Centennial Coal

Cooranbong Haul Road

Landscape and Rehabilitation Management Plan

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1. Introduction

Centennial Coal Pty Limited (Centennial) proposes to construct a private haul road between the Centennial owned Cooranbong pit top surface facilities and the existing Eraring-Newstan haul road. The private haul road is designed to allow coal mined from the Mandalong Mine to be transported to the Newstan Colliery surface facilities for processing and transport into the export market.

Centennial Coal Pty Ltd currently owns and operates the Mandalong and Cooranbong Collieries. Surface facilities are located adjacent to the Eraring Power Station, northwest of Cooranbong on the western side of Lake Macquarie, NSW. These facilities include workforce amenities, mining support infrastructure, coal storage facilities and a coal preparation plant.

The construction and operation of the private haul road was proposed by Centennial in the 1997 Environmental Impact Statement (EIS) prepared by Umwelt Australia Pty Limited (Umwelt) and subsequently approved by the NSW Department of Planning (DoP) in October 1998. Approval of the haul road was conditional to a number of Development Consent Conditions outlined in the Development Consent (DA 97/800).

This Landscape and Rehabilitation Management Plan has been developed in accordance with the already approved Mandalong Mine Environmental Management Strategy, and approved site surface Environmental Management Plans. This addition to the existing Environmental Management Plans is designed to meet the requirements of Development Consent Conditions and government requirements. A detailed Construction Environmental Management Plan will also be developed by the construction contractors prior to the commencement of work and approved by Centennial.

2. Background

The construction and operation of the private haul road was approved by the NSW DoP in 1998 conditional to Centennial meeting the requirements of a number of associated Development Consent Conditions. The alignment of the haul road route has been developed through a number of ecological and engineering considerations. The alignment adopted by Centennial is one that results in minimal environmental impact to the surrounding flora, fauna and fauna habitat. **Figure 1** details the alignment of the haul road route proposed by Centennial.

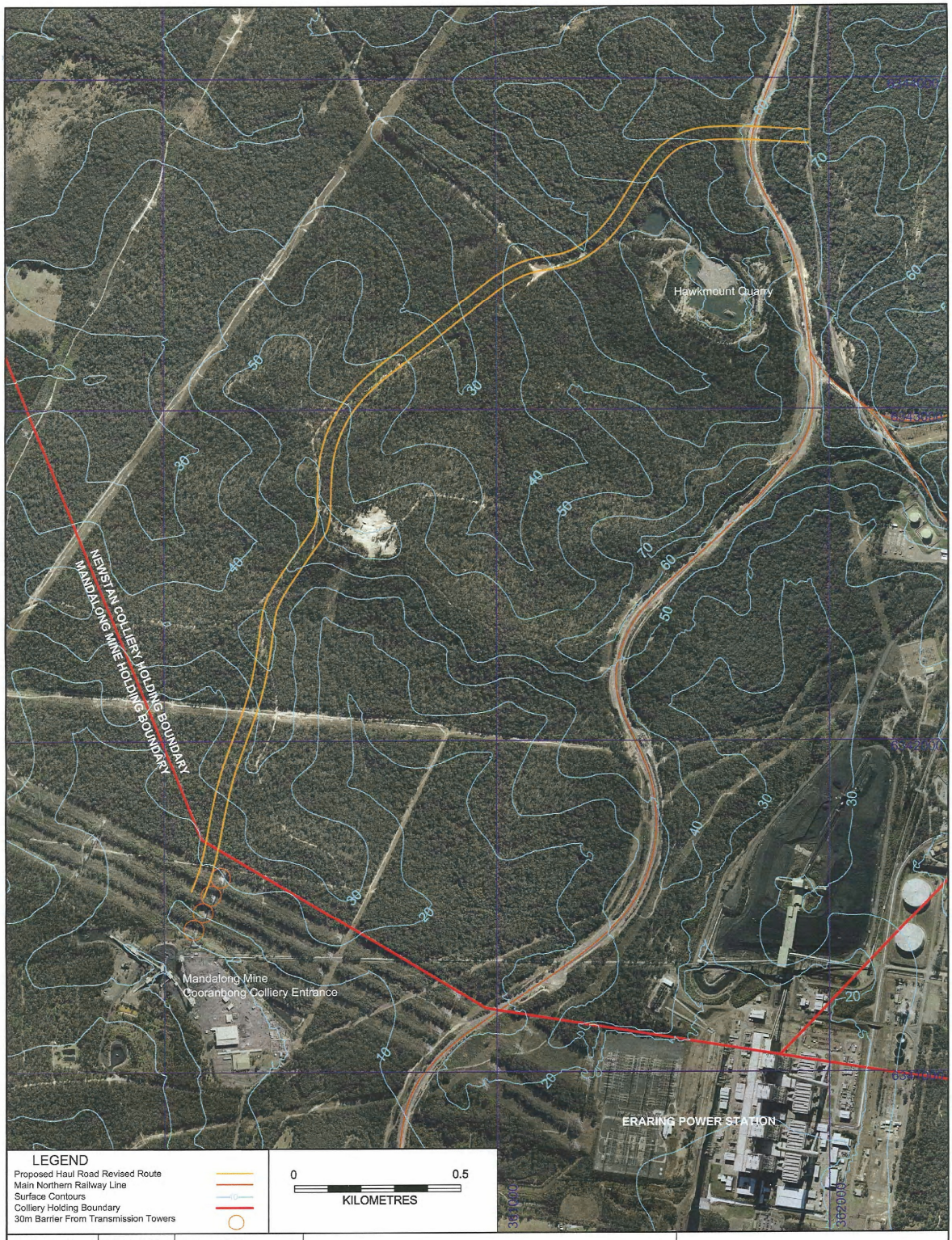
3. Objective

This Landscaping and Revegetation Management Plan was developed as a response to the environmental risks identified in the:

- Mandalong Mine Environmental Management Strategy
- Cooranbong Colliery Life Extension Project (CCLEP) Environmental Impact Statement
- CCLEP Commission of Inquiry Submissions
- Department of Urban Affairs and Planning Development Consent Conditions (Consent Conditions)

It is the intention of this Plan to address land management issues having regard to Centennial's internal environmental management standards and the requirements of Lake Macquarie City Council and the development consent.

