

Ecology Report (Hunter Eco, 2011)



APPENDIX 4



Centennial Coal

**Mandalong Mine Ventilation Air Methane Abatement
Demonstration Project**

Ecology Report

HUNTER ECO

May 2011

FUTURE POWER



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Mandalong Mine Ventilation Air Methane Abatement Demonstration Project Ecology Report

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Colin Driscoll
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CONTENTS

1	INTRODUCTION	3
2	THE PROPOSED SITE	4
3	METHODS	6
3.1	Vegetation and flora	6
3.2	Fauna	6
3.3	Threatened species	6
4	THREATENED SPECIES ASSESSMENT RESULTS	7
4.1	NSW State	7
4.1.1	Flora	7
4.1.1	Fauna	7
4.2	Commonwealth	9
4.2.1	Flora	9
4.2.1	Fauna	9
4.2.2	Migratory species	12
5	FIELD SURVEY RESULTS	13
5.1	Flora and vegetation communities	13
5.1.1	Endangered Ecological Communities	16
6	IMPACT ASSESSMENT	17
6.1	Threatened species 7-part test	17
6.1.1	Threatened flora and fauna	17
6.1.2	Endangered ecological community	18
6.2	Commonwealth significant impact criteria – vulnerable species	20
7	CONCLUSION	21
8	RECOMMENDATIONS	21
9	REFERENCES	24
10	APPENDIX 1 FULL FLORISTIC LIST	25
11	APPENDIX 2 FLORISTIC PLOT AND MEANDER DATA	29

TABLES

TABLE 1 THREATENED FLORA SPECIES RECORDED FROM WITHIN 5 KM OF THE PROJECT SITE	7
TABLE 2 THREATENED FAUNA SPECIES RECORDED FROM WITHIN 5 KM OF THE PROJECT SITE	8
TABLE 3 THREATENED FLORA SPECIES REPORTED FROM THE COMMONWEALTH PROTECTED MATTERS SEARCH	9
TABLE 4 THREATENED FAUNA SPECIES RECORDED FROM THE COMMONWEALTH PROTECTED MATTERS SEARCH	11
TABLE 5 MIGRATORY SPECIES RECORDED FROM THE COMMONWEALTH PROTECTED MATTERS SEARCH	12
TABLE 6 FAUNA SPECIES RECORDED ON THE SITE	13
TABLE 7 THE VEGETATION COMMUNITIES IN THE DISTURBANCE AREA	13

FIGURES

FIGURE 1 THE MANDALONG MINE SURFACE FACILITIES AND PROPOSED PROJECT SITE	5
FIGURE 2 VEGETATION COMMUNITIES IN AN AROUND THE PROJECT SITE	14
FIGURE 3 THE AREA RECOMMENDED FOR REHABILITATION	23

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Mandalong Mine Ventilation Air Methane Abatement Demonstration Project

Ecology Report

1 Introduction

Centennial Mandalong Pty Limited (Centennial Mandalong) wishes to lodge an application with the NSW Department of Planning (DoP) seeking approval to modify the current development consent at Mandalong Mine under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to permit the installation of new technology to capture and abate mine ventilation air methane. The proposed modification would permit the development of Phase 1 of the Mandalong Greenhouse Abatement Facility (MGAF). The MGAF is an integrated on-site solution to address Mandalong's fugitive emissions, which, under a Carbon Pollution Reduction Scheme (CPRS), will potentially be a significant cost impost to the mine.

Mandalong Mine was granted development consent DA 97/8000 by the then Minister for Urban Affairs and Planning on the 14 October 1998 under Part 4 of the EP&A Act following the submission of the *Cooranbong Colliery – Life Extension Project EIS* (Umwelt 1998) and a Commission of Inquiry. The Mandalong Mine comprises: The Mandalong Mine underground workings and surface infrastructure near Morisset; The Cooranbong Services Site underground workings and surface infrastructure near Dora Creek; and The Delta Entry Site, which encompasses an entry and coal delivery system, near Wyee at the Vales Point Rail Unloader Facility.

At this point in time, Centennial Mandalong seeks to modify the current development consent at Mandalong Mine under Section 75W of the EP&A Act to permit the development of Phase 1 of the MGAF. Phase 1 is essentially a demonstration phase involving the installation of a single VAM-RAB unit to capture and abate approximately 10 cubic metres per second (m³/s) or one-thirtieth of the mine's total VAM. Note that there is no heat recovery or generation component to this phase. Tests will be conducted over an initial three month period to verify performance of the technology. Successful implementation of Phase 1 may result in the overall MGAF development, which is anticipated to comprise up to 36 VAM-RAB units (12 VAM-RAB packs) and integration of this new technology with existing and/or approved infrastructure (gas flares and gas engines) to capture and abate up to 100 percent of total mine VAM (approximately 300 m³/s).

This is a report of the ecological impact of the proposed Phase 1 project.

2 The proposed site

It is proposed that the single VAM-RAB unit be placed in front of one of the two mine ventilation fans that are located at the northern end of the Mandalong surface facilities (**Figure 1**). This area also contains the methane gas drainage plant for the mine.

The project site is located on the eastern side of the Mandalong flood plain which consists of a mosaic of cleared grazing land, scattered trees and areas of remnant vegetation. The elevation across the project site is around 6 m and, other than for areas artificially built up, the land is subject to periodic inundation with very little drainage. There are a number of interconnected wetlands in the area.

The project site consists of a detached area of 5500 m² being an earth stockpile from the time that the F3 Freeway was constructed and the main area (3.5 ha) around the existing ventilation fans and gas drainage plant.



Figure 1 The Mandalong mine surface facilities and proposed project site

3 Methods

The overall investigation has been conducted according to the following guidelines:

- *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities* (DEC 2004);
- *Draft Guidelines for Threatened Species Assessment* (DEC and DPI 2005); and
- *Threatened Species Survey and Assessment Guidelines – Introduction to Field Survey Methods* (DECCW 2009).

3.1 Vegetation and flora

A vegetation community map was prepared with the communities described according to the classification of NPWS (2000). Floristic data was collected from random meander and from targeted plots placed in representative areas of the different communities present. All but one of the plots were the standard 20 m x 20 m from which cover and abundance data was collected for all species present using the modified 1-6 Braun-Blanquet scale.

Data from the plots was compared with the NSW Scientific Committee determinations for endangered ecological communities (EEC) and an assessment was made as to whether any of the communities present could be classed as an EEC.

3.2 Fauna

The overall project disturbance area was a small part of an already small area of remnant vegetation. An assessment was made, based on the structure, floristic content and overall habitat connectivity of the disturbance area and immediate surrounds that mammal trapping would not provide any useful additional information for this study. Furthermore, since there were no trees with potential habitat hollows in the area nocturnal surveys were not conducted.

Fauna species seen or heard during the daytime field surveys were recorded.

3.3 Threatened species

A list of threatened species was obtained from the Atlas of NSW Wildlife from within a 5 km radius of the project site (data obtained March 2011). The habitat requirements of these species as provided in DEC (2005) were assessed against the habitat present in the subject site and an evaluation made as to the likelihood of the species occurring there.

