

## **APPENDIX E**

### ***Ecological Impact Assessment***





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## **NARAMA WEST MODIFICATION: ECOLOGICAL IMPACT ASSESSMENT**

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Cumberland Ecology has been engaged by Hansen Bailey Environmental Consultants (Hansen Bailey) on behalf of Xstrata Coal Pty Limited (Xstrata Coal) to complete an ecological impact assessment for the Narama West Modification (the Modification). The purpose of the assessment is to form part of an Environmental Assessment (EA) being prepared by Hansen Bailey to support the Modification to Project Approval (PA) 09\_0176 under section 75W, Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The full ecological impact assessment is contained within **Appendix A**, while a summary of findings is provided below.

### **1. The Modification**

Ravensworth Operations Pty Ltd (Ravensworth Operations) is a wholly owned subsidiary of Xstrata Coal and comprises of the active Ravensworth North and Narama mining areas and the former Cumnock, Ravensworth West and Ravensworth South mining areas. Ravensworth Operations is situated within the Singleton Local Government Area and located approximately 15 kilometres (km) north-west of Singleton and 17 km south-east of Muswellbrook in the Upper Hunter Valley of New South Wales (NSW) (see Figure 1 of Appendix A).

Ravensworth Operations currently conducts open cut mining activities under PA 09\_0176, which was approved 11 February 2011, to provide high quality thermal and semi-soft coking coal to export and domestic markets at a maximum of 16 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal.

Xstrata Coal is seeking a modification to PA 09\_0176 under section 75W, Part 3A of the EP&A Act. The Modification involves:

- Recovery of approximately 2.7 Million tonnes (Mt) of ROM coal by open cut mining methods over a period of two years in an approved overburden emplacement area (OEA) within the Narama mining area (referred to as the Narama West mining area);
- Production within the approved maximum limit of 16 Mtpa of ROM coal;
- Operations being undertaken via truck and shovel or dragline mining techniques;
- Utilisation of the existing equipment fleet;
- Tailings and rejects emplacement as per approved existing operations;
- Utilisation of existing infrastructure, including the Coal Handling and Preparation Plant, coal terminal, rail loop, workshops and offices;
- Transportation of domestic coal to neighbouring power stations via the existing conveyor system;
- Transportation of product coal to the Port of Newcastle for export via the Main Northern Railway; and
- Retention of the approved final landform with overburden used to progressively backfill the final void.

The conceptual layout of the Modification is illustrated in Figure 2 of Appendix A.

## **2. Methods of Investigation**

The ecological impact assessment completed by Cumberland Ecology has relied upon a pre-existing database of ecological information and records collected during a field inspection in October 2012 for the area within the approved operations boundary, in particular the Modification disturbance boundary (see Figure 2 of Appendix A).

The flora and fauna in the Modification disturbance boundary and within surrounding land have been studied in the past as a component of the Fauna Biodiversity Monitoring Program for Ravensworth Operations in 2009 and during investigations for the Ravensworth Operations Project EA completed in 2010. Information from Cumberland Ecology's involvement in the implementation of a monitoring program for biodiversity offsets, including a Ravensworth North offset, which is of relevance to the Modification disturbance boundary was also reviewed to understand the likely impacts of the proposed activity.



Cumberland Ecology conducted a site inspection within the Modification disturbance boundary in October 2012. During this inspection, notes and photographs were taken of the rehabilitated woodland and grassland vegetation. The inspection included a habitat assessment for flora and fauna as well as collection of incidental flora and fauna records.

### 3. Impact Assessment

The Modification will disturb an additional 88.7 ha of land within an approved OEA, including 54.7 ha associated with the proposed mining area and 34.0 ha associated with the OEA. The Modification disturbance boundary currently supports 71.9 ha of rehabilitated land, including 13.5 ha of rehabilitated woodland and 58.4 ha of rehabilitated exotic pasture grassland, and 16.8 ha of disturbed, unvegetated land and small dams.

The land within the Modification disturbance boundary supports only rehabilitated woodland vegetation, which does not conform to any Endangered or Critically Endangered communities listed under the *NSW Threatened Species Conservation Act 1995* (TSC Act) or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The rehabilitated woodland within the Modification disturbance boundary, does however, support suitable habitat for a number of threatened fauna species, including woodland bird species listed as threatened under the TSC Act. One such species (Speckled Warbler) was recorded during the October 2012 site inspection. This species is known to colonise and use relatively young woodland regeneration within the Modification disturbance boundary and rehabilitation and natural woodland within the approved operations boundary.

The rehabilitated woodland within the Modification disturbance boundary is small, fragmented and isolated from adjacent woodland habitat by exotic pasture lands and the existing operations within the Narama mining area. It is therefore unlikely the rehabilitated woodland would support optimal habitat for woodland birds. The removal of the rehabilitated woodland within the Modification disturbance boundary is unlikely to result in significant impacts on threatened flora and fauna.

The approved operations boundary is composed of 76.4 ha of rehabilitated woodland and 1,000 ha of rehabilitated exotic pasture grassland. The 71.9 ha to be removed by the Modification, therefore represents only a small portion of rehabilitated land within the approved operations boundary.

Following completion of operations within the Modification disturbance boundary, this area will be utilised as an OEA for future mining at Ravensworth Operations as stipulated under PA 09\_0176. This will be rehabilitated upon cessation of the future mining activities in accordance with the approved Mining Operations Plan. Based upon improvements to rehabilitation techniques in recent years, woodland can now be re-established to a higher standard than the current rehabilitation and so will result in a return to a similar or better habitat state for flora and fauna in the long term. Future rehabilitation is predicted to restore habitats for such species as the Speckled Warbler.

No significant impacts are predicted to occur on any of the flora, fauna or ecological communities known or predicted to occur within the Modification disturbance boundary. The Modification is not likely to result in any significant impacts on any threatened species or communities, or any Matters of National Environmental Significance. The Modification does not require referral to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities.

Yours sincerely



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Director

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*Appendix A*

Narama West Modification:

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## **A.1 Introduction**

### **A.1.1 Purpose**

Cumberland Ecology has been engaged by Hansen Bailey Environmental Consultants (Hansen Bailey) on behalf of Xstrata Coal Pty Limited (Xstrata Coal) to complete an ecological impact assessment for the Narama West Modification (the Modification). The purpose of the assessment is to form part of an Environmental Assessment (EA) being prepared by Hansen Bailey to support the Modification to Project Approval (PA) 09\_0176 under section 75W, Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The ecological impact assessment considers the likely impacts of the Modification on native flora and fauna with a key focus on impacts to threatened species listed by the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

### **A.1.2 Background**

Ravensworth Operations Pty Limited (Ravensworth Operations) is a wholly owned subsidiary of Xstrata Coal and comprises of the active Ravensworth North and Narama mining areas and the former Cumnock, Ravensworth West and Ravensworth South mining areas. Ravensworth Operations is situated within the Singleton Local Government Area (LGA) and located approximately 15 kilometres (km) north-west of Singleton and 17 km south-east of Muswellbrook in the Upper Hunter Valley of New South Wales (NSW). Figure 1 illustrates the location of Ravensworth Operations and its approved operations boundary.

Ravensworth Operations currently carries out open cut mining activities under PA 09\_0176, approved 11 February 2011, to provide high quality thermal and semi-soft coking coal to export and domestic markets at a maximum of 16 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal.

### **A.1.3 Modification Description**

Xstrata Coal is seeking a modification to PA 09\_0176 under section 75W, Part 3A of the EP&A Act.

The Modification involves:

- Recovery of approximately 2.7 Million tonnes (Mt) of ROM coal by open cut mining methods over a period of two years in an approved overburden emplacement area (OEA) within the Narama mining area (referred to as the Narama West mining area);
- Production within the approved maximum limit of 16 Mtpa of ROM coal;
- Operations being undertaken via truck and shovel or dragline mining techniques;
- Utilisation of the existing equipment fleet;
- Tailings and rejects emplacement as per approved existing operations;

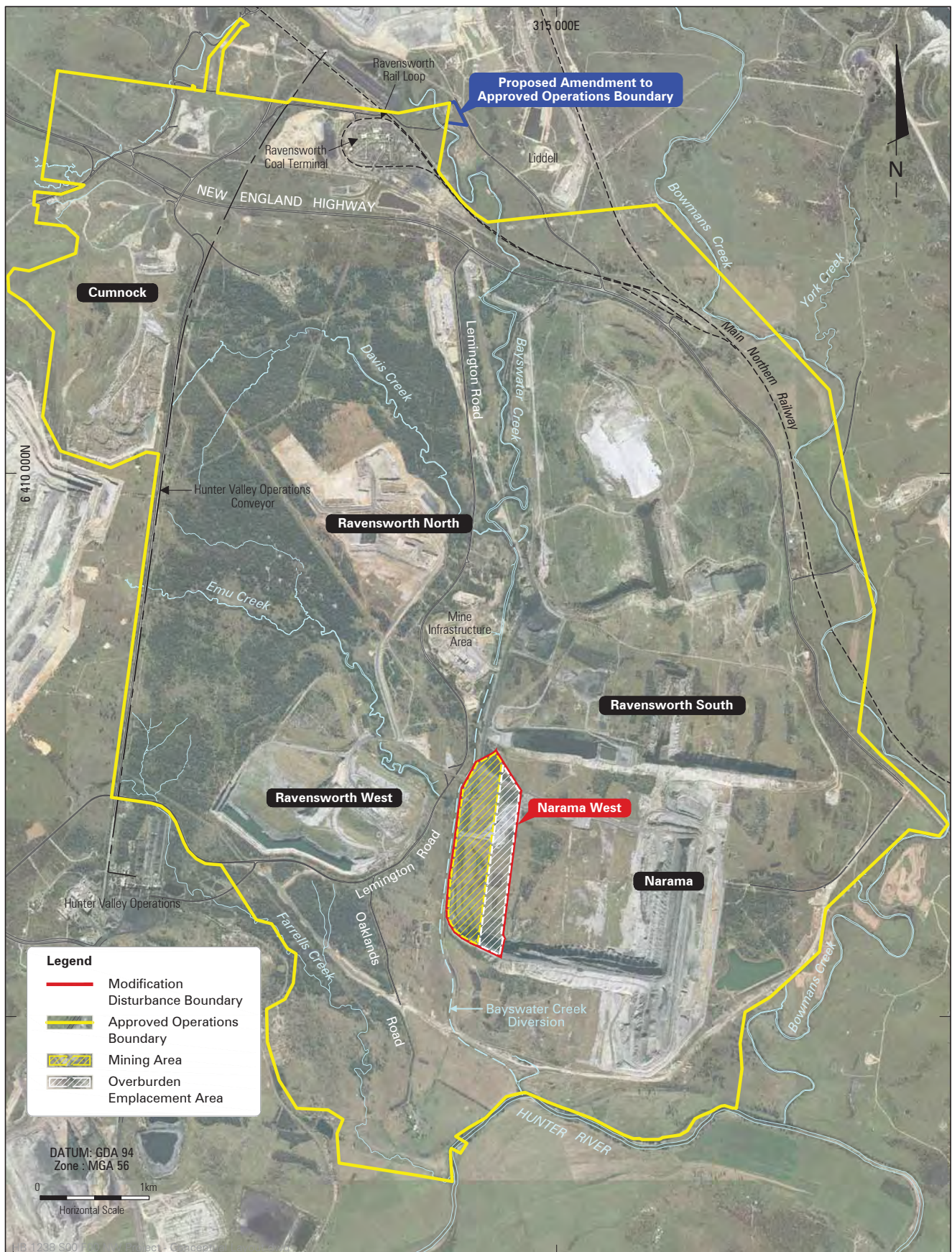
- Utilisation of existing infrastructure, including the Coal Handling and Preparation Plant, coal terminal, rail loop, workshops and offices;
- Transportation of domestic coal to neighbouring power stations via the existing conveyor system;
- Transportation of product coal to the Port of Newcastle for export via the Main Northern Railway; and
- Retention of the approved final landform with overburden used to progressively backfill the final void.

The conceptual layout of the Modification is illustrated in Figure 2.

Mining operations are likely to commence in 2013 and continue through to 2014, however, may occur later pending approval of the Modification, scheduling of operations and availability of equipment.







## **A.2 Methods**

The ecological impact assessment completed by Cumberland Ecology has relied upon a pre-existing database of ecological information and records collected during a field inspection in October 2012 for the area within the Ravensworth Operations approved operations boundary (approved operations boundary), in particular the Modification disturbance boundary.

### **A.2.1 Literature Review**

The flora and fauna in the Modification disturbance boundary and within surrounding land have been studied in the past as a component of the Fauna Biodiversity Monitoring Program for Ravensworth Operations in 2009 and during investigations for the Ravensworth Operations Project EA completed in 2010. Information from Cumberland Ecology's involvement in the implementation of a monitoring program for biodiversity offsets, including a Ravensworth North offset, which is of relevance to the Modification disturbance boundary was also considered in the literature review. These studies were reviewed to characterise the potential flora, fauna and vegetation communities present within the Modification disturbance boundary and to understand the likely impacts of the proposed activity.

### **A.2.2 Database Analysis**

Database searches of both Commonwealth (EPBC Act) and NSW (TSC Act) listed threatened flora and fauna species were conducted for the locality (within a 5 km radius of the Modification disturbance boundary). Database searches included:

- The NSW BioNet Atlas of NSW Wildlife; and
- The Commonwealth EPBC Protected Matters Search Tool.

These database searches provided detailed information about the known or likely occurrence of threatened flora, fauna and ecological communities in the locality of the Modification disturbance boundary.

### **A.2.3 Flora and Fauna**

As extensive flora and fauna surveys were conducted as a component of previous studies, the current surveys for flora and fauna were limited to observations made during a single site inspection in October 2012. During the inspection, notes and photographs were taken of flora and fauna present within the Modification disturbance boundary.

#### *i. Habitat Assessment*

A habitat assessment for flora and fauna was conducted during the current site inspection. The nature and extent of flora and fauna habitats within the Modification disturbance boundary, including areas of suitable fauna forage, shelter and breeding habitat, were identified and assessed. The assessment included consideration of important indicators of habitat condition and complexity.



Notes were made of important microhabitat features such as tree hollows, fallen logs and branches, bush rock, and leaf litter as well as the presence of permanent or ephemeral water features. An assessment of the structural complexity of vegetation, the age class of forest and woodland, habitat connectivity and the nature and extent of human disturbance within the Modification disturbance boundary was also undertaken and considered.

Tree hollow abundance and size were used as an indicator of habitat value for hollow-dependent fauna, including arboreal mammals, hollow-nesting birds and microbats. Hollows observed during the site investigation were recorded and the general vegetation condition and tree maturity was used to predict whether trees on site were likely to contain hollows.

#### **A.2.4 Limitations and Assumptions**

As the Modification is to occur within a rehabilitated landscape where flora and fauna has previously been studied, good information existed to allow for the prediction of impacts. Targeted surveys for threatened fauna were therefore not needed or undertaken within the Modification disturbance boundary during the current assessment.

Threatened flora and fauna likely to occur in the locality of the Modification are well known, and can be predicted with confidence based on results of previous surveys, database searches, recent observations and habitat assessment. Where suitable habitat conditions exist within the Modification, threatened species known from the locality have been assumed to occur.

### **A.3 Results**

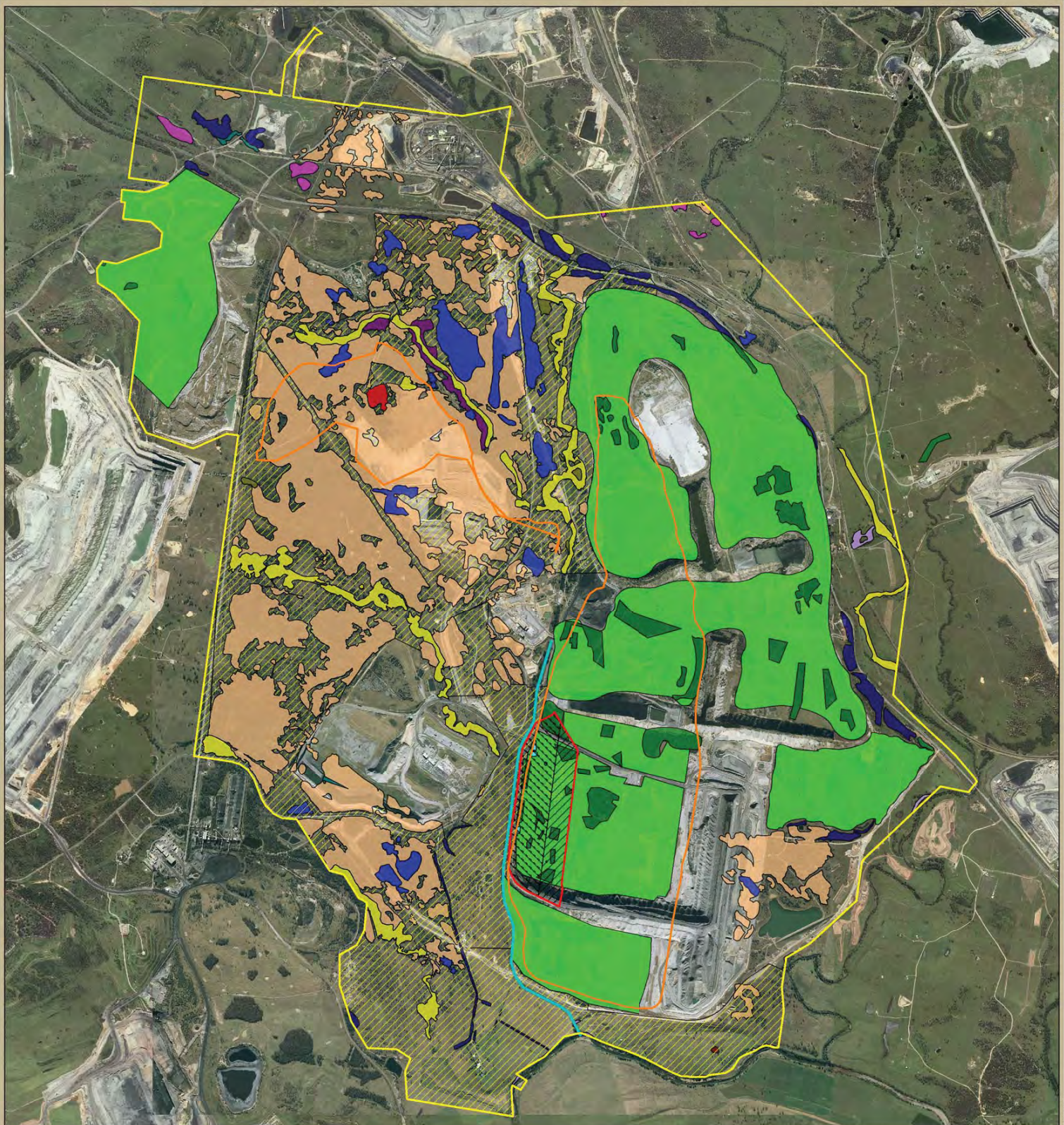
#### **A.3.1 Flora**

**Figure 3** illustrates the vegetation communities present within the approved operations boundary and **Figure 4** illustrates the vegetation communities of the Modification disturbance boundary.

