Travers

bushfire & ecology

Vegetation Management Plan

Macarthur Memorial Park
Lot 1 DP 218016, Lot B DP 370979
& Lot 22 DP 564065
166 - 176 St Andrews Road,
Varroville

July 2018
(REF: 18NETT02)

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166 - 176 St Andrews Road,
Varroville

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The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

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List of abbreviations

APZ	asset protection zone
BPA	bushfire protection assessment
CLUMP	conservation land use management plan
DCP	Development Control Plan
CPW	Cumberland Plain Woodland
DEC	NSW Department of Environment and Conservation (superseded by DECC from 4/07)
DECC	NSW Department of Environment and Climate Change (superseded by DECCW from 10/09)
DECCW	NSW Department of Environment, Climate Change and Water (superseded by OEH from 4/11)
DoEE	Federal Department of Environment and Energy (formerly SEWPAC)
EEC	endangered ecological community
EPA	Environmental Protection Agency
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESMP	ecological site management plan
FF	flora and fauna assessment
FM Act	*Fisheries Management Act 1994*
FMP	fuel management plan
HTA	habitat tree assessment
IPA	inner protection area
LEP	Local Environment Plan
LGA	local government area
NES	national environmental significance
NPWS	NSW National Parks and Wildlife Service
NSW DPI	NSW Department of Industry and Investment
OEH	Office of Environment and Heritage (Part of the NSW Department of Premier and Cabinet)
OPA	outer protection area
PBP	*Planning for Bush Fire Protection 2006: A Guide for Councils, Planners, Fire Authorities and Developers*
POM	plan of management
RF Act	*Rural Fires Act*
RFEF	River-Flat Eucalypt Forest
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants

SEPP 44	*State Environmental Protection Policy No 44 – Koala Habitat Protection*
SEWPAC	Federal Department of Sustainability, Environment, Water, Population and Communities
SIS	species impact statement
SULE	safe useful life expectancy
TPO	tree preservation order
TPZ	tree preservation zone
TRRP	tree retention and removal plan
TSC Act	*Threatened Species Conservation Act 1995*
VMP	vegetation management plan

Introduction 1

Travers bushfire & ecology has been engaged to prepare a vegetation management plan (VMP) for Macarthur Memorial Park - a proposed cemetery development within Lot 1 DP 218016, Lot B DP 370979 & Lot 22 DP 564065, 166 - 176 St Andrews Road, Varroville located in the Campbelltown local government area. The entire area of this lot will hereafter be referred to as the 'study area'.

The vegetation management Plan is an overview for the entire masterplan area with designated management zones. *Travers bushfire & ecology* has assumed that specific revegetation and bush regeneration plans will be prepared for each management zone prior to commencement of the works to meet the overall performance targets of this VMP.

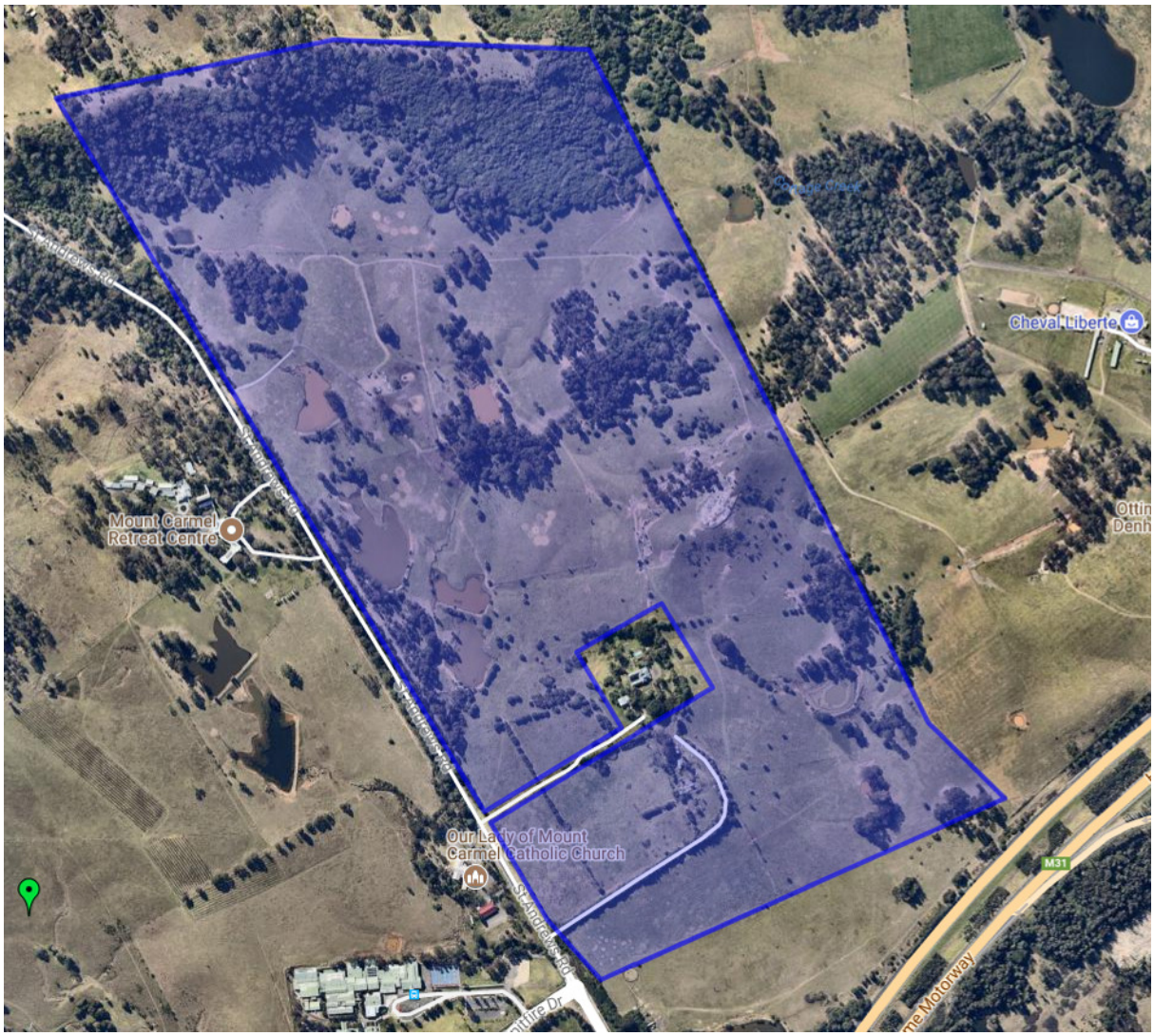


Figure 1 – Site overview (Source - Google Earth)

1.1 Proposed development

The proposed development (Figure 2) on the 113ha site includes a five (5) stage construction (Figure 3) of Macarthur Memorial Park at 166-176 St Andrew Road, Varroville.

The proposal includes the construction of six (6) buildings, along with an integrated road network. The existing outbuildings (barn and cottage) will be used for educational purposes. The proposed multipurpose chapel is a Class 9b building under the Building Code of Australia and is considered an 'assembly' building. The administration building, gatehouse, café, function centre and staff buildings are Class 5, 6 & 8 buildings.

1.2 Aims of the VMP

The following objectives for the retention, consolidation, enhancement and management of retained bushland and riparian zone include:

- Protect and regenerate the Cumberland Plain Woodland (CPW) CEEC;
- Provide alternative revegetation offsets within the site for impacted vegetation;
- Retain and manage hollow-bearing trees and enrichment of habitat resources;
- Ensure an effective and a resilient restoration outcome; and
- Maximise native vegetation cover and species diversity within the site.

Schedule 1 – Vegetation Management Works of this VMP provides a plan of restoration works and the performance targets to be achieved by contractors undertaking restoration works. Schedule 1 and the associated zooms have been prepared to be issued to potential contractors undertaking the restoration works. The VMP provides guidelines for how the restoration works are to be undertaken and is subject to compliance certification.

Figure 2 – Overall site plan

STAGE 1 (From 2019 to 2104)
- All buildings and services constructed.
- Outbuildings restoration.
- Entrances A to C.
- All roads within Stage 1 only (to the extent permissible under Bushfire Regulation).
- All landscaping and furniture within Stage 1.
- Shelters as required.
- The rest of the site remains UNCHANGED.

STAGE 2 (From 2105 to 2130)
- All roads within Stage 2 only
- All landscaping and furniture within Stage 2.
- Shelters as required.
- The rest of the site remains UNCHANGED.

STAGE 3 (From 2131 to 2140)
- All roads within Stage 3 only
- All landscaping and furniture within Stage 3.
- Shelters as required.
- The rest of the site remains UNCHANGED.

STAGE 4 (From 2141 to 2155)
- All roads within Stage 4 only
- All landscaping and furniture within Stage 4.
- Shelters as required.
- Entrance C
- The rest of the site remains UNCHANGED.

STAGE 5 (From 2156 to 2170)
- All roads within Stage 5.
- All landscaping and furniture within Stage 5.
- Shelters as required.

The above stages are based on current statistical information and projections.

Figure 3– Staging plan

Management Context 2

The following sections provide a brief description of site.

2.1 Site description

Table 1 provides a summary of the planning, cadastral, topographical, and disturbance details of the subject site.

Table 1 – Site features

Location	St. Andrews Road, Varroville
Local government area	City of Campbelltown
Grid reference	299000E 6235700N
Elevation	50-100m AMSL
Topography	Situated on a steady SE sloping landscape parallel to St Andrews Road with a steeper incline towards the vegetated northern boundary.
Geology and soils	Geology; Shale carbonaceous claystone, laminate, coal in parts. Unnamed sandstone member – fine to medium grained quartz-lithic sandstone.
Catchment and drainage	Catchment – Bunbury Curran Creek Small creeks and tributaries across the site drain SE joining until they reach Bunbury Curran Creek.
Vegetation	Where present, native vegetation has a riparian structure due to small creeks and tributaries running through the site. In most areas, trees are around 15-25m tall, there is a limited mid-storey which is mostly made up of weeds such as African Olive, and a ground layer of grasses and herbs. The vegetation is highly modified throughout the study area due to previous clearing.
Existing land use	Rural, grazing and unmanaged
Clearing	The majority of the study area has been previously cleared for indicated land uses.

2.2 Vegetation description

Five (5) disturbed vegetation communities were identified within the study area through ground truthing.

- Vegetation Community 1 – Cumberland Plain Woodland
- Vegetation Community 2 – African Olive
- Vegetation Community 3 – Heritage Gardens
- Vegetation Community 4 – Exotic Vegetation
- Vegetation Community 5 – Dam with Occasional Fringing Sedges

Cumberland Plain Woodland

This vegetation community encompasses the remnant native terrestrial vegetation south of the escarpment and commensurate with the EEC of the same name under the *TSC Act*. This vegetation community also corresponds to '*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest*' which is listed as a Critically Endangered Ecological Community (CEEC) within the Commonwealth *EPBC Act* (1999).

There is approximately 16.5 ha of moderate-good and 7.02 ha of low condition Cumberland Plain Woodland present within the study area. Condition assessment has been determined using the biometric field assessment method such as used for BioBanking applications.

The canopy comprises mostly a mixture of *Eucalyptus tereticornis* and *Eucalyptus moluccana* to a height of between 15-25m and a projected foliage cover of 10-30% dependent upon the age of the trees. There were seldom any *Eucalyptus crebra* within the canopy.

The mid-storey is largely dominated by the exotic African Olive trees. Where native mid-storey was present, the diversity was very low and generally restricted to just *Bursaria spinosa* var. *spinosa.*

The ground layer was found to be sparse in the majority of remnants due to a lack of light and competition from African Olives. Consequently, there was regularly less than 20% coverage of natives in the ground layer. Often half of the ground cover was dominated by African Olive seedlings. Some native species that were found regularly amongst the quadrats included *Microlaena stipoides, Oplismenus aemulus, Themeda triandra, Glycine clandestina, Brunoniella pumilio, Dichondra repens, Cheilanthes sieberi* and *Solanum prinophyllum.*

Escarpment area

The canopy comprises mostly a mixture of *Eucalyptus tereticornis* and *Eucalyptus moluccana* to a height of between 20-30m and a projected foliage cover of 10-30% dependent upon the age of the trees.

The mid-storey is largely dominated by the exotic African Olive trees. Where native mid-storey was present, the diversity was very low and generally restricted *Acacia implexa* and less frequently *Bursaria spinosa* var. *spinosa.*

The ground layer was found to be sparse in the majority of remnants due to a lack of light and competition from African Olives. Ground layer vegetation was similarly suppressed with less than 5% coverage, 50% of the ground cover was dominated by African Olive seedlings. Some native species that were found amongst the quadrats included *Oplismenus aemulus, Microlaena stipoides, Brunoniella* spp.*, Dichondra repens* and *Cyperus gracilis.*

African Olive stands

African Olives were abundant on the escarpment, in particular, on the eastern side where it is the primary vegetation type. Within this vegetation community, native species was generally around five (5) species or less per 0.04 ha area, and typically treeless or less than 5% coverage. Severe African Olive infestations account for 7.36 ha of vegetation coverage within the site.

Heritage gardens

These are landscaped garden beds that surround the existing dwelling which form part of the heritage curtilage.

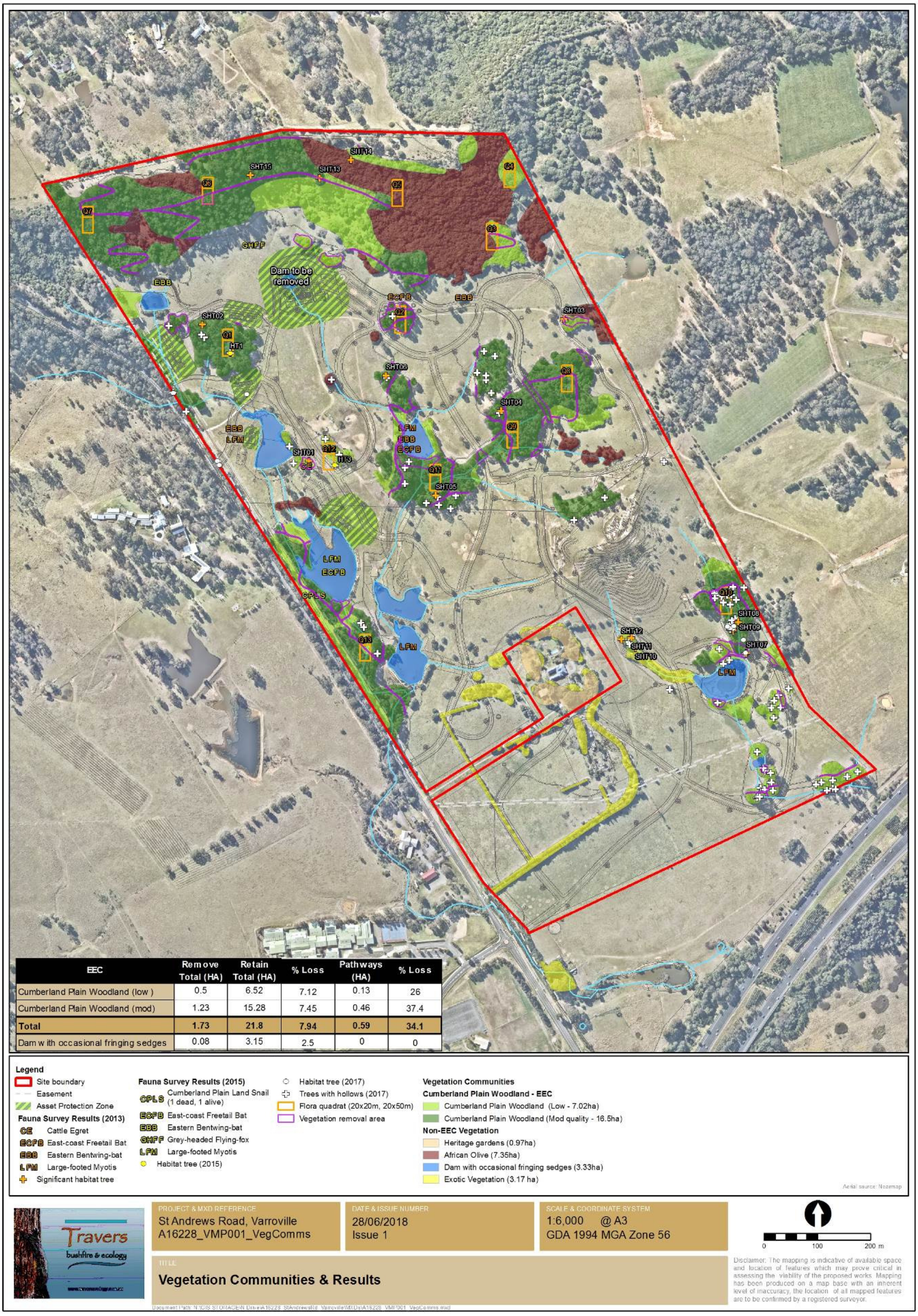
In the immediate surrounds, the gravelled carriage drive, lawn tennis court site and plantings are elements of a substantially intact mid-19th century garden. The garden contains Moreton Bay Figs, Hoop Pines, Funeral Cypresses, White Cedars, Pepper and Coral Trees, a Norfolk Island Hibiscus, Bauhinia, Agaves, Oleanders, Mauritius hemp (the stretch of original drive in front of the house is a forest of these), Yuccas, Aloes and hedges of *Tecoma capensis*, common olive and African Boxthorn. The kitchen garden, laid out in 1809 and described in Sturt's 1839 sale advertisement may have occupied sloping ground to the north west of the house (http://www.scenichills.org.au/history_6.html)

Exotic vegetation

This describes largely the planted rows of African Olives around driveways and near the existing dwelling.

Dam with occasional fringing sedges

This describes the dams on site and their fringing vegetation on low adjacent topography. No target floristic surveys were conducted within the dams.



EEC	Remove Total (HA)	Retain Total (HA)	% Loss	Pathways (HA)	% Loss
Cumberland Plain Woodland (low)	0.5	6.52	7.12	0.13	26
Cumberland Plain Woodland (mod)	1.23	15.28	7.45	0.46	37.4
Total	**1.73**	**21.8**	**7.94**	**0.59**	**34.1**
Dam w ith occasional fringing sedges	0.08	3.15	2.5	0	0

Legend

- Site boundary
- Easement
- Asset Protection Zone

Fauna Survey Results (2013)

- CE Cattle Egret
- ECFB East-coast Freetail Bat
- EBB Eastern Bentwing-bat
- LFM Large-footed Myotis
- Significant habitat tree

Fauna Survey Results (2015)

- CPLS Cumberland Plain Land Snail (1 dead, 1 alive)
- ECFB East-coast Freetail Bat
- EBB Eastern Bentwing-bat
- GHFF Grey-headed Flying-fox
- LFM Large-footed Myotis
- Habitat tree (2015)
- Habitat tree (2017)
- Trees with hollows (2017)
- Flora quadrat (20x20m, 20x50m)
- Vegetation removal area

Vegetation Communities

Cumberland Plain Woodland - EEC

- Cumberland Plain Woodland (Low - 7.02ha)
- Cumberland Plain Woodland (Mod quality - 16.5ha)

Non-EEC Vegetation

- Heritage gardens (0.97ha)
- African Olive (7.35ha)
- Dam with occasional fringing sedges (3.33ha)
- Exotic Vegetation (3.17 ha)

Aerial source: Nearmap

Travers bushfire & ecology

PROJECT & MXD REFERENCE
St Andrews Road, Varroville
A16228_VMP001_VegComms

DATE & ISSUE NUMBER
28/06/2018
Issue 1

SCALE & COORDINATE SYSTEM
1:6,000 @ A3
GDA 1994 MGA Zone 56

0 100 200 m

TITLE
Vegetation Communities & Results

Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

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Figure 4 – Vegetation Mapping

2.3 Fauna results

Fauna species observed throughout the duration of fauna surveys are listed in Table 2 below.