A similar list was obtained using the Protected Matters Search Tool (EPBC 2011) for species protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

4 Threatened species assessment results

4.1 NSW State

This section considers threatened species listed in the schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act)

4.1.1 Flora

Table 1 lists the 9 threatened flora species recorded from within 5 km of the project site. Only *Maundia triglochinos* has been recorded in a wetland about 50 m to the north and there is no wetland habitat for this species within the project site. *Melaleuca biconvexa* is abundant across the Mandalong floodplain with the nearest record about 1 km west of the project site. The other species are found in dry habitat of which there is none in the project site.

Table 1 Threatened flora species recorded from within 5 km of the project site

Family	Scientific Name	Common Name	Status
Asteraceae	<i>Rutidosis heterogama</i>	Heath Wrinklewort	V
Elaeocarpaceae	<i>Tetratheca juncea</i>	Black-eyed Susan	V
Fabaceae (Mimosoideae)	<i>Acacia bynoeana</i>	Bynoe's Wattle	E1
Juncaginaceae	<i>Maundia triglochinos</i>		V
Myrtaceae	<i>Angophora inopina</i>	Charmhaven Apple	V
Myrtaceae	<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V
Myrtaceae	<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E1
Orchidaceae	<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V
Proteaceae	<i>Grevillea parviflora subsp. parviflora</i>	Small-flower Grevillea	V

4.1.1 Fauna

Table 2 lists the threatened fauna species recorded from within 5 km of the project site. There were 15 birds, 5 marsupials, 1 mega bat, 6 micro bats and 3 amphibians that had been recorded. At best the habitat in the project area would be part of a home range for itinerant nectar feeding species (feeding on Redgum blossom) such as Swift Parrot, Regent Honey-eater or Grey-headed Flying-Fox. There were no habitat hollows for micro bats to roost in or for the prey, such as Ring-tailed Possum, of large forest owls. There was no habitat connectivity for gliders to access the area.

Even though wet, the habitat was unsuitable for any of the three amphibian species recorded in the wider area: no wallum paperbark habitat for the Wallum Froglet; no sandstone ponded drainage lines in moist forest for the Giant Barred Frog; and no Hawkesbury Sandstone for the Red-crowned Toadlet.

Table 2 Threatened fauna species recorded from within 5 km of the project site

Family	Scientific Name	Common Name	Status
Birds			
Accipitridae	<i>Hieraaetus morphnoides</i>	Little Eagle	V
Accipitridae	<i>Lophoictinia isura</i>	Square-tailed Kite	V
Accipitridae	<i>Pandion haliaetus</i>	Osprey	V
Anatidae	<i>Oxyura australis</i>	Blue-billed Duck	V
Ardeidae	<i>Ixobrychus flavicollis</i>	Black Bittern	V
Cacatuidae	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V
Cacatuidae	<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V
Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E1
Meliphagidae	<i>Xanthomyza phrygia</i>	Regent Honeyeater	E1
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella	V
Psittacidae	<i>Glossopsitta pusilla</i>	Little Lorikeet	V
Psittacidae	<i>Lathamus discolor</i>	Swift Parrot	E1
Strigidae	<i>Ninox strenua</i>	Powerful Owl	V
Tytonidae	<i>Tyto novaehollandiae</i>	Masked Owl	V
Tytonidae	<i>Tyto tenebricosa</i>	Sooty Owl	V
Marsupials			
Dasyuridae	<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V
Macropodidae	<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E1
Petauridae	<i>Petaurus australis</i>	Yellow-bellied Glider	V
Petauridae	<i>Petaurus norfolcensis</i>	Squirrel Glider	V
Phascolarctidae	<i>Phascolarctos cinereus</i>	Koala	V
Megachiropteran Bats			
Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V
Microchiropteran Bats			
Molossidae	<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V
Vespertilionidae	<i>Miniopterus australis</i>	Little Bentwing-bat	V
Vespertilionidae	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V
Vespertilionidae	<i>Myotis macropus</i>	Southern Myotis	V
Vespertilionidae	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V
Amphibians			
Myobatrachidae	<i>Crinia tinnula</i>	Wallum Froglet	V
Myobatrachidae	<i>Mixophyes iteratus</i>	Giant Barred Frog	E1
Myobatrachidae	<i>Pseudophryne australis</i>	Red-crowned Toadlet	V

4.2 Commonwealth

This section considers species listed as threatened in the schedules of the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act).

4.2.1 Flora

Table 3 shows the 7 flora species reported from the Commonwealth protected matters search. Other than for the Illawarra Greenhood which would be well outside it's range at the project site, the other species have been determined in s4.1.1 above not to be present.

Table 3 Threatened flora species reported from the Commonwealth protected matters search

Common Name	Species	Status	Type of presence
Bynoe's Wattle	<i>Acacia bynoeana</i>	Vulnerable	Species or species habitat likely to occur within area
Charmhaven Apple	<i>Angophora inopina</i>	Vulnerable	Species or species habitat likely to occur within area
Leafless Tongue-orchid	<i>Cryptostylis hunteriana</i>	Vulnerable	Species or species habitat may occur within area
Small-flower Grevillea	<i>Grevillea parviflora</i> <i>subsp. parviflora</i>	Vulnerable	Species or species habitat likely to occur within area
Biconvex Paperbark	<i>Melaleuca biconvexa</i>	Vulnerable	Species or species habitat known to occur within area
Illawarra Greenhood	<i>Pterostylis gibbosa</i>	Endangered	Species or species habitat may occur within area
Black-eyed Susan	<i>Tetraloche juncea</i>	Vulnerable	Species or species habitat likely to occur within area

4.2.1 Fauna

Table 4 lists the fauna species recorded from the Commonwealth protected matters search. There were 3 birds, 1 mega bat, 1 micro bat, 3 marsupials, 1 rodent, 5 amphibians and 1 reptile.

As described in s4.1.2 above, the habitat was generally unsuitable for most species other than itinerant nectar feeding species like the Regent Honey-eater and Swift Parrot and Grey-headed Flying-Fox. The low-lying moist habitat was unsuitable for most of the species, however it could be suitable for the Australian Painted Snipe although there have been no records of the species from the immediate region.

Between the RTA stockpile and main project areas there is a wetland with habitat that appears superficially suitable for the Green and Golden Bell Frog with open,

unshaded water and abundant Typha. This area would not be disturbed by the proposed works.

Table 4 Threatened fauna species recorded from the Commonwealth protected matters search

Common Name	Species	Status	Type of presence
Birds			
Regent Honeyeater	<i>Anthochaera phrygia</i>	Endangered	Species or species habitat likely to occur within area
Swift Parrot	<i>Lathamus discolor</i>	Endangered	Species or species habitat likely to occur within area
Australian Painted Snipe	<i>Rostratula australis</i>	Vulnerable	Species or species habitat may occur within area
Microchiropteran Bats			
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Vulnerable	Species or species habitat may occur within area
Megachiropteran Bats			
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Vulnerable	Roosting known to occur within area
Marsupials			
Spot-tailed Quoll (SE mainland population)	<i>Dasyurus maculatus maculatus</i>	Endangered	Species or species habitat may occur within area
Brush-tailed Rock-wallaby	<i>Petrogale penicillata</i>	Vulnerable	Species or species habitat may occur within area
Long-nosed Potoroo	<i>Potorous tridactylus tridactylus</i>	Vulnerable	Species or species habitat may occur within area
New Holland Mouse	<i>Pseudomys novaehollandiae</i>	Vulnerable	Species or species habitat known to occur within area
Amphibians			
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	Vulnerable	Species or species habitat likely to occur within area
Green and Golden Bell Frog	<i>Litoria aurea</i>	Vulnerable	Species or species habitat may occur within area
Littlejohn's Tree Frog	<i>Litoria littlejohni</i>	Vulnerable	Species or species habitat may occur within area
Stuttering Frog	<i>Mixophyes balbus</i>	Vulnerable	Species or species habitat likely to occur within area
Giant Barred Frog, Southern	<i>Mixophyes iteratus</i>	Endangered	Species or species habitat likely to occur within area
Reptiles			
Broad-headed Snake	<i>Hoplocephalus bungaroides</i>	Vulnerable	Species or species habitat likely to occur within area

4.2.2 Migratory species

Table 5 lists the migratory species recorded from the Commonwealth protected matters search. The habitat would be unsuitable for the terrestrial species but could be visited by any of the wetland species.

