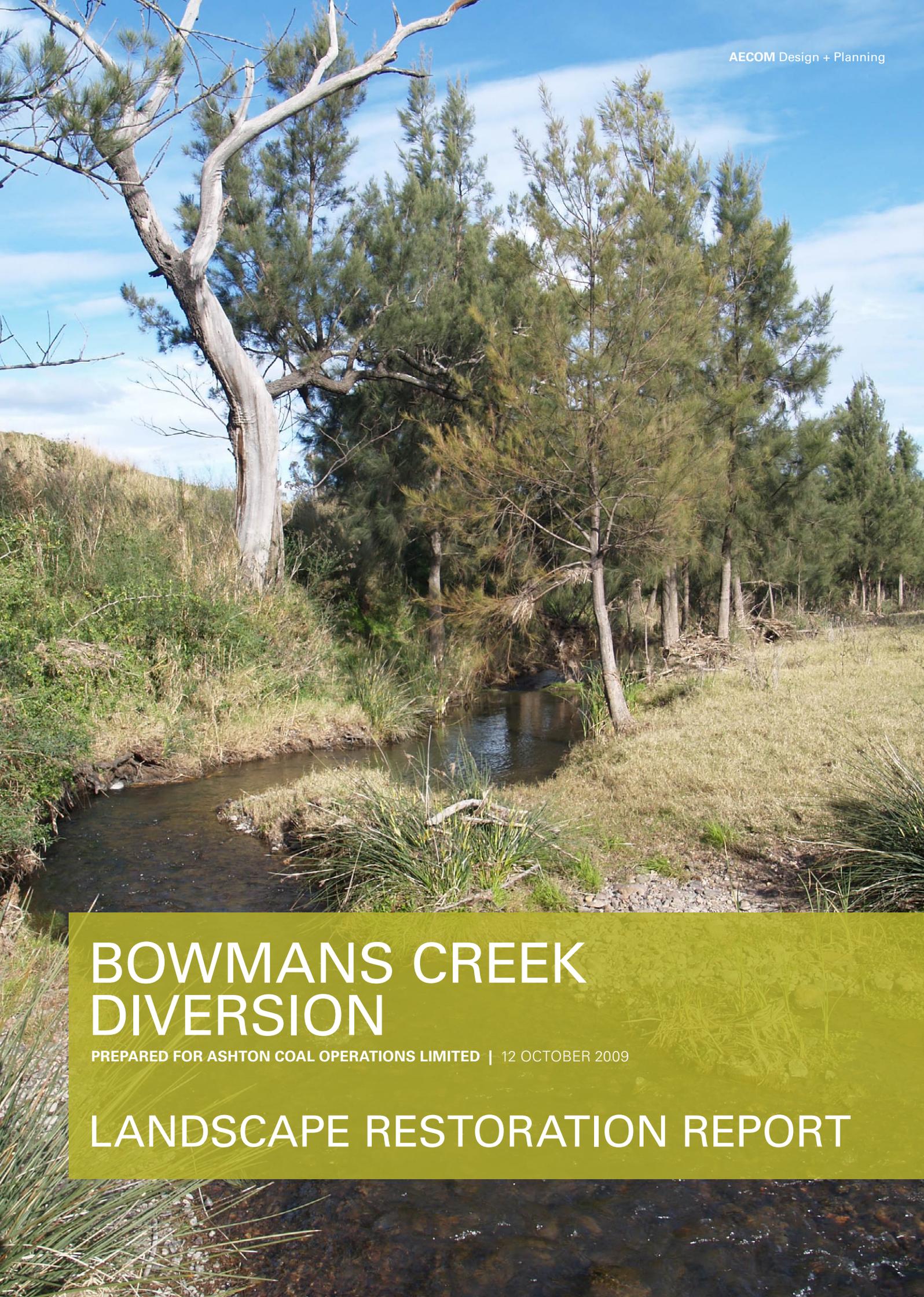


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## Appendix 10 Landscape Restoration Report

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# BOWMANS CREEK DIVERSION

PREPARED FOR ASHTON COAL OPERATIONS LIMITED | 12 OCTOBER 2009

## LANDSCAPE RESTORATION REPORT



# DOCUMENT CONTROL SHEET

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**Author(s):** Mark Blanche  
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**Distribution:** Phil Fletcher - Ashton Coal Operations Limited  
Dr Steve Perrens – Evans & Peck

Revision	Date	Approved	Details of Revision
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Draft 2	24 September 2009	Mark Blanche	n/a
Draft 3	25 September 2009	James Rosenwax	n/a
Draft 4	02 October 2009	Mark Blanche	n/a
Final Version	12 October 2009	James Rosenwax	n/a

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## **APPENDIX 1 – LANDSCAPE DRAWINGS**

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## **APPENDIX 3 – COMMUNITY PROFILE: HUNTER VALLEY RIVER OAK FOREST**

## **APPENDIX 4 - COMMUNITY PROFILE: HUNTER FLOODPLAIN RED GUM WOODLAND**



1.0

Introduction

## 1.00 INTRODUCTION

AECOM Design + Planning has been commissioned by Ashton Coal Operations Limited (ACOL) to prepare a landscape restoration approach for the two proposed watercourse diversions on Bowmans Creek, as described within the head document.

This report is to be read in conjunction with the following drawings (refer Appendix 1):

- » SK01 – Masterplan – Eastern Diversion;
- » SK02 – Detail Area / Sections - Eastern Diversion;
- » SK03 – Masterplan – Western Diversion;
- » SK04 – Detail Area / Sections - Western Diversion;
- » SK05 – General Details

## 1.01 BACKGROUND

The project is described in detail within the head document. For the purposes of this report, the project involves the construction of two diversions on Bowmans Creek between the New England Highway and the Hunter River:

- » Eastern Diversion - which will start about 150 m south of the New England Highway and extend for about 830 m approximately along the eastern edge of the floodplain to join an existing oxbow channel (approximately 125 m long) and then drain into the existing creek. This diversion will involve excavation of a meandering channel that mimics the geomorphic features of the adjacent reach of Bowmans Creek, including variable width (about 35m to 100m) and variable bed levels to create pools and riffles. Typical maximum excavation depth in this diversion is varies from 4.0m to 5.5m.
- » Western Diversion - which will start just downstream of the existing streamflow monitoring station (operated by the Office of Water). This diversion, which will extend for approximately 780 m, will also mimic the geomorphic characteristics of the adjacent reach of Bowmans Creek which is typically about 7m deep. Top width of this diversion channel will vary from 45 to 70 m.

In each instance, block banks will be placed in the existing channel to direct flows into the diversion channels. The block banks will be installed in two phases as follows:

- » Phase 1 – up to the 6 month average recurrence interval flood;
- » Phase 2 – up to the 5 year average recurrence interval flood.

The Phase 1 temporary block bank will minimise the potential for a highly damaging flood event passing through the diversions within the early period of the landscape restoration, as the flow for each diversion will be split between the existing reach of the creek and the diversion. The 5 year average recurrence interval flood through the diversion in this instance has been calculated to be approximately equal to that of the 1 year average recurrence interval flood if all of the flow was passing through the diversion.

Construction of each diversion will be undertaken in four phases over a total period of about four months for each diversion:

- » Bulk earthworks to create the general form of the channel;
- » Detailed channel shaping to develop the required geomorphic characteristics in the base of the channel and install rock bars and engineered log jams;
- » Landscape detailing and revegetation;
- » Construction of block banks and final cut-in at the ends of the diversion channels.



General Approach

2.0



## 2.00 GENERAL APPROACH

The landscape restoration approach for the Bowmans Creek diversions proposes the establishment of plant communities that will be characteristic of those that were present prior to European colonisation. Objectives of the approach are to create plant communities that establish rapidly, are species rich and have dense plant cover, so as to achieve:

- » Quick ground-holding characteristics  
Sufficient to withstand flooding early within the plant establishment period (PEP);
- » Resistance to on-going weed colonisation, maximising the potential for natural colonisation / regeneration of the planted species, particularly the native grasses;
- » A diverse suite of endemic species that maximise the potential for colonising of new niches as they become available in the developing community;
- » High plant cover rates to ensure the communities will have natural resistance to weed colonisation, good ground-holding characteristics sufficient for a range of periodic flood events, and sufficient species diversity to develop into an appropriate climax community.

## 2.01 PREVIOUS STUDIES

A substantial number of previous studies have been undertaken for the site. The key studies of relevance to this report are discussed below.

### 2.01.01 Flora And Fauna Assessment

HLA-Envirosciences undertook a flora and fauna assessment of the site in 2001. The assessment included a summary of eight (8) previous flora and fauna assessments commencing from 1984, and undertaken either specifically for the site, or within close proximity to the site, in addition to species identified within the NSW National Parks and Wildlife Service Wildlife Atlas. The report provides a species list incorporating findings from six (6) of the previous flora and fauna assessments, the NPWS Wildlife Atlas and the HLA 2001 study (refer Appendix 2). No threatened species (flora or fauna) were observed on the site.

Of relevance to the works proposed within this report, the assessment identified the following plant communities within close proximity to the proposed creek diversion works:

- » Grassland - comprising a combination of dry pasture and improved pasture, to the flood terrace through which Bowmans Creek cuts. Limited regeneration was noted as occurring within the dry pasture. The improved pasture has a very high percentage of weed cover;
- » Bulloak – a primary colonising community of which the key species, Bulloak (*Allocasuarina luehmannii*) tends to form dense monoculture stands, due to the fallen cladodes which cause the exclusion of most other tree and shrub species;
- » Riparian – a community dominated by River Oak (*Casuarina cunninghamiana*), with a lesser component of Rough-barked Apple (*Angophora floribunda*). The community is highly disturbed by grazing impacts.

Additionally, seven (7) specimens of River Red Gum (*Eucalyptus camaldulensis*) were identified in the narrow riparian corridor of the southern meander of Bowmans Creek, on the adjoining property to the west. Within the Hunter Catchment, this population is unique in NSW, being the only one to occur within a coastal catchment, and is restricted to 19 stands, covering approximately 100 hectares (ERM, 2006).

### **2.01.02 Hunter-Central Rivers Cma Mapping**

The Hunter-Central Rivers Catchment Management Authority has produced vegetation mapping of the Central Hunter Valley (Hunter-Central Rivers CMA, 2007). The mapping identifies existing plant communities as a series of Map Units (MU), for each of which it provides a general assessment, e.g. significance / condition / threat assessment, and a list of key species. The following plant communities identified within the CMA reporting were identified by the author as being likely to be associated with Bowmans Creek and its adjoining flood terrace environs:

- » MU 13 – Hunter Floodplain Red Gum Woodland Complex;
- » MU 30 – Hunter Valley River Oak Forest (identified by the CMA mapping);
- » MU 32 – Central Hunter Bulloak Forest Regeneration.

The River Red Gum population within the Hunter Catchment is listed as an endangered population under the Threatened Species Conservation Act, 1995 (TSCA). The CMA further states that the regional TSCA listed population of Red Gums is in danger of extinction from the introduction of 'non-natural hybrid River Red Gums for revegetation projects' which could result in the extinction of the local gene pool for this species (Hunter-Central Rivers CMA, 2007).

With regard to the Hunter Floodplain Red Gum Woodland Complex, the Hunter-Central Rivers CMA states that the community is under extreme threat, is not reserved, and that urgent protection and management agreements are required with private landholders (Hunter-Central Rivers CMA, 2007).

Additionally, the mapping identifies the subject site as being centrally located within a proposed regional vegetation linkage.

## 2.02 PROPOSED VEGETATION COMMUNITIES

### 2.02.01 Hunter Valley River Oak Forest

This community is proposed for the low active floodplain and adjoining inset benches (refer Masterplan and Detail Area / Sections drawings for locations). As can be seen from the sections, the low active floodplain comprises of a cobble / sand / silt material mix placed over a synthetic clay liner, while the inset benches comprise of in-situ alluvial material.

The profile for this community (including a list of key species) is attached (refer Appendix 3). The community typically forms a mid-high to tall forest with a mid-dense canopy almost exclusively dominated by River Oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*). Other less frequent canopy species may include Rough-barked Apple (*Angophora floribunda*), Forest Red Gum (*Eucalyptus tereticornis*), Swamp Oak (*Casuarina glauca*). Rainforest-affiliated low trees and shrubs sometimes form an understorey stratum, which may include such species as Native Peach (*Trema tomentosa* var. *viridis*), Ironwood (*Backhousia myrtifolia*) and Muttonwood (*Rapanea variabilis*) (Hunter-Central Rivers CMA, 2007).

### 2.02.02 Hunter Floodplain Red Gum Woodland

This community is proposed for the side slopes and adjoining flood terrace (refer Masterplan and Detail Area / Sections drawings for locations). The side slopes are likely to comprise of lenses of various alluvial materials including cobbles, sand, silt and clay.

The profile for this community (including a list of key species) is attached (refer Appendix 4). The community typically forms a mid-high to very tall or open woodland, and occurs on floodplains and floodplain rises along the Hunter River and several major tributaries. Sites on major floodplains between Singleton and several kilometres south of Scone are dominated by River Red Gum (*Eucalyptus camaldulensis*), often as a sole dominant canopy species. Forest Red Gum (*Eucalyptus tereticornis*), Yellow Box (*Eucalyptus melliodora*) and Rough-barked Apple (*Angophora floribunda*) can co-dominate in places although they usually form a minor part of the canopy. River Oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) once formed a gallery forest, within the typically surrounding Red Gum Forest, along most creeks and rivers (Hunter-Central Rivers CMA, 2007).



# Restoration Method

# 3.0

## 3.00 RESTORATION METHOD

Following is a description of the proposed method for the undertaking of the landscape restoration works (the works). Landscape restoration will commence upon completion of the channel forming works, and will be undertaken as a staged process.

The key steps that will be undertaken in the construction of the works are described below.

## 3.01 WORKS METHOD

### 3.01.01 Protection of the Works

Fence off the works area, or undertake other measures as necessary to ensure stock are no longer (in perpetuity) able to access the area, allowing for restricted stock access to the area of the diversion if they are not able to otherwise access unrestored sections of the creek.

### 3.01.02 Weed Management

Weed management will be a key factor in determining the success of the project, particularly within the first 12 to 18 months of the Plant Establishment Period (PEP). Very high weed densities are present on the flood terrace within which the diversions are constructed, particularly within the areas of improved pasture. The following weed management process is recommended:

- » Slash or otherwise manage the flood terrace for weeds within 50 metres of the creek diversions to minimise the extent of weed seed inputs to the area of the works – slashing is to commence prior to commencement of the engineering works, and take place at intervals sufficient to stop substantial setting of weed seed for at least the first 12-18 months of the PEP;
- » Undertake restoration treatments quickly upon completion of the civil engineering works to minimise the opportunity for weed colonisation;
- » Weed manage prepared areas with glyphosate (e.g. Roundup Biactive) as required prior to undertaking restoration treatments;
- » Regularly undertake initial weed management of the works until a dense native plant cover is in place, and that is of sufficient capacity to provide for natural regeneration of native species and minimise habitat / colonisation opportunities for weeds;
- » Thereafter, undertake weed management as required.

### 3.01.03 Soil Preparation

The following soil preparation measures will be undertaken:

- » Low Active Floodplain – For those areas of the works that comprise of placed cobble material, i.e. to the low active floodplain, no soil preparation will be required after the material has been placed. However, the placed cobble material will be carefully selected during the creek construction phase of works to ensure it contains a sand / silt / clay content sufficient to support an appropriate level of plant growth for the proposed plant species;
- » Inset Benches – The inset benches will comprise of various alluvial materials. Soil testing will be undertaken to the benches to determine its suitability for planting into, and ameliorants applied as required sufficient to ensure an appropriate level of plant response;
- » Lower Side Slopes – The lower side slopes are defined as that area below the 5 year average recurrence interval flood. It is proposed that this area be mass planted with cell-grown seedlings to ensure a relatively quick cover. Given that it is anticipated that the side slopes will constitute a series of alluvial lenses comprising of a range of materials, soil testing will be undertaken on a representative sample of each lens type to test chemical and physical soil properties and identify any requirements for amelioration to a level that seeks to provide a greater advantage to native seedlings than colonising weed species, e.g. low P levels. Additionally, the lens material will be assessed to determine whether it can readily be planted into with cell size plants, e.g. if it comprises of a substantial cobble content, it may not be possible to plant cell size seedlings into it. If the lens cannot be planted into, than provision will be made for the installation of a thin (say 75mm depth) layer of site topsoil as described below.

- » Upper Side Slopes and Flood Terrace – The upper side slopes are defined as that area above the 5 year average recurrence interval flood. It is proposed that this area be subject to direct seeding of native grasses in the first place, in conjunction with a limited structural planting of cell-grown seedlings.
- » Site Topsoil – Site topsoil will be stockpiled as part of the civil works package. Prior to stripping of topsoil, testing will be undertaken to determine the depth to which the majority of the weed seed load is situated. For areas to be stripped for their topsoil, this top layer (potentially in the order of 100mm) will be scalped and removed well away from stockpile sites, in order to remove the majority of the soil weed seed bank. The remaining topsoil will subject to soil testing and amelioration as required prior to installation.

#### **3.01.04 Protective Matting / Erosion Protection**

Protective matting will be applied to the following areas for both erosion control and weed suppression:

- » Inset Benches – Unlike the low active floodplain which is to comprise of a cobble mix, the inset benches will comprise of various alluvial materials which will potentially be susceptible to erosion. Subject to the findings of the previously undertaken soil testing, and the materials composition of the benches, these benches will be covered with a heavy duty, biodegradable protective matting to assist in the prevention of erosion from storm events until the plant material has established sufficiently to perform this role;
- » Lower Side Slopes – To minimise the level of risk of major damage to landscape restoration works within the first 12–18 months, it is proposed that those areas of the sides slopes that fall below the level of the 1 year average recurrence interval flood are to be matted with a medium duty, biodegradable protective matting assist in the prevention of erosion from storm events until the plant material has established sufficiently to perform this role.