Table 2 – Fauna observations for the study area

Common name	Scientific name	Method observed		
Birds		**July 2013**	**Sept 2015**	**April 2017**
Australasian Grebe	*Tachybaptus novaehollandiae*	O	O	O W
Australian Hobby	*Falco longipennis*	O		
Australian King Parrot	*Alisterus scapularis*	O	O	
Australian Magpie	*Gymnorhina tibicen*	O	O	O W
Australian Pelican	*Pelecanus conspicillatus*		O	
Australian Raven	*Corvus coronoides*	O	O	O W
Australian White Ibis	*Threskiornis molucca*	O		
Australian Wood Duck	*Chenonetta jubata*	O	O	O W
Barn Owl	*Tyto alba*	O		
Bar-shouldered Dove	*Geopelia humeralis*	W	W	
Bell Miner	*Manorina melanophrys*	W	W	O W
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O		
Black-fronted Dotterel	*Elseyornis melanops*		O	
Black-shouldered Kite	*Elanus axillaris*	O		
Brown Gerygone	*Gerygone mouki*	O		
Brown Goshawk	*Accipiter fasciatus*		O	
Cattle Egret	*Ardea ibis*	O		
Chestnut Teal	*Anas castanea*	O		
Common Blackbird *	*Turdus merula*	O	W	
Common Myna *	*Acridotheres tristis*	O	O	
Common Starling *	*Sturnus vulgaris*	O	O	O
Crested Pigeon	*Ocyphaps lophotes*	O	O	O W
Double-barred Finch	*Taeniopygia bichenovii*	O		
Dusky Moorhen	*Gallinula tenebrosa*	O	O	O
Eastern Rosella	*Platycercus eximius*	O	O	O W
Eastern Yellow Robin	*Eopsaltria australis*	O	W	
Eastern Whipbird	*Psophodes olivaceus*			W
Eurasian Coot	*Fulica atra*	O	O	
Fairy Martin	*Hirundo ariel*	O		
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	W	W	
Galah	*Cacatua roseicapilla*	O	O	
Golden Whistler	*Pachycephala pectoralis*	O	W	
Grey Butcherbird	*Cracticus torquatus*	O	O	O W
Grey Fantail	*Rhipidura fuliginosa*	O	O	O W
Grey Shrike-thrush	*Colluricincla harmonica*		W	
Grey Teal	*Anas gracilis*		O	
Hardhead	*Aythya australis*	O	O	O
Laughing Kookaburra	*Dacelo novaeguineae*	W	O	
Lewin's Honeyeater	*Meliphaga lewinii*	W	W	O W
Little Black Cormorant	*Phalacrocorax sulcirostris*	O	O	
Little Pied Cormorant	*Phalacrocorax melanoleucos*	O	O	
Long-billed Corella	*Cacatua tenuirostris*	W[PR]	W	O W
Magpie-lark	*Grallina cyanoleuca*	O	O	O W
Masked Lapwing	*Vanellus miles*	O	O	O W
Nankeen Kestrel	*Falco cenchroides*	O		
Noisy Miner	*Manorina melanocephala*	O	O	O W
Pacific Black Duck	*Anas superciliosa*	O	O	O W
Peregrine Falcon	*Falco peregrinus*	O		
Pied Currawong	*Strepera graculina*	W		

Common name	Scientific name	Method observed		
Purple Swamphen	*Porphyrio porphyrio*	O	O	
Rainbow Lorikeet	*Trichoglossus haematodus*	O	O	O W
Red-browed Finch	*Neochmia temporalis*	O	O	
Red-rumped Parrot	*Psephotus haematonotus*	O	O	O W
Red-whiskered Bulbul *	*Pycnonotus jocosus*	O	W	O W
Rose Robin	*Petroica rosea*			O W
Silvereye	*Zosterops lateralis*	O	O	O
Spotted Pardalote	*Pardalotus punctatus*	O	W	
Spotted Turtle-Dove *	*Streptopelia chinensis*	O	W	
Straw-necked Ibis	*Threskiornis spinicollis*			O
Striated Pardalote	*Pardalotus striatus*	O	W	
Sulphur Crested Cockatoo	*Cacatua galerita*		W	
Superb Fairy-wren	*Malurus cyaneus*	O	O	O W
Wedge-tailed Eagle	*Aquila audax*	O		
Welcome Swallow	*Hirundo neoxena*	O	O	O W
White-browed Scrubwren	*Sericornis frontalis*	W[PR]		O W
White-faced Heron	*Egretta novaehollandiae*	O	O	
White-winged Chough	*Corcorax melanorhamphos*			O W
Willie Wagtail	*Rhipidura leucophrys*	O	O	O W
Yellow-faced Honeyeater	*Caligavis chrysops*		W	
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*			O
Yellow Thornbill	*Acanthiza nana*	O		O W
Yellow-billed Spoonbill	*Platalea flavipes*		O	
Mammals				
Black Rat *	*Rattus rattus*	E	O	
Domesticated Cattle *	*Bos taurus*	O	O	O W
Domesticated Dog *	*Canis lupus familiaris*		W	
East-coast Freetail Bat [TS]	*Micronomus norfolkensis*	U	U	U
Eastern Bentwing-bat [TS]	*Miniopterus orianae oceansis*	U	U	U
Eastern Freetail-bat	*Mormopterus ridei*	U	U	U
European Red Fox *	*Vulpes vulpes*	O	O	
Goat *	*Capra hircus*		O	
Gould's Wattled Bat	*Chalinolobus gouldii*	U	U	U
Grey-headed Flying-fox [TS]	*Pteropus poliocephalus*		O	
Horse *	*Equus caballus*	O		O
Large-footed Myotis [TS]	*Myotis macropus*	U	U	U
Little Forest Bat	*Vespadelus vulturnus*	U[PR]	U[PR]	
Rabbit *	*Oryctolagus cuniculus*	O	O	O
Southern Forest Bat	*Vespadelus regulus*			U
Sugar Glider	*Petaurus breviceps*	O		
Wallaby sp.	*Wallabia* or *Macropus sp.*	P[PR]		
White striped Freetail Bat	*Austronomus australis*			U
Reptiles				
Cream-striped Shining Skink	*Cryptoblepharus virgatus*		O	
Eastern Long-necked Turtle	*Chelodina longicollis*		O	
Bar-sided Skink	*Eulamprus tenuis*			O
Grass Skink	*Lampropholis guichenoti*	O	O	
Red-Bellied Black Snake	*Pseudechis porphyriacus*	O		
Amphibians				
Common Eastern Froglet	*Crinia signifera*	W	W	W
Dwarf Tree Frog	*Litoria fallax*	W	W	
Peron's Tree Frog	*Litoria peronii*		W	
Smooth Toadlet	*Uperoleia laevigata*	O	W	W
Striped Marsh Frog	*Limnodynastes peronii*		W	

2.4 Threatened species, EECs and endangered populations

The flora and fauna assessment report (*Travers* 2017), five (5) threatened fauna species including:-

- Cumberland Plain Land Snail (*Meridolum corneovirens*),
- Grey-headed Flying-fox (*Pteropus poliocephalus*),
- Eastern Bentwing-bat (*Miniopterus orianae oceansis*),
- East-coast Freetail Bat (*Micronomus norfolkensis*) and
- Large-footed Myotis (*Myotis macropus*),

No threatened flora species were recorded and no endangered flora populations occur in the study area.

One (1) EEC, Cumberland Plain Woodland was recorded within the study area.

In respect to EPBC *Act* listed species one (1) threatened fauna species Grey-headed Flying-fox (*Pteropus poliocephalus*), one (1) protected migratory bird species, Cattle Egret (*Ardea ibis*), no threatened flora species, and one (1) EEC '*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest'* listed under this Act were recorded within the study area.

Cumberland Plain Woodland occurs throughout the site in varying condition, but no high quality remnants were observed because of grazing, clearing and dense infestations of African Olive. There is approximately 23.52 ha of Cumberland Plain Woodland of which 7.02 ha is in low condition.

2.5 Vegetation condition and connectivity

The CPW on the escarpment in the northern portion of the site is steep however it has moderate connectivity value to woodland towards the east, west and northwest through adjacent properties. The connectivity that exists within the combined local patch also continues along nearby riparian channels running along the western boundary of the site.

This provides a refuge for locally occurring fauna, however, this connectivity eventually terminates before reaching any large regional conservation areas and as such does not form part of any contiguous regional corridor.

This VMP requires the restoration of the escarpment CPW progressively over the life of the project and will include target weed control, bush regeneration and revegetation works. These works will enhance the function of the escarpment as native connective habitat and maintain the scenic values of the escarpment.

2.6 Riparian features

An inspection of the site and its watercourses was undertaken on 27 June 2013 (Watercourse Assessment – *Travers bushfire & ecology* 2017) to identify the presence or absence of watercourse features. The inspection identified that the majority of mapped first order streams within the site as per the topographic maps were swales or drainage lines that did not have any channel formation. Whilst the stream order categorisation for all other streams was maintained as per the Strahler method, the drainage lines were re-categorised as 'not a watercourse' subject the inspections findings.

The role of the drainage lines to protect the catchment for stability and erosion control has been integrated into the landscape management of the site as shown on the Vegetation Management Plans. These drainage lines have been intercepted either by buildings, re-

contouring or roadworks but drainage infrastructure will still be required to manage flows from their sub-catchments during periods of heavy rainfalls.

The extent of each validated watercourse is shown on Figure 5 which also identifies drainage lines that are not watercourses.

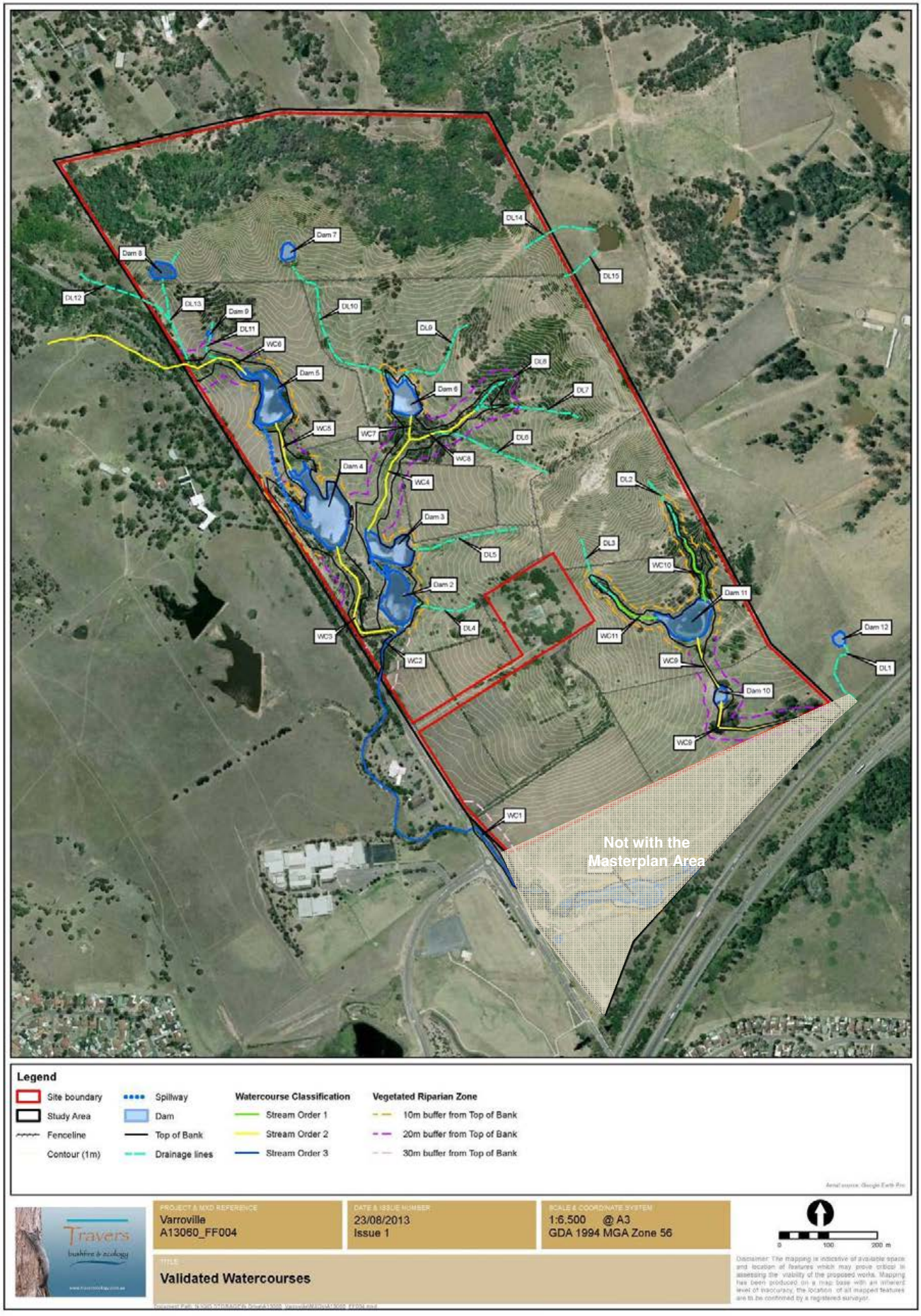


Figure 5 - Validated watercourses

Photo 1 – *Deep incised gully SE Portion of the site, held in check by remnant native canopy and weeds (Watercourse 10),*

Photo 2 – *Intermittent channel with a wide grassed channel (Watercourse 7),*

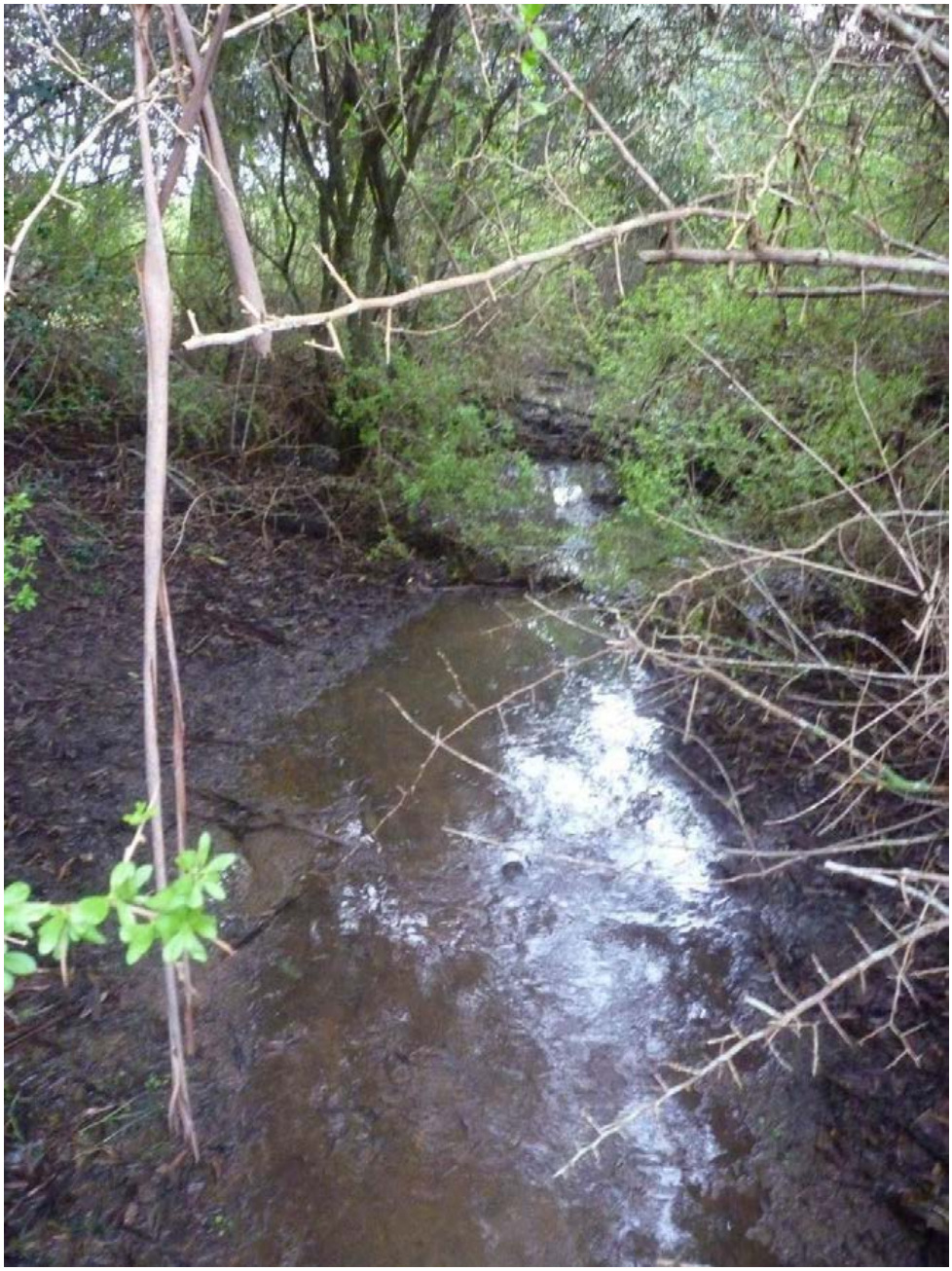


Photo 3 *– Typical Lower reach (Water Course 9)*

The Project proposes consolidation of the drainage lines into the main watercourses (Watercourse Assessment – Travers bushfire & ecology 2017), restoration of the riparian zones using Cumberland Woodland species and a significant improvement in riparian protection, riparian habitat and connectively

Photo 4 – *Typical drainage line - grassed swale with small dam at head no evidence of drainage < 12 hours after heavy rains (Drainage line 13)*

Photo 5 *– Dam 4 (approx. 9,950m^2)*

Restoration Strategy 3

The proposed development has been designed to minimise impact on existing EECs and associated habitat features.

This VMP has incorporated typical restoration and threatened species habitat conservation measures to improve the ecological value of the EEC remnant and associated riparian corridor.

The VMP restoration works program will be extended to twenty (20) years with a review at five (5) yearly intervals. Where intensive works are not required for the full twenty (20) years, this will be stated within the objectives of each zone, but with ongoing maintenance in perpetuity. Any development consent will be subject to a condition requiring a new VMP to be prepared at every new development phase through the 150-year life of the planning proposal.

3.1 Management zones

For the purposes of this VMP, the following management zones have been identified.