##### *i. Rehabilitated Woodland*

The Modification disturbance boundary currently contains 13.5 ha of rehabilitated woodland vegetation. This represents approximately 18% of the 76.4 ha of rehabilitated woodland vegetation within the approved operations boundary. This vegetation community is not listed under the EPBC Act or the TSC Act. Woodland vegetation within this community is approximately 10 to 15 years old. As such, trees within the community have obtained a diameter at breast height (dbh) of up to 20 – 30cm and a maximum height of approximately 10 – 12m, as shown in **Photograph 1**.





## Legend

- Project Boundary
- Modification Disturbance Boundary
- Approved Overburden Emplacement Area Boundary
- Overburden Emplacement Area
- Mining Area
- Dam
- Bayswater Creek Diversion

## Rehabilitation

- Rehabilitated Woodland
- Rehabilitated Pasture Grassland

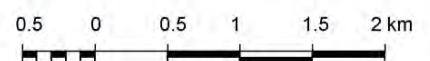
## Vegetation Communities (Umwelt 2011)

- Broad-leaved Ironbark Woodland
- Central Hunter Box - Ironbark Woodland
- Central Hunter Bullock Forest Regeneration
- Central Hunter Ironbark - Spotted Gum - Grey Box For
- Central Hunter Swamp Oak Forest
- Derived Grassland
- Hunter Floodplain Red Gum Woodland Complex
- Hunter Valley River Oak Forest
- Planted areas
- River-flat Eucalypt Forest
- Rough-barked Apple Open Forest
- Rough-barked Apple Open Forest (Regenerating)

Image Source:  
19950A\_RSO\_1m\_250612.ers  
and  
Aerial Imagery\_March2012\_50cm\_Mosaic.ecw



Figure 3. Vegetation of the Project Boundary







## Legend

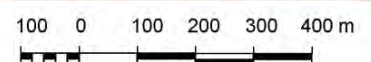
- |   |  |
|---|--|
| Project Boundary                              | Modification Disturbance Boundary                    |
| Approved Overburden Emplacement Area Boundary | Overburden Emplacement Area                          |
| Mining Area                                   | Dam  |
| Bayswater Creek Diversion                     |  |
| <b>Rehabilitation</b>                         |  |
| Rehabilitated Woodland                        | Broad-leaved Ironbark Woodland                       |
| Rehabilitated Pasture Grassland               | Central Hunter Box - Ironbark Woodland               |
|   | Central Hunter Bullock Forest Regeneration           |
|   | Central Hunter Ironbark - Spotted Gum - Grey Box For |
|   | Central Hunter Swamp Oak Forest                      |
|   | Derived Grassland                                    |
|   | Hunter Floodplain Red Gum Woodland Complex           |
|   | Hunter Valley River Oak Forest                       |
|   | Planted areas  |
|   | River-flat Eucalypt Forest                           |
|   | Rough-barked Apple Open Forest                       |
|   | Rough-barked Apple Open Forest (Regenerating)        |

## Vegetation Communities (Umwelt 2011)

Image Source:  
19950A\_RSO\_1m\_250612.ers  
and  
Aerial Imagery\_March2012\_50cm\_Mosaic.ecw



Figure 4. Vegetation of the Modification





**Photographs 1 and 2** illustrate the rehabilitated woodland community present within the Modification disturbance boundary. Canopy species present include *Corymbia maculata* (Spotted Gum) and *Eucalyptus tereticornis* (Forest Red Gum). Mid-storey species include *Acacia salicina*, *Acacia implexa* and *Cassinia quinquefaria*. Understorey species include *Eremophila debilis*, *Linum marginale*, *Vittadinia cuneata*, *Asperula conferta*, *Wahlenbergia* sp. and *Geranium* sp. Grasses were dominated by *Chloris gayana* (Rhodes Grass), but *Cymbopogon refractus* (Barbed Wire Grass) and *Aristida vagans* (Three-awned Spear Grass) were also present. The understorey vegetation is shown in **Photograph 2**.

ii. *Rehabilitated Exotic Pasture Grassland*

The Modification disturbance boundary currently contains 58.4 ha of rehabilitated pasture grassland. This represents approximately 6% of the 1,000 ha of rehabilitated pasture grassland within the approved operations boundary. **Photograph 3** illustrates the rehabilitated pasture grassland present within the Modification disturbance boundary. This vegetation community is dominated by a dense groundcover of exotic grasses such as Rhodes Grass. Some native grass and herb species are also present, with similar species to those described for the woodland occurring to a lesser extent in the grassland. The grassland within the rehabilitated pasture does not conform to the requirements of Derived Native Grassland of an associated C/EEC, as defined under the EPBC Act or the TSC Act.

iii. *Threatened Species*

No threatened flora species (as listed under the EPBC Act or the TSC Act) were recorded within the Modification disturbance boundary during the current site investigation. The rehabilitated woodland and exotic pasture grassland communities of the Modification are unlikely to support any of the threatened flora species known to occur in the wider locality. The historical disturbance to these areas, combined with the isolation of rehabilitated woodland from other similar habitats has resulted in very limited opportunities for threatened flora species to recolonise these areas in the short amount of time since rehabilitation.



**Photograph 1**      **Rehabilitated Woodland – Canopy**



**Photograph 2**      **Rehabilitated Woodland – Understorey**



**Photograph 3      Rehabilitated Exotic Pasture Grassland**

### **A.3.2 Fauna**

#### *i. Database Analysis and Previous Fauna Surveys*

Database analysis indicates that 73 threatened fauna species are known to occur in the locality surrounding the proposed Modification. Most such species occur in natural or semi-natural habitats rather than rehabilitation. Hence, it is unlikely that the majority of these species would occur within the Modification disturbance boundary as there is limited habitat available.

Analysis of the database searches indicates 28 threatened fauna species have the potential to be impacted by the Modification. Previous fauna surveys for the Ravensworth Operations Project EA (2010) recorded a high diversity of species, but these species were found predominantly within natural and semi-natural woodland. A total of 180 fauna species were recorded within the Ravensworth Operations Project Area, including 13 species listed as threatened under the EPBC Act and/or TSC Act.

**Table 1** provides the likelihood of occurrence for threatened fauna within the Modification disturbance boundary.

**Table 1 Likelihood of Occurrence of Threatened Fauna**

Common Name	Scientific Name	EPBC	TSC	Database	EA	Likelihood of Occurrence in the Modification Disturbance Boundary
Green and Golden Bell Frog	<i>Litoria aurea</i>	V	E	x	x	Unlikely to occur within the Modification. No suitable habitat
Spotted Harrier	<i>Circus assimilis</i>		V	x		Likely, but as a component of a much larger home range. Forage habitat only within the Modification
Little Eagle	<i>Hieraaetus morphnoides</i>		V	x		Likely, but as a component of a much larger home range. Forage habitat only within the Modification
Square-tailed Kite	<i>Lopholictinia isura</i>		V	x		Likely, but as a component of a much larger home range. Forage habitat only within the Modification
Little Lorikeet	<i>Glossopsitta pusilla</i>		V	x		Likely, but as a component of a much larger habitat mosaic. Occasional forage habitat only within the Modification
Swift Parrot	<i>Lathamus discolor</i>	E	E	x		Potential. Marginal occasional forage habitat only within the Modification
Turquoise Parrot	<i>Neophema pulchella</i>		V	x		Potential. Forage habitat only within the Modification
Masked Owl	<i>Tyto novaehollandiae</i>		V	x	x	Potential, but as a component of a much larger home range. Forage habitat only within the Modification
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>		V	x	x	Potential. Forage habitat only within the Modification
Speckled Warbler	<i>Chthonicula sagittata</i>		V	x	x	Known. Recorded within the Modification
Regent Honeyeater	<i>Anthochaera phrygia</i>	E	E	x		Potential. Marginal occasional forage habitat only within the Modification
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>		V	x		Potential. Occasional forage habitat only within the Modification
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>		V	x	x	Potential. Forage and breeding habitat present within the Modification



**Table 1 Likelihood of Occurrence of Threatened Fauna**

Common Name	Scientific Name	EPBC TSC Database	EA	Likelihood of Occurrence in the Modification Disturbance Boundary
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	x	Potential. Habitat present
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata</i>	V	x	Potential. Forage and breeding habitat present within the Modification
Scarlet Robin	<i>Petroica boodang</i>	V	x	Potential. Forage habitat only within the Modification
Diamond Firetail	<i>Stagonopleura guttata</i>	V	x	Potential. Forage and breeding habitat present within the Modification
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	x	Likely. Occasional forage habitat only within the Modification
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V	x	Potential. Forage habitat only within the Modification
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	V	x	Potential. Forage habitat only within the Modification
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	x	Potential. Forage habitat only within the Modification
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V	x	Potential. Forage habitat only within the Modification
Little Bentwing-bat	<i>Miniopterus australis</i>	V	x	Potential. Forage habitat only within the Modification
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V	x	Potential. Forage habitat only within the Modification
Southern Myotis	<i>Myotis macropus</i>	V	x	Potential. Forage habitat only within the Modification
Corben's Long-eared Bat	<i>Nyctophilus corbeni</i>	V	x	Potential. Forage habitat only within the Modification
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V	x	Potential. Forage habitat only within the Modification
Eastern Cave Bat	<i>Vespadelus troughtoni</i>	V	x	Potential. Forage habitat only within the Modification

Key: V = vulnerable, E = endangered, as listed under the TSC Act or EPBC Act

X = indicates that the species was recorded by the study indicated

ii. *Fauna Habitat Assessment*

A fauna habitat assessment undertaken during the current site inspection indicated that the rehabilitated woodland within the Modification disturbance boundary provides limited habitat value for a number of fauna groups. Due to the historical disturbance, relative isolation and lack of structural complexity these small woodland patches provide habitat only for highly mobile species and/or species tolerant of human disturbance. These include birds, bats and the Eastern Grey Kangaroo (*Macropus giganteus*). A number of TSC Act listed threatened woodland birds are known or likely to occur within the small rehabilitated woodland patches. The area within the Modification disturbance boundary also provides suitable habitat for introduced fauna, particularly the Red Fox (*Vulpes vulpes*) and European Rabbit (*Oryctolagus cuniculus*).

No tree hollows were recorded in the rehabilitated woodland within the Modification disturbance boundary during the current site inspection. Given the relatively young age of trees present within this community it is unlikely that hollows will develop naturally for many years. It is therefore unlikely that the area within the Modification disturbance boundary would provide suitable shelter or breeding habitat for arboreal mammals, microbats or hollow-nesting birds.

The rehabilitated exotic pasture grassland within the Modification disturbance boundary is capable of providing habitat for common and resilient grassland species, particularly reptiles, birds and kangaroos. It is unlikely that these grassland areas alone would support threatened fauna species, although they may form a component of a much larger home range for some species.

The mosaic of woodland and grassland vegetation within the Modification disturbance boundary and surrounding areas may also provide suitable forage habitat for raptors, including those listed under the TSC Act. These woodland areas are unlikely however to provide suitable breeding habitat for these species.

There are several small dams located within the Modification disturbance boundary (see **Figure 4** and **Photograph 4** and **5**). These dams currently support common fauna species such as eels, freshwater turtles and common waterbirds. Some of these dams (e.g. Dam 1 – **Photograph 4**) are likely to retain permanent water whereas others (e.g. Dam 2 – **Photograph 5**) are ephemeral. None of these dams provide suitable habitat for threatened species, including the Green and Golden Bell Frog, as they are heavily degraded and do not support suitable aquatic vegetation, which is of importance to this species.



**Photograph 4**      **Dam 1**



**Photograph 5**      **Dam 2**

### *iii. Current Fauna Observations*

Fauna observed during a site inspection undertaken by Cumberland Ecology in October 2012 was typical of disturbed woodland and grassland habitats in the locality. Several common woodland and grassland bird species were observed, and signs (scats etc.) indicated that these habitats were also utilised by foxes, rabbits and macropods.

During the site inspection one threatened woodland bird species, the Speckled Warbler, was recorded in the rehabilitated woodland within the Modification disturbance boundary. The habitat assessment indicated that a number of additional small woodland birds are likely to forage here. However, the rehabilitated woodland does not currently provide suitable nesting habitat for any of the hollow-dependant species such as the Brown Treecreeper.

Several common waterbirds were observed in dams within the Modification disturbance boundary during the current site inspection. It is likely that a number of additional common species would occur in these dams, although they do not provide suitable habitat for any of the threatened wetland species known from the wider locality.

## **A.4 Impact Assessment**

### **A.4.1 Vegetation**

The Modification will disturb 88.7 ha of land within an approved OEA resulting in the removal of 71.9 ha of rehabilitated land, including 13.5 ha of rehabilitated woodland and 58.4 ha of rehabilitated exotic pasture grassland, and 16.8 ha of disturbed, unvegetated land and small dams. None of this vegetation meets the criteria as a Critically Endangered or Endangered Ecological Community under either the EPBC Act or the TSC Act. No offsets are therefore required as the rehabilitated areas will be returned to woodland and grassland communities at the conclusion of future mining activities.

The total area of rehabilitated woodland within the approved operations boundary is 76.4 ha of rehabilitated woodland and 1,000 ha of rehabilitated exotic pasture grassland. The 71.9 ha to be removed by the Modification therefore represents only a small portion of rehabilitated land within the approved operations boundary.

No threatened flora species were recorded within the Modification disturbance boundary and none are predicted to occur given historical disturbance and isolation from adjacent vegetation communities. Impacts on threatened flora resulting from the Modification are therefore unlikely.

Following completion of operations within the Modification disturbance boundary, this area will be utilised as an OEA for future mining at Ravensworth Operations as stipulated under PA 09\_0176. This will be rehabilitated upon cessation of the future mining activities in accordance with the approved Mining Operations Plan.

#### **A.4.2 Fauna**

One Vulnerable (TSC Act) woodland bird (Speckled Warbler) was recorded within the Modification disturbance boundary during the October 2012 site inspection. Previous ecological assessments indicate that a number of additional threatened fauna have the potential to occur in the rehabilitated woodland and exotic pasture grasslands within the Modification disturbance boundary. However, given the historical clearing of all vegetation within the Modification disturbance boundary, the relatively young age of revegetated communities and the isolation of small patches of young woodland from other intact woodland communities, it is highly unlikely that the Modification would result in significant impacts on any of the threatened fauna known to occur in the locality.

Fauna groups with potential to be impacted by the Modification are discussed below.

##### *i. Amphibians*

The small dams within the Modification disturbance boundary are likely to provide habitat for a number of common amphibian species. These frogs would occur throughout the wider locality and larger areas of suitable habitat are present elsewhere.

The area within the Modification disturbance boundary does not provide suitable habitat for the Green and Golden Bell Frog which is listed under the EPBC and TSC Act.. These species were recorded during previous surveys within the broader Ravensworth Operations Project Area, but not in areas near or within what now constitutes the Modification disturbance boundary. No other threatened amphibians are likely to occur in the Modification disturbance boundary.

The dams within the Modification disturbance boundary are highly disturbed and do not support suitable aquatic vegetation for the Green and Golden Bell Frog. It is therefore unlikely that the Modification will result in any significant impacts on the Green and Golden Bell Frog.

##### *ii. Birds*

The rehabilitated woodland and exotic pasture grassland within the Modification disturbance boundary currently provide suitable habitat for a number of common grassland and woodland birds. These species are highly mobile and adaptable to human disturbance. Further, similar or better habitats to those present in the Modification disturbance boundary are well represented in the wider locality. It is therefore unlikely that the Modification will result in any significant impacts on common woodland or grassland bird species.

A number of threatened (EPBC Act and TSC Act) listed birds are known to occur within the locality of the Modification disturbance boundary. In addition to the Speckled Warbler, which was recorded during the October 2012 site inspection, the rehabilitated woodland and adjacent grassland within the Modification disturbance boundary would provide suitable forage habitat for other TSC Act woodland birds, including the Brown Treecreeper, Diamond Firetail, Grey-crowned Babbler, Turquoise Parrot, Scarlet Robin, Hooded Robin, Black-chinned Honeyeater, Varied Sittella and Little Lorikeet. The rehabilitated woodland within the Modification disturbance boundary does not currently support tree hollows. As such the Modification would not therefore provide nesting habitat for Brown Treecreeper, Turquoise Parrot or Little Lorikeet.



