

Appendix C Flora and Fauna

Western Rail Coal Unloader



FLORA AND FAUNA IMPACT ASSESSMENT

- Final Report
- April 2007



Western Rail Coal Unloader

FLORA AND FAUNA IMPACT ASSESSMENT

- Final Report
- April 2007

Sinclair Knight Merz
ABN 37 001 024 095
100 Christie Street
PO Box 164
St Leonards NSW
Australia 1590
Tel: +61 2 9928 2100
Fax: +61 2 9928 2500
Web: www.skmconsulting.com

LIMITATION: This report has been prepared on behalf of and for the exclusive use of Sinclair Knight Merz Pty Ltd's Client, and is subject to and issued in connection with the provisions of the agreement between Sinclair Knight Merz and its Client. Sinclair Knight Merz accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.



Contents

1.	Introduction	1
1.1	General Introduction	1
1.2	Project Appreciation	3
1.3	Study Objectives	3
2.	Preliminary Review	5
2.1	Existing Environment	5
2.2	Biodiversity Databases	5
2.3	Threatened Flora	6
2.4	Endangered Ecological Communities	6
2.5	Threatened Fauna	7
2.6	Threatened Aquatic Species	8
3.	Vegetation and Flora Survey	11
3.1	Methodology	11
3.1.1	Threatened Flora – Capertee Stringybark	12
3.1.2	Limitations	12
3.2	Results	13
3.2.1	Floristic Diversity	13
3.2.2	Vegetation Communities	13
3.2.3	Threatened and Rare Flora	19
3.2.4	Introduced Flora Species	20
4.	Fauna Habitat and Survey	22
4.1	Fauna Habitats	22
4.2	Methodology	23
4.3	Limitations	25
4.4	Results	25
4.4.1	Species Diversity	25
4.4.2	Threatened Fauna	27
5.	Aquatic Habitat Assessment	28
5.1	Methodology	28
5.2	Results	28
5.2.1	Aquatic Habitats of the Study Area	28
5.2.2	Threatened Aquatic Species	30
5.3	Discussion	30
5.3.1	Waterways classification	30



5.3.2	Riparian Corridor Value	31
6.	Impact Assessment	32
6.1	General Impacts	32
6.1.1	Conveyor Route	32
6.1.2	Rail Loop Infrastructure	32
6.1.3	Fauna movement	32
6.2	Key Thresholds	33
6.3	Threatened Species Conservation Act, 1995	33
6.3.1	Critical habitat	34
6.3.2	Endangered Populations	34
6.3.3	Endangered Ecological Communities	34
6.3.4	Threatened Flora	34
6.3.5	Threatened Fauna	36
6.3.6	Threatened Fish	42
6.4	Environment Protection and Biodiversity Conservation Act, 1999	42
6.4.1	Nationally Listed Threatened Species:	42
7.	Avoidance and Mitigation Recommendations	48
7.1	Avoidance	48
7.2	Mitigation	48
7.2.1	Natural Vegetation	48
7.2.2	Water Quality	49
7.2.3	Creek Crossing Structures	49
7.2.4	Creek Restoration	49
7.2.5	Fauna movement	51
7.2.6	Introduced species	51
7.2.7	Induction of construction personnel	51
8.	References	52
Appendix A	Threatened Flora Assessment	54
Appendix B	Flora Species List	60
Appendix C	Fauna Species List	65



1. Introduction

1.1 General Introduction

Sinclair Knight Merz (SKM) has been commissioned by Delta Electricity to prepare an Environmental Assessment (EA) for the proposed Western Rail Coal Unloader (WRCU) with associated rail loop and conveyor located in the vicinity of the Mt Piper and Wallerawang Power Stations. This report provides an assessment of flora and fauna impacts associated with this extension, and forms a specialist component of the EA.

A map showing the locality of the study area is provided as **Figure 1** Locality Plan

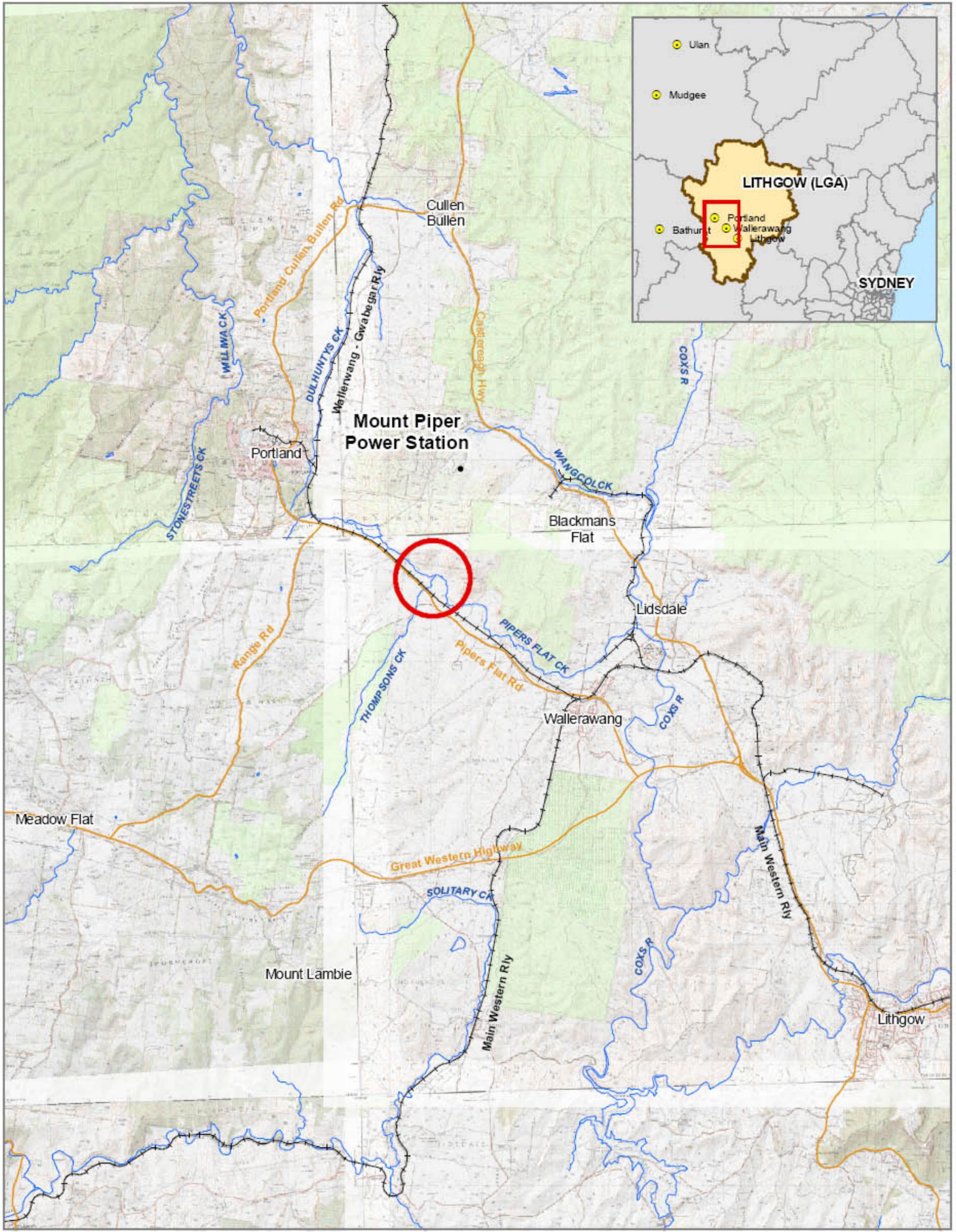


Fig 1: Regional Locality of Proposal

Delta Electricity Western Rail Coal Unloader

Legend

- Main Highways
- + + Rail
- Rivers
- State Forest
- Project Site



1:120,000

0 2.5 5

Kilometers



1.2 Project Appreciation

Delta Electricity operates two power stations, Mt Piper and Wallerawang, near Lithgow in the central west of New South Wales. Coal for these stations is currently supplied from a number of local coal mines via conveyor or road transport. Delta Electricity is proposing to construct a rail coal unloader facility in the vicinity of the stations to enable the supply of coal by rail from a wider selection of mines, predominantly north of the power stations.

This assessment addresses the project concept design at Piper's Flat which forms a loop connecting to the Mudgee rail line branch at two points south of Portland. The rail loop would be fully contained within the Piper's Flat area, bounded by the existing Mudgee branch to the south and by the ridge that rises to the north. The area is of disturbed land isolated by manmade and natural features. The rail track's initial connection with the Mudgee branch is located just east of a dammed reservoir. Coal received from the rail unloader would be transported to the power station via a conveyor as illustrated on **Figure 2**.

1.3 Study Objectives

This report documents the results of a flora and fauna assessment conducted by Sinclair Knight Merz to investigate the impacts of the proposed coal conveyor and rail loop. The information presented in the report is based on a review of available data and site investigations to assess the potential impacts of the proposal in relation to relevant State and Commonwealth environmental and threatened species legislation.

The specific objectives of this report are to:

- Identify species, ecological communities and populations of local, regional, state and national conservation significance, and their habitats, which are known or considered likely to occur within lands affected by the proposal.
- Describe the biological environment of the study area in relation to terrestrial and aquatic flora and fauna species.
- Assess the potential impacts of the proposed coal conveyor and rail loop on the ecological values of the study area.



2. Preliminary Review

2.1 Existing Environment

A previous assessment reported on the terrestrial flora and fauna issues occupying the Mt Piper Power Station perimeter lands and the nearby Thompsons Creek Dam (Ecotone Ecological Consultants 1996). The data presented in the Ecotone report documents the results of comprehensive seasonal surveys and has been reviewed for this assessment.

The previous surveys were concentrated within the naturally vegetated perimeter lands of the power station including some former mining and state forest lands although avoided existing disturbed and regenerating lands adjacent to plant infrastructure. The Ecotone (1996) study covered a broader range of topography and habitat types and a considerably larger area than the surveys for this assessment including land surrounding the study area.

Surveys for terrestrial flora and fauna were undertaken over four seasons from autumn 1995 to the summer of 1995/1996. These surveys involved the identification and mapping of vegetation communities, transect and quadrat surveys for flora and targeted surveys for threatened plant species. Fauna surveys included live-trapping using Elliott, cage and pit traps as well as mist nests and harp traps for microchiropteran bats. Additional techniques included spotlighting, ultrasonic bat detectors, owl call playback, scat collection and analysis and searches for scratch-marks, tracks and other signs.

2.2 Biodiversity Databases

Data sources used in this review included the:

- DEC Atlas of NSW Wildlife;
- Database of the Royal Botanic Gardens PlantNET and Australian Museum FaunaNET;
- Records published in scientific journals, reports and general flora and fauna distribution texts;
- Results of local environmental studies, and studies done to support various environmental impact assessments (e.g. Ecotone 1996); and
- Other relevant databases including the National Herbarium, Department of Environment and Heritage (nationally threatened species, EPBC Act), and records published in the Birds Australia database.

All of the threatened flora and fauna species, endangered populations and ecological communities known to occur within the study locality have been tabulated. This information will be utilised in the preparation of lists of threatened species deemed potential inhabitants of the study area (i.e. potential subject species).

SINCLAIR KNIGHT MERZ



2.3 Threatened Flora

A total of 34 threatened flora species have some habitat attributes within the study area (**Table 1**). Of these species at least 6 have marginal habitat qualities and 28 have good habitat qualities. The total list of threatened flora species considered are listed in **Appendix A** along with the distribution and preferred habitat conditions for each species. Threatened flora records for the local area surrounding the study area are illustrated on **Figure 3**.

■ **Table 1 Threatened Flora Species of the Study Locality.**

Threatened Flora	Status			Habitat quality in Study Area
	Cwth	NSW	RoTAP	
<i>Acacia baueri</i> subsp. <i>aspera</i>	-	V	2RC	Marginal
<i>Acacia clunies-rossiae</i>	-	V	2RC-t	Marginal
<i>Acacia flocktoniae</i>	V	V	2VC-	Marginal
<i>Calotis glandulosa</i>	V	V	3VC-	Good
<i>Darwinia peduncularis</i>	-	V	3RCi	Good
<i>Dillwynia tenuifolia</i>	V	V	2RCa	Marginal
<i>Derwentia blakelyi</i>	-	V	2K	Good
<i>Diuris aequalis</i>	E	V	3VC-	Good
<i>Eucalyptus cannonii</i>	V	V	2VCi	Good
<i>Eucalyptus pulverulenta</i>	V	V	3V	Good
<i>Grevillea evansiana</i>	V	V	2VC	Good
<i>Grevillea obtusifolia</i>	E	E	-	Good
<i>Hibbertia puberula</i>	-	E	-	Marginal
<i>Lepidium hyssopifolium</i>	E	E	3ECi+	Good
<i>Persoonia acerosa</i>	V	V	2VC-	Marginal
<i>Persoonia hindii</i>	-	E	2V	Good
<i>Persoonia hirsuta</i>	E	E	3KCi	Good
<i>Persoonia marginata</i>	V	V	2V	Good
<i>Prostanthera stricta</i>	V	V	2V	Good
<i>Pultenaea glabra</i>	V	V	3VCa	Good
<i>Zieria citriodora</i>	V	E	-	Good
<i>Zieria murphyi</i>	V	V	2VC-	Good

2.4 Endangered Ecological Communities

Of the eight vegetation communities identified from the Mt Piper power station perimeter lands in the Ecotone (1996) report, none of these are listed as an Endangered Ecological Community (EEC) under the schedules of the Commonwealth *EPBC Act* or NSW *TSC Act*. The presence of EEC's in the study area is addressed in this study.



2.5 Threatened Fauna

Twenty-nine threatened fauna species have been recorded in the wider locality (10-kilometre radius) of the Mt Piper power station site (refer **Figure 4**); and these species are listed below in **Table 2**.

■ Table 2 Threatened fauna species of the study locality

Common name	Species	Status		Recorded from Mt Piper perimeter lands*
		C'wth	NSW	
Brush-tailed Rock Wallaby	<i>Petrogale penicillata</i>	E	E	
Regent Honeyeater	<i>Xanthomyza phrygia</i>	E	E	
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V	V	✓
Green and Golden Bell Frog	<i>Litoria aurea</i>	V	E	
Bathurst Copper Butterfly	<i>Paralucia spinifera</i>	V	E	
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V	
Blue Mountains Water Skink	<i>Eulamprus leuraensis</i>		E	
Giant Dragonfly	<i>Petalura gigantea</i>		E	
Stuttering Frog	<i>Mixophyes balbus</i>		E	
Booroolong Frog	<i>Litoria booroolongensis</i>		E	
Koala	<i>Phascolarctos cinereus</i>		V	
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>		V	✓
Powerful Owl	<i>Ninox strenua</i>		V	✓
Eastern Bent-wing Bat	<i>Miniopterus schreibersii</i>		V	✓
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>		V	✓
Yellow-bellied Glider	<i>Petaurus australis</i>		V	
Brown Treecreeper	<i>Climacteris picumnus</i>		V	✓
Grey-crowned Babbler	<i>Pomatostomus temporalis temporalis</i>		V	
Black-chinned Honeyeater	<i>Melithreptus gularis gularis</i>		V	
Hooded Robin	<i>Melanodryas cucullata</i>		V	
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>		V	✓
Barking Owl	<i>Ninox connivens</i>		V	
Diamond Firetail	<i>Stagonopleura guttata</i>		V	
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>		V	✓
Squirrel Glider	<i>Petaurus norfolcensis</i>		V	
Square-tailed Kite	<i>Lophoictinia isura</i>		V	
Speckled Warbler	<i>Pyrrholaemus sagittata</i>		V	
Pink-tailed Legless Lizard	<i>Aprasia parapulchella</i>		V	
Turquoise Parrot	<i>Neophema pulchella</i>		V	



2.6 Threatened Aquatic Species

Searches for threatened aquatic species records from the regional area have been sourced from databases (CANRI) and previous investigations (Jones *et al* 1995). Records of Macquarie Perch (*Macquaria australasica*) a species listed under the EPBC Act and TSC Act have been recorded from the Cox's River catchment. Such records have occurred from tributaries in the lower catchment such as Little River which are considered to be in relatively pristine condition. Given the condition of the waterways in the study area (lack of riparian cover, high turbidity and bank erosion) populations of this species are unlikely to occur.



- **Figure 3 Threatened flora records**



- **Figure 4 Threatened fauna records**



3. Vegetation and Flora Survey

3.1 Methodology

Detailed flora field surveys were undertaken within the study area from 14-17 August 2006. Following changes to the proposal layout additional surveys were undertaken on the 13 February 2007 to determine additional locations of Capertee Stringybark and habitats which may potentially be impacted.

The survey effort was concentrated primarily on the sections of the proposed works site containing remnant native vegetation, particularly the proposed route for the coal loader conveyor. Land proposed for the rail loop is dominated by a modified and heavily grazed pasture and therefore was not surveyed as intensively. The survey effort in this area targeted creek crossings and isolated remnant trees. A handheld GPS was used to record the location of survey methods undertaken, vegetation community boundaries, rare and threatened flora species and any other items of interest.

The flora survey involved traverses on foot of all vegetation types present within the study area. More detailed surveys were undertaken in areas of native vegetation and included vegetation plots (20 x 20m quadrats) and numerous traverses across the entire study area. The surveys aimed to identify the floristics and structure of the vegetation, and the type and distribution of plant communities present. Flora survey methods undertaken for this study including field work undertaken on the 14-17 August 2006 and the 13 February 2007 are shown in **Figure 5**, showing locations of quadrats and an indicative extent of general traverses where threatened flora species were targeted.

Identification of plant communities was undertaken including an assessment of the presence of Endangered Ecological Communities (EEC's) as listed under the *Threatened Species Conservation Act 1995* (TSC Act). Site data, for each quadrat and transect was recorded in standardised format and information including, species presence, richness, cover abundance, site location, aspect, as well as a GPS location and digital photographs were collated. The overall condition of the site vegetation was noted, including the extent of modification and weed invasion.

Searches were undertaken for threatened flora species listed under the TSC Act and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) considered potential subject species and any additional rare or significant plant species. Cropper (1993) suggests that a general traverse is a suitable method for detecting the presence of rare species during flora surveys. As such, several general traverses were undertaken across the entire study area as part of the field surveys, focussing on areas of remnant vegetation.