- Management Zone A – Escarpment reserve (Cumberland Plain Woodland) – 18.44ha
- Management Zone B – North western woodland reserve (Cumberland Plain Woodland) – 0.99ha
- Management Zone C - Central Riparian Zone (Cumberland Plain Woodland) – 6.99ha
- Management Zone D – Western Riparian Zone (Cumberland Plain Woodland) – 9.15ha
- Management Zone E – Eastern Woodland reserve (Cumberland Plain Woodland) – 0.47ha
- Management Zone F – South Eastern Riparian Zone (Cumberland Woodland) – 5.21ha

The restoration strategy is similar in approach to all zones but the following considerations are relevant to each zone and a specific revegetation and bush regeneration plan will need to be prepared for each management zone as the staging of works proceed.

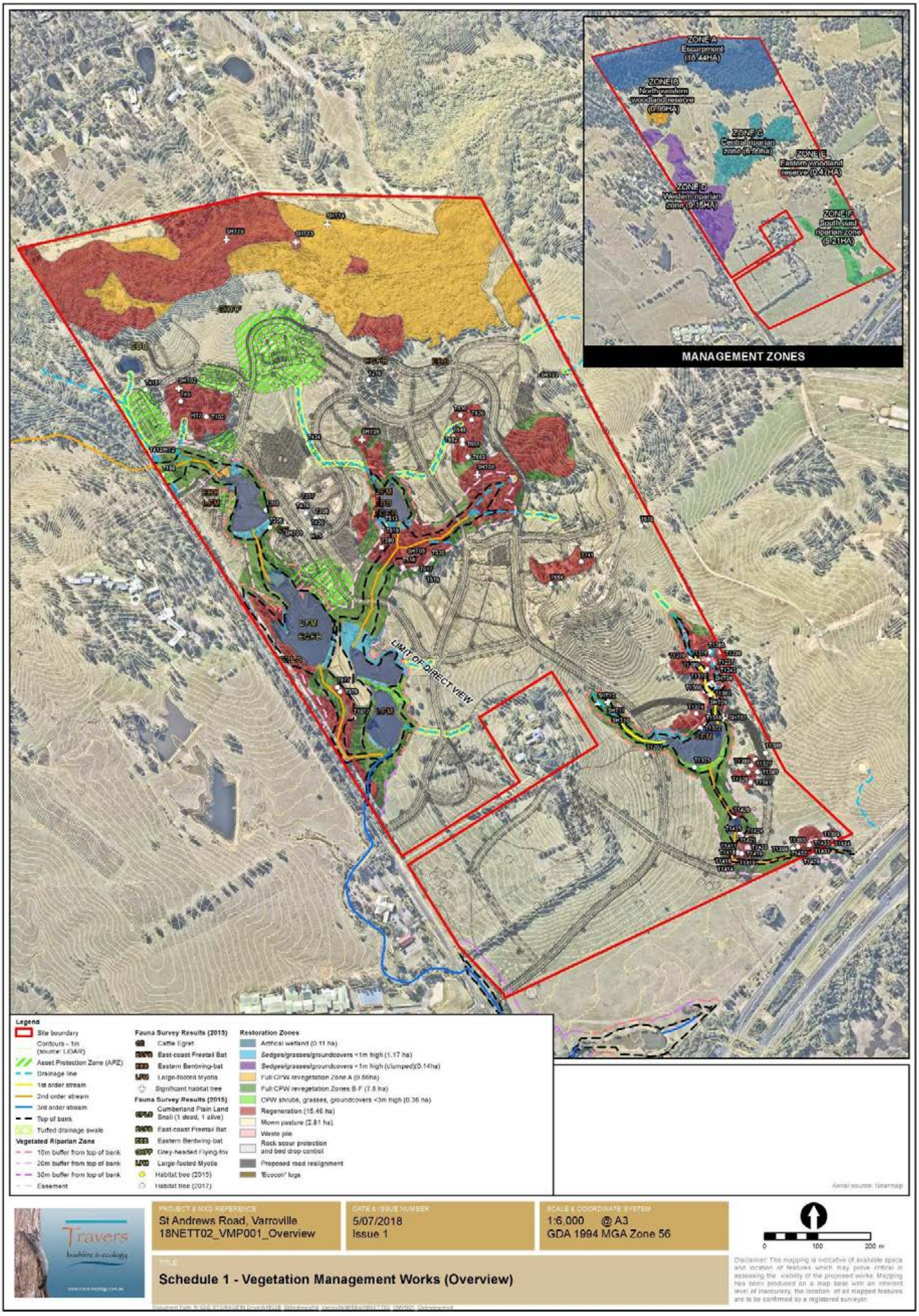


Figure 6 – Management Zones

3.1.1 Management Zone A – Escarpment reserve (Cumberland Plain Woodland) – Moderate to High Priority

This management zone contains is a remnant Cumberland Plain Woodland on the lower, mid and upper slopes. The extent of weed infestation within this zone means that it will have a very long restoration program of 20 plus years to remove weeds, revegetate and regenerate in a mosaic manner.

To ensure the slopes remain stable at all times the weed control and revegetation works are to be undertaken in strategic locations to progressively consolidate the better condition areas and expand into the existing densely weed infested areas.

A staged and mosaic approach should be undertaken to reduce the area of bare soil susceptible to erosion at any one time:

- Woody weeds such as African Olive should be controlled using cut-and-paint or drill-and-fill herbicide techniques to minimise soil disturbance, and the stumps and roots left in situ to provide soil stabilisation.
- An initial seeding of sterile or non-invasive cover grasses (e.g. Japanese Millet) is to be used to provide a quickly-established ground cover to reduce erosion and supress weeds.
- A covering of biodegradable erosion protection is to be laid following seeding of the cover grass. This may be either hydromulch or pegged and overlapped jute matting.
- Planting of CPW species is to follow establishment of the cover grass.

Whilst there is remnant native vegetation present the area is to be progressively restored to a natural state over an estimated 20 plus years within with ongoing maintenance for the life of the project.

3.1.2 Management Zone B – North western woodland reserve (Cumberland Plain Woodland) – Moderate Priority

This management zone is a smaller but highly resilient CPW regrowth area of land and is to be progressively restored to a natural state over an estimated 5 years within with ongoing maintenance for the life of the project. Regeneration should be promoted initially prior to commencing planting to minimise restoration costs.

As this area is an important visual location MZB will be a moderate priority management zone.

3.1.3 Management Zone C - Central Riparian Zone (Cumberland Plain Woodland) – Moderate priority

This management zone is a significant area of land and is to be progressively restored to a natural state over an estimated 10 years within with ongoing maintenance for the life of the project. Regeneration should be promoted initially prior to commencing planting to minimise restoration costs.

Stabilisation of creek embankments may need to be undertaken at particularly locations to reduce erosion. Jute mesh unstable areas and establishment of a groundcover over these areas is a moderate priority. Weed thickets along creek line embankments are to be removed in a staged manner and using manual techniques such as frilling, drilling or cut/paint. Logs may be utilised for additional stabilisation works as required.

As this area is an important visual location, MZC will be a moderate priority management zone.

3.1.4 Management Zone D – Western Riparian Zone (Cumberland Plain Woodland) – High priority

This management zone is a significant area of land and is to be progressively restored to a natural state over an estimated 5 years within with ongoing maintenance for the life of the project. As this area is an important visual location MZD will be a high priority management zone. A combination of restoration and strategic revegetation works will be needed for ecological and visual management purposes.

This management zone contains the threatened Cumberland Plain Land Snail. Therefore a specific restoration plan is to be developed taking into account the following strategies:

1. Protection of the CPLS habitat though strategic fencing and redirection of pedestrian traffic.
2. Enrichment of on ground log habitat to provide dry weather shelters and protection against predation.
3. Strategic canopy planting of Forest Red Gum to support the snail population.
4. Strict control of vehicle movements through CPLS habitat for any proposed works or landscape maintenance purposes.
5. Stabilisation of creek embankments may need to be undertaken at particularly locations to reduce erosion. Jute mesh unstable areas and establishment of a groundcover over these areas is a high priority. Weed thickets along creek line embankments are to be removed in a staged manner and using manual techniques such as frilling, drilling or cut/paint. Logs may be utilised for additional stabilisation works as required.

3.1.5 Management Zone E – Eastern Woodland reserve (Cumberland Plain Woodland) – Low priority

This management zone contains is a remnant CPW area on the slopes. It has a low restoration priority but is simplistic in that it can be fenced initially to promote regeneration. This approach will minimise more expensive revegetation approaches allowing targeted enrichment planting to be undertaken once the resilience has been demonstrated under management.

Whilst there is remnant native vegetation present the area is to be progressively restored to a natural state over an estimated 5 years within with ongoing maintenance for the life of the project.

3.1.6 Management Zone F – South Eastern Riparian Zone (Cumberland Woodland) – Low priority

This management zone contains highly eroded banks and beds and stabilisation works are required. It is likely to be one of the last areas to be restored.

Stabilisation of creek embankments may need to be undertaken at particularly locations to reduce erosion. Jute mesh unstable areas and establishment of a groundcover over these areas will be undertaken as soon as possible to stabilise the ground surface and prevent erosion. Weed thickets along creek line embankments are to be removed in a staged manner and using manual techniques such as frilling, drilling or cut/paint. Logs may be utilised for additional stabilisation works as required.

Within the core riparian zones, groundcovers are to be placed at 6 plants per m^2.

Whilst there is remnant native vegetation present the area is to be progressively restored to a natural state over 10 years with ongoing maintenance for the life of the project.

3.2 Key restoration strategies

The key strategies adopted include:

- Protect and restore EEC vegetation to a fully structured vegetation community;
- Protect and enhance habitat resources including but not limited to tree hollows;
- Restoration of riparian corridors and escarpment to enhance connectivity through the site;
- Retention of all bush rock areas in particular within the escarpment;
- Establishment of on ground habitat by selectively harvesting trees to be removed for the proposed development and relocation into suitable habitat areas for Cumberland Plain Snail and to improve terrestrial shelter habitat; and
- Installation of permanent fencing and passive pedestrian controls designed to exclude human access to sensitive habitat areas.

3.2.1 Planting densities

Specific planting densities are described in section 3.8 for the various management zones.

Within APZs, the sedges/grasses/groundcover plantings within riparian zones are to be planted in clumps, no larger than $10m^2$ at the same planting rate of 6 per $1m^2$. There shall be breaks between clumps of at least 3m, and the overall proportion or foliage cover of plantings to be approximately 25% of the area.

3.3 Site preparation

Prior to the commencement of each construction stage, the following works are to be undertaken to protect threatened species habitat and any ecologically sensitive vegetation:

- All vegetation, waterway and habitat protection measures are to be installed under the direction of the Project Ecologist;
- Any on-ground refugia (logs including felled trees & rocks) from the 'impacted zone' is to be retained and relocated under the direction of the Project Ecologist;
- All hollow bearing or habitat trees to be removed are to be dismantled under the supervision of a Project Ecologist;
- Standard *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to works within the conservation area to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres; and
- Conservation area signage is to be installed along all boundaries of protection zones.

3.4 Permanent protection fencing

Permanent protection fencing shall be installed along the edge CPW containing Cumberland Plain land snails or adjoin (see Schedule 1), consisting of 5-strand plain wire rural fence and timber posts at a maximum separation of 50m or alternative wildlife friendly fencing (Figure 7).

Fencing must also facilitate dispersion across the site for native species typical of CPW including potential macropods.

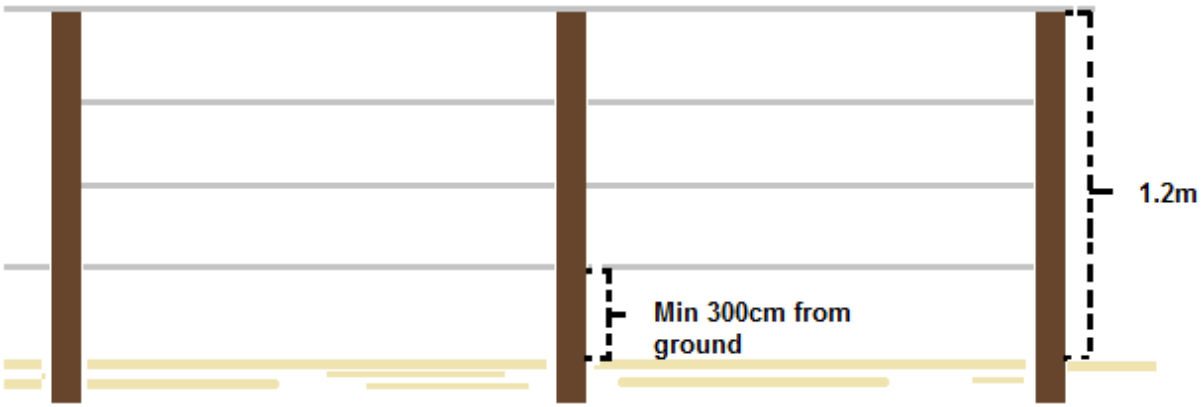


Figure7 – Typical 4-5 plain wire strand fence with timber posts every 50 m and support posts in between

3.5 Temporary protection fencing

Prior to commencement of construction works within each lot, construction proof fencing is to be installed to minimise the area of disturbance during construction of any dwellings. Sediment fencing is to be installed at the base of the construction fencing as a primary sediment collection measure. It is to be installed and maintained to prevent erosion along the fence and is to include sediment fence kickbacks on sloped lands to slow water directed along the fence. The sediment fence is to be reinforced at all low points with additional hay bales to support the fence against the weight of trapped sediment.

Prior to commencement of construction works, temporary tree protection fencing is to be installed for all trees in close proximity to any construction works and under direction of the project ecologist or arborist.

3.6 Hollow-bearing trees

Schedule 1 Vegetation Management Works identifies all hollow trees to be affected by the proposed works (Table 2). Any hollow bearing tree to be retained and are in close proximity to proposed works are to be fully protected with plastic bunting on the drip line of the tree. Any works within the drip line of a hollow bearing tree is to be supervised by a fauna ecologist or arborist so as to prevent any damage to its roots, branches or trunk. Should any damage to an existing tree be incurred then rectification of the damage is to be undertaken under the advice and direction of the appointed arborist.

All hollow-bearing trees proposed with the potentially impacted areas shall be clearly marked with a **'H'** Symbol to indicate its protection status. The contractors are to be managed such that all due care is taken to prevent damage to trees to be retained and is not to remove the trees without first receiving direction from the fauna ecologist. A fauna ecologist is to be present at the removal of each habitat tree. Refer to section 3.7 for details.

The Tree Assessment report prepared by *Travers bushfire & ecology* (2017) identified a total of thirty-five (35) hollow-bearing trees requiring likely removal due mostly to poor health and safety reasons. These trees contain a total of 113 small (0-10cm) hollows, 21 medium (10-30cm) hollows and 1 large (30+) hollow that will be removed. Many of these trees and their respective hollows have not been inspected for use by stag-watching or tree climber.

Some hollow dependent fauna species were recorded during survey including Sugar Glider, Barn Owl, Australian King Parrot, Australian Wood Duck, Eastern Rosella, Galah, Laughing Kookaburra, Long-billed Corella, Pacific Black Duck, Rainbow Lorikeet, Red-rumped Parrot, Striated Pardalote, Eastern Freetail-bat, Gould's Wattled Bat, Little Forest Bat, Dwarf Tree Frog and Whistling Tree Frog as well as two threatened fauna species including East-coast Freetail Bat and Large-footed Myotis.

Given that a significant number of hollows are proposed for removal and the potential for the two threatened microbats to occur it is recommended that all remaining hollow-bearing trees to be removed are stag-watched during warmer months to determine any use by microbats. This should be undertaken with an ultrasonic recorder so that any emerging bats can be identified. These hollows may alternatively be inspected by tree climber and videoscope for signs of current or previous use.

Any of these trees recorded to contain a threatened microbat should be retained within the landscape with appropriate protection measures imposed. If the tree is unsafe and cannot be made safe by securing it with cable or poles then it should be fenced for safety reasons. If this cannot be achieved and the tree requires removal then the hollow section should be effectively cut and relocated into a suitable nearby recipient tree to permit its ongoing use. This is particularly important given that artificially constructed bat boxes have not been demonstrated effective for any threatened microbat species. If the hollow is a large section this may require the use of a crane and advanced securing measures and the selection of a large and structurally sound recipient tree.

The removal of all hollows should be under the supervision of a fauna ecologist. Any hollows found to contain fauna or otherwise identified as high quality hollows by the fauna ecologist should also be prepared for reattachment to a retained tree at a later date. The management and relocation of resident fauna should be undertaken by the fauna ecologist at the time of hollow removal and priority measures for threatened species encountered.

It is recommended that all hollows that are not relocated to another tree are instead replaced with a constructed nest box. The number and type of boxes should be estimated and installed prior to any habitat tree removal so that a represented number of the boxes may be used as temporary housing for the recovered displaced fauna. Therefore boxes suitable for the various fauna likely to be encountered should be provided. The residual number of constructed boxes can be calculated following complete hollows removal.

Hollow-bearing tree HT3 (T430) is an isolated large dead tree within the open landscape. The hollow within this tree is good quality and is located 6m from the ground. As a preferred management option, all upper limbs above this hollow may be removed for safety and thus retaining the trunk and hollow. Such retention would not be warranted if an inspection of the hollow by tree climber revealed no use by fauna.

Tree T579 and T610 were observed to be utilised by the locally significant Peregrine Falcon and Hobby Falcon during surveys. Both trees are dead and are located along the ridgeline within the eastern boundary and hence are important as outlook perches for these and other raptors. T579 has been identified for removal. It is recommended that this tree is retained and fenced and/or managed limbs if deemed to be unsafe.