**Note:** The project has been designed such that the proposed block banks that will direct water into the diversions, will initially be constructed to divert water up to the 1 in 6 month Average Recurrence Interval (ARI) storm event (these will later be increased in size to divert flows up to the 1 in 5 year ARI storm event). Storm events greater than this 1 in 6 month ARI will be split between the diversion and the existing stream. As a result, it has been calculated that the 1 year ARI storm event calculated for the diversions (based upon the final 1 in 5 year ARI block bank being in place), will broadly equate to a 1 in 5 year ARI storm event with the 6 month block bank in place. It is considered that this 1 in 5 year ARI storm level provides an acceptable level of flood damage risk to the restoration works in the early stages of the project.

### **3.01.05 Planting - Long-stem Tubes**

Planting to the low active floodplain and inset benches will include long-stem tubes of River Oak, which have been developed specifically for riparian situations. These tube plantings are essentially tall (about 1m high) plants with a single long stem, most of which in fact comprises of roots. Once established, other species from the Hunter Valley River Oak Forest community will be planted using a mix of long-stem tubes for those species for which they are available. Where proposed species are not able to be procured in a long-stem form, these will be planted as cell-grown seedlings progressively in small numbers throughout the period of the works to minimise losses to flood. The initial planting of long-stem tubes will be undertaken at average three (3) to four (4) metre centres across the area of the low active floodplain and inset benches. This density allows for open cobble and bench areas as is characteristic of the community, as well providing niches for following-up planting of additional species.

### **3.01.06 Planting - Cell-grown Seedlings**

Cell-grown seedlings will be planted to the lower side slopes at an average density of 8 plants sq.m. The planting palette will comprise of a mix of robust and quick growing species from all structural layers to maximise early soil holding properties, including a substantial ground layer of native grasses and forbs such as *Lomandra longifolia*. An initially species diverse structural planting will be undertaken for this area, with an emphasis on the canopy and shrub layers, to assess the relative performance of different species within the Hunter Floodplain Red Gum Woodland community, including at different heights up the bank, and possible responses to periodicity of inundation and soil types. Once this initial planting is established, staged supplementary planting will take place to increase species diversity and plant density where required.

### **3.01.07 Direct Seeding**

Direct seeding of a select suite of native grasses will be undertaken to the upper slopes and flood terrace edge in conjunction with a structural planting initially in limited numbers, to provide a dense, weed resistant cover, into which later staged planting can be undertaken to create a species rich community characteristic of Hunter Floodplain Red Gum Woodland. As with the planting to the lower side slopes, an assessment will be made of the relative performance of different species within the Hunter Floodplain Red Gum Woodland community, to help determine an optimal species composition for later supplementary planting. The outer five (5) metres of the corridor restoration will be seeded initially to a dense cover of native grasses to provide a robust weed barrier between the works and the adjoining weed community on the flood terrace. Select native grass species will include: Kangaroo Grass (*Themeda australis*); Scented Top (*Capillipedium spicigerum*) and Wild Sorghum (*Sorghum lieocladum*), species which have previously performed well in direct seeding applications. Additionally, a sterile cover crop will be judiciously used during the initial period of direct seeding, sufficient to assist in weed suppression without unduly compromising the growth of the young native seedlings.

### **3.01.08 Watering**

Watering, where needed, will be undertaken for a minimum period of 3 months after each planting or direct seeding event.

### 3.01.09 Plant Provenance

Where available, provenance River Red Gum seed will be utilised for this project.

A key aim of the project is to provide a flexible, cost effective and adaptive approach to the restoration process, which takes advantage of the opportunities offered by the relatively long life of the project, i.e. a period of some 14 years. Advantages of this approach are as follows:

- » Facilitates early focus on ground stabilisation and associated simplified maintenance approach, i.e. weed management is less constrained by the number and range of species planted and subsequent very high need in the early stages of the project for skilled, highly labour intensive weed management, which given the area to be covered for this project would be very difficult to adequately resource. The proposed approach of having a limited number of robust native grass species providing the main initial ground holding and weed suppressing function, simplifies maintenance and provides better protection, increased soil moisture holding capability and a more biologically active soil layer for subsequent plantings over that available in a single occurrence conventional mass planting processes;
- » Facilitates early commencement of the works in keeping with ACOL's program, as seed is only required for a handful of species, and cell-grown seedlings can initially be procured in readily low, achievable quantities;
- » Provides appropriate lead time to procure a diverse suite of species in high numbers;
- » Facilitates the opportunity for collection of provenance propagation materials by ACOL, e.g. for *Eucalyptus camaldulensis*, and may facilitate the same for other species in the normal course of nurseries providing plant material for the project, given the opportunity for substantial plant order lead times;
- » Facilitates a gradual building up of species diversity, by-passing problems often associated with procurement of particular species, e.g. limited viable seed drop in some seasons;
- » Early structural planting provides a framework for the later introduction of 'softer' species that are difficult to introduce in the early phases of a project due to their particular requirements, e.g. areas with dappled light, elevated soil moisture, wind and sun protection, locally increased humidity, etc.

## 3.02 PLANTING PROGRAM

Broad planting and seeding phases are described below.

### 3.02.01 Phase 1 – Site Stabilisation

This phase of the works would take place over the first 2 -3 years of the project. Key objectives of this phase would be to:

- » Quickly stabilise the works;
- » Provide a quick and robust weed suppressing native plant cover which will improve soil structure and microclimate;
- » Assess initial species performance, in order to tailor the initial species planting lists.

### 3.02.02 Phase 2 – Community Structure

This phase of the works would generally take place between years 3 and 6 of the project. Key objectives of this second phase of the project would be to:

- » Augment species diversity of the communities sufficient to provide a significant level of species richness, characteristic of the community, e.g. in the order of say 30 to 40 species for the upper side slopes and approximately 40 species for the lower side slopes (both communities are Hunter Floodplain Red Gum Woodland), and 20-30 species for the Hunter Valley River Oak Forest community within the Low Active Floodplain and Inset Benches;
- » Increase numbers and density of particular species where required.

### 3.02.03 Phase 3 – Species Diversity

This phase of the works would generally take place between years 6 and 8 of the project. Key objectives of this third phase of the project would be to:

- » Further augment species composition of the communities to a comprehensive suite of up to say 50 species;
- » Providing the ‘softer’ and harder to establish species in the now substantially ameliorated natural environment which should by that stage provide many of the niches necessary for the establishment of these species.



# Corridor Management

# 4.0

## 4.00 CORRIDOR MANAGEMENT

The landscape restoration method proposed within this report proposes that the works be undertaken gradually and in a staged and adaptive manner, commencing with site stabilisation using a combination of direct seeding of native grasses and planting, followed by a gradual building up community structure and species richness, until a robust, and relatively low maintenance, self-perpetuating corridor community is created.

An appropriate level of resources will be committed in the initial plant establishment period, in particular during the first 12 to 18 months after implementation. During this phase weed control will be regularly and rigorously undertaken, so as to facilitate the colonising of the great majority of available niches by native species. Once this outcome has been achieved, it can be expected that the required maintenance effort will significantly drop-off, until it reaches a relatively low, long-term maintenance level.

As part of this process, management will be adaptive, with outcomes being monitored and evaluated against restoration goals and objectives, and management actions adjusted as required to best meet these. These principles are summarised in the flow diagram below.

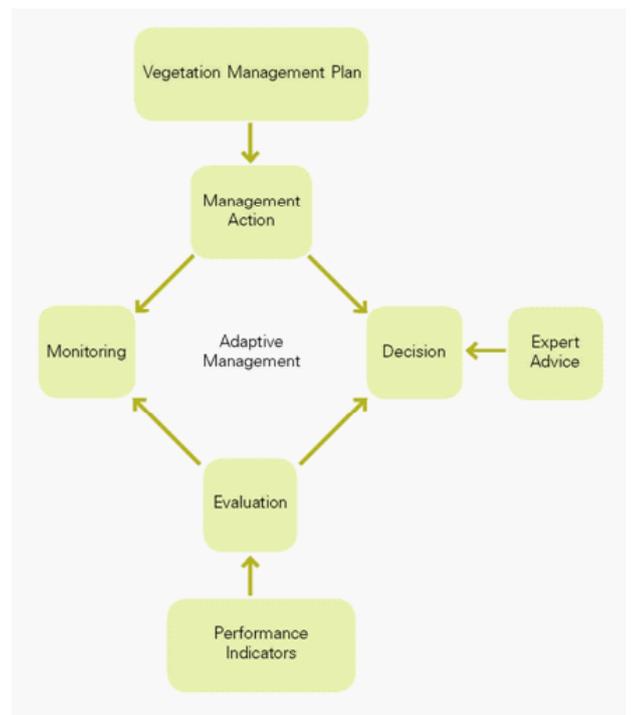


Figure 1: Adaptive Management Flow Diagram

## 4.01 EXISTING MANAGEMENT PLANS

The works will be undertaken generally in accordance with the following ACOL management plans which are currently in place:

- » Environmental Management Strategy – Phase 2  
Underground Mining Operations
- » Land Management Plan
- » Landscape and Revegetation Management Plan
- » Weed Management Plan.



# References



## REFERENCES

Brooks, A, et al. 2006. *Design guidelines for the reintroduction of wood into Australian Streams*. Land & Water Australia, Canberra.

ERM, 2006. *Bowmans Creek Geomorphology, Pre-mining Assessment*.

Hunter-Central Rivers CMA, 2007. *Vegetation of the Central Hunter Valley, NSW*

HLA-Envirosciences Pty Limited, 2001. *Environmental Impact Statement, Ashton Coal Project, Volume 2 – Appendix J, Flora and Fauna Survey Report*

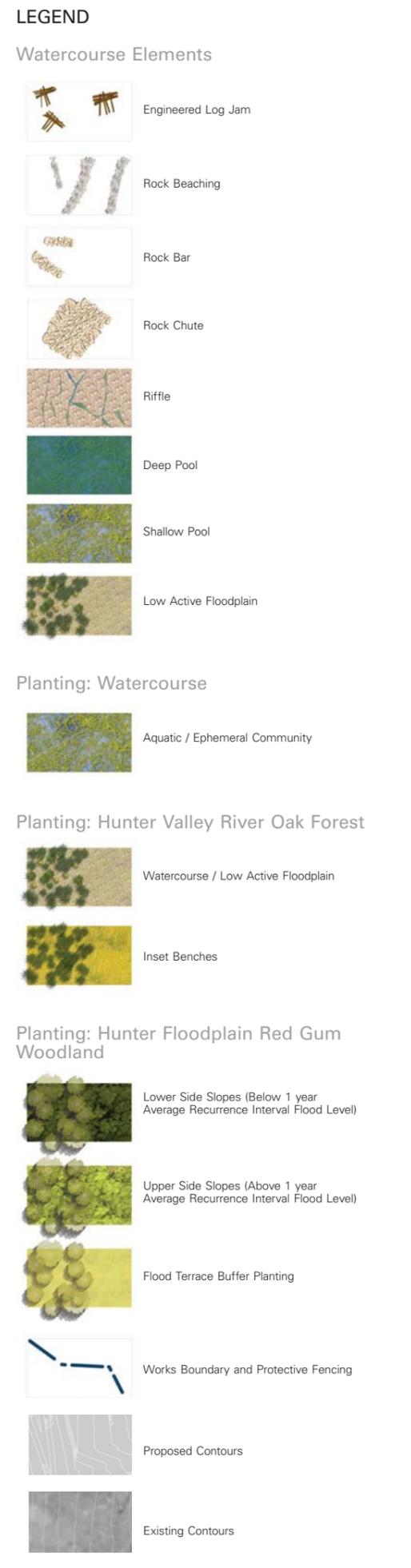
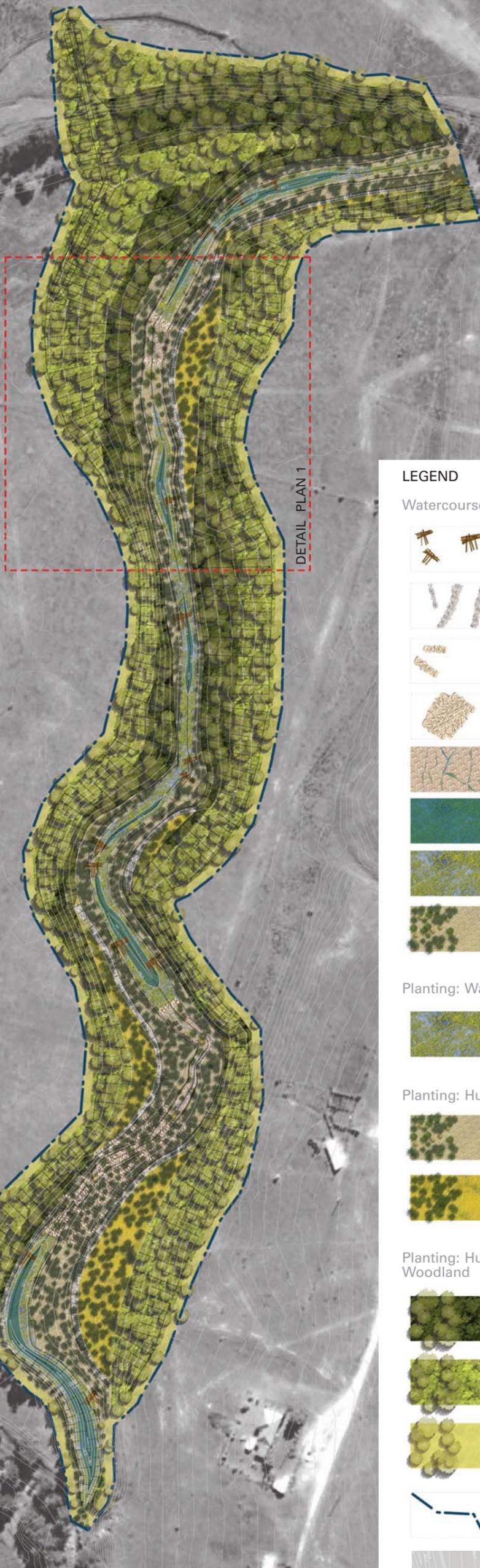
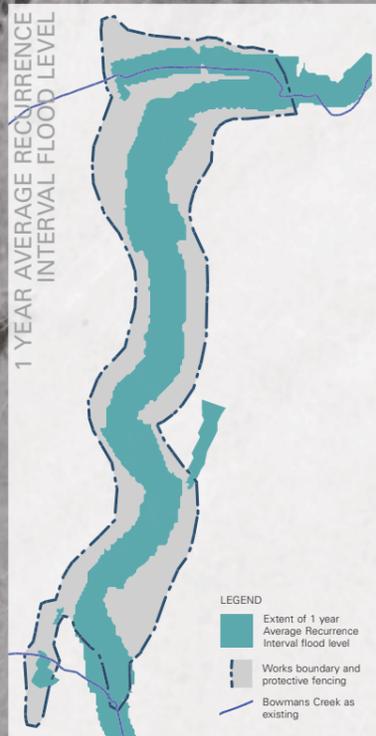
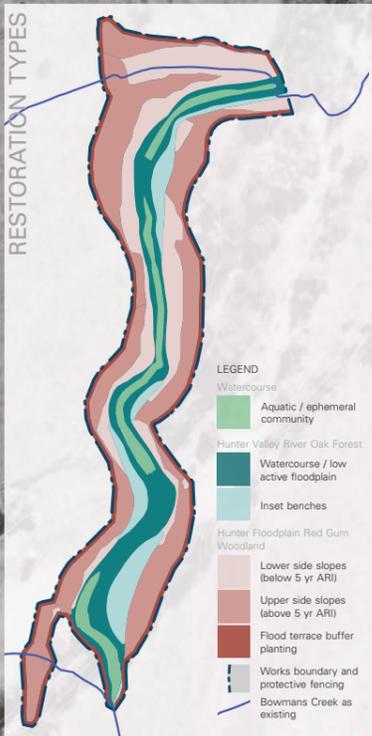
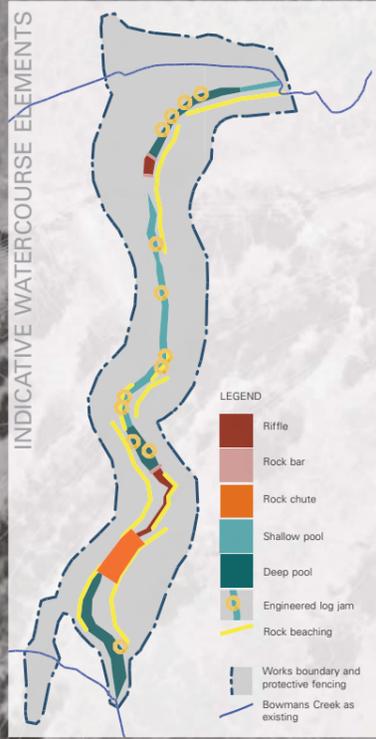