Figure 1 – FINAL Haul Road Alignment



4. Site Description

The proposed private haul road is located within the Lake Macquarie Local Government Area (LGA) on Crown Land, The majority of the haul road traverses the Centennial Newstan Colliery holding, with the small southern portion falling within the Centennial Mandalong Colliery Holding. Centennial Coal holds the current Mining Lease (Consolidated Coal Lease CCL 746) over the surface and land to unlimited depth.

The area surrounding the mine sites consists of a matrix of remnant woodlands, rocky complexes, riparian zones, aquatic habitats and estuarine communities, which are interspersed with urban and industrial developments. Two dormant gravel extraction quarries exist in the area immediately adjacent to the proposed haul road. The quarries have current Permissive Occupancy (PO) and extraction licences over the area. Current holders of the two PO's are Lake Macquarie Council and J.P.Hussey. The existing Eraring-Newstan haul road and the Great Northern Railway Line lie to the east of the Project area. A number of unformed and haphazard roads and tracks occur throughout the area and past logging activity is evident. The area has two significant powerline easements intersecting the area to the south. Some exotic weed species are present on the site but are generally restricted to the disturbed edges of roadsides and tracks.

The haul road traverses Crown Land zoned 9 (Natural Resources) under the provisions of the Lake Macquarie Local Environment Plan (LEP). It passes through a mosaic of two dominant vegetation communities; Coastal Plains Smooth-barked Apple Woodland, and Coastal Plains Scribbly Gum Woodland. While evidence of a recent fire event is present, the vegetation has otherwise been subjected to a seemingly low level of disturbance. The haul road alignment passes through undulating terrain comprising small hills with slopes of typically 5% to 10% and shallow gullies occasionally with slopes up to 15%. The terrain ranges in elevation from approximately 10 m AHD in the valley floor immediately north of Cooranbong Colliery to approximately 50 m AHD on ridge lines.

The haul road route crosses three ephemeral water courses of varying condition. The creeks that are traversed by the existing road on the site have been subjected to heavy siltation probably caused from the unsealed tracks and dormant quarry sites. The creek not crossed by the existing road, to the north of LMCC Hawkmount quarry, is highly modified and is fed from a gutter leading from the quarry. These creek areas contain typical, albeit limited, riparian vegetation.

4.1. Vegetation Communities

The Threatened Species Conservation Act 1995 defines an ecological community as 'an assemblage of species occupying a particular area'. Two separate vegetation communities were identified to be impacted on as a result of the construction and operation of the haul road. These were:

Map Unit 30 *Coastal Plains Smooth-barked Apple Woodland* (5.07ha)

The primary canopy species for this community were Angophora costata, Corymbia gummifera and Eucalyptus piperita. The shrub layer consisted of Banksia spinulosa, Lambertia formosa, Leptospermum trinervium and along drainage lines, Leptospermum polygalifolium. Ground species were generally Entolasia stricta, Pteridium esculentum and Imperata cylindrica.

Map Unit 31 *Coastal Plains Scribbly Gum Woodland* (6.5ha)

The primary canopy species for this community were Eucalyptus haemastoma, Corymbia gummifera, Eucalyptus capitellata and Angophora costata. Shrub species were Banksia oblongifolia, Banksia spinulosa, Hakea bakeriana, Leptospermum trinervium and Isopogon anemonifolius. Ground cover was generally Entolasia stricta, Ptilothryx deusta and Xanthorrhoea latifolia.

Neither of these communities are listed in the schedules of the *NSW Threatened Species Conservation Act 1995* as being Endangered Ecological Communities.

The Hunter Eco 2009 report on the vegetation communities along the proposed Cooranbong Colliery to Awaba haul road identified that there were two vegetation communities that will be impacted on as a result of the construction of the haul road. These were the Coastal Plains Smooth Barked Apple Woodland and the Coastal Plains Scribbly Gum Woodland. The report identified that neither the Smooth Barked Apple Woodland nor the Scribbly Gun Woodland met any commonly used measures to define a significant vegetation community.

4.2. Habitat

The native vegetation in the Haul Road survey area is part of a continuous large woodland owned by the Crown. The total area of continuous woodland in the Consolidated Coal Lease (CCL746) alone which is a small part of the existing Crown land is in excess of 3,000 ha. The removal of 12 ha of woodland for the construction of the Haul Road will not impact significantly on the overall habitat available for native fauna species. Previous fauna surveys undertaken across the site have identified a number of hollow-dependent fauna species that could potentially utilise the hollow bearing trees for habitat. These species include listed gliders, owls and bats. As a result, wherever possible hollow-bearing trees will be relocated to existing disturbed areas outside the haul road corridor and fallen logs salvaged for use as habitat for ground-dwelling animals. Fallen tree hollows and/or nest boxes will be installed to compensate for the loss of habitat trees.

4.3. Tetratheca juncea

Tetratheca juncea is confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion. It is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. It spreads via underground stems which can be up to 50 cm long.

Large populations of this species are particularly important. The woodland where *Tetratheca juncea* was recorded will be partially cleared by the project (approximately 13 hectares). The proposed disturbance area however is surrounded by large areas of intact woodland. The project will not fragment or isolate areas of *Tetratheca juncea* habitat as a result of the work carried out. Ecologists have indicated that the removal of woodland habitat will not have a significant impact to the local populations of either *Tetratheca juncea* or *Grevillea parviflora subsp. parviflora*. The rehabilitation of existing disturbed areas will, in time, replace the habitat for the *Tetratheca juncea* and *Grevillea parviflora subsp. parviflora* that will be lost through the construction of the haul road.

