
<i>Galium gaudichaudii</i>		<i>Triptilodiscus pygmaeus</i>	
<i>Geranium antrorsum</i>		<i>Typha orientalis</i>	
<i>Geranium retrorsum</i>		<i>Velleia paradoxa</i>	?
<i>Geranium solanderi</i>		<i>Verbascum thapsus</i>	i
<i>Glycine clandestina</i>		<i>Verbascum virgatum</i>	i
<i>Glycine tabacina</i>		<i>Verbena bonariensis</i>	i
<i>Gnaphalium involucratum</i>		<i>Veronica calycina</i>	
<i>Gnaphalium sp.</i>		<i>Vittadinia cuneata</i>	
<i>Gonocarpus tetragynus</i>		<i>Vittadinia muelleri</i>	
<i>Goodenia pinnatifida</i>		<i>Vulpia sp.</i>	i
<i>Haloragis heterophylla</i>		<i>Wahlenbergia communis</i>	
<i>Hardenbergia violacea</i>		<i>Wahlenbergia gracilis</i>	
<i>Hibbertia obtusifolia</i>		<i>Wahlenbergia sp.</i>	
<i>Hirschfeldia incana</i>	i	<i>Wahlenbergia sp. 1</i>	
<i>Holcus lanatus</i>	i	<i>Wahlenbergia sp. 2</i>	
<i>Hordeum sp.</i>	ipg	<i>Wurmbea dioica</i>	
<i>Hovea linearis</i>		<i>Zornia dyctiocarpa</i>	uncommon

i = introduced

ipg = introduced pasture grass

nw = noxious weed

V = vulnerable

E = endangered

APPENDIX 2

Fauna Results

Table A2.1: Total Fauna Species List

The following is a cumulative list of fauna species that were recorded during the sampling surveys

- 1 = Murrumbidgee River Corridor
- 2 = ACT and NSW west of Gibraltar 'saddle'
- 3 = Gibraltar 'saddle'
- 4 = Properties east of Gibraltar 'saddle'
- 5 = Burra Creek, east of Burra Road

Class Name	Family Name	Latin Name	Common Name	Status	Comment	1	2	3	4	5
Invertebrates		<i>Keyacris scura</i>	Keys Matchstick Grasshopper		Uncommon in ACT					1
Amphibians	Hylidae	<i>Litoria lesueuri</i>	Lesueur's Tree Frog				1	1		
		<i>Litoria peronii</i>	Peron's Tree Frog			1				1
	Myobatrachidae	<i>Crinia parvinsignifera</i>	Plains Froglet			1				1
		<i>Crinia signifera</i>	Common Eastern Froglet			1		1		1
		<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog					1		1
		<i>Paracrinia haswell</i>	Haswell's Frog				1		1	
		<i>Uperoleia laevigata</i>	Smooth Toadlet					1		1
Reptiles										
	Agamidae	<i>Physignathus lesueurii</i>	Eastern Water Dragon							1
		<i>Pogona barbata</i>	Common Bearded Dragon			1				1
	Chelidae	<i>Chelodina longicollis</i>	Eastern Long-necked Tortoise			1		1	1	1
	Elapidae	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake				1			1
		<i>Pseudonaja textilis</i>	Eastern Brown Snake				1			1
	Pygopodiidae	<i>Aprasia parapulchella</i>	Pink-tailed worm lizard		V (TSC and EPBC Acts)		1			
	Gekonidae	<i>Diplodactylus vittatus</i>	Stone Gecko					1	1	
	Scincidae	<i>Carlia tetradactyla</i>	Four-fingered Skink							1
		<i>Ctenotus taeniolatus</i>	Copper-tailed Skink				1			1

Class Name	Family Name	Latin Name	Common Name	Status	Comment	1	2	3	4	5
		<i>Egernia cunninghami</i>	Cunningham's Skink				1			
		<i>Morethia boulingieri</i>	Boulenger's Skink			1				
		<i>Lampropholis delicata</i>	Delicate Skink			1				1
		<i>Tiliqua scincoides</i>	Common blue-tongue Lizard			1	1			1
		<i>Ctenotus robustus</i>	Striped Skink			1			1	
		?	Unidentified skink					1		
Birds										
	Acanthizidae	<i>Gerygone olivacea</i>	White-throated Gerygone			1		1		
	Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle			1		1		
		<i>Elanus axillaris</i>	Black-shouldered Kite		Uncommon breeding resident			1		
	Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck			1				
		<i>Anas castanea</i>	Chestnut Teal			1				
		<i>Chenonetta jubata</i>	Australian Wood Duck						1	
	Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron			1		1		
	Artamidae	<i>Artamus cyanopterus</i>	Dusky Woodswallow			1		1		
		<i>Cracticus torquatus</i>	Grey Butcherbird			1				
		<i>Gymnorhina tibicen</i>	Australian Magpie			1	1	1		
		<i>Strepera graculina</i>	Pied Currawong			1		1		
	Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo			1		1		1
		<i>Cacatua roseicapilla</i>	Galah			1		1	1	1
		<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V (TSC Act)		1		1		1
		<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo			1		1		
	Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike			1	1	1	1	1
		<i>Lalage sueurii</i>	White-winged triller	V (NC Act)		1		1		1
		<i>Cormobates leucophaeus</i>	White-throated Treecreeper			1	1	1	1	
	Charadriidae	<i>Vanellus miles</i>	Masked Lapwing			1				
	Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon			1		1	1	
		<i>Phaps chalcoptera</i>	Common Bronzewing			1				1
	Corcoracidae	<i>Corcorax melanorhamphos</i>	White-winged Chough			1		1		
	Corvidae	<i>Corvus coronoides</i>	Australian Raven			1	1	1	1	1
	Cuculidae	<i>Cacomantis fiabelliformis</i>	Fan-tailed Cuckoo			1				
		<i>Chrysococcyx basalis</i>	Horsfield's Bronze Cuckoo			1				1

Class Name	Family Name	Latin Name	Common Name	Status	Comment	1	2	3	4	5
		<i>Cucullus pallidus</i>	Pallid Cuckoo			1	1	1	1	1
	Dicruridae	<i>Grallina cyanoleuca</i>	Magpie Lark			1	1	1	1	1
		<i>Myiagra inquieta</i>	Restless Flycatcher		Uncommon breeding resident	1				
		<i>Rhipidura leucophrys</i>	Willie Wagtail			1				
		<i>Rhipidura albiscapa</i>	Grey Fantail			1		1		1
	Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel			1	1			
		<i>Falco longipennis</i>	Australian Hobby			1				
	Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra			1				1
		<i>Todiramphus sanctus</i>	Sacred Kingfisher			1		1		
	Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow			1				
		<i>Hirundo nigricans</i>	Tree Swallow			1				
	Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren			1	1	1		
	Meliphagidae	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater			1	1	1	1	1
		<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater			1				1
		<i>Melithreptus lunatus</i>	White-naped Honeyeater			1				
		<i>Lichenostomus leucotis</i>	White-eared Honeyeater			1				
		<i>Manorina melanocephala</i>	Noisy Miner			1	1	1	1	1
		<i>Philemon corniculatus</i>	Noisy Friarbird			1				
		<i>Anthochaera carunculata</i>	Red Wattlebird			1				
	Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater			1	1			1
	Motacillidae	<i>Anthus novaeseelandiae</i>	Richard's Pipit			1				
	Muscicapidae	<i>Acrocephalus stentoreus</i>	Clamorous Reed-Warbler			1				1
		<i>Daphoenositta chrysoptera</i>	Varied Sittella			1		1		1
		<i>Colluricincla harmonica</i>	Grey Shrike-thrush			1	1	1		
		<i>Zoothera lunulata</i>	White's thrush			1				
		<i>Pachycephala pectoralis</i>	Golden Whistler			1				
		<i>Pachycephala rufiventris</i>	Rufous Whistler			1	1			1
		<i>Sminornis brevirostris</i>	Weebill			1	1	1		1
	Pardalotidae	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill			1	1			1
		<i>Aphelocephala leucopsis</i>	Southern whiteface			1				1

Class Name	Family Name	Latin Name	Common Name	Status	Comment	1	2	3	4	5
		<i>Acanthiza pusilla</i>	Brown Thornbill					1		
		<i>Acanthiza reguloides</i>	Buff-rumped Thornbill			1	1	1		
		<i>Pardalotus punctatus</i>	Spotted Pardalote			1	1	1		
		<i>Chthonicola sagittata</i>	Speckled Warbler	V (TSC Act)				1		
		<i>Pardalotus striatus</i>	Striated Pardalote			1	1	1	1	
		<i>Aegintha temporalis</i>	Red-browed Firetail				1			
		<i>Stagonopleura guttata</i>	Diamond Firetail	V (TSC Act)		1				1
		<i>Taeniopygia bichenovii</i>	Double-barred Finch		Uncommon		1			
		<i>Petroica boodang</i>	Scarlet Robin			1	1			
		<i>Microeca fascinans</i>	Jacky Winter					1		
	Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird					1		
	Phalacrocoracidae	<i>Phalacrocorax carbo</i>	Great Cormorant				1			
		<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant				1			
	Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe			1				
	Psittacidae	<i>Platyercus elegans</i>	Crimson Rosella			1				1
		<i>Alisterus scapularis</i>	Australian King Parrot				1	1		
		<i>Psephotus haematonotus</i>	Red-rumped parrot					1		
		<i>Platyercus eximius</i>	Eastern Rosella			1		1		1
	Zosteropidae	<i>Zosterops lateralis</i>	Silvereye				1			
Birds (Introduced)										
	Fringillidae	<i>Carduelis carduelis</i>	European Goldfinch				1			
	Pardalotidae	<i>Passer domesticus</i>	House sparrow						1	
	Sturnidae	<i>Sturnus vulgaris</i>	Common Starling					1	1	1
		<i>Turdus merula</i>	Common Blackbird						1	
Mammals										
	Molossidae	<i>Mormopterus</i> sp. 4	Freetail Bat			1				
		<i>Mormopterus</i> sp.	Freetail Bat			1				
		<i>Tadarida australis</i>	White-striped Freetail Bat			1				
	Monotreme	<i>Tachyglossus aculeatus</i>	Echidna				1			1
	Macropodidae	<i>Macropus giganteus</i>	Eastern Grey Kangaroo			1	1			
	Phalangeridae	<i>Trichosurus vulpecula</i>	Common Brushtail Possum				1			1

Class Name	Family Name	Latin Name	Common Name	Status	Comment	1	2	3	4	5
	Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat			1	1	1		
		<i>Chalinolobus morio</i>	Chocolate Wattled Bat							
		<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat	V (TSC Act)		1		1		
		<i>Myotis macropus</i>	Large-footed Myotis	V (TSC Act)		1				
		<i>Nyctophilus</i> sp.	Long-eared Bat			1		1		
		<i>Vespadelus darlingtoni</i>	Large Forest Bat			1				
		<i>Vespadelus regulus</i>	Southern Forest Bat					1		
		<i>Vespadelus vulturinus</i>	Little Forest Bat			1		1		
	Vombatidae	<i>Vombatus ursinus</i>	Common Wombat				1			1
Mammals (Introduced)										
	Canidae	<i>Canis familiaris</i>	Dog (domestic)			1	1	1	1	1
		<i>Vulpes vulpes</i>	Fox			1	1	1	1	1
	Felidae	<i>Felis catus</i>	Cat (domestic)						1	
	Leporidae	<i>Lepus capensis</i>	Brown Hare						1	
		<i>Oryctolagus cuniculus</i>	Rabbit			1	1	1	1	1
	Bovidae	<i>Bos taurus</i>	Cattle (stock)			1	1	1	1	1
		<i>Ovis aries</i>	Sheep (stock)			1	1	1	1	1
		<i>Capra aegagrus hircus</i>	Goat (stock)					1	1	1
	Camelidae	<i>Vicugna pacos</i>	Alpaca (stock)						1	
	Equidae	<i>Equus caballus</i>	Horse (domestic)						1	1
		<i>Sus scrofa</i>	Pig (stock)						1	

• excluding commercial stock, which occur throughout

1= Murrumbidgee River Corridor

2= ACT and NSW west of Gibraltar 'saddle'

3= Gibraltar 'saddle'

4= Burra farm areas

5= Burra Creek, east of Burra Road

Table A2.2: Trapping Results
Cage Trapping

Location	Waypoint No.	Eastings	Northing	Type of trapping	Date traps were set	Date traps were observed	Dates traps were collected	No of days traps have been observed as at 19.12.08	Results (Total of species)	Observer	Comments
Devitt Property	4	698129	6061054	Cage Trapping. TRAP 1	2/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008.	15/12/2008	10	Nil	LLB, AKR, MJS, KMC, TO	TO inspected traps on Sunday the 7th of December. Traps closed from 13-15/12/2008
Devitt Property	5	698101	6061032	Cage Trapping TRAP 2	2/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008.	15/12/2008	10	Nil	LLB, AKR, MJS, KMC, TO	TO inspected traps on Sunday the 7th of December. Traps closed from 13-15/12/2008

Devitt Property	6	698061	6060998	Cage Trapping TRAP 3	2/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008.	15/12/2008	10	Nil	LLB, AKR, MJS, KMC, TO	TO inspected traps on Sunday the 7th of December. Traps closed from 13- 15/12/2008
Devitt Property	7	698046	6061005	Cage Trapping TRAP 4	2/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008.	15/12/2008	10	Nil	LLB, AKR, MJS, KMC	TO inspected traps on Sunday the 7th of December. Traps closed from 13- 15/12/2008
Devitt Property	8	698062	6061043	Cage Trapping TRAP 5	2/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008.	15/12/2008	10	Nil	LLB, AKR, MJS, KMC, TO	TO inspected traps on Sunday the 7th of December. Traps closed from 13- 15/12/2008

Burra Creek	17	702176	6064739	Cage Traps (1)	2/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008.	15/12/2008	10	Nil	LLB, AKR, MJS, KMC, TO	TO inspected traps on Sunday the 7th of December. Traps closed from 13- 15/12/2008
Burra Creek	18	702138	6064679	Cage Traps (2)	2/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008.	15/12/2008	10	Nil	LLB, AKR, MJS, KMC, TO	TO inspected traps on Sunday the 7th of December. Traps closed from 13- 15/12/2008
Burra Creek	19	702147	6064659	Cage Traps (3)	2/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008.	15/12/2008	10	Nil	LLB, AKR, MJS, KMC, TO	TO inspected traps on Sunday the 7th of December. Traps closed from 13- 15/12/2008

Burra Creek	20	702213	6064597	Cage Traps (4)	2/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008.	15/12/2008	10	Nil	LLB, AKR, MJS, KMC, TO	TO inspected traps on Sunday the 7th of December. Traps closed from 13- 15/12/2008
Burra Creek	21	702211	6064525	Cage Traps (5)	2/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008.	15/12/2008	10	Nil	LLB, AKR, MJS, KMC, TO	TO inspected traps on Sunday the 7th of December. Traps closed from 13- 15/12/2008
Angle Crossing	37	691790	6059992	Cage Trap	16/12/2008	16/12/2008, 17/12/2008, 18/12/2008, 19/12/2008	19.12.08	4	Nil	LLB, KMC	Traps closed 19/12/2008

Angle Crossing	38	691818	6060002	Cage Trap	16/12/2008	16/12/2008, 17/12/2008, 18/12/2008, 19/12/2008	19.12.08	4	Nil	LLB, KMC	Traps closed 19/12/2008
Angle Crossing	39	691838	6059965	Cage Trap	16/12/2008	16/12/2008, 17/12/2008, 18/12/2008, 19/12/2008	19.12.08	4	Nil	LLB, KMC	Traps closed 19/12/2008
Angle Crossing	40	691824	6059938	Cage Trap	16/12/2008	16/12/2008, 17/12/2008, 18/12/2008, 19/12/2008	19.12.08	4	Nil	LLB, KMC	Traps closed 19/12/2008

Angle Crossing	41	691812	6059900	Cage Trap	16/12/2008 16/12/2008 17/12/2008, 18/12/2008, 19/12/2008	19.12.08	4	Nil	LLB, KMC	Traps closed 19/12/2008
Angle Crossing				Cage Trap	20/01/2009 20/1/2009, 21/1/2009, 22/1/2009, 23/1/2009, 24/1/2009, 25/1/2009, 26/1/2009/ 27/1/2009, 28/1/2009, 29/1/2009	29.1.2009	10	Nil	TE, JC	Traps closed 29/1/2009
Angle Crossing				Cage Trap	20/01/2009 20/1/2009, 21/1/2009, 22/1/2009, 23/1/2009, 24/1/2009, 25/1/2009, 26/1/2009/ 27/1/2009, 28/1/2009, 29/1/2009	29.1.2009	10	Nil	TE, JC	Traps closed 29/1/2009

Angle Crossing	Cage Trap	20/01/2009	20/1/2009, 21/1/2009, 22/1/2009, 23/1/2009, 24/1/ 2009, 25/1/2009, 26/1/2009/, 27/1/2009, 28/1/2009, 29/1/2009	29.1.2009	10	Nil	TE, JC	Traps closed 29/1/2009
Angle Crossing	Cage Trap	20/01/2009	20/1/2009, 21/1/2009, 22/1/2009, 23/1/2009, 24/1/ 2009, 25/1/2009, 26/1/2009/, 27/1/2009, 28/1/2009, 29/1/2009	29.1.2009	10	Nil	TE, JC	Traps closed 29/1/2009
Angle Crossing	Cage Trap	20/01/2009	20/1/2009, 21/1/2009, 22/1/2009, 23/1/2009, 24/1/ 2009, 25/1/2009, 26/1/2009/, 27/1/2009, 28/1/2009, 29/1/2009	29.1.2009	10	Nil	TE, JC	Traps closed 29/1/2009

Pit-fall trapping

Location	Waypoint No.	Easting	Northing	Type of trapping	Date traps were set	Date traps were observed	Dates traps were collected	No of days traps have been observed as at 19.12.08	RESULTS (total of species found over trapping period)	Observer	Comments
Devitt Property	9	693108	6060991	Pit-Fall Trap	2/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008, 16/12/2008, 17/12/2008, 18/12/2008, 19/12/2008	19/12/2008	14	1 X Haswell's Froglet (<i>Paracrinia haswelli</i>), Spotted Marsh Frog (<i>Limnodynasties tasmaniensis</i>), Wolf Spider, Sugar Ants, Scorpions, Centipedes,	LLB, AKR, KMC, MJS	TO inspected traps on Sunday the 7th of December. Traps closed from 13-15/12/2008
Boss property	10	698661	6061183	Pit-Fall Trap	3/12/2008	3/12/2008, 4/12/2008, 5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008, 16/12/2008, 17/12/2008, 18/12/2008.		10	7 x Spotted marsh Frog (<i>Limnodynasties tasmaniensis</i>), 5 x Wolfspider	LLB, AKR, KMC, MJS	TO inspected traps on Sunday the 7th of December. Traps closed from 13-15/12/2008
Bill Koffman's Property	21	700696	6063154	Pit-Fall Trap	5/12/2008	5/12/2008, 6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008, 16/12/2008, 17/12/2008, 18/12/2008.	19.12.08	12	6 x Spotted marsh frog, 1 x Haswell's Froglet (<i>Paracrinia haswelli</i>), 5 x Wolf spiders, Sugar Ants.	LLB, AKR, KMC, MJS	TO inspected traps on Sunday the 7th of December. Traps closed from 13-15/12/2008

19/12/2008					
Angle Crossing	22	691979	6060537	Pit-Fall Trap	6/12/2008
					19.12.08
					30
					TO inspected traps on Sunday the 7th of December. Traps closed from 13- 15/12/2008
					LLB, AKR, KMC, MJS
					Wolf Spiders, Sugar Ants, Centipedes, Scorpions, <i>Lymnodynastes tasmaniensis</i>
					6/12/2008, 7/12/2008, 8/12/2008, 9/12/2008, 10/12/2008, 11/12/2008, 12/12/2008, 16/12/2008, 17/12/2008, 18/12/2008, 19/12/2008, 16/12/2008, 17/12/2008, 18/12/2008, 19/12/2008, 17/12/2008, 18/12/2008, 19/12/2008, 20/1/2009, 21/1/2009, 22/1/2009, 23/1/2009, 24/1/2009, 25/1/2009, 26/1/2009/ 27/1/2009, 28/1/2009, 29/1/2009, 31/1/2009, 1/2/2009, 2/2/2009, 3/2/2009, 4/2/2009
Angle Crossing				Pit-Fall Trap	19/01/2009
					4.2.2009
					15
					Traps closed 4.2.2009
					JC, KMC, TO, TE
					Wolf Spiders, Sugar Ants, Centipedes, Scorpions, <i>Lymnodynastes tasmaniensis</i>
					20/1/2009, 21/1/2009, 22/1/2009, 23/1/2009, 24/1/2009, 25/1/2009, 26/1/2009/ 27/1/2009, 28/1/2009, 29/1/2009, 31/1/2009,

Lnergans Property	50	695829	6060374	Pit-Fall Trap	18/12/2008	1/2/2009,	4.2.09	19	Wolf Spiders, Sugar Ants, Centipedes, Scorpions, <i>Lymnodynastes tasmaniensis</i>	LLB, AKR, KMC, MJS,Te	Traps closed 4.2.2009
						2/2/2009,					
						3/2/2009,					
						4/2/2009					
						16/12/2008,					
						17/12/2008,					
						18/12/2008,					
						19/12/2008,					
						20/1/2009,					
						21/1/2009,					
						22/1/2009,					
						23/1/2009,					
						24/1/2009,					
						25/1/2009,					
						26/1/2009/,					
27/1/2009,											
28/1/2009,											
29/1/2009,											
31/1/2009,											
1/2/2009,											
2/2/2009,											
3/2/2009,											
4/2/2009											

Arthropod burrow monitoring

Location	Waypoint No.	Easting	Northing	Type of trapping	Date traps were set	Date traps were observed	Dates traps were collected	No of days traps have been observed as at 4/2/2009	Results (total species found during trapping period)	Observer
Burra Creek	23	702013	6064644	Artificial Arthropod Burrow (line of 10)	2/12/2008	15/12/2008, 18/12/2008, 14/1/2009, 16/1/2009, 19/1/2009, 21/1/2009, 24/1/2009, 26/1/2009, 29/1/2009, 1/2/2009, 4/2/2009, 9/2/2009, 14/2/2009, 18/2/2009, 22/2/2009, 24/2/2009	to date (24/2/2009)	16	Wolf Spiders	LLB, KMC, MJS, JC, TE

Burra Creek	24	702008	6064580	Artificial Arthropod Burrow (line of 10)	2/12/2008	15/12/2008, 18/12/2008, 14/1/2009, 16/1/2009, 19/1/2009, 21/1/2009, 24/1/2009, 26/1/2009, 29/1/2009, 1/2/2009, 4/2/2009, 9/2/2009, 14/2/2009, 18/2/2009, 22/2/2009, 24/2/2009	to date (24/2/2009)	16	Wolf Spiders	LLB, KMC,MJS,JC, TE
Burra Creek	25	702199	6064522	Artificial Arthropod Burrow (line of 10)	2/12/2008	15/12/2008, 18/12/2008, 14/1/2009, 16/1/2009, 19/1/2009, 21/1/2009, 24/1/2009, 26/1/2009, 29/1/2009, 1/2/2009, 4/2/2009, 9/2/2009, 14/2/2009, 18/2/2009, 22/2/2009, 24/2/2009	to date (24/2/2009)	16	Nil	LLB, KMC,MJS,JC, TE

Angle Crossing	27	691690	6060348	Artificial Arthropod Burrow (line of 10)	9/10/2008	17/12/2008, 19/12/2008, 13/1/2009, 15/1/2009, 18/1/2009, 20/1/2009, 23/1/2009, 25/2/2009, 28/1/2009, 31/1/2009, 1/2/2009, 4/2/2009, 12/2/2009, 15/2/2009, 20/2/2009, 27/2/2009,	to date (27/2/2009)	16	Nil	LLB, KMC,MJS,JC, TE,TO
Angle Crossing	30	691662	6060377	Artificial Arthropod Burrow (line of 10)	10/12/2008	17/12/2008, 19/12/2008, 13/1/2009, 15/1/2009, 18/1/2009, 20/1/2009, 23/1/2009, 25/2/2009, 28/1/2009, 31/1/2009, 1/2/2009, 4/2/2009, 12/2/2009, 15/2/2009, 20/2/2009, 27/2/2009	to date (27/2/2009)	16	Nil	LLB, KMC,MJS,JC, TE,TO

Angle Crossing	47	692010	6060518	Artificial Arthropod Burrow (line of 10)	5/12/2008	17/12/2008, 19/12/2008, 13/1/2009, 15/1/2009, 18/1/2009, 20/1/2009, 23/1/2009, 25/2/2009, 28/1/2009, 31/1/2009, 1/2/2009, 4/2/2009, 12/2/2009, 15/2/2009, 20/2/2009, 27/2/2009	to date (27/2/2009)	16	Wolf Spider, Beetles.	LLB, KMC,MJS,JC, TE,TO
Angle Crossing	48	692140	606565	Artificial Arthropod Burrow (line of 10)	5/12/2008	17/12/2008, 19/12/2008, 13/1/2009, 15/1/2009, 18/1/2009, 20/1/2009, 23/1/2009, 25/2/2009, 28/1/2009, 31/1/2009, 1/2/2009, 4/2/2009, 12/2/2009, 15/2/2009, 20/2/2009, 27/2/2009	to date (27/2/2009)	16	Nil	LLB, KMC,MJS,JC, TE,TO

Boss Property	31	698624	6061236	Artificial Arthropod Burrow (line of 20)	4/12/2008	16/12/2008, 19/12/2008, 13/1/2009, 21/1/2009, 24/1/2009, 26/1/2009, 29/1/2009, 1/2/2009, 4/2/2009, 9/2/2009, 14/2/2009, 18/2/2009, 22/2/2009, 24/2/2009	to date (24/2/2009)	14	Wolf Spider s	LLB, KMC,MJS,JC, TE
Boss Property	32	698611	6061267	Artificial Arthropod Burrow (line of 20)	4/12/2008	16/12/2008, 19/12/2008, 13/1/2009, 21/1/2009, 24/1/2009, 26/1/2009, 29/1/2009, 1/2/2009, 4/2/2009, 9/2/2009, 14/2/2009, 18/2/2009, 22/2/2009, 24/2/2009	to date (24/2/2009)	14	Nil	LLB, KMC,MJS,JC, TE

Devitt Property	42	698121	6060963	Artificial Arthropod Burrow (line of 10)	3/12/2008	16/12/2008, 19/12/2008, 14/1/2009, 16/1/2009, 19/1/2009, 21/1/2009, 24/1/2009, 26/1/2009, 29/1/2009, 1/2/2009, 4/2/2009, 9/2/2009, 14/2/2009, 18/2/2009, 22/2/2009, 24/2/2009	to date (24/2/2009)	16	Wolf Spiders; 1 x Lymnodynastes tasmaniensis	LLB, KMC,MJS,JC, TE
Devitt Property	43	698127	6060951	Artificial Arthropod Burrow (line of 10)	3/12/2008	16/12/2008, 19/12/2008, 14/1/2009, 16/1/2009, 19.1.2009, 21/1/2009, 24/1/2009, 26/1/2009, 29/1/2009, 1/2/2009, 4/2/2009, 9/2/2009, 14/2/2009, 18/2/2009, 22/2/2009, 24/2/2009	to date (24/2/2009)	16	Wolf Spiders ; 1 x Lymnodynastes tasmaniensis	LLB, KMC,MJS,JC, TE

Longergans Property	50	695829	6060374	Artificial Arthropod Burrow (line of 10)	18/12/2008	19/12/2008, 13/1/2009, 15/1/2009, 18/1/2009, 20/1/2009, 23/1/2009, 25/2/2009, 28/1/2009, 31/1/2009, 1/2/2009, 4/2/2009, 14/2/2009, 18/2/2009, 22/2/2009, 24/2/2009	to date (24/2/2009)	15	Wolf Spiders ; 1 x Lymnodynastes tasmaniensis	LLB, KMC,MJS,JC, TE
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Owl Surveys

Location	Waypoint No.	Easting	Northing	Type of trapping	Date of Owl Survey	Total number of Owl Surveys	Results	Observer	Comments
Burra Creek	23	702013	6064644	Owl Survey	3/12/2008, 4/12/2008, 8/12/2008	3	Nil	LLB, AKR, MJS, KMC	
Side of Road at Waypoint 28. Near good bushland	28	697541	6060527	Owl Survey	3/12/2008, 4/12/2008	2	Nil	LLB, AKR, MJS, KMC	
Devitt Property	43	698127	6060951	Owl Survey	3/12/2008, 8/12/2008	2	Nil	LLB, AKR, MJS, KMC	
Angle Crossing	29	692381	6060812	Owl Survey	4/12/2008, 8/12/2008, 11/12/2008	3	Nil	LLB, AKR, MJS, KMC	

Anabat

Location	Waypoint No.	Eastings	Northing	Type of trapping	Date Anabat was set	Date Anabat was collected	Results	Recorder
Devitt Property	4	698129	6061054	Anabat	1/12/2008	2/12/2008	Definite Species <i>Chalinolobus gouldii</i> – 1 definite, 1 probable, 1 possible	AKR, LLB
Angle Crossing	26	691808	6060227	Anabat	8/12/2008	9/12/2008	Definite Species <i>Tadarida australis</i> – 15 definite sequences <i>Chalinolobus gouldii</i> – 2 definite <i>Vespadelus vulturinus</i> - 1 definite, 2 probable <i>Mormopterus</i> sp. 4 – 2 definite, 1 probable Probable Species <i>Nyctophilus</i> sp. - 1 probable <i>Vespadelus darlingtoni</i> – 2	LLB, MJS
Side of Road	28	697541	6060527	Anabat	9/12/2008	10/12/2008	Possible Species <i>Miniopterus schreibersii</i> oceanensis – 1 <i>Vespadelus</i> sp. or <i>Miniopterus schreibersii</i> oceanensis – 2 <i>Chalinolobus gouldii</i> or <i>Mormopterus</i> sp. – 2 sequences <i>Nyctophilus</i> sp. or <i>Myotis macropus</i> – 1 sequence, could be either. Definite Species <i>Vespadelus vulturinus</i> – 6 definite, 7 probable <i>Nyctophilus</i> sp. - 1 definite, 1 probable Probable Species <i>Chalinolobus gouldii</i> – 2 probable <i>Miniopterus schreibersii</i>	LLB, MJS

29	692381	6060812	Anabat	11/12/2008	12/12/2008	LLB, MJS
Angle Crossing						
oceanensis – 4 probable, 2 possible						
Possible Species <i>Vespadelus vulturinus</i> or <i>Chalinolobus morio</i> – 2						
Definite Species <i>Tadarida australis</i> – 5 definite sequences						
Probable Species <i>Mormopterus</i> sp 4 – 1 sequence <i>Vespadelus darlingtoni</i> – 1 <i>Vespadelus vulturinus</i> – 2 Definite Species <i>Tadarida australis</i> – 3 definite sequences						
Probable Species <i>Chalinolobus gouldii</i> or <i>Mormopterus</i> sp 4 – 1 sequence <i>Vespadelus darlingtoni</i> or <i>Miniopterus schreibersii</i> oceanensis – 1 <i>Vespadelus vulturinus</i> or <i>Chalinolobus morio</i> – 2						
44	695989	6060689	Anabat	16/12/2008	17/12/2008	LLB, KMC
Near Angle Crossing						
No bat calls detected						

Rock turning

Location	Easting	Northing	Date	RESULTS (Total of species)	Observer	Duration	Est. No. of rocks turned
Nash	692500	606500	5 September 2008	<i>Aprasia parapulchella</i> <i>Aprasia parapulchella</i> <i>Aprasia parapulchella</i> <i>Aprasia parapulchella</i>	TO	.5hr	50
Nash	692500	606500	9 September 2008		TO	.5hr	50
Moore	692700	6060700	11 September 2008		TO	.5hr	50
Nash	692500	606500	19 November 2008		TO	.45hr	25
Burra Creek	702176	6064739	2 December 2008	<i>Limnodynastes tasmaniensis</i>	TO	1hr	200
Burra Creek	702138	6064679	3 December 2008		TO	1hr	150
Angle Crossing	691790	6059992	16 December 2008	<i>Uperoleia laevigata</i> , <i>Ctenotus taeniolatus</i>	TO	1hr	150
Angle Crossing	691818	6060002	16 December 2008		TO	1hr	100
Angle Crossing	691838	6059965	16 December 2008		TO	1hr	100
Angle Crossing	691824	6059938	16 December 2008	<i>Ctenotus taeniolatus</i>	TO	.5 hr	50
Angle Crossing	691812	6059900	16 December 2008	Nil	TO	.5 hr	50
Angle Crossing	691812	6059900	26 January 2009	Nil	TO	.5 hr	50
Angle Crossing	691812	6059900	26 January 2009	<i>Diplodactylus vittatus</i>	TO	.5 hr	50
Angle Crossing	691812	6059900	26 January 2009	<i>Ctenotus taeniolatus</i>	TO	.5 hr	50
Loneragan	695829	6060374	26 January 2009	Nil	TO	.5 hr	80
Loneragan	695829	6060374	26 January 2009	Nil	TO	.5 hr	50
Burra Creek	702213	6064597	9 February 2009	<i>Carlia tetradactyla</i>	TO	.5hr	50
Loneragan	695829	6060374	10 February 2009	Nil	TO	0.5	50
Burra Creek	702213	6064597	12 February 2008	<i>Limnodynastes tasmaniensis</i>	TO	0.5	100
McDonald	695500	6060300	11 May 2009	<i>Egernia cunninghami</i>	TO, BJS	0.1hr	20
							1475

APPENDIX 3

Noxious and Environmental Weeds in NSW and ACT

Table A3.1 Declared noxious weeds under the *Noxious Weeds Act 1993* in the Queanbeyan and Palerang control areas.