## APPENDIX 1

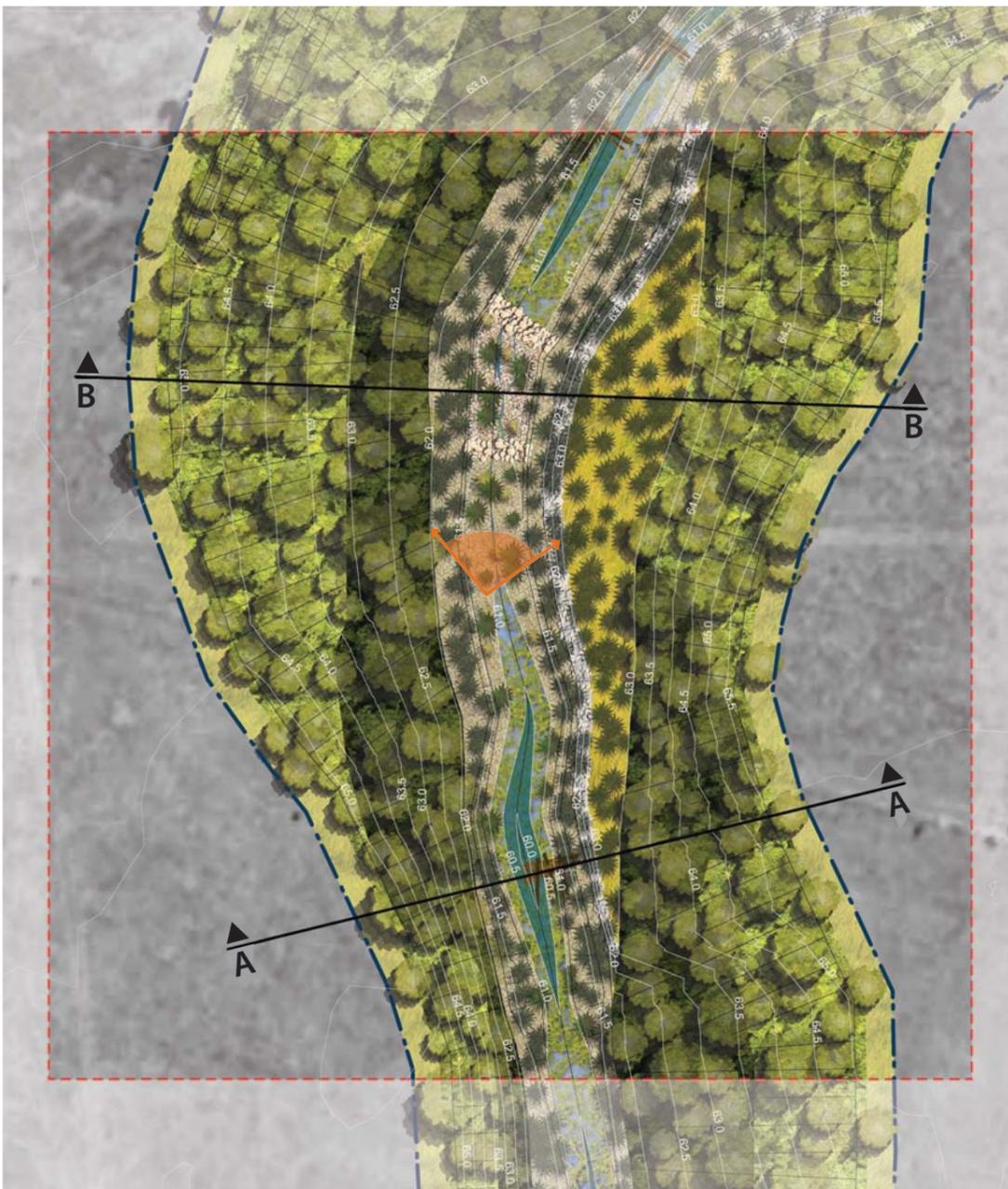
# LANDSCAPE DRAWINGS

- » SK01 – Masterplan – Eastern Diversion
- » SK02 – Detail Area / Sections - Eastern Diversion
- » SK03 – Masterplan – Western Diversion
- » SK04 – Detail Area / Sections - Western Diversion
- » SK05 – General Details

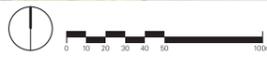








Detail Plan 1 Scale 1:500@B1



Perspective View Looking Upstream

DETAIL LEGEND

Watercourse Elements

- Engineered Log Jam
- Rock Beaching
- Rock Bar
- Riffle
- Deep Pool
- Shallow Pool
- Low Active Floodplain

Planting: Watercourse

- Aquatic / Ephemeral Community

Planting: Hunter Valley River Oak Forest

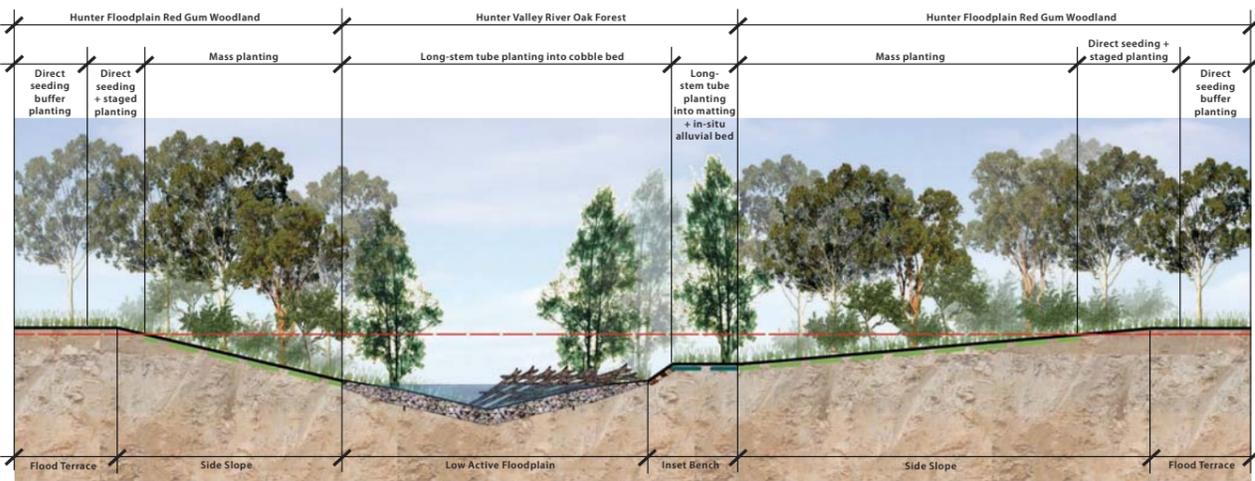
- Watercourse / Low Active Floodplain
- Inset Benches

Planting: Hunter Floodplain Red Gum Woodland

- Lower Side Slopes (Below 1 year Average Recurrence Interval Flood Level)
- Upper Side Slopes (Above 1 year Average Recurrence Interval Flood Level)
- Flood Terrace Buffer Planting

- Works Boundary and Protective Fencing
- Perspective Point for Perspective View

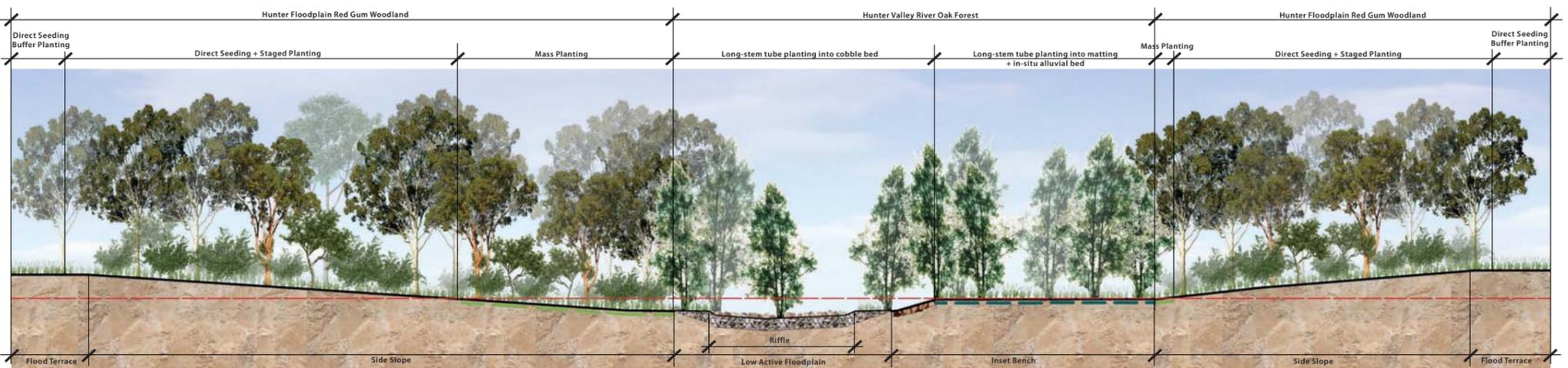
- Proposed Contours
- Existing Contours



Section A-A Scale 1:200@B1

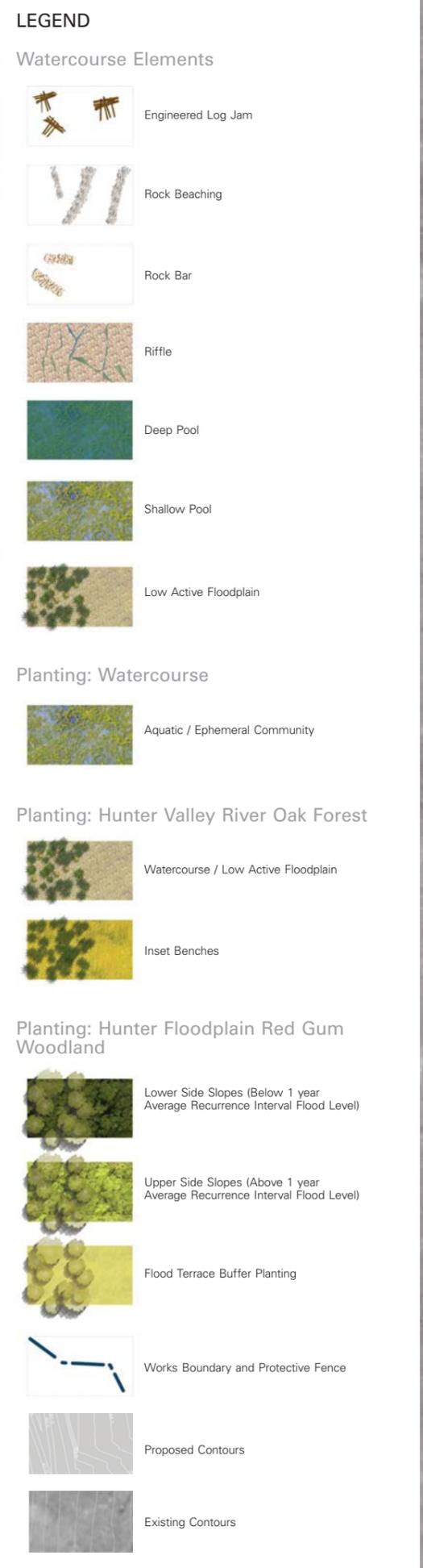
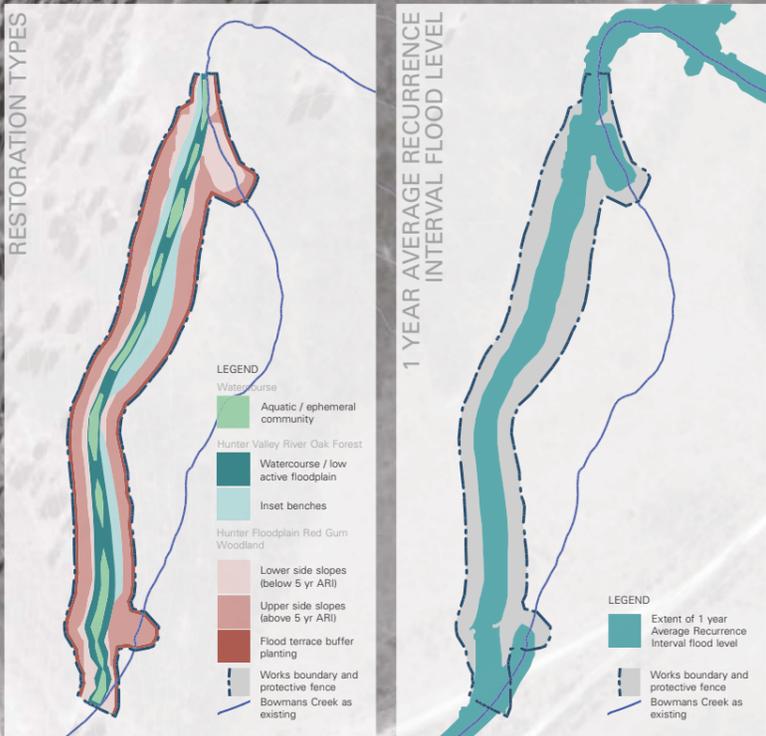
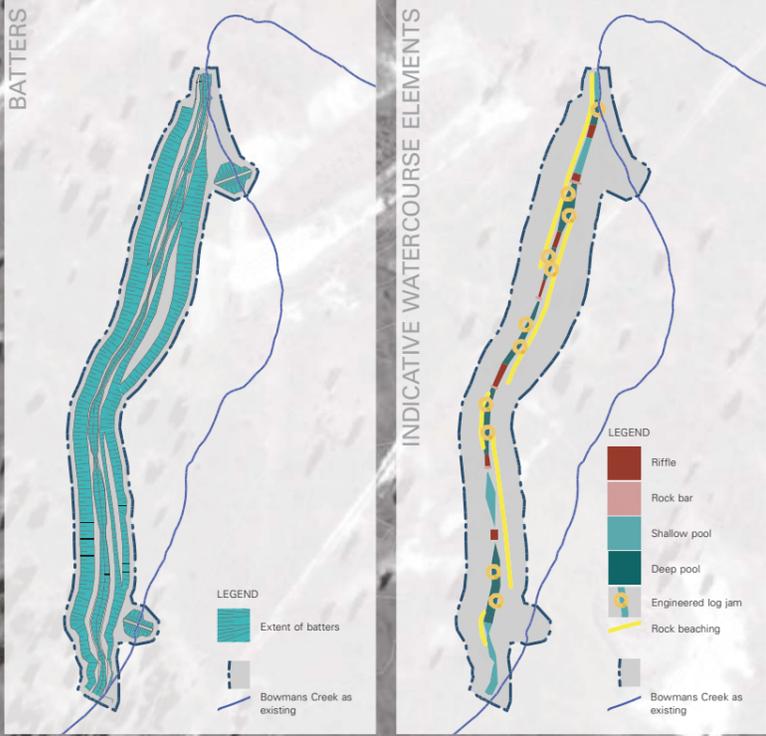
SECTION LEGEND

- Cobble Bed over Geosynthetic Clay Liner
- Rock Beaching
- Medium Duty Matting
- Heavy Duty Matting
- Engineered Log Jam
- 1 Year Average Recurrence Interval Flood Level

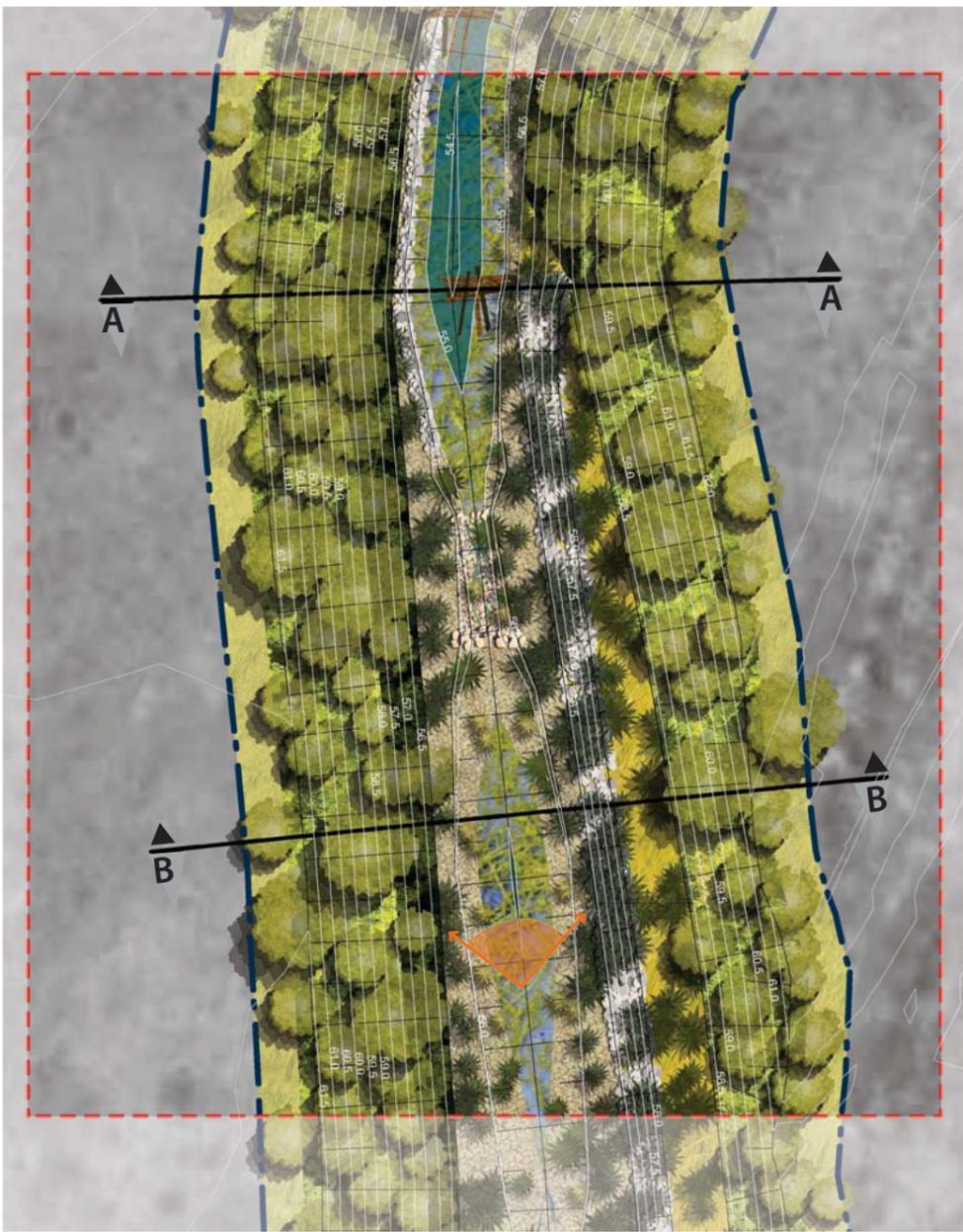


Section B-B Scale 1:200@B1









Detail Plan 2 Scale 1:500@B1



DETAIL LEGEND

Watercourse Elements

- Engineered Log Jam
- Rock Beaching
- Rock Bar
- Riffle
- Deep Pool
- Shallow Pool
- Low Active Floodplain
- Works Boundary and Protective Fencing
- Perspective Point for Perspective View