5. Relevant Development Consent Conditions

Development Consent condition 71 provides detail on the matters which should be included in this Flora and Fauna Management Plan. These matters are set out in **Table 2** below, together with notation of the section of this document in which each matter is addressed.

Table 1 – Requirements of Development Consent DA 97/800

Condition	Development Consent Conditions	Section of this document
79	The Applicant shall, within 6 months of the date of this consent, or within such further period as council may require, submit for the Councils approval a detailed landscaping and rehabilitation plan for the surface facility sites (including the haul road) prepared by a suitably qualified person. The plan shall include:	This management plan
79(i)	Use of indigenous species;	Section 8
79(ii)	Consideration of revegetation works along creeklines;	Section 9.8
79(iii)	Details of the establishment of vegetation and the construction of mounding or bunding, for the purposes of maintaining satisfactory visual amenity, ecological functioning and habitat provision.	
79(iv)	Details of the visual appearance of buildings, structures, facilities or works (including paint colours and specifications);	NA
79(v)	Increased landscaping to screen the mine access site when viewed from the southbound lanes of the freeway;	NA
79(vi)	Details of replanting of native vegetation must occur at the entrance, south east corner and north east corner of the mine access site as well as between the Cooranbong Colliery and railway to ensure the stockpiles are not visible; and	NA
79(vii)	Details, specifications and staged work programmes to be undertaken, including a maintenance programme of all landscape works.	Section 9 Section 10 Section 11 Section 12
	The landscaping and revegetation plan must be consistent with the Environmental management Strategy, and the Applicant shall make copies available to the Community Consultative Committee within fourteen days of approval by Council	Section 6

6. Mandalong Mine Environmental Management Strategy

This Landscape and Rehabilitation Management Plan forms part of the Environmental Management Strategy (EMS) for the Mandalong Mine Project. The EMS was approved by the then Department of Urban Affairs and Planning (DUAP) on 15/08/00. The EMS details aspects such as:

- relevant legislative and statutory framework,
- overall roles, responsibilities and accountabilities,
- overall environmental management, ecological and community objectives and performance outcomes

The specific objectives for landscaping and rehabilitation are outlined below.

The environmental management objectives with respect to landscaping and rehabilitation are to:

- Increase the visual amenity of the surface facilities through revegetation and landscaping.

The ecological and community objectives for catchment management and restoration with respect to landscaping and rehabilitation are to:

- Establish areas of self-sustaining native revegetation.
- Maintain or increase current levels of habitat provision within the area of effect of the surface facilities.
- Maintain or increase current levels of ecological functioning within the area of effect of the surface facilities.

7. Vegetation Clearance

Areas required to be disturbed for construction access will be restricted to areas proposed to be disturbed as part of the construction of the haul road. The location of any topsoil stockpiles or temporary site buildings will be located in already previously disturbed areas. Vegetation clearing is to be undertaken progressively wherever possible to minimise the area exposed to erosion and is to be done in conjunction with drainage and erosion controls. Clearing operations are to cease during heavy rainfall and erosion and sediment control measures are to be monitored both during and immediately following rainfall. Natural buffer zones between disturbed areas and natural drainage lines are to be retained where possible. Approximately 13 hectares of vegetation will be required to be disturbed as a result of the construction of the haul road.

8. Revegetation Species

Flora surveys were undertaken during the environmental impact assessment for the Project. The area of survey included the haul road route. The survey results and listing of species may be found in the Cooranbong Colliery Life Extension Project Environmental Impact Statement Volume 1.

Indigenous species will be used based on the findings of these surveys. **Table 3** lists just a few of the commonly used species for revegetation across the site. A suitably qualified ecologist will be engaged by Centennial to assist in determining a suitable species mix for the rehabilitation areas for the Cooranbong Haul Road Project and to ensure the seed mix is adjusted to match the adjacent vegetation communities.

Table 2 – Commonly Used Native Vegetation Species in Revegetation

Species Name	Species Name
Acacia suaveolens	Acacia longifolia
Acacia falcate	Lomandra longifolia
Banksia spinulosa	Allocasuarina littoralis
Melaleuca nodosa	Eucalyptus robusta
Allocasuarina torulosa	Angophora costata
Corymbia maculata	Eucalyptus piperita
Eucalyptus siderophloia	Acacia decurrens

9. Rehabilitation programme

Details on the rehabilitation measures to be engaged for the haul road Project are outline below. A summary of the proposed Project timelines for these activities can be found in Appendix 2.

9.1. Topsoil management

Depending on its constituents, topsoil can serve a number of important functions such as the supply of seed and other propagules, contribution of beneficial micro-organisms, supply of nutrients, rapid development of groundcover, and the amelioration of adverse constituents in the underlying material. Topsoil will be removed and respread with great care. Both the nature of the equipment used and the soil moisture content influence the degree of soil compaction and structural breakdown that can occur during these procedures. The combined use of a front-end loader, truck and bulldozer for the removal, transport and spreading of topsoil is the best combination to reduce compaction.

During rehabilitation operations it is critical that topsoil is handled in a manner that will conserve plant diversity in the topsoil seed bank and maximise plant establishment after respreading. Specific topsoil management measures that will be implemented include:

- collecting topsoil at a time of year when the soil seed bank is likely to be highest if possible;
- respreading the topsoil directly onto an area prepared for rehabilitation;
- where the amount of topsoil available is limited, it is best to spread it to a thinner depth or in strips;
- any earthworks considerations, such as scarifying to 'key in' the topsoil and reduce the likelihood of it being lost through erosion—care will be taken not to dilute the topsoil with spoil material and to scarify across, not down, slopes;
- the final topsoil surface will be freshly disturbed and suitable for direct seeding.