Source: <http://www.agric.nsw.gov.au/noxweed>

Common name	Scientific name
African boxthorn	<i>Lycium ferocissimum</i>
African love grass	<i>Eragrostis curvula</i>
Alligator weed	<i>Alternanthera philoxeroides</i>
Bathurst, Noogoora, Californian Cockle burrs	<i>Xanthium</i> spp.
Black knapweed	<i>Centaurea nigra</i>
Blackberry	<i>Rubus fruticosus</i> (agg. spp.)
Broomrape	<i>Orobanche</i> spp.
Cabomba	<i>Cabomba</i> spp.
Chilean Needle Grass	<i>Nessella nessiana</i>
Dodder	<i>Cuscuta campestris</i>
Fireweed	<i>Senecio madagascariensis</i>
Gorse	<i>Ulex europaeus</i>
Green cestrum	<i>Cestrum parqui</i>
Harrisia cactus	<i>Harrisia</i> spp.
Hawkweed	<i>Hieracium</i> spp.
Hemlock	<i>Conium maculatum</i>
Horehound	<i>Marrubium vulgare</i>
Horsetail	<i>Equisetum</i> spp.
Karoo thorn	<i>Acacia karroo</i>
Kochia	<i>Kochia scoparia</i>
Lagarosiphon	<i>Lagarosiphon major</i>
Mexican feather grass	<i>Nassella tenuissima</i> syn <i>Stipa tenuissima</i>
Miconia	<i>Miconia</i> spp.
Nodding thistle	<i>Carduus nutans</i>
Pampas grass	<i>Cortaderia</i> spp.
Parthenium weed	<i>Parthenium hysterophorus</i>
Paterson's curse, Vipers Italian bugloss	<i>Echium</i> spp.
Prickly pears	<i>Opuntia</i> spp.
Rhus tree	<i>Toxicodendron succedaneum</i>
Salvinia	<i>Salvinia molesta</i>
Scotch, English broom	<i>Cytisus scoparius</i>
Scotch, Illyrian, Stemless thistles	<i>Onopordum</i> spp.
Senegal tea plant	<i>Gymnocoronis spilanthoides</i>
Serrated tussock	<i>Nassella trichotoma</i>
Siam weed	<i>Chromolaena odorata</i>
Spotted knapweed	<i>Centaurea maculosa</i>
St John's wort	<i>Hypericum perforatum</i>
Sweet briar	<i>Rosa rubiginosa</i>
Water hyacinth	<i>Eichhornia crassipes</i>
Water lettuce	<i>Pistia stratiotes</i>
Willows	<i>Salix</i> spp.

Table A3.2 Weeds of National Significance established or with the potential to become established.

Source:

http://www.tams.act.gov.au/_data/assets/pdf_file/0019/63532/DRAFT_ACT_WEED_STRATEGY_-_for_public_comment.pdf

Common name	Scientific name
Established	
Alligator weed	<i>Alternanthera philoxeroides</i>
Blackberry	<i>Rubus fruticosus</i> (agg. spp.)
Chilean Needle Grass	<i>Nassella nessiana</i>
Gorse	<i>Ulex europaeus</i>
Serrated tussock	<i>Nassella trichotoma</i>
Willows	<i>Salix</i> spp.
Potential to become established	
Bridal Creeper	<i>Asparagus asparagoides</i>
Cabomba	<i>Cabomba</i> spp.
Salvinia	<i>Salvinia molesta</i>

APPENDIX 4

Summary of Weather Conditions during the Survey Period

Data from the Bureau of Meteorology webpage

Sep-08		Min Temp	Max Temp	Rain
Mean		3.1	18.3	
Lowest		-4.4	10.5	0
Highest		11.8	26	16.2
Total				31.2

Oct-08				
Mean		6.9	23.1	
Lowest		-0.5	13.8	0
Highest		13.8	29.7	19.2
Total				37.2

Nov-08				
Mean		10.5	23.1	
Lowest		5.3	12.6	0
Highest		16.2	32.3	16.4
Total				66.4

Dec-08				
Mean		12.2	24.9	
Lowest		5.7	19.8	0
Highest		16.5	30.9	55.6
Total				105.2

Jan-09				
Mean		14.1	31.3	
Lowest		9	22.4	0
Highest		20.5	38.2	29.2
Total				59

Feb-09				
Mean		16.1	29.3	
Lowest		10.1	15.8	0
Highest		21.1	39.9	1.6
Total				1.6

APPENDIX 5

Canberra Ornithologists Group (COG) bird data from the Williamsdale area

The following list was provided by the Canberra Ornithological Group Inc. (COG) and gives a cumulative census of bird data gathered over the past 20 years from the local area.

BASysOrder	RAOName	No of sighting events	Sum of individuals sighted	Threatened	migratory
49	Australasian Grebe	32	38		
854	Australasian Pipit	101	139		
37	Australasian Shoveler	4	4		
256	Australian Hobby	14	15		
430	Australian King-Parrot	8	10		
722	Australian Magpie	462	1971		
96	Australian Owlet-nightjar	55	56		
204	Australian Pelican	2	5		
737	Australian Raven	394	997		
789	Australian Reed-Warbler	13	18		
229	Australian White Ibis	2	41		
32	Australian Wood Duck	223	953		
26	Black Swan	1	1		
688	Black-faced Cuckoo-shrike	253	322		
306	Black-fronted Dotterel	36	43		
234	Black-shouldered Kite	12	14		
255	Brown Falcon	86	94		
244	Brown Goshawk	23	25		
12	Brown Quail	1	1		
589	Brown Thornbill	292	407		
514	Brown Treecreeper	63	94	NC & TSC ACT	
659	Brown-headed Honeyeater	142	329		
475	Brush Cuckoo	5	5		
584	Buff-rumped Thornbill	333	2457		
217	Cattle Egret	2	2		
40	Chestnut Teal	1	1		
245	Collared Sparrowhawk	3	3		
818	Common Blackbird*	29	31		
63	Common Bronzewing	23	26		
865	Common Greenfinch*	1	1		
827	Common Myna*	2	2		
824	Common Starling*	180	915		
653	Crescent Honeyeater	11	13		
66	Crested Pigeon	151	313		
695	Crested Shrike-tit	1	1		

BASysOrder	RAOName	No of sighting events	Sum of individuals sighted	Threatened migratory
436	Crimson Rosella	422	1860	
840	Diamond Firetail	27	58	NC & TSC ACT
502	Dollarbird	7	7	
832	Double-barred Finch	16	50	
281	Dusky Moorhen	7	7	
716	Dusky Woodswallow	77	266	
487	Eastern Barn Owl	2	2	
437	Eastern Rosella	367	1479	
598	Eastern Spinebill	253	324	
776	Eastern Yellow Robin	98	127	
786	Eurasian Skylark	18	22	
863	European Goldfinch*	102	257	
807	Fairy Martin	14	38	
474	Fan-tailed Cuckoo	78	87	
769	Flame Robin	35	55	
621	Fuscous Honeyeater	44	111	
415	Galah	335	1146	
413	Gang-gang Cockatoo	23	81	TSC Act
409	Glossy Black-Cockatoo	74	267	TSC Act
699	Golden Whistler	82	105	
198	Great Cormorant	14	18	
719	Grey Butcherbird	291	380	
725	Grey Currawong	217	254	
730	Grey Fantail	278	532	
247	Grey Goshawk	1	2	
707	Grey Shrike-thrush	179	231	
39	Grey Teal	18	20	
45	Hardhead	1	2	
51	Hoary-headed Grebe	1	1	
772	Hooded Robin	31	54	NC & TSC ACT
468	Horsfield's Bronze-Cuckoo	28	29	
852	House Sparrow*	42	51	
763	Jacky Winter	9	16	
493	Laughing Kookaburra	370	796	
744	Leaden Flycatcher	103	190	
199	Little Black Cormorant	6	8	
253	Little Eagle	17	18	NC ACT
197	Little Pied Cormorant	25	27	
739	Little Raven	33	386	
753	Magpie-lark	330	446	
310	Masked Lapwing	58	62	
829	Mistletoebird	123	134	
254	Nankeen Kestrel	146	171	
226	Nankeen Night-Heron	1	1	
654	New Holland Honeyeater	3	11	

BASysOrder	RAOName	No of sighting events	Sum of individuals sighted	Threatened	migratory
666	Noisy Friarbird	210	301		
626	Noisy Miner	310	1808		
711	Olive-backed Oriole	58	64		
44	Pacific Black Duck	130	275		
671	Painted Honeyeater	1	1	NC, TSC & EPBC Acts	
472	Pallid Cuckoo	91	96		
259	Peregrine Falcon	20	25		
723	Pied Currawong	326	470		
501	Rainbow Bee-eater	28	72		M
633	Red Wattlebird	332	1424		
839	Red-browed Finch	80	275		
299	Red-capped Plover	1	1		
768	Red-capped Robin	2	3		
445	Red-rumped Parrot	94	362		
747	Restless Flycatcher	47	48		
54	Rock Dove	1	1		
770	Rose Robin	2	2		
793	Rufous Songlark	24	30		
702	Rufous Whistler	224	435		
498	Sacred Kingfisher	30	32		
522	Satin Bowerbird	1	1		
767	Scarlet Robin	271	396	Preliminary listing TSC Act	
470	Shining Bronze-Cuckoo	38	38		
799	Silvereye	98	970		
481	Southern Boobook	20	21		
591	Southern Whiteface	28	42		
567	Speckled Warbler	13	17	TSC Act	
594	Spotted Pardalote	257	404		
678	Spotted Quail-thrush	1	1		
230	Straw-necked Ibis	6	30		
597	Striated Pardalote	348	588		
580	Striated Thornbill	274	2380		
11	Stubble Quail	17	30		
419	Sulphur-crested Cockatoo	386	11618		
527	Superb Fairy-wren	342	1664		
249	Swamp Harrier	1	1		
88	Tawny Frogmouth	12	12		
808	Tree Martin	41	77		
686	Varied Sittella	68	245	NC ACT	
252	Wedge-tailed Eagle	168	229		
568	Weebill	321	527		
806	Welcome Swallow	143	242		
573	Western Gerygone	9	9		
241	Whistling Kite	1	1		

BASysOrder	RAOName	No of sighting events	Sum of individuals sighted	Threatened	migratory
240	White-bellied Sea-Eagle	1	1		M
556	White-browed Scrubwren	46	79		
714	White-browed Woodswallow	2	3		
614	White-eared Honeyeater	270	559		
222	White-faced Heron	102	110		
643	White-fronted Chat	2	2		
661	White-naped Honeyeater	63	3788		
213	White-necked Heron	6	9		
623	White-plumed Honeyeater	70	115		
578	White-throated Gerygone	172	224		
101	White-throated Needletail	13	77		M
511	White-throated Treecreeper	376	703		
757	White-winged Chough	124	812		
692	White-winged Triller	26	27	NC Act	
733	Willie Wagtail	291	368		
581	Yellow Thornbill	15	34		
608	Yellow-faced Honeyeater	356	66519		
582	Yellow-rumped Thornbill	357	1906		
410	Yellow-tailed Black-Cockatoo	129	374		
616	Yellow-tufted Honeyeater	4	4		

* introduced

APPENDIX 6

NSW: Part 3A Impact Assessments

White Box- Yellow Box – Blakely’s Red Gum grassy woodland

‘Box Gum Grassy Woodland’

Box Gum Grassy Woodland (BGGW) is listed as an Endangered Ecological Community under the TSC Act and as Critically Endangered under the EPBC Act. The description of this vegetation type differs slightly between State and Federal legislation: Under the EPBC Act, there must be either:

- An intact tree layer and predominately native ground layer; or
- An intact native ground layer with a high diversity of native plant species but no remaining tree layer.
- Under the TSC Act, areas of grassy groundcover with some herbs may be considered to be BGGW.

Box Gum Grass Woodland occurs as Open-woodland with the following canopy species: *Eucalyptus albens*, *E. melliodora* and *E. blakelyi*. Other tree species occur, depending on habitat and location. Shrubs are sparse to absent. Common grass species include *Themeda australis*, *Austrostipa* spp., *Austrodanthonia* spp. and *Poa sieberiana*. Box Gum Grassy Woodland provides habitat for a range of threatened flora and fauna species.

Threats to this vegetation type include: Clearing, degradation and fragmentation of remnants for agricultural, forestry, infrastructure and residential development;

- Continuous heavy grazing and trampling, resulting in losses of plant species, erosion and altered nutrient levels;
- Invasion by weeds;
- Invasion by feral animals;
- Disturbance and clearing of remnants for road, rail and infrastructure maintenance and upgrades;
- Harvesting of firewood; and
- Collection of woody debris.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not relevant.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Up to 7 ha of BGGW (which includes 2.4 ha in good condition and 4.2 ha in poor condition) would be affected by the proposal. While attempts would be made to avoid mature hollow-bearing trees it has been estimated that between 100 and 150 mature trees could be removed, most of which occurs in 1-126283; 201-754889; 170-744889 and Gibraltar 'saddle' area.

A section of the study area will be disrupted by the excavation of a trench, which will be infilled after installation of the pipeline, then rehabilitation of the disturbed area would be carried out. It is assumed that, if sufficient care is taken, a similar suite of native species will be recruited on a large proportion of the disturbed areas, and a long-term maintenance recovery plan will ensure that weed invasion is minimised.

Does the proposal affect any threatened species that are at the limit of its known distribution?

Box Gum Grassy Woodland extends to the north, south, east and west of the study area, and is not at a limit of its known distribution.

How is the proposal likely to affect the current disturbance regimes?

Current disturbances include grazing, weed invasion, and altered nutrient and fire regimes. The disturbed areas will be maintained and monitored for at least two years after completion of the project, to ensure recovery of the original vegetation.

How is the proposal likely to affect habitat connectivity?

Mature trees will be avoided in all areas except in the Gibraltar 'saddle' section. The main impact will be to ground cover vegetation (in the form of a narrow construction corridor) which would be affected in the short term. Rehabilitation of the disturbed areas would not commence immediately after the disturbance but when entire pipeline construction has been completed.

How is the proposal likely to affect critical habitat?

Critical habitat for BGGW has not been defined, although this vegetation type is generally known to occur on relatively fertile soils on the tablelands and western slopes, generally between the 400 and 800 isohyets, at altitudes of from 170m to 1200m.

Conclusion

Box Gum Grassy Woodland has been drastically reduced in area and highly fragmented as a result of clearing for pasture and cropping. In most stands where the soil is still reasonably natural, and where an associated seed bank survives, it is likely that the vegetation stands, under appropriate management, will respond to assisted natural regeneration. This is considered to be the case in the stands of BGGW through which the pipeline would extend, therefore most of the habitat in which BGGW occurs in the study area, will not be adversely affected in the long term. The exception to this assessment relates to the Gibraltar ‘saddle’ area and a small portion in the western section of 1-126283 and eastern portion of 170-754889 and adjoining 141-7544889 that would be affected. Although it is likely that appropriate rehabilitation techniques would restore the ground-cover structure and floristics to original conditions, the removal of between 100 and 150 mature trees may be considered as causing a significant impact on a local stand of BGGW. For this reason, consideration should be given to the provision of supplementary habitat, either by the purchase of offsets or by carrying out revegetation works on suitable, adjacent land.

Small Purple-pea

Swainsona recta

Swainsona recta is an erect perennial plant with slender stems, purple to bluish flowers and pinnate leaves. Preferred habitat is open woodland with a native grassy ground-cover of *Themeda australis*, *Poa sieberiana* var. *sieberiana* or *Austrostipa* spp. There are two separate populations remaining: One between Wellington and Mudgee and the other in the Canberra Williamsdale district. Seventeen known populations, ranging in size from 10 to >400 individuals are known. A “...scattered population...” occurs “...along the Williamsdale-Tralee railway easement (NSW)”, as well as in Kambah, Aranda Bushland and Mount Taylor, in the ACT (ACT Government 2004). The species is listed as Endangered both under the TSC Act and the EPBC Act.

Threats include habitat loss and degradation, due to past and current land management, urban development, changes in grazing pressures and competition from weeds or other understorey species. Research by Buza, Thrall and Young (2000) indicates that inbreeding depression occurs in smaller populations.

Swainsona recta is very restricted to only a few known locations along the Goulburn-Cooma Railway corridor, a few isolated locations in the ACT and one new location on the eastern bank of Burra Creek. It may be possible to avoid the large proportion of these individuals by reducing the width and modifying construction methods of the area of disturbance, wherever *Swainsona recta* individuals are known or likely to occur.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

It is possible that a small area of habitat for *Swainsona recta* within the Goulburn-Cooma railway corridor may be affected. However, provided that the proposed construction corridor width is restricted to 15 m or less, that the alignment avoids any potential habitat within the railway corridor and that plant, equipment and spoil are not located in potential habitats the species is unlikely to be directly affected. Moreover, the larger population to the north (fenced) within the railway easement will not be affected.

Proposals to protect the seed bank within the topsoil in any suitable habitat (outside the railway corridor) are intended to take into account the potential for seeds and propagules of *Swainsona recta* to be present in disturbed topsoil, and to facilitate the recruitment of seedlings, should seed occur, after completion of excavation.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat may remain disturbed for a maximum period of 12 months. The disturbed area will then be rehabilitated to its original condition. Topsoil and seed banks will be protected according to a set of protocols outlined in “*Recommendations for Minimising Disturbances and Reinstating Native Grassy vegetation: Murrumbidgee to Googong (M2G) Transfer Pipeline Project*” (see Appendix 8), and a maintenance and monitoring programme will be followed to ensure complete recovery of the original native vegetation.

Does the proposal affect any threatened species that are at the limit of its known distribution?

Swainsona recta occurs in Victoria and ACT, as well as the Wellington-Mudgee area. The population in the study area is therefore not located at the northern, western, eastern or southern limit of distribution.

How is the proposal likely to affect the current disturbance regimes?

Current disturbances include grazing, weed invasion, and altered nutrient and fire regimes. The disturbed areas would be maintained and monitored for at least two years after completion of the project, to ensure recovery of the original vegetation.

How is the proposal likely to affect habitat connectivity?

The existing population within the railway easement is currently described as “scattered”, apart from several concentrated areas which have previously been fenced (although individual plants occur outside these fenced areas). The plants die back to rootstocks, then resprout in autumn. Seeds have no apparent dispersal mechanism, so may rely on rainfall, ants or other organisms for dispersal beyond parent plants. It is possible that disturbance in adjacent habitats, coupled with after-care may provide improved opportunities for seed dispersal and germination.

How is the proposal likely to affect critical habitat?

Critical habitat for *Swainsona recta* has not been defined, although the species is generally known to occur in grassland and Box Gum Woodland. The proposed pipeline excavation will require the disturbance of about 16.7 ha of potential habitat within the construction corridor for *Swainsona recta* (note: species was only found within a small portion of the Goulburn-Cooma Railway corridor and at Burra Creek during this study) from an estimated 10,865 ha of similar habitat in the ACT and 250,729 ha in NSW. The fenced areas in the railway easement which contain the concentrated population of *Swainsona recta* will not be affected, therefore it is unlikely that the proposed development will affect critical habitat for *Swainsona recta*. However, any outlying plants, which occur south of the main population, are at risk from the proposed development and should be avoided.

Conclusion

Provided that:

- the construction corridor through the Goulburn-Cooma Railway corridor is reduced to 15 m in width and is aligned with an existing drainage culvert;
- spoil, equipment and plant are not placed anywhere within the railway corridor; and,
- the site is rehabilitated according to the provisions outlined in Appendix 8 of this document.

the impacts on the *Swainsona recta* are likely to be minor because:

- Habitat for this species in the study area is restricted to good quality vegetation remnants within the Goulburn-Cooma Railway corridor and at Burra Creek, which would not be affected by the development;

- The proposal is unlikely to have a major impact on the lifecycle of the species; and
- The proposal is unlikely to significantly reduce the availability of potential habitat for this species in the study area through processes such as fragmentation, modification or clearing.

Silky Swainson's Pea	<i>Swainsona sericea</i>
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Swainsona sericea is listed as Vulnerable under the TSC Act and is a prostrate to erect perennial with densely hairy stem, pods and leaves. The purple flowers are borne in Spring. Populations of this species occur in the northern and southern tablelands, although the largest populations occur in the Monaro. Only one population is known to occur in a conservation reserve, where the species is considered to be rare. It is estimated that less than 10,000 mature individuals occur naturally in New South Wales.

Preferred habitat includes Grasslands and Grassy Woodlands. Threats include Loss and degradation of habitat and/or populations for residential and agricultural developments; loss and degradation of habitat and/or populations by invasion of weeds, loss and degradation of habitat and/or populations by intensification of grazing regimes and loss and degradation of habitat and/or populations by road works.

The results of the survey indicate that *Swainsona sericea* is widespread in the study area and locality (if not region). It is likely that some individuals will be affected by the proposed pipeline.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

It is possible that some individuals of *Swainsona sericea* will require removal, although a number of individuals which occur in areas adjacent to the proposed pipeline alignment will not be affected.

Proposals to protect the seed bank within the topsoil are intended to take into account the potential for seeds and propagules of *Swainsona sericea* to be present in disturbed topsoil, and to facilitate the recruitment of seedlings and resprouted stems, after completion of excavation.

Research (NG&GW 2001) indicates that *Swainsona sericea* "...does not tolerate dense vegetation cover or high moisture regimes. Light intermittent or pulse grazing favours the species but it does not appear to tolerate disturbances such as irrigation, cultivation and heavy continuous grazing...." These observations will

be taken into account during rehabilitation in areas where *Swainsona sericea* has been recorded.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat may be disturbed for a maximum period of 12 months. The disturbed area will then be rehabilitated to its original condition. Topsoil and seed banks will be protected according to a set off protocols outlined in “*Recommendations for Minimising Disturbances and Reinstating Native Grassy vegetation: Murrumbidgee to Googong (M2G) Transfer Pipeline Project*” (see Appendix 8), and a maintenance and monitoring programme will be followed to ensure complete recovery of the original native vegetation.

Does the proposal affect any threatened species that are at the limit of its known distribution?

Swainsona sericea is listed as Vulnerable in Victoria and New South Wales and Endangered in South Australia. In New South Wales, populations occur in the Monaro as well as on the Northern Tablelands. The population in the study area is therefore not located at the northern, western or southern limit of distribution, but may be near the eastern limit of distribution.

How is the proposal likely to affect the current disturbance regimes?

Current disturbances include grazing, weed invasion, and altered nutrient and fire regimes. The disturbed areas will be maintained and monitored for at least 2 years after completion of the project, to ensure recovery of the original vegetation.

How is the proposal likely to affect habitat connectivity?

The existing population within the study area consists of a number of scattered individuals, some of which may be affected by the proposed pipeline, while it is likely that other individuals within the population will not be affected. Seeds have no apparent dispersal mechanism, so may rely on rainfall, ants or other organisms for dispersal beyond parent plants. Seeds appear to require some form of scarification for germination. It is possible that the disturbance, coupled with after-care will provide improved opportunities for seed dispersal and germination.

How is the proposal likely to affect critical habitat?

Critical habitat for *Swainsona sericea* has not been defined, although the species is generally known to occur in Grassland and Box – Gum Woodland. The

proposed pipeline excavation will require the disturbance of about 16.7 ha of suitable habitat for *Swainsona sericea*, from an estimated 10,865ha of similar habitat in the area, therefore it is unlikely that the proposed development will affect critical habitat for *Swainsona sericea*

Button Wrinkle Wort	<i>Rutidosia leptorrhynchoidea</i>
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Rutidosia leptorrhynchoidea is a perennial herb, multi-stemmed in form with bright yellow flowers. The flower heads are borne terminally in summer, and are surrounded at the base by bracts with papery edges.

Populations have been recorded in Goulburn, Michelago, Canberra to Queanbeyan, as well as in parts of Victoria. The preferred habitat is Box Gum Grassy Woodland, derived Grassland or Natural Temperate Grassland, usually on shallow, stony red-brown clay loams. The species is listed as Endangered both under the TSC Act and the EPBC Act.

Populations have been recorded to the north of the study area, near Jerrabomberra. (NSW NPWS 2008). Some individuals were recorded within the study area, although none occur within the proposed pipeline alignment.

The following threats have been identified; (see DECC 2005a)

- Loss, degradation and fragmentation of habitat and/or populations for residential and agricultural developments.
- Loss and degradation of habitat and/or populations by intensification of grazing regimes
- Loss and degradation of habitats and/or populations by invasion of weeds
- Increased competition from other native grassland species within the habitat because of adverse increases of biomass and the resultant closing up of the inter-tussock spaces that this species requires.
- Increased competition from other native grassland species within the habitat because of reduced fire frequency.
- Loss and degradation of habitat and/or populations from rail reserve maintenance and road works.
- Inherent risk of loss of small populations from natural or un-natural catastrophic events.

A further threat relates to the potential for genetic decline: Young and Murray (2000) found that five new tetraploid populations had been "...accompanied by a genetic bottleneck for allozyme diversity as measured by allelic richness...", which will tend to have a negative affect on population viability and individual fitness.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

It is unlikely that any individuals of *Rutidosia leptorrhynchoidea* will require removal, although a number of individuals which occur in areas adjacent to the proposed pipeline alignment will not be affected.

Proposals to protect the seed bank within the topsoil are intended to take into account the potential for seeds and propagules of *Rutidosia leptorrhynchoidea* to be present in disturbed topsoil, and to facilitate the recruitment of seedlings and resprouted stems, after completion of excavation.

As research indicates that the small populations have lower genetic diversity and reduced fertilisation success, and that most populations are not sufficiently close for exchange of genetic material, and as no known individuals in the study area will require removal, it is unlikely that the proposed development would affect the lifecycle of a population of *Rutidosia leptorrhynchoidea*.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat will be disturbed for a maximum period of 12 months. The disturbed area will then be rehabilitated to its original condition. Topsoil and seed banks will be protected according to a set of protocols outlined in “*Recommendations for Minimising Disturbances and Reinstating Native Grassy vegetation: Murrumbidgee to Googong (M2G) Transfer Pipeline Project*”, and a maintenance and monitoring programme will be followed to ensure complete recovery of the original native vegetation.

Does the proposal affect any threatened species that are at the limit of its known distribution?

Rutidosia leptorrhynchoidea occurs south of the Great Dividing Range in Victoria and into South-east NSW and ACT. The population in the study area is possibly located near the eastern limit of distribution.

How is the proposal likely to affect the current disturbance regimes?

Current disturbances include grazing, weed invasion, and altered nutrient and fire regimes. The disturbed areas will be maintained and monitored for about 2 years after completion of the project, to ensure recovery of the original vegetation.

How is the proposal likely to affect habitat connectivity?

Several scattered plants were recorded along roadsides within the study area, although no individuals would require removal. Research indicates that genetic exchange between populations only occurs in a few instances, therefore it is likely that, because all existing individuals will be retained, there will be no alteration to habitat connectivity.

How is the proposal likely to affect critical habitat?

*Critical habitat for *Rutidosia leptorrhynchoides** has not been defined, although the species is generally known to occur in plains Grasslands and Grassy woodlands, on fertile clays to clay loams. The proposed pipeline excavation will require the disturbance of 16.7 ha of suitable habitat for *Rutidosia leptorrhynchoides*, from an estimated 10,865ha of similar habitat in the area. No existing individuals of *Rutidosia leptorrhynchoides* will be affected, therefore it is unlikely that the proposed development will affect critical habitat for *Rutidosia leptorrhynchoides*.

Michelago Parrot Pea	<i>Dillwynia glauca</i>
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Dillwynia glauca is listed as Endangered under the TSC Act and is an erect shrub to 2.5m tall with yellow and red pea-flowers. There are three known populations of this species; near Windellama, Michelago and Numeralla. The populations nearest the study area occur in woodlands "...dominated by *E. rossii*, *E. nortonii* and *E. dives* with a shrubby understorey ...on either rocky sandstone hill tops or slaty outcrops. The altitudinal range of this species is between 580m and 840m." (Jobson & Weston 1998).

Threats include Clearing of habitat in rural-residential subdivisions; Grazing and trampling by stock causing root damage, prevention of seedling establishment and erosion; Pasture improvement; Habitat disturbance during road maintenance and weeds and roadside spraying of herbicides.

No individuals of *Dillwynia glauca* were recorded during the survey. No suitable habitat for this species occurs within the proposed corridor. It is unlikely that any individuals will be affected by the proposed pipeline.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

All known individuals of this species in the Michelago area occur further to the south of the study area. Less than 20 individuals have been recorded in the Michelago population. This species is, however locally abundant in the Windellama area. Although there is "...potential habitat between the known

sites...” (DEC 2005, no suitable habitat for this species occurs within the proposed corridor, and no individuals of this species were recorded during searches in or near the proposed corridor.

It is therefore unlikely that the proposal would affect the life cycle of this species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat will be disturbed for a maximum period of 12 months. The disturbed area will then be rehabilitated to its original condition. Topsoil and seed banks will be protected according to a set off protocols outlined in “*Recommendations for Minimising Disturbances and Reinstating Native Grassy vegetation: Murrumbidgee to Googong (M2G) Transfer Pipeline Project*”, and a maintenance and monitoring programme will be followed to ensure complete recovery of the original native vegetation.

As no individuals of *Dillwynia glaucula* will be affected by the proposed pipeline development and as no suitable habitat currently occurs within the corridor, it is unlikely that any habitat of this species will be affected.

Does the proposal affect any threatened species that are at the limit of its known distribution?

Dillwynia glaucula occurs further to the south and also to the north-east, therefore the proposed corridor does not occur at the limit of known distribution for *Dillwynia glaucula*.

How is the proposal likely to affect the current disturbance regimes?

Current disturbances include grazing, weed invasion, and altered nutrient and fire regimes. The disturbed areas will be maintained and monitored for at least 2 years after completion of the project, to ensure recovery of the original vegetation.

How is the proposal likely to affect habitat connectivity?

Populations of *Dillwynia glaucula* occur extensively to the north-east of the proposed corridor, and scattered, smaller populations occur further to the south. Searches indicate that there are three separate populations, although There is “...potential habitat between the known sites...” (DEC 2005. No individuals of *Dillwynia glaucula* were recorded within the proposed corridor, and no suitable habitat for this species occurs, therefore the proposal is unlikely to affect habitat connectivity.

How is the proposal likely to affect critical habitat?

Critical habitat for *Dillwynia glauca* has not been defined, although the species is generally known to occur "...on exposed patches of clay or rocky outcrops in eucalypt woodland...or in Natural Temperate Grassland" (DEC 2005). The proposed pipeline excavation will require the disturbance of less than 1 ha of suitable habitat, from an estimated 1,000ha of similar habitat in the area, therefore it is unlikely that the proposed development will affect critical habitat for *Dillwynia glauca*

Pale Pomaderris	<i>Pomaderris pallida</i>
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Pomaderris pallida is a small shrub to 1.5m high with small yellow flowers borne in Spring. This species is listed as Vulnerable under the EPBC Act and TSC Act. This species is only known from 15 locations in the ACT, southern NSW and eastern Victoria, with the largest populations occurring along the Murrumbidgee, Cotter and Paddys Rivers in ACT.