Table 5 Migratory species recorded from the Commonwealth protected matters search

Migratory Terrestrial Species		
Common Name	Species	Type of presence
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Species or species habitat likely to occur within area
White-throated Needletail	<i>Hirundapus caudacutus</i>	Species or species habitat may occur within area
Rainbow Bee-eater	<i>Merops ornatus</i>	Species or species habitat may occur within area
Black-faced Monarch	<i>Monarcha melanopsis</i>	Breeding may occur within area
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	Breeding likely to occur within area
Rufous Fantail	<i>Rhipidura rufifrons</i>	Breeding may occur within area
Regent Honeyeater	<i>Xanthomyza phrygia</i>	Species or species habitat likely to occur within area
Migratory Wetland Species		
Great Egret, White Egret	<i>Ardea alba</i>	Species or species habitat may occur within area
Cattle Egret	<i>Ardea ibis</i>	Species or species habitat may occur within area
Latham's Snipe	<i>Gallinago hardwickii</i>	Species or species habitat may occur within area
Painted Snipe	<i>Rostratula benghalensis s. lat.</i>	Species or species habitat may occur within area

5 Field survey results

A total of 123 flora species was recorded from within the project site (**Appendix 1**) of which 34 species were weeds and 4 species were non-endemic natives that had been planted as rehabilitation vegetation following completion of the F3 Freeway. Data from the floristic plots and the stockpile meander can be found in **Appendix 2**.

Table 6 lists the few fauna species recorded.

Table 6 Fauna species recorded on the site

Scientific Name	Common Name
<i>Macropus giganteus</i>	Eastern Grey Kangaroo
<i>Wallabia bicolor</i>	Swamp Wallaby
<i>Malurus cyaneus</i>	Superb Fairy Wren
<i>Acanthiza nana</i>	Yellow Thornbill
<i>Zosterops lateralis</i>	Silvereye

5.1 Flora and vegetation communities

Figure 2 shows the vegetation communities mapped in and around the project site. **Table 7** shows the two vegetation communities within the proposed disturbance area boundary for the single VAM-RAB unit, one of which is a NSW TSC Act listed endangered ecological community. No Commonwealth listed endangered communities were present.

Table 7 The vegetation communities in the disturbance area

Community	Total area (m ²)
Disturbed/Rehabilitated vegetation	290
MU38 Redgum - Roughbarked Apple Swamp Forest EEC	3540

MU31 Coastal Plains Scribbly Gum Woodland – Snappy Gum variant

MU31 commonly has *Eucalyptus haemastoma* as the scribbly gum. In this variant the scribbly gum is *Eucalyptus racemosa* (Snappy Gum) with no other eucalypts in the canopy. There was a dense midstorey of *Melaleuca nodosa* paperbarks and no shrubs. The ground layer was sparse containing among other species, *Entolasia marginata*, *Lomandra longifolia*, *Pseuderanthemum variable*, and *Dianella caerulea* var *caerulea*.

MU37 Swamp Mahogany – Paperbark Forest

This community is really a hybrid between MU37 and MU38 and has been classified here as MU37 because there are a few scattered *Eucalyptus robusta*. *Eucalyptus amplifolia* subsp *amplifolia* is the more abundant canopy species, redgums being characteristic of MU38. The vine *Parsonsia straminea* was a significant canopy species in the moderately dense midstorey of *Melaleuca linariifolia* and *Melaleuca nodosa* paperbarks.