Stockpiles will be constructed to minimise deterioration of seed, nutrients and soil biota, by avoiding topsoil collection when saturated following rainfall (this will promote composting), and

by creating stockpiles of lower height (one to three metres). The duration of stockpiling will be minimised, as periods longer than about six to 12 months may cause structural degradation and death of seeds and micro-organisms, especially when soil moisture content is high. Surface and subsoil material should be stockpiled separately.

9.2. Seeding

Seeding is widely used across the Australian mining industry for establishing both native vegetation communities and pastures. It is often the most cost-effective means of establishing a range of plant species over a large area.

Where possible, seed will be collected locally, because it will be best adapted to the conditions and will maintain the genetic integrity of local provenances. After collection, seed will need to be cleaned and stored under conditions that will maintain maximum viability over the period of storage and minimise damage due to pests and fungi.

9.2.1. Ecosystem succession

Successional aspects of an eco-system will be considered to assist in establishing a diverse, sustainable native ecosystem. Pioneer species that readily colonise disturbed areas will be included in the seed mix; however, species characteristics of later successional stages will also be established early. The relative abundances of species will change as early colonisers die out and longer-lived species, or those that colonise later, become proportionally more dominant.

9.2.2. Timing of seeding

The timing of seeding is critical and can vary significantly depending on local climatic conditions. Usually, the best time to seed is prior to reliable rainfall, however, reliable rainfall is difficult to predict. It is important to apply seed onto recently spread topsoil, even if reliable rainfall is not expected for several months.

It is anticipated that the seed mixed used on the rehabilitated areas associated with the haul road will include both a mix of locally collected seed (approximately 50%) and purchased native woodland seed mix. Further localised seed collection will be undertaken to ensure enough seed is available for rehabilitation of all areas.

9.3. Hydroseeding

Hydroseeding is a planting process which utilises a slurry of seed and mulch. The slurry is transported in a tank, either truck or trailer mounted and sprayed over prepared ground in a uniform layer. Hydroseeding is an alternative to the traditional process of broadcasting or sowing dry seed. It promotes quick germination and inhibits soil erosion.

The mulch in the hydroseed mixture helps maintain the moisture level of the seed and seedlings. The slurry often has other ingredients including fertilizer, tackifying agents, green dye and other additives. Where considered appropriate, hydroseeding will be used across the Project site.

9.4. Planting of seedlings

The use of hand-planted seedlings has advantages and disadvantages over direct seeding. Advantages include less wastage of seed, more accurate planting densities, better survival rates

(in some but not all cases) and usually better survival where weed competition is a problem. It is anticipated that planting of seedlings in rehabilitated areas would best be suited to the riparian vegetation areas along the creeklines. Where appropriate, Centennial will undertake localised planting of locally propagated seedlings in the creekline areas.

9.5. Seed Collection

Seed Collection will be undertaken across the site during the construction of the haul road to ensure a supply of local seed can be maintained for use in rehabilitation works.

9.5.1. Requirements of seed collection

Requirements for seed collection are specified below:

- preference for seed collection would be given to those plants that are to be removed in construction areas and those which are representative of vegetation communities to be restored in revegetation works.
- seed collection is to be carried out by a suitably qualified professional in a manner that preserves the parent plant and that removes only a small percentage of reproductive material from the overall population in a particular area (unless in an area of clearing).
- collected seed must be labelled and stored under appropriate conditions, reflective of the nature of the seed collected, until seed distribution is to be initiated.

9.6. Rehabilitation of Disturbed Areas

Centennial will undertake progressive and short term stabilisation of all disturbed areas associated with the construction of the haul road (including batters and road verges) using fast growing plants such as sterile grasses. Native vegetation species will be established on rehabilitated sites. Table 2 lists typical native species commonly used in rehabilitation on site.

Weed free topsoil will be stripped and stockpiled during the construction phase and reused during rehabilitation works. This will preserve the local native seed content. Suitable plant material removed from the disturbance areas will be chipped and used in site rehabilitation works, or will be spread into surrounding bushland. This retains a store of local seed, which can replenish the soil seed bank.

The vegetation re-established on batters and in other disturbed areas will be composed of species found in the surrounding native vegetation. The restored vegetation would reflect the ecology of the adjoining vegetation.

9.7. Rehabilitation of Gravel Quarry

The Haul Road crosses an area of Permissive Occupancy (PO 1979/6) held over a section of Crown land adjacent to the haul. The Permissive Occupancy allows for the construction and operation of a gravel quarry within this area. The quarry is currently not utilised for extraction purposes. Centennial Coal are currently in discussions with the holder of the Permissive Occupancy Licence to determine the future use of this area. Consideration of rehabilitation of this quarry site is a factor in the overall impact minimisation of the haul road however is subject to the current operator of the quarry relinquishing the existing PO licence.

Rehabilitation of this site will require the site will be deep ripped following final contouring and immediately seeded. If any of the topsoil/mulch material is left over from the haul road, this will be spread prior to ripping and seeding.

9.8. Rehabilitation of Hawkmount Quarry

LMCC currently hold Permissive Occupancy 1961/64 over approximately 475 hectares of land adjacent to the haul road for the operation of the Hawkmount Quarry. The Hawkmount Quarry is not currently being utilised by LMCC. Recent discussions between Centennial Coal and LMCC indicate that LMCC will relinquish their Permissive Occupancy over the land. A long term strategy for Centennial Coal is to undertake the rehabilitation of the quarry on behalf of LMCC. Rehabilitation of the quarry can compensate for the loss of vegetation cleared as a result of the haul road construction. Rehabilitation of the Hawkmount quarry is subject to the relinquishment of the existing PO over this land.