Preferred habitat is dry Open-forest and shrubland, associated with *Eucalyptus mannifera* – *E. macrorhyncha*- *Callitris* woodlands on granite slopes, river slopes and hillsides (DECC 2005b).

Threats include rural residential development, weed competition, browsing by feral goats, inappropriate fire regimes, fragmentation, stochastic processes and loss of remnants.

The species was previously recorded on the western banks of the Murrumbidgee River west of Angle Crossing. No individuals of this species were recorded in the study area.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

It is unlikely that any individuals of *Pomaderris pallida* occur within the proposed pipeline alignment. No individuals of *Pomaderris pallida* were recorded during targeted searches.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

No extant habitat for *Pomaderris pallida* will be affected by the proposed pipeline.

Does the proposal affect any threatened species that are at the limit of its known distribution?

Pomaderris pallida occurs near Kambah Pool, near the junction of the Murrumbidgee and Cotter rivers, and near the junction of the Cotter and Paddys Rivers. It has also been recorded on the western bank of the Murrumbidgee River near Angle Crossing. No individuals of *Pomaderris pallida* were recorded and none would be affected by the proposal, therefore the study area is not at the limit of known distribution.

How is the proposal likely to affect the current disturbance regimes?

Current disturbances include grazing, weed invasion, and altered nutrient and fire regimes. The disturbed areas will be maintained and monitored for at least 2 years after completion of the project, to ensure recovery of the original vegetation. As no area of extant habitat for *Pomaderris pallida* occurs in the study area, this consideration is not applicable.

How is the proposal likely to affect habitat connectivity?

No individuals will be affected by the proposed pipeline. Habitat connectivity is not a consideration for this species in the context of the proposed development.

How is the proposal likely to affect critical habitat?

Critical habitat for *Pomaderris pallida* has not been defined, although the species is generally known to occur in Dry Sclerophyll forests (shrubby sub-formation: Red Stringybark-Brittle Gum-Inland Scribbly Gum on skeletal hills. No examples of this habitat occur in the study area, therefore it is unlikely that the proposed development will affect critical habitat for *Pomaderris pallida*.

Golden Sun Moth

Synemon plana

The Golden Sun Moth *Synemon plana* is listed as Critically Endangered under the EPBC Act and Endangered under the TSC Act (NSW) and the NC Act (ACT).

The Golden Sun Moth occurs in Natural Temperate Grasslands and Box Gum Grassy Woodlands in which the ground layer is dominated by native grasses, including wallaby grasses *Austrodanthonia* spp., speargrass *Austrostipa* spp. and Redgrass *Bothriochloa macra*, Kangaroo Grass *Themeda australis*, as well as in degraded grasslands dominated by the exotic Chilean Needlegrass *Nassella nesiiana*, a weed of national significance (DEWHA 2008d). Habitat for this

species may contain several wallaby grass species, which are typically associated with other grasses, particularly spear-grasses *Austrostipa* spp. Grasslands dominated by wallaby grasses are typically low and open. The bare ground between the tussocks is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically where the females are observed displaying to attract males (DECC 2005b).

The life cycle of the Golden Sun Moth is relatively well understood. The flying season is short, typically lasting from six to eight weeks (during November and December in the ACT region). Males typically fly in bright sunshine during the warmest part of the day, between 10:00 and 14:00 hrs. Adults emerge continuously throughout the flying season (DECC 2005b), but only live for two to five days and cannot feed (DEWHA 2008d). It is believed that the females lay up to 200 eggs at the base of the *Austrodanthonia* tussocks after mating. The eggs hatch after 21 days. The larvae tunnel underground where they remain feeding on the roots of *Austrodanthonia* before digging a vertical tunnel to the surface where the pupa remains for six weeks until the adult moths emerge (DEWHA 2008d).

Female Golden Sun Moths have reduced hind wings and are reluctant to fly, even when disturbed. Males, which are capable of flight, are unlikely to fly greater than 100 m away from areas of suitable habitat. Thus populations separated by distances of greater than 200 m can be considered effectively isolated and populations which have gone extinct, or vacant patches of suitable habitat, are highly unlikely to be recolonised (DECC 2005b).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Lower quality grasslands dominated by *Austrodanthonia* sp.- *Austrostipa* sp. occur in modified parts of the study area, such as east of the Goulburn-Cooma railway corridor and along Williamsdale Road east of the Gibraltar 'saddle', where it comprised mostly non-native pasture. These areas form potential habitat for the Golden Sun Moth and could be used for breeding, although the level of grazing is probably restrictive.

The Golden Sun Moth was not recorded in the study area or within 10 km of the study area. Extensive targeted searches for the species were conducted in November and December 2008 and did not result in a positive sighting. Given the lack of good quality habitat, the lack of records of the species in the study area, and the narrow corridor of disturbance, it is unlikely that the proposal would disrupt the lifecycle of the Golden Sun Moth within the study area.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The dominant vegetation within the study area is non-native and native grassland and grassy woodland. Woodland graded into dry sclerophyll forest through the top of the Gibraltar ‘saddle’, and reverted back to grassy woodland to the east. Woodland habitats east of the ‘saddle’ were, for the most part, scattered and highly modified, although there were some examples of potential habitat along Burra Creek.

Low quality grasslands dominated by *Austrodanthonia* sp.- *Austrostipa* sp. occur in modified parts of the study area, such as east of the Goulburn-Cooma railway corridor and along Williamsdale Road east of the Gibraltar ‘saddle’. Grassy habitat along Burra Creek was considered to be in good to moderate condition and represented potential habitat for the Golden Sun Moth.

The proposal would remove between 2 ha and 4 ha of secondary grassland, however, given that the species was not recorded during the current surveys; the lack of historical records of the species in the local area (the nearest known population is located approximately 30 km to the north); the former vegetation was for the most part woodland; and the current limiting grazing and cropping regimes across the study area, it is considered unlikely that a population of the species would occur.

Does the proposal affect any threatened species that are at the limit of its known distribution?

The Golden Sun Moth NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut (DECC 2005b). The study area is at the eastern limit of distribution for the species.

How is the proposal likely to affect the current disturbance regimes?

The area of potential habitat for the Golden Sun Moth is predominantly grazed by sheep. The disturbance during construction is unlikely to change the current disturbance regime.

How is the proposal likely to affect habitat connectivity?

The Golden Sun Moth has not been recorded within 10 km of the study area or within the study area itself. The potential habitat for this species in the study area is patchy and generally of low quality. The proposed corridor of disturbance would range from 15 m to 40 m in width, which is unlikely to create barriers to this species’ movement through the landscape. It is unlikely that the proposal would affect habitat connectivity for this species.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for the Golden Sun Moth (DECC 2008; DEWHA 2008c).

Conclusion

The effects of the proposal on the Golden Sun Moth are likely to be minor as:

- Limited habitat availability for this species;
- The species has not been recorded in the locality;
- The proposal is unlikely to have a major impact on the lifecycle of the species; and
- The proposal is unlikely to significantly reduce the availability of potential habitat for this species in the study area through processes such as fragmentation, modification or clearing.

Pink-tailed Worm Lizard	<i>Aprasia parapulchella</i>
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The Pink-tailed Worm Lizard is listed as Vulnerable under the EPBC Act (Commonwealth), the TSC Act (NSW) and recently the NC Act (ACT).

Pink-tailed Worm Lizard is a small fossorial reptile from the family Pygopodidae (legless lizards), which has a maximum snout vent length of 14 cm and a total length of about 24 cm. Pink-tailed Worm Lizard is oviparous (egg laying) with a clutch size of two. Females may need to reach an age of about 3 or 4 years before it can reproduce. There is little data on the breeding behaviour of this species (Osborne and Coghlan 2004).

The species lives beneath surface rocks and occupies ant burrows and feeds on ants, particularly their eggs and larvae (Osborne and Jones 1995b). Key habitat features for the presence of Pink-tailed Worm Lizard are a cover of native grasses, particularly Kangaroo Grass (*Themeda australis*) and other native grasses, sparse or no tree cover, little or no leaf litter, and scattered small rock with shallow embedment in the soil surface.

In the Canberra region the species is found in area containing acid volcanic rock types - Late Silurian acid volcanics - that are derived from decomposing rhyodacite, rhyolite or dacite or other Silurian volcanic rocks (Osborne and

Coghlan 2004). The distribution of the species is centred on the ACT and this appears to be related to less soil (and rock) disturbance evidenced by the presence of a native grass cover, particularly Kangaroo Grass *Themeda triandra*, Red-leg Grass *Bothriochloa macra* and Wattle Mat-rush *Lomandra filiformis*. The likelihood of occurrence of *A. parapulchella* increases with increasing cover of Kangaroo Grass (Osborne and Coghlan 2004). Alternatively, dominance of speargrasses (*Stipa falcata*, *S. bigeniculata*) and Tussock Grass *Poa labillardieri* decreases the likelihood of finding the species (Osborne and Coghlan 2004; ACT Government 2007b; ACT Government 2005). However, moderate numbers of disturbed sites dominated by exotic ground cover species, such as *Avena*, *Vulpia*, *Hypocheirus* and *Bromus* supported at least some individuals, although it was not known if these sites support viable populations (Osborne and Coghlan 2004)

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The species has been recorded outside the study area: within the Gigerline Nature Reserve immediately north of Angle Crossing; about 10 km to the north-east (Biosis Research and DECC Atlas of NSW Wildlife) and approximately 1 km to the south (DECC Atlas of NSW Wildlife). The Pink-tailed Worm Lizard was recorded during this study at a number of locations within the ACT section of the study area, and has a seemingly wide distribution within the Murrumbidgee River Corridor (Figure 10). The species was not recorded along Burra Creek despite extensive rock turning nor was it recorded in any other location in the NSW sections of the study area, although some areas of potential habitat have not been adequately surveyed (i.e. blocks 152-754889 and 170-754889).

The dispersal ability of the Pink-tailed Worm Lizard is not well known. Populations appear to be relatively isolated (Bionet atlas) and the species is unlikely to travel far due to its fossorial nature and dependence upon native grasslands containing partially-embedded rocks. Individuals are thought to remain faithful to the same rocks over a long period of time (DEWHA 2008a). It is considered likely that locations within the study area where the species has been recorded contain a core proportion of a local population.

There is little data on the breeding behaviour of this species. The Pink-tailed Worm Lizard is oviparous (egg laying) with a clutch size of two. Females may need to reach an age of about 3 or 4 years before they can reproduce.

The Pink-tailed Worm Lizard feeds on ants, particularly their eggs and larvae, within burrows under rocks (Osborne and Jones 1995a).

The proposal would remove up to 1.52 ha of potential habitat for this species within the NSW sections of the study area. Another 0.4 ha of unlikely, but

underdetermined, rock habitat for the species occurred in the Gibraltar ‘saddle’ area. Indirect impacts may include sedimentation and erosion of habitat, however, control methods are likely to reduce these effects.

While it is considered unlikely that the proposal would have a major affect on the lifecycle of the Pink-tailed Worm Lizard, some areas of potential habitat have not been adequately surveyed (152-754889 and 170-754889) and should be subject to targeted surveys in Spring 2009.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The Pink-tailed Worm Lizard has a wide distribution within the Murrumbidgee River Corridor and was recorded within the ACT sections during the current surveys (Figure 10). The NSW component of the study area provides potential habitat for the Pink-tailed Worm Lizard, however, not all areas of potential habitat in NSW were fully surveyed, see above.

The proposal is likely to result in a direct loss of 1.52 ha of potential habitat for the Pink-tailed Worm Lizard. It was not determined that the proposal would affect a significant area of known habitat for the species in NSW, and further surveys should be undertaken.

Indirect impacts may include sedimentation and erosion of habitat, however, control methods are expected to reduce such effects.

Given the relatively small area of impact it is considered unlikely that the proposal would have a major affect on the distribution and habitat of the Pink-tailed Worm Lizard within the NSW components of the study area.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Pink-tailed Worm Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. There is a concentration of populations within the Canberra/Queanbeyan Region (DEC 2005a). The study area is at the eastern limit of the distribution for this species.

How is the proposal likely to affect current disturbance regimes?

The areas of known and potential habitat for the Pink-tailed Worm Lizard are currently subject to varying levels of sheep grazing. Following construction of the pipeline and associated infrastructure, sheep grazing would continue. The

proposed construction is unlikely to significantly alter the current disturbance regime.

How is the proposal likely to affect habitat connectivity?

Given the known distribution of Pink-tailed Worm Lizard within the ACT section of the study area and the presence of suitable habitat both north and south of Angle Crossing (within the Murrumbidgee River Corridor), the proposal has the potential to fragment some components of this species habitat in this area. However, this is yet to be confirmed in the NSW sections of the study area.

Given the relatively small extent of potential habitat that would be affected it is considered unlikely a significant area would remain isolated from each other in the long-term despite the seemingly limited dispersal abilities of the Pink-tailed Worm Lizard.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for the Pink-tailed Legless Lizard (DECC 2008).

However, surface rocks, which provide shelter for both the Pink-tailed Legless Lizard and ants, which provide burrows and food for the lizard, are considered vital for the survival of the species (DEC 2005a). The proposal would remove some components of this habitat from the study area.

Conclusion

The affects of the proposal on the Pink-tailed Legless Lizard are somewhat undetermined and will require sampling surveys in some sections (152-75889 and 170-754889) to determine if the species is present. However the proposal is unlikely to have a significant impact because:

- The proposal is unlikely to remove a large proportion of this species potential habitat within the NSW components of the study area;
- The proposal is unlikely to have a major impact on the lifecycle of the Pink-tailed Legless Lizard occurring within the study area;
- The proposal is unlikely to have a major impact on the composition of known and/or potential habitat for the species within the study area (e.g. loss, disturbance, fragmentation).

Grassland Earless Dragon***Tympanocryptis pinguicolla***

The Grassland Earless Dragon is listed as Endangered under the EPBC Act (Commonwealth), the TSC Act (NSW) and the NC Act (ACT).

The Grassland Earless Dragon historically ranged from Bathurst to Cooma, including the ACT region and Victoria. The only populations now known are in the ACT and adjacent NSW at Queanbeyan, and on the Monaro between Cooma and south-west of Nimmitabel (DECC 2005c).

The Grassland Earless Dragon is restricted to a small number of Natural Temperate Grassland sites dominated by wallaby grasses (*Austrodanthonia* spp.), spear grasses (*Austrostipa* spp.), Poa Tussock (*Poa sieberiana*), Red Grass (*Bothriochloa macra*), and occasionally Kangaroo Grass (*Themeda australis*). Introduced pasture grasses occur at many of the sites supporting this species, which has also been captured in secondary grassland. 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).

Females are oviparous, and have been found gravid in both spring and early summer, with the eggs laid in late spring or early summer. Clutches of between three and six eggs are laid. Young emerge in summer and early autumn. Some adults must live longer than one year (Robertson and Cooper 2000).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The majority of the study area is grazing land with little surface rock cover. Parts of the study area contain native grasslands that may be suitable for this species, however, targeted surveys were carried out in the appropriate season and the species was not recorded. Additionally, the preferred habitat for this species in the study area is considered to be low to moderate quality. Partially embedded surface rocks, and spider and insect holes could be used for shelter and laying of eggs.

The proposal is unlikely to disturb potential refuge sites for this species in the study area. Given the lack of good quality habitat, lack of records of the species in the locality, and narrow corridor of disturbance, it is unlikely that the action would disrupt the breeding cycle of the Grassland Earless Dragon within the study area.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The dominant form of vegetation within the study area is grassy woodland, particularly west of the Gibraltar ‘saddle’. Woodland graded into dry sclerophyll forest through the top of the ‘saddle’, and reverted back to grassy woodland to the east. Woodland habitats east of the ‘saddle’ were, for the most part, scattered and highly modified, although there were some examples of good habitat north of Williamsdale Road and along Burra Creek. The grasses in these woodlands were mostly *Themeda australis*, representing marginal habitat for the Grassland Earless Dragon.

Lower quality grasslands dominated by *Austrodanthonia* sp.- *Austrostipa* sp. occur in modified parts of the study area, such as east of the Goulburn-Cooma railway corridor and along Williamsdale Road east of the Gibraltar ‘saddle’. Grassy habitat along Burra Creek was considered to be in good to moderate condition. These grasslands represent low quality preferred habitat for the Grassland Earless Dragon.

The proposal would involve the removal of between up to 2 ha of secondary grassland that represents low potential habitat for the Grassland Earless Dragon. Some of this habitat is considered marginal and much of the preferred habitat is in poor condition. Targeted surveys were conducted across the study area but the species was not recorded. Given the lack of records within local area, the lack of good quality preferred habitat, it is unlikely that a population of this species occurs in the study area and thus the proposal is unlikely to cause a decline in the species.

Does the proposal affect any threatened species that are at the limit of its known distribution?

Known populations of Grassland Earless Dragon occur to the north in the ACT and Queanbeyan, and on the Monaro between Cooma and south-west of Nimmitabel (DECC 2005c). The study area is at the eastern limit of the species distribution.

How is the proposal likely to affect the current disturbance regimes?

The area of potential habitat for the Grassland Earless Dragon is currently grazed by sheep and/or cattle. The proposed construction is unlikely to change the current disturbance regime for this species.

How is the proposal likely to affect habitat connectivity?

No populations of Grassland Earless Dragon have been recorded within 10 km of the study area. The potential habitat for this species in the study area is patchy and generally of poor quality. Additionally, the proposal is unlikely to create barriers to this species' movement through the landscape, given the narrow corridor of disturbance and reinstatement of habitat following construction. It is therefore unlikely that the proposal would affect habitat connectivity in the study area.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for the Grassland Earless Dragon (DECC 2008; DEWHA 2008c).

Conclusion

The effects of the proposal on the Grassland Earless Dragon are likely to be minor as:

- Potential habitat for this species in the study area is generally low quality;
- The species has not been recorded in the study area or surrounds;
- The proposal is unlikely to have a major impact on the lifecycle of the species; and
- The proposal is unlikely to significantly reduce the availability of potential habitat for this species in the study area through processes such as fragmentation, modification or clearing.

Striped Legless Lizard	<i>Delma impar</i>
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The Striped Legless Lizard *Delma impar* is listed as a Vulnerable under the EPBC Act (Commonwealth), the TSC Act (NSW) and the NC Act (ACT).

The Striped Legless Lizard occurs in the Southern Tablelands, the South Western Slopes and possibly in the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma and Tumut areas (DECC 2005e). The formerly continuous distribution around the ACT has been reduced to four discrete areas: Gungahlin, the lower Majura Valley, the lower Jerrabomberra Valley and

Yarramundi Reach. It also occurs in Victoria and south-eastern South Australia (DEWHA 2008b).

The Striped Legless Lizard is found mainly in Natural Temperate Grassland but has also been captured in grasslands with predominately non-native components, and occasionally in open Box Gum Grassy Woodland. Habitat is where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass (*Themeda australis*), spear-grasses (*Austrostipa* spp.) and Poa tussocks (*Poa* spp.), and occasionally wallaby grasses (*Austrodanthonia* spp.). It is sometimes found in grasslands with significant amounts of surface rocks, which are also used for shelter (DECC 2005e). It can also be found in non-native grasslands provided that it has suitable structure and is near an area of good quality habitat.

Striped Legless Lizards appear to have small home ranges, with lizards often recaptured less than 10 m from the original capture site. Individuals have, however, been recorded moving over 60 m from their original capture point. The species forages for ground invertebrates, such as wolf spiders and crickets (DEWHA 2008b).

Lifespan of Striped Legless Lizards is estimated to be at least 10 years, with reproduction starting from two to three years for males and three to four years for females. Females lay one clutch of two eggs in early to mid-summer and hatching occurs in late summer, 35 to 60 days after laying (Smith and Robertson 1999).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The majority of the study area is grazing land with little surface rock cover. Parts of the study area contain native grasslands that may be suitable for this species, however, targeted surveys were carried out in the appropriate season and the species was not recorded. Additionally, the preferred habitat for this species in the study area is considered to be low to moderate quality.

Pitfall traps were inspected every day from November to January. No Striped Legless Lizards were detected in the study area, and none have been recorded in the locality.

The proposal is unlikely to disturb rocks that may provide refuges for this species, but may disturb some grasslands that contain grass tussocks, representing preferred habitat for this species. However, due to grazing pressures, much of the grasslands in the study area contains limited areas of suitable habitat that are a critical habitat feature for this species. Given the

restricted amount of good quality habitat and the lack of records of the species in the locality, it is unlikely that the species occurs in the study area. Given the lack of good quality habitat and the retention of most loose rocks, it is unlikely the proposal would disrupt the lifecycle of the Striped Legless Lizard if a population existed within the study area.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The dominant form of vegetation within the study area is grassy woodland, particularly west of the Gibraltar ‘saddle’. Woodland graded into dry sclerophyll forest through the top of the ‘saddle’, and reverted back to grassy woodland to the east. Woodland and grassland habitats east of the ‘saddle’ were, for the most part, scattered and highly modified, although there were some examples of good habitat north of Williamsdale Road and along Burra Creek.

Lower quality grasslands dominated by *Austrodanthonia* sp.- *Austrostipa* sp. occur in modified parts of the study area, east of the Goulburn-Cooma railway corridor and along Williamsdale Road east of the Gibraltar ‘saddle’, where it comprised mostly non-native pasture. Grassy habitat along Burra Creek was considered to be in good to moderate condition but was not extensive. These grasslands represent marginal habitat for the Striped Legless Lizard.

The proposal will involve the removal about 2 ha of secondary grassland representing potential habitat for the Striped Legless Lizard. This species was searched for extensively in targeted surveys and was not located. Given the lack of records in the study area, it is unlikely a population of this species occurs in the study area and thus the proposal is unlikely to cause a decline in the species.

Does the proposal affect any threatened species that are at the limit of its known distribution?

The Striped Legless Lizard occurs in the Southern Tablelands, the South Western Slopes and possibly in the Riverina. Populations are known in the ACT, Goulburn, Yass, Queanbeyan, Cooma and Tumut areas (DECC 2005e). The study area is at the eastern limit of distribution for the species.

How is the proposal likely to affect the current disturbance regimes?

The area of potential habitat for the Striped Legless Lizard is currently predominantly grazed by sheep and/or cattle. The proposed construction is unlikely to change the current disturbance regime for this species.

How is the proposal likely to affect habitat connectivity?

No populations of Striped Legless Lizard have been recorded within 10 km of the study area. There is little native grassland in the study area that is vigorous enough to provide habitat for this species, although substantial tussocks of native grasses and forbs do occur in patches. The study area could currently provide connectivity for other undiscovered populations in the locality, although given the level of grazing this is unlikely. The potential habitat for this species in the study area is patchy and generally of poor quality. Additionally, the proposal is unlikely to create barriers to this species' movement through the landscape. The proposal is unlikely to change the nature of the study area such that habitat connectivity is significantly affected.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for the Striped Legless Lizard (DECC 2008; DEWHA 2008c).

Conclusion

The effects of the proposal on the Striped Legless Lizard are likely to be minor as:

- Potential habitat for this species in the study area is generally low quality;
- The species has not been recorded in the study area or surrounds;
- The proposal is unlikely to have a major impact on the lifecycle of the species; and
- The proposal is unlikely to significantly reduce the availability of potential habitat for this species in the study area through processes such as fragmentation, modification or clearing.

Rosenberg's Goanna	<i>Varanus rosenbergi</i>
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The Rosenberg's Goanna *Varanus rosenbergi* is listed as Vulnerable under the TSC Act (NSW).

The Rosenberg's Goanna typically inhabits heath, open forest and woodland where it is active diurnally and shelters nocturnally in hollow logs, burrows (which it digs), rock crevices and sandstone outcrops (Aitkens 1999).

This species is a generalist forager and scavenger, and as such its diet consists mainly of insects and smaller reptiles but it will scavenge on mammals killed on roads where available (Green and King 1993). Little published data about home range and mobility of the Rosenberg's Goanna exists. Based on studies conducted in Kangaroo Island, the Rosenberg's Goanna has a relatively small home range, averaging 19.44 ha (Green and King 1993). However, radio-tracking of individuals in the Goobang Dam area, NSW has recorded individuals roaming distances in the order of 4-5 km over a couple of days (Warick Smith, former employee of National Parks & Wildlife Service, Queanbeyan, pers comm.).

The female Rosenberg's Goanna digs a chamber underneath a termite mound where she lays a clutch of up to 14 eggs (which take approximately 8 months to hatch).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Rosenberg's Goanna is dependent on termite mounds for an incubation site for the eggs. Few termite mounds were observed within the study area and are not expected to be impacted by the proposal. This species is a generalist forager and thus foraging grounds are unlikely to be significantly effected by the proposal.

The proposal is therefore unlikely to affect the lifecycle of the Rosenberg's Goanna.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Woodlands were widespread throughout the study area, but varied considerably in floristic and structural condition. Better quality woodlands occurred within the ACT, either side of the Gibraltar 'saddle' and along Burra Creek, east of Burra Road. Functional woodlands with generally low groundcover diversity occurred in the central parts of the study area, west of the Gibraltar 'saddle'.

The Rosenberg's Goanna prefers heaths, forests and woodlands. The proposal will involve the removal of about 14 ha of native vegetation representing potential habitat for the Rosenberg's Goanna. As termite mounds are unlikely to be disturbed or removed due to the proposal, it is unlikely the proposal would reduce the availability of habitat for this species. Additionally, Rosenberg's Goanna has not been recorded in the locality despite targeted surveys. Given the lack of records of this species in the area, it is unlikely to occur in the study area. Given the lack of records of the species in the area, the mobility of the species,

its generalist foraging requirements, and the retention of possible nesting sites, the proposal is unlikely to cause a decline in the species.

Does the proposal affect any threatened species that are at the limit of its known distribution?

Rosenberg's Goanna is patchily distributed in Hawkesbury/Narrabeen sandstone country within NSW, but is also found in isolated occurrences in other states and territories. The species occurs on the Sydney Sandstone, in the Goulburn and ACT regions, and near Cooma in the south. There are also records from the South West Slopes of NSW. The study area is not at or near the limits of distribution for the species.

How is the proposal likely to affect the current disturbance regimes?

The area of potential habitat for the Rosenberg's Goanna within the study area comprises a mixture of remnant woodland and open forest and farmland (predominately sheep grazing and some cropping). The proposed construction is unlikely to change the current disturbance regime for this species.

How is the proposal likely to affect habitat connectivity?

Potential habitat for the Rosenberg's Goanna in the study area is already fragmented and isolated from clearing associated with stock grazing. The potential habitat for this species in the study area is patchy and generally of poor quality. Additionally, the proposal is unlikely to create barriers to this species' movement through the landscape. The proposal would not further fragment or isolate potential habitat for this species.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for the Rosenberg's Goanna.

Conclusion

The effects of the proposal on Rosenberg's Goanna are likely to be minor as:

- Suitable habitat for this species is widespread throughout the study area and the locality;
- The species is considerably mobile;
- The proposal is unlikely to have a major impact on the lifecycle of the species; and

- The proposal is unlikely to significantly reduce the availability of potential habitat for this species in the study area through processes such as fragmentation, modification or clearing.

Woodland Birds

Potential habitat for several threatened woodland bird species occurs in the study area. These species are: Speckled Warbler *Pyrrholaemus sagittatus* Brown Treecreeper *Climacteris picumnus victoriae*, Hooded Robin *Melanodryas cucullata cucullata* and Diamond Firetail *Stagonopleura guttata*. These species have been grouped together due to their similar habitat requirements.

These woodland bird species occur predominately in eucalypt woodlands with a grassy understorey, mostly west of the Great Dividing Range, with some populations occurring in the drier woodland areas of the tablelands and east of the range, including the local area. The Brown Treecreeper and Speckled Warbler are sedentary, and the Hooded Robin and Diamond Firetail are generally sedentary, although some local movement may be undertaken. These species occur in pairs or small family groups.

The Speckled Warbler and Diamond Firetail were recorded during this study (Figure 10), the former in woodland between the Monaro Highway and the Goulburn-Cooma Railway corridor and the later in modified Box Gum Grassy Woodland within property 170-754889 and in Snow Gum Grassy Woodland at Burra Creek.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Speckled Warbler, Hooded Robin and Diamond Firetail generally forage on the ground, with the Brown Treecreeper foraging for arthropods on the trunks and main branches of trees. These species are dependent on habitat features such as grass tussocks, leaf litter and fallen wood.

While no nest sites were observed for these species within the proposed pipeline corridor footprint it would be a reasonable assumption to assume that nesting would occur locally.

The proposal will remove existing vegetation in a relatively narrow strip (which, in areas of good to moderate condition woodland habitat would be limited to 15 m and 20 m, respectively) along the proposed pipeline corridor, which would be rehabilitated post-construction.

Although largely sedentary, all four woodland bird species are known to traverse small distances within their home range and therefore are able to move through

woodland within the surrounding local area. The removal of existing vegetation within the study area is not likely to have a significant adverse effect on the life cycle of these species such that viable local populations might be placed at risk of extinction.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

A range of woodland birds were widely recorded throughout the study area, but their relative abundances were apparently greater in habitat that contained greater floristic and structural complexity. Such habitats occur on site, although variably, within and west of the Gibraltar ‘saddle’ and along Burra Creek.

The proposal would affect 10-12 ha of variable quality grassy woodland habitat that represents known and potential habitat for these woodland bird species. Given the mobility of these species and the extent of suitable habitat in nearby areas, the proposal is unlikely to cause a significant decline in the availability of local habitat for these species.

Does the proposal affect any threatened species that are at the limit of its known distribution?

None of the four woodland bird species are considered to be at the limit of their distribution.

The Speckled Warbler occurs from about Rockhampton in Queensland south to western Victoria. Hooded Robin (south-eastern form) is found from Brisbane to Adelaide and throughout much of inland NSW with the exception of the far north-west. Diamond Firetail occurs in the NSW, ACT, Queensland, Victoria and South Australia. In NSW the concentration of records occur from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Brown Treecreeper (eastern subspecies) is endemic to eastern Australia, occurring in the inland plains and slopes of the Great Dividing Range. The western boundary of the range for this species runs approximately through Wagga Wagga, Temora, Forbes, Dubbo and Inverell.

How is the proposal likely to affect the current disturbance regimes?

The area of potential habitat for these four woodland birds is managed for stock grazing. The proposed construction is unlikely to change the current disturbance regime for these species.

How is the proposal likely to affect habitat connectivity?

Potential habitat in the study area is already fragmented and isolated from clearing associated with stock grazing. The potential habitat for these species in the study area is patchy and generally of poor quality. Additionally, the species' are mobile and the proposal is unlikely to create barriers to their movement. The proposal would not further fragment or isolate potential habitat for these woodland bird species.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for the Speckled Warbler, Brown Treecreeper, Diamond Firetail or Hooded Robin.

Conclusion

The study area contains populations of both Speckled Warbler and Diamond Firetail and potential habitat for the Brown Treecreeper and Hooded Robin. The effects of the proposal on these species are likely to be minor as:

- The Hooded Robin, Speckled Warbler and Brown Treecreeper all have a home range that is considerably larger than that which would be affected by pipeline construction;
- Known and potential habitat for these species are reasonably well represent in the locality;
- The proposal is unlikely to have a major impact on the lifecycle of these species; and,
- Connectivity of habitat will not be diminished by the proposal.

Therefore, the proposal is unlikely to significantly reduce the availability of potential habitat for these species within the study area through processes such as fragmentation, modification or clearing.

APPENDIX 7

EPBC Act Impact Assessments

Critically Endangered and Endangered Ecological Communities

White Box – Yellow Box – Blakely’s Red Gum grassy woodland and derived native grasslands

‘Box Gum Grassy Woodland’

Box Gum Grassy Woodland (BGGW) is listed as a Critically Endangered Ecological Community under the EPBC Act. Representative examples of this community were recorded within the study area and will be impacted by the proposed development. Approximately 11 ha poor to good quality BGGW (of which about 5 ha is in good to moderate condition and conforms to the EPBC Act definition of the community) would either require removal or be affected by varying levels of disturbance, including soil stripping and compaction.

Is the action likely to lead to a long-term adverse affect on an ecological community?

The condition of BGGW within the study area ranges from good quality remnants, in the ACT and parts western NSW sections and the Gibraltar ‘saddle’ area, to patches that have been highly modified through weed invasion, soil disturbance, fragmentation and alteration to nutrient levels. The area that would be impacted by the proposal mostly occurs in vegetation of moderate and poor (mid-storey and ground-cover) condition, apart from approximately 2.6 ha in the ACT and 2.4 ha within NSW, which contains moderate to good quality BGGW and moderate to high species diversity. The proposed development would also require the removal of approximately 65 mature trees in the ACT and about 125 mature trees within the NSW sections of this or associated communities – including up to 50 mature trees in the Gibraltar ‘saddle’ area and an equivalent number in blocks 1-126283, 201-754889, 152—754889 and 170-744889. The loss or modification of 5 ha of this EEC is unlikely to have significant long-term adverse impact on the ecological community.