3.1.1 Threatened Flora – Capertee Stringybark

The threatened flora species Capertee Stringybark *Eucalyptus cannonii* was identified within a large proportion of the study area and counts of this species were undertaken. A handheld GPS was used to record the location of individual Capertee Stringybark specimens. The initial surveys (14-17 August 2006) for Capertee Stringybarks was restricted to a 25m buffer surrounding the existing service trail. With the revision of the proposed route of the conveyor to areas outside this 25m buffer to the west of the existing service trail, additional fieldwork was undertaken on the 13 February 2007 to capture the location of Capertee Stringybarks in this area.

Where clusters of this species were found within a relatively small area (i.e. up to 30x30m area) a GPS way-point was taken in the approximate centre of the cluster and the number of trees recorded. Flagging tape was used to mark the locations of GPS way points to avoid counting trees twice. The total number of specimens in the study area was determined through calculating the sum of the trees recorded against each way-point.

The approximate number of *E cannonii* specimens potentially removed by the proposed coal unloader was calculated by overlaying the development footprint with the Capertee Stringybark GPS way-points using GIS software, and calculating the approximate sum of the specimens recorded for each way-point within the development footprint. Where there was insufficient plant material to distinguish Capertee Stringybark from the closely related *E.macrorhyncha* or plant material has characteristics of both species (a hybrid) a precautionary approach was taken and so these specimens were recorded as Capertee Stringybark for the purposes of this assessment, however the large majority of specimens could be positively identified in the field. Additionally, traverses of areas outside the study area were undertaken to determine the extent of Capertee Stringybark in the surrounding area (refer **Figure 5**).

3.1.2 Limitations

The list of flora and fauna species recorded from this study should not be seen to be fully comprehensive, but an indication of the species present at the time of the survey. A period of several seasons or years is often needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year eg: orchids or migratory birds and require specific weather and seasonal conditions for optimum detection eg: frogs. The conclusions of this report have therefore adopted a precautionary approach to satisfactorily address the presence of threatened species, in that an assessment of the likelihood of threatened species which may occupy the habitat was made. This approach combined with the level of survey effort is considered adequate to identify the conservation values on the site and ensure that the limitations of the survey have been taken into account when drawing conclusions from the study.



3.2 Results

3.2.1 Floristic Diversity

Native floral species richness was moderately low within the naturally vegetated portions of the study area. A total of 109 flora species from 36 families were identified. This total comprised two species of fern, one conifer species, 72 species of dicotyledons and 25 species of monocotyledons. Of the total species recorded, 15 species of introduced flora were identified, representing approximately 14% of the total species diversity. Four of the introduced species, St Johns Wort *Hypericum perforatum*, Blackberry *Rubus fruticosus* and Gorse *Ulex europaeus* are listed as a noxious species within the locality. A comprehensive list of the flora species present within the study area at the time of the survey has been included as **Appendix B**. Considering the flora survey was conducted in late winter, a number of annual species may not have been detected.

3.2.2 Vegetation Communities

The study area comprises three vegetation communities.

- Map Unit 1: Ribbon Gum – Apple Box – Snow Gum Woodland
- Map Unit 2: Brittle Gum – Scribbly Gum – Stringybark Woodland
- Map Unit 3: Regenerating Vegetation

The vegetation communities are summarised in **Table 3**. The distribution of the vegetation communities, as illustrated in **Figure 6**, is related to environmental variables and disturbance history. For example, Map Unit 1 occurs in protected areas such as gullies and east facing slopes. Map Unit 2 occurs in more exposed areas such as west facing slopes and ridge tops. Map Unit 3 occurs in areas which have been cleared but are now regenerating, including areas immediately surrounding the power station, cleared easements and a thin strip along the proposed coal conveyor route adjacent to the existing trail.

Map Unit 1: Ribbon Gum – Apple Box – Snow Gum Woodland

Map unit 1 is associated with the gully areas and lower elevated east-facing slopes along the proposed coal conveyor route. The dominant tree species comprise Ribbon Gum *Eucalyptus viminalis*, Apple Box *Eucalyptus bridgesiana* and Snow Gum *Eucalyptus pauciflora*. Other tree species in this community include Candlebark *Eucalyptus rubida* and Broad-leaved Peppermint *Eucalyptus dives*. Other tree species common to Map Unit 2 occur in this community where the two merge, including Capertee Stringybark, Brittle Gum *Eucalyptus mannifera* and Red Stringybark *Eucalyptus macrorhyncha*.

The shrub layer is generally minimal although Silver Wattle *Acacia dealbata* subsp. *dealbata* can be relatively common in areas. The ground layer is dominated by grass species including Snowgrass *Poa* spp, Silvertop Wallaby Grass *Joycea pallida* and *Austrostipa pubescens*. Herb

SINCLAIR KNIGHT MERZ



species present include Prickly Starwort *Stellaria pungens* and Kidney Weed *Dichondra repens*. Exotic species occur in this community in places including Blackberry *Rubus fruticosus* which occurs as numerous dense clumps (see **Plate 1**) and scattered Plantain *Plantago lanceolata* and Flatweed *Hypochoeris radicata*. A small area of Map unit 1 is on the northern side of the proposed rail loop at Pipers Flat, which is relatively disturbed from agricultural activities comprising smaller trees with a grazed understorey (see **Plate 2**).

This community contains a tree canopy projective foliage cover of approximately 20 -35% and is approximately 15–18 metres high. There is a sparse shrub layer of Silver Wattle varying between 5-20% foliage cover and 1-5 metres in height. The ground cover contains combinations of grass and herb species with a foliage cover between 50 and 85%, with areas of bare earth and leaf litter present in some sections.



Plate 1. Southern end of the proposed coal conveyor route, showing dense infestation of Blackberry



Plate 2. Vegetation within the proposed rail loop area.

Map Unit 2: Brittle Gum – Scribbly Gum – Stringybark Woodland

Map unit 2 occurs on the ridges and west facing slopes of the study area adjacent to the proposed coal conveyor route (see **Plate 3**). The dominant tree species comprise Brittle Gum, Scribbly Gum *Eucalyptus rossii*, Red Stringybark and Capertee Stringybark. Other common tree species include Broad-leaved Peppermint, Thin-leaved Stringybark *Eucalyptus eugenioides* and Narrow-leaved Stringybark *Eucalyptus sparsifolia*, which are generally restricted to the northern end of the proposed conveyor route.

The shrub layer is generally sparse containing spaced clumps of Box-leaf Wattle *Acacia buxifolia*, Silver Wattle, Peach Heath *Lissanthe strigosa* and Sifton Bush *Cassinia arcuata*. The ground layer is dominated by grass species including Snowgrass *Poa* spp, Silvertop Wallaby Grass *Joycea pallida* and Hedgehog Grass *Echinopogon ovatus*. Other groundcover species include Rough Bedstraw *Galium gaudichaudii*, Bidgee-widgee *Acaena novae-zelandiae*, Wattle Mat-rush



Lomandra filiformis subsp. *filiformis*, Blueberry Lily *Dianella revoluta* and Button Everlasting *Helichrysum scorpioides*. Exotic species are generally absent from this community, however in places some minor weed infestations of Plantain *Plantago lanceolata* and Flatweed *Hypochoeris radicata* are present. Along the service trail adjacent to the proposed coal conveyor route there are regenerating examples of this community present (see **Plate 4**).

This community contains a tree canopy projective foliage cover of approximately 20 -35%, approximately 10-15 metres high. There is a sparse shrub layer varying between 5-30% foliage cover and 1-3 metres in height. The ground cover contains combinations of grasses and herb species with a foliage cover between 50 and 85% with areas of bare earth and leaf litter present in some sections.



Plate 3. Brittle Gum-Scribbly Gum-Stringybark Woodland



Plate 4. Regenerating Brittle Gum-Scribbly Gum-Stringybark Woodland (on left)

Map Unit 3: Regenerating Vegetation

Map unit 3 occupies several locations in the study area including:

- Areas of the communications easement along the proposed coal conveyor route adjacent to the service trail (see **Plate 4**);
- Areas surrounding the power station (see **Plate 5**);
- Within the power line easement and disused easements (see **Plate 6**).

Diversity is generally low in these areas however along the proposed coal conveyor route diversity may be higher with recruitment from adjacent remnant vegetation including juvenile *Eucalypt* species. Dominant flora species include Silver Wattle, Sifton Bush and various grass species.



Plate 5. Regenerating vegetation in area surrounding power station

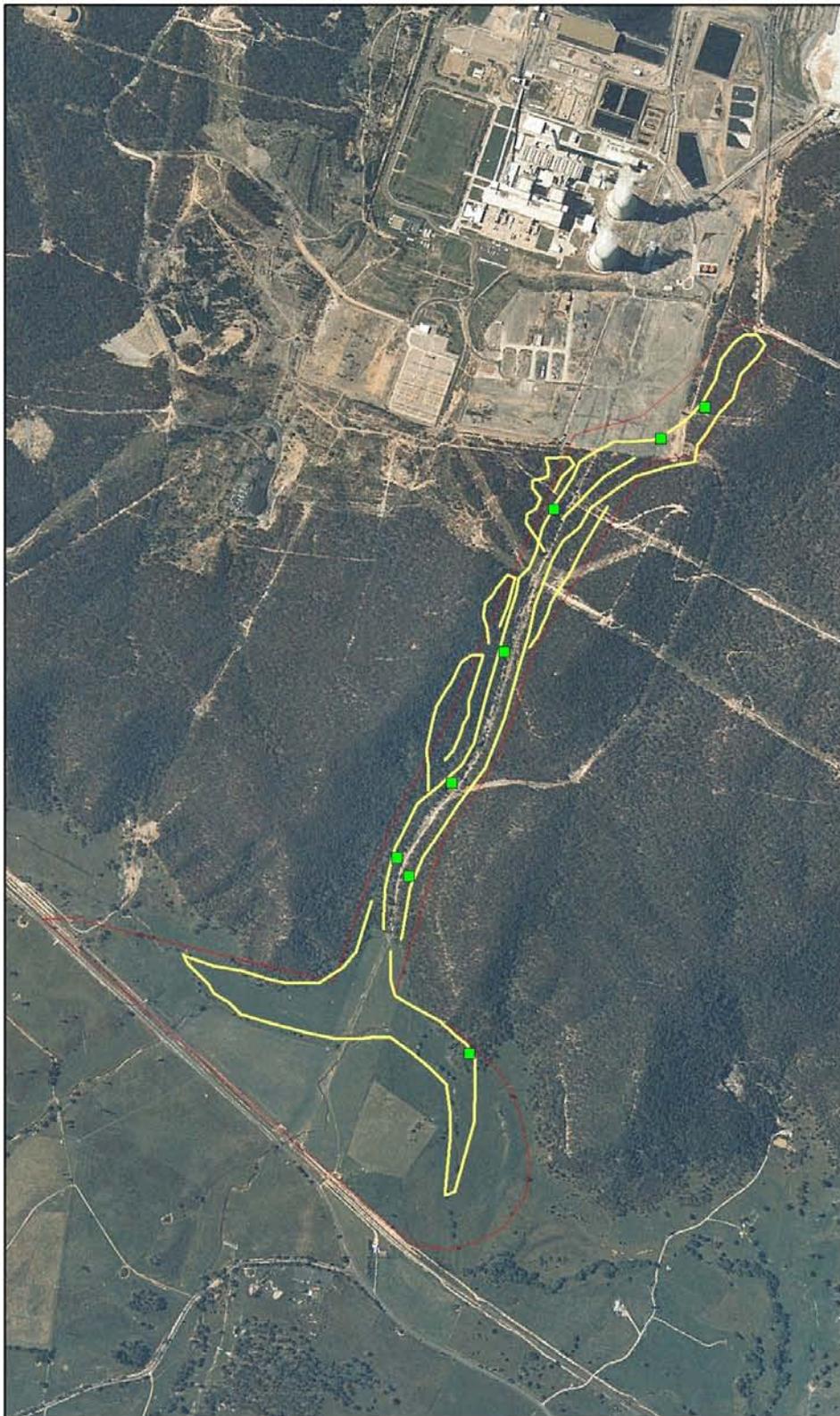


Plate 6. Regenerating/disturbed vegetation within power line easement

■ **Table 3 Summary of vegetation communities**

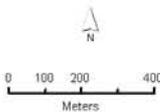
Vegetation Community	Species composition / Description
Map Unit 1: Ribbon Gum – Apple Box – Snow Gum Woodland	<p>Canopy: <i>Eucalyptus viminalis</i>, <i>Eucalyptus bridgesiana</i>, <i>Eucalyptus pauciflora</i>, <i>Eucalyptus dives</i>, <i>Eucalyptus rubida</i>, <i>Eucalyptus cannonii</i>, <i>Eucalyptus mannifera</i>, <i>Eucalyptus macrorhyncha</i></p> <p>height/cover: 15–20 metres / 20-35%</p> <p>Shrubs: <i>Acacia dealbata</i> subsp. <i>dealbata</i>, <i>Lissanthe strigosa</i></p> <p>Grasses: <i>Joycea pallida</i>, <i>Austrostipa pubescens</i>, <i>Poa</i> spp</p> <p>Herbs: <i>Stellaria pungens</i>, <i>Acaena novae-zelandiae</i>, <i>Dichondra repens</i></p> <p>Ferns: <i>Pteridium esculentum</i>, <i>Cheilanthes sieberi</i></p> <p>Vines/Climbers: <i>Rubus fruticosus</i></p>
Map Unit 2: Brittle Gum – Scribbly Gum – Stringybark Woodland	<p>Canopy: <i>Eucalyptus mannifera</i>, <i>Eucalyptus rossii</i>, <i>Eucalyptus macrorhyncha</i>, <i>Eucalyptus cannonii</i>, <i>Eucalyptus dives</i>, <i>Eucalyptus eugenioides</i>, <i>Eucalyptus sparsifolia</i></p> <p>Height/cover: 10–15 metres / 20-35%</p> <p>Shrubs: <i>Acacia buxifolia</i>, <i>Acacia dealbata</i> subsp. <i>dealbata</i>, <i>Lissanthe strigosa</i>, <i>Indigofera australis</i>, <i>Monotoca scoparia</i>, <i>Cassinia arcuata</i>, <i>Astroloma humifusum</i>, <i>Hibbertia obtusifolia</i>, <i>Bursaria longisepala</i> var. <i>pilosa</i>, <i>Hovea heterophylla</i>, <i>Bossiaea buxifolia</i>, <i>Podolobium ilicifolium</i>, <i>Brachyloma daphnoides</i></p> <p>Grasses: <i>Joycea pallida</i>, <i>Poa</i> spp , <i>Echinopogon ovatus</i></p> <p>Herbs/Other: <i>Galium gaudichaudii</i>, <i>Acaena novae-zelandiae</i>, <i>Hypericum gramineum</i>, <i>Helichrysum scorpioides</i>, <i>Lomandra filiformis</i> subsp. <i>filiformis</i>, <i>Veronica calycina</i></p> <p>Ferns: <i>Cheilanthes sieberi</i></p>
Map Unit 3: Regenerating Vegetation	<p>Shrubs: <i>Acacia dealbata</i> subsp. <i>dealbata</i>, <i>Cassinia arcuata</i>, <i>Acacia penninervis</i></p> <p>Height/cover: 1-5 metres / 0-15%</p> <p>Understorey: <i>Poa</i> spp., <i>Joycea pallida</i>, <i>Hydrocotyle laxiflora</i></p>

Figure 5
Flora Survey Methods



Legend

- Traverses
- Quadrats



Source:
Aerial photograph: NSW Dept Lands
Vector Mapping: SKM

File Name: MP_007b_FloraMethods.mxd
File Location: I:\ENVR\Projects
EN021541\Technical\GIS\Template
Date: 18/4/2007
Revision: 2
Datum: GCS_GDA_1984





- **Figure 6 Vegetation Communities**



3.2.3 Threatened and Rare Flora

One flora species the Capertee Stringybark *Eucalyptus cannonii* was recorded in the study area. The species is scheduled as Vulnerable under both the TSC Act (State listed species) and the EPBC Act (nationally threatened species).

The distribution of Capertee Stringybark was found to occur in 3 distinct groups adjacent to the proposed coal loader conveyor route (see **Figure 7**). This species was generally confined to areas of Map Unit 2, however in some areas where Map Unit 1 and 2 merge it was also found in Map Unit 1. The population of Capertee Stringybark within the study area is estimated to be approximately 500 individuals. A similar species Red Stringybark *Eucalyptus macrorhyncha* was also relatively common along the proposed coal loader conveyor route, however the two species generally occur in separate clusters except for a few locations. At the time of the survey most specimens had sufficient biological material present (in particular the flower buds) for correct identification. However, a small number of Red Stringybark may have been included in the counts of Capertee Stringybark where these species occurred together or where there was insufficient material present for positive identification. Hybrids of these two species are common at some locations (DEC 2005), however little evidence of this was recorded in the study area.

General observations from the surrounding area indicate that Capertee Stringybark is widely dispersed and Ecotone (1996) recorded it as locally common throughout the Mt Piper perimeter lands. Recent surveys in the Ben Bullen State Forest (SKM 2007) has determined the presence of this species between Baal Bone Mine and Mt Piper Power Station, where it was found to be abundant within clusters along power easements and trails.

Another species regarded as regionally significant due to its limited distribution in NSW in the Capertee district is the Clustered Daisy-bush *Olearia suffruticosa* which was recorded in low abundance in areas outside the proposal area. A small number of this species was also recorded by Ecotone (1996) in perimeter lands to the west of the Mt Piper Power Station.

Other threatened flora species could potentially be present within the study area, but were undetectable during the survey period due to their cryptic nature when not in flower. Threatened flora that are difficult to detect outside their flowering period that have been identified as potentially occurring in the study area in **Section 2.3** include Doubletail Buttercup *Diuris aequalis*, *Derwentia blakelyi* and Hairy Geebung *Persoonia hirsuta*. To mitigate potential impacts to these species if present within the proposed works area, it is recommended that once the location of the proposed coal unloader has been surveyed, pre-clearance surveys be undertaken during the respective flowering times for these species, in late spring and summer. Surveys conducted during February 2007 (late summer) did not detect the presence of any of these species.