9.9. Rehabilitation of Access Track

On the completion of construction, sections of the existing access track will be rehabilitated. Some sections will be required to be retained to allow for access to sediment basins, translocation recipient sites and the proposed fence lines to allow for monitoring and maintenance of these areas. The areas that will remain as access tracks will be determined at the completion of the construction of the haul road and will be kept to a minimal area.

Rehabilitation of the access track will consist of deep ripping the road easement, dragging any adjacent logs or timber back onto the road, and tree seeding. It is assumed that all the topsoil/mulch material will be used up at that time. However, if any material is still available this should be spread over the road prior to ripping. The objective of all site preparation is to create a suitable seed bed.

9.10. Creek Lines

The haul road route crosses three ephemeral water courses of varying condition. The creeks that are traversed by the existing road on the site have been subjected to heavy siltation probably caused from the unsealed tracks and dormant quarry sites. The creek not crossed by the existing road, to the north of LMCC Hawkmount quarry, is highly modified and is fed from a gutter leading from the quarry. These creek areas contain typical, albeit limited, riparian vegetation.

The haul road is using existing creek crossings as much as possible to minimise disturbance to the creek lines and associated riparian vegetation. To minimise impacts on aquatic habitat during construction, works at creek crossings will be programmed to be undertake in a dry period or low flow period. All in stream construction works will be completed as soon as possible. A minimum of a 50 m buffer from any watercourse will be implemented for stockpiling of materials and sediment and erosion control practices will be implemented to ensure that sediment does not enter watercourses. Areas surrounding the creek crossings will be stabilised and rehabilitated using suitable riparian vegetation species.

Centennial will also undertake localised planting of propagated seedlings in the areas in and around creeks wherever appropriate. The species to be used in these areas will be determined by a suitably qualified ecologist.

10. Habitat Regeneration

Habitat regeneration will be conducted thorough the placement of tree crowns from the clearing zone onto any appropriate disturbed areas external to the road corridor to promote regeneration of these areas. Timber that is not considered millable and recently inhabited hollow bearing trees will

also be placed in nearby currently disturbed areas to provide sheltering habitat for terrestrial fauna species.

11. Translocation

The haul road alignment proposed in the 1997 EIS was relocated to reduce the impacts on populations of Tetratheca juncea and Grevillea parviflora subsp. parviflora. Unfortunately it is not possible to connect the haul road from the Cooranbong pit top surface facilities to the Eraring-Newstan Haul road without the interfering with a minor portion of the population of these species.

In the circumstance that species of threatened flora could not be avoided, the conditions of consent allow for the translocation of the plants from the disturbance area. Such translocation should be "*in accordance with the* "*Guidelines for the Translocation of Threatened Plants in Australia" (Australian Network for Plant Conservation, 1997) and to the satisfaction of NPWS*."

A proposal is currently being prepared by Hunter Eco to detail the methods to undertake the translocation and propagation programme. In accordance with the Development Consent, this plan will be submitted to the Department of Environment and Climate Change (DECC) for approval prior to any translocation of these species occurring. Any translocation of *Tetratheca juncea* and *Grevillea parviflora subsp. parvilflora* will be done in accordance with the approved translocation proposal.

The proposal will identify appropriate recipient sites that will be prepared prior to relocation to limit the transport time between sites. Ideally the entire root body and associated soil should be moved as a whole. Small individual plants can be removed by manual labour. Larger clumps of plants will require mechanical removal to limit disturbance and plant stress. Mechanical removal can occur via backhoe or front end loader.

12. Rehabilitation Maintenance Programme

Future maintenance details for the landscaping and revegetation works will include replacing any dead tubestock and the control of weeds. Additional fertilizer application to encourage growth may be required and will be assessed on an annual basis. If rehabilitation in an area is not successful, remedial actions will be determined on an individual site basis.

12.1. Weeds

The majority of the vegetation the corridor passes through is free from weed infestation. Only two locations were discovered showing signs of infestation (see Figure 4). These two locations were in close proximity to areas that have a history of disturbance. The northern site is a small infestation of Pampas Grass close to the outlet of a nearby dam. The second site, with the greatest infestation of a range of species, is on the southern side of a disused quarry. It seems the site has largely been used for waste dumping that has provided a source for the majority of the weeds present.

The weed species identified can be found in Table 1 below.

Table 3 – Weed Species Identified

Common Name	Scientific Name	Class (if declared noxious)
Pampas Grass	*Cortaderia* species	**4**
Lantana	*Lantana camara*	**5**
Bitou Bush	*Chrysanthemoides monilifera* subsp. *rotundata*	**4**
Castor Oil Plant	*Ricinus communis*	n/a
Giant Reed	*Arundo donax*	n/a
Garden Escapes		
Banana	*Musa acuminata*	n/a
Bougainvillea	*Bougainvillea glabra*	n/a
Wild Tobacco Tree	*Solanum mauritianum*	n/a

12.1.1. Noxious Weed Classification

The following classes are also described as per the Noxious Weeds Act 1993.
Class 1 – The plant must be eradicated from the land and the land must be kept free of the plant (All of NSW Declaration)
Class 2 - The plant must be eradicated from the land and the land must be kept free of the plant (Control area specific)
Class 3 – The plant must be fully and continuously suppressed and controlled
Class 4 – The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Class 5 – The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with (All of NSW Declaration)

12.2. Weed Control

The construction of the haul road and associated loss of habitat would not result in the establishment of invasive species in the habitat. Some invasive species would establish at the edges of the new road but would not penetrate into the undisturbed habitat.

A baseline survey of weed species and abundance using a transect survey method along the east and west extents of the entire haul road route. These transects were followed by foot for the length of the haul road. All weed species present within this transect were recorded and photographed to establish the baseline survey dataset.