Planting: Watercourse

- Aquatic / Ephemeral Community
- Watercourse / Low Active Floodplain
- Inset Benches

Planting: Hunter Valley River Oak Forest

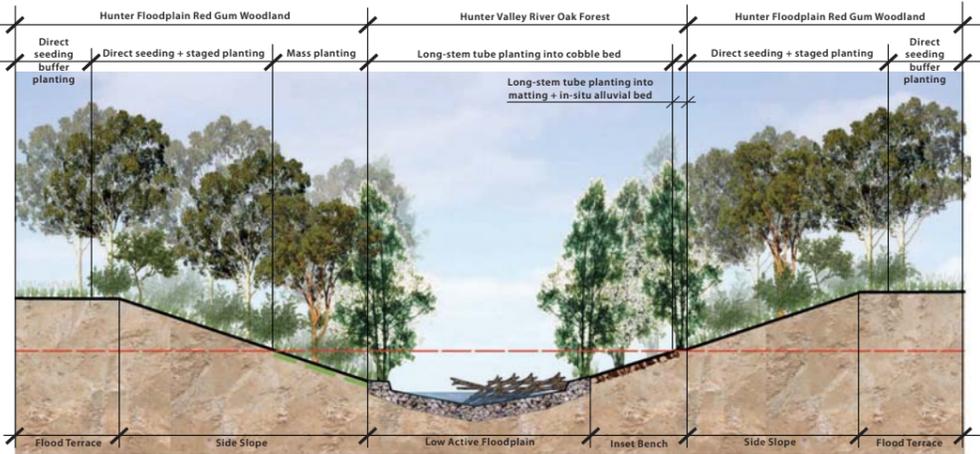
- Lower Side Slopes (Below 1 year Average Recurrence Interval Flood Level)
- Upper Side Slopes (Above 1 year Average Recurrence Interval Flood Level)
- Flood Terrace Buffer Planting

Planting: Hunter Floodplain Red Gum Woodland

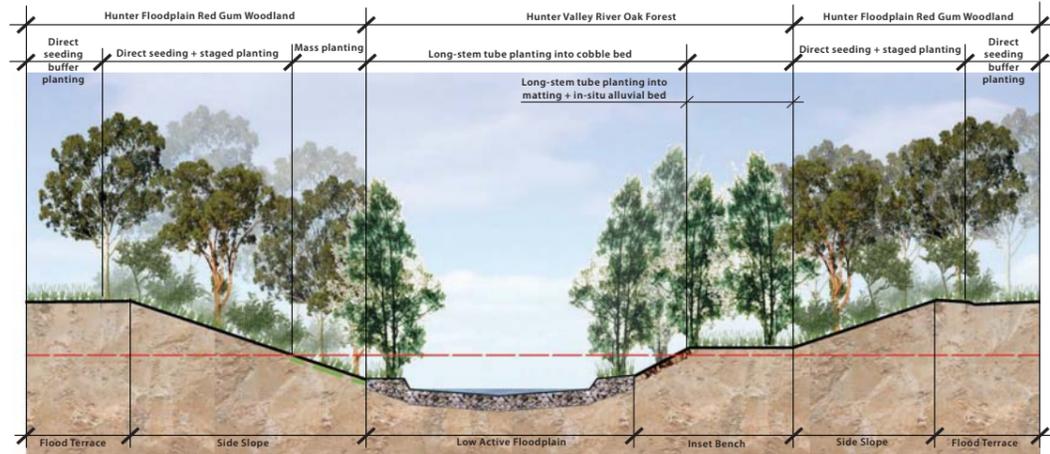
- Proposed Contours
- Existing Contours

SECTION LEGEND

- Cobble Bed over Geosynthetic Clay Liner
- Rock Beaching
- Medium Duty Matting
- Engineered Log Jam
- 1 Year Average Recurrence Interval Flood Level



Section A-A Scale 1:200@B1

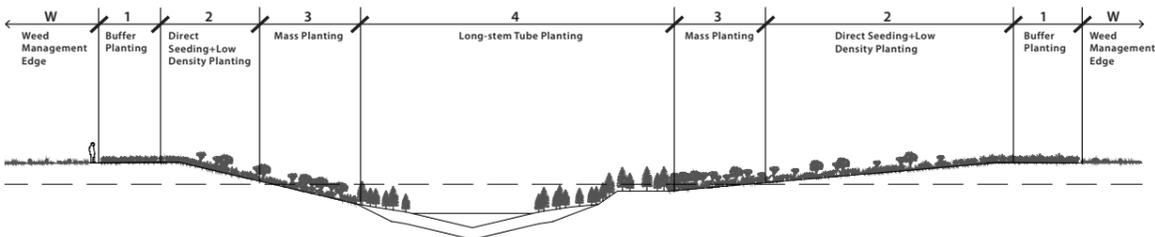


Section B-B Scale 1:200@B1

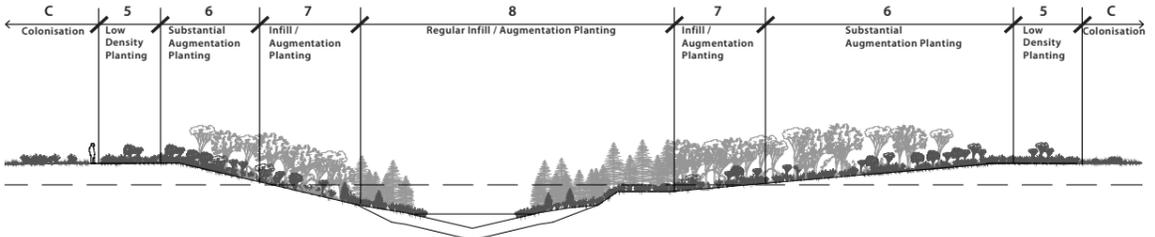


Perspective View Looking Upstream

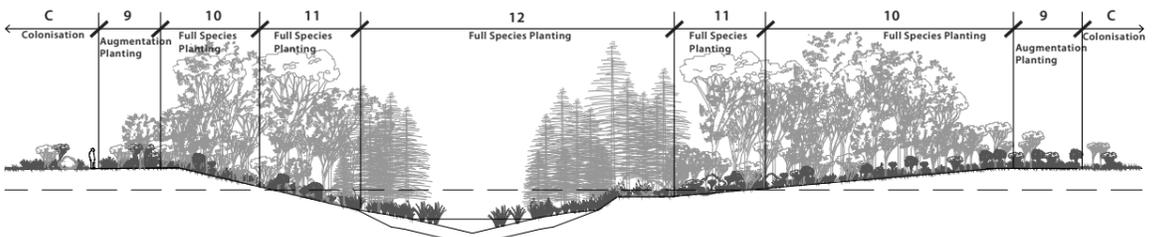




Phase 1 - Site Stabilisation - Year 1-3



Phase 2 - Community Structure - Year 3-6



Phase 3 - Species Diversity - Year 6-8

NOTE: All works to be fenced to prevent entry of stock into the works area.

Staging of Landscape Restoration

- ### Hunter Floodplain Red Gum Forest
- |  |   |
|--|---|
| <b>Trees</b>   | <b>Grass</b>                                      |
| <i>Eucalyptus camaldulensis</i>                              | <i>Cynodon dactylon</i>                           |
| <i>Eucalyptus tereticornis</i>                               | <i>Austrostipa verticillata</i>                   |
| <i>Angophora floribunda</i>                                  | <i>Microlaena stipoides</i> var. <i>stipoides</i> |
| <i>Brachychiton populneus</i> subsp. <i>populneus</i>        | <i>Aristida ramosa</i>                            |
| <i>Eucalyptus melliodora</i>                                 | <i>Austrodanthonia fulva</i>                      |
| <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> | <i>Cynoglossum australe</i>                       |
| <i>Eucalyptus crebra</i>                                     | <i>Eragrostis leptostachya</i>                    |
| <i>Eucalyptus punctata</i>                                   | <i>Sporobolus creber</i>                          |
| <i>Casuarina glauca</i>                                      |   |
| <b>Shrubs and Groundcovers</b>                               | <b>Sedges and Rushes</b>                          |
| <i>Notelaea microcarpa</i> var. <i>microcarpa</i>            | <i>Carex</i> sp.                                  |
| <i>Bursaria spinosa</i>                                      | <i>Cyperus fulvus</i>                             |
| <i>Exocarpos strictus</i>                                    | <i>Cyperus gracilis</i>                           |
| <i>Notelaea neglecta</i>                                     | <i>Juncus</i> sp.                                 |
| <i>Solanum cinereum</i>                                      |   |
| <i>Dichondra repens</i>                                      | <b>Ground Fern</b>                                |
| <i>Einadia hastata</i>                                       | <i>Cheilanthes austrotenuifolia</i>               |
| <i>Pratia purpurascens</i>                                   | <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>  |
| <i>Altemanthera denticulata</i>                              | <i>Marsilea drummondii</i>                        |
| <i>Calotis lappulacea</i>                                    |   |
| <i>Commelina cyanea</i>                                      | <b>Twiner</b>                                     |
| <i>Einadia trigonos</i>                                      | <i>Glycine tabacina</i>                           |
| <i>Geranium solanderi</i> var. <i>solanderi</i>              | <i>Desmodium varians</i>                          |
| <i>Rumex brownii</i>   | <i>Glycine clandestina</i>                        |
| <i>Ajuga australis</i>                                       |   |
| <i>Lepidium pseudohyssopifolium</i>                          |   |
| <i>Oxalis exilis</i>   |   |
| <i>Oxalis radiocosa</i>                                      |   |
| <i>Plantago debilis</i>                                      |   |
| <i>Pratia concolour</i>                                      |   |
| <i>Sida corrugata</i>  |   |
| <i>Solanum americanum</i>                                    |   |
| <i>Urtica incisa</i>   |   |
| <i>Amaranthus macrocarpus</i> var. <i>macrocarpus</i>        |   |

- ### Hunter Valley River Oak Forest
- |  |   |
|--|---|
| <b>Trees</b>   | <b>Grass</b>  |
| <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> | <i>Austrostipa verticillata</i>                     |
| <i>Angophora floribunda</i>                                  | <i>Oplismenus aemulus</i>                           |
| <i>Eucalyptus tereticornis</i>                               | <i>Echinochloa termatophila</i>                     |
|  | <i>Cynodon dactylon</i>                             |
| <b>Shrubs and Groundcovers</b>                               | <i>Echinopogon ovatus</i>                           |
| <i>Acacia falcata</i>  | <i>Microlaena stipoides</i> var. <i>stipoides</i>   |
| <i>Acacia longifolia</i>                                     |   |
| <i>Acacia paradoxa</i>                                       | <b>Sedges</b>                                       |
| <i>Ficus coronata</i>  | <i>Carex appressa</i>                               |
| <i>Hymenanthera dentata</i>                                  | <i>Schoenus apogon</i>                              |
| <i>Myoporum montanum</i>                                     |   |
| <i>Notelaea venosa</i>                                       | <b>Ground Fern</b>                                  |
| <i>Nyssanthus diffusa</i>                                    | <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>    |
| <i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>       |   |
| <i>Solanum prinophyllum</i>                                  | <b>Vine</b>   |
| <i>Lomandra longifolia</i>                                   | <i>Pandorea pandorana</i> subsp. <i>pandorana</i>   |
| <i>Dichondra Repens</i>                                      | <i>Calystegia marginata</i>                         |
| <i>Persicaria decipiens</i>                                  | <i>Cayratia clematidea</i>                          |
| <i>Plectranthus parviflorus</i>                              | <i>Clematis glycinoides</i> var. <i>glycinoides</i> |
| <i>Pratia purpurascens</i>                                   | <i>Eustrephus latifolius</i>                        |
| <i>Commelina cyanea</i>                                      | <i>Desmodium varians</i>                            |
| <i>Convolvulus erubescens</i>                                | <i>Glycine clandestina</i>                          |
| <i>Cotula australis</i>                                      | <i>Stephania japonica</i> var. <i>discolor</i>      |
| <i>Cynoglossum australe</i>                                  |   |
| <i>Einadia hastata</i>                                       |   |
| <i>Galium propinquum</i>                                     |   |
| <i>Geranium solanderi</i> var. <i>solanderi</i>              |   |
| <i>Plantago debilis</i>                                      |   |
| <i>Plantago gaudichaudii</i>                                 |   |
| <i>Solenogyne belloides</i>                                  |   |
| <i>Stellaria pungens</i>                                     |   |
| <i>Urtica incisa</i>   |   |

Engineered Log Jams



Engineered Log Jam, in this case log step with paired abutment jams. Williams River, NSW  
Photo provided by Chris Gippel



Engineered Log Jams at the completion of construction  
Photo provided by Chris Gippel

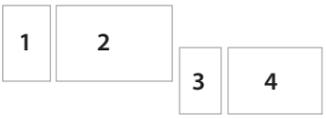


The same site as above seven years later with the engineered log jams visible at the middle right of frame  
Photo provided by Chris Gippel



- 1 Photo of Bowmans Creek showing existing cobble watercourse and remnant River Oak Forest character.
- 2 Example of densely planted water course 15 months after planting, as proposed for the lower side slopes, showing ground-holding capability of the approach. Intensive weed management is crucial to the success of this approach in the early phase of the project.
- 3 The proposed works will provide substantial habitat opportunities for a range of both aquatic and terrestrial fauna.
- 4 Example of Kangaroo Grass cover 15 months after being direct seeded to this site, as proposed for the upper slopes.

Image Key Plan





## APPENDIX 2

# SPECIES LIST – SITE AND LOCAL ENVIRONS

Species list excerpt from flora and fauna assessment for the site  
– HLA Envirosciences 2001



**Flora and Fauna Report – White Mining Limited – Ashton Mine Project**

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**APPENDIX 2**

**FLORA OF THE STUDY SITE, LOCAL AREA AND  
WITHIN A 20 KM X 20 KM GRID (NPWS WA DATA)**



**Flora and Fauna Report – White Mining Limited – Ashton Mine Project**

**APPENDIX 2**

- I - Exotic species (\*\* = declared noxious species)  
 Status - Status in Threatened Species Conservation Act 1995 & National Parks and Wildlife Act 1974.
- 1 - Present Study
  - 2 - Croft and Associates (1986a) – Rixs Creek
  - 3 - EEPS and Associates (1989) – Camberwell
  - 4 - ERM Mitchell McCotter (1999) – Ravensworth West
  - 5 - ERM Mitchell McCotter (1997) – Ravensworth East
  - 6 - Croft and Associates (1986b) – Ravensworth South
  - 7 - Dames and Moore (1990) – Glennies Creek
  - 8 - Sinclair Knight Merz (1997) – Lemington South
  - 9 - NSW National Parks and Wildlife Service Wildlife Atlas

*Coniferopsida*

Scientific Name	Common Name	I	Status	Source
<i>Cupressaceae</i>				
<i>Callitris columellaris</i>			U	6,8
<i>Callitris endlicheri</i>	Black Cyprus Pine		U	6,8
<i>Pinaceae</i>				
<i>Pinus pinaster</i>	Cluster Pine	*	U	8

*Cycadopsida*

Scientific Name	Common Name	I	Status	Source
<i>Zamiaceae</i>				
<i>Macrozamia spiralis</i>			U	6

*Filicopsida*

Scientific Name	Common Name	I	Status	Source
<i>Adiantaceae</i>				
<i>Adiantum aethiopicum</i>	Common Maidenhair		P13	3,6
<i>Aspleniaceae</i>				
<i>Asplenium flabellifolium</i>	Necklace Fern		U	3

**Flora and Fauna Report – White Mining Limited – Ashton Mine Project**
**Appendix 2: Flora (*Filicopsida* continued)**

Scientific Name	Common Name	I	Status	Source
<b><i>Dennstaedtiaceae</i></b>				
<i>Pteridium esculentum</i>	Bracken		U	3,8
<b><i>Lindsaeaceae</i></b>				
<i>Lindsea microphylla</i>			U	8
<b><i>Marsileaceae</i></b>				
<i>Marsilea drummondii</i>	Common Nardoo			6
<i>Marsilea mutica</i>	Common Nardoo		U	1,4,8
<b><i>Sinopteridaceae</i></b>				
<i>Cheilanthes austrotenuifolia</i>	Rock Fern		U	1,2
<i>Cheilanthes distans</i>			U	4,10
<i>Cheilanthes seiberi</i>	Mulga Fern		U	1,3,6,8,10
<i>Cheilanthes sp.</i>	Mulga Fern		U	4

***Magnoliopsida (Liliidae)***

Scientific Name	Common Name	I	Status	Source
<b><i>Agavaceae</i></b>				
<i>Agave americana</i>	Century Plant	*	U	2
<i>Yucca aloifolia</i>	Yucca	*	U	8
<b><i>Alliaceae</i></b>				
<i>Ipheion uniflorum</i>	Spring Star-flower	*	U	1
<i>Nothoscordum borbonicum</i>	Onion Weed	*	U	6
<b><i>Antheriaceae</i></b>				
<i>Arthropodium milleflorum</i>	Vanilla Lily		U	6
<i>Arthropodium minus</i>	Small Vanilla Lily		U	6
<i>Caesia parviflora</i>				
<i>Tricoryne elatior</i>	Autumn Yellow Lily		U	6
<i>Tricoryne simplex</i>	Northern Rush Lily		U	6
<b><i>Asphodelaceae</i></b>				
<i>Aloe saponaria</i>	Soap Aloe	*	U	1
<b><i>Commelinaceae</i></b>				
<i>Aneilema biflorum</i>			U	8