3.2.4 Introduced Flora Species

A total of 15 introduced flora species were identified in the study area, including 4 noxious species, listed in **Table 4** (indicated in bold). The *Noxious Weeds Act 1993* outlines the responsibilities for control and management of noxious weeds. Weed management strategies should be implemented as part of any proposed works.

■ Table 4 Introduced Flora Species of the Study area

Species	Common Name	Noxious Species
<i>Briza maxima</i>	Quaking Grass	
<i>Cirsium vulgare</i>	Spear Thistle	
<i>Cynosurus echinatus</i>	Crested Dogstail	
<i>Dactylis glomerata</i>	Cocksfoot	
<i>Echium plantagineum</i>	Patterson's Curse	
<i>Hypericum perforatum</i>	St Johns Wort	W4
<i>Hypochaeris radicata</i>	Catsear	
<i>Phalaris aquatica</i>	Canary Grass	
<i>Phalaris minor</i>	Lesser Canary Grass	
<i>Pinus radiata</i>	Radiata Pine	
<i>Plantago lanceolata</i>	Plantain	
<i>Rosa rubiginosa</i>	Sweet Briar	W4
<i>Rubus fruticosus</i>	Blackberry	W4
<i>Salix babylonica</i>	Weeping Willow	
<i>Ulex europaeus</i>	Gorse	W3

W2 Noxious weeds must be continually suppressed and destroyed;

W3 Noxious weeds must be prevented from spreading and their numbers and distribution reduced; and

W4 Noxious weeds must not be sold, propagated or knowingly distributed.

Weed abundance was found to be generally low within remnant vegetation, except for parts of Map Unit 1 which supported dense clumps of Blackberry and patches of St Johns Wort. As expected a greater abundance of agricultural weeds such as St Johns Wort and pasture grasses were found to occur within the proposed rail loop area which has been previously cleared and grazed. There are only scattered individuals of Gorse in the vicinity of the proposed coal loader conveyor route.



- **Figure 7 Locations of *Eucalyptus cannonii***



4. Fauna Habitat and Survey

Field surveys for fauna were aimed at assessing the species richness of the site and investigate the fauna habitats present and the potential for local threatened fauna species to occur. The survey incorporated a range of techniques to target species from all fauna groups including mammals, birds, reptiles and amphibians. These techniques included live-trapping for small to medium sized terrestrial and arboreal mammals, live trapping and ultrasonic call detection for microchiropteran bats, nocturnal census (spotlighting, owl call playback and frog searches), searches for active herpetofauna (reptiles and amphibians), diurnal bird census and recording of indirect evidence of fauna presence (tracks, scats, nests, diggings, bones and other traces). In addition, all opportunistic sightings of fauna were recorded.

A full description of the specific methodologies used during the terrestrial fauna field survey is discussed in **Section 4.2**.

4.1 Fauna Habitats

■ *Modified grassland habitats (grazing land)*

Grassland is a common feature of the Pipers Flat area selected for the rail loop infrastructure occupied by grazing land. This habitat supports a diversity of fauna adapted to open and modified landscapes such as grazing macropods, some reptiles, raptors, granivorous and insectivorous birds. Occasional isolated mature trees are scattered throughout the grasslands and these provide perching, nesting and refuge habitat for birds as well as potential roosting and breeding hollows for microbats and birds.

■ *Open forest and woodland habitats*

Open forest and woodland covers the majority of the elevated lands surrounding the proposed conveyor route. These habitats generally comprise a sparse to open understorey and low shrub diversity. Some areas have been selectively cleared or grazed and subsequently relatively young regrowth is present. Large mature trees and dead stags are scattered throughout woodland habitats in low densities and are absent from many areas of regrowth. Small to medium sized tree hollows are well represented in the forest / woodland areas which support the best quality habitats for arboreal and hollow-dependent fauna on the property. The presence of sandstone rocky slopes provides sheltering opportunities for native small mammals.

■ *Dams and creeks*

Dams and creeks provide open water with some reed and sedge habitats that are locally significant for dependent fauna. The dam habitats are characterised by both relatively deep and shallow water areas and occasionally exhibit dense inundated and fringing vegetation comprising reeds and sedges.

SINCLAIR KNIGHT MERZ



4.2 Methodology

The fauna survey was conducted during the period from 14-17 August 2006. Three sites were selected from aerial photograph, topographic map and site reconnaissance to concentrate trapping efforts through sampling the woodland habitats as these were expected to yield the majority of the fauna species assemblage. Steep slopes were also targeted by general herpetofauna searches at woodland habitat sites where possible. Surveys in cleared grasslands and dams were restricted to observational data and no specific survey sites or trapping were used. The location of the fauna trap sites, spotlighting transects and other techniques is shown on **Figure 8**.

Mammals

The live-trapping survey for small to medium sized mammals was conducted using ground and tree-mounted traps at each of the three sample sites. 25 ground traps (Elliott type A, 33 x 10 x 9 cm, aluminium folding traps) were placed along transects at intervals of 10 metres and placed in or under cover at every opportunity. Traps were left open for a three-night period (96 hours) equating to 126 ground trap nights.

Ten tree traps (Elliott type B, 15 x 16 x 45 cm aluminium folding traps) were placed at each of the three sites in a grid, with each trap spaced 75-100 metres apart. Traps were mounted on a platform attached to the tree trunk at a height of 4 metres. Each trap grid was active for three consecutive nights (96 hours). Total Elliott (type B) trapping effort equated to 60 trap nights. All Elliott traps were baited with a mixture of peanut butter, rolled oats and honey and cage traps were baited with tinned sardines. The trunk of the tree adjacent to the tree trap was sprayed with a mixture of water and honey to act as an attractant. Traps were checked in the morning and captured animals were measured, weighed and released.

Spotlighting was undertaken for all medium and large-sized terrestrial and arboreal mammals, as well as nocturnal birds, by two observers over two nights using Lightforce 50Watt hand-held spotlights. The locations of sightings of fauna species were recorded during the spotlighting surveys.

Bats

Standard two-bank 4.2m² harp traps were used to sample for microchiropteran bats at three sites over 3 nights for a total of 6 trap nights. Harp traps were placed in forested areas along narrow gaps such as creeks, gullies and vehicle tracks as such locations are generally associated with natural flyways for microchiropteran bats. Captured bats were collected in the morning, measured and weighed. Captured individuals were held that day and released at the capture point the following night. A stationary ultrasonic bat call detector (Anabat II, Titley Electronics) was used with a storage ZCAIM unit to record bat calls at 3 sites adjacent to farm dams, forest edges and vehicle tracks. Calls were recorded continuously between 1800 and 0500 hours over three nights. Recorded

SINCLAIR KNIGHT MERZ



calls were later identified to genus or species level where possible using computer frequency analysis software (Analook v.4.0). Spotlighting and listening for calls of megachiropteran bats (*Pteropus* spp) was conducted during spotlighting activities.

Diurnal Birds

A formal bird census was conducted at each of the three trap sites in addition to opportunistic bird census conducted over remaining areas of the study area. Formal census involved point counts along designated transects (up to 100m where possible) sampling natural vegetated areas. A standard 20-minute survey was carried out during early morning sessions where birds were identified on the basis of visual identification and characteristic call. All opportunistic observations of bird species were recorded whilst undertaking general survey activities on the site. A total of approximately eight person hours were spent surveying for birds.

Nocturnal Birds

Nocturnal birds were surveyed using the playback of pre-recorded calls of threatened owl species. Calls were played at the start of the spotlighting surveys. These surveys involved initial listening periods at dusk for 30 minutes, followed by playing the species recorded call for five minutes duration. Each call was followed by a ten minute listening period for an audible response before commencing with the next species call. The end of the last call was followed by a five-minute listening period for any audible response, then spotlighting for approximately 10-minutes. The pre-recorded calls were played through a portable cassette and broadcast via a loudhailer (Toa megaphone). Species targeted included the Powerful Owl, Masked Owl and Barking Owl.

Searches and listening for calls of other nocturnal birds was conducted during the spotlighting surveys.

Herpetofauna Census

Reptiles and amphibians were surveyed by hand-searches in suitable habitat, and spotlighting for nocturnal species.

For reptiles, hand searches concentrated on the hill slopes and mid slopes and around dead trees and included turning rocks wherever encountered to target the threatened Pink-tailed Lizard.

All opportunistic sightings of active herpetofauna were noted. A nocturnal search was conducted around farm dams using a head torch to survey for active frogs. Frogs were identified on the basis of their characteristic call as well as by direct observation. A total of approximately eight person hours were surveyed for reptiles and amphibians.



Searches for Evidence of Species Presence

Searches were conducted for animal dung (scats) of predatory and non-predatory species. Where encountered these were identified to species level if possible. The search concentrated on the ground beneath trees as well as around hollow logs and tracks. Searches were made for other characteristic signs of fauna species presence including tracks, bones, hair, shed skins and animal remains, as well as nests, diggings, chew marks, scratchings and pellets (indicative of birds of prey).

4.3 Limitations

The list of flora and fauna species recorded from this study should not be seen to be fully comprehensive, but an indication of the species present at the time of the survey. A period of several seasons or years is often needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year eg: orchids or migratory birds and require specific weather and seasonal conditions for optimum detection eg: frogs. The conclusions of this report have therefore adopted a precautionary approach to satisfactorily address the presence of threatened species, in that an assessment of the likelihood of threatened species which may occupy the habitat was made. This approach combined with the level of survey effort is considered adequate to identify the conservation values on the site and ensure that the limitations of the survey have been taken into account when drawing conclusions from the study.

4.4 Results

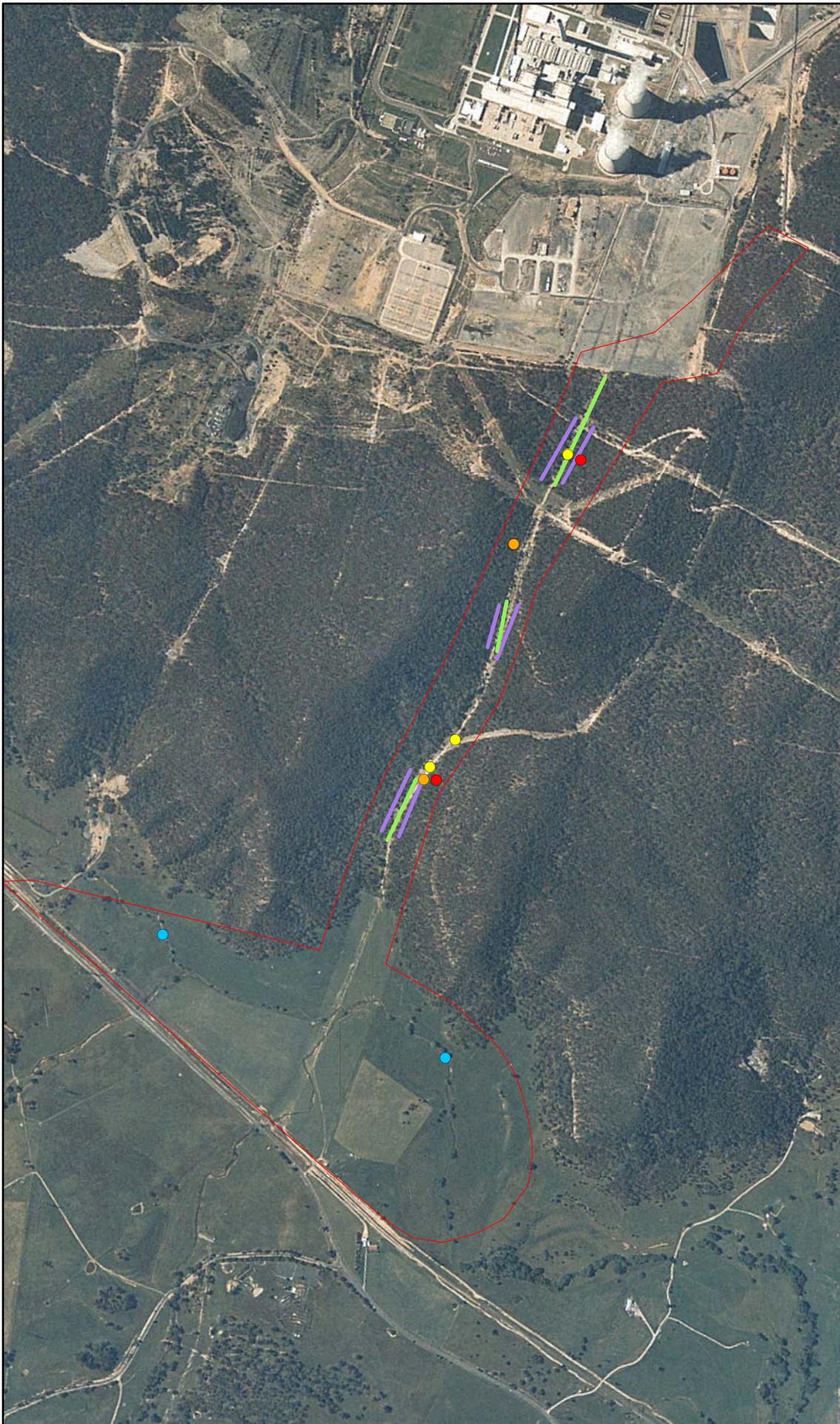
4.4.1 Species Diversity

A total of 45 fauna species were recorded from the study area during the field survey. This list comprised 29 bird species, 13 mammal species, and two frog species. The list of species and the respective habitat types from which they were recorded are provided in **Appendix B**.

The fauna assemblage encountered is considered generally low and may be the result of the small area surveyed as well as the degree of past disturbance of the habitats, in particular the modified pasture and creek areas. The bird species assemblage was dominated by honeyeaters (Meliphagidae), with several insectivores and granivorous species also present.

Areas of dense shrub growth occur on the upper slopes, gullies and hill tops in the study area and these areas provide higher quality habitat for smaller bird species which were noted to occur and possibly restricted to such areas. This included smaller passerines such as the Buff-rumped and Striated Thornbill, Grey Fantail and Superb Blue Fairy-wren.

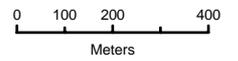
Figure 8
Fauna Survey Sites



Legend

Survey Type

- Anabat
- Aquatic
- Harp Trap
- Owl Call Playback
- Elliot Traps
- Spotlighting



Source:
Aerial photograph: NSW Dept Lands
Survey sites: SKM

File Name: MP_006a_FaunaSurvey.mxd
File Location: I:\ENVR\Projects\
EN02154\Technical\GIS\Template
Date: 20/10/2006
Revision: 1
Datum: GCS_GDA_1994



Other than honeyeaters, the most abundant bird species in the woodland and grassland habitats on lower slopes included the Red-browed and White-browed Treecreepers, Crimson Rosella, Galah, Australian Magpie, Australian Raven, Striated and Spotted Pardalote. Each of these species is adapted to modified woodland habitats with a reduced or absent understorey.

Of the 13 mammal species recorded 7 of these were microchiropteran bats. Additional bat species are likely to occur and would require several survey periods to detect. These species roost in tree hollows and are all common and widespread species in both forest and woodland habitats in eastern NSW.

The most widespread and abundant species recorded was the Eastern Grey Kangaroo *Macropus giganteus* which was observed from all parts of the study area including woodland and open grassland areas. Small mammal diversity and abundance was low, consisting of only one species, the native Brown Antechinus *Antechinus stuartii*.

Three arboreal mammals were recorded, the Common Ringtail Possum *Pseudechis peregrinus*, Common Brushtail Possum *Trichosurus vulpecula* and Sugar Glider *Petaurus breviceps*. These species were relatively common and sighted in several locations wherever tree hollows were present

The frog fauna identified during the survey was low, although this may be a reflection of cold conditions during the survey and general lack of freshwater habitats present. Few additional species would be expected.

No reptiles were recorded despite intensive searches and this is related to the cool conditions during the survey and lack of microhabitat features (rocks and logs).

4.4.2 Threatened Fauna

No threatened fauna species (*TSC Act* or *EPBC Act*) were identified from the study area as a result of the field surveys. However several species are known from the Mt Piper power station perimeter lands (Ecotone 1996) and may occasionally utilise the site based on the habitat assessment. Further discussion on threatened species is provided in Section 6 of the report.



5. Aquatic Habitat Assessment

5.1 Methodology

A number of freshwater streams have the potential to be directly or indirectly impacted by the proposal and as such an assessment of the condition of these streams and the potential for each to provide habitat for threatened aquatic species was conducted. The methodology used to assess aquatic habitats within the study area is outlined below.

A list of aquatic endangered communities, threatened species and endangered populations with potential to occur within the study area has been derived from a variety of sources including those listed below. Background information used to gain a better understanding of the overall condition of streams and aquatic habitats within the locality and relevant catchments, such as:

- DEC Threatened Species Database Records for the locality (i.e. 10 km radius)
- DEH Online Protected Matters Search Tool for Matters of National Environmental Significance (NES) (DEH 2006a); and
- Online search of NSW Department of Primary Industries website threatened species lists (DPI 2006).

A visual habitat assessment of all streams likely to be traversed by the proposed rail loop within close proximity to the proposed construction area was conducted using a standard pro-forma field sheet. Notes were taken on the aquatic and riparian vegetation present, substrate type, water quality (if water was present), habitat types, and general condition and health of the reach.

5.2 Results

5.2.1 Aquatic Habitats of the Study Area

The proposed rail loop at Pipers Flat includes 4 crossings of Pipers Flat Creek. The following field assessment results shown in **Table 5** were collected at Pipers Flat Creek (refer to **Figure 8**).