Is the action likely to reduce the extent of a community?

Much of the vegetation that occurs in the study area has been modified for agricultural purposes, however, some good quality remnants occur in the ACT, ACT/NSW border and either side of the Gibraltar ‘saddle’. Vegetation mapping indicates that approximately 10,865 ha of BGGW occur within the ACT. This mapping also shows the plant community generally occurs as small disturbed remnants within agricultural, residential and recreational land. The proposal will result in direct impacts to approximately 5 ha of BGGW that is relevant to the EPBC Act from within the study area.

Is the action likely to fragment an occurrence of the community?

The band of BGGW to be removed as part of the proposal will mainly relate to short-term to medium-term disturbance of the ground-cover, while mature trees will be retained. The area will be rehabilitated as soon as possible after the pipeline has been installed. The removal or modification of vegetation within the study area would not result in the further isolation of any areas of BGGW.

Is the action likely to adversely affect habitat critical to the survival of an ecological community?

The Threatened Species Scientific Committee and the Minister for the Environment, Water Resources, Heritage and the Arts maintain a register of critical habitat. To date, there is no critical habitat listed for BGGW.

Is the action likely to modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for the community's survival?

The proposal would removal approximately 5 ha of BGGW that is in moderate to good condition. Another 6 ha of mostly poor condition BGGW (generally did not contain a minimum of 12 native non-grass understorey species) would also be removed. The action is not likely to modify or destroy abiotic factors that are necessary for the survival of the remaining patches of BGGW outside the construction area, as the disturbance area will be restricted to a narrow band. The proposal will not involve use of any chemicals or result in disturbance to the soil profile and vegetation outside the construction corridor. The removal of 5 ha of moderate to good quality BGGW understorey is not considered likely to impact on the survival of BGGW.

Is the action likely to result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat;?

Given the presence of invasive weed species in the study area, there is potential for further weed dispersal post clearing, however, as the area will be maintained and monitored for at least two years after completion of the development, it is considered unlikely that there will be further impacts on BGGW in the study area.

Is the action likely to interfere with the recovery of an ecological community?

An Action Plan (ACT Government 2004) refers to regeneration of disturbed patches and maintaining all structural layers, including the understorey, to ensure the viability of the remnant. In its present state, the understorey of BGGW in the study area is variable in content and density of native grass and forb species. The proposed rehabilitation and maintenance proposals will be dedicated to the regeneration of BGGW in the study area to ensure its viability in the long term.

Conclusion

Some components of good to moderate quality BGGW would be affected by the proposed action, however, this would amount to little more than 5 ha, which would be fully rehabilitated after construction. The removal of between 180 and 200 mature eucalypt trees from the site means that restoration of the original upper canopy structure would be a long-term process. Provided that proposed rehabilitation is well funded and resourced the impacts to the community are unlikely to be significant. However, given the removal of moderate to good quality BGGW, with the associated removal of approximately 200 mature native trees across the study area, would be affected it is recommended that the proposal be Referred to DEWHA for further consideration.

Recommendations for Controlling Actions may include further reduction of the construction width within moderate quality vegetation and commencement of recovery operations as soon as is practicable after infilling.

Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT

Natural Temperate Grasslands (NTG) mainly occur in valleys below 625 m, where trees are uncommon because of factors such as low temperatures, low rainfall, clay soils or soils of low fertility. It is possible that NTG is the most threatened ecosystem in Australia, with only 0.5% of its original area surviving in good condition (ACT Government 2005).

Perennial Tussocks growing to 1m in height, interspersed with other grass species and forbs form the structure of this vegetation type. NTG provides habitat for a range of threatened flora and fauna species.

Threats to this vegetation type include: pastoral and agricultural development; urban and infrastructure development; weed invasion; changed and inappropriate fire regimes; and other forms of disturbance associated with land management or feral animals.

NTG is listed as an Endangered Ecological Community under the EPBC Act. This community was recorded within the ACT section of the study area and will be impacted by the proposal, with approximately 1.7 ha requiring removal or varying levels of disturbance

Is the action likely to lead to a long-term adverse affect on an ecological community?

Natural Temperate Grassland within the study area is for the most part in good condition though some sections are modified through weed invasion, soil disturbance and fragmentation. The area that will be impacted by the proposal is in moderate to good condition, based mainly on presence and density of native grasses and forbs. Although the proposal would remove approximately 1.7 ha of NTG the planned rehabilitation of the site after completion of the development would re-establish much of this community over time. It is unlikely that the proposal would have long-term adverse impact on the ecological community.

Is the action likely to reduce the extent of a community?

The vegetation in the study area occurs in an area where the original vegetation has been extensively cleared and altered for agricultural purposes. Vegetation mapping indicates that approximately 1,000 ha of NTG occur within a 10 km radius of the study area. This mapping also shows the plant community generally occurs as small disturbed remnants within agricultural, residential and recreational land. The proposal would result in direct impacts to approximately 1.7 ha of NTG from within the study area.

Is the action likely to fragment an occurrence of the community?

The band of NTG to be removed as part of the proposal will mainly relate to short-term disturbance. The area will be rehabilitated at the completion of construction. The removal or modification of vegetation within the study area would not result in the further isolation of any areas of NTG.

Is the action likely to adversely affect habitat critical to the survival of an ecological community?

The Threatened Species Scientific Committee and the Minister for the Environment, Water Resources, Heritage and the Arts maintain a register of critical habitat. To date, there is no critical habitat listed for Natural Temperate Grassland

Is the action likely to modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for the community's survival?

The proposal will result in the removal of 1.7 ha of NTG that is in moderate to good condition. The action is not likely to modify or destroy abiotic factors that are necessary for the survival of the remaining patches of NTG in the vicinity of the study area, as the disturbance area will be restricted to a narrow band, which has been aligned to minimise the other patches of grassland in good condition. The proposal will not involve use of any chemicals or result in disturbance to the soil profile of the adjoining vegetation. The removal of 1.7 ha of NTG is not considered likely to impact on the survival of NTG.

Is the action likely to result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat;?

Given the presence of invasive weed species in the study area, there is potential for further weed dispersal post clearing, however, as the area will be maintained and monitored for at least two years after completion of the development, it is considered unlikely that there will be further impacts on NTG in the study area as a result of the proposal.

Is the action likely to interfere with the recovery of an ecological community?

An Action Plan (ACT Government 2005) refers to several actions aimed at improving conservation of Native grasslands: These include, *inter alia*, "...establishing mechanisms to assist in the application of best practice to facilitate outcomes on reserves and off-reserve land". The proposed rehabilitation and Maintenance proposals will be dedicated to the regeneration of Natural Temperate Grassland in the study area to ensure its viability in the long term. The proposed rehabilitation measures and on-going maintenance will ensure that the disturbed stands of native grassland will recover to a better level than prior to the disturbance.

Conclusion

Based on the above assessment, NTG is unlikely to be significantly impacted by the proposal and, as such, a Referral under the provisions of the EPBC Act is not recommended for this ecological community

Critically Endangered or Endangered Species

Small Purple-pea	<i>Swainsona recta</i>
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Is the action likely to lead to a long-term decrease in the size of a population of a species?

The population of *Swainsona recta* within the railway easement has been previously recorded and searches have been carried out for individuals and meta-populations, resulting in the fencing of several sections of the easement. Efforts will be made to minimise the area of disturbance, and therefore to minimise the number of individuals of *Swainsona recta* which may be disturbed during excavation.

The topsoil which may contain propagules of *Swainsona recta* will be treated according to a strict set of protocols, and the areas will be maintained and monitored, afterwards. It is therefore possible that the existing population would eventually increase, rather than decrease.

Is the action likely to reduce the area of occupancy of the species?

Several scattered individuals of *Swainsona recta* were recorded within the proposed pipeline alignment. Once the pipeline is installed, the area will be rehabilitated, therefore the area of occupancy of *Swainsona recta* within the easement will not be reduced.

Is the action likely to fragment an existing population into two or more populations?

The main areas of concentration of *Swainsona recta* within the railway easement have previously been fenced and will not be affected. The plants which occur within the proposed pipeline alignment occur as scattered individuals, therefore the action will not fragment an existing population.

Is the action likely to adversely affect habitat critical to the survival of a species?

‘Habitat critical to the survival of a species or ecological community’ is defined by DEH (2006) as areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal;
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- to maintain genetic diversity and long term evolutionary development; or,

- for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act (DEH 2006). To date, there is no critical habitat listed by the Minister for the Department of the Environment, Water, Heritage and the Arts for *Swainsona recta*.

The recovery actions which aim to meet the overall recovery objective include:

- Protect known populations from changes to land use;
- Do not undertake road works, pasture modification or other changes in land use that may affect populations;
- Do not increase grazing pressures on sites where populations persist – reduce grazing pressures where possible;
- Eliminate grazing on sites where populations occur, fencing is appropriate;
- Erect on-site signs to alert maintenance staff to the presence of the species;
- Undertake weed control in and adjacent to populations, taking care to spray or dig out only target weeds;
- Undertake Cypress Pine thinning at selected sites;
- Monitor known populations to ensure that management is retaining populations;
- Undertake burning trials on sites to establish a suitable biomass control regime; and to encourage recruitment;
- Search for new populations in potential habitat; and
- Mark sites and potential habitat onto maps used for planning.

The habitat in the study area is not an area considered to be necessary for breeding, dispersal or succession; to maintain genetic diversity; or for the reintroduction of populations or recovery of the species. Therefore, the proposal will not impact on habitat critical to the survival of the *Swainsona recta*.

Is the action likely to disrupt the breeding cycle of a population?

The proposal is considered unlikely to impact the pollination or dispersal of a local population of *Swainsona recta*, given that the proposal:

- Will result in the short-term disturbance of a small proportion of habitat;
- Will not interfere with fire regimes within the study area or locality;

- Will not increase vehicular, bike, pedestrian, or other, access to a known population of the species;
- Is unlikely to increase rubbish dumping within known or potential habitats for the species; and,
- Is unlikely to significantly increase levels of weed invasion within adjacent areas as a programme of maintenance and monitoring will be followed for at least 2 years.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The proposal will result in direct impacts to approximately 16.7 ha of potential habitat for *Swainsona recta*. The area to be directly impacted represents approximately 0.14% of similar habitat types in the local area. Vegetation adjacent to the proposal is already largely cleared, subject to disturbances, particularly grazing, erosion and weed invasion.

Given the relatively small area of habitat directly impacted and poor condition of vegetation in the study area, the proposal is unlikely to modify, destroy or decrease the availability or quality of habitat such that it may result in the decline of the species.

The proposal would impact a very small area of habitat for *Swainsona recta* within the railway easement. The proposal will not result in the isolation or fragmentation of potential habitat for the species.

Given the condition and size of the potential habitat within the study area and the very small area to be removed or modified, it is not considered that the proposal would affect the long term survival of a local population. The proposal is not likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a population of the species is likely to decline.

Is the action likely to result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat;?

Strict protocols for protection during and after all operations will be followed, in order to minimise the potential for weed invasion.

Is the action likely to introduce disease that may cause the species to decline?

The proposal is unlikely to introduce disease that may cause *Swainsona recta* to decline. However, as a precaution contractors should ensure that sub contractor plant and vehicles are clean and free of dirt and organic materials prior to use on sites near areas of native vegetation.

Is the action likely to interfere with the recovery of the species?

No Recovery Plan as published by DEWHA is available for *Swainsona recta*, although the overall objective of such a recovery plan would be to ensure the continued and long-term survival of *Swainsona recta* in the wild by promoting the *in-situ* conservation of the species across its natural range. Specific recovery objectives that relate to *Swainsona recta* are described above.

Conclusion

The proposal would impact upon 16.7 ha of potential habitat for *Swainsona recta* within the study area although the species is only known from a very small proportion of the study area – Goulburn-Cooma Railway corridor and at Burra Creek. A relatively small proportion of potential habitat (approximately 0.14%) would be impacted by the proposal compared to the area of potential habitat that is available in the locality.

The effects of the proposal on *Swainsona recta* and its potential habitat are likely to be minor provided that:

- The construction corridor through the Goulburn-Cooma Railway corridor is reduced to between 10m and 15m in width and is located within the disturbed drainage culvert that crosses the railway corridor;
- Spoil and or equipment and plant are not placed anywhere within the railway corridor; and,
- The site is rehabilitated according to the provisions outlined in Appendix 8 of this document.

Provided that the conditions above are met the proposal is unlikely to fragment or isolate any local populations of this species, and the habitat to be disturbed within the narrow section of the railway corridor is not considered important to this species. For these reasons it is considered unlikely that the proposal would have a significant impact on the local population of *Swainsona recta*.

Button Wrinkle Wort***Rutidosia leptorrhynchoidea*****Is the action likely to lead to a long-term decrease in the size of a population of a species?**

The individuals of *Rutidosia leptorrhynchoidea* that occur within the study area are not located within the proposed pipeline easement.

The topsoil which may contain propagules of *Rutidosia leptorrhynchoidea* will be treated according to a strict set of protocols, and the areas will be maintained and monitored, afterwards. It is therefore unlikely that the existing population would decrease as a result of the proposed development.

Is the action likely to reduce the area of occupancy of the species?

Several scattered individuals of *Rutidosia leptorrhynchoidea* were recorded within the study area, although not within the proposed pipeline alignment. Once the pipeline is installed, the area will be rehabilitated, therefore the area of occupancy of *Rutidosia leptorrhynchoidea* within the study area will not be reduced..

Is the action likely to fragment an existing population into two or more populations?

The plants which occur within the study area occur as scattered individuals, and none will require removal, therefore the action will not fragment an existing population.

Is the action likely to adversely affect habitat critical to the survival of a species?

‘Habitat critical to the survival of a species or ecological community’ is defined by DEH (2006) as areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal;
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- to maintain genetic diversity and long term evolutionary development; or,
- for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat

maintained by the Minister under the EPBC Act (DEH 2006). To date, there is no critical habitat listed by the Minister for the Department of the Environment, Water, Heritage and the Arts for *Rutidosia leptorrhynchoides*.

The following threats have been identified; (see DECC 2005a)

- Loss, degradation and fragmentation of habitat and/or populations for residential and agricultural developments.
- Loss and degradation of habitat and/or populations by intensification of grazing regimes
- Loss and degradation of habitats and/or populations by invasion of weeds
- Increased competition from other native grassland species within the habitat because of adverse increases of biomass and the resultant closing up of the inter-tussock spaces that this species requires.
- Increased competition from other native grassland species within the habitat because of reduced fire frequency.
- Loss and degradation of habitat and/or populations from rail reserve maintenance and road works.
- Inherent risk of loss of small populations from natural or un-natural catastrophic events.
- A further threat relates to the potential for genetic decline: Young and Murray (2000) found that five new tetraploid populations had been “...accompanied by a genetic bottleneck for allozyme diversity as measured by allelic richness...”, which will tend to have a negative affect on population viability and individual fitness.

The habitat in the study area is not an area considered to be necessary for breeding, dispersal or succession; to maintain genetic diversity; or for the reintroduction of populations or recovery of the species. Therefore, the proposal will not impact on habitat critical to the survival of *Rutidosia leptorrhynchoides*.

Is the action likely to disrupt the breeding cycle of a population?

The proposal is considered unlikely to impact the pollination or dispersal of a local population of *Rutidosia leptorrhynchoides*. Given that the proposal;

- Will result in the short-term disturbance of a small proportion of potential habitat,
- Will not interfere with fire regimes within the study area or locality,
- Will not increase vehicular, bike, pedestrian, or other, access to a known population of the species,

- Is unlikely to increase rubbish dumping within known or potential habitats for the species, and,
- Is unlikely to significantly increase levels of weed invasion within adjacent areas as a programme of maintenance and monitoring will be followed for at least 2 years.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The proposal will result in direct impacts to approximately 16.7 ha of potential habitat for *Rutidosia leptorrhynchoides*. The area to be directly impacted represents approximately 0.14% of similar habitat types in the local area. Vegetation adjacent to the proposal is already largely cleared, subject to disturbances, particularly grazing, erosion and weed invasion.

Given the relatively small area of habitat directly impacted and poor condition of vegetation in the study area, the proposal is unlikely to modify, destroy or decrease the availability or quality of habitat such that it may result in the decline of the species.

The proposal would impact a very small area of potential habitat for *Rutidosia leptorrhynchoides* within the railway easement. The proposal will not result in the isolation or fragmentation of potential habitat for the species.

Given the condition and size of the potential habitat within the study area and the very small area to be removed or modified, it is not considered that the proposal would affect the long term survival of a local population. The proposal is not likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a population of the species is likely to decline.

Is the action likely to result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat;?

Strict protocols for protection during and after all operations will be followed, in order to minimise the potential for weed invasion.

Is the action likely to introduce disease that may cause the species to decline?

The proposal is unlikely to introduce disease that may cause *Rutidosia leptorrhynchoides* to decline. However, as a precaution contractors should ensure

that sub contractor plant and vehicles are clean and free of dirt and organic materials prior to use on sites near areas of native vegetation.

Is the action likely to interfere with the recovery of the species?

No Recovery Plan as published by DEWHA is available for *Rutidosia leptorrhynchoides*, although the overall objective of such a recovery plan would be to ensure the continued and long-term survival of *Rutidosia leptorrhynchoides* in the wild by promoting the *in-situ* conservation of the species across its natural range. Specific recovery objectives that relate to *Rutidosia leptorrhynchoides*, include:

- Improve condition of habitat;
- Secure populations or habitat from potentially incompatible land use or catastrophic loss;
- Increase knowledge of biology, ecology or management requirements;
- Increase community awareness and support; and
- Increase the number of populations or individuals

Conclusion

The proposal would impact upon a small area of habitat for *Rutidosia leptorrhynchoides* in the study area. A relatively small area of potential habitat would be impacted by the proposal (16.7 ha) compared to the area of potential habitat available in the locality (approximately 0.14%). The proposal is unlikely to fragment or isolate any local populations of this species, and the habitat to be disturbed is not considered important to this species. For these reasons it is considered unlikely that the proposal would have a significant impact on a population of *Rutidosia leptorrhynchoides*

Hoary Sunray

Leucochrysum albicans* var. *tricolor

Leucochrysum albicans var. *tricolor* is a perennial herb with white, woolly stems and leaves. The flowering period extends from October to March. This species is not palatable to stock, and it would appear that grazing is beneficial, as a result of a reduction in competition from other plant species. A population occurs in Cuumbeun Nature Reserve, on the escarpment to the east of the Queanbeyan Valley. This species occurs on "...undulating valley floors with deeper soils..." in Grassy Woodland (NSW NPWS 2006).

This species is listed as Threatened under the EPBC Act. Individuals of this species do not occur in large numbers within the proposed pipeline route but nevertheless some populations may be affected. Populations also occur along

roadside vegetation along Williamsdale Road and at Burra Creek outside the development footprint.

Is the action likely to lead to a long-term decrease in the size of a population of a species?

Some individuals of *Leucochrysum albicans* var. *tricolor* that occur within the study area are located within the proposed pipeline easement and may require removal.

Research has indicated the importance of maintaining habitat and safe sites for regeneration "...are of immediate importance to the persistence of all *Leucochrysum albicans* var. *tricolor* populations." (Costin, Morgan and Young 2001)

The topsoil which may contain propagules of *Leucochrysum albicans* var. *tricolor* will be treated according to a strict set of protocols, and the areas will be maintained and monitored, afterwards. It is therefore unlikely that the existing population would decrease as a result of the proposed development.

Is the action likely to reduce the area of occupancy of the species?

Several scattered individuals of *Leucochrysum albicans* var. *tricolor* were recorded within the study area, some of which lie within the proposed pipeline alignment. In the short-term, the area of occupancy may be reduced, although once the pipeline is installed, the area will be rehabilitated, therefore the area of occupancy of *Leucochrysum albicans* var. *tricolor* within the study area could eventually be increased.

Is the action likely to fragment an existing population into two or more populations?

The plants which occur within the study area occur as scattered individuals, and several will require removal. Research indicates that this species generally occurs in "...relatively widely dispersed patches within populations..." because the seeds are wind dispersed and do not rely on a soil-borne seed bank for germination of seedlings (Gilfedder & Kirkpatrick 1994).

A targeted rehabilitation programme for this species will ensure that the action will not fragment an existing population in the long term.

Is the action likely to adversely affect habitat critical to the survival of a species?

‘Habitat critical to the survival of a species or ecological community’ is defined by DEH (2006) as areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal;
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- to maintain genetic diversity and long term evolutionary development; or,
- for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act (DEH 2006). To date, there is no critical habitat listed by the Minister for the Department of the Environment, Water, Heritage and the Arts for *Leucochrysum albicans* var. *tricolor*

The habitat in the study area is not an area considered to be necessary for breeding, dispersal or succession; to maintain genetic diversity; or for the reintroduction of populations or recovery of the species. Therefore, the proposal will not impact on habitat critical to the survival of *Leucochrysum albicans* var. *tricolor*.

Is the action likely to disrupt the breeding cycle of a population?

The proposal is considered unlikely to impact the pollination or dispersal of a local population of *Leucochrysum albicans* var. *tricolor*. Given that the proposal:

- Will result in the short-term disturbance of a small proportion of habitat;
- Will not interfere with fire regimes within the study area or locality;
- Will not increase vehicular, bike, pedestrian, or other, access to a known population of the species;
- Is unlikely to increase rubbish dumping within known or potential habitats for the species; and,
- Is unlikely to significantly increase levels of weed invasion within adjacent areas as a programme of maintenance and monitoring will be followed for at least 2 years.

Gilfedder & Kirkpatrick (1994) suggest that the creation of bare areas for seedling establishment and the controlled management of competing grass species should be considered in a revegetation plan for this species.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The proposal will result in direct impacts to approximately 16.7 ha of potential habitat for *Leucochrysum albicans* var. *tricolor*. The area to be directly impacted represents approximately 0.14% of similar habitat types in the local area. Vegetation adjacent to the proposal is already largely cleared, subject to disturbances, particularly grazing, erosion and weed invasion.

Given the relatively small area of habitat directly impacted and poor condition of vegetation in the study area, the proposal is unlikely to modify, destroy or decrease the availability or quality of habitat such that it may result in the decline of the species.

The proposal would impact a very small area of habitat for *Leucochrysum albicans* var. *tricolor* within the railway easement. The proposal will not result in the isolation or fragmentation of potential habitat for the species.

Given the condition and size of the potential habitat within the study area and the very small area to be removed or modified, it is not considered that the proposal would affect the long term survival of a local population. The proposal is not likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a population of the species is likely to decline.

Is the action likely to result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat;?

Strict protocols for protection during and after all operations will be followed, in order to minimise the potential for weed invasion.

Is the action likely to introduce disease that may cause the species to decline?

The proposal is unlikely to introduce disease that may cause *Leucochrysum albicans* var. *tricolor* to decline. However, as a precaution contractors should ensure that sub contractor plant and vehicles are clean and free of dirt and organic materials prior to use on sites near areas of native vegetation.

Is the action likely to interfere with the recovery of the species?

No Recovery Plan as published by DEWHA is available for *Leucochrysum albicans* var. *tricolor*, although the overall objective of such a recovery plan would be to ensure the continued and long-term survival of *Leucochrysum albicans* var. *tricolor* in the wild by promoting the *in-situ* conservation of the species across its natural range.

Conclusion

The proposal would impact upon a small area of habitat for *Leucochrysum albicans* var. *tricolor* in the study area. A relatively small area of habitat would be impacted by the proposal (16.7 ha) compared to the area of potential habitat available in the locality (approximately 10,865 ha). The proposal is unlikely to fragment or isolate any local populations of this species, and the habitat to be disturbed is not considered important to this species. For these reasons it is considered unlikely that the proposal would have a significant impact on a population of *Leucochrysum albicans* var. *tricolor*.

Golden Sun Moth

Synemon plana

The Golden Sun Moth *Synemon plana* is listed as Critically Endangered under the EPBC Act and Endangered under the TSC Act (NSW) and the NC Act (ACT).

The Golden Sun Moth occurs in Natural Temperate Grasslands and Box Gum Grassy Woodlands in which the ground layer is dominated by native grasses, including wallaby grasses *Austrodanthonia* spp., speargrass *Austrostipa* spp. and Redgrass *Bothriochloa macra*, Kangaroo Grass *Themeda australis*, as well as in degraded grasslands dominated by the exotic Chilean needlegrass *Nassella nessiana*, a weed of national significance (DEWHA 2008d). Habitat for this species may contain several wallaby grass species, which are typically associated with other grasses, particularly spear-grasses *Austrostipa* or. Grasslands dominated by wallaby grasses are typically low and open. The bare ground between the tussocks is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically where the females are observed displaying to attract males (DECC 2005b).

The life cycle of the Golden Sun Moth is relatively well understood. The flying season is short, typically lasting from six to eight weeks (during November and December in the ACT region). Males typically fly in bright sunshine during the warmest part of the day, between 10:00 and 14:00 hrs. Adults emerge continuously throughout the flying season (DECC 2005b), but only live for two to five days and cannot feed (DEWHA 2008d). It is believed that the females lay

up to 200 eggs at the base of the *Austrodanthonia* tussocks after mating. The eggs hatch after 21 days. The larvae tunnel underground where they remain feeding on the roots of *Austrodanthonia* before digging a vertical tunnel to the surface where the pupa remains for six weeks until the adult moths emerge (DEWHA 2008d).

Female Golden Sun Moths have reduced hind wings and are reluctant to fly, even when disturbed. Males, which are capable of flight, will not fly greater than 100 m away from areas of suitable habitat. Thus populations separated by distances of greater than 200 m can be considered effectively isolated and populations which have gone extinct, or vacant patches of suitable habitat, are highly unlikely to be recolonised (DECC 2005b).

Is there a real chance or a possibility that the action will lead to a long-term decrease in the size of a population of the species?

Good quality native grassland, dominated by *Themeda australis*, occurs in the western sections of the study area and some areas along Williamsdale Road and Burra Creek. This is considered marginal potential habitat for the Golden Sun Moth. Other poor quality grasslands dominated by *Austrodanthonia* sp.-*Austrostipa* sp. occur in other more modified parts of the study area, such as east of the Goulburn-Cooma railway corridor and along Williamsdale Road east of the Gibraltar ‘saddle’. Grassy habitat along Burra Creek was considered to be in good to moderate condition. Those areas containing *Austrodanthonia* sp. form preferred potential habitat for the Golden Sun Moth and could be used for breeding, although the level of grazing is probably restrictive.

The Golden Sun Moth was not recorded in the study area or within 10 km of the study area. Given the lack of good quality habitat, the lack of records of the species in the study area, and the narrow corridor of disturbance, it is unlikely that the action would decrease the size of a local population of the Golden Sun Moth.

Is there a real chance or a possibility that the action will reduce the area of occupancy of a population of the species?

The Golden Sun Moth was not recorded in the study area or within 10 km of the study area. Parts of the study area contain native grasslands that may be suitable for this species, however, targeted surveys were carried out in the appropriate season and the species was not recorded. The lack of records in the area and lack of success in targeted surveys suggest the species does not inhabit the study area. It is therefore unlikely that the action would reduce the area of occupancy for this species.

Is there a real chance or a possibility that the action will fragment an existing population into two or more populations?

The Golden Sun Moth was not recorded in the study area or within 10 km of the study area. Parts of the study area contain native grasslands that may be suitable for this species, however, targeted surveys were carried out in the appropriate season and the species was not recorded. The lack of records in the area and lack of success in targeted surveys suggest a population of this species is unlikely to occur in the study area.

The draft guidelines for determining a significant impact (under the EPBC Act) on the Golden Sun Moth suggest that fragmentation of a population through the introduction of barriers to dispersal (such as through creating gaps of greater than 200 m, or structures that prohibit movement) would be considered a significant impact (DEWHA 2009b). The proposed disturbance corridor would be a maximum of 40 m, so no fragmentation of habitat is expected.

Given the lack of good quality habitat and the patchy nature of this potential habitat, the narrow disturbance corridor, and the lack of records of the species in the study area, it is unlikely that the proposal would fragment an existing population into two or more populations.

Is there a real chance or a possibility that the action will adversely affect habitat critical to the survival of the species?

No critical habitat has been listed for the Golden Sun Moth (DEWHA 2008c). *Austrodanthonia* tussocks are considered vital for the survival of the species, as it lays its eggs at the base of these plants, and the larvae feed on them. Lower quality grasslands dominated by *Austrodanthonia* sp.- *Austrostipa* sp. occur in modified parts of the study area, such as east of the Goulburn-Cooma railway corridor and along Williamsdale Road east of the Gibraltar 'saddle', where it comprised mostly non-native pasture. Extensive targeted searches for the species in November and December did not reveal its presence. Given the lack of good quality habitat and the lack of records of this species in the area, it is considered unlikely that the action would adversely affect habitat critical to the survival of the Golden Sun Moth.

Is there a real chance or a possibility that the action will disrupt the breeding cycle of an important population of the species?

Lower quality grasslands dominated by *Austrodanthonia* sp.- *Austrostipa* sp. occur in modified parts of the study area, such as east of the Goulburn-Cooma railway corridor and along Williamsdale Road east of the Gibraltar 'saddle', where it comprised mostly non-native pasture. These areas form potential habitat

for the Golden Sun Moth and could be used for breeding, although the level of grazing is probably restrictive.

The Golden Sun Moth was not recorded in the study area or within 10 km of the study area. Extensive targeted searches for the species in November and December did not reveal its presence. Given the lack of good quality habitat, the narrow disturbance corridor, and lack of records of the species in the study area, it is unlikely that the species breeds in the study area, and therefore it is unlikely the proposal would disrupt the lifecycle of the Golden Sun Moth within the study area.

Is there a real chance or a possibility that the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Grassy woodland provided the dominant form of vegetation within the study area, particularly west of the Gibraltar ‘saddle’. Through the top of the ‘saddle’ woodland graded into dry sclerophyll forest and reverted back to grassy woodland to the east. Woodland habitats east of the ‘saddle’ were, for the most part, scattered and highly modified, although there were some examples of good habitat north of Williamsdale Road and along Burra Creek. The grasses in these woodlands were mostly *Themeda australis*, and thus are likely to represent marginal habitat at best for this species.

Lower quality grasslands dominated by *Austrodanthonia* sp.- *Austrostipa* sp. occur in modified parts of the study area, such as east of the Goulburn-Cooma railway corridor and along Williamsdale Road east of the Gibraltar ‘saddle’, where it comprised mostly non-native pasture. Grassy habitat along Burra Creek was also considered to be in good to moderate condition. These lower quality habitats contain Wallaby Grass species preferred by the Golden Sun Moth.

The draft guidelines for determining a significant impact (under the EPBC Act) on the Golden Sun Moth suggest that habitat loss, degradation or fragmentation of greater than 0.5 ha for a large area of known habitat (greater than 10 ha), or any habitat loss, degradation or fragmentation for small or fragmented areas of known habitat could be considered a significant impact (DEWHA 2009b). The area of disturbance, while much greater than 0.5 ha over more than 10 ha, is very narrow (40 m in width as a maximum).

This species was searched for extensively during November and December and was not located. Given the lack of records in the study area and locality, and the low quality of potential habitat for this species, it is considered unlikely that the potential habitat in the study area supports populations of the Golden Sun Moth. In addition, the study area is already disturbed and patchy and potential habitat is

of low quality. As such, the proposal is considered unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Is the action likely to result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat;?

The study area currently contains areas of improved pasture featuring exotic groundcover, with some native species. Other invasive plant or animal species are not likely to become established in this area.

Is there a real chance or a possibility that the action will introduce disease that may cause the species to decline?

Diseases have not been identified as a threat to populations of the Golden Sun Moth. It is not anticipated that the proposal would introduce a disease that may cause the species to decline.

Is there a real chance or a possibility that the action will interfere substantially with the recovery of the species?

Given the lack of good quality habitat, and lack of records of the species in the study area, and the small area, it is unlikely that the action would interfere with the recovery of the Golden Sun Moth.

Conclusion

Based on the above assessment, a population of the Golden Sun Moth is unlikely to be significantly impacted by the activities and as such a Referral under the provisions of the EPBC Act is not recommended for this species.