Table 2 – Habitat tree data

Tree No	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows and other habitat features recorded
Significant habitat trees (study area)						
SHT1 (T428)	Forest Red Gum	115	24	30	70	2x 0-5 branch hollows, 1x 30-35cm trunk hollow
SHT2 (T46)	Forest Red Gum	100	13	24	30	2x 0-5 branch hollows, 3x 0-5cm trunk hollows, 2x 10-15cm branch hollows
SHT3 (T610)	dead tree	90	13	19	0	3x 0-5 branch hollows, 2x 5-10cm trunk hollows, 2x 5-10cm branch hollows, 4x 10-15cm branch hollows
SHT4 (T814)	dead tree	110	13	27	0	5x 0-5 branch hollows, 2x 0-5cm trunk hollows, 1x 5-10cm branch hollows, 2x 15-20cm branch hollows
SHT5 (T518)	Forest Red Gum	90	19	28	70	4x 0-5 branch hollows, 2x 5-10cm branch hollows, 3x 10-15cm trunk hollows
SHT6 (T241)	dead tree	90	12	22	0	4x 0-5 branch hollows, 5x 5-10cm branch hollows, 1x 15-20cm trunk hollows
SHT7 (1249)	dead tree	110	13	25	0	1x 0-5 branch hollows, 1x 5-10cm trunk hollows, 2x 5-10cm branch hollows, 1x 10-15cm branch hollows, 2x 10-15cm trunk hollows (good quality), 1x 15-20cm broken trunk hollows
SHT8	Grey Box	45	11	26	65	Small-sized raptor nest
SHT9 (T1364)	Grey Box	65	14	29	60	1x 5-10cm trunk hollows, 1x 5-10cm branch hollows, 1x 10-15cm branch hollows, 1x 25-30cm broken trunk hollow (good quality)
SHT10 (T1201)	Grey Box	110	17	32	60	2x 5-10cm branch hollows, 2x 10-15cm branch hollows, 2x 15-20cm broken trunk hollows
SHT11 (T1200)	Grey Box	80	13	27	65	2x 10-15cm branch hollows, 2x 15-20cm blow branch hollows
SHT12 (T1169)	Grey Box	80	14	25	60	1x 5-10cm trunk hollow (good quality), 1x 10-15cm trunk hollow, 1x 15-20cm branch (bee nest inside)
SHT13	Grey Box	120	20	28	60	2x 10-15cm branch hollows, 1x 15-20cm branch, 1x 25-30cm broken trunk hollow (good quality)
SHT14	dead tree	70	6	23	0	1x 10-15cm branch hollows, 1x 20-25cm broken trunk hollow
SHT15	Forest Red Gum	85	17	28	55	2x 10-15cm branch hollows
Habitat trees (subject site)						
HT1 (T102)	Forest Red Gum	110	16	19	70	2x 0-5cm branch, 1x 10-15cm trunk base
HT2 (T413)	Forest Red Gum	80	17	25	75	1x 0-5cm branch, 1x 0-5cm trunk
HT3 (T430)	dead tree	75	12	22	0	1x 5-10cm trunk (good quality) hollow 6m from ground. Trunk and hollow may be retained following upper limb management
HT4 (T1437)	dead tree	90	2	12	0	Hollow stag
HT5 (T1438)	Grey Box	85	17	20	65	Epicormic growth
	Forest Red Gum	80	14	25	65	1x 0-5cm branch spout hollow,

Tree No	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows and other habitat features recorded
HT6 (T45)						2x 5-10cm branch hollows (1 low with bees), suppressed below
HT7 (T102)	Forest Red Gum	150	16	25	70	1x 0-5cm trunk hollow, 1x 5-10cm trunk split cavity, rabbit warren at base,lean, hollows, deadwood,broken crown
HT8 (T186)	Dead Stag	70	3	10	0	7x broken spout hollows, dead,dangerous
HT9 (T203)	Forest Red Gum	90,45	10	22	90	Bar-sided Skink shelter, 1x 0-5cm trunk hollow, good shape & form
HT10 (T206)	Grey Box	35,35	4	20	40	1x 0-5cm trunk hollow, cambium damage at base,dehydrated,dieback,deadwood,narrow canopy
HT11 (T207)	Grey Box	100	13	25	70	1x dead trunk,kino,deadwood
HT12 (T208)	Grey Box	140	22	26	70	bird nest, 1x 0-5cm branch spout hollow, 1x 5-10cm trunk hollow, rabbit warren at base kino,deadwood
HT13 (T216)	Forest Red Gum	175	25	35	90	1x 0-5cm branch spout hollow, remove weedy understorey,deadwood
HT14 (T380)	Forest Red Gum	86	24	30	80	2x 0-5cm branch spout hollows, remove weeds around base
HT15 (T415)	Dead Stag	65	13	15	0	1x 0-5cm branch spout hollow, 1x 5-10cm trunk base hollow
HT16 (T429)	Grey Box	90	22	29	80	1x 0-5cm branch spout hollow, deadwood, small kino
HT17 (T434)	Forest Red Gum	110	23	20	70	3x 0-5cm branch spout hollows, rabbit burrows around base, weeds around base, poss good bat roost
HT18 (T513)	Forest Red Gum	190	25	35	75	1x 0-5cm branch spout hollow, rabbit warren at base,remove weedy understorey and competition,broken branches
HT19 (T515)	Forest Red Gum	130	20	35	90	1x 5-10cm branch spout hollow
HT20 (T516)	Forest Red Gum	80,80	13	25	0	3x 0-5cm branch spout hollows, 1x 0-5cm trunk hollow, 1x 5-10cm branch spout hollow, 1x 15-20cm trunk hollow, broken limbs, 1x trunk dead
HT21 (T517)	Forest Red Gum	140	20	30	95	2x 0-5cm branch spout hollows, 1x 0-5cm trunk hollow (good quality), 1x 5-10cm branch spout hollow, remove weedy understorey and competition,good shape & form
HT22 (T519)	Dead Stag	100	4	16	0	3x 0-5cm branch spout hollows, 3x 0-5cm trunk hollow, 2x 5-10cm branch spout hollow, 1x 5-10cm trunk hollow, 3x 10-15cm branch spout hollows, 3x 15-20cm trunk hollow, 1x 15-20 branch spout hollow Significant habitat(hollows), manage broken spout but keep
HT23 (T520)	Forest Red Gum	110	20	30	90	1x 5-10cm branch spout hollow, remove weedy understorey and competition,good shape & form
HT24 (T579)	Dead Stag	80	4	13	0	3x 0-5cm branch spout hollows, 3x 0-5cm trunk hollow,

Tree No	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows and other habitat features recorded
						3x 5-10cm branch spout hollow
HT25 (T620)	Dead Stag	110	20	36	0	3x 0-5cm branch spout hollows
HT26 (T630)	Dead Stag	95	21	29	0	2x 0-5cm branch spout hollows, 1x 0-5cm trunk hollow, 2x 5-10cm branch spout hollows, hollow right through trunk
HT27 (T648)	Narrow-leaved Ironbark	16,3	5	9	80	1x 0-5cm broken trunk hollow, broken trunk, small deadwood
HT28 (T651)	Narrow-leaved Ironbark	60	18	30	45	2x 0-5cm branch spout hollows, deadwood, epicormic growth, remove weeds below
HT29 (T652)	Narrow-leaved Ironbark	75	18	22	45	1x 10-15cm low branch spout hollow, remove weeds around base, deadwood, old cambium damage at base
HT30 (T653)	Narrow-leaved Ironbark	115	27	29	65	2x 0-5cm branch spout hollows, 1x 0-5cm branch hollow, 1x 5-10cm branch spout hollow, remove weeds around base, epicormic growth, prominant tree
HT31 (T664)	Dead Stag	43,10, 7,20	9	16	40	1x 10-15cm low branch spout hollow, main stem dead
HT32 (T741)	Dead Stag	100	10	35	0	3x 0-5cm branch spout hollows, 2x 0-5cm trunk hollow, 2x 5-10cm branch spout hollow, 1x 10-15cm branch spout hollow, 1x 15-20cm branch spout hollow, dead,potential raptor tree
HT33 (T977)	Forest Red Gum	80,85, 100	15	28	90	2x 0-5cm branch spout hollows, good shape & form,some erosion near base
HT34 (T979)	Forest Red Gum	160	15	30	90	2x 0-5cm branch spout hollows, 1x 0-5cm trunk hollow, good shape & form
HT35 (T1077)	Forest Red Gum	180	15	20	50	1x 0-5cm branch spout hollows, 1x 0-5cm trunk hollow, 1x 5-10cm branch spout hollow, strangled by fig tree,unbalanced,large broken limbs
HT36 (T1202)	Dead Stag	60	16	21	0	1x 0-5cm branch spout hollow
HT37 (T1236)	Grey Box	75	23	30	95	1x 0-5cm branch spout hollow, magnificent tree, prominent
HT38 (T1237)	Grey Box	70	11	28	55	1x 0-5cm branch spout hollow, 1x 5-10cm branch spout hollow, epicormic growth, bracket fungi in main fork, remove weeds and small trees around base
HT39 (T1242)	Forest Red Gum	55	11	30	75	1x 0-5cm branch spout hollow, lean, deadwood
HT40 (T1276)	Grey Box	75	10	23	80	1x 0-5cm branch spout hollows, 1x 0-5cm trunk hollow, remove weed understorey and smaller competition
HT41 (T1277)	Grey Box	90	13	25	85	2x 0-5cm branch spout hollows, 1x 5-10cm branch spout hollow, remove weed understorey and smaller competition
HT42 (T1278)	Dead Stag	85	1	11	0	3x 0-5cm branch spout hollows, 3x 0-5cm trunk hollows, 3x 5-10cm trunk hollows
HT43 (T1279)	Grey Box	90	5	13	60	2x 0-5cm branch spout hollows, 2x 5-10cm trunk hollows, declining from nearby competition
HT44 (T1280)	Forest Red Gum	115	15	26	90	2x 0-5cm branch spout hollows, remove weed understorey and smaller competition

Tree No	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows and other habitat features recorded
HT45 (T1281)	Dead Stag	110	7	15	5	1x 0-5cm branch spout hollows, 2x 0-5cm trunk hollow, 1x 5-10cm broken trunk hollow, 1x 20-30cm broken trunk hollow,
HT46 (T1283)	Grey Box	30	4	10	5	1x 5-10cm trunk hollow, 1x 5-10cm branch spout hollow
HT47 (T1284)	Grey Box	90	17	30	85	1x 0-5cm branch hollow, 1x 5-10cm branch spout hollow, remove weed understorey and smaller competition
HT48 (T1285)	Forest Red Gum	60	8	13	55	1x 0-5cm branch spout hollow, 1x 5-10cm broken trunk hollow, suppressed above,broken limbs,low foliage
HT49 (T1286)	Grey Box	110	15	33	75	2x 0-5cm branch spout hollows, 1x 5-10cm trunk hollow, 1x 10-15cm branch spout hollow, remove weed understorey and smaller competition
HT50 (T1318)	Dead Stag	19	3	7	0	2x 0-5cm fissures - suitable for microbats
HT51 (T1322)	Dead Stag	73	15	24	0	1x 0-5cm split cavity
HT52 (T1323)	Dead Stag	93	13	22	0	1x 0-5cm branch hollow, 2x 0-5cm split cavities
HT53 (T1327)	Dead Stag	80	16	25	0	3x 0-5cm branch hollows, 2x 0-5cm split cavities
HT54 (T1328)	Dead Stag	78	10	24	0	3x 0-5cm branch hollows, 1x 0-5cm split cavity
HT55 (T1362)	Grey Box	100	15	27	80	3x 0-5cm branch spout hollows, 1x 5-10cm trunk hollow, 1x 10-15cm branch hollow, remove weed understorey & smaller competition
HT56 (T1365)	Grey Box	90	3	18	10	3x 0-5cm branch hollows, rabbit warren at base
HT57 (T1366)	Grey Box	60	10	23	60	2x 0-5cm branch spout hollows, 1x 0-5cm trunk hollow
HT58 (T1370)	Grey Box	55	3	15	5{+	2x 0-5cm branch spout hollows, 1x 5-10cm trunk hollow, bracket fungi,epicormic growth,deadwood,hollows
HT59 (T1374)	Grey Box	100	10	30	45	2x 5-10cm branch spout hollows, 1x 5-10cm trunk hollow, hollows,suppressed above,fungal damage,insect attack borers,deadwood,broken limbs
HT60 (T1388)	Dead Stag	100	10	32	0	3x 0-5cm branch spout hollows, 3x 0-5cm trunk hollow, raptor lookout
HT61 (T1389)	Forest Red Gum	100	23	42	90	2x 5-10cm branch hollows, remove weed understorey & smaller competition
HT62 (T1390)	Grey Box	116	15	35	90	1x 0-5cm branch spout hollow, 1x 10-15cm trunk hollow (good quality), 1x 15-20cm trunk hollow (good quality), remove weed understorey & smaller competition
HT63 (T1391)	Grey Box	100	20	35	80	1x 5-10cm branch spout hollow, 1x 10-15cm trunk hollow
HT64 (T1393)	Grey Box	110	16	25	80	3x 0-5cm branch spout hollows, medium deadwood
HT65 (T1394)	Grey Box	100	12	24	85	1x 0-5cm branch spout hollows, stressed,burl
HT66 (T1399)	Grey Box	100, 100	17	30	75	2x 0-5cm branch spout hollows, 2x 5-10cm branch spout hollows, bird nest, remove weed understorey & smaller competition
HT67 (T1404)	Dead Stag	30	1	8	0	2x 5-10cm trunk hollows

Tree No	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows and other habitat features recorded
HT68 (T1405)	Grey Box	31	8	20	45	1x 0-5cm branch spout hollow, dieback
HT69 (T1406)	Grey Box	46	10	26	5	1x 5-10cm broken trunk hollow
HT70 (T1414)	Grey Box	75	18	28	75	2x 0-5cm branch spout hollows, 1x 5-10cm branch spout hollow, remove weeds and small trees around base
HT71 (T1415)	Grey Box	47	9	12	45	1x 0-5cm branch spout hollow, suppressed above, tilting canopy, deadwood
HT72 (T1416)	Forest Red Gum	35	2	9	20	1x 5-10cm broken trunk hollow, broken crown
HT73 (T1417)	Forest Red Gum	65	12	25	65	1x 0-5cm branch hollow, epicormic growth
HT74 (T1418)	Grey Box	70	13	15	40	1x 0-5cm branch spout hollow, 1x 10-15cm branch spout hollow, heavy lean
HT75 (T1419)	Dead Stag	65	2	5	0	1x 0-5cm branch spout hollow, 1x 5-10cm branch hollow
HT76 (T1420)	Grey Box	65	20	28	60	1x 0-5cm branch spout hollow, 1x 5-10cm branch spout hollow, reduced foliage, deadwood
HT77 (T1421)	Grey Box	42	10	19	45	1x 5-10cm branch spout hollow, tilting canopy, next to poor tree
HT78 (T1423)	Dead Stag	70	14	14	0	2x 5-10cm branch spout hollows
HT79 (T1424)	Forest Red Gum	110	20	31	70	1x 0-5cm branch spout hollow, 1x 5-10cm branch spout hollow, lean, lower deadwood
HT80 (T1425)	Forest Red Gum	85	20	28	55	1x 0-5cm branch spout hollow, reduced foliage, unbalanced canopy
HT81 (T1426)	Dead Stag	65	8	13	0	1x 0-5cm branch spout hollow, 1x 10-15cm branch spout hollow
HT82 (T1428)	Forest Red Gum	150	20	23	80	1x 0-5cm branch spout hollow, prominent, significant sized base, deadwood
HT83 (T1429)	Grey Box	60	12	28	15	2x 5-10cm branch spout hollows, all upper tree dead
HT84 (T1431)	Grey Box	65	10	24	15	1x 5-10cm branch spout hollow, 1x 10-15cm branch spout hollow, 1x 30-40cm trunk split cavity, split at first fork, 1/2 canopy dead
HT85 (T1432)	Grey Box	70	19	27	60	1x 5-10cm branch spout hollow, part broken crown, mistletoe
HT86 (T1433)	Grey Box	58	8	25	35	2x 0-5cm branch spout hollow, lean, broken crown, cambium damage strip
HT87 (T1434)	Grey Box	80	30	27	75	1x 5-10cm branch spout hollow, remove weeds around base

3.7 Weed management

The following weed management and maintenance works are to be undertaken within the site.

The objectives of weed management actions are to protect and rehabilitate the existing, regrowth or remnant Cumberland Plain Woodland EEC and protect and improve the condition of the riparian corridors. This will primarily involve the removal of any weed infestations, bush regeneration, planting of suitable native endemic species and the ongoing maintenance of replanted areas.

State prohibited or locally controlled weeds observed on site are:

- *Lantana camara* (Lantana)
- *Lycium ferocissimum* (African boxthorn)
- *Olea europaea subsp. cuspidata* (African olive)
- *Rubus fruticosus* sp. agg. (Blackberry)
- *Echium plantagineum* (Paterson's curse)
- *Opuntia stricta* (Common prickly pear)
- *Araujia sericifera* (Moth vine)

The growth of these plants must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction.

Other highly invasive and persistent weed species that have been observed within or in proximity to the site include:

- *Araujia sericifera* (Moth vine)
- *Gomphocarpus fruticosus* (Narrow-leaved cotton bush)
- *Phytolacca octandra* (Inkweed)
- *Polygala virgata* (Milkwort)
- *Bryophyllum delagoense* (Mother-of-millions)
- *Daucus carota* (Wild carrot)
- *Paspalum dilatatum* (Paspalum)
- *Pennisetum clandestinum* (Kikuyu)

These weeds and in particular the listed Noxious Weeds have significant implications to the success of revegetation works and will require intensive targeted weed control and ongoing eradication throughout the planting and maintenance period. Refer to Appendix 2 for a more information about which weeds occur on site and the weed control priority.

3.7.1 Weed management strategy

Given the likely presence of invasive environmental weeds on site, a combination of selective spraying, hand removal and competitive planting techniques will be used to control weeds. The weed control priorities are listed in Attachment 2.

Weeding efforts will also be focussed generally across the riparian zone. These efforts will provide a buffer against weed incursions from adjoining land uses and improve internal habitat for native flora and fauna. Riparian restoration is to be undertaken in a manner that does not destabilise or further destabilise creeks banks. Strategies for weed control are described for each management zone in further detail in section 3.1.

Manually remove and appropriately dispose of invasive aquatic weeds from the water course.

Weeding works are to be carried out by an appropriately qualified and licensed bushland regeneration company under the direction of a consulting project ecologist. Bushland regeneration supervisors should possess a minimum of a Certificate in Bushland regeneration or equivalent with at least three (3) years of field experience.

There are currently a number of low impact bush regeneration techniques used in bushland management for the removal of weeds. The bush regeneration process (*Buchanan, 1989*) involves:

- The *Bradley Method* of minimal soil disturbance during weed removal
- Clearing and stabilising techniques
- The use of herbicides

- The use of fire (pile burns)
- Biological controls

Employing the *Bradley Method* for regeneration requires the removal of weeds in phases. Stages of weed removal can be broken into three (3) components:

Primary weeding

A staged approach to weed removal should be undertaken within the riparian corridor within the site to reduce bank destabilisation. This involves removal of small areas of weeds at any one time through targeted herbicide use and hand removal. Woody weeds such as African Olive and Privet should be controlled using cut-and-paint or drill-and-fill herbicide techniques to minimise soil disturbance, and the stumps and roots left in situ to provide bank stabilisation. Any logs should be reused to stabilise the creek bank. All weed propagules are to be selectively isolated from native vegetation, bagged, removed and disposed of separately to native brush, which can be mulched. A covering of biodegradable erosion protection, such as pegged and overlapped jute matting, is to be used to further stabilise the bank.

Secondary or follow-up weeding

Secondary or follow-up weeding involves intensive weeding in areas that have already received primary work to remove weed regrowth or overlooked weeds.

Maintenance weeding

After primary and secondary weeding and natural regeneration of the bushland, the area should be able to resist most weeds. However, weeds will re-establish on the site from bird, wind, water transport and other seed or propagule dispersal mechanisms within the site. Maintenance weeding should be undertaken 4-6 times a year until such time as the resistance of the bushland to weeds increases, then only requiring hand weeding on a needs basis. Maintenance weeding is to be conducted for a minimum period of twenty (20) years.