Areas of rehabilitated woodland within the Modification disturbance boundary are small and relatively young compared to other woodland habitats in the wider locality. Combined with the relative isolation of these small patches it is unlikely that the Modification will result in any significant impacts on threatened woodland birds.

The EPBC Act listed Endangered Regent Honeyeater and Swift Parrot are known to occur in the locality of the Modification disturbance boundary and forage on blossom and lerps of both Spotted Gum and Forest Red Gum. Both of these tree species occur within the Modification disturbance boundary. The rehabilitated woodland within the Modification disturbance boundary could therefore provide occasional forage for the Regent Honeyeater and/or Swift Parrot. However, as both bird species are known to typically favour taller, more mature vegetation it is highly unlikely that the Modification disturbance boundary would support significant or regular forage for either the Regent Honeyeater or the Swift Parrot.

The rehabilitated woodland and exotic pasture grassland of the Modification currently provide suitable forage habitat for a number of common raptor species such as the Wedge-tailed Eagle (*Aquila audax*), Nankeen Kestrel (*Falco cenchroides*), Black-shouldered Kite (*Elanus axillaris*) and Brown Falcon (*Falco berigora*). It is also possible that the mosaic of rehabilitated woodland and grassland may form a component of a much larger home range for threatened (TSC Act) raptors, including the Little Eagle, Spotted Harrier and Square-tailed Kite. However, the young rehabilitated woodland within the Modification disturbance boundary does not currently provide suitable nesting habitat for these species and better quality woodland and grassland habitats are present throughout the wider locality. It is therefore unlikely that the Modification will result in significant impacts on any raptors, including threatened species.

The Masked Owl was recorded during previous surveys of the Ravensworth Operations Project Area, but not in areas near or within what now constitutes the Modification disturbance boundary. The rehabilitated woodland vegetation within the Modification disturbance boundary may provide some limited forage habitat for this species; however, they do not currently provide suitable roosting or nesting habitat for the Masked Owl. Much larger areas of better quality woodland habitat for this species occur in the wider locality and it is therefore highly unlikely that the Modification would result in a significant impact on the Masked Owl.

### *iii. Bats*

The rehabilitated woodland and grassland communities within the Modification disturbance boundary currently provide suitable forage habitat for a number of common bat species. There is also the potential for flying-foxes and microchiropteran bats (microbats) listed as threatened under the EPBC Act and/or the TSC Act to forage in these areas. Furthermore, the small dams within the Modification disturbance boundary provide potential forage habitat for the Southern Myotis as well as sources of drinking water and insects for other microbat species.

The rehabilitated woodland vegetation does not currently provide any significant roosting habitat for any bat species, although some microbats can shelter in dense foliage or beneath decorticating bark. There is no shelter present within the Modification disturbance boundary for any cave-dependent microbat species.

Given the age and size of patches of rehabilitated woodland within the Modification disturbance boundary and the presence of larger and better quality woodland in the wider locality, it is highly unlikely that the Modification will result in any significant impacts on either the Grey-headed Flying-fox or any of the cave or hollow-dependent threatened microbats known from the area.

*iv. Other fauna*

A range of common woodland and grassland-dependent fauna are known or anticipated to occur within the Modification disturbance boundary. These species are highly adaptable, often highly mobile and are present throughout the wider locality. Suitable habitat for all of these species occurs throughout the area. It is highly unlikely that removal of the small dams, rehabilitated woodland or exotic pasture grassland for the Modification will result in any significant impacts on any common fauna species.

All fauna predicted to occur within the rehabilitated woodland should be highly mobile, and capable of leaving the area without assistance during clearing operations for the Modification. Draining of the dams prior to development of the Modification may result in mortality of common aquatic species such as eels and turtles. These species should be captured and relocated where possible to adjacent dams that will not be impacted by the Modification.

## **A.5 Conclusion**

Approximately 88.7 ha of land will be disturbed within an approved OEA as a result of the Modification. This will include the removal of 71.9 ha of rehabilitated land, including 13.5 ha of rehabilitated woodland and 58.4 ha of rehabilitated exotic pasture grassland, and 16.8 ha of disturbed, unvegetated land and small dams. The total area of rehabilitated woodland within the approved operations boundary is 76.4 ha of rehabilitated woodland and 1,000 ha of rehabilitated exotic pasture grassland. The 71.9 ha to be removed by the Modification, therefore represents only a small portion of rehabilitated land within the approved operations boundary.

None of the vegetation to be removed under the Modification meets the criteria for Critically Endangered or Endangered Ecological Communities as listed under the EPBC Act and/or the TSC Act. These communities support relatively young vegetation, with limited habitat value when compared to larger, better quality and more intact woodland and grassland habitats occur in the wider locality. No offsetting would be required for the removal of the rehabilitated vegetation within the Modification disturbance boundary.

No threatened flora species were detected within the Modification disturbance boundary. Given the nature of rehabilitated vegetation present, it is highly unlikely that any of the threatened flora species known from the locality would occur within the Modification disturbance boundary.

One Vulnerable (TSC Act) bird (Speckled Warbler) was recorded within the Modification disturbance boundary. It is likely that a number of additional threatened birds and bats may forage in rehabilitated woodland and exotic pasture grassland of the Modification. However larger, better quality habitat for all of these species occurs in the wider locality.

Following completion of operations within the Modification disturbance boundary, this area will be utilised as an OEA for future mining at Ravensworth Operations as stipulated under PA 09\_0176. This will be rehabilitated upon cessation of the future mining activities in accordance with the approved Mining Operations Plan.

No significant impacts are predicted to occur on any of the flora, fauna or ecological communities known or predicted to occur within the Modification disturbance boundary. The Modification is not likely to result in any significant impacts on any threatened species or communities, or any Matters of National Environmental Significance. The Modification does not require referral to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities.

## A.6 References

AECOM Australia Pty Ltd (2009) **Fauna Biodiversity Monitoring – Ravensworth Complex**. Prepared for Ravensworth Operations.

OEH (NSW) **NSW BioNet Atlas of NSW Wildlife**: <http://www.bionet.nsw.gov.au/>

SEWPaC (2012) **EPBC Protected Matters Search Tool**:  
<http://www.environment.gov.au/epbc/pmst/index.html>

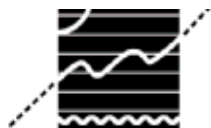
Umwelt (Australia) Pty Ltd (2010) **Ravensworth Operations Project Environmental Assessment Vol. 3 – Chapter: Ecological Assessment**. Prepared for Ravensworth Operation Pty Ltd



## **APPENDIX F**

### ***Economic Impact Assessment***





## Gillespie Economics

Environmental and Resource Economics: Environmental Planning and Assessment

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12 February 2013

Chelsea Kavanagh  
Hansen Bailey  
PO Box 473  
Singleton, NSW 2330

Dear Ms Kavanagh

### **Narama West Modification – Economic Impact Assessment**

Gillespie Economics has been engaged by Hansen Bailey Environmental Consultants (Hansen Bailey) on behalf of Xstrata Coal Pty Limited (Xstrata Coal) to complete an economic impact assessment for the Narama West Modification (the Modification). The purpose of the assessment is to form part of an Environmental Assessment being prepared by Hansen Bailey to support a modification to Project Approval (PA) 09\_0176 under section 75W, Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The full economic impact assessment is contained within Attachment 1, while a summary of findings is provided below.

### **The Modification**

Ravensworth Operations Pty Ltd (Ravensworth Operations) is a wholly owned subsidiary of Xstrata Coal and comprises of the active Ravensworth North and Narama mining areas and the former Cumnock, Ravensworth West and Ravensworth South mining areas. Ravensworth Operations is situated within the Singleton Local Government Area and located approximately 15 kilometres (km) north-west of Singleton and 17 km south-east of Muswellbrook in the Upper Hunter Valley of New South Wales (see Figure 1 of Attachment 1).

Ravensworth Operations currently conducts open cut mining activities under PA 09\_0176, which was approved 11 February 2011, to provide high quality thermal and semi-soft coking coal to export and domestic markets at a maximum of 16 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal.

Xstrata Coal is seeking a modification to PA 09\_0176 under section 75W, Part 3A of the EP&A Act.

The Modification involves:

- Recovery of approximately 2.7 Million tonnes of ROM coal by open cut mining methods over a period of two years in an approved overburden emplacement area within the Narama mining area (referred to as the Narama West mining area);
- Production within the approved maximum limit of 16 Mtpa of ROM coal;
- Operations being undertaken via truck and shovel or dragline mining techniques;
- Utilisation of the existing equipment fleet;
- Tailings and rejects emplacement as per approved existing operations;
- Utilisation of existing infrastructure, including the Coal Handling and Preparation Plant, coal terminal, rail loop, workshops and offices;
- Transportation of domestic coal to neighbouring power stations via the existing conveyor system;
- Transportation of product coal to the Port of Newcastle for export via the Main Northern Railway; and

- Retention of the approved final landform with overburden used to progressively backfill the final void.

The conceptual layout of the Modification is illustrated in Figure 2 of Attachment 1.

### **Benefit Cost Analysis**

A Benefit Cost Analysis (BCA) was undertaken to consider the economic efficiency of the Modification. The BCA for the Modification involved the following key steps:

- Identification of the “with” and “without” Modification scenarios;
- Identification and valuation of the incremental benefits and costs;
- Consolidation of value estimates using discounting to account for temporal differences;
- Application of decision criteria;
- Sensitivity testing; and
- Consideration of non-quantified benefits and costs.

The BCA identified the estimated net production benefits of the Modification to Australia at \$31 Million (M). Any environmental, social or cultural impacts of the Modification to Australia, after mitigation, would need to be valued at more than \$31M for the Modification to be undesirable from an economic efficiency perspective.

The main impacts of the Modification relate to greenhouse gas and ecology.

- The Australian damage costs of greenhouse gas emissions from the Modification are estimated in the order of \$0.4M.
- The Modification will result in the clearing of 71.9ha of previously rehabilitated land; none of which conforms to Endangered or Critically Endangered communities. Following completion of operations within the Modification disturbance boundary, this area will be utilised as an overburden emplacement area for future mining at Ravensworth Operations as stipulated under PA 09\_0176. This will be rehabilitated upon cessation of the future mining activities in accordance with the approved Mining Operations Plan.

The value of these impacts is likely to be considerably less than \$31M.

The economic impact analysis found that the Modification will provide additional economic activity to the regional and state economy for a period of two years with existing operations progressing as per originally scheduled.

Regards



Rob Gillespie

## **ATTACHMENT 1 – ECONOMIC IMPACT ASSESSMENT**

### **1.0 INTRODUCTION**

Gillespie Economics has been engaged by Hansen Bailey Environmental Consultants (Hansen Bailey) on behalf of Xstrata Coal Pty Limited (Xstrata Coal) to complete an economic impact assessment for the Narama West Modification (the Modification). The purpose of the assessment is to form part of an Environmental Assessment (EA) being prepared by Hansen Bailey to support a modification to Project Approval (PA) 09\_0176 under section 75W, Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

#### **1.1 Background**

Ravensworth Operations Pty Limited (Ravensworth Operations) is a wholly owned subsidiary of Xstrata Coal and comprises of the active Ravensworth North and Narama mining areas and the former Cumnock, Ravensworth West and Ravensworth South mining areas. Ravensworth Operations is situated within the Singleton Local Government Area (LGA) and located approximately 15 kilometres (km) north-west of Singleton and 17 km south-east of Muswellbrook in the Upper Hunter Valley of New South Wales (NSW). Figure 1 illustrates the location of Ravensworth Operations and its approved operations boundary.

Ravensworth Operations currently carries out open cut mining activities under PA 09\_0176, approved 11 February 2011, to provide high quality thermal and semi-soft coking coal to export and domestic markets at a maximum of 16 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal.

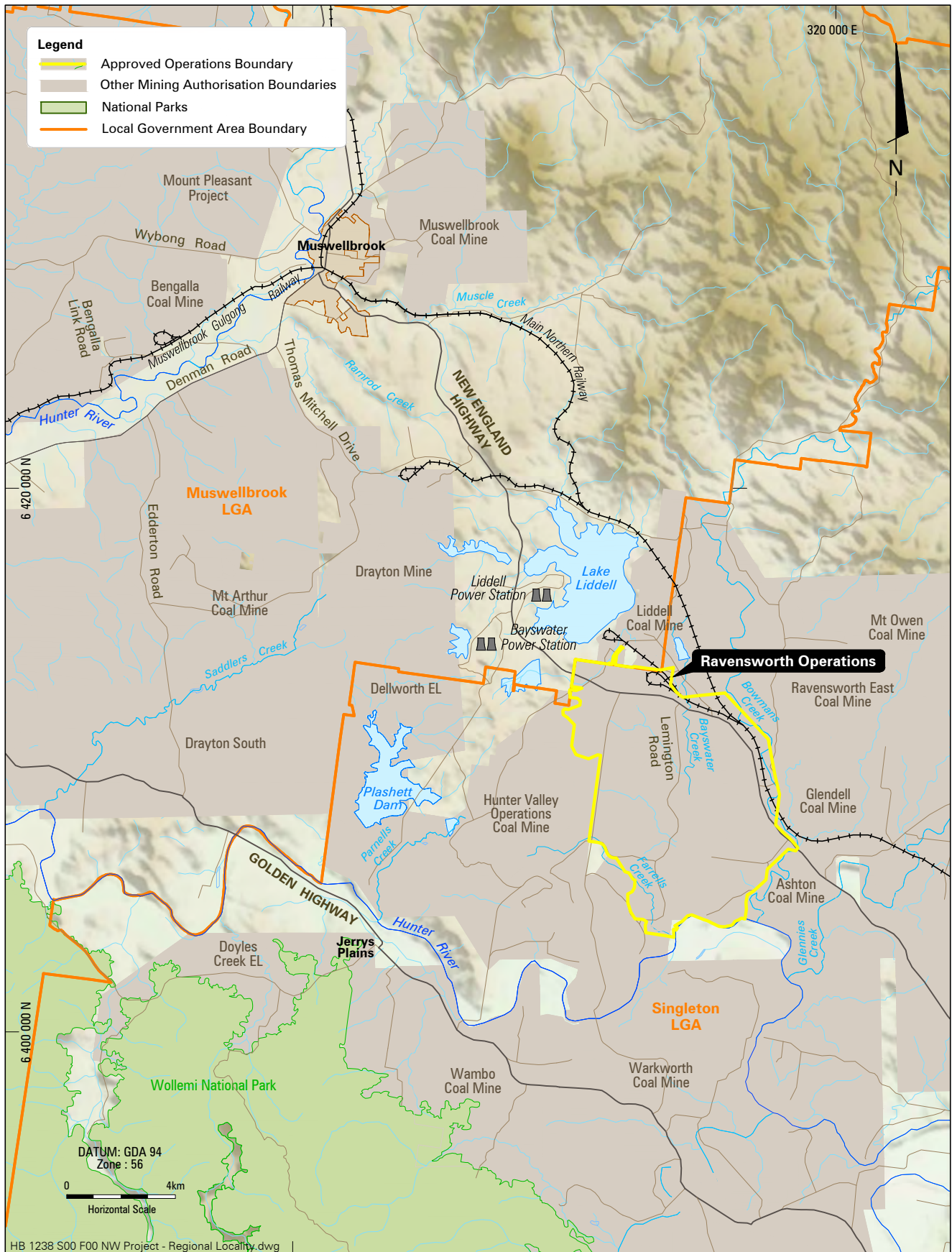
#### **1.2 Modification Description**

Xstrata Coal is seeking a modification to PA 09\_0176 under section 75W, Part 3A of the EP&A Act.