■ Table 5 Aquatic Field Assessment Results

Criteria	Site 1 – Pipers Flat Creek (west of proposed conveyor)	Site 2 – Pipers Flat Creek (east of proposed conveyor creek diversion area)
Flow Regime:	Flowing creek with permanent pools to about 2 metres depth	Slow flowing permanent to semi permanent creek
Stream Substrate:	Gravel and Clay	Gravel
Water Quality (visual assessment):	Clear, absence of algal scum and no/little odour	Relatively turbid
Adjoining Landuse:	Grazed pasture	
Riparian	No remnant riparian vegetation present. Weeping Willows are the dominant tree species	

SINCLAIR KNIGHT MERZ



Criteria	Site 1 – Pipers Flat Creek (west of proposed conveyor)	Site 2 – Pipers Flat Creek (east of proposed conveyor creek diversion area)
Vegetation:	along the channel occurring with pasture grasses.	
In-stream Vegetation:	Mainly exotic grasses, however some native species are present including Common Rush <i>Juncus usitatus</i> , Tall Sedge <i>Carex appressa</i> and Austral Mudwort <i>Limosella australis</i> .	Mainly exotic grasses, however some native species are present including Common Rush <i>Juncus usitatus</i> .
Nearby Wetlands:	Thompsons Creek Dam occurs up stream of Thompsons Creek to the south of the study area and an un-named dam occurs up stream of Pipers Flat Creek. There are also larger dams downstream including Warragamba Dam.	
Refuge Areas:	There are some deep pools to 2 metres depth which may provide refuge	Little to none
Spawning Areas:	Deep pools, gravel beds, snags, boulders and riffles	Shallow pools, gravel beds
Barriers to Fish Passage:	No Barriers in study area, however dams up stream and downstream of this area provide barriers to movement.	
Disturbances	Unrestricted stock access to creek. Moderate to high bank erosion and subsequent sedimentation of creek. High level exotic vegetation cover.	
Threatened Species Habitat:	Unlikely habitat for local threatened fish species due to the high level of disturbance and lack of adequate habitat attributes.	
Migratory Species:	Small and large dams up stream and downstream of this area limit movements of migratory fish and are therefore unlikely to be present.	
Introduced Fish:	Likely to be present, none apparent during visual surveys	
Waterway Class (Fairfull and Witheridge 2003):	Class 2 – Moderate Fish Habitat	
Riparian corridor classification (c.f. DIPNR 2004)	Category 1 Riparian corridor	



Plate 7: Pipers Flat Creek



Plate 8: Bank erosion along Pipers Flat Creek

SINCLAIR KNIGHT MERZ



5.2.2 Threatened Aquatic Species

Macquarie Perch (*Macquaria australasica*) are listed as Endangered under the EPBC Act and in NSW they are listed as Vulnerable under the *Fisheries Management Act 1994*. Records of the species are known from the Coxs River (Sydney Water 2005) of which Pipers Flat Creek is a tributary.

The Macquarie Perch is a riverine, schooling species and prefers deep, rocky holes with considerable vegetation cover and areas of shallow running water for spawning (DEH 2006a). Macquarie Perch are especially sensitive to degradation and are essentially restricted to pristine streams preferring clear, cool water with riffles (McDowell 1996). There are recent records from tributaries with the Warragamba protected area which are examples of relatively pristine waterways with few degrading processes. Although some habitat elements are present within Pipers Flat Creek the highly degraded nature of the creek and the barriers provided by dams up and downstream, makes habitats of the study area unsuitable for this species, and therefore it is unlikely to be present.

5.3 Discussion

5.3.1 Waterways classification

Pipers Flat Creek is considered to provide moderate to low value fish habitat. The NSW Fisheries classification scheme for watercourse crossings (Fairfull and Witheridge 2003) has been applied to Pipers Flat Creek within the vicinity of the proposed works is detailed below in **Table 6**.

■ Table 6 Classification Scheme for Watercourse Crossings

Classification	Characteristics of watercourse	Minimum preferred engineering solutions
Class 2 – Moderate fish habitat	Smaller named permanent or intermittent stream, creek or river. Clearly defined drainage channels with semi-permanent to permanent waters in pools or in connected wetland areas. Marine or freshwater aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area.	A large box culvert or a bridge crossing. Cross-sectional area of structure should aim to equal the cross-sectional area of the watercourse.

(source: Fairfull and Witheridge 2003)

Fairfull and Witheridge (2003) provides a comprehensive overview of the best way to plan, design, construct and maintain waterway crossings to minimise impacts on fish passage and aquatic habitats and must be followed in NSW.



5.3.2 Riparian Corridor Value

Discussions with DNR during the course of the assessment identified a preference by the Department to categorise Pipers Flat Creek according to the habitat value criteria outlined in DIPNR (2004). In this regard DNR suggested the creek should be classified as a category 1 environmental corridor. The overall objective of this environmental corridor category is to *'maintain connectivity between one destination to another for the movement of aquatic and terrestrial fauna and flora'* (DIPNR 2004).

At present lands surrounding Pipers Creek, in the vicinity of the rail loop, are completely modified and cleared of vegetation with a long-history of cattle grazing. As any existing habitat connectivity for terrestrial flora and fauna along the creek is absent there is essentially no scope to *'maintain connectivity'* as an outcome of the project. However the proposal to divert a short section of Pipers Flat Creek is consistent with the objectives of this category, in that these works would effectively maintain connectivity along the creek for aquatic fauna and fish passage.

The project would concentrate on the restoration of new and old creek areas in accordance with the guidelines of DIPNR (2004). Riparian vegetation protection or restoration under this category should concentrate on an area of 50 m width along the creek bank (i.e. 40 m from the top of the bank plus 10 m buffer).



6. Impact Assessment

6.1 General Impacts

6.1.1 Conveyor Route

The proposed coal loader comprises a conveyor raised above the ground and transports coal from the rail loop to the Mt Piper power station. The conveyor traverses a generally straight route with a disturbance area of approximately 15 metres wide by 1.7 km in length through areas of remnant vegetation. Assuming vegetation clearance will be required along this entire length approximately 2.5 ha of remnant vegetation will require removal, however the placement of the conveyor within disturbed/regenerating areas will reduce the amount of clearing required.

Capertee Stringybark was recorded as a common component of the vegetation surrounding and within the conveyor route. Generally this species occurs in clusters along the proposed conveyor route comprising approximately 500 individuals with all age classes represented. The total number of Capertee Stringybarks within the perimeter lands of the Mt Piper Power Station is likely to be much larger than the extent within the study area given the presence of comparable habitat throughout. The closely related Red Stringybark also occurs within and surrounding the proposed conveyor route, generally occurring separately from the clusters of Capertee Stringybark. However these two species do intergrade in places and hybrids are often found in these areas. It is anticipated that up to 50 Capertee Stringybark may have to be removed for the proposed conveyor, however this number may be smaller depending upon the exact placement of the conveyor.

6.1.2 Rail Loop Infrastructure

The site for the proposed rail loop is located on predominantly cleared agricultural land and comprises a grazed pasture and disturbed riparian zones of Pipers Flat Creek. There is also a small area of low quality remnant vegetation on the northern side of the proposed rail loop comprising younger remnant trees with a pasture understorey (see **Plate 2**).

As part of the rail loop construction, low-lying lands will be filled to raise the level of the track above the floodplain. Spoil for the embankments will be trucked from the Lamberts Gully mine to the rail loop site along the conveyor easement. This proposal will involve construction of a 20 m wide vehicle track adjacent to the conveyor, most of which will follow the existing track in this location which would be widened up to 8 m. A new section of track will traverse through uncleared vegetation at the southern end of the route before entering onto the cleared lands adjacent to Pipers Flat Creek. No Capertee Stringybarks were recorded in this location.

6.1.3 Fauna movement

The proposed conveyor and associated maintenance track and infrastructure will create a physical barrier to fauna dependent on ground movements, such as small and medium sized terrestrial

SINCLAIR KNIGHT MERZ



mammals, some frog species, particularly ground dwelling species and possibly reptiles. Many species could be expected to traverse the conveyor and track including arboreal mammals and there will be no barrier to mobile species such as birds and bats.

6.2 Key Thresholds

Potential ecological impacts from the proposal can be minimised through restricting the footprint of the proposed conveyor to within the existing easement and tracks where possible. However it is likely that between approximately up to 50 of the estimated 500 individual Capertee Stringybark within the study area will require removal. No threatened fauna were recorded in the disturbance areas and the habitat contained within the works area is considered of relatively low value due to the lack of critical habitat features (vegetation structure, logs, hollows and rocks) compared to the surrounding slopes. No threatened fauna area expected to occur.

Mitigation measures should be enforced during the construction of the project, particularly for the proposed coal conveyor and riparian areas within the proposed rail loop. Measures to avoid impacts on threatened species and their habitat imposed by this development include:

- Appropriate placement of the proposed coal conveyor and access trails to utilise existing disturbed areas along the proposed route, including regenerating vegetation within the existing communications easement and the service trail;
- Marking the limits of clearing and installing temporary fencing around areas of remnant vegetation outside the construction footprint to avoid unnecessary vegetation and habitat removal;
- Storage of equipment and stockpiling of resources should be restricted to designated areas in cleared and degraded land to minimise the overall impact of the construction and avoid unnecessary vegetation and habitat removal and disturbance;
- Restoration of riparian zones at Pipers Flat disturbed from the proposed rail loop;
- Collection of seed from Capertee Stringybarks in the study area to be used in the restoration of existing degraded areas such as areas surrounding Mt Piper Power Station and areas disturbed from the construction of the proposed conveyor;
- Appropriate management of weeds should be implemented to ensure they are not spread throughout areas of remnant vegetation; and
- The use of best-practice sediment and erosion controls.

6.3 Threatened Species Conservation Act, 1995

An assessment of the impacts of this proposal on species, populations and ecological communities listed under Schedules 1, 1A and 2 of the TSC Act and Schedules 4, 4A and 5A of the FM Act has been undertaken. The proposal is to be assessed under Part 3A of the EP&A Act and consequently

SINCLAIR KNIGHT MERZ



this impact assessment was undertaken in accordance with the Draft Guidelines for Threatened Species Assessment (DEC 2005).

6.3.1 Critical habitat

Critical habitat is defined as an area that is critical to the survival of an endangered species, population or ecological community. The proposal will not impact on critical habitat declared under the TSC Act.

6.3.2 Endangered Populations

No endangered populations were recorded in the study area

6.3.3 Endangered Ecological Communities

No endangered ecological communities were recorded in the study area.

6.3.4 Threatened Flora

Capertee Stringybark *Eucalyptus cannonii*

The listed Capertee Stringybark (Schedule 2 TSC Act) was recorded as locally common within remnant vegetation surrounding the proposed coal conveyor. The location of trees surveyed within the proposed conveyor route are shown in **Figure 7**. General observations from the surrounding area indicate that Capertee Stringybark is widely dispersed and Ecotone (1996) recorded it as locally common throughout the Mt Piper perimeter lands.

This species is well represented within conservation reserves, and has limited potential threats other than land clearing (Hunter and White 1999). Hunter and White (1999) consider the listing of this species as Vulnerable under the TSC Act as no longer appropriate due to the variation and size of populations within the current reserve network and non-productive private land.

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

Capertee Stringybark is restricted to an area of about 100 x 60 km in the central tablelands of NSW, with the western extent comprising a line between Bathurst and Mudgee and the eastern extent comprising a line between Lithgow and the town of Bylong (DEC 2005). Within the area Capertee Stringybark is often locally frequent (DEC 2005). Some populations are quite large, with one population in Winburndale Nature Reserve estimated to be at a minimum of 6000 individuals with the total closer to 10,000 individuals. The species is also reserved in other conservation reserves comprising Avisford Nature Reserve, Wollemi National Park and Gardens of Stone National Park, with the total reserved population estimated to exceed 20,000 plants in at least 14 separate populations (DEC 2000a). The species has limited potential threats other than land clearing (Hunter and White 1999).

SINCLAIR KNIGHT MERZ



The distribution of Capertee Stringybark in the study area is relatively extensive and many individuals were also recorded in adjacent lands outside the proposal area. The approximate number of individuals within the study area is estimated to be approximately 500 individuals. General observations from the surrounding area indicate that Capertee Stringybark is widely dispersed and Ecotone (1996) recorded it as locally common throughout the Mt Piper perimeter lands.

Up to 50 Capertee Stringybark individuals will require removal depending upon the exact alignment of the coal conveyor, and a relatively large number of individuals will remain within the study area and surrounding areas of remnant vegetation. The proposed coal conveyor will result in a small degree of fragmentation, however this is not expected to significantly disrupt ecological processes such as pollination that may cause genetic isolation of Capertee Stringybarks. Considering these factors, the proposal is unlikely to adversely affect the life cycle of Capertee Stringybark at Mt Piper.

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

The proposed coal conveyor will disturb only a very small area of habitat with the implementation of the recommended mitigative measures and large areas of potential habitat will remain in surrounding areas. The proposed area of disturbance represents a very small fraction of the potential habitat for Capertee Stringybark in the local area. With the implementation of adequate weed management principles during construction of the proposed coal conveyor, Capertee Stringybark habitat is unlikely to be significantly disturbed in the long-term, and any disturbed areas of habitat are likely to regenerate with recruitment from the surrounding woodland and existing soil seed bank. Therefore it is unlikely that the proposal will adversely affect potential habitat for Capertee Stringybark. Additionally, it is recommended that seeds are collected from Capertee Stringybark in the proposal area, and propagated seedlings used in restoration activities within existing disturbed areas and areas disturbed from the proposed construction activities.

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

The Capertee Stringybark population at Mt Piper is at the southern edge of the species distribution (DEC 2000). However, the proposal will not reduce the distributional extent of Capertee Stringybark considering that up to 50 of the estimated 500 Capertee Stringybark individuals in the study area will require removal provided that the proposed coal conveyor is appropriately placed. A relatively large number of individuals will remain within the study area and the surrounding areas of remnant vegetation.

SINCLAIR KNIGHT MERZ



How is the proposal likely to affect current disturbance regimes?

Grazing and firewood collection are the major disturbance regimes operating within the study area. With the procurement of these lands by Delta Electricity, grazing activities and firewood collection are likely to cease. Access to areas of remnant vegetation will be limited by the proposed rail loop which will deter firewood collection in this area. Weed species within areas of remnant vegetation are most likely spread by stock allowed to intermittently graze this area. Therefore it is likely that disturbance regimes will cease or become less frequent with the implementation of the proposal.

How is the proposal likely to affect habitat connectivity?

The proposed coal conveyor will result in a small degree of fragmentation to the remnant vegetation. However this is not expected to significantly disrupt ecological processes such as pollination which would cause isolation of habitats and/or species.

How is the proposal likely to affect critical habitat?

No critical habitat has been identified for this species.

6.3.5 Threatened Fauna

The list of threatened fauna species recorded from the Mt Piper power station perimeter lands and the surrounding study area is provided in Section 2. Through an analysis of the known habitat requirements of these threatened species, in relation to the diversity of habitats present within the proposed impact area, a list of potential subject species has been compiled. Potential subject species are defined as those threatened species considered likely to occur in the habitats present within the study area.



■ **Table 7 Assessment of the potential for threatened fauna species to occur within the habitats present in the impact area**

Common name	Species	Habitat requirements	Likely presence in the extension area
Brush-tailed Rock Wallaby	<i>Petrogale penicillata</i>	Open forest habitats with exposed rocks, rock overhangs and steep topography	Not expected
Regent Honeyeater	<i>Xanthomyza phrygia</i>	A nomadic species typically associated with forest and woodland habitats with the presence of suitable foraging species such as Yellow Box and Red Ironbark	Not expected
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	Open and closed forest habitats, requires large expansive areas of habitat to sustain territory size.	Extensive areas of habitat within Ben Bullen State Forest suitable for this species.
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	No camps known to be present in the local area, nearest camps in Western Sydney. Suitable foraging habitat present.
Green and Golden Bell Frog	<i>Litoria aurea</i>	Ephemeral creeks, dams, ponds with adjacent grassy areas	Not expected
Bathurst Copper Butterfly	<i>Paralucia spinifera</i>	Inhabits open forest / woodland areas above 900m in elevation and prefers sites that receive full all-day sun. Also requires the presence of the Native Blackthorn (<i>Bursaria spinosa</i> ssp <i>lasiophylla</i>) in the understorey an important host plant critical for larvae.	Low potential. While the habitat is marginal, there are several records of this species approximately 7-8 km to the southeast of the Mt Piper power station.
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Open forest and woodland habitats, a cave roosting species which favours sandstone escarpment areas for roosting	Potential foraging area, no roosting habitat present
Blue Mountains Water Skink	<i>Eulamprus leuraensis</i>	Sedge swamps, hanging swamps in the upper Blue mountains area	Not expected
Giant Dragonfly	<i>Petalura gigantea</i>	Sedge swamps, freshwater wetlands and peat bogs	Not expected
Stuttering Frog	<i>Mixophyes balbus</i>	Permanent streams in moist and wet sclerophyll forests	Not expected
Booroolong Frog	<i>Litoria booroolongensis</i>	A highland species (200 – 1000m asl) associated with western-flowing rocky streams on the slopes and tablelands of the Great Dividing Range. Streams are slow-flowing and bordered by grassy vegetation.	Not expected
Koala	<i>Phascolarctos cinereus</i>	Open forests and woodlands with favoured food tree species	Not expected
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	Moist and tall open forests, particularly in steep topographic areas	Not expected
Powerful Owl	<i>Ninox strenua</i>	Open forests with dense wet gullies and creek areas, requires large mature trees with hollows for breeding and dense areas of vegetation for prey and roosting	Not expected
Eastern Bent-wing Bat	<i>Miniopterus schreibersii</i>	Forages in a variety of habitat types including cleared and modified environments, a cave roosting species	May forage for insects in all areas

SINCLAIR KNIGHT MERZ



Common name	Species	Habitat requirements	Likely presence in the extension area
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	Open forest habitats with She-oak species (<i>Allocasuarina</i> sp) required for food.	Not expected, no food trees identified from the works area
Yellow-bellied Glider	<i>Petaurus australis</i>	Tall open forest habitats, favours mature wet sclerophyll forest and dense gullies.	Not expected
Brown Treecreeper	<i>Climacteris picumnus</i>	Woodland bird species, favour dry sclerophyll forests and woodlands, generally with a sparse understorey, grassy areas and logs.	Potential habitat present, may occur
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>		
Black-chinned Honeyeater	<i>Melithreptus gularis gularis</i>		
Hooded Robin	<i>Melanodryas cucullata</i>		
Diamond Firetail	<i>Stagonopleura guttata</i>		
Speckled Warbler	<i>Pyrrholaemus sagittata</i>		
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	Occurs in a variety of open forest and woodland habitats, with hollow-bearing trees required for roosting, may forage in younger regrowth and modified environments	May forage for insects in all areas, potential roost sites present.
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>		
Barking Owl	<i>Ninox connivens</i>	Forest and woodland habitats, particularly drier western slopes and riverine areas, hunts for birds and small mammals.	Not expected
Squirrel Glider	<i>Petaurus norfolcensis</i>	Forest and woodland habitats, particularly areas with a diversity of eucalypt species in the canopy.	Not expected. No habitat present in the study area. Not recorded from the Mt Piper perimeter lands despite intensive four seasonal trapping survey (Ecotone 1996).
Square-tailed Kite	<i>Lophoictinia isura</i>	Occurs in a variety of open forest and woodland habitats, particularly riverine woodlands	Not expected
Pink-tailed Legless Lizard	<i>Aprasia parapulchella</i>	In general, occurs in open grassland and woodland habitats that have a substantial cover of rocks and exposed rock. A small population is known from the Bathurst area	Low potential to occur on the basis that suitable sheltering habitat is very poorly represented in the proposed works area. Although some rocky sites occur on the stepper slopes adjoining the site and individuals may occur.
Turquoise Parrot	<i>Neophema pulchella</i>	Open forest and woodlands	Not expected

No threatened fauna species (TSC Act or EPBC Act) were identified on the site during the field surveys. Indeed, the results of the field survey and habitat assessment indicate that the habitat is not suitable for the large majority of threatened fauna species that are known to occur in the area. This conclusion is based on the lack of critical habitat features and degree of modification and impacts from past activities.