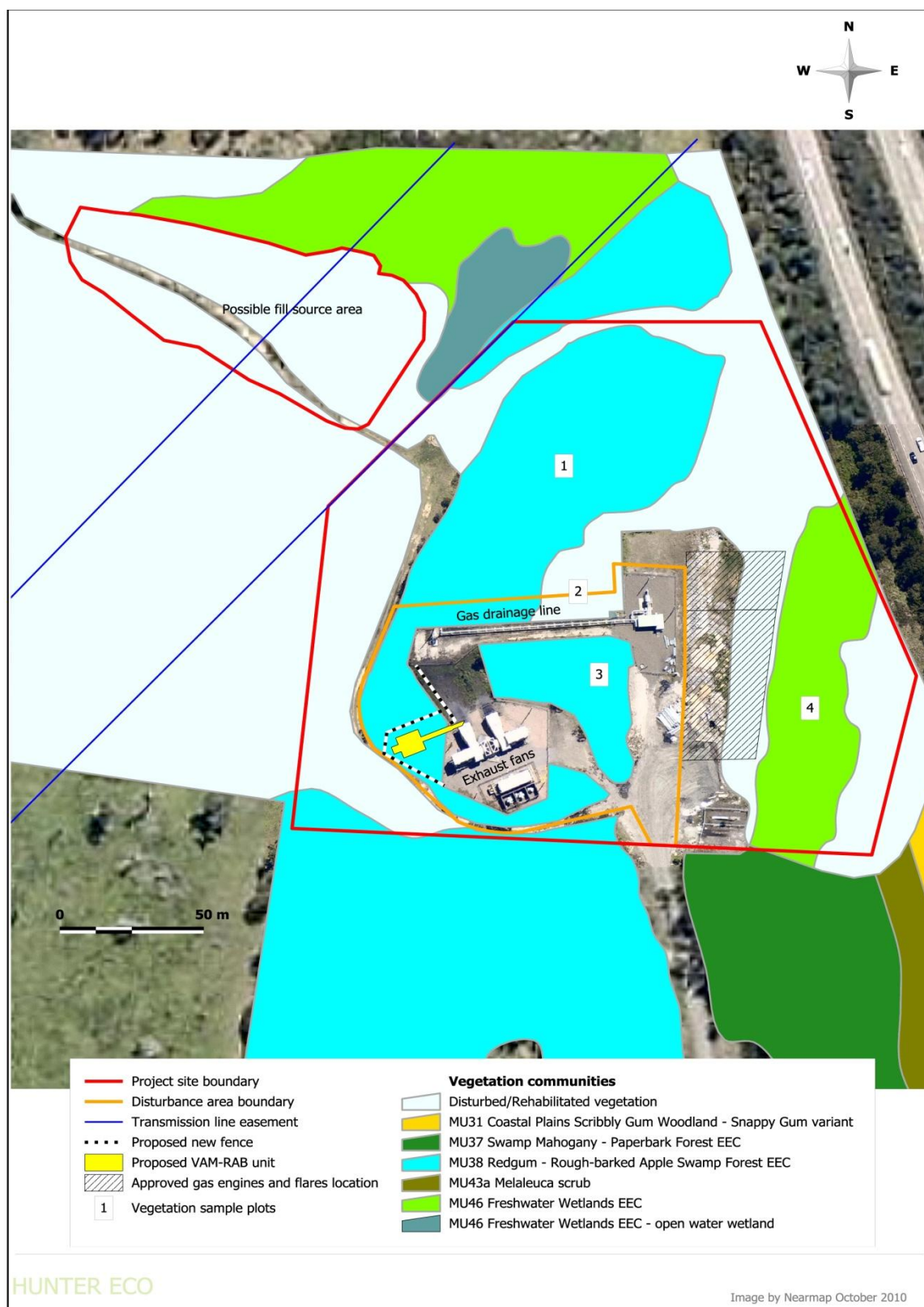


Figure 2 Vegetation communities in an around the project site

There was no shrub layer. The ground layer was made up of dense *Carex appressa* along with *Gahnia clarkei*, *Adiantum aethiopicum*, *Calochlaena dubia*, *Microlaena stipoides* var *stipoides* and a number of small herbs.

MU38 Redgum – Roughbarked Apple Forest

This community was characterised by a canopy of *Eucalyptus amplifolia* subsp *amplifolia* redgums and *Angophora floribunda* apple. Depending on the location there was a midstorey of *Melaleuca nodosa* paperbarks or no midstorey. There was no shrub layer and the ground layer was made up of sometimes dense *Carex appressa* and *Poa affinis* along with *Entolasia marginata* and various herbs and other grasses.

MU43a Melaleuca scrub

This has been classified as MU43a due to the dense low canopy of *Melaleuca nodosa* paperbarks. Taller emergents were *Eucalyptus globoidea*, *Angophora costata* and *Eucalyptus resinifera* subsp *resinifera*. This is most likely a derived community resulting from aggressive paperbark regrowth after substantial clearing of the original canopy a long time ago, certainly over 50 years. The remnant canopy emergents suggest that the pre-1750 condition would have been a eucalypt forest with the paperbarks as part of the mid canopy.

MU46 Freshwater wetland complex

MU46 is the nearest that the NPWS (2000) classification comes to describing the combination of species present. As a consequence of past clearing, the condition of wetlands is highly variable and considerably more sampling than the 9 sites that made up the NPWS (2000) classification would be required to encompass the variation. There are two areas of MU46, one at the northern boundary where there is a distinct wetland with open water and aquatic plants and the other at the eastern side of the project site which is a more swampy area. The primary aquatic plants at the northern end were *Typha orientalis* and *Triglochin microtuberosa*. The eastern area was dominated by *Carex appressa* tussocks along with *Persicaria strigosa* and a variety of herbs and sedges.

Disturbed or rehabilitated vegetation

There were 66 species in the fill stockpile area of which 26 were weeds and 4 were non-endemic native species. There were scattered low emergent species comprising of: *Acacia decurrens*, *Casuarina glauca*, *Eucalyptus botryoides* and *Eucalyptus tereticornis*. A dense tall shrub layer was dominated by *Kunzea ambigua*, *Leptospermum polygalifolium* and scattered *Solanum mauritianum*. The ground cover was dominated by the exotic grasses: *Andropogon virginicus*, *Axonopus fissifolius*, *Cynodon dactylon*, *Paspalum dilatatum* and *Paspalum urvillei*.

The disturbed area within the main project site was dominated by the exotic grasses *Paspalum urvillei* and *Axonopus fissifolius*.

5.1.1 Endangered Ecological Communities

Swamp Sclerophyll Forest (SSF) on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

The NSW Scientific Committee (SC) determination specifically refers to MU37 as being part of this EEC.

River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions

The NSW Scientific Committee (SC) determination specifically refers to MU38 as being part of this EEC.

Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions

The NSW Scientific Committee (SC) determination specifically refers to MU46 as being part of this EEC. The determination also provides other information that further supports the MU46 at the Mandalong site as being the EEC, particularly the part that lies east of the gas plant.

The EEC is "associated with periodic or semipermanent inundation by freshwater, although there may be minor saline influence in some wetlands. They typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains."

"The structure of the community may vary from sedgelands and reedlands to herbfields, and woody species of plants are generally scarce."

The part mapped as MU46 east of the gas plant is located in a depression that is periodically inundated, is at 6 m elevation and is directly connected to the Mandalong floodplain. It also lies in a drainage basin with water flowing from the MU37 community to the south from which community the MU46 community has clearly been derived as a result of clearing. It is a sedgeland dominated by *Carex appressa* with other wetland species and few woody species.

6 Impact assessment

The primary impacts of the proposed works would be modification and loss of 3540 m² of floodplain EEC within the disturbance area along with the potential for disturbance of the surrounding floodplain and wetland EEC's. The offsite impacts would be negated with appropriate sediment control and access control measures.

There would be no impact on any State or Commonwealth listed threatened flora or fauna species.

The impact of any proposal with the potential to disturb threatened species or endangered communities is assessed by applying the NSW State 7-part test and the Commonwealth test of impact. These tests are applied in the following sections.

6.1 Threatened species 7-part test

Although there were no threatened flora or fauna species found or considered likely to be present the 7-part test is formally applied.

6.1.1 Threatened flora and fauna

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

There were no threatened flora or fauna species present or considered likely to be present in which case no viable local population would be placed at risk of extinction.

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

No endangered populations have been listed.

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

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

Not applicable to threatened species test.

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

Not applicable to threatened species test.

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

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

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

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

The habitat to be modified or removed is located around the perimeter of the existing ventilation fans and gas extraction plant and is split by an access track along the southern side. The modification or loss of any of this habitat would not create further fragmentation and not have a significant impact on any threatened species.

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

No critical habitat was present.

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

Consistent with the improve or maintain principle, the proposed action will have a net gain in habitat through the implementation of a proposed offset plan.

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

Clearing of native vegetation is a key threatening process.

6.1.2 Endangered ecological community

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

Not applicable to the consideration of an EEC

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

Not applicable to the consideration of an EEC

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

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

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

The habitat to be modified or removed is located around the perimeter of the existing ventilation fans and gas extraction plant and is split by an access track along the southern side. Half of the area to be modified or disturbed is already an island surrounded by infrastructure and access road. The modification or loss of any of this

habitat would not create further fragmentation and not have a significant impact on the surrounding remnant.

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

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

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

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

The habitat to be modified or removed is located around the perimeter of the existing ventilation fans and gas extraction plant and is split by an access track along the southern side. Half of the area to be modified or disturbed is already an island surrounded by infrastructure and access road. The modification or loss of any of this habitat would not create further fragmentation and not have a significant impact on the surrounding remnant. The loss of any of this community would not negatively impact on the survival of the remaining community; this is self-evident in that the current remnant has persisted despite the past clearing in and around it.

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

No critical habitat was present.

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

Consistent with the improve or maintain principle, the proposed action will have a net gain in habitat through the implementation of a proposed offset plan, as discussed in section 8 'Recommendations'.

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

Clearing of native vegetation is a key threatening process.

6.2 Commonwealth significant impact criteria – vulnerable species

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of an important population* of a species;**

There were no important populations of any threatened species present in or around the proposed disturbance area.