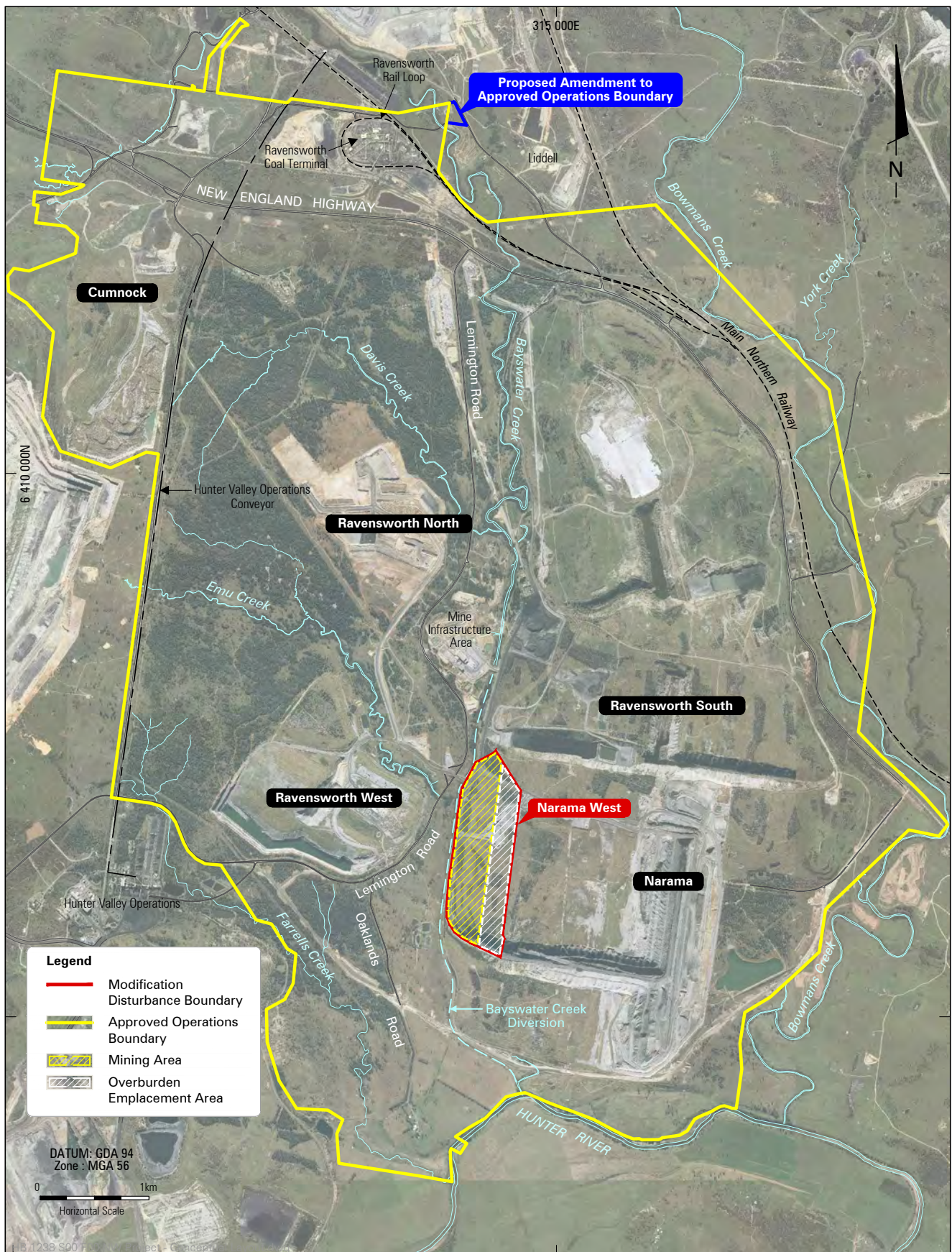
The Modification involves:

- Recovery of approximately 2.7 Million tonnes (Mt) of ROM coal by open cut mining methods over a period of two years in an approved overburden emplacement area (OEA) within the Narama mining area (referred to as the Narama West mining area);
- Production within the approved maximum limit of 16 Mtpa of ROM coal;
- Operations being undertaken via truck and shovel or dragline mining techniques;
- Utilisation of the existing equipment fleet;
- Tailings and rejects emplacement as per approved existing operations;
- Utilisation of existing infrastructure, including the CHPP, coal terminal, rail loop, workshops and offices;
- Transportation of domestic coal to neighbouring power stations via the existing conveyor system;
- Transportation of product coal to the Port of Newcastle for export via the Main Northern Railway; and
- Retention of the approved final landform with overburden used to progressively backfill the final void.

The conceptual layout of the Modification is illustrated in Figure 2.







### 1.3 Economic Analysis

From an economic perspective, there are two important aspects of the Modification:

- The economic efficiency of the Modification (i.e. consideration of economic costs and benefits); and
- The regional economic impacts of the Modification (i.e. the economic stimulus that the Modification would provide to the regional and state economy).

The *Draft Guideline for Economic Effects and Evaluation in EIA* (draft guideline) (James and Gillespie, 2002) identified economic efficiency as the key consideration of economic analysis. Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of developments. The draft guideline identified BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts (James and Gillespie, 2002).

The draft guideline considered that the regional economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Economic stimulus to a region can be estimated using input-output modelling of the regional economy (regional economic impact assessment).

This assessment provides:

- An evaluation of the economic efficiency of the Modification (Section 2);
- Identification of the distribution of impacts between stakeholder groups (Section 3); and
- A consideration of the regional economic impacts of the Modification (Section 4).



## **2.0 BENEFIT COST ANALYSIS**

### **2.1 Introduction**

#### ***Introduction to Benefit Cost Analysis***

BCA has its theoretical underpinnings in neoclassical welfare economics. Applications in NSW are guided by these theoretical foundations as well as the NSW Treasury (2007). BCA applications within the NSW environmental assessment framework are further guided by NSW DP&I draft guideline.

BCA is primarily concerned with comparison of the present value of aggregate benefits to society, as a result of a project, policy or program, with the present value of the aggregate costs. Provided the present value of aggregate benefits to society exceed the present value of aggregate costs (i.e. a net present value of greater than zero), the project is considered to improve the economic welfare of society and hence is desirable from an economic efficiency perspective.

BCA is not primarily concerned with distributional considerations. Nevertheless, the distribution of the costs and benefits of a project can provide additional information that may be of assistance to decision-makers.

The BCA for this Modification is undertaken from a global and national level perspective. Initially, all the benefits and costs of the Modification, whomever they accrue to are included in the BCA. This is then truncated to include only those benefits and costs of the Modification that accrue to Australia.

While coal is an intermediate good (i.e. it is used as an input into the production of other goods and services) the economic impact assessment is limited to assessment of the Modification as defined in Section 1.2. In accordance, with economic theory and conventional practices in BCA, the downstream use of coal is not included in the analysis.

#### ***Steps in Benefit Cost Analysis***

BCA of the Modification involves the following key steps:

- identification of the “with” and “without” Modification scenarios;
- identification and valuation of the incremental benefits and costs;
- consolidation of value estimates using discounting to account for temporal differences;
- application of decision criteria;
- sensitivity testing; and
- consideration of non-quantified benefits and costs.

What follows is a BCA of the Modification based on financial, technical and environmental advice provided by Xstrata Coal and its’ specialist consultants.

### **2.2 Identification of the “With” and “Without” Modification Scenarios**

Ravensworth Operations is currently approved for the mining of up to 16 Mtpa of ROM coal. Relative to mining “without” the Modification scenario, the Modification will enable the recovery of an additional 2.7 Mt of ROM coal by open cut mining methods in an approved OEA within the Narama West mining area. This additional mining is likely to commence in 2013 and continue through to 2014, however, may occur later pending approval of the Modification, scheduling of operations and availability of equipment. Coal extraction will remain within the approved maximum limit of 16 Mtpa of ROM coal, with existing operations progressing as per originally scheduled.

## 2.3 Incremental Costs and Benefits

The incremental level of production from the Modification is not expected to result in any additional capital costs but would be associated with average annual incremental operating costs in the order of \$44 Million (M) for two years. While royalties are a cost to Xstrata Coal, they are part of the overall net production benefit of the mining activity that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of the Modification. Nevertheless, it should be noted that the Modification would generate total royalties to NSW in the order of \$14M (\$12M, present value).

The Modification will result in incremental thermal coal production of 1.7Mt (product coal), assumed to be sold in 2014 at a value of \$105/tonne.

There is obviously considerable uncertainty around future coal values and hence assumed coal values have been subjected to sensitivity testing (see Section 2.5).

## 2.4 Consolidation of Value Estimates and Threshold Value Analysis

At the NSW Treasury recommended central discount rate of 7%, the Modification is estimated to have total net production benefits of \$75M. Assuming 100% foreign ownership, the net production benefits accruing to Australia are estimated at \$31M. This threshold value is the minimum opportunity cost to society of not proceeding with the Modification. Interpreted another way, any environmental, cultural or social impacts of the Modification to Australia, after mitigation measures, would need to be valued at greater than \$31M (present value) to make the Modification undesirable from an economic efficiency perspective.

No significant incremental impacts are predicted with respect to air quality, noise, Aboriginal heritage, non-Aboriginal heritage, surface water, groundwater, agriculture, traffic and transport, visual amenity or social. The main environmental impacts of the Modification relate to greenhouse gas generation and ecology.

Using a carbon value of \$25/t CO<sub>2</sub>-e, the incremental global damage costs from greenhouse gas emissions associated with the Modification are valued at \$4M present value<sup>1</sup>. The Australian damage costs from the Modification greenhouse gas emissions are estimated in the order of \$0.4M. The global greenhouse gas costs from the Modification will be internalised into Xstrata Coal's operating costs via the carbon tax.

The Modification will result in the clearing of 71.9 ha of previously rehabilitated land; none of which conforms to Endangered or Critically Endangered communities. The rehabilitated woodland within the Modification disturbance boundary is small, fragmented and isolated from adjacent woodland habitat by exotic pasture lands and the existing operations within the Narama mining area. Following completion of operations within the Modification disturbance boundary, this area will be utilised as an OEA for future mining at Ravensworth Operations as stipulated under PA 09\_0176. This will be rehabilitated upon cessation of the future mining activities in accordance with the approved Mining Operations Plan.

## 2.5 Sensitivity Testing

The estimated threshold value of \$31M is most sensitive to assumptions about the economic value of coal. If coal value reduced by 20% over the life of the Modification then the threshold value would reduce to \$20M. Alternatively, if coal value increased by 20% the threshold value would increase to \$42M.

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<sup>1</sup> It should be noted that greenhouse gas generation associated with sea transport and usage of the product coal is considered to be outside of the scope of the BCA of the Project.

### **3.0 DISTRIBUTION OF IMPACTS**

While Xstrata Coal would initially bear the production costs and receive the financial production benefits of the Modification, the net production benefits would be distributed between a number of stakeholders including Xstrata Coal and its shareholders in the form of net profits, the NSW government in the form of royalties (estimated at \$12M present value) and the Commonwealth government in the form of company tax (estimated at \$19M present value).

Greenhouse gas impacts of the Modification occur globally with \$0.4M accruing to Australia. Global greenhouse gas costs will be internalised into Xstrata Coal's operating costs via the carbon tax. The impacts on ecology will be borne by those who hold values for this area of vegetation which are likely to be households at the local level. However, the values lost will be restored through subsequent rehabilitation.

Overall, the net production benefits that directly accrue to NSW are likely to be greater than the residual environmental, cultural and social impacts. As well as resulting in net benefits to Australia the Modification would also result in net benefits to NSW.

## 4.0 REGIONAL ECONOMIC IMPACTS

Regional economic impact assessment is concerned with the effect of an impacting agent on an economy in terms of a number of specific indicators, such as gross regional output, value-added, income and employment.

These indicators are defined as follows:

- **Gross regional output** - is the gross value of business turnover;
- **Value-added** – is the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services brought in to produce the gross regional output;
- **Income** – is the wages paid to employees including imputed wages for self employed and business owners; and
- **Employment** – is the number of people employed (including full-time and part-time).

The main impacting agent for the Modification is the expenditure in the regional economy as a result of additional mining activity, which is likely to commence in 2013 and continue through to 2014 (with 2014 assumed to represent the peak year of economic activity). This mining may occur later pending approval of the Modification, scheduling of operations and availability of equipment. The regional economy of the Singleton, Muswellbrook and Upper Hunter Shire LGAs will experience this impact.

For this assessment, Gillespie Economics obtained data from Xstrata Coal on the direct output, value-added, income and employment associated with the additional production in 2014. The Type 11A ratio multipliers estimated for the Ravensworth Operations Project Economic Assessment<sup>2</sup> were then applied to these direct effects to estimate the flow-on and total impacts.

**Table 1: Estimated Annual Regional Economic Impacts of the Modification**

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
<b>OUTPUT (\$000)</b>	117,740	25,903	5,887	31,790	149,530
<i>Type 11A Ratio</i>	1.00	0.22	0.05	0.27	1.27
<b>VALUE ADDED (\$000)</b>	54,806	9,317	2,192	11,509	66,315
<i>Type 11A Ratio</i>	1.00	0.17	0.04	0.21	1.21
<b>INCOME (\$000)</b>	5,908	7,444	2,481	9,925	15,833
<i>Type 11A Ratio</i>	1.00	1.26	0.42	1.68	2.68
<b>EMPLOYMENT (No.)</b>	49	91	44	135	184
<i>Type 11A Ratio</i>	1.00	1.84	0.9	2.74	3.74

Note: Totals may have minor discrepancies due to rounding.

The annual regional economic impact associated with the Modification in 2014 is estimated at up to:

- \$149M in annual direct and indirect regional output or business turnover;
- \$66M in annual direct and indirect regional value added;
- \$16M in annual direct and indirect household income; and
- 184 direct and indirect jobs, which remain within the approved workforce limit of 550 employees.

The impacts in 2013 will be in the order of 40% of these levels.

The NSW impacts would be larger because of the ability of the larger economy to capture more of the incremental expenditure and the greater intersectoral linkages.

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<sup>2</sup> Gillespie Economics (2009) Ravensworth Operations Project Economic Assessment, prepared for Ravensworth Operations Pty Ltd.

## **APPENDIX G**

### ***Blast Vibration Assessment for REA 86***





## RAVENSWORTH OPEN CUT

### DETERMINING SAFE (NON-DAMAGING) GROUND VIBRATION LIMITS FOR THE REA 86 SITE

#### 1. INTRODUCTION

Terrock Consulting Engineers were requested by Mr Greg Newton, Environment and Community Coordinator to determine 'safe' (non-damaging) ground vibration levels for the REA 86 site near the Ravensworth North Open Cut. The REA 86 site is an Aboriginal Cultural Heritage Site containing grinding grooves in rock ledges where tools etc. were historically sharpened in the bed of the creek near water. Nearby mining operations, including blasting, must not damage the site.

At present, the Peak Particle Velocity (PPV) is limited to 30 mm/s by Development Consent Conditions. Any increase in the current limit requires the modification of the Development Consent.

#### 2. DETERMINATION OF GROUND STRAINS

Ground strain represents the change of dimension of the surface of the ground, including rock, as the ground vibration wave passes. Ground strain can be predicted from Plane Wave Strain theory derived by Dowding (1985) and New (1986), and is simply that the strain resulting in the ground can be determined by the following approximation:

$$\text{Ground Strain} = \frac{\text{Peak Particle Velocity (PPV}_g\text{)}}{\text{Seismic Velocity (SV)}}$$

The original derivation does not distinguish between the ground vibration wave types; Compressional (P), Shear (S) or Rayleigh (R) wave. The velocities of the P, S and R waves are determined by the difference in arrival times between the airblast and the wave types in the wave trace. The velocity of sound in air does not vary significantly from 340 m/s. The relationship is:

$$\text{Elapsed Time (seconds)} = \frac{\text{Distance}}{0.34} - \frac{\text{Distance}}{\text{Wave Velocity}}$$

The velocity of the P, S and R waves have been determined to be 2000 m/s; 1200 m/s and 700 m/s respectively. These velocities have been observed for Hunter Valley overburden and interburden blasts for hundreds of measurements at many mines over a period of more than 20 years, and are regarded as characteristic. Little variation has been observed in the characteristic values.

In order to establish the relationship between  $PPV_g$  and Ground Strain, a number of measurements were taken by installing appropriate instrumentation on the rock ledge, with the appropriate permission of the relevant aboriginal group.

The  $PPV_g$  was measured by geophone with the two horizontal axes aligned with the mechanical strain amplifiers used to measure the ground strain. The instrumentation is shown in **Figure 1**.



**Figure 1 - Mechanical Strain Amplifiers and Geophone attached to the Rock at REA 86**

The measured component  $PPV_g$ 's and peak strains are listed in **Table 1** together with the instantaneous peak vector  $PPV_g$ 's. The peak ground vibration is plotted against peak strain in **Figure 2**, together with the strains predicted from Plane Wave Strain Theory for Compressional (P), Shear (S) wave and Rayleigh (R) wave velocities.

Table 1 – Measured and Predicted Strains

Blast Date	PPV Rad. (mm/s)	PPV Trans (mm/s)	P Vector PV (mm/s)	Strain Rad. $\mu\epsilon$	Strain Trans. $\mu\epsilon$	Peak Vector St $\mu\epsilon$	Predicted Strains	
							P wave $\mu\epsilon$	S Wave $\mu\epsilon$
19/06/2012	1.40	2.26	2.66	1.22	1.77	2.00	1.33	2.21
13/01/2012	9.52	8.12	10.44	3.24	6.21	6.22	5.2	8.7
# 1 22/08/12	3.17	2.29	3.91	1.93	0.92	1.96	1.96	1.17
#2	0.8	0.5	0.94	0.72	0.49	0.78	0.47	0.28
#3	2.2	1.0	2.41	0.55	0.38	0.56	1.20	0.72

For the first blast, the measured strains are in close agreement with predicted strains using a Shear Wave Velocity of 1200 m/s. The second blast strains lie between the P and S wave predictions. The shear wave velocity provides the most conservative (high) predictions. The three separate phases of the third blast provided similar data, i.e. the peak strain measurements would be conservatively predicted from the Shear Wave Velocity of 1200 m/s.