## Flora and Fauna Report - White Mining Limited - Ashton Mine Project

Appendix 2: Flora (*Magnoliopsida (Liliidae)* continued)

Scientific Name	Common Name	I	Status	Source
<b>Cyperaceae</b>				
<i>Bolboschoenus caldwellii</i>			U	8
<i>Carex tereticaulis</i>			U	9
<i>Cyperus difformis</i>	Dirty Dora		U	1,6,8
<i>Cyperus eragrostis</i>	Umbrella Sedge	*	U	1,6,8
<i>Cyperus gracilis</i>			U	1
<i>Cyperus laevigatus</i>			U	8
<i>Cyperus sp.</i>		?	U	4,7
<i>Eleocharis acuta</i>	Spike Rush		U	3,6
<i>Eleocharis equisetina</i>			U	6
<i>Eleocharis pusilla</i>			U	6
<i>Eleocharis sp.</i>		?	U	3,4,7
<i>Eleocharis sphacelata</i>	Tall Spike-rush		U	4,5,6,8
<i>Fimbristylis dichotoma</i>			U	1,4
<i>Gahnia aspera</i>			U	3,5,6
<i>Lepironia articulata</i>			U	6
<i>Schoenoplectus mucronatus</i>			U	6
<i>Schoenoplectus validus</i>			U	6
<b>Hydrocharitaceae</b>				
<i>Ottelia ovalifolia</i>	Swamp Lily		U	3,8
<b>Irididaceae</b>				
<i>Romulea longifolia</i>	Onion Weed	*	U	2
<i>Romulea roea var australis</i>	Onion Weed	*	U	4
<i>Wurmbea dioica</i>	Early Nancy		U	2
<b>Juncaceae</b>				
<i>Juncus acutus</i>	Sharp Rush		U	1,2,3,4,5,8
<i>Juncus continuus</i>			U	8
<i>Juncus pauciflorus</i>			U	8
<i>Juncus planifolius</i>			U	9
<i>Juncus procerus</i>			U	8
<i>Juncus sp.</i>		?	U	3,7
<i>Juncus subglaucus</i>			U	5
<i>Juncus subsecundus</i>				8
<i>Juncus usitatus</i>			U	1,2,3,4

**Flora and Fauna Report – White Mining Limited – Ashton Mine Project****Appendix 2: Flora (*Magnoliopsida (Liliidae)* continued)**

Scientific Name	Common Name	I	Status	Source
<b><i>Juncaginaceae</i></b>				
<i>Triglochin procerum</i>	Water Ribbons		U	2,3,4,8
<b><i>Lomandraceae</i></b>				
<i>Lomandra confertifolia</i>			U	1,8,10
<i>Lomandra filiformis</i>	Wattle Mat-rush		U	4,8
<i>Lomandra longifolia</i>			U	1,3,5,6,10
<i>Lomandra multiflora</i>	Many Flowered Mat-rush		U	1,3,6,10
<b><i>Luzuriagaceae</i></b>				
<i>Eustrephus latifolius</i>	Wombat Berry		U	6
<i>Geitonoplesium cymosum</i>			U	9
<b><i>Orchidaceae</i></b>				
<i>Dipodium sp.</i>			U	9
<i>Microtis unifolia</i>	Common Onion Orchid		U	8
<b><i>Phormiaceae</i></b>				
<i>Dianella longifolia</i>			U	8,10
<i>Dianella laevis</i>			U	3
<i>Dianella revoluta</i>			U	1,8
<i>Dianella sp.</i>			U	1
<b><i>Poaceae</i></b>				
<i>Agrostis avenacea</i>	Beard Grass		U	3,5,6
<i>Alloteropsis</i>	Cockatoo Grass		U	3
<i>Andropogon virginicus</i>	Whiskey Grass	*	U	8
<i>Aristida ramosa</i>	Wire Grass		U	1,4,10
<i>Aristida sp.</i>			U	3,10
<i>Aristida vagans</i>	Threeawn Speargrass		U	1,2,3,4,5,6,8
<i>Axonopus affinis</i>	Narrow-leaved Carpet Grass		U	8
<i>Avena sterilis</i>	Wild Oats	*	U	3
<i>Botriochloa decipiens</i>	Redleg Grass		U	2,4
<i>Botriochloa macra</i>	Redleg Grass		U	3,4,5,6,10
<i>Briza minor</i>	Shivery Grass	*	U	1,6
<i>Bromus cartharticus</i>	Prairie Grass	*	U	1,3,6
<i>Bromus sp.</i>	Brome	*	U	4

**Flora and Fauna Report – White Mining Limited – Ashton Mine Project**
**Appendix 2: Flora (*Magnoliopsida (Liliidae)* continued)**

Scientific Name	Common Name	I	Status	Source
<b>Poaceae continued</b>				
<i>Chloris gayana</i>	Rhodes Grass	*	U	1,3,4,5,6,8
<i>Chloris sp.</i>			U	2
<i>Chloris truncata</i>	Windmill Grass		U	1,4,5,6,8,10
<i>Cortaderia selloana</i>	Pampas Grass	**	U	8
<i>Cymbopogon refractus</i>	Barbed Wire Grass		U	1,2,4,5,8
<i>Cynodon dactylon</i>	Couch		U	1,2,3,4,5,6,8,10
<i>Cynodon incomplectus</i>		*	U	6
<i>Danthonia linkii</i>	Wallaby Grass		U	1
<i>Danthonia monticola</i>	Wallaby Grass		U	5,6
<i>Danthonia richardsonii</i>	Wallaby Grass		U	9
<i>Danthonia sp.</i>	Wallaby Grass		U	3,4,10
<i>Danthonia tenuior</i>	Wallaby Grass		U	8
<i>Dichanthium sericeum</i>	Queensland Blue Grass		U	2
<i>Dichelachne inaequiglumis</i>			U	1
<i>Dichelachne micrantha</i>	Shorthair Plumegrass		U	3,5,6,8
<i>Echinochloa colona</i>	Awnless Barnyard Grass		U	6
<i>Echinopogon sp.</i>			U	9
<i>Eleusine indica</i>	Crowsfoot Grass	*	U	8
<i>Elymus scaber</i>	Common Wheat Grass		U	6
<i>Elymus scaber</i>			U	3
<i>Entolasia stricta</i>	Wiry Panic		U	8
<i>Enteropogon acicularis</i>			U	1
<i>Eragrostis brownii</i>	Browns Lovegrass		U	1,2,8
<i>Eragrostis lacunaria</i>	Purple Lovegrass		U	5,6
<i>Eragrostis molybdea</i>			U	6
<i>Eragrostis parviflora</i>	Weeping Lovegrass		U	5,6
<i>Eragrostis sp.</i>	Lovegrass		U	4
<i>Hordeum leporinum</i>	Barley Grass	*	U	3,5,6
<i>Imperata cylindrica</i>	Blady Grass		U	8,10
<i>Lolium perenne</i>	Ryegrass	*	U	1,6
<i>Lolium rigidum</i>	Wimmera Ryegrass	*	U	6
<i>Melinis repens</i>	Red Natal Grass	*	U	1,2,4
<i>Microlaena stipoides</i>			U	1,8

**Flora and Fauna Report – White Mining Limited – Ashton Mine Project**
**Appendix 2: Flora (*Magnoliopsida (Liliidae)* continued)**

Scientific Name	Common Name	I	Status	Source
<b>Poaceae continued</b>				
<i>Panicum effusum</i>	Hairy Panic		U	4,10
<i>Paspalum constrictum</i>	Box Grass		U	6
<i>Paspalum dilatatum</i>	Paspalum	*	U	1,2,3,4,5,6,8
<i>Paspalum distichum</i>	Water Couch		U	1,3,6
<i>Pennisetum clandestinum</i>	Kikuyu	*	U	1,3,4,6,8
<i>Pennisetum setaceum</i>	Fountain Grass	*	U	4
<i>Phalaris aquaticum</i>	Phalaris	*	U	8
<i>Phalaris paradoxa</i>	Paradoxa Grass	*	U	5
<i>Phragmites australis</i>	Common Reed		U	1,2,3,6,8
<i>Poa annua</i>		*	U	8
<i>Poa labillardierei</i>			U	9
<i>Poa sp.</i>			U	7
<i>Setaria gracilis</i>	Slender Pigeon Grass	*	U	1,2,8
<i>Sorghum bicolor</i>	Sorghum	*	U	1
<i>Sorghum halepense</i>	Johnson Grass	**	U	3,6
<i>Sorghum leiocladum</i>	Wild Sorghum		U	6,10
<i>Sporobolus creber</i>	Slender Rats Tail		U	1,4,10
<i>Sporobolus elongatus</i>	Slender Rats Tail Grass		U	6
<i>Sporobolus indicus</i>	Parramatta Grass		U	6
<i>Sporobolus virginicus</i>	Sand Couch		U	3
<i>Stipa aristiglumis</i>	Plains Grass		U	6,8
<i>Stipa bigeniculata</i>	Yanganbil		U	1,6
<i>Stipa densiflora</i>	Foxtail Speargrass		U	6
<i>Stipa ramosissima</i>	Stout Bamboo Grass		U	3,6
<i>Stipa scabra</i>	Rough Spear Grass		U	1,3,4,5,6,10
<i>Stipa sp.</i>			U	2,3,7,10
<i>Stipa variabilis</i>	Species Complex	?	U	3,6
<i>Stipa verticillata</i>			U	9
<i>Themeda australis</i>	Kangaroo Grass		U	1,2,4,5,6,7,10
<b>Potamogetonaceae</b>				
<i>Potamogeton tricarinatus</i>	Floating Pondweed		U	1,6,8
<i>Potamogeton pectinatus</i>	Sago Pondweed		U	3
<i>Potamogeton perfoliatus</i>	Clasped Pondweed		U	3

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**Appendix 2: Flora (*Magnoliopsida (Liliidae)* continued)**

Scientific Name	Common Name	I	Status	Source
<i>Typhaceae</i>				
<i>Typha orientalis</i>	Cumbungi		U	1,3,4,6,7,8

***Magnoliopsida (Magnoliidae)***

Scientific Name	Common Name	I	Status	Source
<i>Acanthaceae</i>				
<i>Brunoniella pumilio</i>			U	10
<i>Aizoaceae</i>				
<i>Galenia pubescens</i>	Galenia	*	U	1,3,4,5,6
<i>Amaranthaceae</i>				
<i>Amaranthus pungens</i>		*	U	8
<i>Amygdalaceae</i>				
<i>Prunus armeniaca</i>	Apricot	*	U	8
<i>Prunus persica</i>	Peach	*	U	1,8
<i>Anacardiaceae</i>				
<i>Schinus areira</i>	Pepper Tree	*	U	1,2,3,4,8
<i>Apiaceae</i>				
<i>Centella asiatica</i>	Pennywort		U	4,10
<i>Ciclospermum leptophyllum</i>	Slender Celery	*	U	6
<i>Foeniculum vulgare</i>	Fennel	*	U	1,3,4,6,8
<i>Hydrocotyle bonariensis</i>	Pennywort	*	U	3
<i>Platysace ericoides</i>			U	6
<i>Trachymeme incisa</i>			U	1
<i>Apocynaceae</i>				
<i>Nerium oleander</i>	Oleander	*	U	8
<i>Parsonsia straminea</i>	Common Silkpod		U	3,6
<i>Asclepiadaceae</i>				
<i>Gomocarpus fruticosus</i>	Narrow-leaved Cotton Bush	*	U	1,2,3,4,5,6,8,10
<i>Marsdenia rostrata</i>	Common Milk Vine		U	6
<i>Asteraceae</i>				
<i>Arctotheca calendula</i>	Cape Weed	*	U	1,4
<i>Aster subulatus</i>	Bushy Starwart	*	U	1,4,8

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**Appendix 2: Flora (*Magnoliopsida (Magnoliidae)* continued)**

Scientific Name	Common Name	I	Status	Source
<b><i>Asteraceae</i> continued</b>				
<i>Biddens pilosa</i>	Pitchfolks	*	U	1,2,4,6,8,10
<i>Brachyscome</i> sp.			U	1,6
<i>Brachyscome multifida</i>			U	10
<i>Bracteantha bracteata</i>	Golden Everlasting		U	6
<i>Calocephalus citreus</i>	Lemon Beauty Heads		U	1,5
<i>Calotis cuneifolia</i>	Purple Burr-daisy		U	1,2,6
<i>Calotis hispidula</i>	Bogan Flea		U	1
<i>Calotis lappulacea</i>	Yellow Burr Daisy		U	4,8,10
<i>Carthamus lanatus</i>	Saffron Thistle	*	U	1,3,6
<i>Cassinia cunninghamii</i>			U	1
<i>Cassinia quiquefaria</i>	Dead Finish		U	3
<i>Cassinia uncatata</i>			U	10
<i>Centipedia minima</i>	Spreading Sneezeweed		U	8
<i>Centipedia</i> sp.	Sneezeweed		U	10
<i>Chondrilla juncea</i>	Skeleton Weed	*	U	3
<i>Chrysocephalum apiculatum</i>	Yellow Buttons		U	1,3,5,6,8,10
<i>Chrysocephalum semipapposum</i>	Clustered Everlasting		U	3,6
<i>Cirsium arvense</i>	Perennial Thistle	*	U	6,8
<i>Cirsium vulgare</i>	Spear Thistle	*	U	1,3,4,5,6
<i>Conyza alba</i>		*	U	3,10
<i>Conyza bonariensis</i>	Flaxleaf Fleabane	*	U	1,3,5,6,8
<i>Cotula australis</i>	Carrot Weed		U	1,6,8
<i>Cotula coronopifolia</i>	Water Buttons	*	U	3
<i>Craspedia uniflora</i>	Common Billy Buttons		U	6
<i>Epaltes australis</i>	Spreading Nut-heads		U	8
<i>Erigeron canadensis</i>	Canadian Fleabane	*	U	6
<i>Gnaphalium sphaericum</i>	Common Cudweed		U	1,8
<i>Gnaphalium spicatum</i>	Spiked Cudweed		U	6
<i>Helichrysum</i> sp.			U	7,10
<i>Hypochaeris radicata</i>	Catsear, Flatweed	*	U	1,8,10
<i>Leptorhynchos tetrachaetus</i>	Beauty Buttons		U	5,6
<i>Olearia elliptica</i>	Sticky Daisy Bush		U	2,6
<i>Ozothamum diosmifolius</i>	White Dogwood		U	1,2,6,8

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Appendix 2: Flora (*Magnoliopsida* (*Magnoliidae*) continued)

Scientific Name	Common Name	I	Status	Source
<b>Asteraceae continued</b>				
<i>Pseudognaphalium luteoalbum</i>	Jersey Cudweed		U	3,6,8
<i>Schkuhria pinnata</i>	Dwarf Marigold	*	U	1,6
<i>Senecio glossanthus</i>			U	3,5,6
<i>Senecio hispidulus</i>	Fireweed		U	8
<i>Senecio jacobaea</i>	Ragwort	*	U	6
<i>Senecio lautus</i>	Ragwort		U	2,3
<i>Senecio madagascariensis</i>	Fireweed	*	U	1,4,6,8,10
<i>Senecio quadridentatus</i>	Cotton Fireweed		U	6,8
<i>Senecio sp.</i>		?	U	3,4,10
<i>Sigesbeckia orientalis ssp orientalis</i>			U	
<i>Silybum marianum</i>	Variegated Thistle	*	U	1,6,8
<i>Sonchus asper</i>	Prickly Sowthistle	*	U	1,3
<i>Sonchus oleraceus</i>	Common Sowthistle	*	U	1,6,8
<i>Tagetes minuta</i>	Stinking Roger	*	U	1
<i>Taraxacum officinale</i>	Dandelion	*	U	1,3,4,5,6
<i>Vittadinia cervicularis</i>			U	5
<i>Vittadinia dissecta</i>	Fuzzweed		U	10
<i>Vittadinia sp</i>	Fuzzweed		U	4,10
<i>Vittadinia sulcata</i>	Fuzzweed		U	9
<i>Vittadinia trilobia</i>	Fuzzweed		U	1
<i>Xanthium occidentale</i>	Noogoora Burr	*	U	1,6
<i>Xanthium sp.</i>	Burr	**	U	4
<i>Xanthium spinosum</i>	Bathurst Burr	**	U	1,3,6,8
<b>Bignoniaceae</b>				
<i>Pandorea pandorana</i>	Wonga Wonga Vine		U	6
<b>Boraginaceae</b>				
<i>Cynoglossum australe</i>			U	6
<i>Echium vulgare</i>	Vipers Bugloss	*	U	8
<i>Echium plantagineum</i>	Paterson's Curse	*	U	1
<b>Brassicaceae</b>				
<i>Brassica tournefortii</i>	Mediterranean Turnip	*	U	1,2
<i>Hirschfeldia incana</i>	Buchan Weed	*	U	6



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Appendix 2: Flora (*Magnoliopsida (Magnoliidae)* continued)