*An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

- **reduce the area of occupancy of an important population;**

There were no important populations of any threatened species present in or around the proposed disturbance area.

- **fragment an existing important population into two or more populations;**

There were no important populations of any threatened species present in or around the proposed disturbance area.

- **adversely affect habitat critical to the survival of a species;**

No threatened species were present. The proposed action would not affect habitat critical to the survival of any threatened species.

- **disrupt the breeding cycle of an important population;**

There were no important populations of any threatened species present in or around the proposed disturbance area.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

There were no threatened species present in or around the proposed disturbance area. The proposed action would not affect habitat such that a threatened species is likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

There were no threatened species present in or around the proposed disturbance area. The proposed action would not result in invasive species becoming established and place any vulnerable species at risk.

- **introduce disease that may cause the species to decline; or**

There were no threatened species present in or around the proposed disturbance area. The proposed action would not result in diseases becoming established and place any vulnerable species at risk.

- **interfere substantially with the recovery of the species.**

There were no threatened species present in or around the proposed disturbance area. There were no threatened species present in or around the proposed disturbance area.

7 Conclusion

The works associated with the installation of one trial VAM-RAB unit would result in the loss or modification of approximately 3540 m² of the listed endangered ecological community *River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*.

There would be no impact on any State or Commonwealth listed threatened flora or fauna species.

Scope exists for the rehabilitation of existing disturbed areas within and adjoining the project site, as discussed below in Section 8. This rehabilitation would offset the loss or modification of the endangered ecological community to the extent that the overall result would be a net gain in the amount of the community in the area.

8 Recommendations

In keeping with the principles of *Maintain or Improve* and *Ecologically Sustainable Development* a strategy to offset the loss or modification of the River-Flat Eucalypt Forest EEC is recommended. The remnant EEC in the immediate vicinity of the proposed works is fragmented by degraded areas as a consequence of past activity, particularly the construction of the F3 Freeway.

These degraded areas amount to about 1.25 ha and rehabilitation would result in 2 ha of continuous habitat (Figure 3). This would adjoin 3 ha of existing habitat to the south, resulting in 5 ha of continuous habitat. A bushfire risk assessment would be conducted to determine the width of an asset protection zone around the gas engines and gas flares. In this area the density of rehabilitation would be tailored to suit the APZ requirements.

The species used in the rehabilitation should be sourced from local provenance to avoid potential genetic conflicts between local and imported species known as outbreeding depression. Outbreeding depression is expressed as reduced fitness in offspring from the crossing of two differently adapted populations. The potential for outbreeding depression would not be restricted to the immediate rehabilitation area. For example, pollen from eucalypts can be transported over long distances by fauna or the introduced honey bee. Genetic material from trees planted in the proposed rehabilitation area would be transferred to trees elsewhere in the Mandalong floodplain. Redgums should be *Eucalyptus amplifolia* grown from seed collected from trees in the Mandalong floodplain.

Two communities would be rehabilitated: MU38 Redgum – Rough-barked Apple (0.9 ha) and MU37 Swamp Mahogany – Paperbark (0.35 ha). The MU37 community would be established in the area mapped as MU46 on the eastern side of the gas engines to be continuous with the existing MU37 community. The currently mapped MU46 has come about as a consequence of past clearing of the tree and shrub cover. This is

the case for a large portion of the Mandalong floodplain that is dominated by *Carex* tussocks. Comparing the data from Plot 3 and Plot MU37 in Appendix 2 (ignoring exotic species) it can be seen that the biodiversity value of the area currently mapped as MU46 would be doubled when the rehabilitation had become established.

The species making up these two communities are listed in Appendix 2: MU38 Plot 1 and Plot MU37 which was a sample from the area adjoining that mapped as MU46 east of the gas engines. The most abundant native species in these lists should be used in the rehabilitation. Weed management works would also be undertaken in the rehabilitated areas, to ensure improved rehabilitation outcomes.

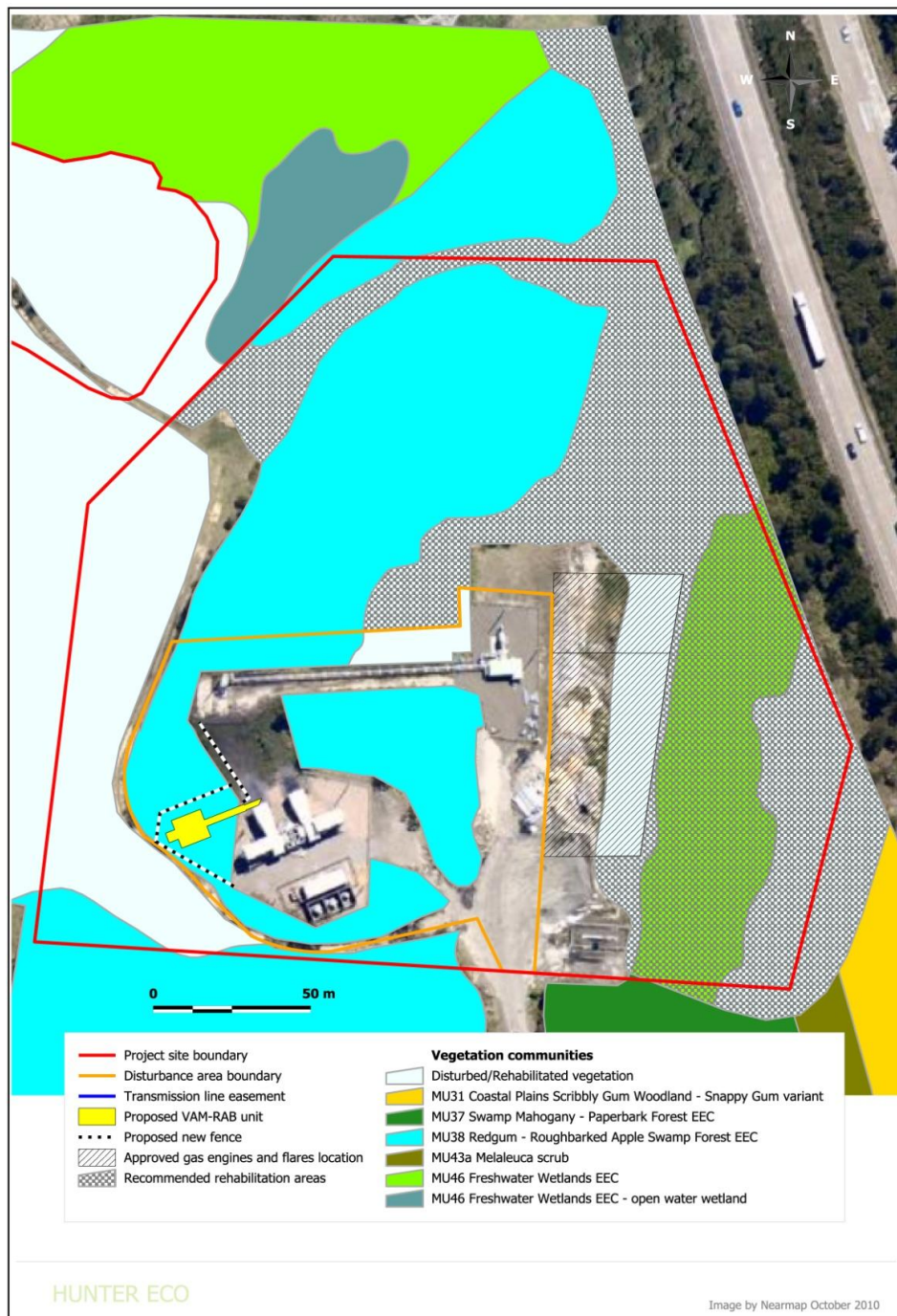


Figure 3 The area recommended for rehabilitation

The hatched grey area would be rehabilitated to MU38. The hatched light green area would be rehabilitated to MU37.