SINCLAIR KNIGHT MERZ



However the presence of natural open forest and woodland habitat provides some habitat value to a small diversity of threatened fauna species as evidenced by the habitat assessments. The list of potential subject species includes:

Woodland birds	■ Brown Treecreeper	■ Grey-crowned Babbler
	■ Diamond Firetail	■ Black-chinned Honeyeater
	■ Speckled Warbler	■ Hooded Robin
Microchiropteran Bats	■ Eastern False Pipistrelle	■ Greater Broad-nosed Bat
Other Mammals	■ Spotted-tail Quoll	■ Grey-headed Flying Fox
Reptiles	■ Pink-tailed Worm Lizard	
Invertebrates	■ Bathurst Copper Butterfly	

Impact Assessment

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

Potential impacts on small populations of these threatened fauna may result from the clearing of vegetation and habitat to accommodate the coal conveyor and haul road access. This relates to the reduction in available habitat for local populations and potential loss of critical features that provide shelter such as tree hollows used by the Brown Treecreeper for breeding and as roost sites for hollow-roosting bats in addition to surface rocks (Pink-tailed Worm Lizard) and feeding habitat (Bathurst Copper Butterfly).

On a landscape scale, the loss of habitat has been minimised through selection of the Pipers Flat route option, which will predominantly traverse through an existing disturbed easement and vehicle track. In contrast the former option involved considerably more habitat disturbance.

Fauna habitat identified within the works area is relatively low in value compared to the surrounding hillslopes and indeed the remainder of the Mt Piper perimeter lands, as evidenced by the fauna species diversity recorded in the study area compared to the broader perimeter lands (c.f. Ecotone 1996). Much of the tree cover is considered young in age and relatively few mature or hollow-bearing trees were noted. Further the cover of rocks in the proposal area is very low in abundance compared to observations of the surrounding landscape, particularly on the upper slopes. As a result of these observations it is evident that the proposal area provides very marginal and low quality sheltering habitat for the assessed threatened fauna and that higher quality and more extensive areas of preferred habitat are represented in the surrounding landscape.

The habitat is to be disturbed potentially provides for foraging life-cycle events for woodland birds and microchiropteran bats. These species forage over large areas which may include forest and woodland but also open modified and degraded lands. The proposal will not significantly impact on the local availability of foraging habitat and the degree of clearing is not expected to significantly impact on feeding habitat for local populations of woodland birds given the extent of suitable and

SINCLAIR KNIGHT MERZ



indeed better quality habitats present in the locality. The current potential for these species to occur in the proposal area will remain post-construction.

The proposal area provides potential foraging habitat for Spotted-tail Quoll and Grey-headed Flying Fox which both utilise large areas of habitat for hunting and foraging. The removal of 2ha of potential habitat for these species is unlikely to have potential impacts to the life cycle of these species, as this area would comprise only a very small proportion of the species home range.

There are no known roost sites 'flying-fox camps' for the Grey-headed Flying-fox in the study area and the nearest known camps are from the Sydney area including the Botanic Gardens, Cabramatta, Gordon, Penrith, and Wheeney Creek and Yarramundi in the Hawkesbury. There are no existing roost sites within the areas selected for development of infrastructure for the coal conveyor project.

Habitat for the Grey-headed Flying-fox and Spotted-tailed Quoll is extensive throughout all naturally vegetated areas of the region. In particular, high conservation value remnants are conserved in several national parks, conservation reserves and state forests within proximity to Mt Piper. Indeed the Mt Piper perimeter lands also provide potential habitat for these species.

The habitat in the proposal area was not identified as preferred or potential foraging habitat for the Bathurst Copper Butterfly or Pink-tailed Worm Lizard.

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

The habitats within the works area are of comparatively lower value for these threatened species than the surrounding hillslopes and indeed the remainder of the Mt Piper perimeter lands. This is evidenced by the degree of disturbance and past clearing of remnant vegetation and the state of regeneration. The degree of clearing required for this project is not expected to significantly impact on local populations of the assessed species given the extent of suitable and indeed better quality habitats present in the locality. Further pre-clearing surveys have been recommended to identify and flag hollow-bearing habitat trees in proximity to the works area with the aim of further minimising the loss of these features in the final design and construction phase of the project.

There are no known roost sites 'flying-fox camps' for the Grey-headed Flying-fox in the study area and the nearest known camps are from the Sydney area including the Botanic Gardens, Cabramatta, Gordon, Penrith, and Wheeney Creek and Yarramundi in the Hawkesbury. There are no existing roost sites within the areas selected for development of infrastructure for the coal conveyor project.

Habitat for the Grey-headed Flying-fox and Spotted-tailed Quoll is extensive throughout all naturally vegetated areas of the region. In particular, high conservation value remnants are



conserved in several national parks, conservation reserves and state forests within proximity to Mt Piper. Indeed the Mt piper perimeter lands also provide potential habitat for these species

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

The Bathurst Copper Butterfly is restricted to the Bathurst and Lithgow area however the habitat in the proposal area has been identified as low quality and not preferred by this species.

None of the remaining species are at the limit of their distribution on the study area

How is the proposal likely to affect current disturbance regimes?

The impacts from cattle grazing as well as gully erosion and weed invasion are the major disturbance regimes operating within the study area. With the procurement of these lands by Delta Electricity, grazing activities will cease.

Weed species within areas of remnant vegetation are most likely spread by stock allowed to intermittently graze this area. Therefore it is likely that disturbance regimes will be cease or become less frequent with the implementation of the proposal. Weeds should be monitored post-construction to determine their invasiveness and a weed management plan prepared if necessary.

The issue of erosion within creek areas should be addressed through stabilisation and restoration of creek areas as discussed in the recommendations section of the report.

How is the proposal likely to affect habitat connectivity?

The proposed coal loader conveyor and access track may provide a barrier to movements of larger mammals including ground and tree dwelling species moving across the landscape.

Potential movement opportunities will also be impacted along the short section of Pipers Flat Creek diverted for the proposal. Measures to provide and restore connectivity in riparian areas are required as a component of the project and this is discussed in the recommendations section of the report.

How is the proposal likely to affect critical habitat?

The Pipers Flat option was selected to minimise disturbance to vegetation and habitat. Given the degree of disturbance and modification to the habitat within the works area resulting from past activities, this small area is unlikely to constitute critical habitat for the assessed species. Comparatively larger and higher quality habitats are represented through the surrounding landscape and Mt Piper perimeter lands that may provide critical habitat should populations of these

SINCLAIR KNIGHT MERZ



threatened fauna occur. There is no evidence gathered by the field surveys to suggest that the proposal area provides critical habitat for the assessed species.

6.3.6 Threatened Fish

Records of Macquarie Perch (*Macquaria australasica*) have been recorded from the Cox's River catchment (Sydney Water 2005) of which Thompson's Creek and Piper Flat Creek are included in. These records have occurred from tributaries in the lower catchment such as Little River which are considered to be in relatively pristine condition. Given the condition of the waterways in the study area (i.e. lack of riparian cover, high turbidity and bank erosion) populations of this species are unlikely to occur.

6.4 Environment Protection and Biodiversity Conservation Act, 1999

There is a statutory responsibility to comply with the requirements and intent of the Commonwealth *Environment Protection and Biodiversity Conservation Act*, 1999 (EPBC Act) in relation to the protection and management of threatened species. This assessment deals specifically with the significance of impacts from the proposed coal conveyor and rail loop on nationally threatened species and commonwealth migratory species.

6.4.1 Nationally Listed Threatened Species:

Capertee Stringybark *Eucalyptus cannonii*

This assessment deals specifically with the significance of impacts from the proposed development on the nationally Vulnerable Capertee Stringybark. Appropriate placement of the proposed coal conveyor will minimise the removal of this species in the study area, however a small number of individuals of this species are expected to be removed by the proposed activity. Of the estimated 500 individuals recorded in the study area, potentially 50 of these may require removal depending upon the exact alignment of the coal conveyor.

The closely related Red Stringybark *Eucalyptus macrorhyncha* was also present within the study area, occurring adjacent Capertee Stringybark in some areas. A small number of *E.macrorhyncha* may have been included in the counts of Capertee Stringybark where these species occurred together or where there was insufficient material present for positive identification. Hybrids of these two species are common at some locations (DEC 2005), however evidence of this was recorded in only a few locations where the two species intergrade.

The assessment of nationally threatened species present within or known to utilise the study area has been undertaken in accordance with the significant impact criteria for endangered and vulnerable species as outlined in the Significant Impact Guidelines relating to matters of national environmental significance (DEH 2006) to determine whether the proposal would have a

SINCLAIR KNIGHT MERZ



significant impact on any of these species, and hence on a matter of national environmental significance. This assessment is provided below.

1. Lead to a long-term decrease in the size of an important population of a species.

Capertee Stringybark is restricted to an area of about 100 by 60 km in the central tablelands of NSW, with the western extent comprising a line between Bathurst and Mudgee and the eastern extent comprising a line between Lithgow and the town of Bylong (DEC 2005). Within this range Capertee Stringybark is often locally common (DEC 2005). Some populations are quite large, with one population in Winburndale Nature Reserve estimated to be at a minimum of 6000 individuals with the total closer to 10,000 individuals. The species is also reserved in other conservation reserves comprising Avisford Nature Reserve, Wollemi National Park and Gardens of Stone National Park, with the total reserved population estimated to exceed 20,000 plants in at least 14 separate populations (DEC 2000a).

The distribution of Capertee Stringybark in the study area is relatively extensive and many individuals were also recorded in adjacent lands outside the proposal area. The approximate number of individuals within the study area is estimated to be approximately 500 individuals. The distribution of Capertee Stringybark within the study area is generally within 3 clusters along the proposed coal conveyor route.

Up to 50 Capertee Stringybark individuals will require removal depending upon the exact alignment of the coal conveyor, and a relatively large number of individuals will remain within the study area and surrounding areas of remnant vegetation (Ecotone 1996). Considering this the proposal is unlikely to lead to a long-term decrease in the size of the local population. Additionally, to offset the potential loss of individual trees, Capertee Stringybarks should be propagated from seed collected from the study area to be used in native plantings in disturbed areas surrounding the power station and areas disturbed from proposed construction activities.

2. Reduce the area of occupancy of an important population

The Capertee Stringybark population at Mt Piper is at the southern edge of the species distribution (DEC 2000). The proposal will reduce the area of occupancy for Capertee Stringybark, however only a small number of Capertee Stringybark (up to 50) individuals will require removal depending upon the exact alignment of the coal conveyor, and a relatively large number of individuals will remain within the study area and surrounding areas of remnant vegetation. The importance of the population is not highly significant to maintaining the entire population, however there is some significance considering the species is at or near its distributional limit.



3. Will the action adversely affect habitat critical to the survival of the species?

Habitat critical to the survival of a species refers to areas that are necessary:

- *For activities such as foraging, breeding, roosting, or disposal;*
- *For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators;*
- *To maintain genetic diversity and long-term evolutionary development; or*
- *For the reintroduction of populations or recovery of the species.*

The area of habitat proposed for removal is unlikely to be critical to the survival of the species, considering the high representation of the species and suitable habitat in conservation reserves and areas surrounding the study area. The proposed coal conveyor will disturb only a very small area of habitat with the implementation of the recommended mitigative measures (see **Section 5.2.4**).

The proposal is likely to reduce threatening processes for this species. Grazing and firewood collection are the major disturbance regimes operating within the study area. With the procurement of these lands by Delta Electricity, grazing activities and firewood collection are likely to cease. Access to areas of remnant vegetation will be limited by the proposed rail loop which will deter firewood collection in this area. Weed species within areas of remnant vegetation are most likely spread by stock allowed to intermittently graze this area.

4. Modify, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

The proposed area of disturbance represents a very small fraction of the potential habitat for Capertee Stringybark. The proposed coal conveyor will disturb only a very small area of habitat with the implementation of the recommended mitigative measures (see **Section 5.2.4**), and therefore is unlikely to remove, modify or decrease the availability or quality of habitat for Capertee Stringybark to the extent that the species will decline. The proposed coal conveyor will result in a small degree of fragmentation, however this is not expected to significantly disrupt ecological processes such as pollination and seed dispersal that would cause isolation of habitats or species. To offset the potential loss of habitat for Capertee Stringybarks, this species should be propagated from seed collected from the study area and plantings established and maintained within disturbed areas surrounding the power station and other disturbed areas.

5. Result in invasive species that are harmful to a vulnerable species becoming established in the threatened species habitat.

Weed species recorded in the study area could potentially be further spread into areas of remnant vegetation. The implementation of weed management principles during construction will greatly

SINCLAIR KNIGHT MERZ



minimise or eliminate this from occurring. Invasive species have not been identified as a major threatening process for this species (DEC 2005).

6. Interferes substantially with the recovery of the species

There is no recovery plan or designated recovery actions for this species under the EPBC Act. The proposal is unlikely to significantly conflict with any recovery actions proposed for the species considering the large reserved populations, many individuals will be retained in the surrounding areas and the minimal impact to individuals and areas of potential habitat.

Threatened Fauna

This assessment deals specifically with the significance of impacts from the proposed development on the nationally vulnerable Grey-headed Flying-fox and Spotted-tailed Quoll and Bathurst Copper Butterfly. The first two species are expected to utilise habitat that may be affected by the proposed activity. The habitat is considered only very marginal for the Bathurst Copper Butterfly and certainly not preferred habitat. All remaining threatened fauna species are considered either not to occur in the study area, or the habitat is only very marginal in extent and quality and there would be no impacts on suitable habitat resulting from the proposed activities.

The assessment of nationally threatened species present within or known to utilise the study area has been undertaken in accordance with the significant impact criteria for endangered and vulnerable species as outlined in the Significant Impact Guidelines relating to matters of national environmental significance (DEH 2006) to determine whether the proposal would have a significant impact on any of these species, and hence on a matter of national environmental significance. This assessment is provided below.

1. Lead to a long-term decrease in the size of an important population of a species.

There are no known roost sites 'flying-fox camps' for the Grey-headed Flying-fox in the study area and the nearest known camps are from the Sydney area including the Botanic Gardens, Cabramatta, Gordon, Penrith, and Wheeney Creek and Yarramundi in the Hawkesbury. There are no existing roost sites within the areas selected for development of infrastructure for the coal conveyor project.

Habitat for the Grey-headed Flying-fox and Spotted-tailed Quoll is extensive throughout all naturally vegetated areas of the region. In particular, high conservation value remnants are conserved in several national parks, conservation reserves and state forests within proximity to Mt Piper. Indeed the Mt piper perimeter lands also provide potential habitat for these species.

There are no records of the Bathurst Copper Butterfly in proximity to the proposal area and the site habitats are not considered suitable for this species given the absence of known food resources.

SINCLAIR KNIGHT MERZ



The proposal would not remove important food resources nor impact on a roosting colony or breeding habitat for these species.

2. Reduce the area of occupancy of an important population

The proposal would not remove a significant area of native remnant or regrowth vegetation and would not result in the loss of an area currently occupied by a nationally threatened species.

3. Will the action adversely affect habitat critical to the survival of the species?

Habitat critical to the survival of a species refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or disposal;
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators;
- To maintain genetic diversity and long-term evolutionary development; or
- For the reintroduction of populations or recovery of the species.

The proposed area of disturbance represents a very small fraction of the potential home range area for the Grey-headed Flying-fox and Spotted-tailed Quoll should these species occur. Both species typically exhibit very large home ranges and Grey-headed Flying-fox are known to travel distances of at least 15km from roost sites to access seasonal foraging resources (Tidemann 1995). No evidence of a roosting colony of the Grey-headed Flying-fox was observed from the field surveys.

The habitat is considered only very marginal for the Bathurst Copper Butterfly and certainly not preferred habitat. All remaining threatened fauna species are considered either not to occur in the study area, or the habitat is only very marginal in extent and quality and there would be no impacts on suitable habitat resulting from the proposed activities.

4. Modify, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

The proposed area of disturbance represents a very small fraction of the potential home range area for the Grey-headed Flying-fox and Spotted-tailed Quoll should these species occur. Both species typically exhibit very large home ranges and Grey-headed Flying-fox are known to travel distances of at least 15km from roost sites to access seasonal foraging resources (Tidemann 1995). No evidence of a roosting colony of the Grey-headed Flying-fox was observed from the field surveys.

The habitat is considered only very marginal for the Bathurst Copper Butterfly and certainly not preferred habitat.



5. Result in invasive species that are harmful to a vulnerable species becoming established in the threatened species habitat.

Weeds have been recorded in the study area and could potentially spread to suitable habitat areas. The implementation of a weed management actions are required to target any weed invasions which could arise from the proposal would significantly reduce the potential impacts of weed species.

6. Interferes substantially with the recovery of the species

The proposal would not conflict with the recovery actions proposed for threatened fauna and would involve minimal impact to the potential habitat for this species in the regional area.

Migratory species or their habitat

A number of listed migratory bird species have been recorded from the western Sydney region which constitutes a part of the range area for migratory species such as the Satin Flycatcher and Black-faced Monarch.