The abundance of weed species within and surrounding the specified corridor is very low to minimal. The main area of infestation is not specifically within the disturbance corridor but incorporates a range of weed species and could act as a source for further infestation.

Further surveying will be required post-construction to assess any changes in weed species and abundance. The disturbance created by the construction will provide for suitable areas for weed infestation and will need to be included in future surveys, along with transects surrounding the corridor.

Timing for future surveying will ideally be 3-4 months after construction to allow for germination and growth of any weeds present to a visible stage.

Appropriate weed management strategies will be developed to manage and control weed species in the immediate vicinity surrounding the haul road route. The focus of weed management strategies will be to target all disturbance areas resulting form the construction of the haul road with additional focus placed on disturbance areas near the *Acacia bynoeana* populations identified within the immediate vicinity of the haul road. The weed control programme will also target the bushland immediately adjacent to disturbance areas to ensure invasive weed species do not encroach on existing weed free habitat. This area will be a minimum of 10 metres from the disturbance footprint of the haul road.

The weed control programme will also focus on targeting the weed populations identified in the location of existing disturbed areas associated with the Hussey and Hawkmount quarries however targeting these weed infestations is subject to the relinquishment of these licences.

Table 4 – Potential Weed Management Strategies

Weed Species	**Knapsack Spraying** Low pressure and low volume application of herbicide mixed as per product label.	**Splatter Gun** Targeted application of herbicide at a higher concentration.	**High-Volume Gun Application** Where non-target risks are minimised I.e. not in close proximity to native vegetation	**Cut Stump/Basal Bark Application** The tree is cut with herbicide applied to the stump or basal bark area
Pampas Grass (northern infestation)	✓	✓		
Pampas Grass (southern infestation)			✓	
Lantana		✓	✓	
Bitou Bush	✓			
Castor Oil Plant	✓			✓
Giant Reed		✓		✓
Garden Escapes				
- Banana				✓
- Bougainvillea				✓
- Wild Tobacco Tree				✓

13. Monitoring

13.1. Rehabilitation

Monitoring of rehabilitation areas will be undertaken a minimum of twice per year and will include:

- an assessment of surface (and slope) stability;
- properties of the soil or root zone media (such as chemistry, fertility and water relations);
- plant community structural attributes (such as cover, woody species density and height);
- plant community composition (such as presence of desired species, weeds); and
- selected indicators of ecosystem functioning (such as soil microbial biomass).

13.2. Weeds

As discussed earlier, a baseline weed survey will be undertaken along two transects along the entire extent of the haul road route prior to construction. Six months post construction, both transects will be walked once again with all weed species present along the transects recorded and photographed to establish the post construction survey dataset. Annual surveys will be undertaken along these transects to determine if the haul road has resulted in an increase in weed infestations. Appropriate weed control measures will be implemented where required.

All weed control measures will be inspected annually and the effectiveness of weed control measures reported.

All rehabilitation areas will be monitored twice a year to assess the presence of weed species. Appropriate weed control measure will be implemented if required.

13.3. Translocation

The proposal for the translocation programme of *Tetratheca juncea* and *Grevillea parviflora subsp. parviflora* will contain a detailed monitoring programme for a period of five years. All translocation monitoring will be done in accordance with the approved proposal.

14. Consultation

This Landscape and Rehabilitation Management Plan has been development in consultation with LMCC.

15. Reporting

A summary of all details of activities undertaken as part of the rehabilitation and management for the Cooranbong haul road will be reported annually in the Mandalong Mine AEMR. A copy of the AEMR is provided to all relevant government agencies.

16. Conclusion

A number of measures have been, and will be, implemented by Centennial Coal to ensure the design, construction and operation of the Cooranbong haul road is completed with consideration to environmental impacts. The rehabilitation undertaken as part of this project will aid in the regeneration of the surrounding environment and provide suitable habitat for a range of flora and fauna species.

Appendix 1 – Summary of Commitments

1. Restrict disturbance to pre-defined disturbance areas

2. Locate topsoil stockpiles or temporary site buildings in already previously disturbed areas

Vegetation clearing is to be undertaken progressively wherever possible

3. Clearing to be done in conjunction with drainage and erosion controls

4. Cease clearing operations during heavy rainfall

5. Natural buffer zones between disturbed areas and natural drainage lines are to be maintained

6. Handle topsoil in a manner that will conserve plant diversity in the topsoil seed bank

7. Wherever possible collect topsoil at a time of year when the soil seed bank is likely to be highest

8. Wherever possible re-spread the topsoil directly onto an area prepared for rehabilitation;

9. Undertake earthworks such as scarifying to reduce the likelihood of it being lost through erosion

10. Scarify across, not down, slopes;

11. Construct stockpiles to minimise deterioration of seed, nutrients and soil biota,

12. Minimse stockpile height (one to three metres)

13. Minimise the duration of stockpiling (no longer than six to 12 months)

14. Use, as much as possible, seed that has been collected locally

15. Include both pioneer and species of later successional stages in the seed mix;

16. Undertake further localised seed collection

17. Undertake localised planting of locally propagated seedlings in the creekline areas whever possible.

18. Undertake progressive and short term stabilisation of all disturbed areas associated with

the construction

19. Establish native vegetation species on rehabilitated sites

20. Reuse weed free stockpiled topsoil during rehabilitation works

21. Restored vegetation to reflect the ecology of the adjoining vegetation

22. Rehabilitation of gravel quarry (subject to the relinquishment of existing PO License)

23. Rehabilitation of Hawkmount Quarry (subject to the relinquishment of existing PO License)

24. Rehabilitation of sections of existing access tracks that will be no longer required

25. Undertake habitat regeneration thorough the placement of tree crowns and hollows into existing disturbed areas

26. Undertake a translocation programme for the Tetartheca juncea and Grevillea parviflora

subsp. parviflora

27. Implement a weed monitoring and control programme for all disturbed areas/rehabilitated areas and immediately adjacent bushland