9 References

DEC (2004) *Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft)*, New South Wales Government Department of Environment and Conservation, Hurstville, NSW.

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DECCW (2009) Threatened Species Survey and Assessment Guidelines: Introduction to field survey methods [Online Resource], <http://www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm>

EPBC (2011) Protected Matters Search Tool. [Online Resource], <http://www.environment.gov.au/erin/ert/epbc/index.html>

NPWS (2000) *Vegetation Survey, Classification and Mapping Lower Hunter and Central Coast Region*. Version 1.2. A project undertaken for The Lower Hunter and Central Coast Regional Environment Management Strategy CRA Unit Sydney Zone National Parks and Wildlife Service.

10 Appendix 1 Full floristic list

*=Weeds + =Native not endemic

Family Name	Scientific Name
Adiantaceae	<i>Adiantum aethiopicum</i>
Adiantaceae	<i>Cheilanthes sieberi</i>
Amaranthaceae	<i>Alternanthera denticulata</i>
Apiaceae	<i>Centella asiatica</i>
Apiaceae	<i>Centella asiatica</i>
Apiaceae	<i>Hydrocotyle laxiflora</i>
Apiaceae	<i>Hydrocotyle laxiflora</i>
Apiaceae	<i>Hydrocotyle peduncularis</i>
Araliaceae	<i>Polyscias sambucifolia</i>
Asteraceae	* <i>Aster subulatus</i>
Asteraceae	* <i>Cirsium vulgare</i>
Asteraceae	* <i>Conyza canadensis</i>
Asteraceae	* <i>Conyza sp.</i>
Asteraceae	* <i>Senecio madagascariensis</i>
Asteraceae	* <i>Taraxacum officinale</i>
Asteraceae	<i>Eclipta platyglossa</i>
Asteraceae	<i>Euchiton gymnocephalus</i>
Asteraceae	<i>Ozothamnus diosmifolius</i>
Brassicaceae	<i>Cardamine paucijuga</i>
Campanulaceae	<i>Wahlenbergia gracilis</i>
Casuarinaceae	<i>Casuarina glauca</i>
Casuarinaceae	<i>Casuarina glauca</i>
Celastraceae	<i>Maytenus silvestris</i>
Chenopodiaceae	<i>Einadia hastata</i>
Commelinaceae	<i>Aneilema biflorum</i>
Commelinaceae	<i>Commelina cyanea</i>
Convolvulaceae	<i>Dichondra repens</i>
Convolvulaceae	<i>Dichondra repens</i>
Convolvulaceae	<i>Polymeria calycina</i>
Cyperaceae	* <i>Cyperus sesquiflorus</i>
Cyperaceae	<i>Carex appressa</i>
Cyperaceae	<i>Carex appressa</i>
Cyperaceae	<i>Carex gaudichaudiana</i>
Cyperaceae	<i>Carex longebrachiata</i>
Cyperaceae	<i>Cyperus eragrostis</i>
Cyperaceae	<i>Cyperus haspan subsp. haspan</i>
Cyperaceae	<i>Cyperus sphaeroideus</i>

Cyperaceae	<i>Eleocharis dietrichiana</i>
Cyperaceae	<i>Gahnia clarkei</i>
Davalliaceae	<i>Davallia pyxidata</i>
Fabaceae (Faboideae)	* <i>Lotus corniculatus</i>
Fabaceae (Faboideae)	* <i>Trifolium repens</i>
Fabaceae (Faboideae)	<i>Glycine clandestina</i>
Fabaceae (Faboideae)	<i>Glycine microphylla</i>
Fabaceae (Faboideae)	<i>Glycine microphylla</i>
Fabaceae (Faboideae)	<i>Lotus uliginosus</i>
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i>
Geraniaceae	<i>Geranium homeanum</i>
Goodeniaceae	<i>Goodenia bellidifolia</i>
Goodeniaceae	<i>Goodenia bellidifolia</i> subsp. <i>bellidifolia</i>
Juncaceae	* <i>Juncus capillaceus</i>
Juncaceae	* <i>Juncus cognatus</i>
Juncaceae	<i>Juncus polyanthemus</i>
Juncaceae	<i>Juncus prismatocarpus</i>
Juncaceae	<i>Juncus usitatus</i>
Juncaceae	<i>Juncus usitatus</i>
Lamiaceae	<i>Plectranthus parviflorus</i>
Lobeliaceae	<i>Pratia purpurascens</i>
Lobeliaceae	<i>Pratia purpurascens</i>
Lomandraceae	<i>Lomandra longifolia</i>
Lomandraceae	<i>Lomandra longifolia</i>
Malvaceae	* <i>Modiola caroliniana</i>
Malvaceae	* <i>Sida rhombifolia</i>
Myrtaceae	+ <i>Eucalyptus botryoides</i>
Myrtaceae	+ <i>Kunzea ambigua</i>
Myrtaceae	+ <i>Leptospermum laevigatum</i>
Myrtaceae	+ <i>Leptospermum polygalifolium</i> subsp. <i>transmontanum</i>
Myrtaceae	<i>Angophora floribunda</i>
Myrtaceae	<i>Eucalyptus amplifolia</i>
Myrtaceae	<i>Eucalyptus amplifolia</i> subsp. <i>amplifolia</i>
Myrtaceae	<i>Eucalyptus amplifolia</i> subsp. <i>amplifolia</i>
Myrtaceae	<i>Eucalyptus tereticornis</i>
Myrtaceae	<i>Melaleuca nodosa</i>
Oleaceae	* <i>Ligustrum sinense</i>