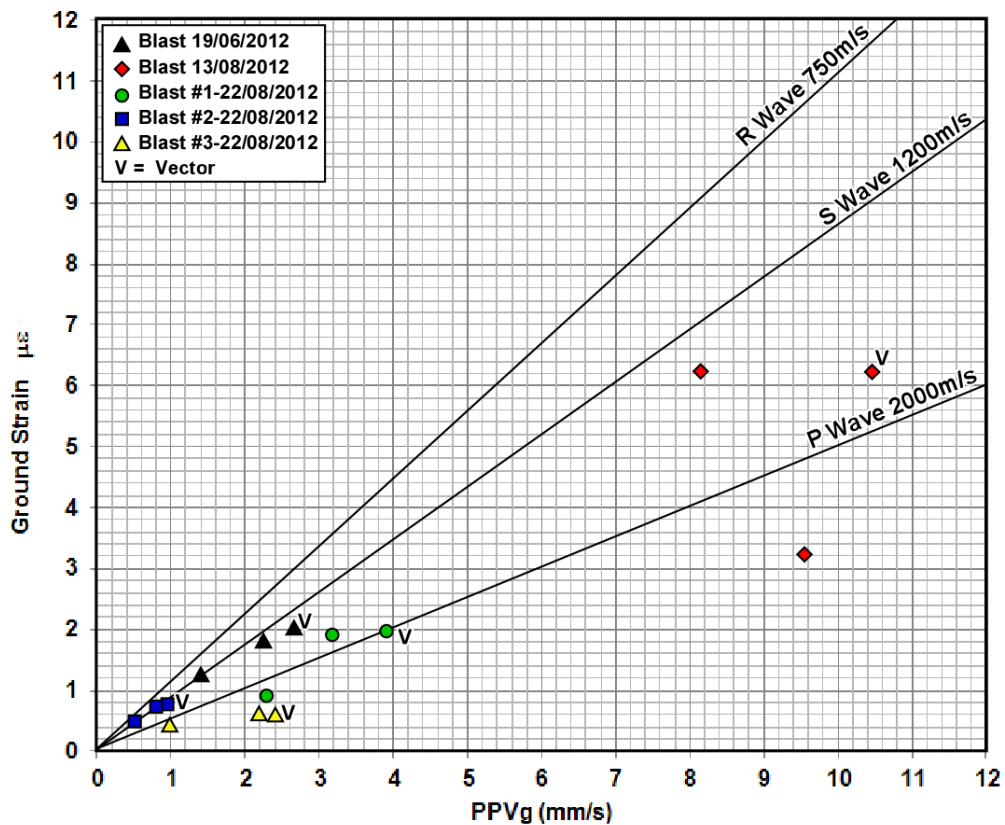


Figure 2 - Measured and Predicted Ground Strain Compared to P, S and R Wave Velocities

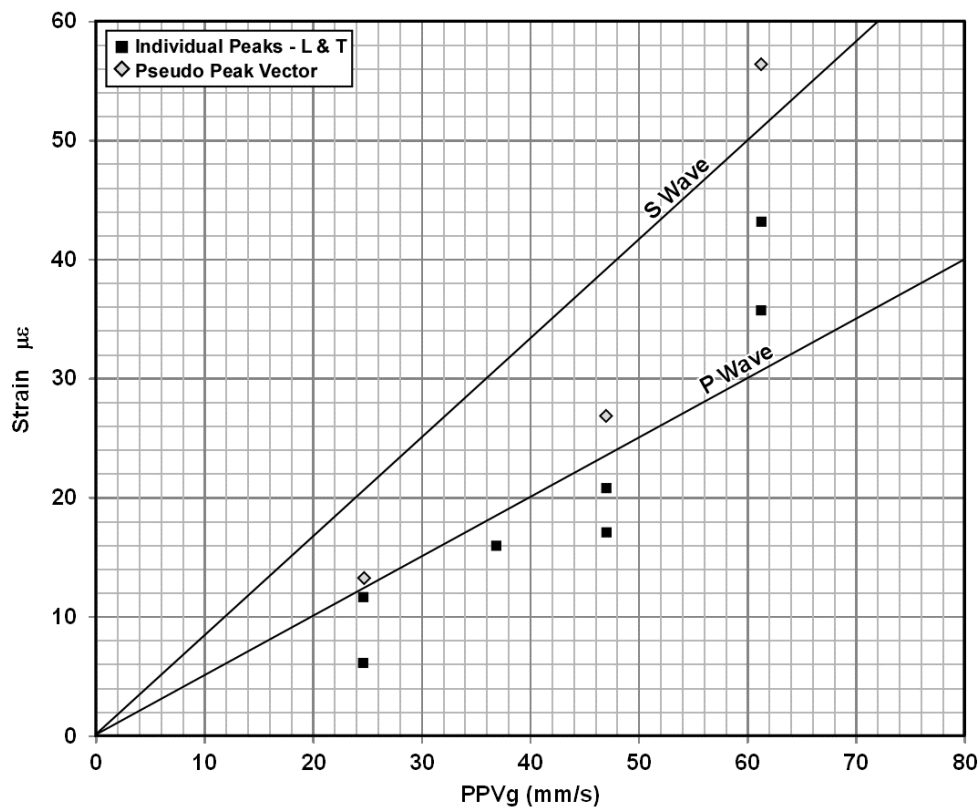
To demonstrate if the hypothesis holds at higher PPV levels, the reported strains measured on the roof of an underground opening in the Bulga Mine were compared to measured PPVs. The measurements were reported in Lewandowski et al (1999), and are listed in **Table 2** below.

**Table 2 – PPV vs Strain – Bulga Mine**

Shot #	PPV Roof (mm/s)	Strain Gauge (1) ( $\mu\epsilon$ )	Strain Gauge (2) ( $\mu\epsilon$ )	Strain Gauge Vector ( $\mu\epsilon$ )*
WS 4 – 3 – 0	36.84	15.92		
WS 4 – 3a – 0	61.26	43.20	35.8	56.40
WS 4 – 5 – 0	46.99	17.10	20.80	26.90
WS 4 – 1 – 0	24.64	6.20	11.60	13.20

\*Pseudo Peak Vector as distinct from instantaneous Peak Vector, i.e. Vector of the peak component strains.

A higher range plot of PPV vs Strain is shown in **Figure 3**. Again, the measured strains lay between the Plane Wave Strain predictions calculated from P and S wave velocities, with the S wave velocities providing the most conservative (high) values. In **Figure 2**, the instantaneous peak vector strains are not much higher than the highest peak component value. The pseudo peak vectors in **Figure 3** are the vectors calculated from the highest component value and are much higher than the individual peak component values. The pseudo peak vectors in **Figure 3** are considered to be therefore conservatively high.



**Figure 3 – Measurement and Predicted Ground Strain (high range)**



Assuming the PPV/Strain relationship holds at even higher levels, the predicted S and P wave velocity strains for milestone PPVs are listed in **Table 3**.

**Table 3 - Measured and Predicted Ground Strain Compared to S Wave Velocity (High Range)**

PPVg (mm/s)	S Wave Peak Strain (μϵ)	P Wave Strain (μϵ)
30	25	15
50	41.6	25
100	83.3	50
150	125	75
200	166	100

### 3. STRENGTH CHARACTERISTICS OF SANDSTONE

From the AusIMM Field Geologists' Manual, Table 7.2.3, the following properties are listed for sandstone:

<b>Sandstone</b>	Tensile Strength	Max	19 MPa
		Min	7 MPa
	Static Modulus of Elasticity	Max	50 x 10 <sup>3</sup> MPa
		Min	10 x 10 <sup>3</sup> MPa

From Hookes Law;

$$\text{Module of Elasticity} = \frac{\text{Stress}}{\text{Strain}} \quad \text{i.e. } E = \frac{\sigma}{\epsilon}$$

$$\therefore \epsilon = \frac{\sigma}{E}$$

$$\therefore \epsilon \text{ range} = \frac{19}{50} \rightarrow \frac{19}{10} \quad ; \quad \frac{7}{50} \rightarrow \frac{7}{10}$$

$$\therefore \epsilon \text{ range} = 380 \mu\epsilon \rightarrow 1900 \mu\epsilon \quad ; \quad 140 \mu\epsilon \rightarrow 700 \mu\epsilon$$

**Lowest value**

Depending on the combination of Tensile Strengths and Elastic Moduli used, the minimum tensile failure strain indicated is 140 – 380 μϵ.

For an indication of the characteristics of Hunter Valley Sandstone, from Lewandowski (1999) the following properties are listed for the immediate parting roof above the Lower Whybrow coal seam. This was the location of the rock where the strain measurements were recorded.

UCS 24 Mpa                      Tensile Strength  $\sigma$  4.5 – 5.9 MPa

Modulus of Elasticity              (E) - 20 GPa

$$\varepsilon = \frac{\sigma}{E}$$

$$\therefore \text{Tensile Failure Strain} = \frac{4.5 \rightarrow 5.9}{20 \times 10^3} = 225 \mu\varepsilon \rightarrow 295 \mu\varepsilon$$

These figures compare to the lower end of the sandstone strengths determined from the generic values above. Also, because the sandstone rock ledge at REA 86 has resisted erosion, it is reasonable to assume that it is stronger and tougher than the other sandstone layers in the area including that above the Lower Whybrow coal seam. It is considered to be a reasonable assumption that the tensile strength lies at the upper end of the Hunter Valley failure strain calculations – therefore it is assumed that 295  $\mu\varepsilon$ , is a conservative estimate.

#### 4. DETERMINATION OF A 'SAFE' GROUND VIBRATION LEVEL FOR REA 86

The rock ledges consist of sandstone with a tensile failure strain conservatively estimated to be 295  $\mu\varepsilon$ . To break the rock, i.e. cause new cracks to occur in the rock, it is necessary to flex the rock so that the tensile strain exceeds 295  $\mu\varepsilon$ .

From the methodology outlined, the PPV that will result in the tensile failure strain is

$$295 \times 10^{-6} = \frac{\text{PPV}}{1200 \times 10^3}$$
$$\therefore \text{PPV} = 354 \text{ mm/s}$$

Allowing for uncertainty factors, the application of a factor of safety is appropriate even though the assumptions made are conservative. An interim safety factor of 3 is suggested which gives an interim limit of 120 mm/s. Ultimately a safety factor of 2 may be appropriate if justifiable by further testing and observation. A 'safe' PPV limit of 175 mm/s is seen as the ultimate target safe level. However, an incremental observational approach is recommended to gradually increase the PPV and confirm by observation and proof strain measurements that no new cracks are forming.

This approach is also considered to be conservative.

Because of the articulation provided by the existing weaknesses such as cracks and joints, which allow the rock to flex without the development of new cracks, even higher strains may be required before the rock is damaged by ground vibration.

## 5. GROUND FLEXURE

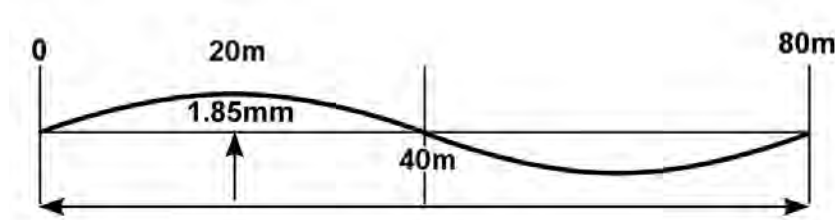
The actual flexure of the surface of the rock ledge can be predicted by Sine Wave theory.

For 175 mm/s at 15 Hz frequency, the surface displacement is  $\frac{PPV}{2 \cdot \pi \cdot f} = \frac{175}{2 \cdot \pi \cdot 15} = 1.85\text{mm}$ .

The wave length is  $\frac{\text{Shear Wave Velocity}(V_s)}{\text{Frequency}(f)} = \frac{1200}{15} = 80\text{m}$ .

Fifteen Hz was chosen as being representative of close distance frequencies with a basis when 65 ms delays are used in the initiation sequence. The prime frequency generated by 65 ms delays is 15.4 Hz, but is subject to directional variation due to a 'Doppler' effect, i.e. frequency changes if the source moves.

The shape of the surface flexure is shown in **Figure 4**:



**Figure 4 – Dimensions of the Surface Flexure at 175 mm/s (schematic, not to scale)**

The jointing planes of the rock ledge are spaced less than 20m apart. The flexure can therefore be accommodated by movement on the articulations provided by the joints. It is most unlikely that any individual rock block will be subjected to the full surface flexure and tensile failure will not occur in an individual block, adding further conservatism to the conclusions of the methodology adopted.

If we define angular strain as  $\epsilon = \frac{\text{Displacement}}{1/4 \text{ wavelength}}$

$$= \frac{PPV_g}{2 \pi f} \times \frac{4f}{V_s}$$

$$= \frac{PPV_g \times 2}{f \times V_s}$$

In this case, 175mm/s @ 15 Hz  $\epsilon = \frac{350}{1200 \pi} = 93 \mu\epsilon$

This compares to the P wave strain prediction of 87.5  $\mu$  and S wave strain of 146  $\mu$ , and represents a lower case prediction.

The surface of the rock is not a continuous rock layer, but is articulated into discrete blocks by jointing planes. The observations by Terrock at a Wilpinjong rock shelter were that the separate rock blocks move synchronously in an integral wave. There are no discordant blocks moving counter to the main motion, thereby increasing strain and the potential for damage.

Strain analysis has shown that new cracks will not be formed in the rock ledge because the tensile strength of the rock will not be exceeded. The discrete blocks of the surface of the rock ledge will flex as an integral unit within the constraints of the surface wave motion.

## 6. FURTHER STRAIN MEASUREMENT

Using the methodology outlined and the conservative assumptions made, it was reasonably concluded that a 'safe' vibration level was 175mm/s. Because this is 'pushing the envelope' to almost three times the last known data points, it is considered prudent to adopt an incremental observational approach. It is therefore suggested that an interim limit of 120 mm/s be applied and if observations show no change to the site and strain measurements confirm the theory, then move to the ultimate limit of 175 mm/s.

A suggested outline for a program to implement this approach would be:

- Measure the ground vibration from all blasts at the rock grooves site;
- Routinely photograph significant features and make comparisons to identify changes – look for the formation of fresh cracks in the rock;
- Install targets across significant joints etc. to monitor any change of joint widths;
- Take more strain measurements as PPV<sub>g</sub>'s approach significant milestone levels to confirm the validity of the plane wave strain theory assumptions.

It is suggested that additional strain measurements be taken from blasts with predicted PPV<sub>g</sub>'s of about 30 mm/s; 60 mm/s and 120 mm/s at REA 86. If there is no observed damage at the interim limit of 120 mm/s then approval be sought to modify the Development Consent Conditions and increase the ground vibration limit to 175 mm/s. In this case, further strain measurements are suggested as PPV<sub>g</sub> levels approach 150 and 175 mm/s.

## 7. CONCLUSIONS

Measurements of the ground strain on the rock ledges at REA 86 has shown the actual strain compares to the strain predictions using S wave velocities to represent an upper (conservative) case up to about 10 mm/s. Confirmation that the velocity/ground strain relationship applies up to 62 mm/s was obtained by direct strain measurements on an underground coal seam roof by Lewandowski (et al). The relationship is

$$\varepsilon = \frac{\text{PPV}_g}{\text{Shear Wave Velocity}} = \frac{\text{PPV}_g}{1200}$$

Literature references, including the parting above the Whybrow Seam at the Bulga mine, indicated that a conservative tensile failure strength of sandstone is 295 µε.

The PPV<sub>g</sub> required to exceed this conservative tensile strength of sandstone and form new cracks is 354 mm/s.

Applying a factor of safety of 3 gives a 'safe'  $PPV_g$  level of 120 mm/s. This is an recommended as an interim limit that is used for the basis of blast design.

Applying a factor of safety of 2 gives a 'safe'  $PPV_g$  of 175 mm/s. This is proposed as an ultimate ground vibration limit at REA 86 as the theory shows it will not cause new cracks to form in the rock ledges. This may also prove to be a 'safe' level as there is still a considerable safety margin to allow for uncertainty factors.

However, before a higher limit is proposed for approval, the strain measurements and condition monitoring must establish that 120 mm/s is 'safe' and projecting the data to 175 mm/s is justifiable.

The articulation provided by the existing joints in the rock ledges which are closer than 20m spacing, will provide further flexibility so that no individual rock block will be subjected to the tensile failure strain. The rock ledges will flex as an integral unit as the wave motion passes, with all rock blocks acting synchronously. Being an elastic motion, the blocks will return to their original positions once the ground motion has passed.

Because the 'safe' vibration limits are much higher than limits applied at rock structures elsewhere, it is recommended that an incremental observational approach be adopted. This will entail routine periodic photographs to be taken to record possible evidence of change and check strain measurements as the ground vibration levels approach milestone levels, e.g. 30 mm/s; 60 mm/s and 120 mm/s (interim limit).

If the observations show that Site REA 86 is not affected by ground vibration levels of 120 mm/s, approval could be sought to increase the limit to 175 mm/s if an appropriate strain measurement and condition monitoring program is implemented.



**Adrian J. Moore**  
**13th September, 2012**



## REFERENCES

AusIMM Monograph 9, 1989, "Field Geologists Manual", Third Edition

Dowding, C.H., 1985, "Blast Vibration Monitoring and Control", Prentice-Hall Inc., Englewood Cliffs, NJ.

Lewandowski, T., Keith, G, Croucher, M., Richards, A. (1999), "The Impact of Surface Blasting on Underground Opening – Geotechnical Assessment", Fragblast 6, South Africa.

New, B.M., 1986, "Ground Vibration Caused by Civil Engineering Works", TRRL Research Report 53.

## **NARAMA RAVENSWORTH OPEN CUT**

### **CUMULATIVE EFFECTS OF BLASTING ON THE REA 86 GRINDING GROOVE SITE**

#### **1. INTRODUCTION**

Terrock Consulting Engineers were requested by Mr Greg Newton, Environment and Community Coordinator, Ravensworth Surface Operations to investigate the possible cumulative effects of blasting on the grinding groove site REA 86.

In the Terrock report "*Determining Safe (Non Damaging) Ground Vibration Limits for the REA Site 86*" [13<sup>th</sup> September, 2012], it was demonstrated that, subject to monitoring and observation, an interim limit of 120 mm/s is appropriate, subject to incremental assessments at milestone PPV levels. If no damage is observed at 120 mm/s, the science suggests that the rock strength may permit the interim limit to be increased in say, approximately 20 mm/s steps to 175 mm/s, with appropriate monitoring and observation, while maintaining an acceptable Factor of Safety.

In the original report, the possible cumulative effects of multiple blasts was not presented or discussed. This report is to correct this omission.

#### **2. POSSIBLE CUMULATIVE EFFECTS**

A feature of mine blasting is that a blast occurs at any location in a mine, or any horizon in a mine, only once. The vibration limits that have been recommended for REA 86 are to ensure that rocks at the grinding groove site are not damaged by blasting. There is a limited number of possible blasts near REA 86 that will result in vibration levels which will approach the recommended limit (interim 120 mm/s). At distances further away from the site, blasts will result in lower levels of vibration. The simplest way to demonstrate this is on an attenuation graph (**Figure 1**). If a blast that would limit ground vibration to 120 mm/s at the grinding grooves, was moved 450m away it would result in a vibration level of 11 mm/s and at 1000m about 3 mm/s. Therefore, there will be more blasts resulting in a low PPV than high PPV from blasts close to the extraction limit near REA 86.