28. Implement a weed control programme to target identified infestation as existing quarries (subject to the relinquishment of existing PO License)

29. Implement a weed monitoring programme

30. Monitor translocated threatened flora
31. Monitor rehabilitation success

Appendix 2 – Programme of Works Timeline

Appendix 3 – Flora Species List

Family	Genera	Specie	Common Name
ACANTHACEAE	Pseuderanthemum	variabilis	
ADIANTACEAE	Adiantum	aethiopicum	Common Maidenhair Fern
AGAVACEAE	Doryanthes	excelsa	Gymea Lily
APIACEAE	Centella	asiatica	
APIACEAE	Hydrocotle	peduncularis	
APIACEAE	Hymenosporum	flavens	
APOCYNACEAE	Parsonsia	straminea	
ARACEAE	Gymnostachys	anceps	Settler\rquotes Flax
ARALIACEAE	Polyscias	sambucifolia	
ASTERACEAE	Onopordum	acanthium	Scotch Thistle
ASTERACEAE	Aster	iso	leaf yellow
ASTERACEAE	*Ageratina	adenophora	Crofton Weed
ASTERACEAE	*Conyza	sp.	Fleabane
ASTERACEAE	*Senecio	madagascariensis	Fireweed
ASTERACEAE	*Taraxacum	officienale	Dandelion
ASTERACEAE	Cassinia	sp.	
ASTERACEAE	Sigesbeckia	orientalis	
ASTERACEAE	Vernonia	cinerea	
BIGNONIACEAE	Pandorea	pandorana	
BLECHNACEAE	Blechnum	indicum	Swamp Water Fern
CASSYTHACEAE	Cassytha	glabella	Devils Twine
CASSYTHACEAE	Cassytha	pubescens	Devil Twine
CASUARINACEAE	Allocasuarina	littoralis	Black She-oak
CELASTRACEAE	Maytenus	silvestris	
CONVOLVULACEAE	Dichondra	repens	Kidney Weed
CONVOLVULACEAE	Polymeria	calycina	
CUNONIACEAE	Callicoma	serratifolia	Black Wattle
CUNONIACEAE	Ceratopetalum	gummiferum	Christmas Bush
CYATHEACEAE	Cyathea	cooperi	Tree Fern
CYPERACEAE	Carex	appressa	
CYPERACEAE	Gahnia	sp.	Saw Sedge
CYPERACEAE	Lepidosperma	laterale	
CYPERACEAE	Ptilothrix	deustum	
DENNSTAEDTIACEAE	Pteridium	esculentum	Bracken
DICKSONIACEAE	Calochlaena	dubia	Soft Bracken Fern
DILLENIACEAE	Hibbertia	sp.	
DILLENIACEAE	Hibbertia	sp.	
DROSERACEAE	Drosera	burmanii	
ELAEOCARPACEAE	Elaeocarpus	reticulatus	Blueberry Ash
EPACRIDACEAE	Leucopogon	appressus	
EPACRIDACEAE	Leucopogon	lanceolatus	
EUPHORBIACEAE	Breynia	oblongifolia	Coffee Bush
EUPHORBIACEAE	Glochidion	ferdinandi	Cheese Tree
FABACEAE	Glycine	clandestina	Love Creeper
FABACEAE	Glycine	microphylla	Love Creeper
FABACEAE	Gompholobium	grandiflorum	
FABACEAE	Gompholobium	latifolium	Broad-leaf Wedge Pea
FABACEAE	Bossiaea	obcordata	
FABACEAE	Bossiaea	rhombifolia	
FABACEAE	Daviesa	genistifolia	
FABACEAE	Daviesa	squarrosa	var. squarrosa

Family	Genera	Specie	Common Name
FABACEAE	Dillwynia	retorta	
FABACEAE	Dillwynia	retorta	ssp. peduncularis
FABACEAE	Discorea	transversa	Native Yam
FABACEAE	Epacris	pulchella	NSW Coral Heath
FABACEAE	Hovea	purpurea	
FABACEAE	Kennedia	rubicunda	Duscky Coral Pea
FABACEAE	Mirbelia	speciosa	
FABACEAE	Oxylobium	ilicifolium	
FABACEAE	Platylobium	formosum	
FABACEAE	Pultanaea	palacea	
FABACEAE	Pultanaea	retusa	
FABACEAE	Pultanaea	villosa	
GENTIANACEAE	*Centaurium	erythraea	Common Centuary
GOODENIACEAE	Goodenia	heterophylla	Variable-leaved Goodenia
GOODENIACEAE	Goodenia	ovata	Hop-Goodenia
GOODENIACEAE	Dampiera	stricta	
GOODENIACEAE	Scaevola	ramossisima	
HAEMODORACEAE	Haemodorum	planifolium	Blood Root
IRIDACEAE	Patersonia	glabrata	
IRIDACEAE	Patersonia	sericea	
JUNCACEAE	Juncus	usitatus	Common Rush
LILIACEAE	Dianella	caerulea	Blue Flax Lily
LILIACEAE	Dianella	caerulea var. producta	Blue Flax Lily
LINDSAEACEAE	Lindsea	linearis	
LINDSAEACEAE	Lindsea	microphylla	
LOBELIACEAE	Lobelia	gracilis	
LOBELIACEAE	Pratia	purpurascens	White Root
MALVACEAE	Howittia	trilocularis	
MENISPERMACEAE	Sarcopetalum	harveyanum	
MIMOSACEAE	Acacia	buxifolia	Box-leaf Wattle
MIMOSACEAE	Acacia	elata	Mountain Cedar Wattle
MIMOSACEAE	Acacia	falcata	
MIMOSACEAE	Acacia	irrorata	Green Wattle
MIMOSACEAE	Acacia	longifolia	Sydney Golden Wattle
MIMOSACEAE	Acacia	myrtifolia	Myrtle Wattle
MIMOSACEAE	Acacia	suaveolans	Sweet-scented Wattle
MIMOSACEAE	Acacia	terminalis	Sunshine Wattle
MIMOSACEAE	Acacia	ulicifolia	Prickly Moses
MYRSINACEAE	Rapanea	variabilis	
MYRTACEAE	Acmena	smithii	Lilly Pilly
MYRTACEAE	Angophora	costata	Smooth-barked Apple
MYRTACEAE	Eucalyptus	crebra	Narrow-leaved Ironbark
MYRTACEAE	Callistemon	linearifolius	
MYRTACEAE	Callistemon	salignus	Willow Bottle Brush
MYRTACEAE	Callistemon	sp.	
MYRTACEAE	Corymbia	gummifera	Red Bloodwood
MYRTACEAE	Corymbia	maculata	Spotted Gum
MYRTACEAE	Eucalyptus	capitellata	Brown Stringybark
MYRTACEAE	Eucalyptus	haemastoma	Scribbly Gum
MYRTACEAE	Eucalyptus	piperita	Sydney Peppermint
MYRTACEAE	Eucalyptus	punctata	Large-fruited Grey Gum
MYRTACEAE	Eucalyptus	racemosa	Scribbly Gum