Oxalidaceae	<i>Oxalis exilis</i>
Oxalidaceae	<i>Oxalis exilis</i>
Pittosporaceae	<i>Billardiera scandens</i>
Plantaginaceae	* <i>Plantago lanceolata</i>
Poaceae	* <i>Andropogon virginicus</i>
Poaceae	* <i>Axonopus fissifolius</i>
Poaceae	* <i>Briza maxima</i>
Poaceae	* <i>Cynodon dactylon</i>
Poaceae	* <i>Parapholis incurva</i>
Poaceae	* <i>Paspalum dilatatum</i>
Poaceae	* <i>Paspalum urvillei</i>
Poaceae	* <i>Pennisetum clandestinum</i>
Poaceae	* <i>Setaria italica</i>
Poaceae	* <i>Setaria sphacelata</i>
Poaceae	* <i>Setaria sphacelata</i> var. <i>sericea</i>
Poaceae	* <i>Sporobolus africanus</i>
Poaceae	* <i>Vulpia bromoides</i>
Poaceae	<i>Echinopogon ovatus</i>
Poaceae	<i>Entolasia marginata</i>
Poaceae	<i>Entolasia stricta</i>
Poaceae	<i>Eragrostis brownii</i>
Poaceae	<i>Hemarthria uncinata</i> var. <i>uncinata</i>
Poaceae	<i>Imperata cylindrica</i> var. <i>major</i>
Poaceae	<i>Imperata cylindrica</i> var. <i>major</i>
Poaceae	<i>Microlaena stipoides</i>
Poaceae	<i>Oplismenus imbecillis</i>
Poaceae	<i>Poa affinis</i>
Poaceae	<i>Poa labillardierei</i> var. <i>labillardierei</i>
Poaceae	<i>Poa labillardierei</i> var. <i>labillardierei</i>
Poaceae	<i>Themeda australis</i>
Polygonaceae	<i>Persicaria decipiens</i>
Polygonaceae	<i>Persicaria strigosa</i>
Polygonaceae	<i>Rumex brownii</i>
Polygonaceae	<i>Rumex</i> sp.
Primulaceae	* <i>Anagallis arvensis</i>
Ranunculaceae	<i>Clematis glycinoides</i>
Ranunculaceae	<i>Ranunculus inundatus</i>
Ranunculaceae	<i>Ranunculus inundatus</i>
Rhamnaceae	<i>Pomaderris ferruginea</i>
Rosaceae	* <i>Rubus anglocandicans</i>
Rubiaceae	* <i>Richardia brasiliensis</i>

Rubiaceae	<i>Galium propinquum</i>
Scrophulariaceae	<i>Veronica plebeia</i>
Solanaceae	* <i>Solanum mauritianum</i>
Typhaceae	<i>Typha orientalis</i>
Verbenaceae	* <i>Lantana camara</i>
Verbenaceae	* <i>Verbena bonariensis</i>
Verbenaceae	<i>Clerodendrum tomentosum</i>

11 Appendix 2 Floristic plot and meander data

Plot 1		
Family Name	Scientific Name	CA
Apiaceae	<i>Centella asiatica</i>	4
Apiaceae	<i>Hydrocotyle laxiflora</i>	2
Asteraceae	* <i>Cirsium vulgare</i>	1
Asteraceae	* <i>Senecio madagascariensis</i>	2
Commelinaceae	<i>Aneilema biflorum</i>	1
Convolvulaceae	<i>Dichondra repens</i>	2
Cyperaceae	<i>Carex appressa</i>	1
Cyperaceae	<i>Carex longebrachiata</i>	3
Fabaceae (Faboideae)	<i>Glycine microphylla</i>	1
Geraniaceae	<i>Geranium homeanum</i>	1
Goodeniaceae	<i>Goodenia bellidifolia</i> subsp. <i>bellidifolia</i>	1
Juncaceae	<i>Juncus usitatus</i>	1
Lamiaceae	<i>Plectranthus parviflorus</i>	2
Lobeliaceae	<i>Pratia purpurascens</i>	3
Lomandraceae	<i>Lomandra longifolia</i>	1
Myrtaceae	<i>Angophora floribunda</i>	2
Myrtaceae	<i>Eucalyptus amplifolia</i> subsp. <i>amplifolia</i>	4
Oxalidaceae	<i>Oxalis exilis</i>	1
Pittosporaceae	<i>Billardiera scandens</i>	1
Plantaginaceae	* <i>Plantago lanceolata</i>	2
Poaceae	* <i>Axonopus fissifolius</i>	2
Poaceae	* <i>Cynodon dactylon</i>	2
Poaceae	<i>Imperata cylindrica</i> var. <i>major</i>	2
Poaceae	* <i>Paspalum dilatatum</i>	1
Poaceae	<i>Poa affinis</i>	1
Poaceae	<i>Poa labillardierei</i> var. <i>labillardierei</i>	6
Rubiaceae	<i>Galium propinquum</i>	1
Verbenaceae	* <i>Verbena bonariensis</i>	1

Plot 2		
Family Name	Scientific Name	CA
Apiaceae	<i>Hydrocotyle laxiflora</i>	2
Asteraceae	* <i>Aster subulatus</i>	1
Asteraceae	* <i>Cirsium vulgare</i>	2
Asteraceae	* <i>Senecio madagascariensis</i>	1
Asteraceae	* <i>Taraxacum officinale</i>	1
Asteraceae	* <i>Conyza canadensis</i>	1
Asteraceae	<i>Eclipta platyglossa</i>	1
Commelinaceae	<i>Commelina cyanea</i>	1
Convolvulaceae	<i>Dichondra repens</i>	2
Cyperaceae	<i>Carex appressa</i>	2
Cyperaceae	<i>Cyperus haspan</i>	2
Juncaceae	<i>Juncus usitatus</i>	2
Lomandraceae	<i>Lomandra longifolia</i>	1
Malvaceae	* <i>Sida rhombifolia</i>	2
Myrtaceae	<i>Eucalyptus amplifolia subsp. amplifolia</i>	3
Oxalidaceae	<i>Oxalis exilis</i>	1
Plantaginaceae	* <i>Plantago lanceolata</i>	1
Poaceae	* <i>Axonopus fissifolius</i>	2
Poaceae	* <i>Paspalum dilatatum</i>	2
Poaceae	* <i>Paspalum urvillei</i>	6
Poaceae	* <i>Setaria sphacelata</i>	1
Poaceae	* <i>Cynodon dactylon</i>	4
Poaceae	<i>Echinopogon ovatus</i>	1
Poaceae	<i>Entolasia marginata</i>	2
Poaceae	* <i>Parapholis incurva</i>	2
Poaceae	<i>Poa labillardierei var. labillardierei</i>	3
Poaceae	* <i>Setaria italica</i>	2
Polygonaceae	<i>Rumex brownii</i>	1
Ranunculaceae	<i>Ranunculus inundatus</i>	1
Verbenaceae	* <i>Verbena bonariensis</i>	2

Plot 3		
Family Name	Scientific Name	CA
Amaranthaceae	<i>Alternanthera denticulata</i>	2
Apiaceae	<i>Hydrocotyle laxiflora</i>	2
Asteraceae	<i>*Conyza canadensis</i>	1
Convolvulaceae	<i>Dichondra repens</i>	1
Convolvulaceae	<i>Polymeria calycina</i>	2
Cyperaceae	<i>*Cyperus sesquiflorus</i>	2
Cyperaceae	<i>Carex appressa</i>	5
Cyperaceae	<i>Cyperus haspan subsp. haspan</i>	3
Cyperaceae	<i>Cyperus sphaeroideus</i>	2
Cyperaceae	<i>Eleocharis dietrichiana</i>	1
Fabaceae (Faboideae)	<i>*Lotus corniculatus</i>	1
Goodeniaceae	<i>Goodenia bellidifolia</i>	1
Juncaceae	<i>*Juncus cognatus</i>	1
Juncaceae	<i>Juncus polyanthemus</i>	2
Juncaceae	<i>Juncus usitatus</i>	2
Myrtaceae	<i>Eucalyptus amplifolia</i>	4
Poaceae	<i>*Paspalum dilatatum</i>	3
Poaceae	<i>*Paspalum urvillei</i>	3
Poaceae	<i>*Pennisetum clandestinum</i>	1
Poaceae	<i>*Cynodon dactylon</i>	3
Poaceae	<i>Echinopogon ovatus</i>	1
Poaceae	<i>Entolasia marginata</i>	2
Poaceae	<i>Hemarthria uncinata var. uncinata</i>	2
Poaceae	<i>*Setaria italica</i>	1
Polygonaceae	<i>Persicaria decipiens</i>	2
Ranunculaceae	<i>Ranunculus inundatus</i>	2
Typhaceae	<i>Typha orientalis</i>	2