Scientific Name	Common Name	I	Status	Source
<b>Brassicaceae continued</b>				
<i>Lepidium africanum</i>	Peppercress	*	U	1
<i>Lepidium bonariensis</i>		*	U	1,8
<i>Lepidium campestre</i>	Field Cress		U	4
<i>Lepidium hyssopifolium</i>			EI	6
<i>Lepidium pseudohyssopifolium</i>			U	1
<i>Lepidium pseudotasmanicum</i>			U	5
<i>Lepidium sp.</i>			U	1
<i>Rapistrum rugosum</i>	Turnip Weed	*	U	1,6
<i>Sisymbrium officinale</i>	Hedge Mustard	*	U	1,8
<b>Cactaceae</b>				
<i>Opuntia aurantiaca</i>	Tiger Pear	**	U	1,4,8
<i>Opuntia stricta</i>	Prickly Pear	**	U	1,2,3,4,5,6,7,8,10
<b>Campanulaceae</b>				
<i>Wahlenbergia communis</i>	Tufted Bluebell		U	1,6,8,10
<i>Wahlenbergia gracilis</i>	Blue Bell		U	1,6,8
<i>Wahlenbergia luteola</i>	Blue Bell		U	10
<i>Wahlenbergia stricta</i>	Tall Blue Bell		U	2,4,6,8
<b>Capparaceae</b>				
<i>Capparis mitchellii</i>	Native Orange		U	6
<b>Caryophyllaceae</b>				
<i>Cerastium glomeratum</i>	Mouse-eared Chickweed	*	U	1,4
<i>Petrorhagia nanteuilii</i>	Proliferous Pink	*	U	1,6
<b>Casuarinaceae</b>				
<i>Allocasuarina luehmannii</i>	Bull Oak		U	1,2,3,4,5,6,7,8,10
<i>Allocasuarina verticillata</i>	Drooping She Oak		U	3
<i>Casuarina cunninghamiana</i>	River Oak		P13	1,3,4,7,8
<i>Casuarina glauca</i>	Swamp Oak		U	1,2,3,4,5,6,8,10
<b>Celastraceae</b>				
<i>Maytenus silvestris</i>	Narrow-leaved Orangebark		U	3,6
<b>Chenopodiaceae</b>				
<i>Chenopodium album</i>	Fat Hen	*	U	1,6,8,10
<i>Einadia hastata</i>	Berry Saltbush		U	6,10

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Appendix 2: Flora (*Magnoliopsida (Magnoliidae)* continued)

Scientific Name	Common Name	I	Status	Source
<b>Chenopodiaceae continued</b>				
<i>Einadia sp.</i>			U	4
<i>Einadia trigonos</i>	Fishweed		U	1,8
<i>Maireana microphylla</i>	Eastern Cottonbush		U	1,2,3,4,6,7,8,10
<i>Sclerolaena birchii</i>	Galvanised Burr		U	1,6
<b>Chloanthaceae</b>				
<i>Spartothamnella juncea</i>	Bead Bush		U	5,6,8
<b>Clusiaceae</b>				
<i>Hypericum granineum</i>	Small St John's Wart		U	1,8
<i>Hypericum perforatum</i>		**	U	6
<b>Convolvulaceae</b>				
<i>Convolvulus arvensis</i>	Bindweed	*	U	6
<i>Convolvulus erubescens</i>	Bindweed		U	1,6
<i>Cuscuta australis</i>	Australian Dodder		U	6
<i>Dichondra repens</i>	Kidney Weed		U	1,3,4,8
<i>Porana commixta</i>	Climbing Bindweed		U	6
<b>Crasulaceae</b>				
<i>Crassula seiberiana</i>	Australian Stonecrop		U	8
<i>Kalanchoe longifolia</i>		*	U	8
<b>Dilleniaceae</b>				
<i>Hibbertia diffusa</i>			U	6
<i>Hibbertia faciculata</i>			U	8
<i>Hibbertia obtusifolia</i>			U	10
<i>Hibbertia sp.</i>			U	3,7
<b>Droseraceae</b>				
<i>Drosera peltata</i>	Sundew		U	2
<b>Elatiniaceae</b>				
<i>Elatine gratioloides</i>	Waterwort		U	8
<b>Epacridaceae</b>				
<i>Epacris sp.</i>			U	10
<i>Lissanthe stringosa</i>	Peach Heath		U	1,2,6
<i>Melichrus urceolatus</i>	Urn Heath		U	1,2

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 Appendix 2: Flora (*Magnoliopsida (Magnoliidae)* continued)

Scientific Name	Common Name	I	Status	Source
<b><i>Euphorbiaceae</i></b>				
<i>Breynia oblongifolia</i>	Coffee Bush		U	1,6,8,10
<i>Chamaesyce dallachyana</i>			U	1
<i>Euphorbia pepus</i>	Radium Plant	*	U	1
<i>Phyllanthus gastroemii</i>			U	8
<i>Ricinus communis</i>	Castor Oil Plant	*	U	6
<b><i>Fabaceae (Faboideae)</i></b>				
<i>Daviesia genistifolia</i>	Bitter Broom Pea		U	1,8,10
<i>Daviesia ulicifolia</i>	Gorse Bitter Pea		U	1,2,5,6,8
<i>Desmodium brachypodum</i>	Large Tick-trefoil		U	6,10
<i>Desmodium varians</i>	Slender Tickfoil		U	1,6,8
<i>Dillwynia sp.</i>				7
<i>Glycine clandestina</i>	Species complex		U	1,2,3,4,6,8,10
<i>Glycine microphylla</i>	Species Complex		U	4,8
<i>Glycine tabacina</i>	Species Complex		U	1,4,6
<i>Hardenbergia violacea</i>	False Sarsaparilla		U	12,3,6,8,10
<i>Hovea linearis</i>			U	6
<i>Indigofera australis</i>			U	3
<i>Jacksonia scoparia</i>	Dogwood		U	6,8
<i>Kennedia prostrata</i>			U	6
<i>Kennedia rubicunda</i>	Red Kennedy Pea		U	1
<i>Lotus australis</i>	Australian Trefoil		U	6
<i>Medicago polymorpha</i>	Burr Medic	*	U	1
<i>Medicago sativa</i>	Lucerne, Alfalfa	*	U	1,6
<i>Medicago sp.</i>		*	U	1,4
<i>Melilotus indicus</i>	Hexham Scent	*	U	1
<i>Melilotus officinalis</i>	Common Melilot	*	U	8
<i>Pultenaea linophylla</i>			U	8
<i>Swainsonia galegifolia</i>	Smooth Darling Pea		U	6
<i>Swainsonia queenslandica</i>			U	10
<i>Trifolium campestre</i>	Hop Clover	*	U	6
<i>Trifolium dubium</i>	Yellow Suckling Clover	*	U	8
<i>Trifolium glomeratum</i>	Clustered Clover	*	U	6

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**Appendix 2: Flora (*Magnoliopsida* (*Magnoliidae*) continued)**

Scientific Name	Common Name	I	Status	Source
<b>Fabaceae (Faboideae) continued</b>				
<i>Trifolium repens</i>	White Clover	*	U	1,4,8
<i>Trifolium sp.</i>		*	U	3
<i>Trifolium subterraneum</i>	Subterranean Clover	*	U	1
<i>Vicia sativa</i>	Common Vetch	*	U	1,8
<b>Fabaceae (Mimosoideae)</b>				
<i>Acacia amblygona</i>	Fan Wattle		U	1,2,3,5,6,8,10
<i>Acacia cultriformis</i>	Knife-leaved Wattle		U	6,8
<i>Acacia deanei</i>	Green Wattle			6
<i>Acacia decora</i>	Western Golden Wattle		U	1,2,3,5,6,7,8
<i>Acacia decurrens</i>	Black Wattle		U	4
<i>Acacia falcata</i>			U	1,2,4,5,8
<i>Acacia farnesiana</i>	Mimosa		U	2
<i>Acacia filicifolia</i>	Fern-leaved Wattle		U	1,8
<i>Acacia homalophylla</i>	Yarran		U	6
<i>Acacia paradoxa</i>	Kangaroo Thorn		U	1,2
<i>Acacia parvipinnula</i>	Silver-stemmed Wattle		U	1,2,7,10
<i>Acacia pendula</i>	Boree/Weeping Myall		U	8
<i>Acacia salicina</i>	Cooba, Native Willow			1,5,8,10
<i>Acacia sp.</i>			U	10
<i>Acacia stricta</i>			U	6
<i>Acacia ulicifolia</i>	Prickly Moses		U	2
<b>Fumariaceae</b>				
<i>Fumaria muralis</i>	Wall Fumitory	*	U	1
<b>Gentianaceae</b>				
<i>Centaurium erythraea</i>		*	U	8
<i>Centaurium tenuiflorum</i>		*	U	5
<b>Geraniaceae</b>				
<i>Geranium retrorsum</i>			U	6
<i>Geranium solanderi</i>	Native Geranium		U	1,6
<b>Goodeniaceae</b>				
<i>Goodenia bellidifolia</i>			U	8
<i>Goodenia hederacea</i>			U	1,8



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Appendix 2: Flora (*Magnoliopsida* (*Magnoliidae*) continued)

Scientific Name	Common Name	I	Status	Source
<b>Goodeniaceae</b>				
<i>Goodenia pinnatifida</i>			U	6
<i>Goodenia pusilliflora</i>			U	6
<i>Goodenia rotundifolia</i>			U	1,6,10
<i>Scaevola albida</i>				6
<b>Haloragaceae</b>				
<i>Gonocarpus teucroides</i>			U	8
<i>Myriophyllum striatum</i>			U	8
<b>Lamiaceae</b>				
<i>Ajuga australis</i>	Austral Bugle		U	6,10
<i>Plectranthus graveolens</i>			U	9
<i>Salvia verbenaca</i>	Wild Sage	*	U	1
<b>Lauraceae</b>				
<i>Cassytha pubescens</i>	Devil's Twine		U	6
<b>Lobeliaceae</b>				
<i>Pratia purpurascens</i>	White Root		U	1,4,6,10
<b>Loranthaceae</b>				
<i>Amyema cambagei</i>	Mistletoe		U	1,4,5,6,8,10
<i>Amyema gaudichaudii</i>	Mistletoe		U	8
<i>Amyema linophyllum</i>	Mistletoe		U	6
<i>Amyema miquelli</i>	Box Mistletoe		U	2,3,5,6
<i>Amyema pendulum</i>	Mistletoe		U	1,8
<i>Amyema quandang</i>			U	8
<i>Amyema sp.</i>			U	10
<i>Lysiana exocarpi</i>	Harlequin Mistletoe		U	6
<i>Muellerina eucalyptoides</i>			U	10
<b>Malaceae</b>				
<i>Malas X domestica</i>	Apple	*	U	1
<b>Malvaceae</b>				
<i>Malva parviflora</i>	Small Flowered Mallow	*	U	6
<i>Modiola caroliniana</i>	Red-flowered Mallow	*	U	1,5,6,8
<i>Sida corrugata</i>			U	6
<i>Sida rhombifolia</i>	Paddy's Lucerne	*	U	1,4,5,6,8,10



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Appendix 2: Flora (*Magnoliopsida (Magnoliidae)* continued)

Scientific Name	Common Name	I	Status	Source
<i>Meliaceae</i>				
<i>Melia azedarach</i>	White Cedar		U	1,8
<i>Menyanthaceae</i>				
<i>Villarsia exaltata</i>			U	8
<i>Myoporaceae</i>				
<i>Eremophila debilis</i>	Winter Apple		U	1,2,6,8,10
<i>Eremophylla deserti</i>	Turkeybush		U	1,8
<i>Myoporum montanum</i>	Western Boobialla		U	1,2,3,6
<i>Myrtaceae</i>				
<i>Angophora bakeri</i>	Narrow-leaved Apple		U	6
<i>Angophora floribunda</i>	Rough-barked Apple		U	1,2,3,4,5,6,8,10
<i>Backhousia mrytifolia</i>	Lemon-scented Gum		U	8
<i>Callistemon shiressii</i>	Wooly Bottlebrush		U	5
<i>Calytrix tetragona</i>	Fringe Myrtle		U	3
<i>Corymbia citriodora</i>	Lemon-scented Gum		U	8
<i>Corymbia maculata</i>	Spotted Gum		U	2,3,4,7,10
<i>Eucalyptus blakelyi</i>	Blakely's Red Gum		U	1,2,3,8,10
<i>Eucalyptus botryooides</i>	Bangalay		U	8
<i>Eucalyptus camaldulensis</i>	River Red Gum		U	8
<i>Eucalyptus canaliculata</i>	Large-fruited Grey Gum		U	10
<i>Eucalyptus cladocalyx</i>	Sugar Gum		U	4,8
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark		U	1,2,3,4,5,6,7,8,10
<i>Eucalyptus fibrosa</i>	Red Ironbark		U	1,2,4,7,10
<i>Eucalyptus melliodora</i>	Yellow Box		U	8
<i>Eucalyptus moluccana</i>	Grey Box		U	1,2,3,4,5,6,7,8,10
<i>Eucalyptus polyanthemos</i>	Red Box		U	6
<i>Eucalyptus punctata</i>	Grey Gum		U	7
<i>Eucalyptus siderophloia</i>	Grey Ironbark		U	6
<i>Eucalyptus tereticornis</i>	Forest Red Gum		U	1,2,3,7,8
<i>Eucalyptus tereticornis ?</i>	Forest Red Gum		U	4
<i>Leptospermum polygalifolium</i>			U	8
<i>Melaleuca armillaris</i>	Honey Myrtle		U	8

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**Appendix 2: Flora (*Magnoliopsida (Magnoliidae)* continued)**

Scientific Name	Common Name	I	Status	Source
<b><i>Myrtaceae</i> continued</b>				
<i>Melaleuca decora</i>			U	8
<i>Melaleuca thymifolia</i>			U	8
<b><i>Oleaceae</i></b>				
<i>Jasminium suavisimum</i>	Sweet Jasmine		U	6
<i>Notelaea longifolia</i>	Native Olive		U	10
<i>Notelaea microcarpa</i>	Native Olive		U	1,6,7,10
<i>Olea europaea</i>	Common Olive	*	U	1,6,7,10
<b><i>Onagraceae</i></b>				
<i>Oenothera sp.</i>	Primrose	*	U	2
<i>Oenothera stricta</i>	Primrose	*	U	3,6
<b><i>Oxalidaceae</i></b>				
<i>Oxalis corniculata</i>	Creeping Oxalis	*	U	1,3,4,6
<i>Oxalis pes-caprae</i>	Sour sob	*	U	1,2,8
<b><i>Papaveraceae</i></b>				
<i>Argemone ochroleuca</i>	Mexican Poppy	*	U	6
<i>Argemone subfusiformis</i>	American Poppy	*	U	8
<b><i>Pittosporaceae</i></b>				
<i>Billardiera scandens</i>	Apple Dumplings		U	2
<i>Bursaria spinosa</i>			U	1,3,5,6,10
<b><i>Plantaginaceae</i></b>				
<i>Plantago coronopus</i>	Buck's-horn Plantain	*	U	6
<i>Plantago gaudichaudi</i>			U	8
<i>Plantago lanceolata</i>	Lambs Tongue	*	U	1,4,6,8
<i>Plantago major</i>	Large Plantain		U	4
<i>Plantago sp.</i>		?	U	2,5
<i>Plantago varia</i>			U	3,6
<b><i>Polygonaceae</i></b>				
<i>Emex australis</i>		*	U	8
<i>Persicaria decipiens</i>	Slender Knotweed		U	6,8
<i>Persicaria hydropiper</i>	Water Pepper		U	8
<i>Persicaria lapathifolia</i>	Pale Knotweed		U	1
<i>Rumex brownii</i>	Swamp Dock		U	6



## Flora and Fauna Report - White Mining Limited - Ashton Mine Project

Appendix 2: Flora (*Magnoliopsida (Magnoliidae)* continued)

Scientific Name	Common Name	I	Status	Source
<b>Polygonaceae continued</b>				
<i>Rumex crispus</i>	Curled Dock	*	U	1,5,6,8
<i>Rumex dumosus</i>	Wiry Dock		U	6
<i>Rumex sp.</i>	Dock	*	U	3,4
<b>Portulacaceae</b>				
<i>Portulaca oleracea</i>	Pig Weed		U	6
<b>Primulaceae</b>				
<i>Anagallis arvensis</i>	Pimpernell	*	U	1,4,6,8,10
<b>Proteaceae</b>				
<i>Banksia integrifolia</i>	Coastal Banksia		U	8
<i>Banksia serrata</i>	Old Man Banksia		U	8
<i>Grevillea arenaria</i>			U	1,6,8
<i>Grevillea mucronulata</i>			U	8
<i>Grevillea robusta</i>	Silky Oak		U	8
<b>Ranunculaceae</b>				
<i>Clematis aristata</i>	Clematis		U	8
<i>Clematis glycinoides</i>			U	10
<i>Ranunculus plebeius</i>			U	8
<b>Rhamnaceae</b>				
<i>Cryptandra amara</i>			U	1
<b>Rosaceae</b>				
<i>Rosa bracteata</i>	Macartney Rose		U	6
<i>Rosa rubiginosa</i>	Sweet Briar	**	U	1,2,3,5,8
<i>Rubus discolor</i>	Blackberry	**	U	1,2
<b>Rubiaceae</b>				
<i>Canthium odoratum</i>	Shiny-leaved Canthium		U	8
<i>Canthium oleifolium</i>	Wild Lemon		U	6
<i>Galium gaudichaudii</i>			U	10
<i>Opercularia diphyllo</i>	Stinkweed		U	8
<b>Rutaceae</b>				
<i>Geijera parviflora</i>	Wilga		U	1,6
<b>Salicaceae</b>				
<i>Salix alba</i>	White Willow	*	U	8
<i>Salix babylonica</i>	Weeping Willow	*	U	1,3,6,8

**Flora and Fauna Report - White Mining Limited - Ashton Mine Project**
**Appendix 2: Flora (*Magnoliopsida (Magnoliidae)* continued)**