Grassland Earless Dragon

Tympanocryptis pinguicolla

The Grassland Earless Dragon is listed as Endangered under the EPBC Act (Commonwealth), the TSC Act (NSW) and the NC Act (ACT).

The Grassland Earless Dragon historically ranged from Bathurst to Cooma, including the ACT region and Victoria. The only populations now known are in the ACT and adjacent NSW at Queanbeyan, and on the Monaro between Cooma and south-west of Nimmitabel (DECC 2005c).

The Grassland Earless Dragon is restricted to a small number of Natural Temperate Grassland sites dominated by wallaby grasses (*Austrodanthonia* spp.), spear grasses (*Austrostipa* spp.), Poa Tussock (*Poa sieberiana*), Red Grass (*Bothriochloa macra*), and occasionally Kangaroo Grass (*Themeda australis*). Introduced pasture grasses occur at many of the sites supporting this species,

which has also been captured in secondary grassland. 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).

Females are oviparous, and have been found gravid in both spring and early summer, with the eggs laid in late spring or early summer. Clutches of between three and six eggs are laid. Young emerge in summer and early autumn. Some adults must live longer than one year (Robertson and Cooper 2000).

Is there a real chance or possibility that the action will lead to a long-term decrease in the size of a population of a species?

High quality native grassland dominated by *Themeda australis* occurs in the western sections of the study area and some areas along Williamsdale Road and Burra Creek. Although this is considered high quality grassland, the floristic composition is not considered to represent preferred habitat for the Grassland Earless Dragon, although it is considered marginal habitat for this species. Lower quality grasslands dominated by *Austrodanthonia* sp.- *Austrostipa* sp. occur east of the Goulburn-Cooma railway corridor and along Williamsdale Road east of the Gibraltar ‘saddle’, where it comprised mostly non-native pasture. Grassy habitat along Burra Creek was also considered to be in good to moderate condition. Those areas containing *Austrodanthonia* sp. form potential habitat for the Grassland Earless Dragon.

No Grassland Earless Dragons have been recorded in the locality. Preferred habitat in the study area for this species is of low to moderate quality. Given the lack of good quality habitat, the lack of records of the species in the study area, and narrow corridor of disturbance, it is unlikely that the action would decrease the size of a population of the Grassland Earless Dragon within the study area.

Is there a real chance or possibility that the action will reduce the area of occupancy of the species?

No Grassland Earless Dragons have been recorded in the locality. Habitats within in the study area are considered to be of low to moderate quality.

Given the limited extent of suitable habitat; the lack of local records; and that no individuals were captured during targeted surveys, the species is unlikely to occupy the site.

It is, therefore, unlikely that the action would reduce the area of occupancy of a population of the Grassland Earless Dragon within the study area.

Is there a real chance or possibility the action will fragment an existing population into two or more populations?

No populations of Grassland Earless Dragon have been recorded within 10 km of the study area. Parts of the study area contain native and/or secondary grasslands that may be suitable for this species, however, this area is not considered to be primary habitat for the species. Targeted surveys during this study also failed to record the species. The absence of any local record and the habitat type and condition suggests a population of this species is unlikely to occur in the locality. The proposal is unlikely to create significant barriers to this species' movement through the landscape.

Given the lack of good quality habitat and the patchy nature of the potential habitat as well as a lack of local records of the species, it is unlikely that the proposal would fragment an existing population into two or more populations.

Is there a real chance or possibility that the action will adversely affect habitat critical to the survival of a species?

No critical habitat has been listed for the Grassland Earless Dragon (DEWHA 2008c). 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). These habitat features critical to the survival of the species are unlikely to be adversely impacted by the action.

Is there a real chance or possibility that the action will disrupt the breeding cycle of a population?

The majority of the study area is grazing land with little surface rock cover. Parts of the study area contain native and/or secondary grasslands that may be suitable for this species, however, targeted surveys were carried out in the appropriate season and the species was not recorded. Additionally, the preferred habitat for this species in the study area is considered to be of low to moderate quality.

Partially embedded surface rocks, and spider and insect holes could be used for shelter and laying of eggs, should the species occur. Potential egg depository sites are unlikely to be significantly affected by the proposal.

It is unlikely that the action would disrupt the breeding cycle of the Grassland Earless Dragon within the study area.

Is there a real chance or possibility that the action will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Grassy woodland and secondary grassland provided the dominant form of vegetation west of the Gibraltar 'saddle'. Through the top of the 'saddle' woodland graded into dry sclerophyll forest and reverted back to grassy woodland to the east. Habitats east of the 'saddle' were, for the most part, scattered and highly modified, and comprised of mostly non-native pasture, although there were some examples of possible habitat occurred north of Williamsdale Road and along Burra Creek, outside the study area.

This species was searched for extensively and was not located. The preferred habitat for this species in the study area is of poor quality and other grassland habitats do not contain the preferred floristic composition for this species. The lack of good quality habitat and lack of records of the species in the locality suggest the species would not be present in the study area, and it is therefore unlikely that the action would decrease the availability or quality of habitat to the extent that the Grassland Earless Dragon is likely to decline.

Is there a real chance or possibility that the action will result in invasive species that are harmful to a critically endangered or endangered/vulnerable species becoming established in the endangered or critically endangered species/vulnerable habitat?

The study area currently contains areas of improved pasture featuring exotic groundcover, with some native species. Other invasive plant or animal species are not likely to become established in this area.

Is there a real chance or a possibility that the action will introduce disease that may cause the species to decline?

Diseases have not been identified as a threat to populations of the Grassland Earless Dragon. It is not anticipated that the proposal would introduce a disease that may cause the species to decline.

Is there a real chance or possibility that the action will interfere substantially with the recovery of the species?

Given the lack of good quality habitat and lack of records of the species in the locality, it is unlikely that the action would interfere with the recovery of the Grassland Earless Dragon.

Conclusion

It is considered unlikely that a population of the Grassland Earless Dragon would be significantly impacted by the proposed development and as such a referral under the provisions of the EPBC Act is not recommended for this species

Vulnerable Species

Under the EPBC Act, an ‘important population’ is a population that is necessary for a species’ long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are considered important populations:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

Pale Pomaderris	<i>Pomaderris pallida</i>
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Is the action likely to lead to a long-term decrease in the size of an important population of a species?

No individuals of *Pomaderris pallida* occur within the study area and no suitable habitat for this species occurs in the study area, therefore the development will not lead to a long-term decrease in the size of a *Pomaderris pallida* population.

Is the action likely to reduce the area of occupancy of the species?

No individuals of *Pomaderris pallida* were recorded within the study area, nor was suitable habitat for this species recorded, therefore the proposed development is not likely to reduce the area of occupancy of *Pomaderris pallida*.

Is the action likely to fragment an existing population into two or more populations?

No suitable habitat and no existing population of *Pomaderris pallida* occurs in the study area, therefore the proposed development will not fragment an existing population of *Pomaderris pallida*.

Is the action likely to adversely affect habitat critical to the survival of a species?

‘Habitat critical to the survival of a species or ecological community’ is defined by DEH (2006) as areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal;

- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- to maintain genetic diversity and long term evolutionary development; or,
- for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act (DEH 2006). To date, there is no critical habitat listed by the Minister for the Department of the Environment, Water, Heritage and the Arts for *Pomaderris pallida*.

The habitat in the study area is not an area considered to be necessary for breeding, dispersal or succession; to maintain genetic diversity; or for the reintroduction of populations or recovery of the species. Therefore, the proposal will not impact on habitat critical to the survival of *Pomaderris pallida*

Is the action likely to disrupt the breeding cycle of an important population?

The proposal is considered unlikely to impact the pollination or dispersal of a local population of *Pomaderris pallida* given that the proposal;

- Will result in the short-term disturbance of a small proportion of habitats, none of which is suitable for *Pomaderris pallida*,
- Will not involve the disturbance of known or suitable habitat for *Pomaderris pallida*

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

No individuals of *Pomaderris pallida* occur within the study areas and no suitable habitat for *Pomaderris pallida* occurs in the study area, therefore the proposed development is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Is the action likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;?

Strict protocols for protection during and after all operations will be followed, in order to minimise the potential for weed invasion.

Is the action likely to introduce disease that may cause the species to decline?

The proposal is unlikely to introduce disease that may cause *Pomaderris pallida* to decline. However, as a precaution contractors should ensure that sub contractor plant and vehicles are clean and free of dirt and organic materials prior to use on sites near areas of native vegetation.

Is the action likely to interfere with the recovery of the species?

As no habitat and no populations or individuals of *Pomaderris pallida* will be affected by the proposed development, it is unlikely that the action would interfere with the recovery of *Pomaderris pallida*.

Conclusion

The proposal will not impact upon any area of habitat for *Pomaderris pallida*, and no suitable habitat for this species occurs in the study area. The proposal is unlikely to fragment or isolate any local populations of this species, and the habitat to be disturbed is not considered important to this species. For these reasons it is considered unlikely that the proposal would have a significant impact on a population of *Pomaderris pallida*.

Pink-tailed Worm Lizard

Aprasia parapulchella

The Pink-tailed Worm Lizard *Aprasia parapulchella* is listed as a Vulnerable under the EPBC Act (Commonwealth) and TSC Act (NSW). This species status under the NC Act (ACT) was recently upgraded from 'special conservation' to Vulnerable.

The Pink-tailed Worm Lizard is a small fossorial reptile from the family Pygopodidae (legless lizards), which has a maximum snout vent length of 14 cm and a total length of about 24 cm . Pink-tailed Worm Lizard is oviparous (egg laying) with a clutch size of two. Females may need to reach an age of about 3 or 4 years before it can reproduce. There is little data on the breeding behaviour of this species (Osborne and Coghlan 2004).

The species lives beneath surface rocks and occupies ant burrows and feeds on ants, particularly their eggs and larvae (Osborne and Jones 1995b). Key habitat

features for the presence of the Pink-tailed Worm Lizard are a cover of native grasses, particularly Kangaroo Grass (*Themeda australis*) and other native grasses, sparse or no tree cover, little or no leaf litter, and scattered small rock with shallow embedment in the soil surface.

In the Canberra region the species is found in area containing acid volcanic rock types - Late Silurian acid volcanics - that are derived from decomposing rhyodacite, rhyolite or dacite or other Silurian volcanic rocks (Osborne and Coghlan 2004). The distribution of the species is centred on the ACT and this appears to be related to less soil (and rock) disturbance evidenced by the presence of a native grass cover, particularly Kangaroo Grass *Themeda triandra*, Red-leg Grass *Bothriochloa macra* and Wattle Mat-rush *Lomandra filiformis*. The likelihood of occurrence of Pink-tailed Worm Lizard increases with increasing cover of Kangaroo Grass (Osborne and Coghlan 2004). Alternatively, dominance of speargrasses (*Stipa falcata*, *S. bigeniculata*) and Tussock Grass *Poa labillardieri* decreases the likelihood of finding the species (Osborne and Coghlan 2004; ACT Government 2007b; ACT Government 2005). However, moderate numbers of disturbed sites dominated by exotic ground cover species, such as *Avena*, *Vulpia*, *Hypocheirus* and *Bromus* supported at least some individuals, although it was not known if these sites support viable populations (Osborne and Coghlan 2004)

Is there a real chance or a possibility that the action will lead to a long-term decrease in the size of an important population of the species?

The Pink-tailed Worm Lizard was recorded during this study at a number of locations within the ACT section of the study area, and has a seemingly wide distribution within the Murrumbidgee River corridor (and Molonglo River corridor), including the study area (Figure 10). The species was not recorded along Burra Creek despite extensive rock turning or elsewhere in the NSW sections of the study area, although searches were limited in some properties due to access restrictions. The species has also been recorded a number of locations outside the study area: approximately 1 km to the south (DECC Atlas of NSW Wildlife) and about 9.5 km to the north (Biosis Research and DECC Atlas of NSW Wildlife).

The proposal is likely to result in a direct loss of known and potential habitat for the Pink-tailed Worm Lizard for the construction of the pipeline and various associated infrastructure (e.g. HLPS and powerline easement) within the ACT components of the study area. The proposed corridor of disturbance is narrow (maximum of 40 m in width). The proposal would remove approximately 2.31 ha of known and/or potential habitat for this species. Indirect impacts may include sedimentation and erosion of habitat, however, control methods are expected to reduce such impacts.

The dispersal ability of the Pink-tailed Worm Lizard is not well known. Populations appear to be relatively isolated and the species is unlikely to travel far due to its mostly fossorial nature and dependence upon habitat that contains partially-embedded rocks and individuals are thought to remain faithful to the same rocks over a long period of time (DEWHA 2008a). The lizard has been caught in pitfall traps in the past which suggests that the species will on occasions travel above ground over some unknown distance. There is no information on what is the likely extent or purpose of such traverses, although it may have some functional relationship to dispersal or breeding. It is therefore possible that some seemingly isolated populations could be active components of a larger local population.

Although 2.31 ha of known habitat, and a proportion of the local population is likely to be affected it is, however, unlikely that this would lead to the long-term decrease in the size of the wider local population of the species.

Is there a real chance or a possibility that the action will reduce the area of occupancy of an important population of the species?

The proposal would remove approximately 2.31 ha of known and/or potential habitat for this species. Given the species' dependence upon partially-embedded rocks and its limited dispersal abilities, any loss of and/or disturbance to the surface rock in this location is likely to reduce the area of occupancy by 2.31 ha for the local population.

Is there a real chance or a possibility that the action will fragment an existing important population into two or more populations?

Given the distribution of records of Pink-tailed Worm Lizard within the ACT section of the study area and the presence of suitable habitat both north, south and east of the study area (eg. particularly within the Murrumbidgee River corridor), it is likely that the vegetation clearing and disturbance within the construction corridor through known and potential habitat could form a barrier to movement for the local population, however, reinstatement of habitat would restrict this impact to the short-term. It should be noted that Angle Crossing Road already forms a potential barrier for north and south movement along the Murrumbidgee River corridor for the species. Other non-natural local barriers include the Monaro Highway and Williamsdale Road.

It is unknown if the proposed works would have a lasting effect on the local movement of the species such that components of the population would become permanently isolated from each.

Is there a real chance or a possibility that the action will adversely affect habitat critical to the survival of the species?

While no critical habitat has been declared for the Pink-tailed Worm Lizard (DEWHA 2008c) there are vital habitat components that the species requires for their survival (DEC 2005a). These features include the presence of loose surface rocks, which provide shelter for both the Pink-tailed Worm Lizard and ants (which also provide burrows and food resources for the lizard).

The proposal would remove some of these habitat components (2.31 ha) from the study area.

Is there a real chance or a possibility that the action will disrupt the breeding cycle of an important population of the species?

The Pink-tailed Worm Lizard is oviparous (egg laying) with a clutch size of two. Females may need to reach an age of about 3 or 4 years before they can reproduce. There is little data on the breeding behaviour of this species. The Pink-tailed Worm Lizard is thought to lay eggs within the ant nests that it uses as a source of food and shelter under rocks (DEC 2005a).

The proposal is likely to result in a direct loss of individuals and known and potential habitat for the Pink-tailed Worm Lizard. Given this loss, the limited dispersal ability of the species, that habitat will be, at least, partially fragmented, and the long term to maturation for females it is possible that the proposal would disrupt the breeding cycle of some components of the local population.

Is there a real chance or a possibility that the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The Pink-tailed Worm Lizard was recorded within the ACT section of the study area. The proposal is likely to remove 2.31 ha of known and/or potential habitat for this species. As discussed above, this action would reduce a small proportion habitat for the species as well as potentially fragmenting some components. While these actions could impact the breeding cycle of the species in the western section of the study area this is not considered to be significant. In consideration of the above it is unlikely that the proposal would remove, modify, destroy, isolate and decrease a significant area of the available habitat to the extent that the species is likely to decline.

Is there a real chance or a possibility that the action will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat?

The study area provides known and potential habitat for the Pink-tailed Worm Lizard in the form of grasslands, ranging in condition from poor to good. Although the Pink-tailed Worm Lizard appears to favour native grasslands, it may also occur in disturbed grasslands or open woodland with a moderate exotic species component. Provided that adequate weed control and rehabilitation programs are implemented it is considered unlikely that the proposal would significantly exacerbate the occurrence of invasive weed species within areas of potential habitat for the Pink-tailed Worm Lizard.

The Pink-tailed Worm Lizard was recorded within better quality habitats within the ACT sections of the study area (and it remains to be found in the NSW sections). While it is possible that the proposal could spread/introduce exotic weed species from other parts of the study area, their management and control will be an important part of the proposed rehabilitation plan.

Rabbits have been identified as a threat to the Pink-tailed Worm Lizard (DEC 2005a) and already exist within the study area it unlikely that the proposal would increase the density or extent of their occurrence.

Is there a real chance or a possibility that the action will introduce disease that may cause the species to decline?

Diseases have not been identified as a threat to populations of the Pink-tailed Worm Lizard (DEWHA 2008a).

The proposal is unlikely to introduce disease that may cause Pink-tailed Worm Lizard to decline. However, as a precaution contractors should ensure that sub contractor plant and vehicles are clean and free of dirt and organic materials prior to use on sites.

Is there a real chance or a possibility that the action will interfere substantially with the recovery of the species?

There is no current National (DEWHA) or State (DECC) recovery plan for the Pink-tailed Worm Lizard, however, a recovery plan was prepared for the species in 1995 by the ACT Government (Osborne and Jones 1995b). The plan, which has now passed the ten-year effective period, identified the following relevant recovery strategies:

- Conduct surveys to determine extent, condition and conservation status of suitable habitat;
- Prepare a monitoring program for the species; and,

- Ensure appropriate habitat management at important sites including the prevention of rock removal.

In addition, the DECC has developed a list of 17 Priority Actions and recovery strategies to help recover this species in NSW. Those actions relevant to the proposal include:

- Undertake a review of threats at known sites;
- Reserve or ensure long-term management of known populations;
- Undertake surveys for the species in areas of identified potential habitat using survey guidelines;
- Search for the species in suitable habitat in areas that are proposed for development or management actions, and mark sites onto maps or plans;
- Control invasions of weeds and pasture species (but be wary of the impact of herbicide use in habitat);
- Protect natural grassland remnants within the known distribution of the species; and,
- Ensure remnant populations remain connected or linked to each other.

While targeted surveys have been carried out for the species (in line with the above recovery strategies) in the ACT and some NSW sections, the proposal could in a very limited sense interfere with the recovery of the Pink-tailed Worm Lizard due to the removal, disturbance, fragmentation and isolation of individuals and habitat.

Conclusion

Based on the above assessment, the Pink-tailed Worm Lizard would be affected by the proposed action. It is, however, unlikely that this would lead to a significant impact on the species although it may result in a negative impact on the some components of the local population, including the direct loss of 2.31 ha of potential habitat and some possible fragmentary effects within the ACT section of the study area. Additional targeted surveys for the species should be conducted in 170-754889 and 152-754889. On this basis a referral to DEWHA is recommended for further consideration of this species.

Striped Legless Lizard	<i>Delma impar</i>
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The Striped Legless Lizard *Delma impar* is listed as Vulnerable under the EPBC Act (Commonwealth), the TSC Act (NSW) and the NC Act (ACT).

The Striped Legless Lizard occurs in the Southern Tablelands, the South Western Slopes and possibly on the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma and Tumut areas (DECC 2005e). The formerly continuous distribution around the ACT has been reduced to four discrete areas: Gungahlin, the lower Majura Valley, the lower Jerrabomberra Valley and Yarramundi Reach. It also occurs in Victoria and south-eastern South Australia (DEWHA 2008b). The study area is at the eastern limit of distribution for this species.

The Striped Legless Lizard is found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component, and occasionally in open Box Gum Grassy Woodland. Potential habitat occurs where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass (*Themeda australis*), spear-grasses (*Austrostipa* spp.) and Poa tussocks (*Poa* spp.), and occasionally wallaby grasses (*Austrodanthonia* spp.). It is sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter (DECC 2005e).

Striped Legless Lizards appear to have small home ranges, with lizards often recaptured less than 10 m from the original capture site. Individuals have, however, been recorded moving over 60 m from their original capture point. The species forages for ground invertebrates, such as wolf spiders and crickets (DEWHA 2008b).

The lifespan of Striped Legless Lizards is estimated to be at least 10 years, with reproduction starting from two to three years for males and three to four years for females. Females lay one clutch of two eggs in early to mid-summer and hatching occurs in late summer, 35 to 60 days after laying (Smith and Robertson 1999).

Is there a real chance or a possibility that the action will lead to a long-term decrease in the size of an important population of the species?

No Striped Legless Lizards have been recorded within the study area. The closest record occurs approximately 20 km to the north in the Jerrabomberra Valley, west of Queanbeyan.

High quality native grassland within the study area includes secondary grassland (the remains of Box/Gum Woodland after removal of trees) and possible NTG (including *Themeda australis*). This high quality native grassland dominates the western sections of the study area and some components along Williamsdale Road and Burra Creek. Lower quality grasslands dominated by *Austrodanthonia* spp. and *Austrostipa* spp. occur in other more modified parts of the study area, such as east of the Goulburn-Cooma railway corridor and along Williamsdale

Road east of the Gibraltar ‘saddle’, where it comprised mostly non-native pasture (although there were exceptions). Grassy habitat along Burra Creek was also considered to be in good to moderate condition. However, the area west of the Goulburn-Bombala Railway easement (ACT) was in better condition than that which occurred to the east (NSW).

The proposal may disturb some grasslands that contain grass tussocks, representing preferred habitat for the Striped Legless Lizard. However, due to grazing pressures, much of the grasslands in the study area contain only small patches of suitable grass tussocks. Given the patchiness of suitable habitat throughout the study area and that the species has not been recorded in the study area despite targeted searches (pitfall traps checked every day from November 2008 to January 2009 inclusive), it is unlikely that the species is present and therefore, it is unlikely that the action would decrease the size of an important population of the Striped Legless Lizard within the study area.

Is there a real chance or a possibility that the action will reduce the area of occupancy of an important population of the species?

No Striped Legless Lizards have been recorded in the locality. Approximately 4 ha of potential habitat (ranging from poor to high quality) would be affected by the proposal. Given the species has not been previously recorded in the study area despite targeted searches, it is unlikely that an important population would inhabit the area, and therefore it is unlikely the action would reduce the area of occupancy of an important population of the Striped Legless Lizard within the study area.

Is there a real chance or a possibility that the action will fragment an existing important population into two or more populations?

No populations of Striped Legless Lizard have been recorded in the locality. Potential habitat (ranging from poor to high quality) occurs throughout the study area. The study area could provide connectivity for other undiscovered populations in the locality, although given the extent and type of agricultural practices (i.e. grazing and cropping) this is considered unlikely. The potential habitat for this species in the study area is patchy. Additionally, the proposal is unlikely to create significant long-term barriers to this species’ movement through the landscape.

Given the lack of good quality habitat and the patchy nature of the potential habitat as well as a lack of local records of the species, it is unlikely that the proposal would fragment an existing population into two or more populations.

Is there a real chance or a possibility that the action will adversely affect habitat critical to the survival of the species?

No critical habitat has been listed for the Striped Legless Lizard (DEWHA 2008c). The Striped Legless Lizard is found mainly in NTG but has also been captured in associated secondary grasslands or grasslands that have a high exotic component. Habitat critical to the survival of the species is unlikely to be adversely impacted by the proposal.

Is there a real chance or a possibility that the action will disrupt the breeding cycle of an important population of the species?

The study area provides potential habitat for the Striped Legless Lizard in the form of primary and secondary grasslands, ranging in condition from poor (heavily disturbed, high occurrence of exotic species) to good (intact native groundcover species, less disturbance). However, targeted surveys were carried out in the appropriate season and the species was not recorded.

Given the patchiness of potential habitat and lack of local records, it is unlikely that the proposal would disrupt the breeding cycle of the Striped Legless Lizard within the study area.

Is there a real chance or a possibility that the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The proposal is likely to remove and/or disturb potential habitat for the Striped Legless Lizard. However, the species is considered unlikely to occur within the study area. If present, the loss of and disturbance to areas of high quality habitat (e.g. western section of the study area, some components along Williamsdale Road, Burra Creek) could impact the species. While the Striped Legless Lizard inhabits a small home range, it is able to travel and could potentially seek out new areas of habitat nearby.

Is there a real chance or a possibility that the action will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat?

The study area provides potential habitat for the Striped Legless Lizard in the form of grasslands, ranging in condition from poor to good. It is considered unlikely that the proposal would significantly exacerbate the occurrence of invasive weed species within areas of potential habitat for the lizard.

Rabbits have been identified as a threat to the Striped Legless Lizard (DECC 2005e; DEC 2005a). Rabbits already occur within the study area and the proposal is considered unlikely to significantly exacerbate their occurrence.

Is there a real chance or a possibility that the action will introduce disease that may cause the species to decline?

Diseases have not been identified as a threat to populations of the Striped Legless Lizard (DEWHA 2008b). It is not anticipated that the proposal would introduce a disease that may cause the species to decline.

Is there a real chance or a possibility that the action will interfere substantially with the recovery of the species?

There is a national recovery plan for the Striped Legless Lizard (Smith and Robertson 1999). Recovery strategies listed by the plan that are relevant to the proposal include:

- Determine the distribution of potential Striped Legless Lizard habitat;
- Identify the nature and extent of the threatening processes affecting Striped Legless Lizard; and,
- Assess the need for salvage and translocation, determine their feasibilities.

In addition, the DECC has developed a list of 16 Priority Actions and recovery strategies to help recover this species in NSW. Those actions relevant to the proposal include:

- Survey potential habitat of Striped Legless Lizard to determine species distribution;
- Survey for the species in suitable habitat in areas that are proposed for development or where changes in management actions are proposed, and mark sites onto maps or plans;
- Retain and protect natural grassland remnants within the known distribution of the species;
- Control invasions of weeds and pasture species (but be wary of the impact of herbicide use in habitat); and,
- Ensure remnant populations remain connected or linked to each other.

The proposal is likely to remove and/or disturb potential habitat however, it is considered unlikely that the Striped Legless Lizard occurs within the study area. Therefore, it is unlikely that the action would interfere with the recovery of the species.

Conclusion

It is considered unlikely that a population of the Striped Legless Lizard would be significantly impacted by the proposed development and as such a referral under the provisions of the EPBC Act is not recommended for this species.

APPENDIX 8

Recommendations for Reinstating Native Grassy Vegetation

**Recommendations for
Minimising Disturbances
and Reinstating Native
Grassy Vegetation:
Murrumbidgee to Googong
(M2G) Transfer Pipeline
Project**

November 2008

Biosis Research Pty. Ltd.

Report for ACTEW Corporation

**Recommendations for
Minimising Disturbances
and Reinstating Native
Grassy Vegetation:
Murrumbidgee to Googong
(M2G) Transfer Pipeline
Project**

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1.0 INTRODUCTION

The Bulk Water Alliance (BWA) is investigating the construction of a pipeline to transfer water from the Murrumbidgee River at Angle Crossing to Burra Creek, which will then drain into the Googong Dam. It is proposed that the pipeline be buried to minimise its visual impact, in line with current community preferences. The pipeline will be approximately 14km in length and will pass through a considerable length of native vegetation, including natural temperate grassland and grassy box/gum woodland. Each of these is listed as a threatened ecological community¹ under ACT, NSW and/or Commonwealth legislation.

This report describes the underlying principles involved in minimising disturbance during construction and in post disturbance management to maximise recovery of the grassy ground layer vegetation.

2.0 GUIDING PRINCIPLES

The most fundamental principle is that disturbance of grassy ground layer vegetation and of the soil in which it grows should be kept to a practicable minimum. The term disturbance refers to: excessive crushing of plants, removal of plants, disturbance of their root systems, physical disturbance of the soil, compaction of the soil, chemical changes to the soil, and changes to the ability of the soil to absorb or retain water. Each of these disturbances has strong potential to modify the plant species composition, growing conditions and competitive relationships between native plants and weeds. Biosis Research recognises that considerable disturbance is inevitable in digging and backfilling a trench, but also strongly suggests that with care, many of the peripheral disturbances can be minimised or even avoided.

¹ Grassy box/gum woodland is classified as a 'critically' endangered ecological community under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. It is also listed as threatened under the Threatened Species Conservation Act, 1995 (NSW) and the Nature Conservation Act, 1980 (ACT).
Natural Temperate Grassland is listed as a threatened ecological community under the Commonwealth and ACT legislation.

3.0 DISTURBANCE: IMPLICATIONS AND RESPONSE

3.1 Soil compaction

Vehicles used to access the pipeline route and machinery used during construction, will unavoidably apply compaction forces to both the vegetation and the soil. This compaction can both kill plants and increase the soil density, removing soil pores which allow the movement of both air and water through the soil. Soil is generally more prone to compaction when there is significant soil moisture, as the water lubricates the soil particles allowing them to move more freely.

Plant death and soil compaction can be reduced by minimising the amount and spread of traffic, and by limiting traffic and works to periods when the soil is least wet. After significant rain events, when the surface soil is at its highest moisture content, traffic and works likely to compact the soil should be completely avoided if at all possible.

3.2 Soil mixing

The mineral and organic composition of soil changes with depth. The near surface soil contains the highest proportion of organic material and living organisms. This soil should be kept separate from the more clayey and less organic subsoil, and the underlying weathered rock, and replaced on top of the subsoil when the trench is backfilled. This surface soil is also likely to contain seed of native plant species which can then germinate and begin to re-establish the natural vegetation cover over the pipeline.

3.3 Bulk density and structure of trench backfill

When removing soil from a trench and subsequently backfilling, the soil bulk density and structure are unavoidably modified. Soil density and structure each have a strong influence on the freedom of both air and water to enter and permeate the soil. Both air and water are necessary for most soil organisms, including plant roots. This is probably most critical in the near surface soil, about the top 100mm. When the trench is being backfilled, careful consideration should be given to the degree of compaction of the separated surface soil being reinstated last.

3.4 Finished soil surface topography

Soil surface topography influences soil moisture movement and thereby the vegetation that can be established or maintained. A depression will tend to collect more moisture

than the surrounding area, while a rise will tend to shed water and produce an effectively drier environment for plants. The ideal finished result would be for the surface topography over the pipeline to be indistinguishable from the surrounding landscape. In practice this may be difficult to achieve, but a realistic target might be to produce the slightest 'ridge' to allow only for the expected settlement, resulting in a level surface in the longer term.

3.5 Weeds

The greatest risk to successful restoration of the native grassy vegetation along the pipeline route is competition from weeds. Physical disturbance of soil usually brings 'fresh' weed seed closer to the surface and closer to light and air. It also usually creates a 'seedbed' which provides more favourable germination conditions. It also often involves the removal of living plants which previously provided competition for newly establishing plants, including weeds. Each of these changes improves conditions for germination and survival of weedy plants, highlighting the importance of keeping soil disturbance to a practical minimum at every stage of the project.

3.6 Weed seed import

Weed seed is easily transported by vehicles and machinery, especially if they carry a significant amount of soil or plant debris from other locations. This is most easily minimised by washing soil and organic debris from vehicles and machinery before bringing them from other areas or work sites.

Weed seed is also frequently introduced with aggregate, soil or organic materials such as mulch, being brought in from external sources. This can be minimised by importing only those materials absolutely necessary for the work. Imported materials may also be treated to kill weed seed by steam sterilisation if that was judged to be practical and valuable.

3.7 Trench spoil stockpiling

The soil and rock spoil excavated from the trench is most likely to be stockpiled next to the trench while the pipe is laid. This also has the potential to cause some compaction, minor physical disturbance and smothering of the ground layer vegetation. Covering the vegetation with a suitable material such as geo-textile, before depositing the trench spoil, is likely to minimise these forms of disturbance, if this is at all practical. This would minimise physical disturbance, weed seed deposition and allow all the spoil to be removed from the ground adjacent to the trench afterwards.

3.8 Smothering of grassy vegetation

Aggregate and organic material imported from offsite sources might also require stockpiling before use. Stockpiling this material on top of the vegetation adjacent to or near the trench may cause damage through smothering, to the grassy vegetation it is placed over. If stockpiling is required, it would be preferable to establish stockpiles in less sensitive areas further from the trench line, or use a barrier material between the stockpile and the ground layer vegetation. The importance of anti-smothering measures will depend upon how long the stockpile or spoil heaps are likely to remain over the vegetation. If the stockpiles or trench spoil are likely to remain only a few days then this may pose minimal threat to the vegetation.

3.9 Vegetation disturbance outside trench

Within the works corridor but outside the trench itself, there is also considerable potential for disturbance of vegetation and soil. Keeping this disturbance to a minimum will also minimise the recovery required and the time and cost of revegetation after project completion. Careful consideration should be used to minimise the volume of traffic along the corridor and to minimise the turning and manoeuvring activity of those vehicles, at least within those sections of the corridor which contain high conservation value vegetation.