Timing – 10 years posts completion of primary restoration works

3.7.2 Herbicide use

The use of herbicides is needed where hand removal of weeds is impractical. The use of *Glyphosate* based herbicides is recommended in accordance with the manufacturers labels. Within 5m of a drainage line only *Roundup Bi-active* ® or equivalent formulations can be used.

Other regularly used herbicides include *Garlon* ®, *Brushoff* ®, *Brush Killer* ® and *Starane 200* ®. These non-*Glyphosate* based herbicides are not to be used adjacent to water bodies.

Grazon DS is not considered a safe chemical to use within high soil moisture zones and that significant off target kill of woody species and aquatic fauna has been tentatively linked to *Grazon DS*. It is recommended that this herbicide is not to be used on site.

An advantage of herbicide use is the low time taken to spray weeds as compared to physically removing them, particularly for large infestations of weeds. The disadvantage is that no single herbicide is effective on all weed species, thus the herbicide used needs to achieve an effective kill.

In general, *Travers bushfire & ecology* supports that the use of herbicides in non-ecologically sensitive areas can be undertaken if:

- There are small areas of dense weeds with few or no native plants to protect;
- There are large areas of predominantly weed coverage;
- Application can be undertaken without the risk of spray drift or off target kills, and
- Weeds are growing too rapidly for physical removal.

The potential for destabilising soils and causing erosion on steep slopes as a result of spraying vegetation with herbicide needs to be considered prior to commencement of weed control works.

Only operators with *Chemcert* or equivalent training must undertake the spraying of weeds. The operator must evaluate the success of each treatment after a set period of time, according to the labelled effective treatment of each species for each herbicide. Care must be taken when applying herbicides near water bodies due to the sensitivity of the waterways and resident flora and fauna to runoff containing these herbicides.

All herbicides must be applied according to the herbicide usage label and provisions of the *Protection of the Environmental Operations Act (NSW POEO Act, 1997).*

All environmental weeds need to be eradicated and controlled across the entire site. Garden waste and weed propagules (seeds, tubers etc.) need to be periodically collected and disposed of at an approved waste transfer facility and shall not be dumped on adjacent bushland or allowed to be washed downstream.

3.8 Restoration works

3.8.1 Overview restoration and revegetation works

Restoration works will focus primarily on the following:

- *Cumberland Plain Woodland (CPW)* – Target weed control of African Olive and privet, revegetation of CPW remnants, linkages and riparian corridors (as shown on Schedule 1), to enhance canopy connectivity, habitat and enhance future fauna movement, revegetation and regeneration of escarpment vegetation.

Revegetation and/or direct seeding will utilise locally collected seed provenance. A diversity of local native species should be planted. Dead trees are not be removed.

Natural regeneration of native vegetation is to be promoted by avoiding activities that limit the regrowth of native species or favour the establishment of weed species. Activities to avoid include:

- Spreading of mulch in areas of high resilience;
- Laying lawn in close proximity to bushland interfaces;
- Application of fertilisers (artificial or animal manures) within 40m to any drainage lines or 20m of any bushland edge;
- Planting of invasive landscape species - noxious or environmental weeds;
- Trampling of plants and compaction of soil;
- Irrigation or stormwater drainage that promotes weed growth or exceeds the absorption capacity of the soil;
- Sedimentation or importation of soil that is high in inorganic or organic nutrients – Native Plant Soil Mix is available from all major landscape supplies is preferable;
- Grazing or keeping domestic animals that deliver high loads of manure e.g. large or many small deposits; and
- Application of grey waters or drainage from animal enclosures directly onto soil without treatment for removal of nutrients.

Native shrub species from Appendix 1 typical of Cumberland Plain Woodland are to be used for revegetation purposes. The location of the planted species will be determined by the revegetation contractors considering existing regeneration and suitable bed conditions.

3.8.2 Cumberland Plain Woodland (CPW) – Zone A: Escarpment reserve

The total area of CPW revegetation within Zone A is be at least 9.66 ha as marked on Schedule 1.

Subject to natural regeneration, the following densities of native plants are to be planted:

- One (1) tree every 50m^2
- One (1) sub canopy tree every 30m^2
- One (1) shrub every 5m^2
- Three (3) native groundcovers and grasses per 1m^2 – subject to natural regeneration

All escarpment CPW plantings will be staged over the life of the project subject to the release of land for plots and burials. Note: More than 25% of trees planted are to be Forest Red Gum (*E. tereticornis*) in accordance with the requirements of the Campbelltown Draft Koala Plan of Management.

3.8.3 Cumberland Plain Woodland (CPW) – Zones B-F: woodland reserves & riparian zones

The total area of CPW restoration is be at least 8.16 ha as marked on Schedule 1.

Subject to natural regeneration, the following densities of native plants are to be planted:

- One (1) tree every 100m^2
- One (1) sub canopy tree every 50m^2
- One (1) shrub every 5m^2
- Three (3) native groundcovers and grasses per 1m^2 – subject to natural regeneration

Note: As with the escarpment reserve, more than 25% of trees planted in the woodland reserves & riparian zones are to be Forest Red Gum (*E. tereticornis*) in accordance with the requirements of the Campbelltown Draft Koala Plan of Management.

Areas surrounding the artificial wetlands – as shown in Schedule 1 to an area of 1.42 ha – are to be planted with native sedges, grasses and groundcovers with the following densities:

- Six (6) native sedges / grasses / groundcovers per 1m^2

3.8.4 Revegetation protection

Protection of revegetated areas is important to the success of plantings and to the timing and economic benefits in the long term. Protection measures include:

- Fencing & pedestrian barriers – to control pedestrian access
- Mulching – to reduce soil moisture loss (to be avoided in areas of medium to high resilience);
- Plant guards around plants – to minimise loss by grazing animals, frost protection and dehydration; and
- Baiting of rabbits (quarterly baiting and as required) – use of Pindone (1080) to minimise rabbit burrows and grazing.

3.8.5 Mulching

Mulching will not be employed within vegetation regeneration areas as shown on Schedule 1, as this will impede regeneration of native species already present within the seed bank.

To protect waterways, mulching should not be undertaken within 10m of the top of bank, as shown on Schedule 1 – Vegetation Management Works. A covering of biodegradable erosion protection, such as pegged and overlapped jute matting, is to be used for revegetation areas within 10m of the top of bank. Mulching is an efficient method to impede the establishment of weed species, soil erosion, compaction and desiccation within revegetation areas. The bush regeneration contractor should apply best practice to locate mulching in areas that has low natural resilience.

Mulch is to be placed at a depth of 50-75mm covering any areas of replanting that have lo natural resilience. Alternatively mulch can be incorporate into the top 50mm of the ground surface to provide a stable soil structure and planting bed resilient to erosion. Hydromulching techniques may also be utilised for revegetation of sleep slopes within the escarpment reserve (Zone A).

Areas surrounding the stems/trunks of plants are to be kept free from mulch, thereby reducing the incidence of collar rot on retained or planted flora.

Mulch from exotic species such as Lantana, African boxthorn or declared noxious weeds are not to be used. The Contractor shall ensure that any mulch used is properly composted before use and sufficient time has elapsed to allow nitrogen drawdown (up to 6 months).

3.9 Sediment and erosion control

It is expected that a sediment fence is to be installed surrounding the proposed construction areas associated with each residential development and connecting road areas in accordance with Landcom '*Managing Urban Stormwater: Soils and Construction'* (2004). The sediment and erosion control fence is to be firmly trenched into the soil.

Kick-backs are to be installed along all sections of sediment fencing that run downslope to slow down any waters being directed down the fence line. The sediment fence is to be supported by fixed hay bales in low sections of the fence where concentrated runoff is directed through the fence.

Sediment and erosion controls throughout the construction area must be installed in accordance with Landcom's '*Managing Urban Stormwater: Soils and Construction'* (2004). (Figures 8 and 9). Techniques and permanent or temporary infrastructure used for erosion and sediment control on site are to be adequately maintained and monitored at all times, particularly after periods of rain, and shall remain in proper operation until all development activities have been completed and the site is sufficiently stabilised with vegetation.

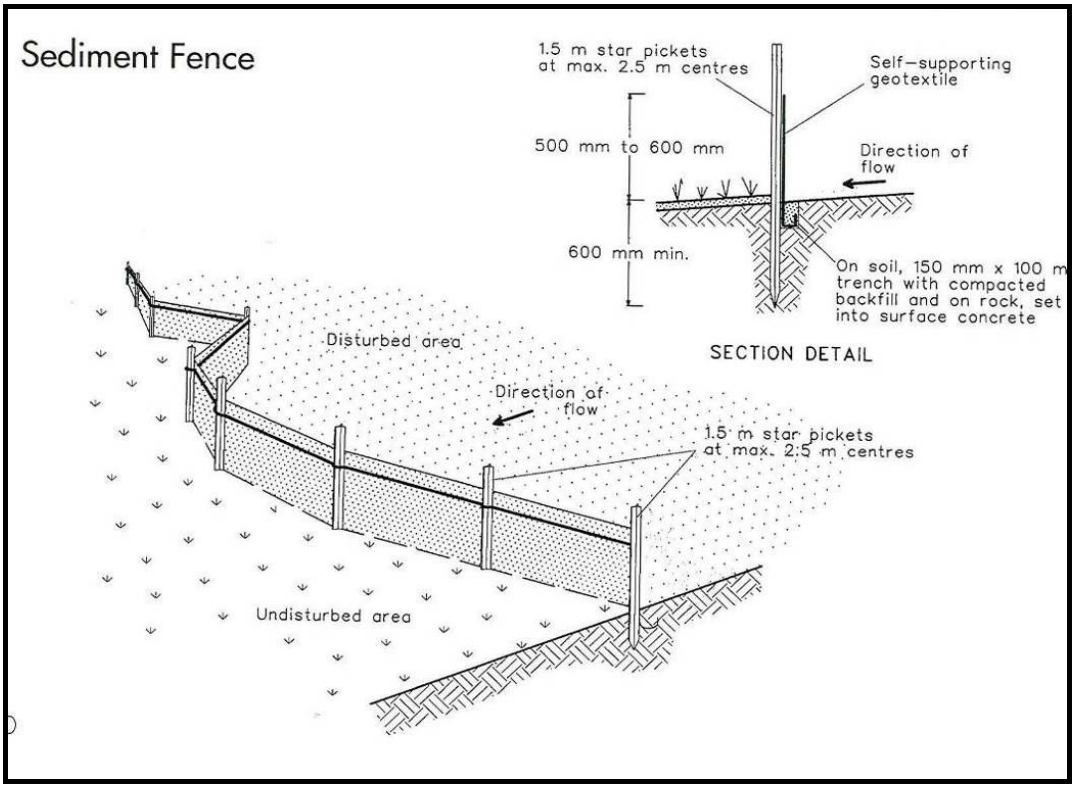


Figure 8 – Generic installation detail of geotextile filter fence

If outlet scour protection is required, it should be installed in accordance with Figure 5. The extent of scour protection is to be determined in consultation with the project ecologist but is to extend to the maximum extent of potential downstream scour. Additional plants are to be installed to assist in stabilisation of moist soils surrounding the outlet.

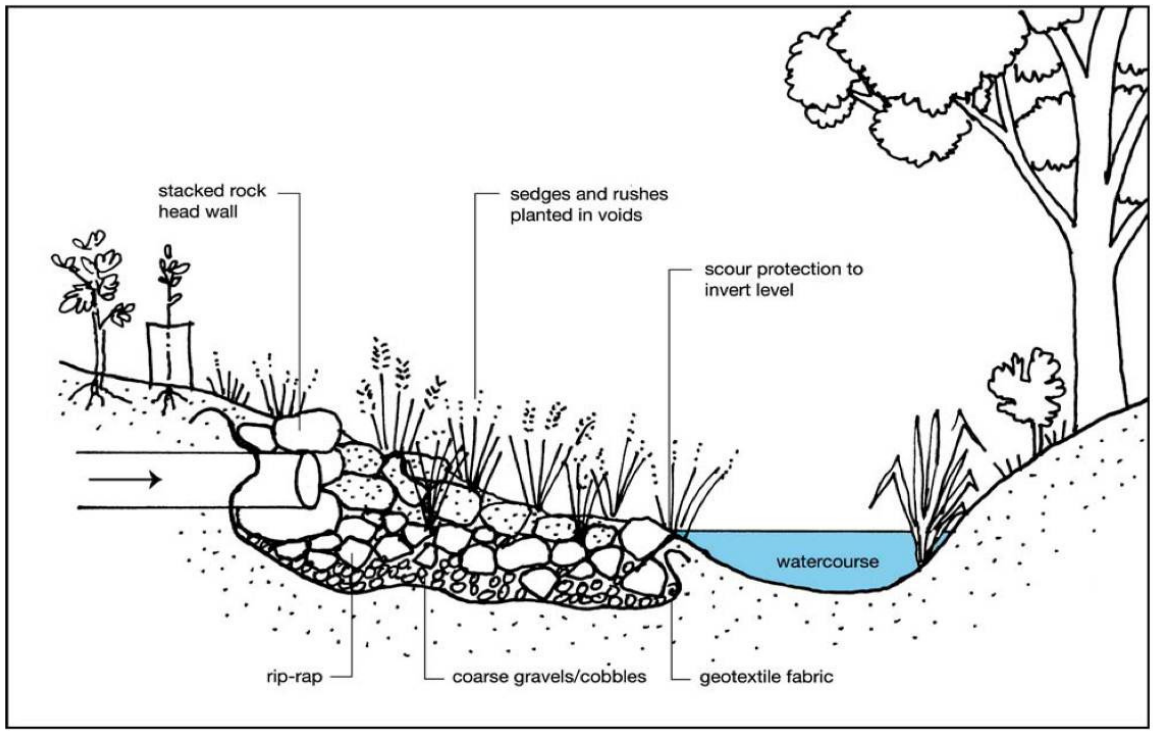


Figure 9 – Outlet scour protection
(Source – NSW DPI - Office of Water Guidelines for Controlled Activities on Waterfront Land – Guidelines for Outlet Structures 2012)

3.10 Hollow-bearing tree removal

Tree hollows provide critical roosting and overnight shelter for many fauna species. Provided the trees that contain hollows are in a healthy condition, they may be considered as "Ecologically Significant" and should be retained as a high priority.

Re-locating existing hollows in nearby remaining trees can compensate for any hollow bearing trees that need to be removed for the proposed development.

If required, guidelines for ameliorating the loss of nesting hollows are as follows:

I) Where possible and practical, hollow bearing limbs identified for removal should have the hollow sections collected and re-erected or installed into retained trees.

II) All collected hollow limbs are to be secured to trees at a minimum height of four metres above ground level facing the east to northeast direction. Re-erected limbs are not to be placed near locations where public access is planned along reserve areas. All re-erected limbs will be inspected annually and any damaged, or in danger of falling, are to be repaired or replaced.

A fauna ecologist is to locate appropriate trees and locations for installing collected hollow limbs.

The following guidelines are provided in the event of a hollow bearing tree that requires removal within the proposed development area.

Pre-Clearing

At least one (1) weeks' notice will be needed prior to the planned date for clearing of any hollow-bearing trees. This is required to allow for suitable daytime and night time inspections of hollow-bearing trees for use by fauna and to plan for the safe felling of the tree/removal of fauna if present.

Removal of all hollow-bearing trees will be under the supervision of a suitably qualified fauna ecologist to enable effective recovery and relocation of any residing fauna. Hollow-bearing trees identified for removal are to be are to be dismantled by an arborist prior to felling the entire tree.

All hollow-bearing trees proposed for removal shall be clearly marked with a **'H'** Symbol to indicate removal under supervision by a suitably qualified fauna ecologist. The contractor is to be managed such that all due care is taken to prevent damage to any trees to be retained and is not to remove the hollow-bearing trees without first receiving instruction from the fauna ecologist. A fauna ecologist is to be present at the felling or removal of each hollow-bearing tree.

After notice is given of the planned removal of trees a fauna ecologist will inspect the trees for use by fauna. This may include inspection of trees at sunset (stag watching) that allows for the detection of diurnal fauna returning to hollows or nocturnal fauna leaving for the night.

In some cases physical inspections of hollows by climbing trees may be required. This will be carried out by suitably qualified arborists under the direction and supervision of the fauna ecologist.

During Clearing

Where fauna is identified within a hollow and the risk of death or injury as a result of machine felling of the tree is high, the tree may need to be felled in sections. This will involve the

removal of hollow limbs or sections by chainsaw with the hollow limb lowered to the ground for removal/relocation of fauna. These works are to be carried out by a suitably qualified arborist under the direction of the fauna ecologist.

In those trees that contain hollows and no fauna has been observed, the tree will be machine felled. Where machinery is required to fell hollow trees, the blade or bucket of the machinery will be tapped against the trunk of the tree to disturb any fauna present and provide time to leave the hollow. Several taps on the trunk and waiting periods between each set of taps may be required at the discretion of the fauna ecologist. The tree will then be felled as gently as possible. All hollow limbs will be inspected by the fauna ecologist after felling for occupation by fauna. Any fauna will be removed and relocated to adjoining bushland.

Where young fauna are identified within a hollow whose survival will be at risk as a result of the removal of the hollow or the felling of the tree, then clearing will not be carried out until those young are old enough to leave the hollow and the care of the parents. It is suggested therefore that clearing is not carried out during breeding times when young are likely to be present within hollows (spring-early summer).

Where possible, hollow limbs removed from trees will be collected by the fauna ecologist for re-erection at a later date. Any fauna injured during clearing will be handed to WIRES for care and rehabilitation, taken to a local vet for appropriate treatment, or euthanased in accordance with Animal Ethics licencing held by the fauna ecologist.

3.11 Onsite effluent management

The location of all effluent treatment areas are to be designed cognisant of the site's ecological constraints.

There will be no disposal of liquid or solid waste including effluent, chemicals or animal manures within the EEC or within 20 metres of the any conservation area as located on Schedule 1- Vegetation Management Works.

There is to be no grazing or keeping of domestic animals within the EEC.

There will be no application of grey waters or drainage from animal enclosures directly onto soil anywhere within the lots, without treatment for removal of nutrients.

Nutrient management from any activity on-site generally requires all drainage to be collected, filtered and treated prior to release to ensure that nutrient concentrations within the soil profile are not elevated above natural soil conditions onsite.

3.12 Fuel management within APZ's

Fuel management within the APZs is to be maintained by regular maintenance of the landscaped areas, mowing of lawns in accordance with the guidelines provided in Appendix 1 of *Bushfire Protection Assessment* (*Travers bushfire & ecology* 2018), and / or as generally advised by the RFS in their publications.

The APZ's are to be managed to the standards required for an inner protection area (IPA).

Fuel loads within the IPA are to be maintained so it does not exceed 4t/ha.

Trees are to be maintained to ensure;

- Canopy cover does not exceed 15% (at maturity)
- Trees (at maturity) should not touch or overhang the building

- Lower limbs should be removed up to a height of 2m above ground
- Preference should be given to smooth barked and evergreen trees

Shrubs are to be maintained to ensure;

- Create large discontinuities or gaps in vegetation to slow down or break the progress of fire towards buildings
- Shrubs should not be located under trees
- Shrubs should not form more than 10% of ground cover in the APZ area
- Shrubs should be in clumps no greater than 5m^2
- Clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of vegetation

Grass is to be maintained to ensure:

- Should be kept mown (as a guide grass should be kept to no more than 100mm in height.
- Leaves and vegetation debris is removed.