Scientific Name	Common Name	I	Status	Source
<b><i>Santalaceae</i></b>				
<i>Exocarpus cupressiformis</i>	Native Cherry		U	2,3,6,8,10
<i>Exocarpus strictus</i>	Dwarf Cherry		U	6
<b><i>Sapindaceae</i></b>				
<i>Dodonea viscosa</i>	Hop Bush		U	6,8
<b><i>Scrophulariaceae</i></b>				
<i>Misopates orontium</i>	Lesser Snapdragon	*	U	1
<i>Verbascum virgatum</i>	Twiggy Mullien	*	U	1,6,8
<b><i>Simaroubaceae</i></b>				
<i>Ailanthus altissima</i>	Tree of Heaven	**	U	8
<b><i>Solanaceae</i></b>				
<i>Lycium ferocissimum</i>	African Boxthorn	**	U	1,8,10
<i>Nicotiana glauca</i>	Tree Tobacco	*	U	4
<i>Solanum chenopodioides</i>	White Tip Nightshade	*	U	8
<i>Solanum cinereum</i>	Narrawa Burr		U	1,5,6
<i>Solanum elegans</i>		*	U	10
<b><i>Solanaceae continued</i></b>				
<i>Solanum nigrum</i>	Black Nightshade	*	U	1,6
<i>Solanum prinophyllum</i>	Forest Nightshade	*	U	1,8,10
<i>Solanum pseudocapsicum</i>	Jerusalem Cherry	*	U	1
<i>Solanum sp.</i>		*	U	2,10
<i>Solanum stelligerum</i>	Star Nightshade		U	6,10
<b><i>Stackhousiaceae</i></b>				
<i>Stackhousia viminea</i>	Slender Stackhousia		U	2
<b><i>Sterculiaceae</i></b>				
<i>Brachychiton populneus</i>	Kurrajong		U	1,6,8,10
<b><i>Thymelaeaceae</i></b>				
<i>Pimelea glauca</i>	Smooth Rice Flower		U	6
<i>Pimelea linifolia</i>	Rice Flower		U	1,6,8
<i>Pimelea sp.</i>			U	2
<b><i>Urticaceae</i></b>				
<i>Urtica incisa</i>	Stinging Nettle		U	1



**Flora and Fauna Report - White Mining Limited - Ashton Mine Project**

**Appendix 2: Flora (*Magnoliopsida* (*Magnoliidae*) continued)**

Scientific Name	Common Name	I	Status	Source
<i>Verbenaceae</i>				
<i>Clerodendrum tomentosum</i>	Velvet Spider-bush		U	6
<i>Lantana camara</i>	Lantana	*	U	10
<i>Verbena bonariensis</i>	Purple Top	*	U	1,2,6,8
<i>Verbena hispida</i>	Rough Verbena	*	U	3
<i>Violaceae</i>				
<i>Viola hederacea</i>	Ivy-leaved Violet		U	1,6,8,10

## APPENDIX 3

# COMMUNITY PROFILE: HUNTER VALLEY RIVER OAK FOREST

Excerpt from Hunter-Central Rivers CMA, 2007. Vegetation of the Central Hunter Valley, NSW

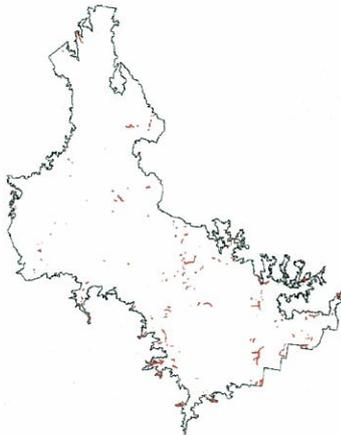


# MU 30 • Hunter Valley River Oak Forest

**Walker & Hopkins classification**

*Casuarina cunninghamiana* subsp. *cunninghamiana* very tall open forest to closed forest

**Distribution in the study area**



**Field photograph of map unit**



<b>REMS equivalent</b>	MU 14 Wollombi Redgum – River Oak Woodland (in part)
<b>Number of sites sampled in study area (and used in delineation)</b>	4 (4)
<b>Number of native taxa recorded</b>	50
<b>Median area</b>	1.72 ha
<b>Mean area</b>	3.27 ha
<b>Pre-European estimated area</b>	unknown
<b>Extant area</b>	955 ha (1.6% of remnant vegetation)
<b>Likely proportion cleared</b>	98.9% (Note: this value includes MU 13 & MU 28)
<b>Model reliability</b>	no model

**Vegetation community significance**

Conservation assessment:	1 (E) and 2 (R)
Reservation status:	extremely poor (very small area of similar community in Towarri NP)
EPBC Act status:	not listed
TSC Act status:	not listed
Regional significance:	significant (highly cleared, restricted, under threat)

**Significant species recorded<sup>1</sup> or expected<sup>2</sup>**

Nationally Rare (ROTAP):	<i>Eucalyptus glaucina</i> (3VCa) <sup>2</sup>
Recommended ROTAP:	none recorded
Threatened (EPBC Act):	<i>Eucalyptus glaucina</i> (V) <sup>2</sup>
Threatened (TSC Act):	<i>Eucalyptus glaucina</i> (V) <sup>2</sup>
Regionally Significant:	<i>Eucalyptus glaucina</i> <sup>2</sup>
Undescribed:	none recorded

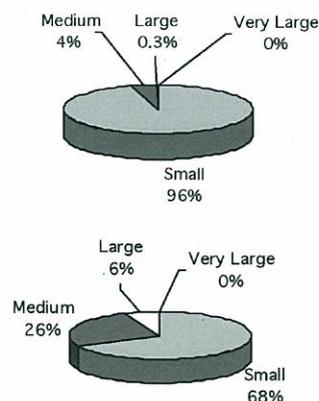
### Local landscape pattern

#### Number of remnants

Very large remnants (>100 ha):	0	0%
Large remnants (40–100 ha):	1	0.3%
Medium remnants (10–40 ha):	13	3.7%
Small remnants (<10 ha):	278	96%

#### Area of vegetation in remnants

Very large remnants (>100 ha):	0 ha	0%
Large remnants (40–100 ha):	60 ha	6%
Medium remnants (10–40 ha):	247 ha	26%
Small remnants (<10 ha):	647 ha	68%



### Floristic description

A mid-high to tall forest with a mid-dense canopy almost exclusively dominated by river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*). Other less frequent canopy species may include rough-barked apple (*Angophora floribunda*), forest red gum (*Eucalyptus tereticornis*), swamp oak (*Casuarina glauca*) or an intergrade between river oak and swamp oak (*Casuarina cunninghamiana*—*glauca*). Rainforest-affiliated low trees and shrubs sometimes form an understorey stratum where the natural structure remains relatively intact. These may include such species as native peach (*Trema tomentosa* var. *viridis*), ironwood (*Backhousia myrtifolia*) and muttonwood (*Rapanea variabilis*). However, in most places the understorey is absent, and the ground cover, which can be sparse to dense, is typically dominated by herbaceous weed species (see the *Significant Weeds* section). The most frequent shrubby weeds are lantana (\**Lantana camara*) and African olive (\**Olea europaea* subsp. *cuspidata*).

Weeping grass (*Microlaena stipoides* var. *stipoides*), couch (*Cynodon dactylon*) and basket grass (*Oplismenus aemulus*) are the most abundant native grasses, and stinging nettle (*Urtica incisa*), kidney weed (*Dichondra repens*), slender knotweed (*Persicaria decipiens*), common cotula (*Cotula australis*), whiteroot (*Pratia purpurascens*), prickly starwort (*Stellaria pungens*), cockspur flower (*Plectranthus parviflorus*), native geranium (*Geranium solanderi* var. *solanderi*) and spiny-headed mat-rush (*Lomandra longifolia*) were the most abundant forbs at the sites sampled.

Vines are common and include wonga wonga vine (*Pandorea pandorana* subsp. *pandorana*), traveller's joy (*Clematis glycinoides* var. *glycinoides*) and wombat berry (*Eustrephus latifolius*), with a rare record of *Calystegia marginata* from Middlebrook. The exotic balloon vine (\**Cardiospermum grandiflorum*) has established substantial infestations within this community, and now forms a dominant component throughout much of its distribution. Sheoak mistletoe (*Amyema cambagei*) is a frequent aerial hemiparasite of river oak.

### Known variants

**Numerous:** This community is extremely variable, being at least in part a response to disturbance arising from altered land use practices. As such, numerous variants occur across the range of its distribution, particularly in response to different land use conditions.

### Habitat

Hunter Valley River Oak Forest occurs mostly along creek banks and (rarely) some alluvial flats. Woolfrey and Ladd (2001) considered that this tendency to grow along river banks and in valleys may be a response to fire regimes. Unlike swamp oak (*Casuarina glauca*), it is not usually associated with soils of higher than usual salinity levels. It usually occurs closer to the high energy banks and shoals in streams than most eucalypts species do.

### Distribution

**Study area:** Hunter Valley River Oak Forest occurs along the Hunter River and its tributaries throughout the study area. In smaller streams of the Belford district and in the central Hunter Valley around Ravensworth, Edderton and Wybong, river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) is usually replaced by swamp oak (*Casuarina glauca*), most often in areas of higher soil salinity.

**Region:** This community occurs broadly between Wingen, Denman and Maitland. Upstream of Fordwich along Wollombi Brook it intergrades into Wollombi Red Gum – Apple Forest. It is currently uncertain whether the riparian communities dominated by river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) along the Goulburn River west of Denman, and along the Pages and Isis rivers, and the Hunter River north of Glenbawn Dam, are part of the same vegetation community, although this does seem likely.

**Example locations:** New England Highway crossing over Black Creek, west of Branxton; Wollombi Brook near Bulga; Golden Highway crossing of the Hunter River at Bowman's Crossing, west of Jerrys Plains.

### **Condition assessment**

This vegetation community is typically highly modified, having been extensively cleared, often grazed and usually infested with weeds. In most places where riparian fencing is present it does not necessarily prevent livestock incursions on to stream banks, so livestock frequently damage the community through trampling, grazing pressure and the addition of nutrients through defecation. Livestock also assist the invasion of weed species, several of which have a significant impact on this community (see the Significant Weeds section).

No sites have been observed where the vegetation could be considered to be in relatively pristine condition, or even necessarily in good condition.

### **Threat assessment**

This community was once probably most threatened by direct clearing, which has been the most significant cause of the reduction in its extent. Presently, clearing of riparian vegetation is not permitted without approval, and the degradation of riparian vegetation is listed as a Key Threatening Process under the NSW *Fisheries Management Act 1994*.

The most significant specific threats to this community are weed invasion and establishment, livestock grazing and the lack of structural intactness, the latter of which is both a result of and further prevented by the former two factors. Most threats occur as a result of the very high edge-area ratio that is exhibited by the long, narrow stands of river oak.

### **Mapping accuracy**

Hunter Valley River Oak Forest is mapped to a high degree of accuracy. Inaccuracies in the mapping will occur where the boundary between this vegetation community and MU 28 Central Hunter Swamp Oak Forest occurs. Even in the field it can be difficult to determine the exact boundary between these two vegetation communities, as *Casuarina cunninghamiana* subsp. *cunninghamiana* and *Casuarina glauca* hybridize and can be difficult to separate. Other errors will occur where dry rainforest was naturally present in sheltered sites along the banks of major watercourses.

The mapped boundary between this vegetation community and MU 13 Hunter Floodplain Red Gum Woodland Complex is relatively arbitrary. It is sometimes difficult to determine where these two communities begin and end when they abut each other. In most instances MU 13 Hunter Floodplain Red Gum Woodland Complex commences at the outer edge of the Hunter Valley River Oak Forest boundary.

**Equivalent vegetation types**

NPWS (2000):	MU 14 Wollombi Redgum – River Oak Woodland (in part)
Hill (2003a):	Unit 3 Alluvial River Oak Forest
Thomas (1998):	<i>Casuarina cunninghamiana</i> (River Oak) River Flat Forest.
Fallding et al. (1999):	none
Hill et al. (2001):	RPF1 River Oak Riparian Forest (in part)
Bell (2004b):	E14 Wollombi Redgum – River Oak Woodland (in part)
Hill (1999):	RPF1 River Oak Riparian Forest (in part)
Bell (1998):	F20 Alluvial River Oak Forest (in part)
ERM Mitchell McCotter (1998a&b):	Riparian Forest (in part)
Hill and Peake (in prep.):	none

**Structure**

Stratum	Height range	Canopy cover
Emergent:	20–30 m	<5%
Upper tree:	15–25 m	40–80%
Shrub:	0.5–3 m	10–40%
Ground:	<1 m	80–100%

**Significant weeds**

Serious weeds include balloon vine (\**Cardiospermum grandiflorum*), blue morning glory (\**Ipomoea indica*), kikuyu (\**Pennisetum clandestinum*), panic veldtgrass (\**Ehrharta erecta*), green cestrum (\**Solanum parquii*), wandering Jew (\**Tradescantia fluminensis*), paspalum (\**Paspalum dilatatum*), shivery grass (\**Briza minor*), lantana (\**Lantana camara*) and African olive (\**Olea europaea* subsp. *cuspidata*) among many others. African olive and balloon vine are particularly insidious.

**Other comments**

An extensive programme of riparian fencing is required to control livestock and to encourage recruitment to allow this vegetation community to persist.

**Key species**

Note: the following diagnostic species list is based on data from three sites only.

Life form	Botanical name	In comm.		Others		Fidelity
		c.a.	Freq.	c.a.	Freq.	
Tree	<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>	4	100%	3	2%	positive
	<i>Angophora floribunda</i>	2	33%	2	15%	uninformative
	<i>Eucalyptus tereticornis</i>	1	33%	2	9%	uninformative
Shrub	<i>Acacia falcata</i>	1	33%	2	9%	uninformative
	<i>Acacia longifolia</i>	1	33%	2	3%	uninformative
	<i>Acacia paradoxa</i>	1	33%	2	4%	uninformative
	<i>Ficus coronata</i>	1	33%	2	5%	uninformative
	<i>Hymenanthera dentata</i>	2	33%	2	7%	uninformative
	<i>Myoporum montanum</i>	1	33%	1	7%	uninformative
	<i>Notelaea venosa</i>	1	33%	1	1%	uninformative
Subshrub	<i>Nyssanthus diffusa</i>	3	33%	2	4%	uninformative
	<i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>	2	33%	2	24%	uninformative

Life form	Botanical name	In comm.		Others		Fidelity
		c.a.	Freq.	c.a.	Freq.	
Subshrub CONTD	<i>Solanum prinophyllum</i>	2	33%	1	16%	uninformative
Forb	<i>Lomandra longifolia</i>	2	100%	2	25%	positive
	<i>Dichondra repens</i>	3	67%	2	49%	constant
	<i>Persicaria decipiens</i>	5	67%	2	2%	positive
	<i>Plectranthus parviflorus</i>	2	67%	1	18%	positive
	<i>Pratia purpurascens</i>	2	33%	2	45%	uninformative
	<i>Commelina cyanea</i>	2	33%	1	15%	uninformative
	<i>Convolvulus erubescens</i>	2	33%	1	3%	uninformative
	<i>Cotula australis</i>	5	33%	2	3%	uninformative
	<i>Cynoglossum australe</i>	2	33%	1	6%	uninformative
	<i>Einadia hastata</i>	2	33%	2	12%	uninformative
	<i>Galium propinquum</i>	3	33%	2	9%	uninformative
	<i>Geranium solanderi</i> var. <i>solanderi</i>	5	33%	2	9%	uninformative
	<i>Plantago debilis</i>	1	33%	2	17%	uninformative
	<i>Plantago gaudichaudii</i>	2	33%	1	1%	uninformative
	<i>Solenogyne bellioides</i>	2	33%	2	2%	uninformative
<i>Stellaria pungens</i>	5	33%	2	3%	uninformative	
<i>Urtica incisa</i>	6	33%	2	12%	uninformative	
Grass	<i>Austrostipa verticillata</i>	4	100%	2	10%	positive
	<i>Oplismenus aemulus</i>	3	67%	2	15%	positive
	<i>Echinochloa telmatophila</i>	2	33%	0	0%	unique
	<i>Cynodon dactylon</i>	6	33%	2	10%	uninformative
	<i>Echinopogon ovatus</i>	3	33%	2	18%	uninformative
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	0	0%	2	43%	negative
Sedge	<i>Carex appressa</i>	2	33%	1	4%	uninformative
	<i>Schoenus apogon</i>	2	33%	1	1%	uninformative
Ground fern	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	2	33%	2	47%	uninformative
Vine	<i>Pandorea pandorana</i> subsp. <i>pandorana</i>	2	67%	1	27%	positive
	<i>Calystegia marginata</i>	2	33%	1	1%	uninformative
	<i>Cayratia clematidea</i>	2	33%	2	15%	uninformative
	<i>Clematis glycinoides</i> var. <i>glycinoides</i>	4	33%	1	23%	uninformative
	<i>Eustrephus latifolius</i>	2	33%	2	26%	uninformative
Twiner	<i>Desmodium varians</i>	2	33%	2	42%	uninformative
	<i>Glycine clandestina</i>	2	33%	2	36%	uninformative
	<i>Stephania japonica</i> var. <i>discolor</i>	2	33%	1	11%	uninformative
Mistletoe	<i>Amyema cambagei</i>	2	33%	2	1%	uninformative
	<i>Muellerina celastroides</i>	2	33%	2	<1%	uninformative



## APPENDIX 4

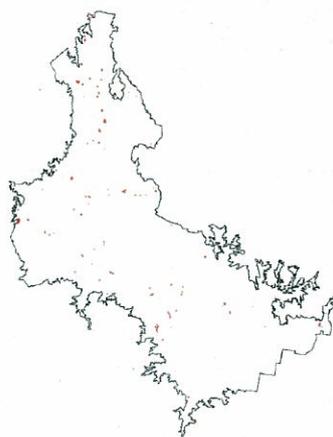
# COMMUNITY PROFILE: HUNTER FLOODPLAIN RED GUM WOODLAND

Excerpt from Hunter-Central Rivers CMA, 2007. Vegetation of the Central Hunter Valley, NSW