A literature search has not provided any guidance as to the effect of repeated blasting on a rock face or rock ledges. However, for guidance, using Strength of Materials principles, the only information found that is at all comparable is the effects of repeated blasting on a timber framed house lined with gypsum plasterboard, a ductile material which also fails at an elastic limit. The elastic limit is the point where any ductile material no longer returns to its original state after loading and beyond which permanent deformation takes place. The relationship between the percentage of the static strength at failure is compared to the number of cycles to failure in **Figure 2**.

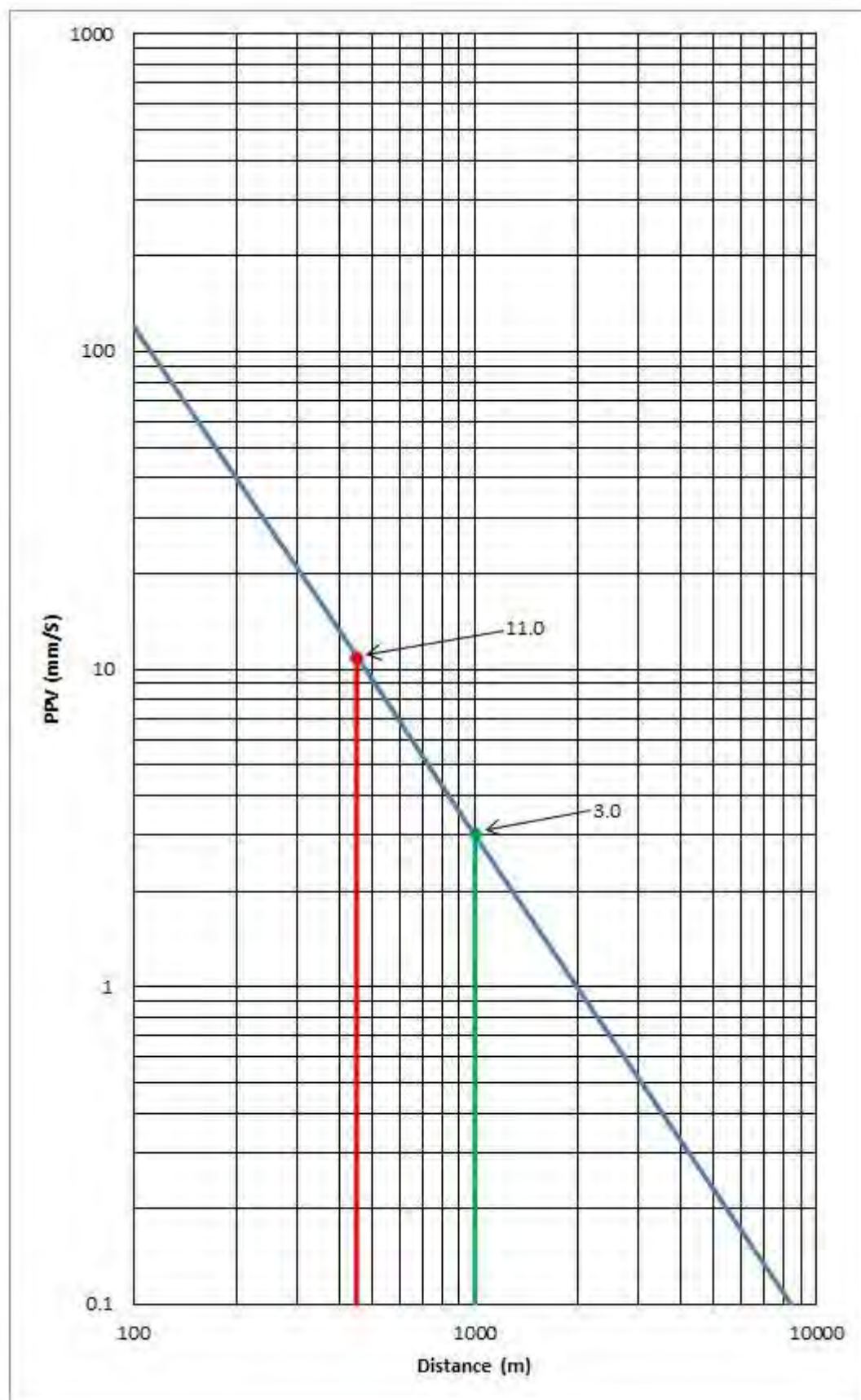
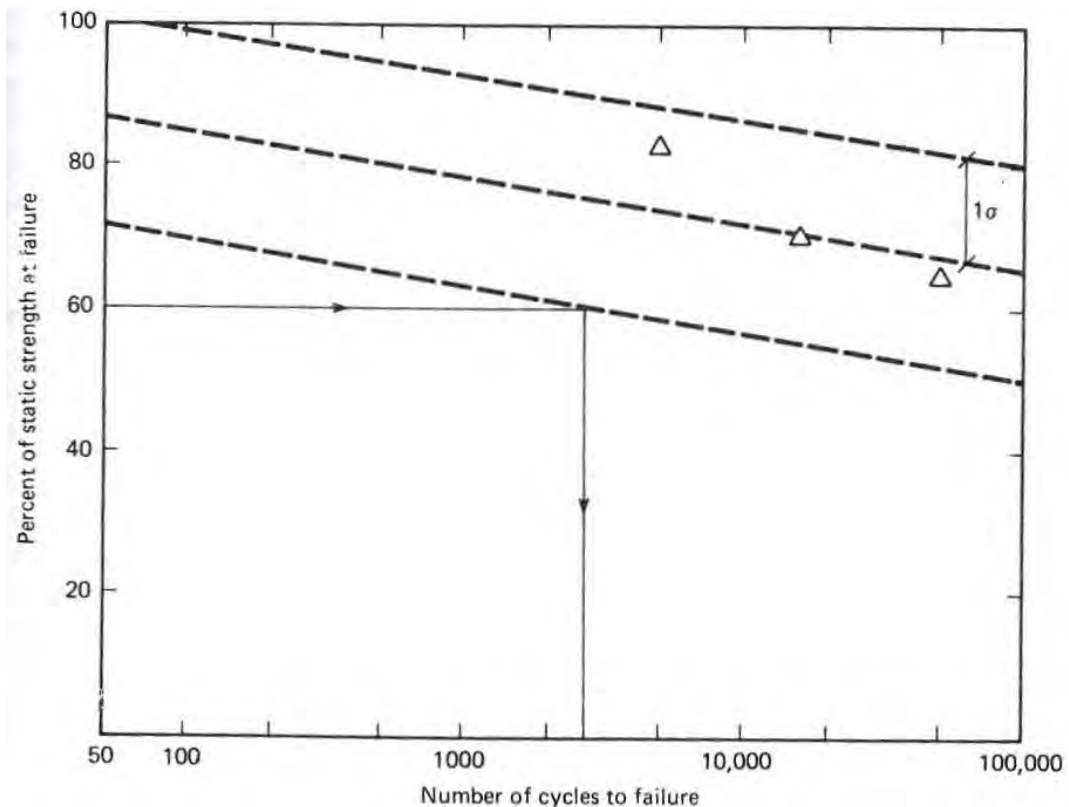


Figure 1 – PPV vs Distance



**Figure 2 - Number of cycles to failure compared to static strength of plasterboard  
(C.H. Dowding, "Blast Vibration Measurement and Control" 1984)**

At 60% of the failure strength, the number of cycles to failure is 2500. At 100% of the failure strength, the number of cycles is about 70. If we make the assumption that rock is also a ductile material and behaves in a manner similar to plasterboard, the following analogy can be made.

Failure Strength (Strain) of rock (tension)	225 → 295 $\mu\epsilon$
Applied Load Strain @ Interim Limit 120 mm/s	$120 \div 1,200,000 = 100 \mu\epsilon$
% Failure strength = $100 \div 225 \rightarrow 295$	34% → 44%

The number of cycles to failure is off the graph, i.e. > 100,000. With a typical blast, the number of cycles with PPV at or near the peak value is in the order of 15 → 20 (**Figure 3**).

The number of blasts therefore is 5,000 → 6,000.

Averaging 100 blasts per year gives 50 → 60 years before the effects of repetitive blasting becomes a possibility for causing damage.

Although plasterboard is obviously a different material to rock, the same principles of response to loading apply to all ductile materials, i.e. the lower the vibration loading is in relation to the failure strength of the rock (within the elastic range of the material), the more vibration cycles and therefore the more blasts before failure would be expected.

To draw an analogy, road pavement is designed to withstand a certain number of high impact cycles from trucks. However, overloaded trucks considerably reduce the number of cycles

before the pavement breaks up. The loading from thousands of cars has no effect on undamaged road pavement.

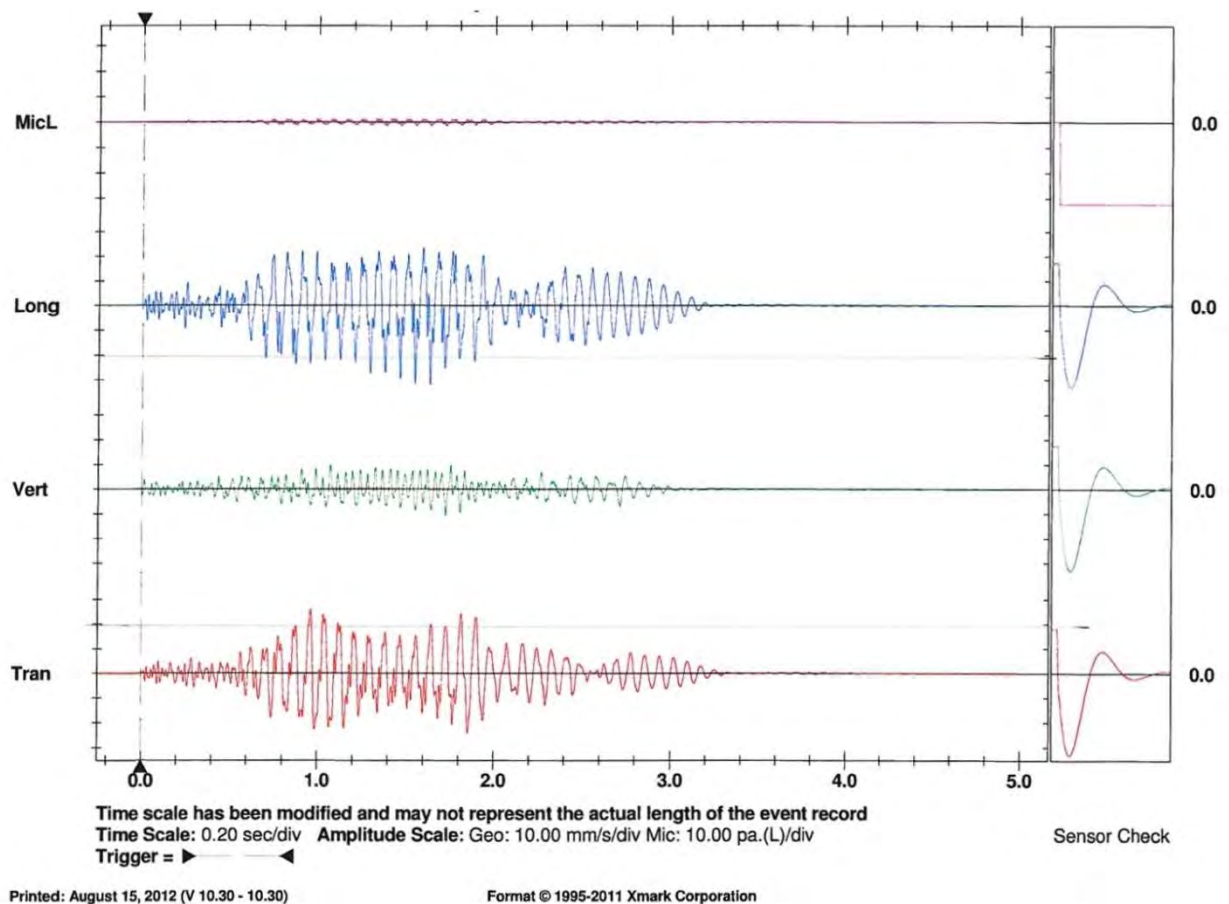


Figure 3 – Typical blast wavetrace with 15 peaks at or near the maximum

### 3. CONCLUSIONS

Upon consideration of the science of the elastic behaviour of materials, in my opinion, it may be reasonably concluded that vibration from repetitive blasting will have no cumulative effect on the rocks of the grinding grooves. There is the potential for a limited number of the nearest blasts to apply a dynamic loading of about 30 – 40% of the failure strain of the rocks and well within their elastic range. The majority of blasts will result in much lower vibration levels and therefore dynamic loading. Blast vibration at the interim limit is therefore not considered to damage REA 86. A higher limit can only apply after an investigation also shows it to be non-damaging.

*Adrian J. Moore.*

Adrian J. Moore  
19<sup>th</sup> February 2013

## **APPENDIX H**

### ***Aboriginal Consultation Records***





## Chelsea Kavanagh

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**From:** Lowder, Ben (Ravensworth North - Coal)  
**Sent:** Tuesday, 11 December 2012 4:01 PM  
**To:** 'cacatua@resetsdsl.net.au'; 'Tracey Skene'; 'Paulette Ryan'; 'paulettery@live.com'; 'dfrenchdfrench@hotmail.com'; 'Mark Hickey'; 'lukehickey'; 'ungooroo5969@hotmail.com'; 'Des Hickey'; 'Arthur Fletcher'; 'wonnarua@bigpond.com'; 'Kathie Kinchela'; 'Yarrowalk Accounts'; 'barry156@bigpond.com'; 'barkumanc@hotmail.com'; 'Darrel Matthews'; 'Ellaine @ HVAC'; 'kawul-cultural-services@hotmail.com'; 'larry.narelle@bigpond.com'; 'les.atkinson@hotmail.com'; 'l.perry@optusnet.com.au'; 'admin@ungooroo.com.au'; 'Wanaruah Local Aboriginal Land Council'; 'aliera.french.trading@hotmail.com'; 'tammy23477@hotmail.com'; 'm-desley@hotmail.com'; 'uhsdc@optusnet.com.au'; 'lea5972@hotmail.com'; 'h973809@bigpond.net.au'; 'tammy23477@hotmail.com'; 'Warren Schillings'; 'abie@yarnteen.com.au'; 'wonnaruaTcustodians@hotmail.com'  
**Cc:** Kelly, Andrew (Ravensworth North - Coal); Newton, Greg (Ravensworth - Coal); 'jane@connectforeffect.com.au'  
**Subject:** Final meeting minutes re: Aboriginal group meeting\_28 Nov 2012  
**Attachments:** 121128\_Minutes from Group Meeting held on 28 Nov 2012.pdf

Hi All,  
After feedback received during today's meeting, I have made the requested changes to the meeting minutes 28 Nov 2012.  
The attached copy will be recorded as a complete and final copy of meeting minutes.

I will prepare a draft copy of meeting minutes for 11 Dec 2012 and send out for comment as soon as available.

Kind regards,

**Ben Lowder**  
*Environmental Coordinator*  
*Xstrata Coal - Ravensworth Project*

*Telephone: +61 2 6570 0637*  
*Fax: +61 2 6570 0660*  
*Mobile: +61 0488 114 949*

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**From:** Lowder, Ben (Ravensworth North - Coal)  
**Sent:** Monday, 10 December 2012 10:31 AM  
**To:** 'cacatua@resetsdsl.net.au'; 'Tracey Skene'; 'Paulette Ryan'; 'paulettery@live.com'; 'dfrenchdfrench@hotmail.com'; 'Mark Hickey'; 'lukehickey'; 'ungooroo5969@hotmail.com'; 'Des Hickey'; 'Arthur Fletcher'; 'wonnarua@bigpond.com'; 'Kathie Kinchela'; 'Yarrowalk Accounts'; 'barry156@bigpond.com'; 'barkumanc@hotmail.com'; 'Darrel Matthews'; 'Ellaine @ HVAC'; 'kawul-cultural-services@hotmail.com'; 'larry.narelle@bigpond.com'; 'les.atkinson@hotmail.com'; 'l.perry@optusnet.com.au'; 'admin@ungooroo.com.au'; 'Wanaruah Local Aboriginal Land Council'; 'aliera.french.trading@hotmail.com'; 'tammy23477@hotmail.com'; 'm-desley@hotmail.com'; 'uhsdc@optusnet.com.au'; 'lea5972@hotmail.com'; 'h973809@bigpond.net.au'; 'tammy23477@hotmail.com'; 'Warren Schillings'; 'abie@yarnteen.com.au'; 'wonnaruaTcustodians@hotmail.com'  
**Cc:** Kelly, Andrew (Ravensworth North - Coal); Newton, Greg (Ravensworth - Coal); 'jane@connectforeffect.com.au'  
**Subject:** Aboriginal group meeting confirmed\_11 Dec 2012

Hi All,  
The group meeting scheduled for **Tuesday 11 December 2012 has been confirmed. The meeting will commence at 9am.** Please ensure you arrive on site 15mins prior to ensure the meeting begins on time. Refer to attached figure for directions to the Ravensworth Office building.

Please note: Although no PPE is required it is necessary to wear closed in shoes, so please no thongs or sandals.

See points below in previous email for intended meeting agenda. Anticipated finish time will be 12:00pm.

If you have any questions or queries, please give me a call on my mobile.