Landscaping to the site is to comply with the principles of Appendix 5 of PBP. In this regard the following landscaping principles are to be incorporated into the development:

- Suitable impervious areas being provided immediately surrounding the building such as courtyards, paths and driveways;
- Restrict planting in the immediate vicinity of the building which may over time and if not properly maintained come in contact with the building;
- When considering landscape species consideration needs to be given to estimated size of the plant at maturity;
- Avoid species with rough fibrous bark, or which retain/shed bark in long strips or retain dead material in their canopies;
- Use smooth bark species of trees species which generally do not carry a fire up the bark into the crown;
- Avoid planting of deciduous species that may increase fuel at surface/ ground level (i.e. leaf litter);
- Avoid climbing species to walls and pergolas;
- Locate combustible materials such as woodchips/mulch, flammable fuel stores away from the building;
- Locate combustible structures such as garden sheds, pergolas and materials such timber garden furniture way from the building; and
- Use of low flammability vegetation species.

Management and Monitoring 4

4.1 Staging

The restoration zones are contained within the following staged areas of the masterplan (Figure 3):

- **Stage 1** - Management Zone A, Management Zone B, Management Zone C Management Zone D
- **Stage 2** - Management Zone E
- **Stage 3 & 4** - Management Zone F
- **Stage 5** - Management Zone F

Zooms for each stage are provided in Schedule 1 at the rear of the document.

Table 3 – Restoration areas per zone (ha)

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Total
Artificial Wetland	0.104	-	-	-	-	**0.11**
Sedges/grasses ground covers <1m high	1.004	-	0.084	0.091	-	**1.17**
Sedges/grasses ground covers <1m high (clumped)	0.139	-	-	-	-	**0.14**
Full CPW revegetation Zone A	9.661	-	-	-	-	**9.66**
Full CPW revegetation	5.508	0.150	0.594	1.548	0.002	**7.80**
CPW shrubs, grasses, groundcovers <3m high	0.241	-	-	0.119	-	**0.36**
Regeneration	12.871	0.462	1.321	0.808	-	**15.46**
Mown Pasture	2.809	-	-	-	-	**2.81**
Overall	**32.337**	**0.612**	**1.999**	**2.566**	**0.002**	**37.516**
Percentage	**86%**	**2%**	**5%**	**7%**	**< 0.005%**	**100%**

Consequently the majority of restoration works fall within stage 1 of the memorial gardens development.

4.2 Monitoring

Monitoring of the progress of all staged restoration and revegetation works including weed removal, plant growth and natural regeneration is to be undertaken every six months until twenty (20) years of maintenance has been undertaken. Annual progress reports will

be submitted to Campbelltown City Council or appointed private certifier outlining the progress of the weed control works and success (or otherwise) of the revegetation works. The offset site will be monitored in terms of vegetation condition and achievement of restoration outcomes.

Monitoring activities will include:

1 A photographic record for comparative purposes taken on an annual basis;
2 A minimum of eight (3) nested flora quadrats are to be undertaken spread across each management area to assess the achievement of the performance targets. The quadrats are to be placed in representative locations and are to be a minimum outer dimension of 5x5m with a 1m^2 internal nested quadrat; and
3 An overall vegetation condition map based on standard bush regeneration vegetation condition assessment methodology will be produced each year for the five year maintenance period.

Permanent photo points will be established as a minimum one in every monitoring quadrat and will be marked on the annually produced vegetation condition map. Details will include unique site identification, photo direction- facing information and GPS co-ordinates (easting and northing) on the monitoring and evaluation report. Elsewhere in each management area a randomly located photo series will be undertaken annually to reflect changing conditions in each area and further inform monitoring progress.

The vegetation condition assessment map is generated in accordance with the Ku-ring-gai Council Weed Assessment Guidelines (1996) - note this document is no longer available through Ku-ring-gai Council). This method provides a rapid vegetation assessment tool that can be updated periodically or on an annual basis (Table 4). This mapping system allows for the weed control/regeneration priorities for vegetation management to be rapidly assessed on the basis of independent audit and management recommendations.

Table 4 – Vegetation condition mapping system criteria
(Source: Ku-ring-gai Council Weed Assessment Guidelines, 1996)

% Weed density	Averaged Vegetation condition class - score	Vegetation condition class - mapping colour	Relative condition	Qualitative accessory information	
				Cause	Description
<10	(1)	green	**Good** (low infestation)	**Edge**	Edge Effects
				S	Physical disturbance of soil
10-30	(2)	**yellow**	**Fair**	**R**	Impacts of stormwater runoff
31-60	(3)	orange	**Poor**	**RV**	Revegetation Site
				D	Dumped garden refuse
>60	(4)	red	**Very Poor** (high infestation)	**V**	Physical disturbance of vegetation
				Mow	Slashing/ Mowing

The Vegetation condition score is based on a structural layer condition assessment eg. A polygon weed score (4, 3, 4) 4.r = serious weed problem in the canopy, middle and ground layers. Overall scored of class 4 with storm water runoff issues identified as a potential cause.

The three scores in each structural layer are averaged into a vegetation overall unit score as follows:-
Overall Class 4 - Average of 3.5 to 4 – very poor condition
Overall Class 3 - Average of 2.5 to 3.5 – poor condition
Overall Class 3 - Average pf 1.5 to 2.5 – fair condition
Overall Class 1 - Average of 1- 1.5 good condition

Please note that a site assessor may class the vegetation score up a level if the types of weeds present are highly invasive and reduced if benign.

The performance targets work in tandem with these guidelines in terms of the expected presence, abundance and cover of noxious and environmental weed species and the expected targets for native vegetation cover across the site as assessed by the project ecologist.

Photopoints, annual vegetation condition mapping and the monitoring of 20 x 20m Floristic biometric plots throughout restoration works will enable the comparison of flora densities and population composition over time. The biometric plots assessment is a component of the NSW Biobanking Assessment Method (2014) based on transect and plot data that is collected on site for each vegetation zone. This biometric scoring considers ecosystem structure, composition and function.

Monitoring of the site is required to be set up at the commencement of regeneration works within the biodiversity offset area. This will allow the determination of pre and post condition of the vegetation and its habitat, and will include identification of any areas suffering from disturbance, sedimentation or in need of contingency rehabilitation, weed control, stabilisation or maintenance of rehabilitated or regenerating areas.

The monitoring and review process will focus on the presence / absence of exotic species, floristic diversity of the bushland, structural integrity of the bushland, revegetation progress and success, monitoring of any sediment fencing or protective fencing and monitoring of pest fauna.

The supply of a professional progress report is a critical performance measure of the appointed contractors. Monitoring and progress reports prepared by the tenderer throughout the course of the project are critical for compliance certification purposes and therefore all monitoring reports will be required to be supplied to the project ecologist and confirmed progress by *Travers bushfire & ecology* to be of an adequate standard.

4.3 Project Ecologist responsibilities

The project ecologist is responsible for directing works, auditing works undertaken and providing certification statements to regulatory authorities. As the approval process for the project is highly complicated there are multiple sets of approvals that require certification.

Project ecologist duties also extend to the following:

1. Approving any specifications for fencing contractors;

2. Reviewing the quality of restoration works and instructing the commencement of any rectification and contingency works;

3. Preparation of compliance certificates. Compliance certificates will be issued by the project ecologist for the following items:

    - Engagement of a bush regeneration contractor and independent project ecologist;
    - Installation of all protective fencing and sediment and erosion control measures;
    - Completion of revegetation planting works including planting shrub species at the required densities;
    - Completion of primary weed control works;
    - Completion of secondary weed control works and revegetation maintenance; and
    - Satisfactory achievement of restoration works as shown on Schedule 1 – Vegetation Management Works and the restoration performance targets (Section 4.2).

4. Determining the need for contingency works and confirming the nature and extent of any variations by the contractor;

5. Preparation of an annual audit report for submission to Council demonstrating achievement of all performance targets, or identifying contingency measures to be funded and undertaken on site to achieve satisfactory restoration standards; and

6. Providing advice throughout the course of the contract works to both the client and contractors to ensure that compliance can be achieved.

Inspections of the site by the consulting project ecologist is to be undertaken prior to, during and post-operations to ensure that vegetated areas designated for retention and exclusion zones are adequately marked and that other appropriate protection procedures are being maintained.

Monitoring of the restoration areas during the maintenance period is to be undertaken by the appointed project ecologist on a minimum 6 monthly basis and the outcomes are to be reported in the annual monitoring report to Campbelltown Council or appointed private certifier. The biodiversity offset area is to be maintained to a high standard, with no future encroachments, tree removal, installed or repaired services, driveways, fences or buildings except for that shown on the *Schedule 1 – Vegetation Management Works.* The biodiversity offset area is to be maintained as an indigenous native bushland area with a focus on enhancing habitat values and re-instating the Cumberland Plain Woodland to a high quality condition.

An inspection is to be undertaken by the project ecologist every 3 months during primary restoration works with the submission of one (1) compliance certificate at the completion of each major phase of work. An annual site audit report is to be submitted detailing the restoration works completed and achievement of the restoration performance targets (Section 4.2).

Following the completion of the year 2 of the maintenance (weed control) period, the project ecologist is to determine whether any additional contingency works required to satisfactorily achievement the performance targets. These works are to be managed by the Catholic Cemeteries Trust under the supervision of the appointed project ecologist.

Monitoring responsibilities and timeframes are outlined below (Table 5).

Table 5 – Monitoring tasks and timeframes

Timeframe	Monitoring task
PROJECT ECOLOGIST	
Site Preparation stage	Establish permanent quadrats and / or transects to enable quantitative recording of factors such as species densities and diversity and extent of cover; Aerial photos to record broad-scale changes – Compare historical aerial photography to gauge the spread and changes in vegetation cover over time;
3 Monthly	Primary Restoration Works Phase - Site monitoring inspection;
6 Monthly	Visual inspection of native vegetation cover, species density, species richness and vegetation condition; worksite protection (fencing) and erosion control;
Annual for life of project	Monitoring quadrat assessment; Vegetation condition map and annual site audit report submitted to Commonwealth detailing the restoration works completed and achievement of the restoration performance targets (Section 8); Comparison of photographic records from each monitoring quadrat; Evaluation of photo series from each management area and comparison of these over the maintenance period for each management area.
Annual for life of project	Determine additional contingency works required to satisfactorily achievement of restoration performance targets (Section 8)
Period	
CONTRACTOR	
Daily	Daily site record containing number of hours, type and location of work;
Monthly	Worksite protection inspection including fencing;
6 Monthly	Prepare work progress report; Vegetation condition maps showing boundaries of weed infestations and assessed vegetation condition of areas based on weed densities (Good, fair, poor and very poor);
Annual	Repeatable 'before' and 'after' photographs – Take the photo from the same point in the same direction within all key treatment sites;
Ongoing	Record any new techniques or approaches being trialled;
PROJECT ECOLOGIST / CONTRACTOR	
Ongoing	Collect and prepare plant lists for both native and exotic species taking note of any rare or endangered plant; Collect lists of animal species observed onsite;

Failure to submit reports by the due dates will result in contract payments being withheld until a satisfactory monitoring report is submitted to the project ecologist.

4.4 Contingency works

A contingency of 15% is to be included in all pricing's to ensure sufficient funding is available for contingency works and is to be separately identified within submitted pricings. The contingency will be used for the following works as directed by the project ecologist:

Additional revegetation sites of areas damaged by other works or non-resilient areas not identified for revegetation at the time of tender;

1. Contingency revegetation works to replace up to 15% of lost planted stock;
2. Urgent sediment and erosion control works;
3. Targeted noxious weed control as directed by the project ecologist

The purpose of the 15% contingency allocation is based on the total cost of the restoration works. Contingency funds will be withheld until such time the project ecologist directs contingency works to be undertaken. Contingency works are required if the performance targets are not met for an unpredictable of non-quoted task of work.

Instructions to contractors for corrective actions are to be given in accordance with section
4.
6.

Reporting to Campbelltown Council on non-compliant matters and the correction actions is required in accordance with section 4.7.

4.5 Compliance certification

Compliance certificates will be issued by the project ecologist for each stage of restoration works for the following items:

- Engagement of a bush regeneration contractor and independent project ecologist;
- Installation of all protective fencing and sediment and erosion control measures;
- Completion of revegetation planting works including planting shrub species at the required densities;
- Completion of primary weed control works;
- Completion of secondary weed control works and revegetation maintenance; and
- Satisfactory achievement of restoration works as shown on Schedule 1 – Vegetation Management Works and the restoration performance targets (Section 4.2).

4.6 Restoration performance targets

An auditing project ecologist is to assess compliance with the following restoration targets on each stage of restoration works. The following sections stipulate how the corrective actions and non-compliant matters are triggered and reported.

The project ecologist is to be a suitability quality ecologist with greater than 10 years' experience in restoration ecology is to be engaged to assess whether the management of the reserves is compliance or non-compliance with the performance targets or the conditions of approval. The assessment against the nominated performance targets will be undertaken by:

- Visual inspection and preparation of vegetation condition mapping
- The mapping in association with floristic quadrats in work zones will be undertaken to demonstrate compliance with % native cover and % weed cover targets.

The site audits are to assess the achievement of the following restoration performance targets:

1. All protective fencing (temporary and permanent), sediment controls and tree protection zones are to be installed prior to clearance of any vegetation and commencement of construction works.

2. Removal of all hollow-bearing trees (if required, not anticipated) will be under the supervision of a suitably qualified fauna ecologist to enable effective recovery and relocation of any residing fauna. Hollow-bearing trees identified for removal are to be are

to be dismantled by an arborist prior to felling the entire tree and high quality hollows relocated into adjoining retained trees for habitat.

3. Weed control and revegetation works are to be carried out by a qualified bushland regenerator to achieve the following weed control targets. The presence, abundance and cover of noxious and environmental weed species is to be reduced by 10% of total coverage every year.

4. All disturbed areas are to be stabilised.

5. All stormwater outlets are to be stabilised with geotextile overlain with rock boulders in accordance with NS W DPI - Office of Water's Controlled Activity Guidelines (2012) for stormwater outlets.

6. No application of fertilizer or disposal of liquid or solid waste including effluent, chemicals or animal manures within 10m of the fenced conservation area.

7. Staged revegetation and regeneration of a minimum 22.8 ha of Cumberland Plain Woodland (CPW) within riparian zones and CPW protection areas. Plantings are to utilise a minimum of 30 locally sourced species typical of CPW vegetation community.

8. Staged revegetation and regeneration of a minimum 18.44 ha of Cumberland Plain Woodland (CPW) within the escarpment lands is to be undertaken. Plantings are to utilise a minimum of 30 locally sourced species typical of CPW vegetation community.

9. Recommended species for Appendix I. Plants are to be sourced from locally collected native seed provenance.

10. Contingency planting, as determined by the project ecologist, may be required to ensure the minimum number of plants are established at the end of the maintenance period.

11. All revegetation areas are to be stabilised, plants protected by cardboard boxes (2L boxes for tube stock plants) and rabbit baiting installed from commencement of revegetation works.

12. Monitoring is to be undertaken by the project ecologist with compliance certification reported to Council at the successful completion of each major item or group of items (section 4.1 of report).

4.7 Instructions for corrective actions

In the event of noncompliance the project ecologist is to issue noncompliance notice within 30 days of site inspection to contractors to undertake corrective contingency actions. The corrective actions are to be clear, measurable, and auditable and time bound. Therefore instructions to undertake corrective actions must include

- a plan identifying the extent of the works to be undertaken
- a specific list of works to be completed and a time frame in which they are to be implemented.
- Lists of any plant or other materials to be used in undertaking the corrective actions
- Define a date for the inspection of auditing of the corrective actions.

4.8 Reporting for non-compliant works

Should the project ecologist determine any non-compliance with the performance targets, the proponent is to ensure reporting is given to the land manager that identify

which performance targets are non-compliant, the proposed or undertaken corrective actions, and the outcome of the corrective applications. A non-compliance notice is to be issued by the project ecologist to the land manager within 30 days of the relevant site inspection.

The timing of reporting on corrective actions is subject to the nature of the event causing noncompliance and the corrective action required. Should the intended area of restoration works as approved under the Masterplan not be achieved at any one restoration management zone, then the project ecologist and land manager is to identify alternative equivalent area restoration zones and how the areas will be protected and managed to compensate for the offsets required to meet the offset targets.

In the event that the non-compliance only effects the quality of the restoration outcomes, than the non-compliance, corrective actions and the outcomes of these are to be included within the annual report. Compliance with the performance targets is to be achieved as a result of the corrective action.

Program of Works 5

The program of works (Table 6) is aimed at providing a management framework for enacting revegetation, regeneration, maintenance, monitoring and review works reasonably required for the conservation of retained bushland and proposed restoration measures. Site rehabilitation, including weed control works is to be undertaken in accordance with Schedule 1 – Vegetation Management Works.

It is noted that as the site will be progressively expanded in stages it is also expected that revegetation works will be progressively staged as well in accordance with those stages. However variation to the proposed staged release of cemetery may be warranted to stabilise, revegetate or prepare areas for release in advance.

5.1 Program of works

For the purposes of the program of works, the listed tasks are divided into the following stages.

Pre-construction works

Pre-construction works refers to all site preparation activities prior to the commencement of any clearing or construction works on site and generally excludes any landscaping and planting works.

This stage will include the installation of protection fencing (temporary and permanent), tree protection zones and sediment fencing. It also includes the identification of hollow-bearing trees that may require removal and any proposed stag-watching or similar (if required), or protection if the hollow-bearing trees are to be retained.

Preparation of pest fauna management may be undertaken during this phase or prior to revegetation works commencing.

Construction works

Construction works refers to the period during which clearing, earthworks and construction of buildings, as well as roads and services being installed. It is during this period that the protection of remnant vegetation is critical to minimising accidental loss of trees or associated vegetation. It is also during this phase that primary restoration works are completed.

Primary restoration works, as defined under this VMP, include the supervised removal of hollow-bearing trees by the fauna ecologist, installation of collected hollows, completion of primary and secondary weed control, maintenance of protective measures, mulching and planting works.

Practical completion of the primary restoration phase is determined by the project ecologist at which point all primary restoration actions need to have been completed and the installed plants are well established, only requiring periodic maintenance or watering. Should there be

a delay in the completion of works, for any reason, then the construction works phase may be extended.

Post construction works

Post construction works essentially consist of maintenance activities, unless further contingency works are identified by the project ecologist for auditing purposes. Maintenance will be undertaken by a fully qualified bush regeneration crew for a minimum of twenty (20) years post completion of primary restoration works.

All bush regeneration crews working on site are required to have at a minimum TAFE Certificate Level II Bush Regeneration qualifications or equivalent to undertaken weeding and revegetation works. All staff are to be supervised by a qualified bush regeneration Supervisor who should possess a minimum of a Certificate IV in Conservation and Land Management or a biological science degree, with at least three (3) years of field experience.

Prior to the release of the construction certificate, all protective measures must be completed, as well as primary weed control and initial revegetation works.