3.10 Timing of works and implications

The timing of construction works is also likely to influence the severity of disturbance and the cost and duration of recovery. Much of the annual growth and all of the flowering and seed production of the ground layer vegetation along the pipeline corridor occurs broadly between October and January. This is therefore the most important period of the year for these plant species in maintaining their populations. It would be preferable for the main construction disturbances to occur outside this period.

Most of the herbaceous weeds in the area germinate with increasing soil moisture and decreasing day length in late autumn and early winter. Vegetation disturbance leading into this period will tend to favour these weeds.

Soil moisture is usually at its highest toward the end of the period when evaporation is lowest, so soil moisture usually peaks around the end of winter and is lowest around the end of summer and early autumn. However this can vary considerably with the vagaries of rainfall variability. The soil is at its most vulnerable to compaction and structural damage when soil moisture is highest, but earthworks are likely to be easiest when significant moisture is present. Disturbed soil is most vulnerable to wind erosion when the soil is dry in late summer and early autumn.

The preferred timing of construction works and vegetation disturbance and the degree of flexibility in planning this will depend on the likely duration of the construction works and the type of vegetation in each section of the pipeline corridor. This will require some discussion with the project and construction managers to explore the possibility of planning the most suitable timing.

4.0 REVEGETATION OF PIPELINE CORRIDOR

Once construction work has been completed, the trench backfilled and the soil surface level re-established, there are broadly two options for re-establishing the native grassy vegetation: sowing seed or plants of the desired species, or managing the natural recovery from seed in the soil and the surrounding vegetation. It is most likely that there will be some natural recruitment from native plant seed in the near surface soil, and with time, from the surrounding vegetation. This natural revegetation can also be augmented by intentional sowing of seed of appropriate species. Another way of intentionally introducing appropriate species is to plant out young plants raised off-site from seed. A number of nurseries and other suppliers can supply suitable plants as ‘plugs’, but this is the most expensive approach to revegetation, especially over larger areas, because of the higher cost per plant and the high labour input required.

4.1 Natural recruitment

Natural recruitment of native grassy vegetation from soil borne seed is normal and can be quite effective, but can take a number of years. The vast majority of native ground layer plants in the project area are perennials which tend to produce lower seed volumes and have lower seedling vigour and early growth, than the majority of weed species which are annuals or biennials. Unfortunately there is often also a high number of seeds of these weedy species in the soil before disturbance. The vegetation which results from natural recruitment of soil borne seed after disturbance (construction) is therefore determined by competition between the newly emerging native plants and weeds. It is quite common for the weeds to become apparently dominant due to their high seed numbers and early vigour, for the first few months or even years. However the native plants being more resilient and suited to Australian conditions often become dominant in the longer term. The most important determinant in the longer term success of revegetation of this type is management of this competition between the establishing native plants and the weeds that establish among them.

4.2 Plant species selection

The vegetation along the proposed pipeline corridor varies from more or less unmodified native vegetation (high conservation value), through more modified but still native dominant pasture (medium conservation value), to introduced plant dominant agricultural vegetation (low conservation value). The dominant species is different in each of these communities, and there is a wide diversity of accompanying plant species in the more native and less modified areas. If seed is sown or young plants planted, the most important species to source are the dominant native grasses. These are the plants that provide the structural backbone of the community and the bulk of the biomass and

ground cover. The wide diversity of other species is likely to recolonise on their own in time.

In the most natural vegetation with the highest conservation value, broadly from Angle Crossing to the Goulburn-Bombala rail line, the dominant grass species and the most important species to re-establish is Kangaroo Grass (*Themeda triandra*).

To the east of the rail line, the vegetation becomes more modified native pasture, though this also includes a significant diversity of native plant species and some residual conservation value. The dominant grass species in this area are Wallaby Grasses (*Austrodanthonia* spp.) and Spear Grasses (*Austrostipa* spp.). These grasses produce higher seed numbers, are strong natural recruiters and are quite resilient to livestock grazing and other disturbances. It is most likely that, as long as the trench is back filled and the soil surface prepared carefully, that these grasses and many other species will successfully recolonise from soil borne seed and the adjacent vegetation.

Another area of more natural vegetation with high conservation value straddles the saddle between Gibraltar Hill and Mt Burra. This area is more timbered, being mostly dry forest and woodland. However the ground layer vegetation is also dominated by Kangaroo Grass and contains a wide diversity of other species.

4.3 Seed

There are a small number of commercial native grass seed suppliers, but the volume of seed available is usually limited and this seed is quite expensive. This seed will also often be collected or grown from populations in different environments and distant areas. There are also a small number of contract native grass seed harvesters who could harvest seed from the paddocks or properties the pipeline passes through. This seed is most likely to be considerably cheaper and more genetically suitable, being of local provenance. However timing is critical here, as the window of opportunity for harvesting seed will be limited to a few months from about November to January.

4.4 On-going management

The most important aspect of on-going management of the revegetation process is the management of weed establishment and competition with the establishing native species.

Most weeds occurring within the project area are non-native plants with short (annual or biennial) lifecycles, vigorous early growth and high seed production volumes. Assuming a reasonable degree of successful establishment of native plants over the pipeline, these short term weeds should decline within a few years, even if they initially appear in high numbers. However a small number of perennial weed plants may offer more significant

and lasting competition for the native vegetation. These include African Lovegrass (*Eragrostis curvula*), St. Johns Wort (*Hypericum perforatum*) and Sweet Briar (*Rosa rubiginosa*).

Weed populations and competition with establishing native plants will vary with time, from place to place along the length of the pipeline, and from one paddock to another.

Some monitoring of the vegetation establishing along the pipeline will be required, to gauge which species are becoming dominant and any management action required. Particular attention will be needed to detect populations of the perennial weeds mentioned above and control actions required to remove these, preferably before they produce seed of their own.

Active weed management can employ careful strategic livestock grazing, judicious use of herbicides, or simple manual techniques. Much of the on-going weed monitoring and management could be, and is likely to be, performed by the owners and managers where the pipeline crosses private land. Areas of public land will need to be monitored and managed by public authorities.

4.5 Possible actions for taking swards (or sections of grassland)

- Thoroughly irrigate the sward no more than one day before excavation begins
- Lift sections of sward by light machinery: Sections should not exceed 1m x 1m, and should not be less than 100mm in depth
- Lay the sward sections in wind-rows: do not stack! Search each section for weed species and carefully remove manually.
- Erect a temporary fence around the wind-row or placed outside the construction easement, to restrict vehicular damage, and to prevent stockpiling of fill and/or materials over the wind-row.
- Sward sections should be returned to a permanent site as soon as possible: Five days should be an optimal maximum. Assume that after 10 days, most of the soil micro-organisms will have died and therefore the survival and establishment possibilities of many species will be greatly inhibited.
- Sward sections should not be allowed to dry out. Occasional irrigation or covering with wet hessian should be carried out during hot, dry periods.
- After infilling, the in-filled material should be lightly compacted. The sward sections should be laid to an appropriate depth, so that they are neither higher

nor lower than the surrounding levels. The sward sections should be lightly compacted, and then lightly top-dressed with top-soil derived from the site.

- The re-laid swards should be irrigated once per week, during hot dry conditions.

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Murrumbidgee River to Googong
Dam Water Transfer Pipeline
(Early Discharge Option):
Terrestrial Habitat Assessment -
Addendum Report

December 2009

Report for Bulk Water Alliance Joint Venture

December 2009

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Cover Photo: a tributary (of Burra Creek) located on the southern side of the Williamsdale Road/Burra Road intersection. The proposed early discharge facility would be located near the stand of trees (Black Poplar *Poplar nigra* and Willow *Salix* sp.) in the background.

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1.0 INTRODUCTION

The Bulk Water Alliance Joint Venture (BWA) is considering an option for the early discharge for the proposed Murrumbidgee River to Googong Dam water transfer project. The original proposal was to discharge into Burra Creek below the ‘Onion Farm’ gauging station, east of Burra Road. The site for the new discharge facility is situated west of the Burra Road and Williamsdale Road intersection, approximately 3 km upstream of the original location (Figure 1). The proposed plan for the facility is provided in Figure 2.

This report provides the outcomes of a terrestrial habitat assessment of the proposed new discharge facility and down-stream banks of Burra Creek, between Williamsdale Road and Lagoon Road crossings. This report should be viewed in conjunction with the *Murrumbidgee River to Googong Dam Water Transfer Pipeline: Terrestrial Flora & Fauna Impact Assessment*, Biosis Research, June 2009.

1.1 Aims

The aims of this assessment were to:

- Review ecological literature and database searches used in previous ecological assessments for the Murrumbidgee River to Googong Dam water transfer project (M2G);
- Undertake a general field based habitat assessment of the subject area;
- Determine if any threatened terrestrial species or endangered ecological community (EEC) are likely to occur within the subject area;
- Determine if any threatened species or Endangered Ecological Community (EEC) is likely to be affected by the construction or operation phases and, if so, determine if this would place any constraints on the proposed development; and,
- Provide recommendations where appropriate.

1.2 Background Reports

Biosis Research Pty. Ltd. (Biosis Research) has contributed detailed ecological material for the M2G project EA/EIS documentation, which was prepared for formal submission to the NSW Department of Planning (DoP) and ACT Planning and Land Authority (ACTPLA).

Previous terrestrial ecology impact assessments for the M2G project include:

- *Draft Overview of ecological constraints for the Murrumbidgee River to Googong Dam Raw Water Transfer-Preliminary Design Project* (Biosis Research December 2007); and,
- *Murrumbidgee to Googong Dam Water Transfer Project: Terrestrial Flora and Fauna Impact Assessment* (Biosis Research June 2009).

1.3 Subject Area

The subject area includes the proposed new discharge facility site, located about 100 m west of the Williamsdale Road/Burra Road intersection (approximate coordinates 6063100 – 701375) and banks along Burra Creek to the Lagoon Road crossing (Figure 1).

The subject area is located approximately 34 km south of the Canberra CBD within the Palerang Local Government Area (LGA), and can be found on the Williamsdale (8726-4N) 1:25,000 Map Sheet.

2.0 METHODS

2.1 Taxonomy

The plant taxonomy (method of classification) used in this report follows Harden (1990; 1993, 1994 and 2002). Additional taxonomic information was sought from the following web sites:

- <<http://plantnet.rbgsyd.nsw.gov.au/search/simple.htm>>;
- <<http://www.anbg.gov.au/index.html>>; and,
- <http://www.weedsrc.org.au/index_flash.html>.

Animal taxonomy used in this report follows the Australian Faunal Directory (AFD) located at <<http://www.environment.gov.au/biodiversity/abrs/online-resources/index.html>>.

2.2 Literature and Database Review

Background information used in this assessment was obtained from previous ecological studies for the proposed M2G water transfer project (see Section 3.0 in Biosis Research, June 2009).

These studies were, however, mostly confined to the proposed construction easement and other infrastructure facilities, as defined at the time, and did not specifically correspond with the section of Burra Creek considered in this assessment.

2.3 Habitat Assessment

A terrestrial habitat assessment was conducted on the subject site on Tuesday 18 August 2009. The assessment included a general examination of the type and condition of vegetation and identification of features that may provide suitable habitat for threatened species.

The assessment of the subject area was conducted on foot between 09:00 and 16:00hrs.

2.4 Condition Assessment Criteria

Categories used to evaluate the vegetation (and habitat) value were Good, Moderate, Poor or Disturbed as detailed below:

Good: containing a high number of indigenous species; no weeds present or restricted to a few species in very low densities. Vegetation contains intact structural layers (eg. ground, shrub, canopy) consistent with the community, or if modified, natural soil profile remains intact

Moderate: containing a moderate number of indigenous species; moderate level of weed invasion; weeds occurring in isolated patches or scattered throughout. Vegetation contains largely intact structural layers or if modified, natural soil profile remains intact. Able to be regenerated to Good condition with minimal level of management;

Poor: containing a low number of indigenous species; high level of weed invasion, occurring in dense patches or dominating entire area. Structure may present but is highly modified and natural soil profile intact. Able to be regenerated to Moderate or Good condition with substantial management; and,

Disturbed: highly modified landscape containing few or no indigenous species; exotic species dominant and/or original native vegetation layers removed. Natural soil profile disturbed. Regeneration to near natural condition would not be possible without intensive efforts.

Other habitat features such as the value of the study area as a habitat corridor, presence of EECs, tree hollows, burrows, rock outcrops were also considered during the site assessment.

3.0 RESULTS

3.1 Database Searches

Searches of the Atlas of NSW Wildlife database within a 5 km radius of the subject area revealed the following threatened species:

- Silky Swainson’s Pea *Swainsona sericea*;
- Pink-tailed Worm Lizard *Aprasia parapulchella*;
- Rosenberg’s Monitor *Varanus rosenbergi*;
- Diamond Firetail *Stagonopleura guttata*;
- Hooded Robin *Melanodryas cucullata*;
- Turquoise Parrot *Neophema pulchella*;
- Speckled Warbler *Chthonicola sagittata*;
- Gang Gang Cockatoo *Callocephalon fimbriatum*; and
- Spotted-tailed Quoll *Dasyurus maculatus maculatus*.

The Giant Burrowing Frog *Heleioporus australiacus* has also been recorded in the area but there are no known extant populations of this species in the region. Any local record of this species would be beyond the western limit of its known NSW distribution, and the authenticity of this record is uncertain.

3.2 Previous Terrestrial Studies

Threatened species and EECs that were previously recorded within the locality (Biosis Research June 2009) have been considered in this assessment.

Three threatened species of plant: Hoary Sunray *Leucochrysum albicans* var. *tricolor* Silky Swainson-pea *Swainsona sericea* and Small Purple-pea *Swainsona recta* were recorded within the Burra area (Biosis Research June 2009). *Leucochrysum albicans* var. *tricolor* was recorded within the Burra Road reserve and Braidwood Travelling Stock Reserve (TSR). *Swainsona recta* and *Swainsona sericea* were recorded on the mid and upper slopes along Burra Creek, downstream of the ‘Onion Farm’ gauging station. The observation of *Swainsona recta* is a new location for this endangered species.

Eight threatened (and one preliminarily listed) animal species were recorded during the previous study (Biosis Research June 2009), they are:

- Pink-tailed Worm Lizard *Aprasia parapulchella* (NC Act, TSC Act and EPBC Act);
- Gang Gang Cockatoo *Callocephalon fimbriatum* (TSC Act);

- Speckled Warbler *Chthonicola sagittata* (TSC Act);
- Diamond Firetail *Stagonopleura guttata* (TSC Act);
- Scarlet Robin *Petroica boodang* (proposed vulnerable listing under the TSC Act);
- White-winged Triller *Lalage sueurii* (NC Act);
- Varied Sittella *Daphoenositta chrysoptera* (NC Act and proposed listing TSC Act);
- Large-footed Myotis *Myotis macropus* (TSC Act); and,
- Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis* (TSC Act).

In addition, six species of conservation interest were also recorded:

- Southern White-face *Aphelocephala leucopsis*, Restless Flycatcher *Myiagra inquieta*, Jacky winter *Microeca fascinans* and Double-barred Finch *Taeniopygia bichenovii* (all regionally uncommon woodland species); and,
- Rainbow Bee-eater *Merops ornatus* and Clamorous Reed-Warbler *Acrocephalus stentoreus* (listed as migratory species under the EPBC Act).

Two high conservation value Ecological Communities were identified within the NSW sections of the proposed pipeline route, they are:

- While Box *Eucalyptus albens*-Yellow Box *Eucalyptus melliodora*-Blakely's Red Gum grassy woodland and derived native grassland (listed nationally as a Critically Endangered Ecological Community - CEEC); and,
- Snow Gum *Eucalyptus pauciflora*-Candlebark *E. rubida*-*E. bridgesiana* grassy woodland and associated secondary grasslands occurred east of the Gibraltar 'saddle' and has been nomination for listing as an EEC under the TSC Act (Crooks *et al.* 2009).

3.3 Limitations

This study undertaken was a brief habitat assessment and did not involve targeted surveys for animals or plot-based vegetation sampling.

4.0 RESULTS

4.1 Vegetation

4.1.1 Proposed New Discharge Facility Site

The area considered for the proposed new discharge facility extended west from the Williamsdale Road crossing at Burra Creek to the access road to block 7-246137, approximately 300m to the west.

Vegetation within this area was mostly modified and included variably disturbed roadside vegetation, grazing paddocks (predominately within blocks 7-246137 and 9-247460) and along an unnamed ephemeral channel, which ran parallel to Williamsdale Road. Groundcovers were typically dominated by non-native herbaceous species and small shrubs (i.e. Phalaris *Phalaris aquatica*, Cocksfoot *Dactylis glomerata*, St Johns Wort *Hypericum perforatum*, Lambs Tongue *Plantago lanceolata* and Sheep's Burnet *Sanguisorba minor*, Great Mullein *Verbascum thapsus*, Fleabane *Conyza* sp., Buchan Weed *Hirschfeldia incana*, Sweet Briar *Rosa rubiginosa*, Spear Thistle *Cirsium vulgare* and Goats Beard *Tragopogon dubius*).

Two small patches (about 250 sq m each) of low to moderate diversity secondary grassland were noted along the southern side of Williamsdale Road. Species included Kangaroo Grass *Themeda australis*, Wallaby Grass *Austrodanthonia* sp., Speargrass *Austrostipa* sp., River Tussock *Poa labillardieri*, Hairy Panic *Panicum effusum* and Weatgrass *Elymus scaber* and forbs Common Everlasting *Chrysocephalum apiculatum*, Narrow-leaf New Holland Daisy *Vittadinia muelleri*. In contrast, the northern roadsides along Williamsdale Road contained seemingly higher species diversity with the addition of Creamy Candles *Stackhousia monogyna*, Scaly Buttons *Leptorhynchos squamatus* and Mat Ruch *Lomandra* sp.

Tree and shrubs on the site were almost exclusively non-native species: Poplars *Poplar nigra* and Willow *Salix* sp., and ornamental shrubs (probably apple *Malus domestica* and/or plum *Prunus* sp.), which occurred along the unnamed channel mentioned above. Apart for three planted eucalypts on the eastern bank of Burra Creek and three Silver Wattle *Acacia dealbata* no other native trees or shrubs occurred on the site.

Rank stands of emergent macrophytes (Cumbungi *Typha orientalis* and Common Reed *Phragmites australis*) occurred within Burra Creek channel, either side of the Williamsdale Road crossing.

The proposed discharge facility site has been modified and has low species diversity and has low conservation value.

4.1.2 Burra Creek and bank vegetation - Williamsdale Road Crossing to Lagoon Road Crossing

The in-stream vegetation between Williamsdale Road and Lagoon Road crossings ranged from rank stands of tall emergent macrophytes (*Typha orientalis*, *Phragmites australis* and Tall Spike Rush *Eleocharis* sp.), particularly in areas of shallow standing water, to virtually no instream vegetation on pebbled and rocky substrates (see aquatic report for further detail, Biosis Research August 2009). Various sedges (*Carex* sp. and *Juncus* sp.) and grasses (*Poa labillardieri* and *Phalaris aquatica*) occupied narrow alluvial benches along the edge of the creekline, which became mixed with native grasses, such as *Themeda australis* and *Austrostipa* sp. and non-native grasses such as *Dactylis glomerata*, on lower and mid slopes above the main channel as well as in the drier sections of the creek bed.

Vegetation on the upper banks contained a variable mix of native and non-native vegetation, which included Snow Gum Grassy Woodland (SGGW) and derived secondary grassland. Dominant trees were Snow Gum *Eucalyptus pauciflora* and Candlebark *E. rubida*, Apple Box *E. bridgesiana* with Black Sally *E. stellulata* as a sub-dominant. Groundcovers within better patches of SGGW exhibited a moderate to high plant diversity and a potential for uncommon and/or threatened plant species to occur. Better quality SGGW occurred on Blocks 1-24740, 2-843907, 168-727590 and 2-858605 (Figure 4).

Trees within disturbed and modified riparian zones and adjoining paddocks contained variable mix of exotic species, including *Poplar nigra* and *Salix* spp.

Vegetation within the remaining paddocks along Burra Creek were variably modified and contained mixed groundcovers which were frequently dominated by non-native pasture grasses or, as on Block 2-854164, planted with eucalypt species of unknown origin.

Blocks 1-24740, 2-843907, 168-727590 and 2-858605 are likely to have moderate to high conservation value. The remaining paddocks exhibited generally low species diversity and as result are considered to have low conservation value.

4.1.3 Burra Road and Braidwood TSR

Road reserve along Burra Road contained remnant SGGW that ranged from poor to good condition. Plant diversity within in some sections was moderate to high

and included *Themeda australis*, *Austrodanthonia* sp., *Austrostipa* sp., *Poa* sp., *Panicum effusum* and *Elymus scaber* and forbs such as *Chrysocephalum apiculatum*, *Vittadinia Mueller*, *Stackhousia monogyna*, *Leptorhynchus squamatus* and a large number of the nationally endangered Hoary Sunray *Leucochrysum albicans* var. *tricolor*.

The Braidwood Travelling Stock Route (TSR) occurs on the eastern side of Burra Road and contained SGGW on the lower elevations and dry sclerophyll woodland on the higher sections. Groundcovers in this area appeared to be as diverse, if not more so, as the roadside vegetation along Burra Road.

Vegetation within the road reserve along Burra Road and Braidwood TSR contain diverse groundcovers that, in addition to *Leucochrysum albicans* var. *tricolor*, could include regionally rare and/or threatened species. These two areas have high conservation value.

Approximately 20 individuals of the NSW threatened Silky Swainson-pea *Swainsona sericea* were also noticed within SGGW situated between Burra Creek and Burra Road north of Lagoon Road crossing.

4.1.4 Flora Species

The flora assessment was limited to identifying dominant plant species and species of interest. Plants recorded during the site assessment are listed in Appendix 1.

4.2 Fauna and Fauna Habitats

The investigation for animal species was limited to a habitat based assessment of the subject area. Species observed during the assessment were recorded and are listed in Appendix 2.

The Scarlet Robin *Petroica boodang*, currently nominated for listing as a vulnerable species under Schedule 2 of the TSC Act, was recorded among exotic riparian vegetation about 50 m south-west of the Williamsdale Road – Burra Road intersection.

Rock outcrops

Rock outcrops with small to medium size ‘floating’ surface rocks were noted on the eastern slopes of Burra Creek on Block 1-24740, approximately 300 m north of the Williamsdale Road crossing; Block 7003-96235, near the Burra Rural Fire Station, and Block 2-858605, north of Lagoon Road crossing.

The rock outcrops provide suitable shelter and basking habitat for a range of locally common reptile species i.e. Cunningham's Skink *Egernia cunninghami* and Common Blue-tongued Lizard *Tiliqua scincoides*. It is also possible that threatened Pink-tailed Worm Lizard *Aprasia parapulchella* also occurs beneath loose surface rocks with rocky areas (Figure 3), however, targeted searches were not conducted for this species during the site assessment.

Woodlands

Grassy woodland habitats along the upper slopes of Burra Creek and within the Braidwood TSR provide good habitat opportunities, including shelter and foraging and potential breeding, for threatened woodland birds, such as the Hooded Robin *Melanodryas cucullata* and Diamond Firetail *Stagonopleura guttata*.

Tree Hollows

Various sized tree hollows were observed within SGGW habitat along the eastern slopes of Burra Creek, and provide potential shelter and nesting habitat for a range of hollow-dependent fauna, including several species of threatened microbat and bird.

Riparian Zone

Riparian habitats ranged from exposed almost dry creek bed with no vegetation to dense stands of emergent macrophyte, as described in Section 4.1.2., above.

Birds observed within or near the riparian zone included Pacific Black Duck *Anas superciliosa*, Clamorous Reed-Warbler *Acrocephalus stentoreus* and Stubble Quail *Coturnix pectoralis*.

Four frog species were identified, either from their advertising calls or observed within Burra Creek, they were: Whistling Tree Frog *Litoria verreauxii*, Common Eastern Froglet *Crinia signifera*, Plains Froglet *C. parinsignifera* and Spotted Marsh Frog *Lymnodynastes tasmaniensis*.

Two species of aquatic reptile, Long-necked Tortoise *Chelodina longicollis* and Eastern Water Dragon *Physignathus lesueurii*, were observed near Williamsdale Road crossing.

Two aquatic mammals were considered in this assessment: Water Rat *Hydromys chrysogaster* and Platypus *Ornithorhynchus anatinus*, though neither species were observed. Grant's (undated) assessment considered the potential presence of Platypus within Burra Creek and concluded that should the species occur it is likely to be in very low numbers. Grant (undated) observed several burrow entrances (possibly attributable to the Platypus) in earthen banks between Williamsdale Road culvert and the Burra Road bridge. However, at the time of the

site visit the stream bed adjacent to most of the consolidated earth banks was dry and the remaining pools were isolated from each other' that habitat scores for Platypus along the various reaches of Burra Creek were low.

More than twenty Common Wombat *Vombatus ursinus* burrow entrances were observed along the Burra Creek channel, many of which occurred less than 0.5 m above the creek bed.

5.0 INTERIM IMPACT ASSESSMENT

Vegetation that occurs on the proposed early discharge facility site has been previously cleared and disturbed for the purpose of commercial stock grazing, previous road works and more recent realignment of the eastern section of Williamsdale Road.

Impacts likely to arise from the proposal construction of the discharge facility include ground disturbance and clearing of mostly non-native groundcover vegetation. There is a potential impact of erosion during the construction and operation phases and a potential initial increase in the sediment loads within Burra Creek.

Water discharge is likely to result in an increased scouring of the tributary and creek bed and there is a possibility of increased bank undercutting at main bends in the Creek, which could affect a small proportion of terrestrial vegetation on the elevated banks, including some small components of SGGW.

The Part 3A Guidelines applied to previous terrestrial studies for the M2G project (Biosis Research June 2009) set out a number of key thresholds that are applied to assess the impacts of the proposal on threatened species, populations or ecological communities. Table 1 provides a summary for each of the key thresholds that relate to threatened species and communities that are known or have the potential to occur in the locality.

Although this impact assessment is preliminary it is considered unlikely that the proposed new discharge option would reduce the long-term viability of and/or accelerate the extinction of and/or adversely affect critical habitat for threatened species, populations or communities within the local area.

Table 1: Interim key thresholds for threatened species and communities

THREATENED SPECIES and COMMUNITIES	WILL THE PROPOSAL REDUCE THE LONG-TERM VIABILITY OF A LOCAL POPULATION OF THE SPECIES or COMMUNITY?	WILL THE PROPOSAL ACCELERATE THE EXTINCTION OF THE SPECIES/COMMUNITY OR PLACE IT AT RISK OF EXTINCTION?	WILL THE PROPOSAL ADVERSELY AFFECT CRITICAL HABITAT?
BGGW and secondary grassland	Unlikely. No obvious loss of habitat	Unlikely	No
SGGW (nomination is being prepared for listing as an EEC)	Unlikely. Minimal impact to this community. Approximately 0.025 ha of modified habitat (secondary grassland) may be affected by the new discharge facility. Possible bank undercutting may affect a small proportion of SGGW along Burra Creek.	Unlikely	No
<i>Swainsona recta</i>	Unlikely. It is unlikely that the proposed new discharge facility would affect any known population of this species. A single plant	Unlikely	No

THREATENED SPECIES and COMMUNITIES	WILL THE PROPOSAL REDUCE THE LONG-TERM VIABILITY OF A LOCAL POPULATION OF THE SPECIES or COMMUNITY?	WILL THE PROPOSAL ACCELERATE THE EXTINCTION OF THE SPECIES/COMMUNITY OR PLACE IT AT RISK OF EXTINCTION?	WILL THE PROPOSAL ADVERSELY AFFECT CRITICAL HABITAT?
	was recorded during the previous study east of Burra Creek below the 'Onion Farm' gauging station.		
<i>Swainsona sericea</i>	Unlikely. It is unlikely that the proposed new discharge facility would affect any known population of this species. Approximately 200 plants were recorded in the Burra Creek area east of the Burra Road bridge.	Unlikely	No
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	Unlikely. It is unlikely that the proposed new discharge facility would have a direct impact on areas containing known population of this species. Recorded within the Burra Road reserve and the Braidwood Travelling Stock Reserve to the east.	Unlikely	No
Golden Sun Moth	Unlikely. Habitat within the study area is limited and/or modified making the area marginal at best for this species.	Unlikely	No
Green & Golden Bell Frog	Unlikely to occur. Very little predicted impact on any area of preferred habitat.	No	No
Southern Bell Frog	Unlikely to occur. Very little predicted impact on any area of preferred habitat.	No	No
Grassland Earless Dragon	Unlikely. Not recorded during previous trapping studies.	Unlikely	No
Pink-tailed Worm Lizard	Unlikely. Potential rock outcrop habitat on blocks: ➤ 1-247460; ➤ 2-858605; and ➤ 7003-96235.	Unlikely	Unlikely
Striped Legless Lizard	Unlikely. Not recorded during previous trapping studies.	Unlikely	No
Rosenberg's Goanna	Unlikely. Not recorded during trapping studies, although likely to occur locally.	Unlikely	No
Australian Painted Snipe	Unlikely. Favoured habitat would not be affected.	Unlikely	No
Brown Treecreeper	Unlikely. Although not recorded during this or the previous study it is expected to occur locally.	Unlikely	No
Diamond Firetail	Unlikely. Although not recorded during this study it is expected to occur locally.	Unlikely	No
Hooded Robin (south-eastern form)	Unlikely. Although not recorded during this study it is expected to occur locally.	Unlikely	No
Scarlet Robin (preliminary listing as a vulnerable sp. under the TSC)	Unlikely. Recorded during this survey within vegetation along Burra Creek south of Williamsdale Road culvert on Block 9-	Unlikely	No

THREATENED SPECIES and COMMUNITIES	WILL THE PROPOSAL REDUCE THE LONG-TERM VIABILITY OF A LOCAL POPULATION OF THE SPECIES or COMMUNITY?	WILL THE PROPOSAL ACCELERATE THE EXTINCTION OF THE SPECIES/COMMUNITY OR PLACE IT AT RISK OF EXTINCTION?	WILL THE PROPOSAL ADVERSELY AFFECT CRITICAL HABITAT?
Act)	247460.		
Varied Sittella (preliminary listing as a vulnerable sp. under the TSC Act)	Unlikely. Previously recorded at Burra Creek area below the 'Onion Farm' gauging station and widely recorded in the ACT and surrounds.	Unlikely	No
Gang-gang Cockatoo	Unlikely. Previously recorded at Burra below the 'Onion Farm' gauging station. Species is widely recorded in the ACT and surrounds.	Unlikely	No
Regent Honeyeater	Unlikely. Although not recorded during this or previous study the species could occur locally. Sporadic local occurrence and in low densities (see COG bird data Biosis Research June 2009).	Unlikely	No
Superb Parrot	Unlikely. Not recorded during this or previous study. Most regional records are from the northern parts of the ACT.	Unlikely	No
Speckled Warbler	Unlikely. Individuals were previously recorded in locality - within woodland habitats between the Goulburn-Cooma railway corridor and the Monaro Highway.	Unlikely	No
Swift Parrot	Unlikely. Not recorded during this or previous study. Recorded Mt Majura area, north Canberra.	Unlikely	No
Eastern False Pipistrelle	Unlikely. No predicted impact on this species habitat.	Unlikely	No
Eastern Bent-wing Bat	Unlikely. No impact on roost habitats. Foraging woodland habitats not impacted.	Unlikely	No
Large-footed Myotis	Unlikely. Foraging habitats (i.e. creekline should not be adversely affected by the proposed development.	Unlikely	No
Spotted-tailed Quoll (south-eastern mainland)	Unlikely. No predicted impact on this species preferred habitat.	Unlikely	No

6.0 RECOMMENDATIONS

The following recommendations are provided to assist the project planning and to reduce the potential impacts on threatened species and their habitats. These recommendations are made on the basis of a preliminary study and, therefore, may be subject to supplementary revision.