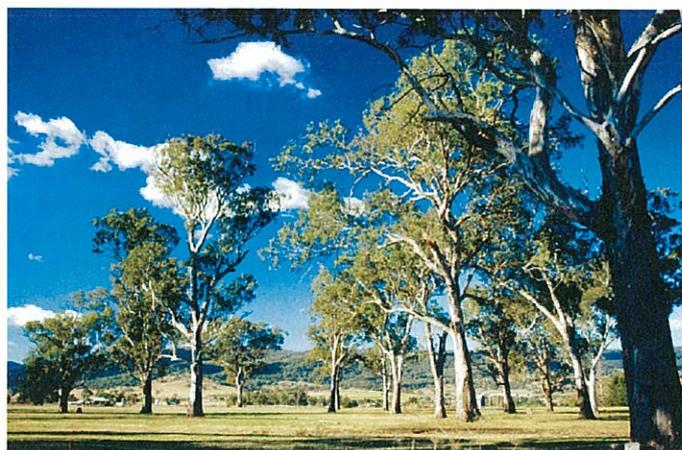
# MU 13 • Hunter Floodplain Red Gum Woodland Complex

**Walker & Hopkins classification** *Eucalyptus camaldulensis* – *Eucalyptus tereticornis* – *Eucalyptus melliodora* very tall woodland

**Distribution in the study area**



**Field photograph of map unit**



<b>REMS equivalent</b>	MU13 Central Hunter Riparian Forest (in part)
<b>Number of sites sampled in study area (and used in delineation)</b>	13 (13)
<b>Number of native taxa recorded</b>	104
<b>Median area</b>	2.15 ha
<b>Mean area</b>	4.45 ha
<b>Pre-European estimated area</b>	41,142 ha (13.1% of study area)
<b>Extant area</b>	436 ha (0.7% of remnant vegetation)
<b>Likely proportion cleared</b>	98.9% (Note: this value includes MU 28 & MU 30)
<b>Model reliability</b>	average

## Vegetation community significance

Conservation assessment:	1 (C) and 2 (V).
Reservation status:	not reserved
EPBC Act Status:	not listed
TSC Act status:	not listed
Regional significance:	significant (very rare, highly cleared, highly threatened, not reserved)

## Significant species recorded<sup>1</sup> or expected<sup>2</sup>

Nationally Rare (ROTAP):	none recorded
Recommended ROTAP:	none recorded
Threatened (EPBC Act):	none recorded
Threatened (TSC Act):	<i>Eucalyptus camaldulensis</i> (E-pop) <sup>1</sup>
Regionally Significant:	<i>Eucalyptus camaldulensis</i> <sup>1</sup>
Undescribed:	none recorded

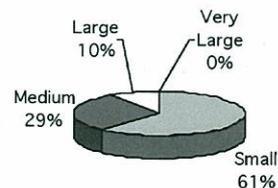
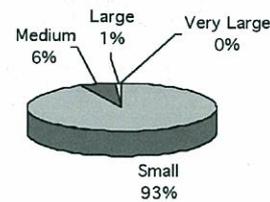
### Local landscape pattern

#### Number of remnants

Very large remnants (>100 ha):	0	0%
Large remnants (40–100 ha):	1	1%
Medium remnants (10–40 ha):	6	6%
Small remnants (<10 ha):	91	93%

#### Area of vegetation in remnants

Very large remnants (>100 ha):	0 ha	0%
Large remnants (40–100 ha):	42 ha	10%
Medium remnants (10–40 ha):	125 ha	29%
Small remnants (<10 ha):	268 ha	61%



### Floristic description

A mid-high to very tall or open woodland occurring on floodplains and floodplain rises along the Hunter River and several major tributaries. Sites on major floodplains between Singleton and several kilometres south of Scone are dominated by river red gum (*Eucalyptus camaldulensis*), often as a sole dominant canopy species. Forest red gum (*Eucalyptus tereticornis*), yellow box (*Eucalyptus melliodora*) and rough-barked apple (*Angophora floribunda*) can co-dominate in places, although they usually form a minor part of the canopy. River oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) once formed a gallery forest, within the typically-surrounding red gum forest, along most creeks and rivers. Today, in many places, all that remains of the surrounding red gum forest are scattered individuals of *Eucalyptus camaldulensis* co-occurring with *Casuarina cunninghamiana* subsp. *cunninghamiana*.

*Eucalyptus camaldulensis* has not been located along Kingdon Ponds north of Parkville, or along the Pages River (D. Lower pers. comm.). Instead, *Eucalyptus tereticornis* forms dominant woodlands on floodplains in these areas. At marginal sites throughout the study area, *Eucalyptus tereticornis* usually takes over from *Eucalyptus camaldulensis* in upstream locations, such as along the lower Wybong Creek.

On rises occurring on and around the margins of floodplains, *Eucalyptus melliodora* often forms a woodland or occasionally a mid-dense forest, to the exclusion of other tree species, although *Eucalyptus tereticornis* and *Angophora floribunda* may also occur with it. *Angophora floribunda* also dominates some sites. Occasional remnants of white cedar (*Melia azedarach*) suggest that it may once have formed an important sub-canopy in some sheltered sites, particularly in the Aberdeen district on the flats below Segenhoe Mountain.

In various parts of the vegetation community's range, it may be dominated almost exclusively by trees in the following combinations: *E. camaldulensis* ± *C. cunninghamiana* subsp. *cunninghamiana*; *E. tereticornis* ± *E. melliodora*; *E. melliodora* ± *A. floribunda*; *A. floribunda*; or variations of the above. These combinations most likely relate to land use history, and local geomorphological conditions.

Shrubs are generally very sparse or absent. The groundcover of most sites has been significantly altered but presumably would have been dominated by a range of native grasses and forbs, with sedges and rushes also being important. Today, dominant groundcovers include couch (*Cynodon dactylon*), lesser joyweed (*Alternanthera denticulata*), slender bamboo grass (*Austrostipa verticillata*), kidney weed (*Dichondra repens*), rushes (*Juncus* spp.), peppergrass (*Lepidium pseudohyssopifolium*), poison pratia (*Pratia concolor*), stinging nettle (*Urtica incisa*), berry saltbush (*Einadia hastata*), dwarf amaranth (*Amaranthus macrocarpus* var. *macrocarpus*), sticky sedge (*Cyperus fulvus*), Australian hound's tongue (*Cynoglossum australe*), *Cyperus gracilis*, knob sedge (*Carex inversa*), variable glycine (*Glycine tabacina*), *Oxalis exilis*, native geranium (*Geranium solanderi* var. *solanderi*), weeping grass (*Microlaena stipoides* var. *stipoides*), common everlasting (*Chrysocephalum apiculatum*), wallaby grass (*Austrodanthonia fulva*), slender plantain (*Plantago debilis*), tufted hedgehog grass (*Echinopogon caespitosus* var. *caespitosus*) and fishweed (*Einadia trigonos* subsp. *trigonos*). The groundcover flora at each site is strongly influenced by surrounding vegetation types and the degree of, and time since, disturbance.

### Habitat

This vegetation community is strongly tied to floodplains of major and intermediate watercourses. It occurs invariably on alluvial soils and generally in locations that receive reasonably regular flooding. It is probable that *Eucalyptus camaldulensis* predominates in areas where water is impounded for several days or weeks after floods.

### Known variants

The following variants are recognised but have not been mapped separately:

**River red gum variant:** Dominated almost exclusively by *Eucalyptus camaldulensis*; may include extensive areas of *Casuarina cunninghamiana* subsp. *cunninghamiana*.

**Forest red gum variant:** Dominated mostly by *Eucalyptus tereticornis*; may include stands of *Eucalyptus melliodora*.

**Yellow box variant:** Dominated by *Eucalyptus melliodora*; may include *Angophora floribunda*.

**Rough-barked apple variant:** Dominated by *Angophora floribunda*.

**Mixed variant:** Contains attributes of two or more variants.

### Distribution

**Study area:** Occurs throughout the study area, along the Hunter River, Goulburn River, Dart Brook, Kingdon Ponds, Wollombi Brook, Wybong Creek, Muscle Creek and the lower reaches of other smaller tributaries. A very small stand occurs in the upper reaches of Doughboy Hollow in Singleton Military Area. The largest and most intact stands occur on Dart Brook south of Scone and at Hunterview near Singleton.

**Region:** NPWS (2000) did not describe this community, however it is partly covered by MU 13 Central Hunter Riparian Forest. It occurs as far east as Maitland LGA (at Hinton and Aberglasslyn), where single trees of *Eucalyptus camaldulensis* and *Eucalyptus tereticornis* are all that remain. It may also occur in Cessnock LGA. This vegetation community also probably occurs further along Goulburn River west of the study area as small, isolated remnants, and also at Bylong (where a small stand of *Eucalyptus camaldulensis* occurs) and possibly further. It may also occur further north along the Pages River in the Blandford district, although evidence is required to confirm this supposition.

**Example locations:** Muscle Creek, Muswellbrook, (including Muswellbrook Golf Course, a highly disturbed remnant); Dart Brook and Kingdon Ponds confluence, near Aberdeen; Dart Brook 2 km south of Scone (the most intact remnant); Kingdon Ponds, 2 km north of Scone; Hunter River at Plashett, near Jerrys Plains; Redbournberry Reserve, Singleton.

### Condition assessment

Most stands of Hunter Floodplain Red Gum Woodland Complex are in poor to very poor condition. This has resulted from: widespread clearing that has been undertaken since European settlement (and possibly still continues); intensive land use for dairying and cropping, and; associated weed invasion and establishment. Most sites have very limited recruitment of native species, and consequently most remnants comprise old or senescent trees. Recruitment is suppressed by weeds, grazing and fertiliser application. Tree dieback is a major problem, with a high proportion of mature trees suffering defoliation and branch pruning. The combination of poor recruitment and early senescence in remnants means that little or no replacement of old growth trees has taken place. Despite the general poor condition of remnants, a few are in relatively good condition and may recover if appropriate management conditions were provided.

### Threat assessment

After direct clearing, floodplain alienation has probably been the most important threatening process for the river red gum variant. Recent studies in the Murray River catchment have shown that without regular flooding, *Eucalyptus camaldulensis* struggles to compete with other species (Murray Darling Basin Commission 2003). When placed in the context of intensive land use, weed impacts and grazing, *Eucalyptus camaldulensis* does not regenerate well. The alienation of floodplains has exacerbated this problem. Little, if any, additional alienation takes place today, however the legacy of previous flood mitigation works continues to limit the rehabilitation of this community.

All variants are seriously threatened by weed invasion and establishment, grazing, fertiliser and herbicide application, tree dieback and increased mistletoe infestation — a natural process that has been exacerbated by the effects of clearing and fragmentation.

The introduction of non-natural hybrid river red gums for revegetation projects and farm forestry could have a very serious impact on the survival of pure river red gum in the Hunter Valley. This practice is continuing and expanding despite abundant evidence that it should not take place (e.g. Daniels and Sheil 1999; Potts and Wilt-

shire 1999; Potts et al. 2001; Potts et al. 2003; Hill 2003; Meddings et al. 2003). If continued, it may result in the extinction of the Hunter Valley genetic pool.

### Mapping accuracy

Hunter Floodplain Red Gum Woodland Complex is mapped with a moderate to high degree of accuracy. As a very high proportion of this community has been cleared there are relatively few control sites upon which this community has been described. Given its fidelity to floodplains and their margins, the modelling of the extent of this community should be relatively accurate.

The mapped boundary between this community and MU 30 Hunter Valley River Oak Forest is relatively arbitrary in many cases. It is often difficult to determine where these two communities begin and end when they abut each other. In most instances MU 13 Hunter Floodplain Red Gum Woodland Complex commences at the outer edge of MU 30 Hunter Valley River Oak Forest boundary.

### Equivalent vegetation types

NPWS (2000):	MU13 Central Hunter Riparian Forest (in part)
Hill (2003a):	MU13 Central Hunter Riparian Forest (in part)
Thomas (1998):	none (although some representative species are present at one site)
Fallding et al. (1999):	none
Hill and Peake (in prep):	none

### Structure

Stratum	Height range	Canopy cover
Upper tree:	18–35m	5–25 (40)%
Ground:	<1m	60–90%

### Significant weeds

This vegetation community is severely threatened by a range of groundcover weed species, most of which are associated with dairying and cropping practices. Kikuyu (*\*Pennisetum clandestinum*) is probably the most prevalent weed. Galenia (*\*Galenia pubescens*) is likely to eventually smother most other groundcover species in this community as it advances across the central and upper Hunter. Other important groundcover weeds include panic veldtgrass (*\*Ehrharta erecta*), carpet grass (*\*Axonopus affinis*), various clovers (*\*Trifolium* spp.), various medics (*\*Medicago* spp.) and khaki weed (*\*Alternanthera pungens*). Castor oil plant (*\*Ricinus communis*) infests numerous sites, developing dense, largely impenetrable patches.

### Other comments

The river red gum (*Eucalyptus camaldulensis*) population within the Hunter catchment is listed as an endangered population under the TSC Act 1995.

This community is under extreme threat and is not reserved. Urgent protection and management agreements with private landholders are required.

### Key species

Life form	Botanical name	In comm.		Others		Fidelity
		c.a.	Freq.	c.a.	Freq.	
Tree	<i>Eucalyptus camaldulensis</i>	3	46%	0	0%	unique
	<i>Eucalyptus tereticornis</i>	3	38%	2	9%	positive
	<i>Angophora floribunda</i>	3	15%	2	15%	uninformative
	<i>Brachychiton populneus</i> subsp. <i>populneus</i>	1	15%	1	14%	uninformative
	<i>Eucalyptus melliodora</i>	4	15%	2	2%	uninformative
	<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>	3	8%	3	2%	uninformative

Life form	Botanical name	In comm.		Others		Fidelity
		c.a.	Freq.	c.a.	Freq.	
Tree CONTD	<i>Eucalyptus crebra</i>	1	8%	3	28%	uninformative
	<i>Eucalyptus punctata</i>	2	8%	2	21%	uninformative
	<i>Casuarina glauca</i>	4	8%	3	3%	uninformative
Shrub	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	2	23%	2	19%	uninformative
	<i>Bursaria spinosa</i>	2	15%	2	26%	uninformative
	<i>Exocarpos strictus</i>	1	15%	1	4%	uninformative
	<i>Notelaea neglecta</i>	2	15%	1	1%	uninformative
Subshrub	<i>Solanum cinereum</i>	2	15%	1	4%	uninformative
Forb	<i>Dichondra repens</i>	2	54%	2	49%	constant
	<i>Einadia hastata</i>	2	31%	2	11%	uninformative
	<i>Pratia purpurascens</i>	1	23%	2	46%	uninformative
	<i>Alternanthera denticulata</i>	2	23%	1	2%	uninformative
	<i>Calotis lappulacea</i>	1	23%	2	13%	uninformative
	<i>Commelina cyanea</i>	2	23%	1	15%	uninformative
	<i>Einadia trigonos</i>	2	23%	1	7%	uninformative
	<i>Geranium solanderi</i> var. <i>solanderi</i>	2	23%	2	9%	uninformative
	<i>Rumex brownii</i>	2	23%	1	8%	uninformative
	<i>Ajuga australis</i>	1	15%	1	10%	uninformative
	<i>Lepidium pseudohyssopifolium</i>	2	15%	1	1%	uninformative
	<i>Oxalis exilis</i>	2	15%	2	6%	uninformative
	<i>Oxalis radicata</i>	1	15%	2	3%	uninformative
	<i>Plantago debilis</i>	3	15%	2	17%	uninformative
	<i>Pratia concolor</i>	3	15%	2	<1%	uninformative
	<i>Sida corrugata</i>	1	15%	2	4%	uninformative
	<i>Solanum americanum</i>	2	15%	2	2%	uninformative
	<i>Urtica incisa</i>	3	15%	2	12%	uninformative
	<i>Amaranthus macrocarpus</i> var. <i>macrocarpus</i>	1	8%	0	0%	unique
Grass	<i>Cynodon dactylon</i>	4	85%	2	9%	positive
	<i>Austrostipa verticillata</i>	4	46%	2	10%	positive
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	4	23%	2	43%	uninformative
	<i>Aristida ramosa</i>	3	23%	2	20%	uninformative
	<i>Austrodanthonia fulva</i>	3	15%	2	9%	uninformative
	<i>Cynoglossum australe</i>	2	15%	1	6%	uninformative
	<i>Eragrostis leptostachya</i>	1	15%	2	17%	uninformative
	<i>Sporobolus creber</i>	2	15%	2	7%	uninformative
Sedge	<i>Carex</i> sp.	3	15%	2	2%	uninformative
	<i>Cyperus fulvus</i>	3	15%	2	1%	uninformative
	<i>Cyperus gracilis</i>	2	15%	2	5%	uninformative
Rush	<i>Juncus</i> sp.	1	31%	1	1%	uninformative
Ground fern	<i>Cheilanthes austrotenuifolia</i>	1	23%	1	6%	uninformative
	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	2	8%	2	48%	uninformative
Aquatic fern	<i>Marsilea drummondii</i>	1	8%	0	0%	unique
Twiner	<i>Glycine tabacina</i>	2	23%	2	25%	uninformative
	<i>Desmodium varians</i>	2	15%	2	43%	uninformative
	<i>Glycine clandestina</i>	2	15%	2	36%	uninformative
Mistletoe	<i>Lysiana exocarpi</i> subsp. <i>tenuis</i>	2	8%	1	1%	uninformative