Kind regards,

**Ben Lowder**

*Environmental Coordinator*

*Xstrata Coal - Ravensworth Project*

*Telephone: +61 2 6570 0637*

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*Mobile: +61 0488 114 949*

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**From:** Lowder, Ben (Ravensworth North - Coal)

**Sent:** Wednesday, 5 December 2012 11:05 AM

**To:** 'cacatua@resetsl.net.au'; 'Tracey Skene'; 'Paulette Ryan'; 'pauletteryan@live.com'; 'dfrenchdfrench@hotmail.com'; 'Mark Hickey'; 'lukehickey'; 'ungooroo5969@hotmail.com'; 'Des Hickey'; 'Arthur Fletcher'; 'wonnarua@bigpond.com'; 'Kathie Kinchela'; 'Yarrawalk Accounts'; 'barry156@bigpond.com'; 'barkumanc@hotmail.com'; 'Darrel Matthews'; 'Ellaine @ HVAC'; 'kawul-cultural-services@hotmail.com'; 'larry.narelle@bigpond.com'; 'les.atkinson@hotmail.com'; 'l.perry@optusnet.com.au'; 'admin@ungooroo.com.au'; 'Wanaruah Local Aboriginal Land Council'; 'aliera.french.trading@hotmail.com'; 'tammy23477@hotmail.com'; 'm-desley@hotmail.com'; 'uhsdc@optusnet.com.au'; 'lea5972@hotmail.com'; 'h973809@bigpond.net.au'; 'tammy23477@hotmail.com'; 'Warren Schillings'; 'abie@yarnteen.com.au'; 'wonnaruaTcustodians@hotmail.com'

**Cc:** Kelly, Andrew (Ravensworth North - Coal); Newton, Greg (Ravensworth - Coal); 'jane@connectforeffect.com.au'

**Subject:** RNP\_Scarred tree inspection & proposed group meeting 11 Dec 2012

Hi All,

Thank you for all those who attended the Aboriginal stakeholder group meeting held 28 November 2012. Please review the attached draft minutes as record of meeting and let me know if you have any additional comments. I aim to finalise these minutes as a complete and final record during the next group meeting.

As agreed during the meeting, the following Aboriginal representatives Glen Morris, Barry French, Arthur Fletcher and William Smith were nominated to carry out an inspection of the 18 scarred trees within the Ravensworth Complex, on behalf of all Aboriginal stakeholders. This visit would provide an opportunity for Aboriginal people to review each tree independent of other assessments carried out by consultants to provide feedback to the wider Aboriginal stakeholder group.

The inspection was carried out on Tuesday 4 December 2012 by those nominated above, with the exception of William Smith who called ahead of the inspection to decline the invitation.

I would like to hold a **follow up meeting on Tuesday 11 December 2012** to discuss the inspection outcome. As agreed on 28 Nov 2012 this meeting will address:

- The position of Aboriginal representatives on the assessment carried out by Andrew Long, 12 Nov 2012.
- Open discussion on future management options for each of the 18 trees
- Outline the procedure of management for cultural scar trees within scheduled impact mining operation areas.

I would like to receive feedback on your availability and the suitability of the proposed date/time. Please respond by Friday 12:00pm so I can make alternative arrangements should this date prove to be unsuitable by the vast majority.

Please give me a call if you have any questions or would like to discuss.

Kind regards,

Ben Lowder  
Environmental Coordinator  
Xstrata Coal - Ravensworth Project

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Mobile: +61 0488 114 949

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**From:** Lowder, Ben (Ravensworth North - Coal)  
**Sent:** Tuesday, 27 November 2012 8:49 AM  
**To:** 'cacatua@resetdsl.net.au'; 'Tracey Skene'; 'Paulette Ryan'; 'pauletteryan@live.com'; 'dfrenchdfrench@hotmail.com'; 'Mark Hickey'; 'lukehickey'; 'ungooroo5969@hotmail.com'; 'Des Hickey'; 'Arthur Fletcher'; 'wonnarua@bigpond.com'; 'Kathie Kinchela'; 'Yarrawalk Accounts'; 'barry156@bigpond.com'; 'barkumanc@hotmail.com'; 'Darrel Matthews'; 'Ellaine @ HVAC'; 'kawul-cultural-services@hotmail.com'; 'larry.narelle@bigpond.com'; 'les.atkinson@hotmail.com'; 'l.perry@optusnet.com.au'; 'admin@ungooroo.com.au'; 'Wanaruah Local Aboriginal Land Council'; 'aliera.french.trading@hotmail.com'; 'tammy23477@hotmail.com'; 'm-desley@hotmail.com'; 'uhsdc@optusnet.com.au'; 'lea5972@hotmail.com'; 'h973809@bigpond.net.au'; 'tammy23477@hotmail.com'; 'Warren Schillings'; 'abie@yarnteen.com.au'  
**Cc:** Kelly, Andrew (Ravensworth North - Coal); Newton, Greg (Ravensworth - Coal); 'Nicola Roche'; 'jane@connectforeffect.com.au'  
**Subject:** RE: RNP\_Scarred tree assessment

Hi All,

Please find attached agenda for scheduled group meeting Wednesday 28 November 2012. **One person from each registered stakeholder group/organisation is invited to attend.**

The day will **kick-off 9:00am at the Ravensworth North Office Complex, Off the new Lemington Rd** (see attached for directions). As this will be an all day event please bring you lunch and some morning tea with you.

No need to bring along Personal Protective Equipment (PPE) as the meeting will not involve leaving the office complex.

I look forward to seeing you at the meeting, if you have any questions please do not hesitate to contact me on 0488 114 949 to discuss.

Kind regards,

Ben Lowder  
Environmental Coordinator  
Xstrata Coal - Ravensworth Project

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Mobile: +61 0488 114 949

---

**From:** Lowder, Ben (Ravensworth North - Coal)  
**Sent:** Friday, 23 November 2012 8:17 AM  
**To:** Lowder, Ben (Ravensworth North - Coal); 'cacatua@resetdsl.net.au'; 'Tracey Skene'; 'Paulette Ryan'; 'pauletteryan@live.com'; 'dfrenchdfrench@hotmail.com'; 'Mark Hickey'; 'lukehickey'; 'ungooroo5969@hotmail.com'; 'Des Hickey'; 'Arthur Fletcher'; 'wonnarua@bigpond.com'; 'Kathie Kinchela'; 'Yarrawalk Accounts'; 'barry156@bigpond.com'; 'barkumanc@hotmail.com'; 'Darrel Matthews'; 'Ellaine @ HVAC'; 'kawul-cultural-services@hotmail.com'; 'larry.narelle@bigpond.com'; 'les.atkinson@hotmail.com'; 'l.perry@optusnet.com.au'; 'admin@ungooroo.com.au'; 'Wanaruah Local Aboriginal Land Council'; 'aliera.french.trading@hotmail.com'; 'tammy23477@hotmail.com'; 'm-desley@hotmail.com'; 'uhsdc@optusnet.com.au'; 'lea5972@hotmail.com'; 'h973809@bigpond.net.au'; 'tammy23477@hotmail.com'; 'Warren Schillings'; 'abie@yarnteen.com.au'  
**Cc:** Kelly, Andrew (Ravensworth North - Coal); Ras, Johan (Ravensworth North - Coal); Walsh, Peter (Ravensworth North - Coal); Newton, Greg (Ravensworth - Coal); Jenkins, Bret (NSW - Coal); 'Nicola Roche'; 'jane@connectforeffect.com.au'; 'Roger Mehr'  
**Subject:** RE: RNP\_Scarred tree assessment

Hi All,

Please refer to attached document for photos of each tree discussed in the scarred tree assessment report.  
Kind regards,

**Ben Lowder**  
*Environmental Coordinator*  
*Xstrata Coal - Ravensworth Project*

*Telephone: +61 2 6570 0696*  
*Fax: +61 2 6570 0660*  
*Mobile: +61 0488 114 949*

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**From:** Lowder, Ben (Ravensworth North - Coal)  
**Sent:** Thursday, 22 November 2012 10:56 AM  
**To:** 'cacatua@resetsl.net.au'; 'Tracey Skene'; 'Paulette Ryan'; 'pauletteryan@live.com'; 'dfrenchdfrench@hotmail.com'; 'Mark Hickey'; 'lukehickey'; 'ungooroo5969@hotmail.com'; 'Des Hickey'; 'Arthur Fletcher'; 'wonnarua@bigpond.com'; 'Kathie Kinchela'; 'Yarrowalk Accounts'; 'barry156@bigpond.com'; 'barkumanc@hotmail.com'; 'Darrel Matthews'; 'Ella @ HVAC'; 'kawul-cultural-services@hotmail.com'; 'larry.narelle@bigpond.com'; 'les.atkinson@hotmail.com'; 'l.perry@optusnet.com.au'; 'admin@ungooroo.com.au'; 'Wanaruah Local Aboriginal Land Council'; 'aliera.french.trading@hotmail.com'; 'tammy23477@hotmail.com'; 'm-desley@hotmail.com'; 'uhsdc@optusnet.com.au'; 'lea5972@hotmail.com'; 'h973809@bigpond.net.au'; 'tammy23477@hotmail.com'; 'Warren Schillings'; 'abie@yarnteen.com.au'  
**Cc:** Kelly, Andrew (Ravensworth North - Coal); Ras, Johan (Ravensworth North - Coal); Walsh, Peter (Ravensworth North - Coal); Newton, Greg (Ravensworth - Coal); Jenkins, Bret (NSW - Coal); 'Nicola Roche'; 'jane@connectforeffect.com.au'; 'Roger Mehr'  
**Subject:** RE: RNP\_Scarred tree assessment

Hi All,

Please find attached the scarred tree assessment report carried out by Andrew Long on the 3 Oct 2012.

The purpose of this report is to evaluate the inconsistencies presented in previous scar tree assessments within the project and provide a determination on the likely nature of each scarred tree on site, i.e. Cultural Vs Agricultural/Natural causes.

The following report presents an appraisal of 18 reported scarred trees identified within the Ravensworth North Project area, six of which have previously been registered as Aboriginal cultural places in accordance with NPWS Act 1974.

An additional three trees have been identified as most likely to be of cultural origin. A total of nine culturally scarred trees therefore exist within the Ravensworth Complex. Five of these trees are identified as existing within the mining footprint and therefore require salvage.

I would like to invite each registered stakeholder or a designated representative to attend a group meeting on Wednesday 28 November 2012 to discuss cultural scarred tree management within the Ravensworth Complex. Please note the meeting will be held at Ravensworth North Office Complex, commencing at 9am. See attachment for directions.

This meeting will also provide an opportunity for other cultural heritage matters to be discussed and I will send out the intended agenda shortly.

Please give me a call if you wish to discuss or have any questions.  
Kind regards,

**Ben Lowder**  
*Environmental Coordinator*  
*Xstrata Coal - Ravensworth Project*

*Telephone: +61 2 6570 0696*  
*Fax: +61 2 6570 0660*  
*Mobile: +61 0488 114 949*

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**From:** Lowder, Ben (Ravensworth North - Coal)  
**Sent:** Friday, 5 October 2012 9:29 AM  
**To:** 'cacatua@resetsl.net.au'; 'Tracey Skene'; 'Paulette Ryan'; 'pauletteryan@live.com'; 'dfrenchdfrench@hotmail.com'; 'Mark Hickey'; 'lukehickey'; 'ungooroo5969@hotmail.com'; 'Des Hickey'; 'Arthur Fletcher'; 'wonnarua@bigpond.com'; 'Kathie Kinchela'; 'Yarrowalk Accounts'; 'barry156@bigpond.com';

'barkumanc@hotmail.com'; 'Darrel Matthews'; 'Ellaine @ HVAC'; 'kawul-cultural-services@hotmail.com'; 'larry.narelle@bigpond.com'; 'les.atkinson@hotmail.com'; 'l.perry@optusnet.com.au'; 'admin@ungooroo.com.au'; 'Wanaruah Local Aboriginal Land Council'; 'aliera.french.trading@hotmail.com'; 'tammy23477@hotmail.com'; 'm-desley@hotmail.com'; 'uhsdc@optusnet.com.au'; 'lea5972@hotmail.com'; 'h973809@bigpond.net.au'; 'tammy23477@hotmail.com'; 'Warren Schillings'; 'abie@yarnteen.com.au'

**Cc:** Kelly, Andrew (Ravensworth North - Coal); Ras, Johan (Ravensworth North - Coal); 'Andy Long'; 'Roger Mehr'; Walsh, Peter (Ravensworth North - Coal); Newton, Greg (Ravensworth - Coal)

**Subject:** RE: RNP\_Scarred tree assessment

Hi All,

As indicated below, on Wednesday 3 Oct 2012 Andrew Long carried out an assessment on the scarred trees identified within the Ravensworth North Project boundary.

Glenn Morris was also expected to participate, however due to unforeseen personal reasons he did not take part on the day. Fortunately, arrangements had been made for Barry French to also participate and was therefore able to provide Aboriginal community representation.

A report detailing the assessment findings is expected in approximately two weeks. I would like to reassure everyone that Ravensworth Operations will not undertake any further action prior to understanding the findings within the report and undertake consultation with the Aboriginal Community stakeholders.

I will be in touch to arrange an information session to discuss assessment findings once available.

Kind regards,

**Ben Lowder**

*Environmental Coordinator*

*Xstrata Coal - Ravensworth Project*

*Telephone:* +61 2 6570 0696

*Fax:* +61 2 6570 0660

*Mobile:* +61 0488 114 949

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**From:** Lowder, Ben (Ravensworth North - Coal)

**Sent:** Friday, 28 September 2012 5:01 PM

**To:** 'cacatua@resetsl.net.au'; 'Tracey Skene'; 'Paulette Ryan'; 'paulettery@live.com'; 'dfrenchdfrench@hotmail.com'; 'Mark Hickey'; 'lukehickey'; 'ungooroo5969@hotmail.com'; 'Des Hickey'; 'Arthur Fletcher'; 'wonnarua@bigpond.com'; 'Kathie Kinchela'; 'Yarrowalk Accounts'; 'barry156@bigpond.com'; 'barkumanc@hotmail.com'; 'Darrel Matthews'; 'Ellaine @ HVAC'; 'kawul-cultural-services@hotmail.com'; 'larry.narelle@bigpond.com'; 'les.atkinson@hotmail.com'; 'l.perry@optusnet.com.au'; 'admin@ungooroo.com.au'; 'Wanaruah Local Aboriginal Land Council'; 'aliera.french.trading@hotmail.com'; 'tammy23477@hotmail.com'; 'm-desley@hotmail.com'; 'uhsdc@optusnet.com.au'; 'lea5972@hotmail.com'; 'h973809@bigpond.net.au'; 'tammy23477@hotmail.com'; 'Warren Schillings'; 'abie@yarnteen.com.au'

**Cc:** Kelly, Andrew (Ravensworth North - Coal); Ras, Johan (Ravensworth North - Coal); 'Andy Long'

**Subject:** RNP\_Scarred tree assessment

Hi All,

I would like to thank you all for the feedback received regarding the need to conduct additional assessment on the scarred trees identified as being of potential cultural origin within the Ravensworth mine boundary of operation.

As discussed in group meeting held 22 August 2012 I intend to engage Andrew Long who developed the scarred tree identification manual for the Office of Environment and Heritage to conduct a review of the two existing reports and provide a third and final assessment. I have taken on board the comments received by the Aboriginal community and also contacted Glenn Morris (Bing) and arranged for his participation to accompany Andrew during the site inspection. As nominated, Glenn will serve to represent the community stakeholders and assist in identification and assessment of the scarred trees.

The purpose of the above assessment is to clarify inconsistencies between previous studies on the scarred trees and provide a clear understanding on the management required in accordance with the Aboriginal Cultural Heritage Management Plan (ACHMP).