1. A detailed assessment of the potential for bank erosion and the efficacy of any proposed mitigation measure should be fully investigated prior to any development approval for the new discharge facility;
2. Avoid the introduction and transportation of weeds (particularly noxious species such as St John's Wort *Hypericum perforatum* and African Love Grass *Eragrostis curvula* into paddocks that contain moderate to high conservation value vegetation (i.e. Blocks 2-858605; 1-247460 and 168-727890);
3. Plant and equipment used during construction should not be stored or within areas that contain vegetation of moderate to high conservation value (see point 2 above);
4. Undertake the clearance or exclusion of Wombats from burrows that would be inundated during level discharge. This may require repeated management action during the life of the project.
5. If native grasslands habitats, particularly on Blocks 2-858605; 1-247460 and 168-727890, roadsides along Burra Road and/or areas of rock outcrop are likely to be disturbed by any activity associated with the proposed works it is recommend that targeted surveys for threatened plants (i.e. *Swainsona recta* and *Swainsona sericea*) and rock rolling for Pink-tailed Worm Lizard be undertaken in any affected area.

7.0 CONCLUSION

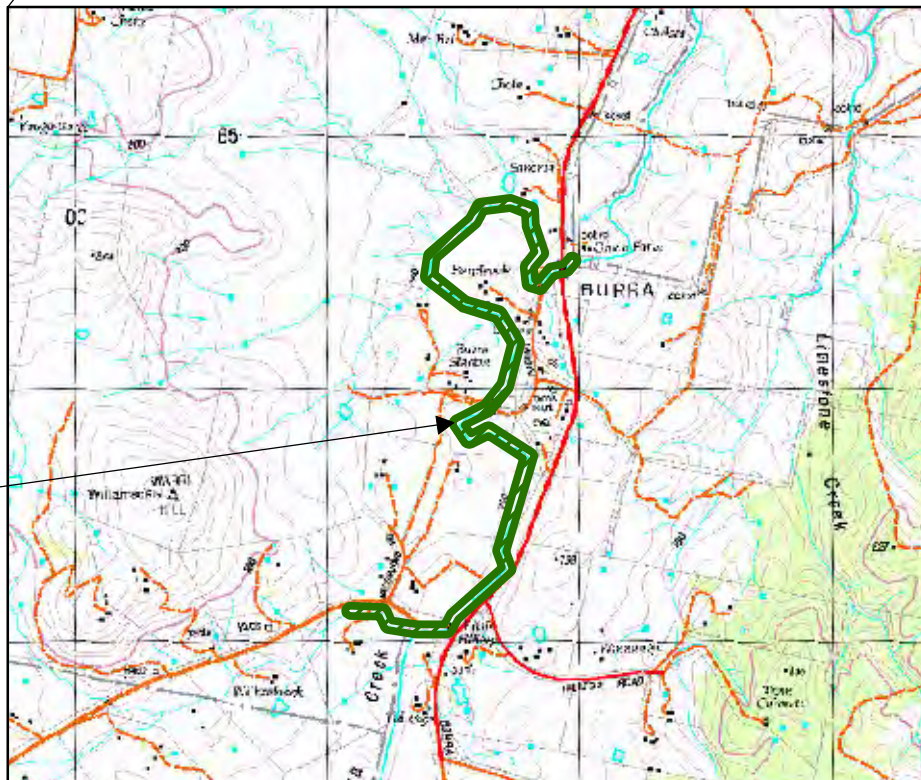
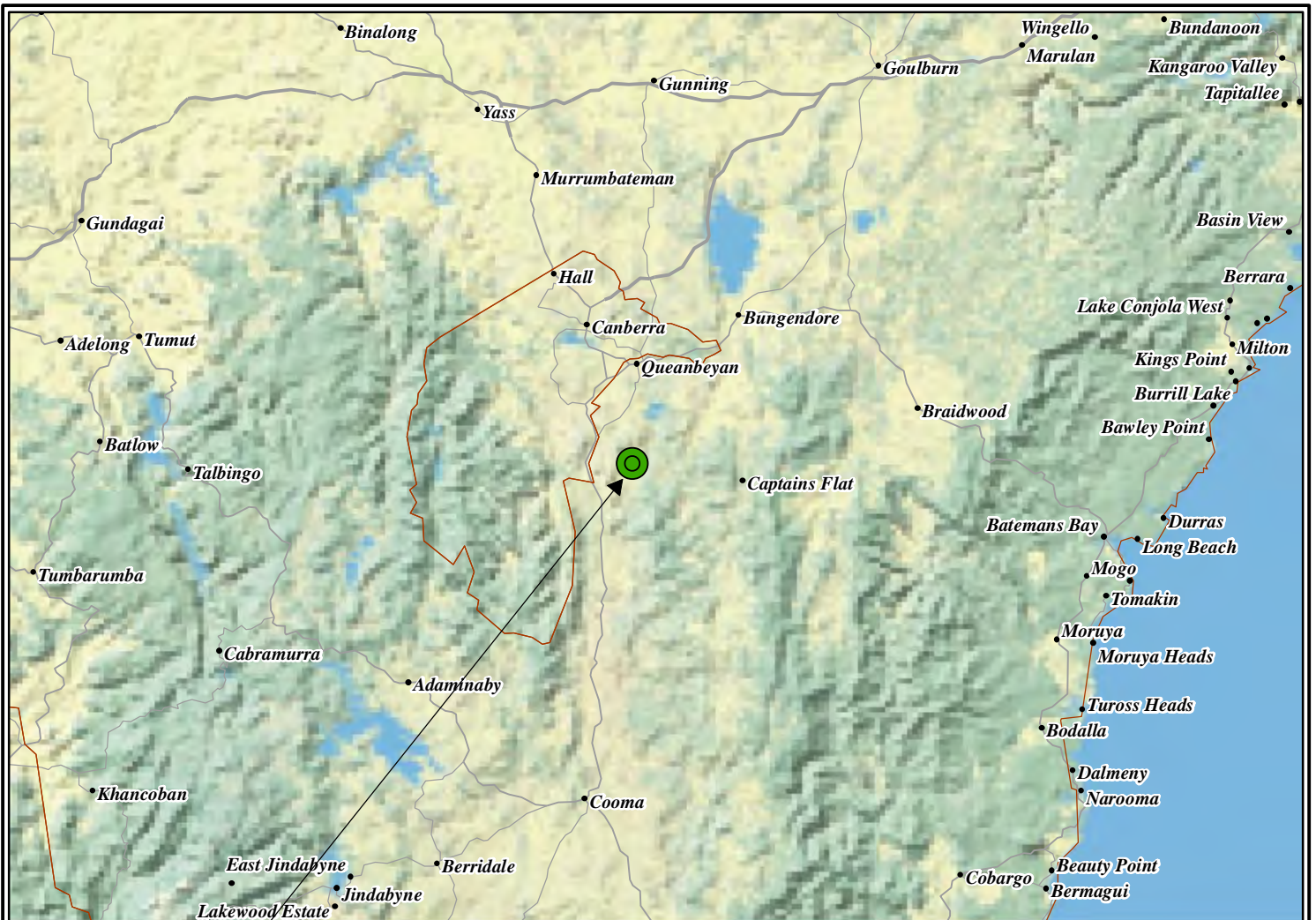
The study area provides a limited range of vegetation and habitat types that have been subject to variable management regimes. The proposed new discharge site has been extensively modified and is in mostly poor condition and has low conservation value. The direct impacts resulting from construction would involve clearing of mostly modified vegetation on the southern side of Williamsdale Road and some components of riparian vegetation along Burra Creek, south of the Williamsdale Road crossing. The construction of the new discharge facility is unlikely to have a significant impact on any threatened terrestrial species or their habitats on the construction site for the discharge facility.

Other areas along the riparian zone and upper banks of Burra Creek contained SGGW and/or secondary grassland components (SGGW has been nominated for listing as an EEC under Schedule 1 Part 3 of the TSC Act) that presented in various conditions that ranged from poor to good condition with low to moderate (possibly high) floristic diversity (i.e. blocks 1-24740, 2-843907, 168-727590 and 2-858605; Burra Road reserve and Braidwood Travelling Stock Reserve). Higher quality patches provide habitat opportunities for rare and threatened plants, including *Leucochrysum albicans* var. *tricolor* and *Swainsona sericea*, as were observed during the assessment. It is unlikely that these habitats would be affected by the construction activity associated with the discharge facility. However, any other works, such as down stream bank stabilisation, could pose some risk to these communities and/or species and further targeted surveys and assessments may be required.

The Scarlet Robin (proposed vulnerable listing under Schedule 2 of the TSC Act) was recorded within exotic vegetation near the Williamsdale Road-Burra Creek crossing. The impact of the new discharge facility on this species is considered negligible.

Rock outcrops within blocks 1-24740; 7003-96235 and 2-858605 provide potential shelter for a range of reptile species, including the threatened Pink-tailed Worm Lizard *Aprasia parapulchella*.

FIGURES



Study Area

Acknowledgements: Topographic imagery from Lands and Property Authority (2006)



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Figure 1: Location of the Study Area in a regional context

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Drawn By: RS

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Checked By: TO

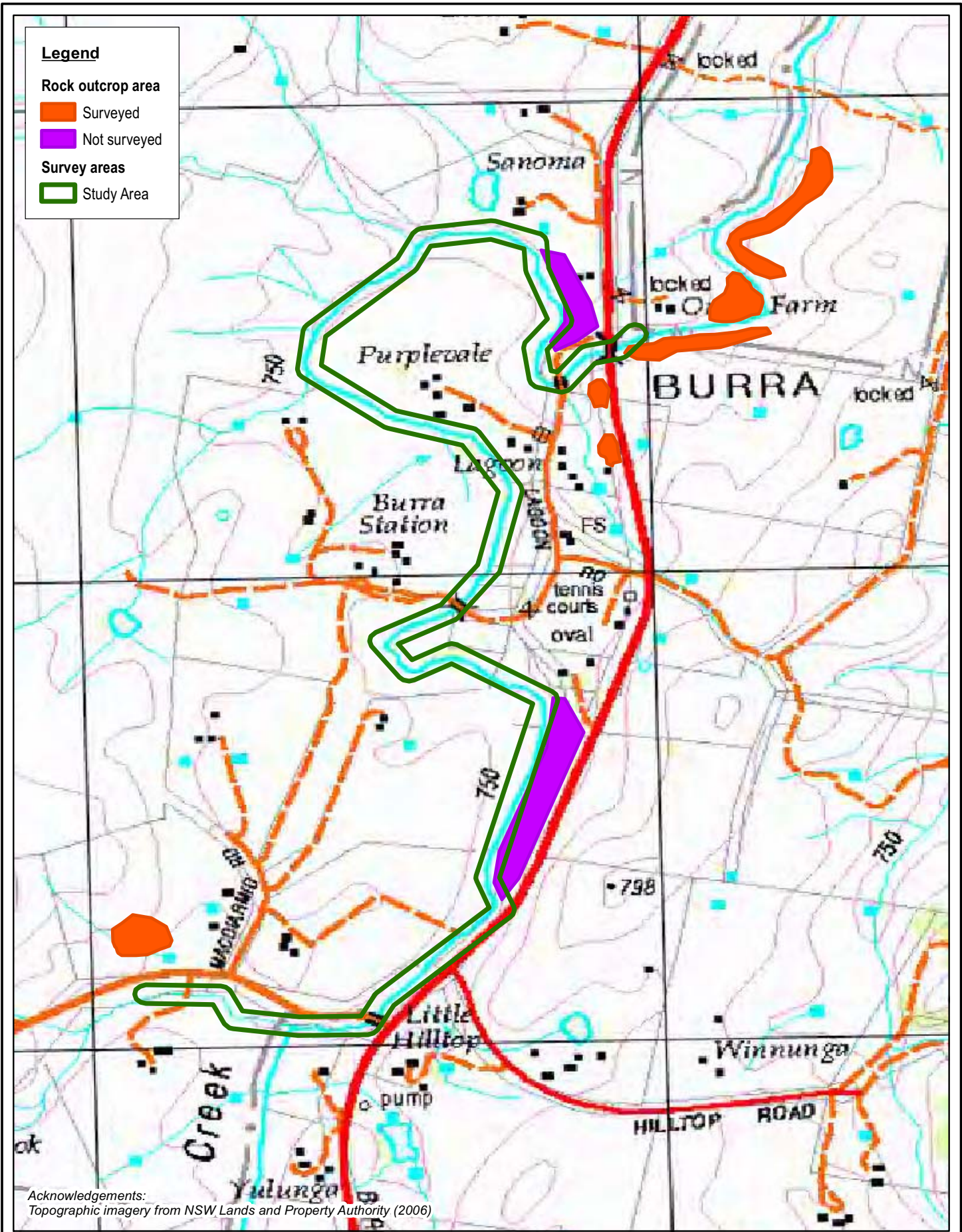
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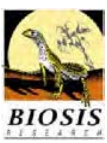


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Acknowledgements:
 Topographic imagery from NSW Lands and Property Authority (2006)

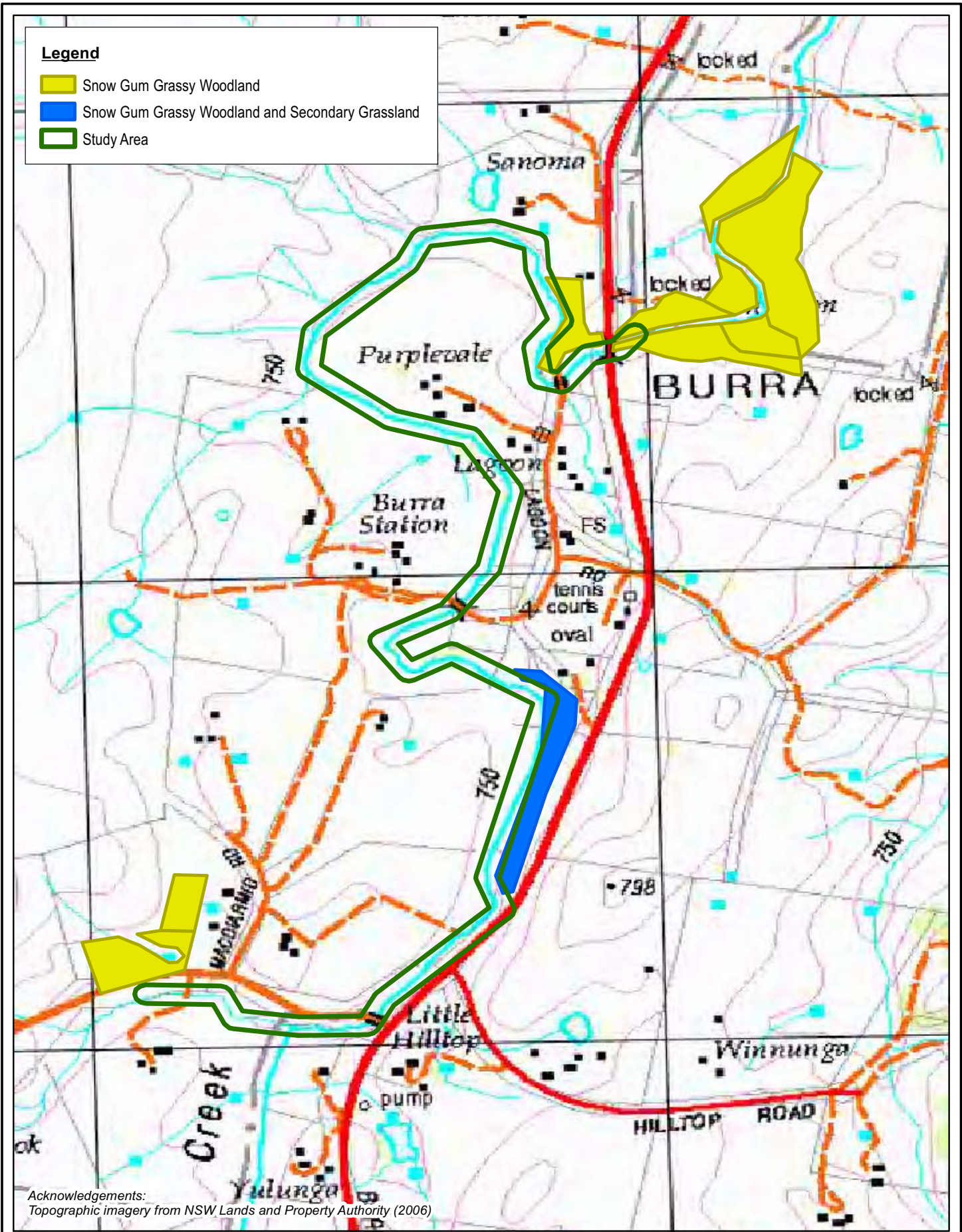


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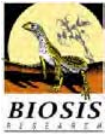
Figure 3: Location of rock outcrops

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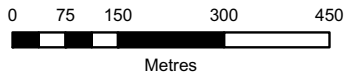
Acknowledgements:
 Topographic imagery from NSW Lands and Property Authority (2006)



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Figure 4: Location of Snow Gum Grassy Woodland

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APPENDICES

APPENDIX 1

Flora Results

Cummulative list of dominant plant species recorded during the field assessment of 18 October 2009.

Class Name	Scientific Name	Common Name	EPBC Act	TSC Act	NC Act	Origin
Adiantaceae	<i>Cheilanthes</i> sp.					N
Apiaceae	<i>Daucus glochidiatus</i>	Native Carrot				N
	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort				N
Asteraceae	<i>Cassinia longifolia</i>					N
	<i>Chrysocephalum apiculatum</i>	Common Everlasting				N
	<i>Conyza</i> sp.					I
	<i>Euchiton involucratus</i>	Star Cudweed				N
	<i>Gnaphalium involucratum</i>					N
	<i>Hypochaeris radicata</i>	Catsear				I
	<i>Lactuca serriola</i>	Prickly Lettuce				I
	<i>Leptorhynchus squamatus</i>	Scaly Buttons				N
	<i>Leucochrysum albicans</i> var. <i>tricolor</i>	Hoary Sunray	E			N
	<i>Onopordum acanthium</i>	Scotch Thistle				I
	<i>Sonchus asper</i>	Prickly Sowthistle				I
	<i>Taraxacum officinale</i>	Dandelion				I
	<i>Tragopogon porrifolius</i>	Salsify				I
	<i>Tragopogon</i> sp.					N
	<i>Vittadinia muelleri</i>	Narrow-leaf New Holland Daisy				N
Boraginaceae	<i>Echium plantagineum</i>	Patterson's Curse				I Noxious
Brassicaceae	<i>Hirschfeldia incana</i>	Buchan Weed				I Noxious
Campanulaceae	<i>Wahlenbergia</i> sp.	A Bluebell				N
Caryophyllaceae	<i>Cerastium fontanum</i>	Chickweed				I
	<i>Petrorhagia nanteuilii</i>	Proliferous Pink				I
	<i>Sceranthus</i> sp.	Knawel				N
	<i>Stellaria angusitifolia</i>	Swamp Starwort				N
Clusiaceae	<i>Hypericum perforatum</i>	St. Johns Wort				I Noxious
Convolvulaceae	<i>Convolvulus erubescens</i>					N
Cyperaceae	<i>Cyperus</i> sp.					N
Epacridaceae	<i>Melichrus urceolatus</i>	Urn Heath				N
Fabaceae (Faboideae)	<i>Glycine clandestina</i>					N
	<i>Glycine tabacina</i>					N
	<i>Indigofera australis</i>					N
	<i>Medicago</i> sp.					N

Class Name	Scientific Name	Common Name	EPBC Act	TSC Act	NC Act	Origin
	<i>Swainsona sericea</i>	Silky Swainson-pea		V		N
	<i>Trifolium</i> spp.	Clover				I
Geraniaceae						
	<i>Erodium crinitum</i>	Blue Storksbill				N
Juncaceae						
	<i>Juncus</i> sp.					N
Lamiaceae						
	<i>Marrubium vulgare</i>	Horehound				I Noxious
	<i>Salvia verbenaca</i>	Wild Sage				I
Lomandraceae						
	<i>Lomandra multiflora?</i>					N
Malvaceae						
	<i>Malva neglecta</i>	Dwarf Mallow				I
Myrtaceae						
	<i>Eucalyptus bridgesiana</i>	Apple Box				N
	<i>Eucalyptus mannifera</i>	Brittle Gum				N
	<i>Eucalyptus melliodora</i>	Yellow Box				N
	<i>Eucalyptus pauciflora</i>	Snow Gum				N
	<i>Eucalyptus stellulata</i>	Black Sally				N
	<i>Eucalyptus rubida</i>	Candlebark				N
	<i>Leptospermum</i> sp.					N
Oxalidaceae						
	<i>Oxalis</i> sp.					N
Pittosporaceae						
	<i>Bursaria spinosa</i> ssp. <i>lasiophylla</i>					N
Plantaginaceae						
	<i>Plantago lanceolata</i>	Lamb's Tongues				I
	<i>Plantago varia</i>					N
Poaceae						
	<i>Anthoxanthum odoratum</i>	Sweet Vernal Grass				I
	<i>Austrodanthonia</i> sp.					N
	<i>Austrostipa</i> sp.	speargrass				N
	<i>Avena</i> sp.	oats				N
	<i>Bothriochloa macra</i>	Red Grass				N
	<i>Bromus</i> sp.					I
	<i>Dactylis glomerata</i>	Cocksfoot				I
	<i>Elymus scaber</i>	Wheat Grass				N
	<i>Eragrostis curvula</i>	African Lovegrass				I Noxious
	<i>Panicum effusum</i>	Poison or Hairy Panic				N
	<i>Phalaris aquatica</i>	Phalaris				I
	<i>Phragmites australis</i>	Common Reed				N
	<i>Poa</i> sp.					N
	<i>Themeda australis</i>	Kangaroo Grass				N
Polygonaceae						
	<i>Acetosella vulgaris</i>	"Sorrel, Sheep Sorrel"				I
	<i>Rumex brownii</i>	Swamp Dock				N
Rosaceae						
	<i>Acaena ovina</i>					N
	<i>Malus domestica</i>	Apple				I
	<i>Prunus</i> sp.	Plum				I
	<i>Rosa rubiginosa</i>	Sweet Briar				I Weed

Class Name	Scientific Name	Common Name	EPBC Act	TSC Act	NC Act	Origin
	<i>Rubus fruticosus</i> aggregate	Blackberry				I Noxious
	<i>Sanguisorba minor</i>					I
Rubiaceae						
	<i>Asperula scoparia</i>	Prickly Woodruff				N
Salicaceae						
	<i>Populus nigra</i>	Black Poplar				I
	<i>Salix</i> sp.					N
Sapindaceae						
	<i>Dodonaea viscosa</i>					N
Scrophulariaceae						
	<i>Linaria pelisseriana</i>					I
	<i>Verbascum thapsus</i>	Blanket Weed				I
Stackhousiaceae						
	<i>Stackhousia monogyna</i>	Creamy Candles				N
Typhaceae						
	<i>Typha orientalis</i>	Broad-leaved Cumbungi				N

Key: E = endangered EPBC Act; N = native; I = introduced.

APPENDIX 2

Fauna Results

Animals observed (or evidence of) during the field assessment of 18 October 2009.

Class Name	Family Name	Latin Name	Common Name	Status	Comment
Amphibians	Hylidae	<i>Litoria verreauxii</i>	Whistling Tree Frog		
	Myobatrachidae	<i>Crinia parinsignifera</i>	Plains Froglet		
		<i>Crinia signifera</i>	Common Eastern Froglet		
		<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog		
Reptiles					
	Agamidae	<i>Physignathus lesueurii</i>	Eastern Water Dragon		
		<i>Pogona barbata</i>	Common Bearded Dragon		
	Chelidae	<i>Chelodina longicollis</i>	Eastern Long-necked Tortoise		
	Scincidae	<i>Egernia cunninghami</i>	Cunningham's Skink		
		<i>Tiliqua scincoides</i>	Common Blue-tongue Lizard		
Birds					
	Acanthizidae	<i>Gerygone olivacea</i>	White-throated Gerygone		
	Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle		overhead
	Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck		
		<i>Chenonetta jubata</i>	Australian Wood Duck		
		<i>Cracticus torquatus</i>	Grey Butcherbird		
		<i>Gymnorhina tibicen</i>	Australian Magpie		
	Cacatuidae	<i>Strepera graculina</i>	Pied Currawong		
		<i>Cacatua galerita</i>	Sulphur-crested Cockatoo		
		<i>Cacatua roseicapilla</i>	Galah		
	Charadriidae	<i>Vanellus miles</i>	Masked Lapwing		
	Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon		
	Corvidae	<i>Corvus coronoides</i>	Australian Raven		
	Dicuridae	<i>Grallina cyanoleuca</i>	Magpie Lark		
		<i>Rhipidura leucophrys</i>	Willie Wagtail		
	Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra		
	Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow		
	Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren		
		<i>Manorina melanocephala</i>	Noisy Miner		
		<i>Philemon corniculatus</i>	Noisy Friarbird		
		<i>Anthochaera carunculata</i>	Red Wattlebird		
	Motacillidae	<i>Anthus novaeseelandiae</i>	Richard's Pipit		
	Muscicapidae	<i>Acrocephalus stentoreus</i>	Clamorous Reed-Warbler	M (EPBC Act)	
		<i>Smicromis brevirostris</i>	Weebill		
	Pardalotidae	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill		
		<i>Aphelocephala leucopsis</i>	Southern Whiteface		
		<i>Acanthiza pusilla</i>	Brown Thornbill		
		<i>Pardalotus striatus</i>	Striated Pardalote		
		<i>Petroica boodang</i>	Scarlet Robin	Preliminary listing (V) under the TSC Act	
	Phasianidae	<i>Coturnix pectoralis</i>	Stubble Quail		
	Psittacidae	<i>Platycercus elegans</i>	Crimson Rosella		
		<i>Psephotus haematonotus</i>	Red-rumped parrot		
		<i>Platycercus eximius</i>	Eastern Rosella		
Birds (Introduced)					
	Fringillidae	<i>Carduelis carduelis</i>	European Goldfinch		
	Pardalotidae	<i>Passer domesticus</i>	House sparrow		
		<i>Turdus merula</i>	Common Blackbird		
Mammals					

Class Name	Family Name	Latin Name	Common Name	Status	Comment
	Monotreme	<i>Tachyglossus aculeatus</i>	Echidna		
	Macropodidae	<i>Macropus giganteus</i>	Eastern Grey Kangaroo		
	Phalangeridae	<i>Trichosurus vulpecula</i>	Common Brushtail Possum		
	Vombatidae	<i>Vombatus ursinus</i>	Common Wombat		Numerous Burrows along Burra Creek
Mammals (Introduced)					
	Canidae	<i>Canis familiaris</i>	Dog (domestic)		
		<i>Vulpes vulpes</i>	Fox		
	Leporidae	<i>Lepus capensis</i>	Brown Hare		
		<i>Oryctolagus cuniculus</i>	Rabbit		
	Bovidae	<i>Bos taurus</i>	Cattle (stock)		
		<i>Ovis aries</i>	Sheep (stock)		
	Equidae	<i>Equus caballus</i>	Horse (domestic)		

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Surveys for Pink-tailed
Worm Lizard *Aprasia*
parapulchella:
Supplementary Report
for the M2G Bulk Water
Transfer Project

December 2009

Biosis Research Pty. Ltd.

Report prepared for Bulk Water Alliance

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December 2009

Tom O'Sullivan

Project no. 5699

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ABBREVIATIONS

BGGW	Yellow Box/Red Gum Grassy Woodland (NC Act) EECs. Also referred to as Yellow Box/White Box/Blakely's Red Gum Woodland (TSC Act) and Yellow Box/White Box/Blakely's Red Gum Woodland and derived grasslands (EPBC Act)
CEEC	Critically Endangered Ecological Community
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts
EEC	Endangered Ecological Community
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
NC Act	<i>ACT Nature Conservation Act 1980</i>
Region	CMA Catchment or IBRA Bioregion (in this case South Eastern Highlands Bioregion)
spp.	species (plural)
sp.	species (singular)
subsp.	subspecies
Subject site	The area that is the subject of the study
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>

1.0 SUMMARY

Biosis Research Pty. Ltd. was commissioned by Bulk Water Alliance to undertake supplementary targeted surveys for the Vulnerable Pink-tailed Worm Lizard *Aprasia parapulchella* for the proposed Murrumbidgee River to Googong Dam Raw Water Transfer Project.

A total of 2598 rocks were turned at five sampling sites within the proposed pipeline alignment. No evidence of the Pink-tailed Worm Lizard was found.

High temperatures during and low rainfall preceding the survey may have made detection of live Pink-tailed Worm Lizards difficult. However, the absence of Pink-tailed Worm Lizard skin sloughs suggests that the species either does not occur, or occurs at low densities within the sampled area.

2.0 INTRODUCTION

Biosis Research Pty. Ltd. was engaged by the Bulk Water Alliance to undertake a supplementary sampling study for the proposed Murrumbidgee River to Googong Dam Raw Water Transfer Project (Figure 1).

The current study was targeted to detect the presence of the threatened Pink-tailed Worm Lizard (PTWL) *Aprasia parapulchella* (listed as vulnerable under the ACT *Nature Conservation Act 1980*; NSW *Threatened Species Conservation Act 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*) and follows earlier, but incomplete, ecological investigations by Biosis Research.

The premise for undertaking this study was: the subject site's proximity to known populations of PTWL to the west in the ACT; the species may occupy disturbed but structurally suitable sites; the potential, although limited, connectivity with suitable habitat to the west; and, the inconclusive outcome of previous studies.

2.1 Location and Description of the Site

The subject site is situated about 1.25 km south-east of Williamsdale, within a commercial sheep grazing property (Figure 1).

Vegetation within the property includes Yellow Box *Eucalyptus melliodora* / Blakely's Red Gum *Eucalyptus blakelyi* Grassy Woodland and secondary grassland in good to poor condition, Peppermint *E. dives* and Brittle Gum *E. mannifera* and native to non-native pasture.

Rock outcrops extend along three main north-south oriented ridgelines, which comprised the target survey areas on the property. Vegetation condition on each of the ridgeline varied in type, species diversity and disturbance and is broadly fits the follow description: the eastern ridge or rise contained good to moderate condition box/gum grassy open woodland; poor to moderate condition secondary grassland on the central ridge; and non-native weed dominated groundcover on the western ridgeline.

Description, Habitat and Ecology of PTWL

The PTWL is a small fossorial reptile from the family Pygopodidae (legless lizards), which has a maximum snout vent length of 14 cm and a total length of about 24 cm. The species is oviparous (egg laying) with a clutch size of two and females may need to reach an age of about 3 or 4 years before it can reproduce.

There is little data on the breeding behaviour of this species (Osborne and Coghlan 2004).

The species lives beneath surface rocks often within ant burrows and feeds on ants, particularly their eggs and larvae (Osborne and Jones 1995).

Key habitat features for the presence of the PTWL are a cover of native grasses, particularly Kangaroo Grass (*Themeda australis*) and other native grasses, sparse or no tree cover, little or no leaf litter, and scattered small rock with shallow embedment in the soil surface.

In the Canberra region the species is found in area containing acid volcanic rock types - Late Silurian acid volcanics - that are derived from decomposing rhyodacite, rhyolite or dacite or other Silurian volcanic rocks (Osborne and Coghlin 2004). The likelihood of occurrence of PTWL increases with increasing cover of Kangaroo Grass (Osborne and Coghlin 2004). Alternatively, dominance of speargrasses (*Stipa* spp.) and Tussock Grass *Poa labillardieri* decreases the likelihood of finding the species (Osborne and Coghlin 2004; ACT Government 2005; ACT Government 2007). A moderate number of disturbed sites dominated by exotic ground cover species, such as *Avena*, *Vulpia*, *Hypocheirus* and *Bromus* supported at least some individuals, although it was not known if these sites support viable populations (Osborne and Coghlin 2004).

2.2 Aims of the Assessment

The primary aim of this assessment was to determine if PTWL occurred in areas of suitable rock habitat along the proposed pipeline corridor within Blocks 201-754889, 152-754889 and 170-754889.

3.0 METHODS

3.1 Hand Searches for PTWL

Surveys were conducted by two people and involved turning loose surface rocks and examining the under surface for the presence of PTWL. Turned rocks ranged from 10 cm to 55 cm in diameter and were returned to the position in which they were found after inspection.

Five sampling sites were laid out across the subject site (Figure 2). A total of 56 transects were established in four grid patterns across the site (Figure 2): Grid 1 contained 16 survey transects; Grid 2a 14; and Grids 2b and 2c contained 12 and 14, respectively. Additional random searches were undertaken in rocky areas adjacent to each grid layout (Figure 2).

Surveys were conducted between 8.30am and 3.00pm on 9, 10 and 11 November 2009.

Due to an insufficient number and scattered pattern of surface rocks searches at Site 3 were conducted randomly.