Plot 4		
Family Name	Scientific Name	CA
Apiaceae	<i>Hydrocotyle peduncularis</i>	3
Asteraceae	* <i>Cirsium vulgare</i>	1
Brassicaceae	<i>Cardamine paucijuga</i>	2
Casuarinaceae	<i>Casuarina glauca</i>	1
Cyperaceae	<i>Carex appressa</i>	5
Cyperaceae	<i>Carex gaudichaudiana</i>	2
Cyperaceae	<i>Cyperus eragrostis</i>	3
Fabaceae (Faboideae)	* <i>Lotus uliginosus</i>	4
Juncaceae	* <i>Juncus capillaceus</i>	1
Juncaceae	<i>Juncus prismatocarpus</i>	2
Juncaceae	<i>Juncus usitatus</i>	1
Poaceae	* <i>Axonopus fissifolius</i>	2
Poaceae	* <i>Paspalum urvillei</i>	3
Polygonaceae	<i>Persicaria strigosa</i>	3
Polygonaceae	* <i>Rumex sp.</i>	2
Ranunculaceae	<i>Ranunculus inundatus</i>	3
Verbenaceae	* <i>Verbena bonariensis</i>	1

Stockpile meander list

Family Name	Scientific Name
Adiantaceae	<i>Adiantum aethiopicum</i>
Adiantaceae	<i>Cheilanthes sieberi</i>
Apiaceae	<i>Centella asiatica</i>
Apiaceae	<i>Hydrocotyle laxiflora</i>
Araliaceae	<i>Polyscias sambucifolia</i>
Asteraceae	* <i>Aster subulatus</i>
Asteraceae	* <i>Cirsium vulgare</i>
Asteraceae	* <i>Conyza sp.</i>
Asteraceae	* <i>Senecio madagascariensis</i>
Asteraceae	* <i>Taraxacum officinale</i>
Asteraceae	<i>Euchiton gymnocephalus</i>
Asteraceae	<i>Ozothamnus diosmifolius</i>
Campanulaceae	<i>Wahlenbergia gracilis</i>
Casuarinaceae	<i>Casuarina glauca</i>
Celastraceae	<i>Maytenus silvestris</i>
Chenopodiaceae	<i>Einadia hastata</i>
Cyperaceae	<i>Carex appressa</i>
Cyperaceae	<i>Gahnia clarkei</i>
Davalliaceae	<i>Davallia pyxidata</i>
Fabaceae (Faboideae)	* <i>Trifolium repens</i>
Fabaceae (Faboideae)	<i>Glycine clandestina</i>
Fabaceae (Faboideae)	<i>Glycine microphylla</i>
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i>
Juncaceae	<i>Juncus usitatus</i>
Lobeliaceae	<i>Pratia purpurascens</i>
Lomandraceae	<i>Lomandra longifolia</i>
Malvaceae	* <i>Modiola caroliniana</i>
Malvaceae	* <i>Sida rhombifolia</i>
Myrtaceae	+ <i>Eucalyptus botryoides</i>
Myrtaceae	+ <i>Kunzea ambigua</i>
Myrtaceae	+ <i>Leptospermum laevigatum</i>
Myrtaceae	+ <i>Leptospermum polygalifolium subsp. transmontanum</i>
Myrtaceae	<i>Eucalyptus tereticornis</i>
Myrtaceae	<i>Melaleuca nodosa</i>
Oleaceae	* <i>Ligustrum sinense</i>
Oxalidaceae	<i>Oxalis exilis</i>
Plantaginaceae	* <i>Plantago lanceolata</i>

Poaceae	<i>*Andropogon virginicus</i>
Poaceae	<i>*Axonopus fissifolius</i>
Poaceae	<i>*Briza maxima</i>
Poaceae	<i>*Cynodon dactylon</i>
Poaceae	<i>*Paspalum dilatatum</i>
Poaceae	<i>*Paspalum urvillei</i>
Poaceae	<i>*Pennisetum clandestinum</i>
Poaceae	<i>*Setaria sphacelata var. sericea</i>
Poaceae	<i>*Sporobolus africanus</i>
Poaceae	<i>*Vulpia bromoides</i>
Poaceae	<i>Entolasia stricta</i>
Poaceae	<i>Eragrostis brownii</i>
Poaceae	<i>Hemarthria uncinata</i>
Poaceae	<i>Imperata cylindrica var. major</i>
Poaceae	<i>Microlaena stipoides</i>
Poaceae	<i>Oplismenus imbecillis</i>
Poaceae	<i>Themeda australis</i>
Polygonaceae	<i>Rumex sp.</i>
Primulaceae	<i>*Anagallis arvensis</i>
Ranunculaceae	<i>Clematis glycinoides</i>
Rhamnaceae	<i>Pomaderris ferruginea</i>
Rosaceae	<i>*Rubus anglocandicans</i>
Rubiaceae	<i>*Richardia brasiliensis</i>
Scrophulariaceae	<i>Veronica plebeia</i>
Solanaceae	<i>*Solanum mauritianum</i>
Verbenaceae	<i>*Lantana camara</i>
Verbenaceae	<i>*Verbena bonariensis</i>
Verbenaceae	<i>Clerodendrum tomentosum</i>

MU37 plot

Scientific Name	Family Name	CA
<i>Pellaea falcata</i>	Adiantaceae	2
<i>Hydrocotyle laxiflora</i>	Apiaceae	1
<i>Hydrocotyle tripartita</i>	Apiaceae	2
<i>Parsonsia straminea</i>	Apocynaceae	3
<i>Pandorea pandorana subsp. pandorana</i>	Bignoniaceae	1
<i>Casuarina glauca</i>	Casuarinaceae	1
<i>Aneilema biflorum</i>	Commelinaceae	1
<i>Dichondra repens</i>	Convolvulaceae	2
<i>Carex appressa</i>	Cyperaceae	6
<i>Carex declinata</i>	Cyperaceae	1
<i>Lepidosperma concavum</i>	Cyperaceae	2
<i>Calochlaena dubia</i>	Dicksoniaceae	3
<i>Geranium homeanum</i>	Geraniaceae	2
<i>Plectranthus parviflorus</i>	Lamiaceae	1
<i>Eucalyptus amplifolia subsp. amplifolia</i>	Myrtaceae	3
<i>Melaleuca linariifolia</i>	Myrtaceae	3
<i>Melaleuca nodosa</i>	Myrtaceae	3
<i>Ligustrum sinense*</i>	Oleaceae	2
<i>Entolasia marginata</i>	Poaceae	2
<i>Microlaena stipoides var. stipoides</i>	Poaceae	3
<i>Oplismenus imbecillis</i>	Poaceae	1
<i>Persicaria strigosa</i>	Polygonaceae	1
* <i>Rumex sp.</i>	Polygonaceae	1
<i>Pyrrosia rupestris</i>	Polypodiaceae	1
<i>Ranunculus sessiliflorus var. sessiliflorus</i>	Ranunculaceae	1
<i>Lantana camara*</i>	Verbenaceae	1