The project area does not provide unique or critical habitat, preferred habitat, or habitat of significance for any of these species, and as discussed previously there would be very minimal impact on native vegetation resulting from the project. Construction of the proposed works would not affect the visitation rates and behaviours of migratory species in the region



7. Avoidance and Mitigation Recommendations

7.1 Avoidance

Wherever possible the design of the proposed coal conveyor and rail loop should consider restricting vegetation clearance to modified areas such as grazed paddocks and areas of regenerating remnant vegetation. This is particularly important for the proposed coal conveyor and associated access trail, to utilise existing disturbed areas along the proposed route, such as regenerating vegetation within the existing communications easement and the service trail.

Additionally, efforts should be made to conserve and appropriately manage the intact areas of remnant vegetation adjoining the works areas and/or restore similar modified areas of vegetation outside the proposed construction footprint to offset any potential small losses associated with individual trees.

The proposed coal conveyor route and/or service trail should be located within these areas of regenerating vegetation adjacent to the service trail wherever applicable, to avoid removal of more mature vegetation including larger trees.

7.2 Mitigation

7.2.1 Natural Vegetation

- The proposed location of the coal conveyor and access trail is surrounded by areas of remnant vegetation. To limit impacts in this area, the proposed disturbance footprint should be clearly defined on-ground using temporary fencing to avoid unnecessary vegetation and habitat removal;
- It would be appropriate to conduct a pre-clearing survey to identify and flag any significant hollow-bearing habitat trees and Capertee Stringybark within the works corridor with the aim of avoiding these features in the final design and construction phases of the project where possible;
- Pre-clearance surveys for other threatened flora species potentially occurring in the study area should be undertaken during their flowering times from late spring to summer, including but not limited to Doubletail Buttercup, *Derwentia blakelyi* and Hairy Geebung;
- To offset potential impacts to Capertee Stringybark, this species should be propagated from seed collected from the study area and plantings established and maintained within existing disturbed areas surrounding the power station or areas disturbed from the proposed construction activities;
- Storage of equipment and stockpiling of resources should be restricted to designated areas in cleared and degraded land to minimise the overall impact of the construction and avoid unnecessary vegetation and habitat removal;

SINCLAIR KNIGHT MERZ



- Restoration of riparian areas disturbed from the proposed rail loop at Pipers Flat. The restoration of the currently cleared or degraded riparian area may assist in maintaining fauna movements;
- Appropriate weed management strategies should be implemented during construction to ensure they are not spread throughout the study area and particularly into areas of remnant vegetation adjacent to the proposal area;
- The use of best-practice sediment and erosion controls;
- Fallen logs encountered within the proposed disturbance footprint should be relocated to areas of retained remnant vegetation; and
- Timber felled for clearing should be retained on the ground in the area as habitat for terrestrial fauna.

7.2.2 Water Quality

The preservation of water quality is an important construction issue particularly for the proposed rail loop which will involve crossings over Pipers Flat Creek. As a result strict sediment and erosion controls should be adopted to prevent impacts on water quality. Appropriate measures to store and manage fuels and oils are to be adopted and spill containment equipment should be carried at all times to prevent and contain accidental spills in the creek.

7.2.3 Creek Crossing Structures

Pipers Flat Creek is considered to provide moderate to low value fish habitat being classified as a Class 2 waterway (Fairfull and Witheridge 2003) indicating a clearly defined drainage channel with semi-permanent pools. As a Class 2 waterway (as classified by NSW Fisheries – DPI) the proposed crossing of Pipers Flat Creek by the rail loop would need to be a large box culvert or bridge with the cross sectional areas of the structure equal to the cross-sectional area of the watercourse in order to facilitate safe fish passage. If a large box culvert is used it is imperative that the crossing structure does not impede fish passage by ensuring that the base of the culvert is positioned below the bed of the creek.

7.2.4 Creek Restoration

The proposal should be consistent with the objectives of the category 1 status of this waterway (refer to DIPNR 2004) by reinstating riparian vegetation and providing connectivity along the creek for movement by terrestrial and aquatic flora and fauna. The following mitigation measures are recommended for the creek restoration:

- Establish and maintain riparian vegetation plantings and macrophytes along Pipers Flat Creek, concentrating on an area 50m wide from either side of the top of the creek bank to filter flow



and enhance bank stability. Discussion on the appropriate species to use in revegetation / restoration works are described in Table 8 below.

- Restore degraded riparian zones on remaining creek areas of Thompsons Creek and Irondale Creek in proximity to new infrastructure to improve the current level of degradation.
- Destruction of creek crossings application of jute matting or similar should be conducted to stabilise soil while construction is being undertaken to prevent sedimentation of creeks. Any woody debris which is required to be removed for the proposal should be relocated to other areas of the creek or placed within the new creek section, and care must be taken not to obstruct fish passage.

Revegetation of Pipers Flat Creek and surrounding areas should use native species which occur in the local area and are adapted to the local conditions. A list of flora species suitable for revegetation of the various habitats of this area are listed in **Table 8**.

- **Table 8 native flora species suitable for revegetation of Pipers Flat Creek and surrounding areas.**

Species	Within Creeklines	Wetlands	Riparian	Sight screens	Higher ground
Trees					
Ribbon Gum <i>Eucalyptus viminalis</i>			X	X	X
Apple Box <i>Eucalyptus bridgesiana</i>			X	X	X
Candlebark <i>Eucalyptus rubida</i>			X	X	X
Snow Gum <i>Eucalyptus pauciflora</i>			X	X	X
Shrubs					
Silver Wattle <i>Acacia dealbata</i>			X	X	X
Tea-tree <i>Leptospermum squarrosum</i>			X	X	X
Grasses					
Kangaroo Grass <i>Themeda australis</i>			X		X
Snowgrass <i>Poa sieberiana</i>			X		X
Sedges/Rushes					
Tall Sedge <i>Carex appressa</i>	X	X			
Common Rush <i>Juncus usitatus</i>	X	X			
Tall Spike-rush <i>Eleocharis sphacelata</i>		X			

The species listed in **Table 8** reflect plants which occur within Ribbon Gum / Apple Box / Snow Gum Grassy Woodland which is likely to have naturally occurred in this area in the past. The shrub cover of this vegetation community type is generally sparse, however Silver Wattle *Acacia dealbata* usually occurs at low densities. Wattle species are fast growing and therefore would be suitable for providing a temporary sight screen surrounding infrastructure relatively quickly until



tree species become well established. Sedge/rush species should be planted within creek lines and wetland areas, with Tall Spike Rush *Eleocharis sphacelata* planted within areas of deeper water in creeklines and wetlands. Grass species are suitable for planting on higher ground the surrounding Pipers Flat Creek.

Habitat is not suitable for Capertee Stringybark in this area surrounding Piper's Flat Creek, and revegetation activities utilising Capertee Stringybark should occur on the dryer slopes surrounding Mt Piper which support disturbed vegetation. Seed should be collected from Capertee Stringybark along the proposed coal conveyor route and seedlings propagated for use in revegetation of disturbed lands surrounding the power station.

7.2.5 Fauna movement

There may be minor impacts on fauna movements as a result of the clearing and construction of the conveyor and new infrastructure. As a result provisions should be made to allow for several fauna crossing points along the conveyor. These would simply need to include a clearance of at least 900mm below the structure at designated locations to allow small and medium sized mammals such as macropods and wombats to pass beneath.

7.2.6 Introduced species

Introduced fauna are currently present within the study area. The construction would not be expected to increase populations or exacerbate the impacts of introduced fauna. The use of the construction machinery and exposure of the ground surface could potentially result in increased spread of weeds, including noxious species. Weed management principles should be implemented during construction such as the appropriate disposal of removed weed material including soil containing propagules and washing down machinery before entering areas of remnant vegetation, particularly after use in weed infested areas such as the grazed lands of Pipers Flat.

7.2.7 Induction of construction personnel

Construction personnel should be aware of the importance of remnant vegetation and the presence of the Capertee Stringybark in the area and other sensitive features including hollow-bearing trees, standing dead trees, trees with bird nests, fallen logs, and shrub cover. All construction personnel should be inducted to the study area and be aware of their environmental responsibilities, including the preservation of tree cover and riparian habitats. Construction personnel should inspect the trunk, foliage and limbs of any trees that require removal to prevent fauna mortality. If fauna species were present, these should be given the opportunity to move away from the construction zone prior to felling. Any animal injured during construction should be appropriately handled and transported to an animal care authority for attention. A stewardship should be encouraged over all fauna encountered, including poisonous snakes and no mortality of fauna should result knowingly from the construction.

SINCLAIR KNIGHT MERZ



8. References

- Andrews, A. 1990, Fragmentation of habitat by roads and utility corridors: a review. in *Aust. Zool.* 26, pp 130 - 141.
- Auld, B.A. & Medd, R. W., 1987, *Weeds - An illustrated botanical guide to the weeds of Australia.* Dept. of Agriculture, Inkata Press, Melbourne.
- Boland D. J. *etal.* 1992, *Forest Trees of Australia.* CSIRO, Melbourne.
- Briggs, J. D. & Leigh, J. H. 1995, *Rare or Threatened Australian Plants* CSIRO Publications.
- Brooker M. I. H. & Kleinig D. A., 1999, *Field Guide to Eucalypts - Volume 1, South-eastern Australia, Second Edition.* Bloomings Books, Melbourne.
- Cogger, H. G. 1992, *Reptiles and Amphibians of Australia.* 4th Ed. Reed Books, Sydney.
- Cropper 1993, *Management of Endangered Plants.* CSIRO, Canberra.
- Department of Environment and Conservation 2000, Impact Assessment Guidelines – *Eucalyptus cannonii.*
http://www.nationalparks.nsw.gov.au/PDFs/Ecannonii_eia_0500.pdf
- Department of Environment and Conservation 2000a, Threatened Species Information – *Eucalyptus cannonii.*
http://www.nationalparks.nsw.gov.au/PDFs/TSprofile_Eucalyptus_cannonii.pdf
- Department of Environment and Conservation 2005, Capertee Stringybark Profile. DEC threatened species website.
<http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10289>
- Department of Environment and Heritage 2006 EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance. Commonwealth of Australia 2006
- Department of the Environment and Heritage (2006a). *Macquaria australasica* in Species Profile and Threats Database, Department of the Environment and Heritage, Canberra. Available from: <http://www.deh.gov.au/sprat>. Accessed 20/10/2006.
- Department of Infrastructure, Planning and Natural Resources, DIPNR (2004). Riparian corridor management study: covering the Wollongong LGA and Calderwood Valley in the Shellharbour LGA.
- Dickman, C. 1991, Use of trees by ground-dwelling mammals: implications for management, pp. 125 - 136 in *Conservation of Australia's Forest Fauna*, Ed. Lunney, D. Royal Zoological Society of NSW and Surrey Beatty and Sons, Mosman.

SINCLAIR KNIGHT MERZ



- Fairfull, S. and Witheridge, G. (2003) Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings. NSW Fisheries, Cronulla, 16 pp.
- Harden, G. J. (Ed). 2000, *Flora of New South Wales* Vol 1 (Revised). Royal Botanic Gardens, Sydney.
- Harden, G. J. (Ed). 2002, *Flora of New South Wales* Vol 2 (Revised). Royal Botanic Gardens, Sydney.
- Harden, G. J. (Ed). 1992, *Flora of New South Wales* Vol 3. Royal Botanic Gardens, Sydney.
- Harden, G. J. (Ed). 1993, *Flora of New South Wales* Vol 4. Royal Botanic Gardens, Sydney.
- Hunter, J.T. and M. White (1999), Notes on the distribution and conservation status of *Eucalyptus cannonii* R.T. Baker, *Cunninghamia* 6(2): 389-394.
- James, T., McDougall, L. and Benson, D. 1999. *Rare Bushland Plants of Western Sydney*, Royal Botanic Gardens, Sydney.
- Jones, Hardwick and Kobayashi (1995). Aquatic Flora and Fauna Survey of Thomson's Creek Reservoir. AWT 95/75.
- Lazarides M., Cowley K. & Hohnen P. 1997, *CSIRO Handbook of Australian Weeds*. CSIRO Publishing, Collingwood Victoria.
- McDowell RM (ed). 1996. *Freshwater Fishes of South-eastern Australia*. Reed: Sydney.
- NSW Fisheries 1999. Policy and Guidelines for Bridges, Roads, Causeways, Culverts and Similar Structures. (Eds. S. Fairfull and S. Carter) NSW Fisheries, Sydney, 19pp.
- NSW Fisheries 2003 Fishnote – Policy and Guidelines for Fish Friendly Waterway Crossings. NSW Fisheries, Sydney.
- Robinson, L. 1991, *Field Guide to the Native Plants of Sydney*. Kangaroo Press, NSW.
- Scotts, D. 1991, Old-growth forests: their ecological characteristics and value to hollow-dependent vertebrate fauna of south-east Australia, pp. 147 - 160 in *Conservation of Australia's Forest Fauna*, Ed. Lunney, D. Royal Zoological Society of NSW and Surrey Beatty and Sons, Mosman.
- Specht, R.L., Roe, E.M. and Boughton, V.H. 1974. Conservation of major plant communities in Australia and Papua New Guinea. *Aust Journal of Botany*. Suppl. Series No. 7
- Stanger, M., Clayton, M., Schodde, R., Wombey, J., and Mason, I. 1997. *CSIRO List of Australian Vertebrates: A reference with conservation status*. CSIRO Publishing, Collingwood, Victoria.
- Sydney Water 2005 Audit of Sydney Drinking Water Catchment. Report to the Minister for the Environment, NSW State Government (December 2005)

SINCLAIR KNIGHT MERZ



Appendix A Threatened Flora Assessment

Threatened Flora	Conservation Status			Distribution and Habitat Requirements*	Suitable Habitat in Study Area
	Cw/ith	NSW	RoTAP		
<i>Acacia baueri</i> subsp. <i>aspera</i>	-	V	2RC-	Restricted to the Sydney region, occurring on the Kings Tableland in the central Blue Mountains and with sporadic occurrences on the Woronora Plateau in the Royal National Park, Mt. Keira district and at Wedderburn. May also occur on the escarpment/Woronora Plateau in the Flat Rock Junction and Stanwell Tops area of the Illawarra. Occurs in low, damp heathlands, often on exposed rocky outcrops over a wide range of climatic and topographical conditions. Appears to prefer open conditions; rarely observed where there is any shrub or tree canopy development; and many of the observations of this species have been made following fire, suggesting the species prefers early successional habitats.	Marginal
<i>Acacia bynoeana</i>	V	E	3VC-	Found in central eastern NSW, from the Hunter District south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include <i>Corymbia gummifera</i> , <i>Eucalyptus haemastoma</i> , <i>Eucalyptus parramattensis</i> , <i>Banksia serrata</i> <i>Angophora bakerii</i> .	No
<i>Acacia clunies-rossiae</i>	-	V	2RC-t	Kanangra Wattle grows in the Kowmung and Coxs River areas entirely within Kanangra-Boyd and Blue Mountains National Parks. Grows in dry sclerophyll forest on skeletal soils on rocky slopes, or on alluvium along creeks.	Marginal
<i>Acacia flocktoniae</i>	V	V	2VC-	The Flockton Wattle is found only in the Southern Blue Mountains (at Mt Victoria, Megalong Valley and Yerranderie. Grows in dry sclerophyll forest on sandstone.	Marginal
<i>Acacia gordonii</i>	E	E	2K	Restricted to the north-west of Sydney. Has a disjunct distribution, occurring in the lower Blue Mountains in the west, and in the South Maroota/Glenorie area in the east. Grows in dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops	No
<i>Acrophyllum australe</i>	V	V	2VCi	Restricted, from Faulconbridge to Lawson, South of Bilpin and near Kings Tableland, in the Blue Mountains area, all within the Central Coast Botanical Subdivision, currently known from 27 sites. Grows in sheltered gullies beneath waterfalls and drip zones of rock overhangs and cliff faces, usually with a south-east to south-west aspect. Typically found in areas where there is a more or less constant supply of water. Usually grows in shale interbeds at the base of small cliffs, in crevices on the sandstone rock face or on talus slopes. The rock overhangs are of Hawkesbury or Narrabeen Sandstone. Associated species commonly include <i>Callicoma serratifolia</i> , <i>Dracophyllum secundum</i> , <i>Todea barbata</i> , <i>Allania endlicheri</i> and <i>Blechnum mbiguum</i> . Found adjacent to open forest of <i>Eucalyptus piperita</i> and <i>Angophora costata</i> and closed forest of <i>Doryphora sassafras</i> and <i>Ceratopetalum apetalum</i> . Frequently growing on very thick layers of moss.	No
<i>Apatophyllum constablei</i>	E	E	2ECi	Known from four sites, three of which are within Wollemi National Park near Gaspers Mountain and Coorongooba Creek, the fourth of which is about 2 km from Glen Davis. Occurs in dry sclerophyll forest on slopes with a north to north-westerly aspect. It typically grows near cliffs (i.e. near the base or just above). The soils at sites are sandy and skeletal, mostly on Narrabeen sandstone. Found in association with <i>Eucalyptus piperita</i> , <i>E. punctata</i> , <i>E. sparsifolia</i> , <i>Banksia serrata</i> , <i>Acacia linifolia</i> , <i>Cleistochloa rigida</i> , <i>Lomandra obliqua</i> .	No
<i>Asterolasia buxifolia</i>	-	E	-	Known from a single site at a granite outcrop in the riparian zone of the Lett River. Rediscovered in 2000, little is known about the species.	No
<i>Boronia deanei</i>	V	V	2VC	There are scattered populations of Deane's Boronia between the far south-east of NSW and the Blue Mountains (including the upper Kangaroo River near Carrington Falls, the Endrick River near Nerriga and Nalbaugh Plateau), mainly in conservation reserves. Grows in wet heath, often at the margins of open forest adjoining swamps or along streams.	No
<i>Caesia parviflora</i>	-	E	-	Found in damp places in open forest on sandstone. This variety occurs uncommonly in	No