Family	Genera	Specie	Common Name
MYRTACEAE	Eucalyptus	resinifera	Red Mahogany
MYRTACEAE	Eucalyptus	robusta	Swamp Mahogony
MYRTACEAE	Kunzea	ambigua	
MYRTACEAE	Leptospermum	polygalifolia	Lemon-scented Tea Tree
MYRTACEAE	Leptospermum	sp.	
MYRTACEAE	Leptospermum	trinervium	
MYRTACEAE	Melaleuca	decora	
MYRTACEAE	Melaleuca	stypheloides	
MYRTACEAE	Melaleuca	thymifolia	
MYRTACEAE	Syncarpia	glomulifera	Turpentine
OXALIDACEAE	Oxalis	sp.	
PHILESIACEAE	Eustrephus	latifolius	Wombat Berry
PHILESIACEAE	Geitonoplesmium	cymosum	Scrambling Lily
PITTOSPORACEAE	Billardiera	scandens	Apple Berry
PITTOSPORACEAE	Pittosporum	revolutum	
POACEAE	*Andropogon	virginicus	Whiskey Grass
POACEAE	*Paspalum	dilatatum	Large Paspalum
POACEAE	*Paspalum	urvillei	Small Paspalum
POACEAE	Cymbopogon	refractus	Barbed Wire Grass
POACEAE	Danthonia	sp.	Wallaby Grass
POACEAE	Dichelachne	micrantha	Short-hair Plume Grass
POACEAE	Echinopogon		
POACEAE	Entolasia	marginata	
POACEAE	Imperata	cylindrica	Blady Grass
POACEAE	Oplismenus	aemulus	
POACEAE	Poa	sp.	
POACEAE	Themeda	australis	Kangaroo Grass
POACEAE	Trocoryne	simplex	
POLYGALACEAE	Commesperma	ericinum	Matchheads
POLYGONACEAE	Persicaria	decipens	
PROTEACEAE	Persoonia	levis	
PROTEACEAE	Persoonia	linearis	
PROTEACEAE	Isopogon	anemonifolius	Drumsticks
PROTEACEAE	Banksia	oblongifolia	
PROTEACEAE	Banksia	serrata	Old-man Banksia
PROTEACEAE	Banksia	spinulosa	Hairpin Banksia
PROTEACEAE	Hakea	bakerana	
PROTEACEAE	Hakea	dactyloides	Finger Hakea
PROTEACEAE	Hakea	salicifolia	Willow-leaved Hakea
PROTEACEAE	Lambertia	formosa	Mountain devil
PROTEACAE	Lomatia	silaifolia	
PROTEACAE	Xylomelum	pyriforme	
RANUNCULACEAE	Clematis	aristata	Travellers Joy
RUBIACEAE	Morinda	jasmenoides	
RUBIACEAE	Pomax	umbellata	Pomax
RUBIACEAE	Rubus	fruiticosus	Blackberry
RUBIACEAE	Rubus	hillii	
SANTALACEAE	Exocarpus	cuppressiformis	Native Cherry
SAPINDACEAE	Dodonaea	triquetra	Hop Bush
SMILACACEAE	Smilax	australis	Wonga Wonga Vine
STERCULIACEAE	Commersonia	fraseri	Black-fellows Hemp
THYMELIACEAE	Pimelea	linifolia	
TREMANDRACEAE	Tetratheca	ericifolia	Black-eyed Susan

Family	Genera	Specie	Common Name
TREMANDRACEAE	Tetratheca	juncea	Black-eyedSusan
TYPHACEAE	Typha	orientalis	Bull Rush
VERBENACEAE	*Lantana	camara	Lantana
VIOLACEAE	Viola	hederacea	Native Violet
VITACEAE	Cissus	hypoglauca	Five-leaf Water Vine
XANTHORRHOEACEAE	Lomandra	filiformis	
XANTHORRHOEACEAE	Lomandra	longifolia	Mat Rush
XANTHORRHOEACEAE	Lomandra	multiflora	
XANTHORRHOEACEAE	Lomandra	obliqua	Fishbones
XANTHORRHOEACEAE	Xanthorrhoea	minor	Grass Tree
ZAMIACEAE	Macrozamia	communis	

Appendix 4 – Examples of Rehabilitation on slopes