Table 6 - Program of works

Action	Responsibility
Stage 1 – Pre-construction works	
• Formation of site management team and establish supervision and consultation processes – minimum project ecologist, and site manager	• Site project manager
• Erection of temporary and permanent fencing, erosion control fencing and tree protection zones	• Site manager / bush regenerator contractor / project ecologist
• Rabbit baiting	• Contractor
• Marking of any hollow-bearing trees to be removed and undertake any required survey prior to removal	• Fauna ecologist
• Commencement of seed collection and propagation contracts	• Bushland regenerator / project ecologist
• Set up monitoring points	• Project ecologist
• Provide certificates of compliance	• Project ecologist
Stage 2 – Construction works	
• Supervision of hollow-bearing tree removal	• Fauna ecologist / tree climber
• Commencement of primary weed control	• Suitably qualified bushland regenerator
• Monitor erosion control measures (monthly – especially after heavy rain) and replace if required	• Contractor with advice of project manager
• Complete revegetation works	• Contractor / project manager
• Commencement of secondary weed control and maintenance weed control	• Contractor / project manager

• Maintenance of protective fencing • Provide certificates of compliance	• Contractor / suitably qualified bushland regenerator • Project ecologist
Stage 3 – Post Construction Works	
• Enrichment planting within revegetation areas (if required). • Continuation of regeneration and weed control maintenance. • Monitoring of quadrats, revegetation works, weed control works and protection devices • Conduct maintenance beyond practical completion as required • Provide certificates of compliance	• Contractor with advice of project ecologist • Contractor / suitably qualified bushland regenerator • Project ecologist • Site manager with advice of project ecologist • Project ecologist

Schedule 1 identifies the location of the planned restoration and regeneration works in relation to the proposed development.

5.2 Typical timeline of restoration works

The following typical timeline (Figure 10) is provided to indicate the overall timing of restoration works. The commencement of the maintenance period of twenty (20 years) is subject to the completion of primary restoration works as certified by the project ecologist. A certificate of completion will be required as evidence of satisfactory results.

The successful implementation of restoration works may affect the release of the occupation certificate or the release of any required bonds as required under the development consent. Therefore contingency restoration works may be required in order for a compliance certificate to be issued.

Upon engagement, contractors are expected to meet the following typical schedule of works.

It is noted that due to the size and scale of works required primary restoration works may be staggered over a longer time period.

	Task Name	Duration	Year 1 - Primary Restoration Works												Year 2												Year 3-20																	
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	STAGE 1 - PRECOMMENCEMENT																																										
1.0	**PROJECT INITIATION**	1 month																																										
1.1	Confirm funding	1 month																																										
1.2	Preparation of contract schedules	1 month																																										
1.3	Submission of fee proposals	1 month																																										
1.4	Contractor approvals & engagement of project ecologist	1 month																																										
2.0	**SITE PREPARATION AND PROPAGATION**																																											
2.1	Pre-commencement vegetation condition assessment & installation of monitoring plots	1 day																																										
2.1	Seed collection	12 months																																										
2.3	Plant propagation (initial & contingency)	8 months																																										
2.4	Installation of protective fencing and signage	2 weeks																																										
2.5	Install sediment and erosion control measures	2 weeks																																										
2.6	Permit to undertake pest (rabbit) control - Pindone baiting - if required	3 weeks																																										
	STAGE 2 - DURING CONSTRUCTION WORKS																																											
3.0	**WEED CONTROL**																																											
3.1	Primary weed control	1 year																																										
3.2	Secondary weed control	3 months																																										
4.0	**REVEGETATION ESTABLISHMENT**	1-1.5yrs																																										
4.1	Site preparation - sediment and erosion control, removal of waste	1-5 days																																										
4.2	Construction works - regrading and stormwater outlet works	6-12 months																																										
4.3	Installation of irrigation system (as appropriate to site)	2 months																																										
4.4	Regeneration works	18 months																																										
4.5	Revegetation works	18 months																																										
4.6	Initial watering & maintenance	18 months																																										
	STAGE 3 - POST CONSTRUCTION WORKS																																											
5.0	**BUSH REGENERATION & REVEGETATION MAINTENANCE**																																											
5.1	Watering, maintenance, weed control and repairs	20 years																																										
5.2	Pest control - rabbit baiting	3 years																																										
5.3	Ongoing bushland regeneration of existing bushland areas	20 years																																										
6.0	**MANAGEMENT AUDITING AND MONITORING**																																											
6.1	Contractor supervision / monitoring	20 years																																										
6.2	Ongoing supervision/auditing/monitoring	20 years																																										
6.3	Submission of annual reporting	20 years																																										
7.0	**CONTINGENCY WORKS (Subject to Audits)**																																											
7.1	Target noxious weeds	as req.																																										
7.2	Replacement planting	as req.																																										
7.3	Watering & maintenance	as req.																																										
7.4	Submission of compliance certification	as req.																																										

Figure 10 – Typical restoration timeline (20 years maintenance)

Recommended Planting List

A1

The following locally occurring native plant species are to be established within the revegetation area. Further species will also be suitable provided that they are recognised as being typical or common species known or demonstrated to occur within the Cumberland Plain Woodland EEC. The appointed bush regeneration contractor may vary the number of plant species to be established provided 80% dominant species is retained as per this Attachment 1.

Table A1.1 – Recommended Species Planting List

CUMBERLAND PLAIN WOODLAND		
Trees		
Acacia decurrens	*Corymbia maculata*	*Eucalyptus moluccana*
Acacia parramattensis	*Eucalyptus crebra*	*Eucalyptus paniculata*
Brachychiton populneus	*Eucalyptus eugenioides*	*Eucalyptus tereticornis*
Clerodendrum tomentosum	*Eucalyptus fibrosa*	*Exocarpos cupressiformis*
Shrubs		
Acacia floribunda	*Cassinia longifolia*	*Einadia hastata*
Acacia implexa	*Daviesia ulicifolia*	*Exocarpos strictus*
Breynia oblongifolia	*Dillwynia sieberi*	*Myoporum montanum*
Bursaria spinosa var. *spinosa*	*Dodonaea viscosa* subsp. *cuneata*	*Olearia viscidula*
Groundcovers & vines		
Aristida vagans	*Digitaria ramularis*	*Lomandra longifolia*
Rytidosperma racemosum	*Echinopogon caespitosus* var. *caespitosus*	*Microlaena stipoides* var. *stipoides*
Rytidosperma tenuius	*Einadia hastata*	*Panicum simile*
Chloris truncata	*Einadia polygonoides*	*Sporobolus creber*
Chloris ventricosa	*Entolasia stricta*	*Themeda triandra*
Commelina cyanea	*Eragrostis benthamii*	*Wahlenbergia gracilis*
Cymbopogon refractus	*Eragrostis brownii*	*Desmodium varians*
Dianella caerulea var. *producta*	*Eragrostis leptostachya*	*Einadia nutans* subsp. *linifolia*
Dianella longifolia	*Lepidosperma laterale*	*Hardenbergia violacea*
Dianella revoluta var. *revoluta*		

Target Weed Species A2

The following weed species may possibly occur on site and are to be targeted on a priority basis subject to degree of invasiveness and implications for regeneration of native flora.

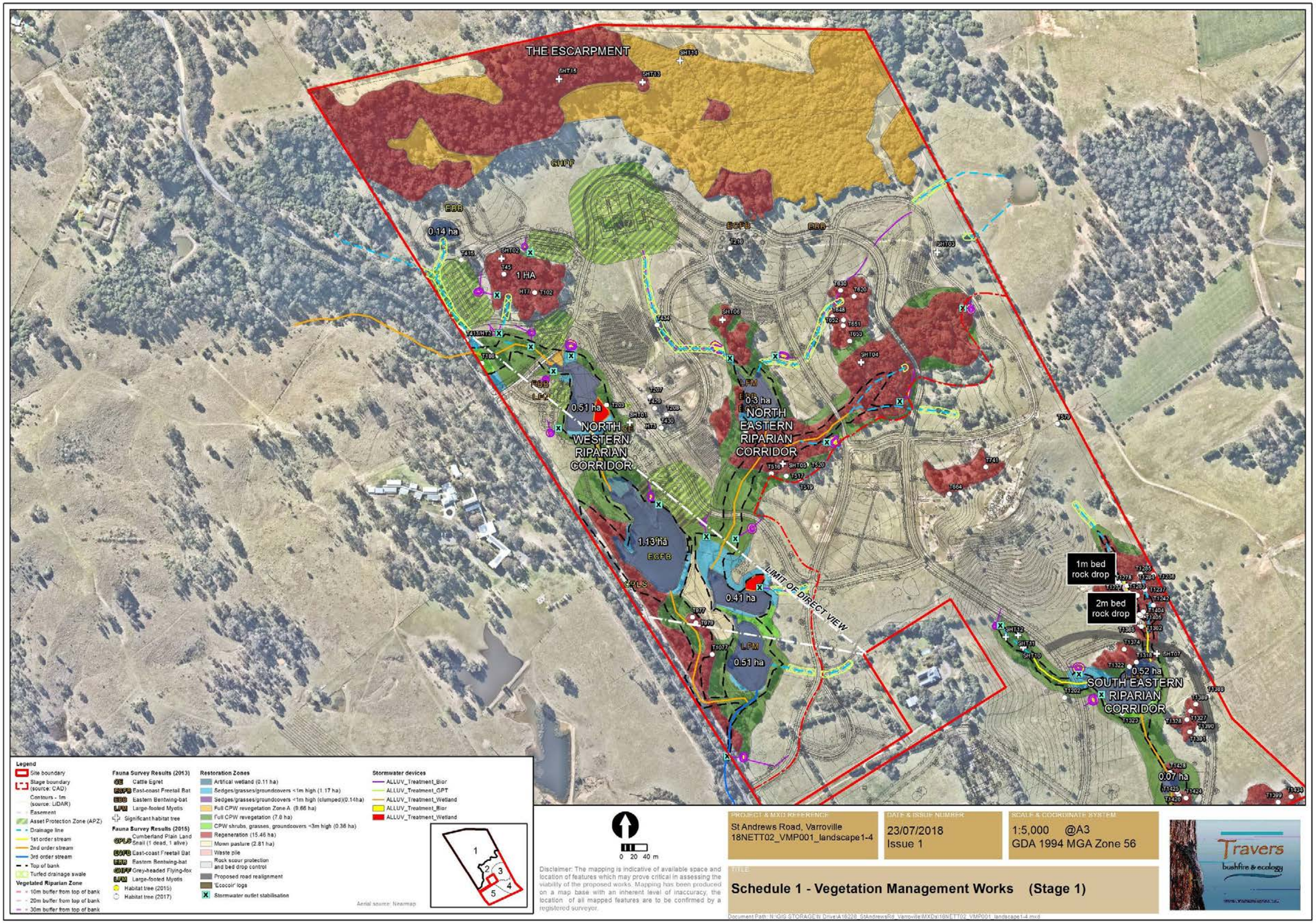
Table A2.1 – Target weed species and control class for the site

Family	Scientific name	Priority
Shrubs	*Gomphocarpus fruticosus*	**Medium**
	Lantana camara	**High**
	Lycium ferocissimum	**High**
	Olea europaea subsp. *cuspidata*	**High**
	Phytolacca octandra	**Medium**
	Polygala virgata	**Medium**
	Rubus fruticosus sp. agg.	**High**
Groundcovers	*Amaranthus viridis*	**Low**
	Anagallis arvensis	**Low**
	Axonopus fissifolius	**Low**
	Bryophyllum delagoense	**Medium**
	Cerastium glomeratum	**Low**
	Chloris gayana	**Low**
	Cirsium vulgare	**Low**
	Conyza bonariensis	**Low**
	Conyza sumatrensis	**Low**
	Daucus carota	**Medium**
	Echium plantagineum	**High**
	Ehrharta erecta	**Low**
	Eleusine tristachya	**Low**
	Lotus suaveolans	**Low**
	Malva sylvestris	**Low**
	Medicago polymorpha	**Low**
	Modiola caroliniana	**Low**
	Opuntia stricta	**High**
	Oxalis corniculata	**Low**
	Paspalum dilatatum	**Medium**
	Pennisetum clandestinum	**Medium**
	Phyllanthus tenellus	**Low**
	Plantago lanceolata	**Low**
	Poa annua	**Low**
	Rumex crispus	**Low**
	Senecio madagascariensis	**High**
	Setaria parviflora	**Low**
	Sida rhombifolia	**Low**
	Solanum nigrum	**Low**
	Soliva sessilis	**Low**
	Sonchus oleraceus	**Low**
	Stachys arvensis	**Low**
	Taraxacum officinale	**Low**
	Trifolium repens	**Low**
	Verbascum virgatum	**Low**
	Verbena brasiliensis	**Low**
Vines	*Araujia sericifera*	**High**

Invasive weeds that commonly occur within the Campbelltown Shire Council also need to be targeted if found on site in accordance with their respective noxious weed category and the 'best practice' methods identified for that noxious weed.

Vegetation Management Works

S1



Legend

- Site boundary
- Stage boundary (source: CAD)
- Contours - 1m (source: LiDAR)
- Easement
- Asset Protection Zone (APZ)
- Drainage line
- 1st order stream
- 2nd order stream
- 3rd order stream
- Top of bank
- Turfed drainage swale

Vegetated Riparian Zone

- 10m buffer from top of bank
- 20m buffer from top of bank
- 30m buffer from top of bank

Fauna Survey Results (2013)

- CE Cattle Egret
- ECFB East-coast Freetail Bat
- EBB Eastern Bentwing-bat
- LFM Large-footed Myotis
- Significant habitat tree

Fauna Survey Results (2015)

- GPLS Cumberland Plain Land Snail (1 dead, 1 alive)
- ECFB East-coast Freetail Bat
- EBB Eastern Bentwing-bat
- GHFF Grey-headed Flying-fox
- LFM Large-footed Myotis
- Habitat tree (2015)
- Habitat tree (2017)

Restoration Zones

- Artifical wetland (0.11 ha)
- Sedges/grasses/groundcovers <1m high (1.17 ha)
- Sedges/grasses/groundcovers <1m high (clumped)(0.14ha)
- Full CPW revegetation Zone A (9.66 ha)
- Full CPW revegetation (7.8 ha)
- CPW shrubs, grasses, groundcovers <3m high (0.36 ha)
- Regeneration (15.46 ha)
- Mown pasture (2.81 ha)
- Waste pile
- Rock scour protection and bed drop control
- Proposed road realignment
- 'Ecocoir' logs
- Stormwater outlet stabilisation

Stormwater devices

- ALLUV_Treatment_Bior
- ALLUV_Treatment_GPT
- ALLUV_Treatment_Wetland
- ALLUV_Treatment_Bior
- ALLUV_Treatment_Wetland

Aerial source: Nearmap

1 2 3 4 5

0 20 40 m

Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

PROJECT & MXD REFERENCE	DATE & ISSUE NUMBER	SCALE & COORDINATE SYSTEM
St Andrews Road, Varroville 18NETT02_VMP001_landscape1-4	23/07/2018 Issue 1	1:5,000 @A3 GDA 1994 MGA Zone 56

TITLE

Schedule 1 - Vegetation Management Works (Stage 1)

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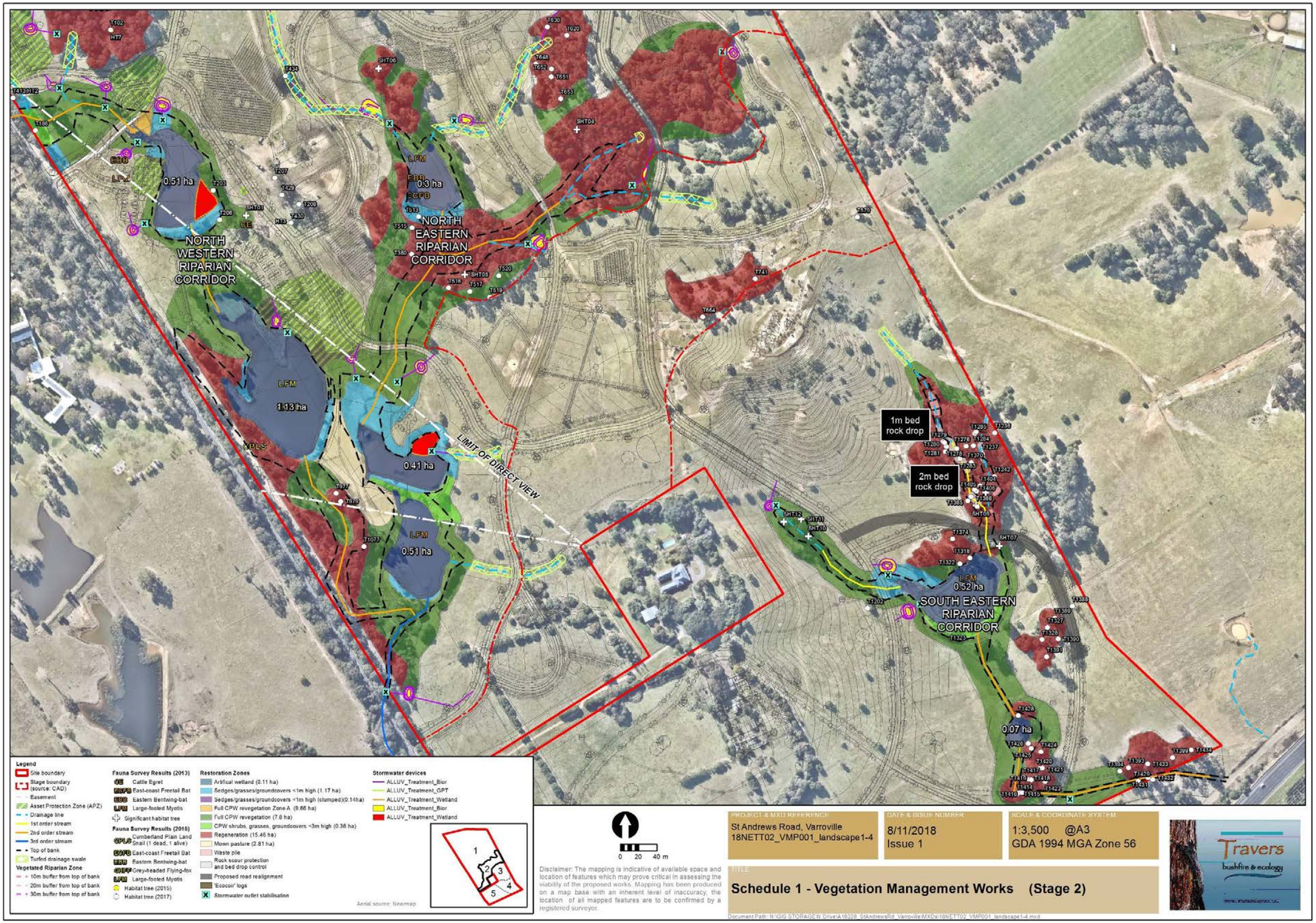
Travers bushfire & ecology