SINCLAIR KNIGHT MERZ



Threatened Flora	Conservation Status			Distribution and Habitat Requirements*	Suitable Habitat in Study Area
	Cwlth	NSW	RoTAP		
<i>var. minor</i>				Tasmania, southern Victoria and south-east South Australia with an outlying population in NSW, in Barcoongere State Forest, between Grafton and Coffs Harbour. This variety may be more common than currently known, as Pale Grass-lilies are often not identified to variety level.	
<i>Calotis glandulosa</i>	V	V	3VC-	Mauve Burr-daisy's main distribution is in the Monaro and Kosciuszko regions. There is a known site in the upper Shoalhaven catchment and record from near Oberon. There are old, highly dubious records from the Dubbo area and Mt Imlay. Found in montane grasslands in the Australian Alps. Found in subalpine grassland (dominated by <i>Poa</i> spp.), Natural Temperate Grassland (dominated by <i>Themeda australis</i>) and Snow Gum (<i>Eucalyptus pauciflora</i>) Woodlands on the Monaro and Shoalhaven area.	Yes
<i>Carex klaphakei</i>	-	E		Found in only three locations, from the Blue Mountains (at Blackheath and Mt Werong) to the Southern Highlands (at Penrose). Grows with other native sedges and rushes in swamps on sandstone at altitudes of greater than 600 m.	No
<i>Darwinia peduncularis</i>	-	V	3RCi	Occurs as local disjunct populations in coastal NSW with a couple of isolated populations in the Blue Mountains. It has been recorded from Brooklyn, Berowra, Galston Gorge, Hornsby, Bargo River, Glen Davis, Mount Boonbourwa and Kings Tableland. Usually grows on or near rocky outcrops on sandy, well drained, low nutrient soil over sandstone.	Yes
<i>Dillwynia tenuifolia</i>	V	V	2RCa	The core distribution is the Cumberland Plain from Windsor to Penrith east to Deans Park. Other populations in Western Sydney are recorded from Voyager Point and Kemps Creek in the Liverpool LGA, Luddenham in the Penrith LGA and South Maroota in the Baulkham Hills Shire. Disjunct localities include the Bulga Mountains at Yengo in the north, and Kurradjong Heights and Woodford in the Lower Blue Mountains. In western Sydney, it may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. At Yengo, is reported to occur in disturbed escarpment woodland on Narrabeen sandstone.	Marginal
<i>Derwentia blakelyi</i>	-	V	2K	Restricted to the western Blue Mountains, near Clarence, near Mt Horrible, on Nullo Mountain and in the Coricudgy Range. Occurs at fewer than 20 locations, none of which is in a conservation reserve. Occurs in eucalypt forest, often in moist areas.	Yes
<i>Diuris aequalis</i>	E	V	3VC-	The Buttercup Doubletail has been recorded in Kanangra-Boyd National Park, Gurnang State Forest, towards Wombeyan Caves, the Taralga - Goulburn area, and the ranges between Braidwood, Tarago and Bungendore. The Type collection (from the 19th Century) is from Liverpool, west of Sydney. Recorded in forest, low open woodland with grassy understorey and secondary grassland on the higher parts of the Southern and Central Tablelands	Yes
<i>Epacris hamiltonii</i>	E	E	2ECi	Occurs in the Blue Mountains, west of Sydney. Found at 72 sites within three creek catchments. The creeks occur in an altitude range of 810 - 940 m a.s.l. and are all located on the northern side of the escarpment and flow into the Grose Valley. All known sites occur within a radius of approximately 5 km. Has a very specific habitat, being found on or adjacent to Narrabeen sandstone cliffs alongside perennial creeks, often below plateau hanging swamps. The soil generally has a spongy/peat-like consistency, with a very high moisture content. Sites are found at the sheltered base of cliffs adjacent to wet gully or swamp vegetation, usually where a perennial or virtually perennial source of water, such as cliff seepages, is present. Associated species include King Fern (<i>Todea barbara</i>), Rough Tree Fern (<i>Cyathea australis</i>) and Coral Fern (<i>Gleichenia rupestris</i>). Sundews (<i>Drosera binata</i>) are also common on the cliff face. Occasionally occurs beside small creek lines which are vegetated with moist gully forest species (<i>Callicoma serratifolia</i> , <i>Doryphora sassafras</i> , <i>Ceratopetalum apetalum</i>).	No
<i>Eucalyptus benthamii</i>	V	V	2VCi	Occurs on the alluvial flats of the Nepean River and its tributaries. There are two major subpopulations: in the Kedumba Valley of the Blue Mountains National Park and at Bents Basin State Recreation Area. A further 18 trees are scattered along the Nepean River, south to The Oaks. Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment. Occurs in open forest. Associated species at the	No

SINCLAIR KNIGHT MERZ



Threatened Flora	Conservation Status			Distribution and Habitat Requirements*	Suitable Habitat in Study Area
	CwIth	NSW	RoTAP		
				Bents Basin site include <i>Eucalyptus elata</i> , <i>E. bauerina</i> , <i>E. amplifolia</i> , <i>E. deanei</i> and <i>Angophora subvelutina</i> . Understorey species include <i>Bursaria spinosa</i> , <i>Pteridium esculentum</i> and a wide variety of agricultural weeds. The Kedumba Valley site lists <i>E. crebra</i> , <i>E. deanei</i> , <i>E. punctata</i> , <i>Leptospermum flavescens</i> , <i>Acacia filicifolia</i> and <i>Pteridium esculentum</i> among its associated species.	
<i>Eucalyptus camonii</i>	V	V	2VCi	Restricted to the western side of the Blue Mountains from Mount Piper in the south to the Mudgee area in the north. There are also populations to the west in Winburndale Nature Reserve and adjacent state forests. Occurs in several local government areas including Greater Lithgow City, Rylstone and Bathurst City. Occurs at more than 55 different locations. Occurs on a wide variety of geological types and soil substrates across a wide altitudinal range. Although also found in a variety of topographic locations, it is commonly found on footslopes. Commonly found in ecotonal areas such as the boundaries of Tablelands Grassy Woodland Complex communities and Talus Slope Woodland vegetation.	Yes
<i>Eucalyptus copulans</i>	E	E	2E	Only two individual trees are known, at Wentworth Falls in the Blue Mountain, though the second tree was struck by lightning and killed. A larger population is thought to have occurred historically in the locality. Due to the low number of records, the habitat is not known. The records coincide with swampy areas along creeklines, however occurrences may not be restricted to this type of habitat. Associated species include <i>Grevillea acanthifolia</i> , <i>Hakea dactyloides</i> , <i>Eucalyptus stricta</i> , <i>Gleichenia dicarpa</i> , <i>Leptospermum juniperinum</i> and <i>Petrophile pulchella</i> .	No
<i>Eucalyptus pulverulenta</i>	V	V	3V	The Silver-leafed Gum is found in two quite separate areas, the Lithgow to Bathurst area and the Monaro (Bredbo, Bombala areas). Grows in shallow soils as an understorey plant in open forest, typically dominated by Brittle Gum (<i>Eucalyptus mannifera</i>), Red Stringybark (<i>E. macrorhyncha</i>), Broad-leafed Peppermint (<i>E. dives</i>), Silvertop Ash (<i>E. sieberi</i>) and Apple Box (<i>E. bridgesiana</i>).	Yes
<i>Euphrasia scabra</i>	-	E	3KCa	There are ten old herbarium collections of Rough Eyebright from NSW (including Port Jackson, Bathurst Plains, Lake George, Jindabyne, Yarrangobilly Caves and Tumbaramba). The species is regarded as extinct in South Australia. There is one population in Tasmania and seven in Victoria. There are three extant populations in NSW: one in Bondi State Forest, two in South East Forests National Park. Total NSW population is between 250 and 500 plants. Occurs in or at the margins of swampy grassland or in sphagnum bogs, often in wet, peaty soil.	No
<i>Grevillea evansiana</i>	V	V	2VC	Restricted to a small area east of Rylstone on the Central Tablelands. Known populations occur on the western side of Wollemi National Park and nearby private lands, within the Rylstone Local Government Area. Grows in dry sclerophyll forest or woodland, occasionally in swampy heath, in sandy soils, usually over Hawkesbury sandstone.	Yes
<i>Grevillea obtusifolia</i>	E	E	-	Subspecies <i>obtusiflora</i> occurs near Rylstone, while subspecies <i>fecunda</i> occurs in the Capertee Valley, north-west of Lithgow, and in the Gardens of Stone National Park. Occurrences of both subspecies are within the Central Tablelands botanical subdivision. Species growing in association with subspecies <i>fecunda</i> include <i>Eucalyptus tenella</i> , <i>E. fibrosa</i> , <i>E. macrorhyncha</i> , <i>E. punctata</i> , <i>Callitris endlicheri</i> , <i>Acacia buxifolia</i> , <i>Leptospermum continentale</i> , <i>Monotoca elliptica</i> , <i>Persoonia linearis</i> , <i>Indigofera</i> sp. and <i>Pomax umbellata</i> .	Yes
<i>Hibbertia puberula</i>	-	E	-	Has not been seen for over 40 years. Early records of this species are from the Hawkesbury River area and Frenchs Forest in northern Sydney, South Coogee in eastern Sydney, the Hacking River area in southern Sydney, and the Blue Mountains. Occurs on sandy soil often associated with sandstone.	Marginal
<i>Isopogon fletcheri</i>	V	V	2VCat	Restricted to a very small area in the Blackheath district of the Blue Mountains on the Central Tablelands. The entire known population occurs within Blue Mountains National Park. Restricted to moist sheltered cliffs within the spray zone of a waterfall. Grows in dry sclerophyll forest and heath on sandstone and is confined to sheltered moist positions.	No
<i>Lastreopsis hispida</i>	-	E	-	Occurs in the Blue Mountains. Also occurs in southern Victoria and Tasmania. Grows in wet forests, frequently under <i>Nothofagus antarcticus</i> . Often rotting on logs.	No

SINCLAIR KNIGHT MERZ



Threatened Flora	Conservation Status			Distribution and Habitat Requirements*	Suitable Habitat in Study Area
	Cwlth	NSW	RoTAP		
<i>Leionema lachnaeoides</i>	E	E	2ECi	Occurs at 10 sites in the upper Blue Mountains, within a 12 km range between Katoomba and Blackheath. Potential habitat occurs in the Megalong and Jamison Valleys. Populations occur on exposed sandstone cliff tops and terraces, at 960 - 1000m altitude and with aspects from south-east to south-west. Habitat vegetation is montane heath and commonly includes <i>Eucalyptus stricta</i> , <i>Allocasuarina nana</i> , <i>Dillwynia retorta</i> , <i>Epacris microphylla</i> and <i>Caustis flexuosa</i> .	No
<i>Lepidosperma evansianum</i>	-	V	-	Currently known from 3 locations (at Blackheath and Wentworth Falls). All known sites occur within Blue Mountains National Park, although they are near the boundary of the reserve. It grows on wet sandstone cliff faces in the Blue Mountains in the central tablelands of New South Wales.	No
<i>Leionema sympetalum</i>	V	V	2VC-	Restricted to a small area within Wollemi National Park, east of Rylstone on the Central Tablelands. Has only ever been recorded at four sites. All known sites are in the Rylstone Local Government Area. May also occur at previously unrecorded locations. Restricted to exposed rocky sandstone formations known as pagodas. The species occurs in dry sclerophyll forest and probably also occurs in open or closed heathland communities.	No
<i>Lepidium hyssopifolium</i>	E	E	3ECi+	There is a population consisting of 6 plants near Bathurst, a population near Bungendore and Crookwell both on the Southern Tablelands. The species was also recorded near Armidale in 1945 and 1958 however it is not known whether it remains in this areas. A specimen collected in the Cooma area about 100 years ago may also be Aromatic Peppercress. The species occurs in a variety of habitats including woodland with a grassy understorey and grassland.	Yes
<i>Melaleuca deanei</i>	V	V	3RC-	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai, Berowra, Holsworthy and Wedderburn areas, and there are also more isolated occurrences at Springwood, Wollemi National Park, Yalwal and the Central Coast areas. The species grows in heath on sandstone	No
<i>Melaleuca sp. 'Megalong Valley'</i>	-	V	-	Known only from a small section of the eastern Megalong Valley in the western Blue Mountains. Occurs in shrubby swamp habitat, in closed scrub dominated by <i>Leptospermum</i> spp., including <i>L. morrisonii</i> , <i>L. juniperinum</i> and <i>L. obovatum</i> with occasional emergent <i>Melaleuca linearifolia</i> and <i>Eucalyptus camphora</i> .	No
<i>Olearia cordata</i>	V	V	2VCi	A NSW endemic with a scattered distribution generally restricted to the south-western Hunter Plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau near Wisemans Ferry east of Maroota. Most known populations occur within conservation reserves (Wollemi National Park, Yengo National Park and Wisemans Ferry Historic Site). Grows in dry open sclerophyll forest and open shrubland, on sandstone ridges.	Yes
<i>Persoonia acerosa</i>	V	V	2VC-	The Needle Geebung has been recorded only on the central coast and in the Blue Mountains, from Mt Tomah in the north to as far south as Hill Top where it is now believed to be extinct. Mainly in the Katoomba, Wentworth Falls, Springwood area. occurs in dry sclerophyll forest, scrubby low-woodland and heath on low fertility soils.	Marginal
<i>Persoonia hindii</i>	-	E	2V	Restricted to the Newnes Plateau in the Blue Mountains, north of Lithgow. Was only discovered in 1989 and all known locations occur within Newnes State Forest. Occurs in dry sclerophyll forests and woodlands on sandy soils.	Yes
<i>Persoonia hirsuta</i>	E	E	3KCi	The Hairy Geebung has been recorded in the Sydney coastal area, the Blue Mountains area and the Southern Highlands. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	Yes
<i>Persoonia marginata</i>	V	V	2V	Known from only four disjunct locations on the Central Tablelands and Central Coast. Core of the species distribution is within Clandulla State Forest, west of Kandons. Disjunct populations occur; to the north at Dingo Creek and Mount Dangar within the Wollemi and Goulburn River National Parks; to the south within Ben Bullen State Forest, south-east of Capertee; and to the south-east at Devils Hole, north of Colo Heights within Parr State Recreation Area. Grows in dry sclerophyll forest and woodland communities on sandstone.	Yes
<i>Pherosphaera fitzgeraldii</i>	E	E	2ECi	All currently-known populations occur in the upper Blue Mountains between Wentworth Falls and Katoomba, a range of nine kilometres. Pre-1950 records occur at Katoomba	No

SINCLAIR KNIGHT MERZ



Threatened Flora	Conservation Status			Distribution and Habitat Requirements*	Suitable Habitat in Study Area
	Cwlth	NSW	RoTAP		
				Falls, Leura Falls and Bonnie Doon Falls. All sites fall within the Blue Mountains local government area. Found within the spray zone or associated drip lines and seepage areas of waterfalls on steep, sandstone cliffs and ledges, at altitudes between 680 and 1000 metres above sea level. The sites face south-east to south-west, and being on near-vertical to vertical slopes or under overhangs, are heavily shaded. The degree of shading from other plants varies from none on exposed cliffs and ledges to up to 70% from nearby rainforest plants on larger, lower ledges and overhang caves.	
<i>Prasophyllum fuscum</i>	V	V	2V	The type specimen is from "moist meadows towards the Georges River" in the Sydney area. The species is likely to be extinct from this area. Harden (1993) states that it is confined to the Blue Mountains area. However, some authorities believe <i>Prasophyllum species</i> from this area are not <i>P. fuscum</i> , but an undescribed species. In addition, some authorities believe it is identical to <i>P. uroglossum</i> which occurs in the Wingecarribee area. Grows in moist heath, often along seepage lines.	No
<i>Prostanthera cryptandroides</i>	V	V	-	Occurs in restricted areas but over a fairly broad range from the Lithgow and Sandy Hollow Districts into the Border Rivers/Gwydir Catchment and up into Queensland. Occurs in the Wollemi National Park and is likely to also occur within the Goulburn River National Park. At Glen Davis, occurs in open forest dominated by <i>Eucalyptus fibrosa</i> . Other eucalypt species may be present as sub-dominants. In the Denman-Gungal and Widden-Baerami Valley areas, occurs on rocky ridgelines on Narrabeen Group Sandstones in association with a range of communities. Associated communities include: Narrabeen Rocky Heath, Narrabeen Acacia Woodland, Narrabeen Exposed Woodland; Open Heath of <i>Calytrix tetragona</i> , <i>Leptospermum parviflorum</i> , <i>Isopogon dawsonii</i> ; and Open Scrubland of <i>Eucalyptus dwyeri</i> , <i>Baeckea densifolia</i> , <i>Dillwynia floribunda</i> , <i>Aotus ericoides</i> and <i>Hemigenia cunefolia</i> .	No
<i>Prostanthera stricta</i>	V	V	2V	Highly restricted, known only from Mt. Vincent and Genowlan Mountain in the Central Tablelands. occurs in the transition zone between fertile basalt caps and infertile sandstones. This area is often characterised by steep rocky sideslopes, cliff lines, sandstone platforms or gentle slopes with exposed sandstone outcrops. Vegetation ranges from Tall Forest to Open Forest to Woodlands. Often a dominant undershrub at Mount Vincent, in heath/scrub communities along cliff edges and sandstone outcroppings, downslope of Tall Open-Open Forest consisting of combinations of <i>Eucalyptus blaxlandii</i> , <i>E. viminalis</i> , <i>E. sparsifolia</i> , <i>E. cannonii</i> and <i>E. punctata</i> . Forms extensive colonies at Genowlan Mountain in Open-forest/Woodlands of <i>Eucalyptus sparsifolia</i> , <i>E. cannonii</i> , <i>E. polyanthemos</i> , <i>E. rossii</i> and <i>E. mannifera</i> . Also extends into heath/scrub and Open-forest/heath communities in this locality.	Yes
<i>Pultenaea glabra</i>	V	V	3VCa	Restricted to the higher Blue Mountains and has been recorded from the Katoomba-Hazelbrook and Mount Victoria areas, with unconfirmed sightings in the Mount Wilson and Mount Irvine areas. All known populations occur within the Blue Mountains Local Government Area. Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone.	Yes
<i>Solanum celatum</i>	-	E	-	Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia. Majority of records are prior to 1960 and the majority of populations are likely to have been lost to clearing. Grows in rainforest clearings, or in wet sclerophyll forests.	No
<i>Stemmacantha australis</i>	-	PE	3V	Presumed Extinct. Usually grows on heavy soils; north from the Jenolan Caves area.	No
<i>Trachymene saniculifolia</i>	E	E	-	Occurs along the banks of the Boyd River in the Kanangra Boyd National Park, approximately 200 km west of Sydney. Restricted to flat or gently sloping ground in the riparian zone of Boyd River. At one site, the species is distributed along a tea-tree (<i>Leptospermum</i> sp.) thicket that borders the banks of the river within a eucalypt woodland. At another site, individuals occur upon a gravel patch situated beside the river.	No
<i>Xanthosia scopulicola</i>	-	V	-	Known only from scattered locations between Kings Tableland (Wentworth Falls) and Boars Head rock (west of Katoomba) in the Blue Mountains. Most populations are within Blue Mountains National Park, though only near the boundary of the reserve. Grows in cracks and crevices of sandstone cliff faces or on rocky outcrops above the cliffs.	No