Table 1: Survey Effort

PERIOD	TARGET SPECIES	NO. OF TRANSECTS OR SITES	TOTAL TRANSECT LENGTH	PERSON HOURS	STAFF
9-11 November 2009	<i>Aprasia / Suta</i>	56 transects laid out in grids. Random transect at one site, and additional random searches adjacent to transect grids	2,598 rocks were turned along an estimated minimum transect length of 2.8 km.	24 person hrs	TO, TE

3.2 Taxonomy

Taxonomy is the term that applies to the classification and naming of living things and is usually based on physical and/or genetic similarities.

Plant taxonomy used in this report follows

<<http://www.environment.gov.au/biodiversity/abrs/online-resources/flora/index.html>>.

Animal taxonomy used in this report follows the Australian Faunal Directory (AFD) located at <<http://www.environment.gov.au/biodiversity/abrs/online-resources/index.html>>.

4.0 RESULTS

4.1 Vegetation

The vegetation on the subject site comprised good to moderate quality Yellow Box *Eucalyptus melliodora*/Blakely's Red Gum *E. blakelyi* Grassy Woodland (BGGW) in the eastern portion of the subject site (Site 1); Brittle Gum *E. mannifera*/Broad-leaved Peppermint *E. dives* with a highly disturbed (weedy) groundcovers at the western boundary (Site 3); and secondary grassland and native pasture that ranged from poor to moderate condition (Sites 2a – 2c). For a full vegetation description see Biosis Research June 2009.

Threatened Plants

The threatened Swainson's Pea *Swainsona sericea* occurred in large numbers within and surrounding Site 1 and in lower numbers between Site 2 and Site 3.

Endangered Ecological Communities

Box Gum Grassy Woodland is listed as an Endangered Ecological Community under the NSW *Threatened Species Conservation Act 1995*; Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and ACT *Nature Conservation Act 1980*.

4.2 Rock-turning

A total of 2,598 rocks were turned across 5 sampling sites and failed to find any evidence of the PTWL (Table 2).

Two reptile species were confirmed Striped Skink *Ctenotus robustus* (Site 2b) and Stone Gecko *Diplodactylus vittatus* were identified beneath rocks.

The Delicate Skink *Lampropholis delicata* was observed in adjoining grassy habitats. Other reptiles observed in the local area included Brown Snake *Pseudonaja textilis*, Bearded Dragon *Pogona barbata* and Blue-tongue Lizard *Tiliqua scincoides*.

Temperatures during the survey averaged 32°C and virtually no rain had been recorded in the two weeks prior to the surveys. Such conditions may encourage animals to retreat deeper into burrows, thus making detection beneath surface rocks difficult. Yet the absence of any evidence of PTWL (i.e. skin slough) beneath over turned rocks within the search area suggests that either species does not occur or, if it does, it occurs at low densities.

Table 2: Sampling Results

Location	Date	Results (Total of species)	Observer	Duration (start - finish)	Est. No. of rocks turned	Max Temp	Notes
Site 1						30	
Transect 1	9 November 2009	Nil	TO/TE	10:00:00 hrs (Start)	91		Skin sloughs identified as <i>Diplodactylus vittatus</i>
Transect 2	9 November 2009	Nil	TO/TE		65		More than 100 <i>Swainsona sericea</i> within the immediate area of Site 1
Transect 3	9 November 2009	Nil	TO/TE		85		White-winged Triller heard calling in tree canopy near Site 1
Transect 4	9 November 2009	Nil	TO/TE		55		High ant abundance and diversity beneath rocks
Transect 5	9 November 2009	Nil	TO/TE		45		
Transect 6	9 November 2009	Nil	TO/TE		45		
Transect 7	9 November 2009	Nil	TO/TE		49		
Transect 8	9 November 2009	Nil	TO/TE		62		
Transect 9	9 November 2009	Nil	TO/TE		11		
Transect 10	9 November 2009	Nil	TO/TE		15		
Transect 11	9 November 2009	Nil	TO/TE		16		
Transect 12	9 November 2009	<i>Diplodactylus vittatus</i> (skin)	TO/TE		21		
Transect 13	9 November 2009	Nil	TO/TE		9		
Transect 14	9 November 2009	Nil	TO/TE		8		
Transect 15	9 November 2009	<i>Diplodactylus vittatus</i> (skin)	TO/TE		16		
Transect 16	9 November 2009	Nil	TO/TE	14:00 hrs (Finish)	20		
Sub total					613		
Additional searches							
Random searches immediately north of Site 1	9 November 2009	Nil	TO/TE	12:00	55		
Random searches immediately south of Site 1	9 November 2009	Nil	TO/TE	14:30	50		
Sub-total					105		
Total Site 1					718		

Location	Date	RESULTS (Total of species)	Observer	Duration (start - finish)	Est. No. of rocks turned	Max Temperat ure	Notes
Site 2a						32	
Transect 17	10 November 2009	Nil	TO	10:15 hrs	15		Ant diversity beneath rocks was much lower than Site 1
Transect 18	10 November 2009	Nil	TO		40		
Transect 19	10 November 2009	Nil	TO		45		
Transect 20	10 November 2009	Nil	TO		28		
Transect 21	10 November 2009	Nil	TO		21		
Transect 22	10 November 2009	Nil	TO		15		
Transect 23	10 November 2009	Nil	TO		18		
Transect 24	10 November 2009	Nil	TO		24		
Transect 25	10 November 2009	Nil	TO		21		
Transect 26	10 November 2009	Nil	TO		28		
Transect 27	10 November 2009	Nil	TO		10		
Transect 28	10 November 2009	Nil	TO		15		
Transect 29	10 November 2009	Nil	TO		32		
Transect 30	10 November 2009	Nil	TO	12:10 hrs	32		
Sub total					344		
Additional searches							
Random seaches immediately south of Site 2a	10 November 2009	Nil	TO	12:30-13:45 hrs	299		
Sub-total					299		
Total Site 2a					643		

Location	Date	RESULTS (Total of species)	Observer	Duration (start - finish)	Est. No. of rocks turned	Temperat ure	Notes
Site 2b						32	
Transect 31	11 November 2009	Nil	TO/TE	08:30 hrs	81		Ant diversity beneath rocks was much lower than Site 1
Transect 32	11 November 2009	Nil	TO/TE		142		
Transect 33	11 November 2009	Nil	TO/TE		48		
Transect 34	11 November 2009	Nil	TO/TE		36		
Transect 35	11 November 2009	Nil	TO/TE		51		

Transect 36	11 November 2009	Nil	TO/TE		72		
Transect 37	11 November 2009	Nil	TO/TE		41		
Transect 38	11 November 2009	Nil	TO/TE		45		
Transect 39	11 November 2009	Nil	TO/TE		38		
Transect 40	11 November 2009	Nil	TO/TE		25		
Transect 41	11 November 2009	Nil	TO/TE		21		
Transect 42	11 November 2009	Nil	TO/TE	10:20 hrs	22		
Sub total					622		

Additional searches							
Lower slopes west of Site 2b and central gully north of Site 2b	11 November 2009	Nil	TO	10:30 -10:45 hrs	80		one Striped Skink <i>Ctenotus robustus</i> observed beneath surface rock within drainage line between Site 2a and 2b
Sub-total					80		
Total Site 2b					702		

Location	Date	RESULTS (Total of species)	Observer	Duration (start - finish)	Est. No. of rocks turned	Temperature	Notes
Site 2c						32	
Transect 43	11 November 2009	Nil	TO/TE	10:50 hrs	10		low diversity and abundance of ants beneath rocks
Transect 44	11 November 2009	Nil	TO/TE		5		Soil beneath rocks was slightly damper than site 2b and - southerly aspect
Transect 45	11 November 2009	Nil	TO/TE		20		
Transect 46	11 November 2009	Nil	TO/TE		41		
Transect 47	11 November 2009	Nil	TO/TE		21		
Transect 48	11 November 2009	Nil	TO/TE		16		
Transect 49	11 November 2009	Nil	TO/TE		21		
Transect 50	11 November 2009	Nil	TO/TE		15		Drooping She-oak <i>Allocasuarina verticillata</i> north of proposed easement avoid removal - GBC food resource
Transect 51	11 November 2009	Nil	TO/TE		32		
Transect 52	11 November 2009	Nil	TO/TE		34		
Transect 53	11 November 2009	Nil	TO/TE		36		

Transect 54	11 November 2009	Nil	TO/TE		51		
Transect 55	11 November 2009	Nil	TO/TE		21		
Transect 56	11 November 2009	Nil	TO/TE	12:20 hrs	40		
Sub-total					363		
Additional searches							
Lower slopes to north and west of Site 2c	11 November 2009	Nil	TO	12:30 to 12:45 hrs	50		
Sub-total					50		
Total Site 2c					413		

Location	Date	RESULTS (Total of species)	Observer	Duration (start - finish)	Est. No. of rocks turned	Temperature	Notes
Site 3						32	
Random searches	11 November 2009	Nil	TO/TE	13:20 hrs	46		low diversity and abundance of ants beneath rocks
	11 November 2009	Nil	TO/TE		51		
	11 November 2009	Nil	TO/TE	15:00 hrs	25		
Total Site 3					122		

4.3 Other Significant Animal Observations

The White-winged Triller *Lalage sueurii* (Vulnerable in the ACT) was heard calling from the tree canopy adjacent to Site 1.

5.0 CONSERVATION SIGNIFICANCE

The absence of any evidence of PTWL during the targeted searches would suggest that a significant population of PTWL does not occur in the rocky areas that were sampled during this study.

6.0 IMPACT ASSESSMENT

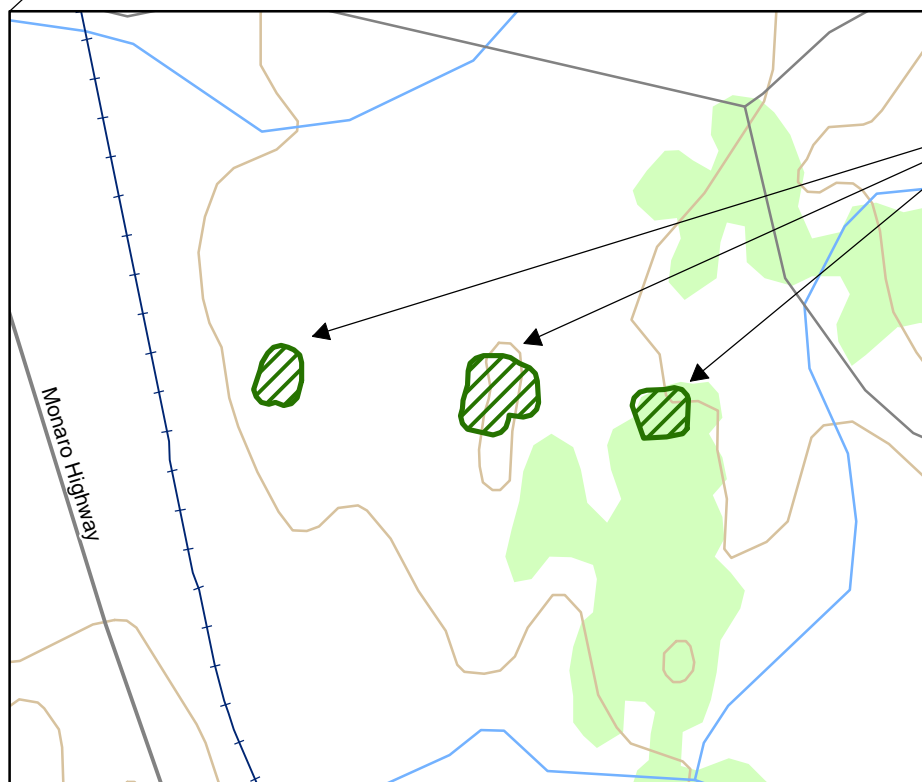
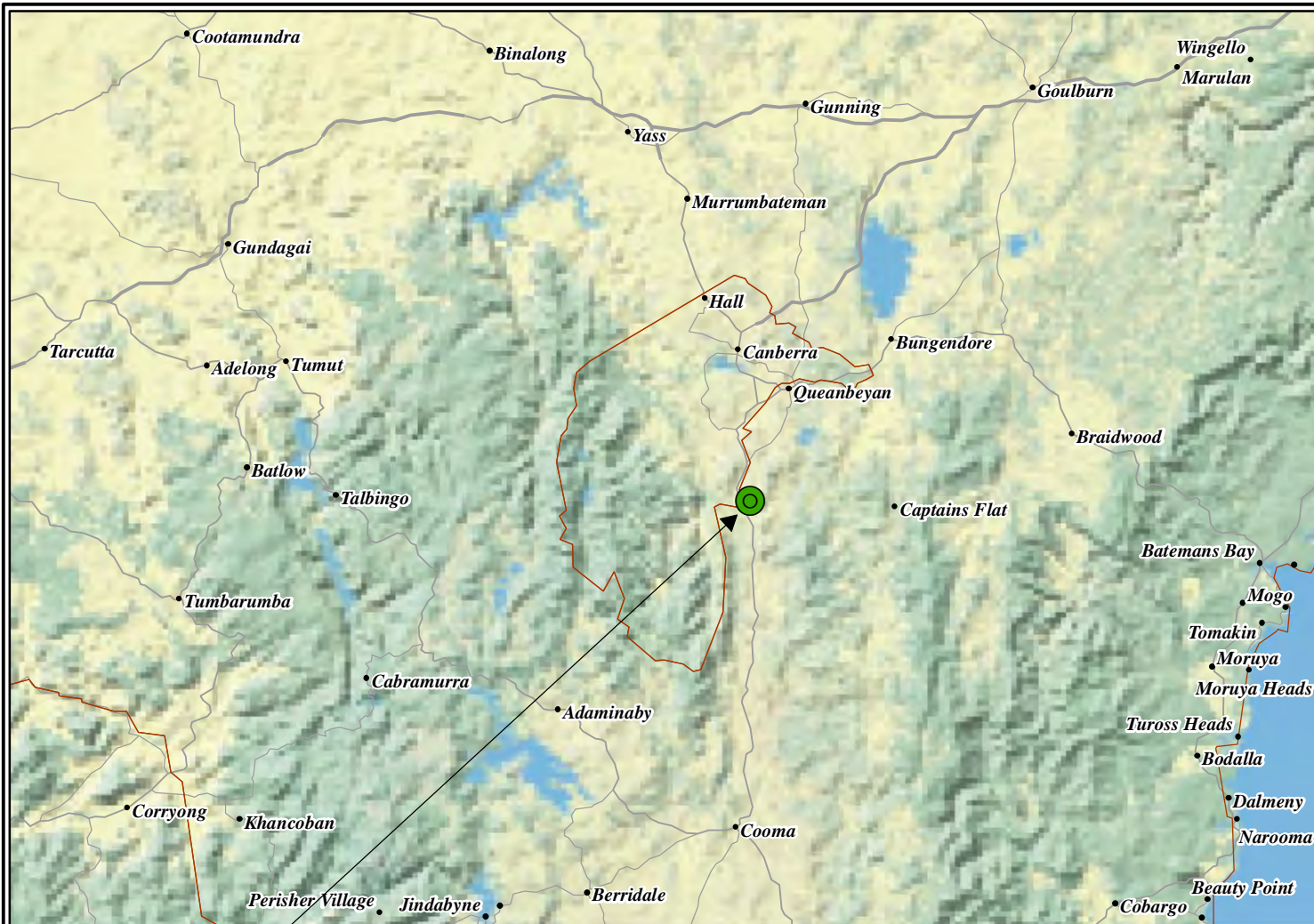
Based on the outcomes of this study it is considered unlikely that the proposed action would have significant negative impact on any local PTWL population.

7.0 RECOMMENDATIONS

Provided that the proposed pipeline alignment and construction width remain unchanged from that presented in the EIS for the Murrumbidgee River to Googong Dam Water Transfer Project then there are no additional or substantive recommendations required in relation to the PTWL within the subject area.

All other recommendations (see Biosis Research July 2009) relating to construction corridor widths, top soil management and reinstatement, post-construction revegetation and tree retention would remain.

FIGURES



Acknowledgements: This product contains Data which is copyright to the Commonwealth of Australia (c.2003-)



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Figure 1: Location of the Study Area in a regional context

Date: 11 December 2009

Drawn By: RS

File ID: S5699

Checked By: TO

Location:...\5699\Mapping\S5699 F1_region.mxd





Legend

-  Transect
-  Area of random search

Figure 2: Overview of the Study Area


Acknowledgements:
Image from Lands and Property Authority SIX Viewer (11/12/2009)

BIOSIS RESEARCH Pty. Ltd.
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Date: 11 December 2009
File: S5699
Location: S5699\Mapping\S5699 F2_overview.mxd

Drawn by: RS
Checked by: TO

0 0.045 0.09 0.18 0.27 0.36
Kilometers



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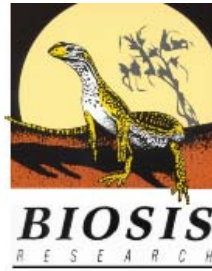
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Pieter van der Walt
Bulk Water Alliance
Tel : (02) 6175 2373
Mob : 0404 018 178

16 December 2009
Our ref: 5699

Dear Pieter,

Burra Creek Targeted Survey for *Aprasia parapulchella*

Biosis Research Pty. Ltd. was engaged by the Bulk Water Alliance to undertake targeted surveys for the Pink-tailed Worm Lizard (PTWL) *Aprasia parapulchella* at Burra Creek (Figure 1).

The current study was targeted to detect the presence of the threatened Pink-tailed Worm Lizard (PTWL) *Aprasia parapulchella* (listed as vulnerable under the ACT *Nature Conservation Act 1980*; NSW *Threatened Species Conservation Act 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*) and follows earlier, but incomplete, ecological investigations by Biosis Research.

The premise for undertaking this study was: the subject site's proximity to known populations of PTWL to the west in the ACT; that the species may occupy disturbed but structurally suitable sites; the potential, although limited, connectivity with suitable habitat to the west; and the inconclusive outcome of previous studies.

The Study Area:

Two sites were surveyed along the banks of Burra Creek approximately 21.5 km south of Queanbeyan. (Figure 2). The sites have been previously disturbed and contained a mixture of non-native and native grasses and forbs. Both sites contained key habitat features for the PTWL including Kangaroo Grass (*Themeda australis*) and other native grasses, sparse or no tree cover, little or no leaf litter, and scattered small rocks. However a large proportion of the rocks, particularly at site 2, were embedded in the soil.

Description, Habitat and Ecology of PTWL:

The PTWL is a small fossorial reptile from the family Pygopodidae (legless lizards), which has a maximum snout vent length of 14 cm and a total length of about 24 cm. The species is oviparous (egg laying) with a clutch size of two and females may need to reach an age of about 3 or 4 years before it can reproduce. There is little data on the breeding behaviour of this species (Osborne and Coghlan 2004).

The species lives beneath surface rocks, often within ant burrows and feeds on ants, particularly their eggs and larvae (Osborne and Jones 1995). Key habitat features for the presence of the PTWL are a cover of native grasses, particularly Kangaroo Grass (*Themeda australis*) and other native grasses, sparse or no tree cover, little or no leaf litter, and scattered small rock with shallow embedment in the soil surface.

In the Canberra region the species is found in area containing acid volcanic rock types - Late Silurian acid volcanics - that are derived from decomposing rhyodacite, rhyolite or dacite or other Silurian volcanic rocks (Osborne and Coghlan 2004). The likelihood of occurrence of PTWL increases with increasing cover of Kangaroo Grass (Osborne and Coghlan 2004). Alternatively, dominance of Speargrasses (*Stipa* spp.) and Tussock Grass (*Poa labillardieri*) decreases the likelihood of finding the species (Osborne and Coghlan 2004; ACT Government 2005; ACT Government 2007). A moderate number of disturbed sites dominated by exotic ground cover species, such as *Avena*, *Vulpia*, *Hypochaeris* and *Bromus* supported at least some individuals, although it was not known if these sites support viable populations (Osborne and Coghlan 2004).

Methods:

Surveys were conducted by two people and involved turning loose surface rocks and examining the under surface for the presence of PTWL. Turned rocks ranged from 10 cm to 55 cm in diameter and were returned to the position in which they were found after inspection.

Surveys were conducted between 8.30am and 10.30am on 15 December 2009. Due to the insufficient number and scattered pattern of surface rocks, searches at the sites were conducted randomly.

Table 1: Survey Effort

PERIOD	TARGET SPECIES	SITE	No. of rocks turned	PERSON HOURS	STAFF
15 December 2009	<i>Aprasia</i>	Burra Creek	248	4 person hours	TE, AKR

Results:

A total of 248 rocks were turned across the two sites and failed to find any evidence of the PTWL (Table 2). Two reptile species were confirmed: Striped Skink *Ctenotus robustus* and Cunningham's Skink *Ergernia cunninghami* near rock outcrops.

Table 2: Survey Results

Site	Surveyed Area	No. Of Rocks Turned	PTWL Recorded
1	Area 1	165	0
2	Area 1	24	0
	Area 2	28	0
	Area 3	31	0
	TOTAL	248	0

The weather during the survey was sunny with temperatures reaching 23°C. No rain had been recorded in the five days prior to the surveys. Such conditions may encourage animals to retreat deeper into burrows, thus making detection beneath surface rocks difficult. Yet the absence of any

evidence of PTWL (i.e. skin slough) beneath overturned rocks within the search area suggests that either the species does not occur or, if it does, it occurs at low densities.

The absence of any evidence of PTWL during the targeted searches would suggest that a significant population of PTWL does not occur in the rocky areas that were sampled during this study. Based on the outcomes of this study it is considered unlikely that the proposed action would have a significant negative impact on any local PTWL population.

Yours sincerely,



Terri-Ann English
Senior Zoologist
Biosis Research Pty Ltd

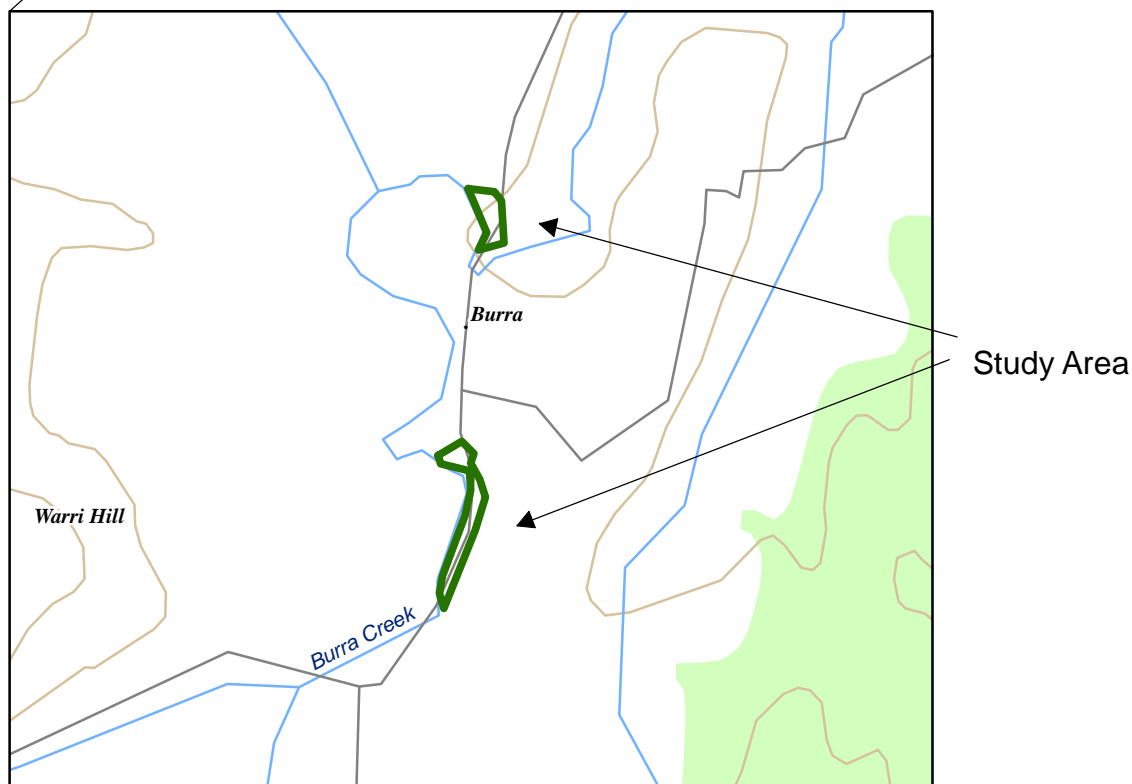
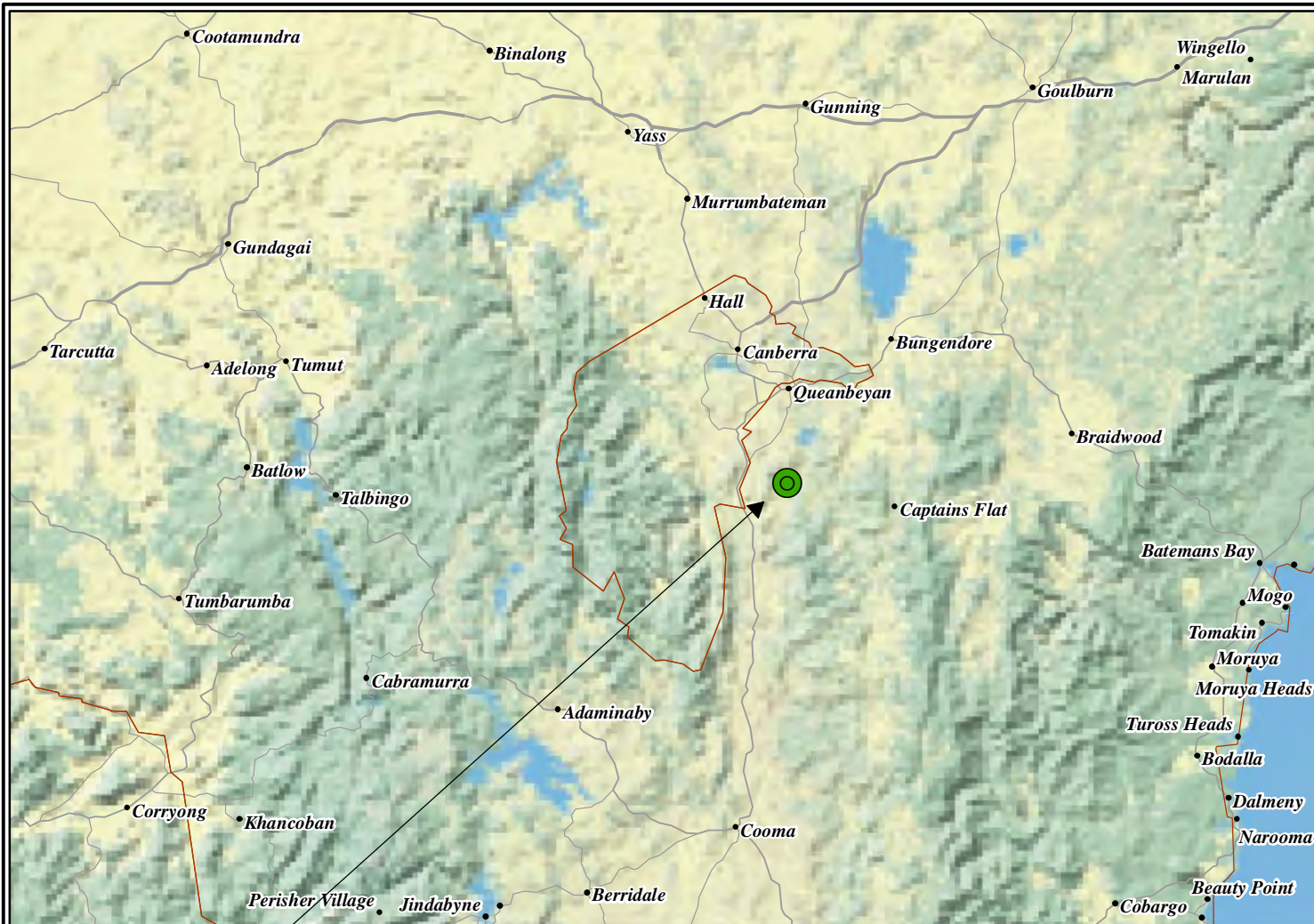
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Figure 1: Location of the Study Area in a regional context

Date: 16 December 2009

Drawn By: RS

File ID: S5699

Checked By: TE

Location: ...5699\Mapping\S5699 BurraRd F1_region.mxd


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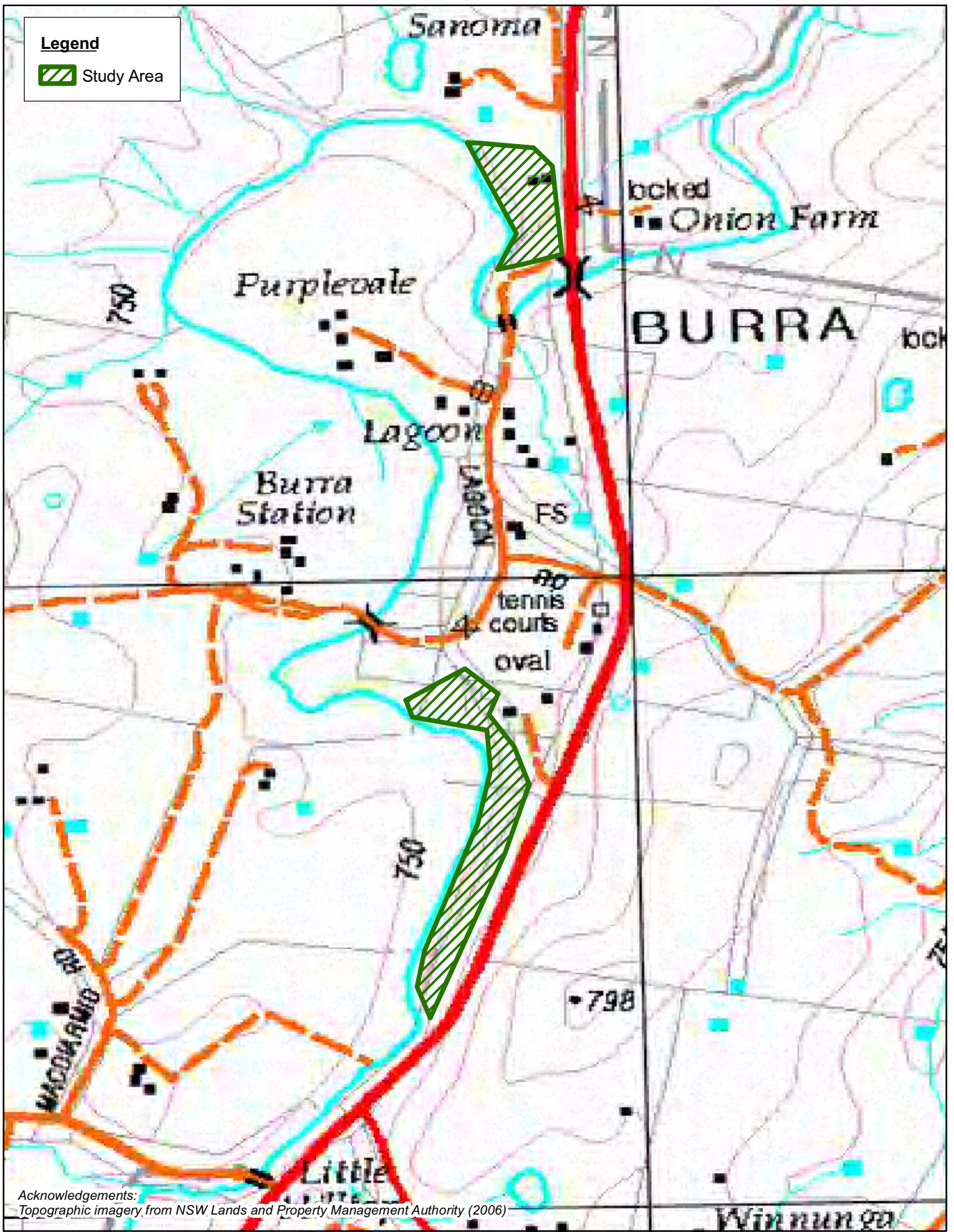


Kilometres

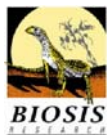


Legend

 Study Area



Acknowledgements:
Topographic imagery, from NSW Lands and Property Management Authority (2006)



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Figure 2: Location of survey areas

Date: 16 December 2009

Drawn By: RS

File ID: S5590

Checked By: TE/KMC

Location: 5590\Mapping\S5590 BurraRd F2_overview.mxd

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Metres