NORTH WESTERN RIPARIAN CORRIDOR
NORTH EASTERN RIPARIAN CORRIDOR
SOUTH EASTERN RIPARIAN CORRIDOR
0.51 ha
0.3 ha
1.13 ha
0.41 ha
0.51 ha
0.52 ha
0.07 ha
LIMIT OF DIRECT VIEW
1m bed rock drop
2m bed rock drop
Legend
Site boundary
Stage boundary (source: CAD)
Easement
Asset Protection Zone (APZ)
Drainage line
1st order stream
2nd order stream
3rd order stream
Top of bank
Turfed drainage swale
Vegetated Riparian Zone
10m buffer from top of bank
20m buffer from top of bank
30m buffer from top of bank
Fauna Survey Results (2013)
Cattle Egret
East-coast Freetail Bat
Eastern Bentwing-bat
Large-footed Myotis
Significant habitat tree
Fauna Survey Results (2015)
Cumberland Plain Land Snail (1 dead, 1 alive)
East-coast Freetail Bat
Eastern Bentwing-bat
Grey-headed Flying-fox
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Habitat tree (2015)
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Stormwater devices
ALLUV_Treatment_Bior
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ALLUV_Treatment_Wetland
ALLUV_Treatment_Bior
ALLUV_Treatment_Wetland
Aerial source: Nearmap
0 20 40 m
Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.
PROJECT & MXD REFERENCE
St Andrews Road, Varroville
18NETT02_VMP001_landscape1-4
DATE & ISSUE NUMBER
8/11/2018
Issue 1
SCALE & COORDINATE SYSTEM
1:3,500 @A3
GDA 1994 MGA Zone 56
TITLE
Schedule 1 - Vegetation Management Works (Stage 2)
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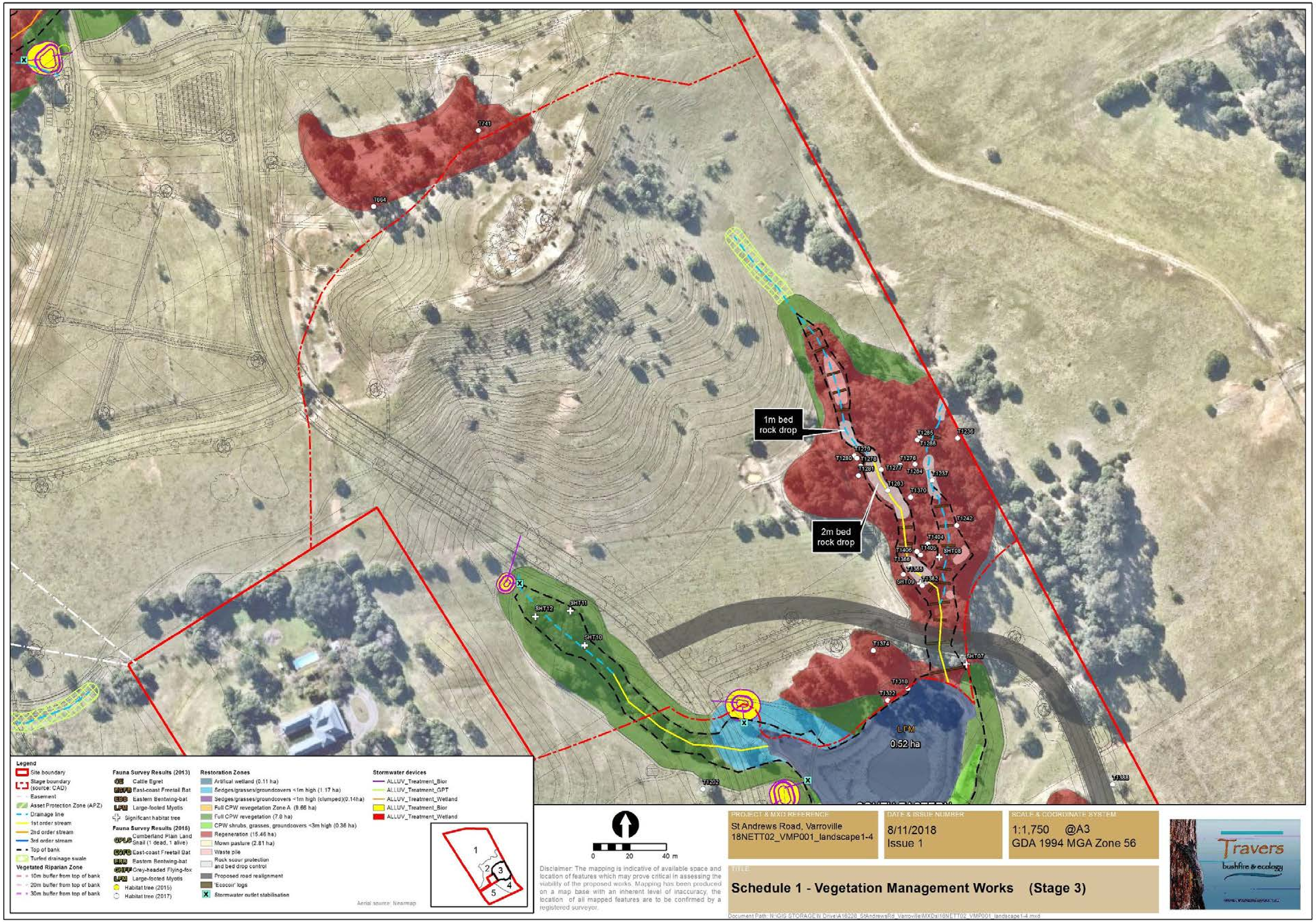
Travers bushfire & ecology



1m bed rock drop
2m bed rock drop
LFM
0.52 ha
Legend
Site boundary
Stage boundary (source: CAD)
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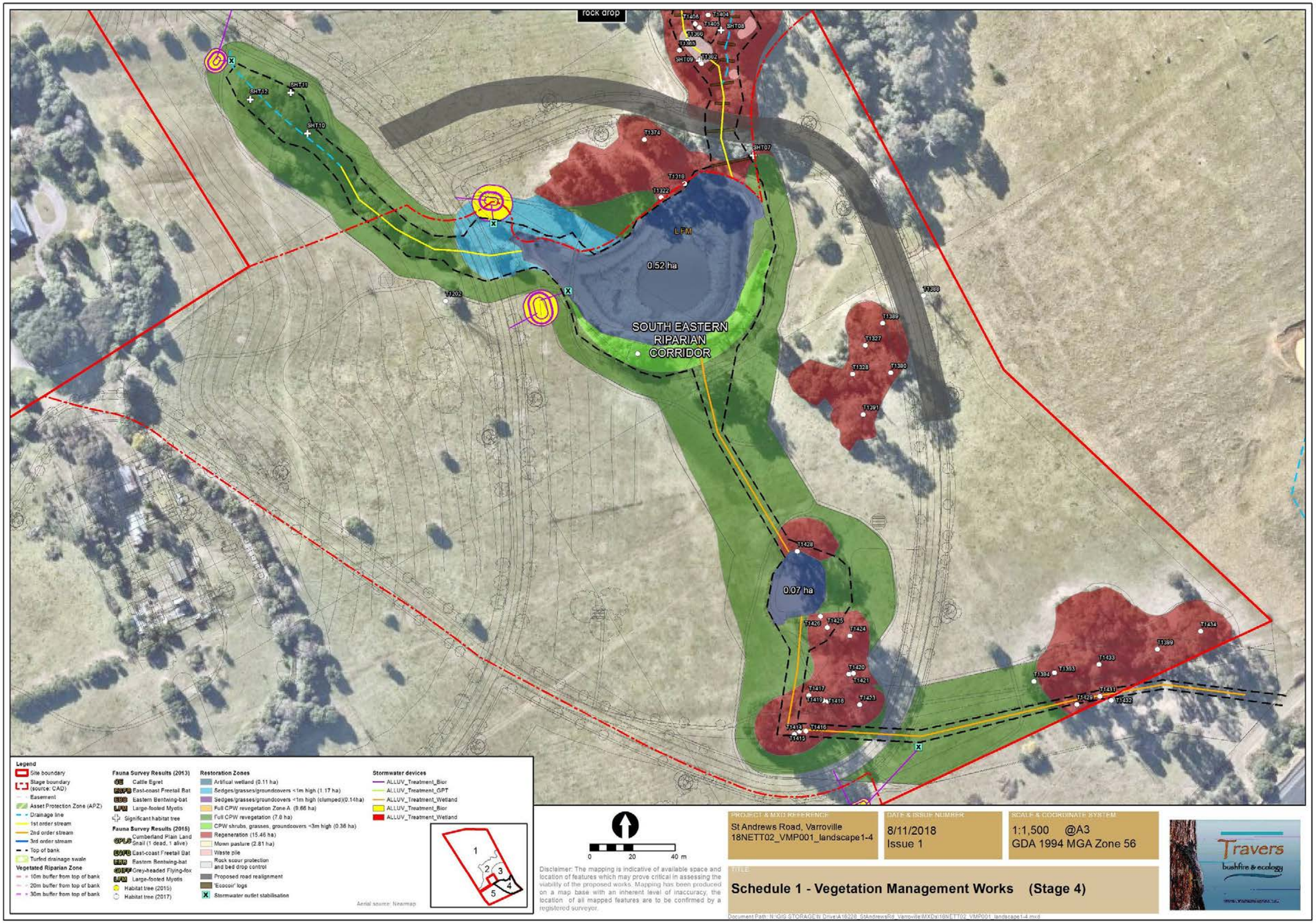
Habitat tree (2015)
Habitat tree (2017)
Restoration Zones
Artificial wetland (0.11 ha)
Sedges/grasses/groundcovers <1m high (1.17 ha)
Sedges/grasses/groundcovers <1m high (clumped)(0.14ha)
Full CPW revegetation Zone A (8.66 ha)
Full CPW revegetation (7.8 ha)
CPW shrubs, grasses, groundcovers <3m high (0.36 ha)
Regeneration (15.46 ha)
Mown pasture (2.81 ha)
Waste pile
Rock scour protection and bed drop control
Proposed road realignment
'Ecocoir' logs
Stormwater outlet stabilisation
Stormwater devices
ALLUV_Treatment_Bior
ALLUV_Treatment_GPT
ALLUV_Treatment_Wetland
ALLUV_Treatment_Bior
ALLUV_Treatment_Wetland
Aerial source: Nearmap
0 20 40 m
Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.
PROJECT & MXD REFERENCE
St Andrews Road, Varroville
18NETT02_VMP001_landscape1-4
DATE & ISSUE NUMBER
8/11/2018
Issue 1
SCALE & COORDINATE SYSTEM
1:1,750 @A3
GDA 1994 MGA Zone 56
TITLE
Schedule 1 - Vegetation Management Works (Stage 3)
Travers bushfire & ecology


rock drop
SHT12
SHT11
SHT10
T1374
SHT07
T1318
T1322
LFM
0.52 ha
T1202
SOUTH EASTERN
RIPARIAN
CORRIDOR
T1388
T1389
T1327
T1328
T1380
T1391
T1428
0.07 ha
T1426
T1425
T1424
T1420
T1421
T1417
T1419
T1418
T1423
T1414
T1416
T1415
T1434
T1399
T1433
T1384
T1383
T1431
T1429
T1432
Legend
Site boundary
Stage boundary (source: CAD)
Easement
Asset Protection Zone (APZ)
Drainage line
1st order stream
2nd order stream
3rd order stream
Top of bank
Turfed drainage swale
Vegetated Riparian Zone
10m buffer from top of bank
20m buffer from top of bank
30m buffer from top of bank
Fauna Survey Results (2013)
CE Cattle Egret
ESFB East-coast Freetail Bat
EBB Eastern Bentwing-bat
LFM Large-footed Myotis
Significant habitat tree
Fauna Survey Results (2015)
CPLS Cumberland Plain Land Snail (1 dead, 1 alive)
ESFB East-coast Freetail Bat
EBB Eastern Bentwing-bat
GHFF Grey-headed Flying-fox
LFM Large-footed Myotis
Habitat tree (2015)
Habitat tree (2017)
Restoration Zones
Artifical wetland (0.11 ha)
Sedges/grasses/groundcovers <1m high (1.17 ha)
Sedges/grasses/groundcovers <1m high (clumped)(0.14ha)
Full CPW revegetation Zone A (8.66 ha)
Full CPW revegetation (7.8 ha)
CPW shrubs, grasses, groundcovers <3m high (0.36 ha)
Regeneration (15.46 ha)
Mown pasture (2.81 ha)
Waste pile
Rock scour protection and bed drop control
Proposed road realignment
'Ecocoir' logs
Stormwater outlet stabilisation
Stormwater devices
ALLUV_Treatment_Bior
ALLUV_Treatment_GPT
ALLUV_Treatment_Wetland
ALLUV_Treatment_Bior
ALLUV_Treatment_Wetland
1
2
3
4
5
Aerial source: Nearmap
0
20
40 m
Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.
PROJECT & MXD REFERENCE
St Andrews Road, Varroville
18NETT02_VMP001_landscape1-4
DATE & ISSUE NUMBER
8/11/2018
Issue 1
SCALE & COORDINATE SYSTEM
1:1,500 @A3
GDA 1994 MGA Zone 56
TITLE
Schedule 1 - Vegetation Management Works (Stage 4)
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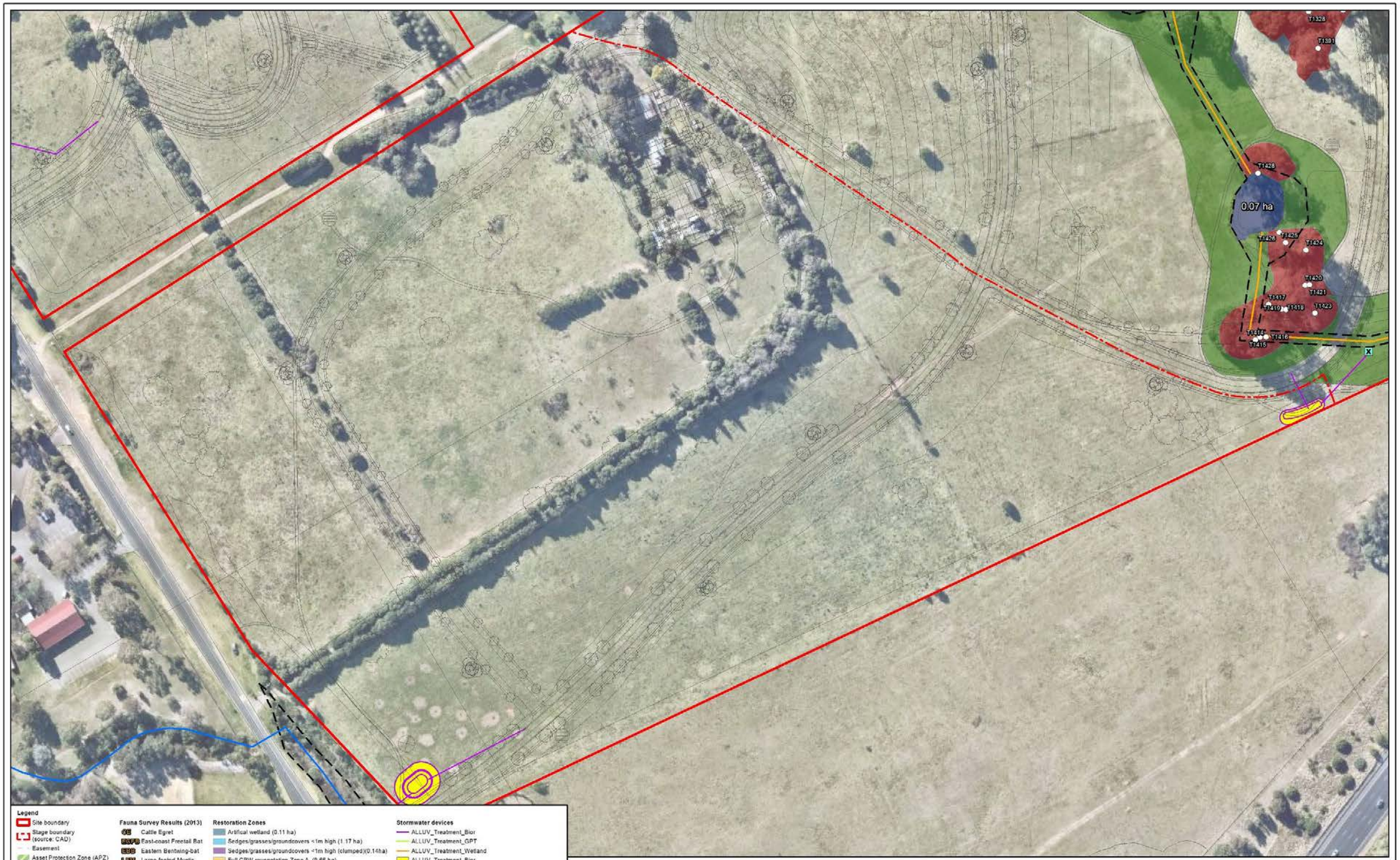
Travers
bushfire & ecology


T1328
T1301
T1428
0.07 ha
T1425
T1426
T1424
T1420
T1421
T1417
T1419
T1418
T1423
T1414
T1416
T1415
X
Legend
Site boundary
Stage boundary (source: CAD)
Easement
Asset Protection Zone (APZ)
Drainage line
1st order stream
2nd order stream
3rd order stream
Top of bank
Turfed drainage swale
Vegetated Riparian Zone
10m buffer from top of bank
20m buffer from top of bank
30m buffer from top of bank
Fauna Survey Results (2013)
CE Cattle Egret
ESFB East-coast Freetail Bat
ESB Eastern Bentwing-bat
LFM Large-footed Myotis
Significant habitat tree
Fauna Survey Results (2015)
CPLS Cumberland Plain Land Snail (1 dead, 1 alive)
ESFB East-coast Freetail Bat
ESB Eastern Bentwing-bat
GHFF Grey-headed Flying-fox
LFM Large-footed Myotis
Habitat tree (2015)
Habitat tree (2017)
Restoration Zones
Artifical wetland (0.11 ha)
Sedges/grasses/groundcovers <1m high (1.17 ha)
Sedges/grasses/groundcovers <1m high (clumped)(0.14ha)
Full CPW revegetation Zone A (9.66 ha)
Full CPW revegetation (7.8 ha)
CPW shrubs, grasses, groundcovers <3m high (0.36 ha)
Regeneration (15.46 ha)
Mown pasture (2.81 ha)
Waste pile
Rock scour protection and bed drop control
Proposed road realignment
'Ecocoir' logs
Stormwater outlet stabilisation
Stormwater devices
ALLUV_Treatment_Bior
ALLUV_Treatment_GPT
ALLUV_Treatment_Wetland
ALLUV_Treatment_Bior
ALLUV_Treatment_Wetland
1
2
3
4
5
Aerial source: Nearmap
0
20
40 m
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PROJECT & MXD REFERENCE
St Andrews Road, Varroville
18NETT02_VMP001_landscape1-4
DATE & ISSUE NUMBER
8/11/2018
Issue 1
SCALE & COORDINATE SYSTEM
1:1,750 @A3
GDA 1994 MGA Zone 56
TITLE
Schedule 1 - Vegetation Management Works (Stage 5)
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Travers
bushfire & ecology