SINCLAIR KNIGHT MERZ



Threatened Flora	Conservation Status			Distribution and Habitat Requirements*	Suitable Habitat in Study Area
	Cwlth	NSW	RoTAP		
<i>Zieria citriodora</i>	V	E	-	The species is known from two sites in NSW - Numerella and Kybean Trig - east of Cooma. The species is also very rare in Victoria. Lemon Zieria grows in low woodland of <i>Eucalyptus mannifera</i> - <i>E. macrorhyncha</i> - <i>E. dives</i> with a shrub understorey .	Yes
<i>Zieria covenyi</i>		E		Has been recorded from only one location, Narrow Neck Peninsula within Blue Mountains National Park, south-west of Katoomba in the Central Blue Mountains. Grows occurs in open sclerophyll forest dominated by <i>Eucalyptus sieberi</i> . The species occurs on gentle east and south-facing slopes and on ridges in shallow sandy soil.	No
<i>Zieria involucrata</i>	V	E	2VCa	Has a disjunct distribution north and west of Sydney, in the Baulkham Hills, Hawkesbury, Hornsby and Blue Mountains LGAs. Recent records for the species come from 22 populations in the catchments of the Macdonald, Colo and Hawkesbury Rivers—between Melon Creek and Mogo Creek in the north to Little Cattai Creek and Wheeny Creek in the south, and from a single population in the upper Blue Mountains north of Katoomba. Occurs primarily on Hawkesbury sandstone. Also occurs on Narrabeen Group sandstone and on Quaternary alluvium. Found primarily in sheltered forests on mid- to lower slopes and valleys, such as in or adjacent to gullies which support sheltered forest, however some populations extend upslope into drier vegetation. Also known from at least two atypical ridgetop locations. The canopy typically includes <i>Syncarpia glomulifera subsp. glomulifera</i> , <i>Angophora costata</i> , <i>Eucalyptus agglomerata</i> and <i>Allocasuarina torulosa</i> .	No
<i>Zieria murphyi</i>	V	V	2VC-	Velvet Zieria is found in the Blue Mountains at Mt Tomah and on the southern tablelands where it has been recorded in Morton National Park in the Bundanoon area. The Velvet Zieria is found in gullies in dry sclerophyll forest with sandy soil.	Yes

RoTAP Codes

- 2 = geographic Range in Australia less than 100km
- 3 = geographic Range in Australia greater than 100km
- V = Vulnerable – at risk over longer period (20-50years)
- E= Endangered – at risk within 10-20 years.
- R = Rare – uncommon plants with no current threats
- C = Reserved
- a = 1000 plants or more know from conservation reserves
- i = less than 100 plants in conservation reserves
- = reserved population size not accurately known

SUMMARY

- Total species assessed: 51
- Marginal habitat attributes present: 6
- Most habitat attributes present: 17
- No or very little habitat attributes present: 28

EPBC Act and TSC Act Codes

- E = Endangered
- V = Vulnerable

* Distribution and habitat requirement information adapted from the Department of Environment and Conservation Threatened Species Website (http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/browse_allspecies.aspx)



Appendix B Flora Species List

Classification/ Scientific name	Recent Synonyms	Common Name	
Ferns			
ADIANTACEAE			
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>		Slender Cloak-fern	
DENNSTAEDTIACEAE			
<i>Pteridium esculentum</i>		Bracken	
Conifers			
PINACEAE			
<i>Pinus radiata</i>		Monterey Pine	i
Flowering Plants - Dicotyledons			
APIACEAE			
<i>Daucus glochidiatus</i>			
<i>Hydrocotyle laxiflora</i>		Stinking Pennywort	
<i>Hydrocotyle tripartita</i>		Tre-foil Pennywort	
<i>Platysace ericoides</i>		Heathe Platysace	
ASTERACEAE			
<i>Bracyscome spathulata</i>			
<i>Cassinia aculeata</i>		Dollybush	
<i>Cassinia arcuata</i>		Sifton Bush	
<i>Cirsium vulgare</i>		Scotch Thistle	i
<i>Helichrysum scorpioides</i>		Button Everlasting	
<i>Hypochoeris radicata</i>		Flatweed	i
BORAGINACEAE			
<i>Cynoglossum australe</i>			
<i>Echium plantagineum</i>		Pattersons Curse	i
CARYOPHYLLACEAE			
<i>Stellaria pungens</i>		Prickly Starwort	
CLUSIACEAE			
<i>Hypericum gramineum</i>		Narrow-leaf St. Johns Wort	
<i>Hypericum perforatum</i>		St. Johns Wort	i
CONVOLVULACEAE			
<i>Dichondra repens</i>		Kidney Weed	
DILLENIACEAE			
<i>Hibbertia obtusifolia</i>		Blunt-leaf Guinea-flower	
ERICACEAE			
<i>Astroloma humifusum</i>		Prickly Pine Heath	
SINCLAIR KNIGHT MERZ			



<i>Brachyloma daphnoides</i>		Daphne Heath
<i>Leucopogon pillifer</i>		Thready Beard heath
<i>Leucopogon virgatus</i>		Common Beard-heath
<i>Lissanthe strigosa</i>		Peach Heath
<i>Monotoca scoparia</i>		Prickly Broom-heath
EUPHORBIACEAE		
<i>Amperea xiphioclada</i>		Broom Spurge
FABACEAE		
FABOIDEAE		
<i>Bossiaea buxifolia</i>		
<i>Daviesia leptophylla</i>		
<i>Desmodium varians</i>		Slender Tick-trefoil
<i>Dillwynia phyllicoides</i>		
<i>Glycine clandestina</i> agg.		Twining Glycine
<i>Gompholobium minus</i>		Dwarf Wedge-pea
<i>Hovea heterophylla</i>		
<i>Hovea linearis</i>		Narrow-leaf Hovea
<i>Indigofera australis</i>		Native Indigo
<i>Mirbelia platylobioides</i>		
<i>Podolobium ilicifolium</i>	<i>Oxylobium ilicifolium</i>	Prickly Shaggy-pea
<i>Pultenaea foliolosa</i>		
<i>Ulex europeus</i>		Gorse
<i>Vicia spp.</i>		Vetch
MIMOSOIDEAE		
<i>Acacia buxifolia</i>		Box-leaf Wattle
<i>Acacia cultriformis</i>		Knife-leaved Wattle
<i>Acacia dealbata</i> subsp. <i>dealbata</i>		Silver Wattle
<i>Acacia gunnii</i>		Ploughshare Wattle
<i>Acacia penninervis</i>		Hickory
<i>Acacia terminalis</i>		Sunshine Wattle
<i>Acacia ulicifolia</i>		Prickly Moses
GERANIACEAE		
<i>Geranium solanderi</i> var. <i>solanderi</i>		Native Cranesbill
GOODENIACEAE		
<i>Goodenia paniculata</i>		Panicled Goodenia
HALORAGACEAE		
<i>Gonocarpus tetragynus</i>		Poverty Raspwort
<i>Gonocarpus teucroides</i>		Raspwort
LAMIACEAE		
<i>Ajuga australis</i> ?		Austral Bugle
LORANTHACEAE		

SINCLAIR KNIGHT MERZ



<i>Amyena miquelii</i>		Droping Mistletoe	
MYRTACEAE			
EUCALYPTS			
<i>Eucalyptus bridgesiana</i>		Apple Box	
<i>Eucalyptus cannonii</i>		Capertee Stringybark	t
<i>Eucalyptus dives</i>		Broad-leaved Peppermint	
<i>Eucalyptus eugenoides</i>	<i>Eucalyptus nigra</i>	Thin-leaved Stringybark	
<i>Eucalyptus macrorhyncha</i>		Red Stringybark	
<i>Eucalyptus mannifera</i>		Brittle Gum	
<i>Eucalyptus pauciflora</i>		Snow Gum	
<i>Eucalyptus rossii</i>		Tableland Scribbly Gum	
<i>Eucalyptus rubida</i> subsp. <i>rubida</i>		Candlebark	
<i>Eucalyptus sieberi</i>		Silvertop Ash	
<i>Eucalyptus viminalis</i>		Ribbon Gum	
PITTOSPORACEAE			
<i>Billardiera scandens</i>		Apple-berry	
<i>Bursaria longisepala</i> var. <i>pilosa</i>			
PLANTAGINACEAE			
<i>Plantago lanceolata</i>		Plantain	i
<i>Plantago varia</i>			
PROTEACEAE			
<i>Persoonia linearis</i>		Narrow-leaf Geebung	
ROSACEAE			
<i>Acaena novae-zelandiae</i>		Bidgy-widgy	
<i>Rosa rubiginosa</i>		Sweet Briar	i
<i>Rubus fruticosus</i> agg.		Blackberry	i
RUBIACEAE			
<i>Galium gaudichaudii</i>			
<i>Galium propinquum</i>		Maori Bedstraw	
RUTACEAE			
<i>Boronia microphylla</i>		Small-leaf Boronia	
SALICACEAE			
<i>Salix babylonica</i>		Weeping Willow	i
SANTALACEAE			
<i>Exocarpos cupressiformis</i>		Cherry Ballart	
<i>Leptomeria acida</i>		Native Current	
SCROPHULARIACEAE			
<i>Limosella australis</i>		Austalian Mudwort	
<i>Veronica calycina</i>		Common Speedwell	
<i>Veronica pleblia</i>		Trailing Speedwell	
STYLIDIACEAE			

SINCLAIR KNIGHT MERZ



<i>Stylidium graminifolium</i>		Grass-leaf Trigger Plant	
VIOLACEAE			
<i>Viola betonicifolia</i>		Showy Violet	
Flowering Plants - Monocotyledons			
CYPERACEAE			
<i>Carex appressa</i>		Tall Sedge	
IRIDACEAE			
<i>Patersonia glabrata</i>		Cauline-leaf Purple-flag	
<i>Patersonia sericea</i> var. <i>sericea</i>		Basal-leaf Purple-flag	
JUNCACEAE			
<i>Juncus cognatus</i>		Rush	
<i>Juncus usitatus</i>		Common Rush	
LOMANDRACEAE			
<i>Lomandra glauca</i> subsp. <i>glauca</i>		Glaucous Mat-rush	
<i>Lomandra filiformis</i> subsp. <i>filiformis</i>		Wattle Mat-rush	
<i>Lomandra longifolia</i> subsp. <i>longifolia</i>		Spiny Mat-rush	
<i>Lomandra multiflora</i> subsp. <i>multiflora</i>		Many-flowered Mat-rush	
PHORMIACEAE			
<i>Dianella revoluta</i> var. <i>revoluta</i>		Black-anther Flax Lily	
POACEAE			
<i>Aristida ramosa</i>		Three-awned Spear Grass	
<i>Austrostipa pubescens</i>	<i>Stipa pubescens</i>	Tall Spear Grass	
<i>Briza maxima</i>		Quaking Grass	i
<i>Cynosurus echinatus</i>		Crested Dogstail	i
<i>Dactylis glomerata</i>		Cocksfoot	i
<i>Echinopogon caespitosus</i>		Hedgehog Grass	
<i>Echinopogon ovatus</i>		Hedgehog Grass	
<i>Eragrostis leptostachya</i>		Paddock Lovegrass	
<i>Joycea pallida</i>	<i>Danthonia pallida</i>	Red-anthered Wallaby Grass	
<i>Panicum effusum</i>		Hairy Panic	
<i>Phalaris aquatica</i>		Canary Grass	i
<i>Phalaris minor</i>		Lesser Canary Grass	i
<i>Poa</i> spp.		Snow Grass	
<i>Poa siebriana</i>		Snowgrass	
<i>Themeda australis</i>	<i>Themeda triandra</i>	Kangaroo Grass	
TOTALS			
	<i>Total Flora Species</i>	109	
	<i>Total Number of Families</i>	36	
	<i>Total Monocotyledons</i>	25	

SINCLAIR KNIGHT MERZ



<i>Total Dicotyledons</i>	81
<i>Total Fern Species</i>	2
<i>Total Conifer & Cycad Species</i>	1
<i>Total Exotic Species</i>	16
<i>Total Threatened Species</i>	1

ABBREVIATIONS:

- i = introduced (i.e. not indigenous to Australia)
- n = native Australian species not considered to be indigenous to the site
- c = cultivated (i.e. planted on the site)
- t = listed as a threatened species under State and/or Commonwealth legislation
- spp. = several species of the one genus (sometimes occurring as a hybrid swarm)
- sp. = unidentified species⁴
- sp. aff. = unidentified species with characteristics similar to the indicated species or genus³
- ? = unconfirmed species⁴
- var. = variety
- subsp. = subspecies
- cv. = cultivar (i.e. a anthropogenic form of the species)
- agg. = an aggregate of several yet to be defined species

NOTES:

1. Recent 'synonyms' include misapplied names.
2. A sample flora assemblage obtained from a short term survey, such as the present one, cannot be considered to be comprehensive, but rather indicative of the actual flora assemblage. It can take many years of flora surveys to record all of the plant species occurring within any area, especially species that are only apparent in some seasons.
4. Not all species can be accurately identified in a 'snapshot' survey due to absence of flowering or fruiting material, etc.

SCIENTIFIC NAMES & AUTHORITIES:

Scientific names & families are those used in the *Flora of New South Wales* as maintained by the Royal Botanic Gardens

(<http://plantnet.rbgsyd.gov.au>).

Orders and higher taxa are based on Angiosperm Phylogeny Group (2003).

For sake of simplicity, scientific names in this list do not include authorities. These can be found in the *Flora of New South Wales*.



Appendix C Fauna Species List

NOTES ON SYMBOLS USED IN THE TABLE

HABITATS

- 1 Open Forest
2 Riparian / Creek
3 Modified Grass / Paddock

OBSERVATION TYPE

- O Observed
W Heard call
P Scat
E Nest/roost/burrow
T Trapped
BC Bat Call (Recorded)

FAMILY/Scientific Name	Common Name	Habitat	Obs Type
MAMMALS			
DASYURIDAE			
<i>Antechinus stuartii</i>	Brown Antechinus	1	T
VOMBATIDAE			
<i>Vombatus ursinus</i>	Common Wombat	1,2,3	O / E
PETAURIDAE			
<i>Petaurus breviceps</i>	Sugar Glider	1	O
PSEUDOCHEIRIDAE			
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	1	O
PHALANGERIDAE			
<i>Trichosurus vulpecula</i>	Common Brushtail Possum	1	O
MACROPODIDAE			
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	1	O / P
RHINOLOPHIDAE			
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	1	BC
VESPERTILIONIDAE			
<i>Miniopterus schreibersii</i>	Large Bent-wing Bat	1	BC
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	1	T
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	1	BC
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	1	BC
<i>Vespadelus darlingtoni</i>	Large Forest Bat	1	T, BC
<i>Vespadelus vulturnus</i>	Little Forest Bat	1	BC
AMPHIBIA			
MYOBATRACHIDAE			
<i>Crinia signifera</i>	Common Eastern Froglet	2	W
HYLIDAE			
<i>Litoria verreauxii</i>	Verreaux's Tree Frog	2	W
AVES			
CHARADRIIDAE			
<i>Vanellus miles</i>	Masked Lapwing	3	O, W
CACATUIDAE			
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black Cockatoo	1	O, W
<i>Cacatua roseicapilla</i>	Galah	1,3	O
PSITTACIDAE			
<i>Platycercus elegans</i>	Crimson Rosella	1	O
CUCULIDAE			

SINCLAIR KNIGHT MERZ



FAMILY/Scientific Name	Common Name	Habitat	Obs Type
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	1	O
HALCYONIDAE			
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	1	O
CLIMACTERIDAE			
<i>Cormobates erythropis</i>	Red-browed Treecreeper	1	O
<i>Cormobates leucophaeus</i>	White-throated Treecreeper	1	O, W
MALURIDAE			
<i>Malurus cyaneus</i>	Superb Fairy-wren	1, 2	O
PARDALOTIDAE			
<i>Pardalotus punctatus</i>	Spotted Pardalote	1	W
<i>Pardalotus striatus</i>	Striated Pardalote	1	W
<i>Acanthiza lineata</i>	Striated Thornbill	1	O
<i>Acanthiza reguloides</i>	Buff-rumped Thornbill	1	O
MELIPHAGIDAE			
<i>Anthochaera carunculata</i>	Red Wattlebird	1	O
<i>Philemon corniculatus</i>	Noisy Friarbird	1	O
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	1	O
<i>Lichenostomus leucotis</i>	White-eared Honeyeater	1	O
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	1	O
<i>Melithreptus lunatus</i>	White-naped Honeyeater	1	O
PETROICIDAE			
<i>Eopsaltria australis</i>	Eastern Yellow Robin	1	O
<i>Petroica multicolor</i>	Scarlet Robin	1	O
PACHYCEPHALIDAE			
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	1	O
DICRURIDAE			
<i>Myiagra rubecula</i>	Leaden Flycatcher	1	O
<i>Rhipidura fuliginosa</i>	Grey Fantail	1	O
CAMPEPHAGIDAE			
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	1	O
ARTAMIDAE			
<i>Gymnorhina tibicen</i>	Australian Magpie	1, 2, 3	O
<i>Strepera graculina</i>	Pied Currawong	1	O
CORVIDAE			
<i>Corvus coronoides</i>	Australian Raven	1	O
CORCORACIDAE			
<i>Corcorax melanorhamphos</i>	White-winged Cough	1	O

SINCLAIR KNIGHT MERZ