The assessment will take place on Wednesday 3 October 2012. I will be in touch with assessment outcomes in due course. In the mean time please contact me on the details below should you have any questions/queries

Kind regards,

**Ben Lowder**

*Environmental Coordinator*

*Xstrata Coal - Ravensworth Project*

*Telephone: +61 2 6570 0696*

*Fax: +61 2 6570 0660*

*Mobile: +61 0488 114 949*



## Minutes

### Community Information Session – 28 November 2012

**Attendees:**

<b>Representative/s</b>	<b>Organization</b>
Andrew Kelly	Ravensworth Operations
Ben Lowder	Ravensworth Operations
Clint Weatherall	Ravensworth Operations
Jane Delaney-John	Connect for effect
Mike Humphreys	Prism Mining Pty Ltd
Clifford Johnson	Muswellbrook Cultural Consultants
Kevin Sampson	Bawurra Consultants
Donna Sampson	Cacatua Consultants
Andrew Jones	Jarban and Mugrebea
Arthur Fletcher	Kauwul T.A. Wonn 1
Terry Matthews	Roger Noel Matthews
Martin Salvador	Deslee Talbott Consultant
Laurie Perry	Wonnarua Nation Aboriginal Corporation
Noel Downs	Wanaruah Local Aboriginal Land Council
Norm Archibald	Yinarr Culture Services
Gordon Griffiths	Wonnarua Culture Heritage
Aliera French	Aliera French Trading
Stephen Griffiths	T & G Culture Consultants
William Smith	Myland

**Meeting Notes:**

Discussion	Outcomes & Actions
<b>Meeting Introduction</b>	
<p>Ben Lowder welcomed all for attending, Arthur Fletcher delivered a welcome to country and requested a minute silence.</p> <p>Ben Lowder began the presentation outlining:</p> <ul style="list-style-type: none"><li>• Visitor induction (need for enclosed shoes)</li><li>• Meeting protocols</li><li>• Participants responsibilities</li><li>• Meeting agenda</li></ul> <p>Question raised by Arthur Fletcher whether the Aboriginal community were happy to proceed with meeting given the level of attendance (14 of 42) by Registered Aboriginal Parties (RAPs). All present agreed they were happy to proceed with the meeting however, information presented needs to be made available to all RAPs before management decisions could be made.</p>	<p>Meeting commenced at 9:20am</p> <p>Meeting information (presentation and minutes) to be forwarded onto all RAPs for comment.</p>
<b>Review of Stage one works</b>	
<p>Brief overview of stage one works presented, as follows:</p> <ul style="list-style-type: none"><li>• Commenced in April 2011 and completed September 2012 (some outstanding tasks remain, to be completed in 2013)</li><li>• 571 Aboriginal sites/places identified</li><li>• 309 Sites fenced to be managed in-situ (end of stage one)</li><li>• 262 Sites salvaged via surface collection</li><li>• 8 Geomorphic investigations</li><li>• 20 Archaeological / Cultural salvage investigations excavations</li><li>• Over 45,000 items recovered (yet to be analysed for cultural value)</li><li>• Grinding groove and Engraving site feature 3D scanned. Baseline data utilised in future monitoring</li></ul>	
<b>Ongoing stage one works</b>	
<p>All surface collection and fencing works for ACHMP stage one is complete.</p> <p>The development of structure to carry out Cultural values assessments in proposed conservation area, Hillcrest identified as ongoing works. Values assessments proposed for early 2013. Noel Downs raised a question whether Hillcrest was solely proposed as an Aboriginal conservation area or also combined to serve as an Ecological conservation area. Andrew Kelly explained that the property would be co-managed as both an Aboriginal &amp; Ecological conservation area. Noel stated that any Aboriginal Offset should be managed in a way that allowed unrestricted Aboriginal use such as hunting and ceremony. Aboriginal land use should be given priority. Ben acknowledged Noel's comments stating that they had been noted and would be</p>	<p>Structure for undertaking cultural values assessment at Hillcrest to be communicated to RAPs once finalised.</p>

<p>discussed following assessment of the suitability of the Hillcrest property as an Aboriginal conservation area.</p> <p>Illustrations of GIS database used to identify Aboriginal cultural heritage sites displayed on screen.</p> <p>Update on stabilisation works at RW41 presented, outlining risk assessment had been carried out, all Archaeological excavations had been lined with geo-fab and backfilled, external consultants GSSE visited site to verify erosion &amp; sediment controls in place and site included in routine monitoring.</p> <p>Question raised how often monitoring was taking place. Ben informed that to date this had occurred each month, however in future site will be included in quarterly monitoring program. Inspection also conducted after heavy rain event.</p> <p>Request made to explain direction of future Archaeological work at RW41. Ben explained preliminary analysis of artefacts recovered from RW41 and Emu creek would assist in assessment of site and answer the question of whether further investigation was required. Some confusion followed with some RAPs concerned that cultural salvage was not being considered. Ben explained that as with all previous investigations the archaeological work needs to be completed in order to assess the site against the triggers within the ACHMP to conduct cultural salvage. Ben stated that analysis of artefacts from RW41 &amp; Emu creek has been identified by Ravensworth Operations as a priority item and the resulting information would be used to inform how the investigation continued. The potential to undertake cultural salvage at RW41 will be discussed following artefact analysis.</p> <p>Pictures of RW41 in current state presented in slideshow</p> <p>Images of 3D scanning at REA 86 Grinding grooves and 37-3-0772 Engraving site presented in slideshow. Ben explained that these scans formed part of baseline recording and could be used in comparison monitoring of each site. Laurie Perry commented on scanning stating that this was very valuable information and commended Ravensworth Operations for recording the site to this level of detail.</p>	<p>Inspections at RW41 to continue on routine monitoring program at quarterly intervals and after heavy rain events.</p> <p>Preliminary analysis of artefacts from RW41 and Emu creek to be completed.</p> <p>Results of artefact analysis will direct the requirement for Archaeological investigation to continue.</p> <p>Potential to conduct cultural salvage at RW41 to be discussed following completion of archaeological work.</p>
<p><b>Vibration monitoring at REA86</b></p> <p>Clint Weatherall and Mike Humphreys presented information on vibration monitoring at REA86</p> <p>Current vibration threshold at Aboriginal Grinding groove site (REA86) is 30mm/second (Peak Particle Velocity) The PPV limit was given as a conservative estimate as there was no history or science around the site and the EA was issued with the following note: "Ravensworth Operations will refine the relevant blast Impact Assessment Criteria applicable to REA 86 through further geotechnical assessment".</p> <p>As agreed to by RAPs on 01/06/2012 a Geophone and Strain Gauge was placed adjacent to the site to measure the vibration and strain during blasting activities.</p> <p>Monitoring results confirm that no blasts have exceeded the 30mm/sec threshold.</p>	

Mike explained research information on the behaviour of vibration around the sandstone feature. The expected Peak Particle Velocity (Vibration) that will result in the Tensile Failure Strain is calculated to be **354mm/s**. The current threshold of 30mm/sec presents a safety factor of over 10, which is extremely conservative. Typical asset protection safety factors exist in the order to 2 to 1.5 (Power lines, rail lines, bridges, etc).

Clint explained that blasting is due to advance closer to the REA 86 site for a short period of time and will then move further away. Based on the monitoring data and research on capacity of sandstone to withstand vibration an application to Department of planning & Infrastructure to have the threshold increased would be made.

A question was raised as to where the vibration monitoring data is stored and how can Aboriginal stakeholders can review the data. Clint explained that this is featured in the Annual Environmental Management Report (AEMR) which is a public document and made available on the internet.

Ravensworth Operations suggest a staged approach to increase the PPV (Vibration) limit. First stage PPV limit of 120mm/sec which is a safety factor of three for the anticipated sandstone tensile failure strain. A higher stage two limit of 175mm/sec (safety factor of two) will be utilised if monitoring and analysis of further results indicate that there is no damage to the site.

The question regarding how close the blasting will approach REA86 was raised. Although Clint could not recall exactly he stated it was approx 280m at its closest point. Clint stated he would confirm this figure after the morning tea break.

Norm Archibald asked if it was known what the condition of the sandstone was under the surface. He asked if it was known whether there were any fissures or cracks underneath the grinding grooves. Mike responded that although the condition of the sandstone underneath the surface was not known the calculations are based on general sandstone structure and features such as cracks and disjointed sections are expected. Scanning baseline data has been recorded for sandstone condition on the surface.

Laurie Perry asked whether the grinding grooves were going to be destroyed. Ben explained that the REA86 grinding groove site formed part of the Ravensworth North Offset Area (RNOA), and therefore protected from future disturbance of any nature. Mining is due to approach the site for a relatively short period of time before moving further away was also explained. Therefore associated vibrations would only temporarily increase before decreasing. Laurie stated he feels much more comfortable knowing this.

Aleria French asked whether another 3D scan has been taken after blasting. Ben confirmed that no additional scans have been undertaken to date. Aleria asked how can you then validate statements such as no effects to the sandstone have occurred. Mike referred to the level that would result in effects to sandstone being 354mm/sec and explained that as

Ravensworth Operations to submit an application with DP&I to increase vibration threshold in two stages. The first stage will involve increasing the vibration limit from 30mm/sec to 120mm/sec. Following review of monitoring data the second stage will involve increasing the vibration limit from 120mm/sec to 175mm/sec

Following morning tea Clint was able to confirm that the closest point blasting operations would approach on REA 86 was 240m.

<p>no vibrations have been recorded over 10.44mm/sec the impact on the REA86 site can be considered practically no effect.</p> <p>Noel identified that there is a difference to what the Aboriginal community feel is monitoring and what Ravensworth Operations consider as monitoring. Noel asked if there was opportunity for an Aboriginal person to be employed to assist in monitoring of this and other sites. Andrew Kelly informed Noel that he did not think that would be possible as most of the monitoring was based on placing sensors around the site and leaving in place during the blast. Ben mentioned the annual monitoring schedule of which REA86 was included whereby Aboriginal representatives participate in inspection of each site within the project boundary. The purpose of this monitoring is to record the current site condition and identify any remedial works required.</p> <p>Following morning tea Clint was able to confirm that the closest point blasting operations would approach on REA86 was 240m.</p> <p>Noel requested that an opportunity is provided for Aboriginal monitoring of REA 86 at the following times:</p> <ul style="list-style-type: none"> <li>• When blasting threshold is increased to 120mm/sec</li> <li>• When blasting is undertaken at closest point to REA 86 (240m)</li> <li>• When blasting threshold is increased to 175mm/sec</li> </ul> <p>A consolidated request for the grinding grooves to be re-scanned if vibration levels approached 120mm/sec was also made.</p> <p>All Aboriginal stakeholders agree to Ravensworth Operations intention to approach DP&amp;I to increase vibration threshold triggers.</p>	<p>Ravensworth Operations committed to engaging Aboriginal stakeholders to participate in monitoring When blasting threshold is increased to 120mm/sec, mine approaches 240m from REA86 and blasting threshold is increased to 175mm/sec,</p> <p>Ravensworth Operations committed to undertaking follow up 3D scanning of the grinding grooves if vibration levels approached 120mm/sec</p>
<p><b>Morning tea Break</b></p>	
<p><b>Scar tree Assessment – Andrew Long</b></p> <p>Background leading to Andrew Long assessment was outlined in presentation. Report aims to evaluate the inconsistencies presented in previous scar tree assessments providing clarity on the likely origin and research potential of each scarred tree on site.</p> <p>Provision for Glen Morris to attend site and accompany Andrew during assessment was made, however due to unforeseen circumstances, Glen did not present on the day.</p> <p>Arrangement for Barry French to attend at short notice on behalf Aboriginal stakeholders was explained.</p> <p>Arthur Fletcher explained that he did express an interest in attending also and was told that this was not possible due to logistical reasons. Arthur was disappointed that he was not contacted when it became known that Glen could not attend. Ben explained that no notice was provided by Glen that he was not able to attend and the assessment had to proceed as Andrew had flown up from Victoria to attend site.</p>	

Noel Downs expressed some concern that the fact that Mark Burns assessment had not been peer reviewed and in his opinion discredited that this presented a risk to the Aboriginal people as all other assessments could be challenged at any point in time due to Mark having a relevant doctorate in trees and their growing habits. Jane Delany John explained to all that under the legislation it is the Aboriginal people that determine what is culturally significant not consultants and Mr Burns having a doctorate is irrelevant.

An overview of assessment outcomes of 18 potential cultural scarred trees assessed was presented, referring to a figure which identified location of each tree in reference to creeks and water ways and future mining disturbance boundary.

Assessment included six previously registered trees on the AHIMS register. Andrew Long assessment concluded that two of these trees were clearly not of cultural origin, two were most unlikely and two were possible.

The assessment states recommendations for Ravensworth Operations to prepare an application to have these six trees removed from the OEH AHIMS register. Ravensworth Operations however have no intentions to submit such an application and these trees will continue to be considered as cultural heritage items and receive protection under the NPWS Act 1974.

Andrew Long concluded that an additional three trees have supporting evidence that they are of cultural origin and should receive registration.

Nine trees of the 18 assessed have either been previously registered or recently identified as requiring registration. Based in A. Long assessment Nine trees are therefore considered as Aboriginal Cultural heritage items by Ravensworth Operations.

Five of the nine Aboriginal scarred trees within the project area are also within future mining disturbance areas and therefore require intervention prior to mining within the area.

Photos of each of the five trees above were presented with brief comments on their condition discussed.

Ben asked for comment regarding suitable management options for the five trees due to be disturbed. Ben outlined feedback he received from Stakeholders over the past week included the following

- High definition Photographic & video recording,
- Ceremony and leave in place, or
- Burning in place, or
- Attempt salvage and relocation.

General discussion on these options followed however it was expressed that as Barry French was absent to the meeting it was not appropriate to have these discussions until his point of view could be heard. Also, Glen Morris should be provided the opportunity to visit each tree and provide comment on management options.

Discussion on appropriate course of action followed. Plan

Six previously registered trees on AHIMS will continue to be considered as cultural heritage items by Ravensworth Operations and receive protection under the NPWS Act 1974, until additional feedback received by Aboriginal stakeholders.

Phase 1 inspection to be carried out in December 2012. Attendees include Glen Morris, Arthur Fletcher,



<p>devised for Glen Morris to attend site and inspect all 18 trees. This would be carried out in two phases. Phase 1 would consist of inspecting the five trees within the mining disturbance area and provide comment on assessment and potential management options for each tree. Due to the mining schedule phase 1 is considered a priority action.</p> <p>The second phase would consist of inspecting all remaining trees assessed in Andrew Long report and provide comment. Arthur Fletcher and William Smith also expressed an interest in attending. This was agreed to by Ravensworth Operations with the addition of Barry French, however it was noted that all attendees other than Glen would be on a volunteer basis and therefore should not be expected to be paid for the day. All Aboriginal stakeholders agreed that the inspection would be undertaken by Glen and it was this feedback that was outstanding.</p> <p>It was also noted that further consultation within the Aboriginal community with Elders was needed to comment on appropriate ceremony for scarred trees.</p> <p>All 18 trees to continue to receive protection until after Glen Morris visit.</p> <p>A meeting shall be arranged following the site inspection whereby feedback from these representatives will be provided. Meeting agenda to focus on determination of appropriate management of trees inspected in phase 1.</p>	<p>William Smith and Barry French.</p> <p>All 18 trees to continue to receive protection until after inspection by nominated Aboriginal representatives (Glen Morris, Barry French, William Smith and Arthur Fletcher).</p> <p>Further consultation within the Aboriginal community with Elders to comment on appropriate ceremony for scarred trees if deemed appropriate. Community representatives to provide feedback at next group meeting.</p> <p>Meeting to be arranged following the inspection by Glen Morris and others. Feedback to be discussed in order to determine appropriate management of trees inspected in phase 1.</p>
<p><b>General Business</b></p> <p>Project approval condition for Ravensworth Operations to hold a one week artefact recording and basic analysis workshop discussed. Ben requested stakeholders to express what they would like to see delivered in this package. The workshop would not be a paid attendance, however a certificate of attendance could be arranged and this is an opportunity to tailor the workshop to assist the knowledge of attendees. No feedback received. Ben indicated that he would prepare a draft scope and circulate for comment. This will be discussed in a future group meeting.</p> <p>Laurie Perry asked if this kind of thing could be included in the XCN RAP (Reconciliation Action Plan). Andrew Kelly indicated that he would pass Laurie's request onto Bret Jenkins who is developing the RAP programs.</p> <p>Some Aboriginal archaeologists were identified (Tracy Skeen &amp; Cheryl Kitchener of <i>Ecobiological</i>) which may be suitable training providers to run the workshop. Ben committed to contacted Ecobiological and investigating their involvement.</p> <p>Ben noted that he was preparing a model to undertake cultural values surveys at Hillcrest. This would be communicated in the near future.</p> <p>Other general business to form part of future meeting agenda items include:</p> <ul style="list-style-type: none"> <li>• Review of ACHMP</li> <li>• Care and control of salvaged material</li> </ul>	

Meeting close @ 14:00





# Recommendation to Increase the Vibration PPV Limit at REA 86 Grinding Groove Site

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November 2012



# Project Approval 09\_0176 Conditions

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- The Proponent shall ensure that blasts on site do not cause exceedance of the criteria in Table 8.
- Table 8 Criteria for Aboriginal axe grinding groove site (REA 86); Ground Vibration 30mm/sec. (Peak Particle Velocity)
- This 30mm/sec is based upon the Environmental Assessment conducted by Umwelt in 2010.



# REA 86 Environmental Assessment Criteria

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The 30mm/sec PPV limit was given as a conservative estimate as there was no history or science around the site and the EA was issued with the following note: “Ravensworth Operations will refine the relevant blast Impact Assessment Criteria applicable to REA 86 through further geotechnical assessment” .

Appendix 6 EA. (Heggies Report 2009) As part of the EA.



## Further Assessment

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- In the interest of the REA 86 site and to determine the effects of blasting on the competent Sandstone; Ravensworth approached the community stakeholder groups on the 01/06/2012 proposing to place a Geophone and Strain Gauge adjacent to the site to measure the vibration and strain at the site during blasting activities. This assessment assisted to provide detailed analysis for the limit and relevant blast Impact Assessment Criteria as required as part of the EA.





# REA 86 Groove Site





## Further Assessment

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- The Strain analysis was carried out over five blasts where strain and vibration was recorded for each blast. These blasts occurred on the 19<sup>th</sup> June, 13<sup>th</sup> July and 22<sup>nd</sup> August. Since the 29<sup>th</sup> June 2012 **ALL** blasts have been monitored on the sandstone for vibration at the Grinding Groove site.
- 3D scanning of the Grinding Grooves site also occurred on the 2<sup>nd</sup> July 2012 as part of our commitment to ensure the security of the grinding grooves site.

# Assessment Results



Blast Date	Peak Vector Vibration (mm/S)	Peak Vector Strain ( $\mu\epsilon$ )
19/06/2012	2.66	2.0
13/07/2012	10.44	6.22
22/08/2012 #1	3.91	1.96
22/08/2012 #2	0.94	0.78
22/08/2012 #3	2.41	0.56



# REA 86 Sandstone Characteristics

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REA 86 Grinding Grooves are present in a sandstone rock mass.

Using Values from the AusIMM field Geologists Manual:

- Sandstone minimum Tensile Failure Strain is indicated at 140 – 380µε
- Characteristics of the Hunter Valley Sandstone, from Lewandowski (1999) indicated that Hunter Valley Sandstone Tensile Failure Strain is indicated at 295µε
- Terrock 2012, *it is reasonable to assume that the REA 86 sandstone is stronger and tougher than other sandstone layers in the area due to the rocks ability to resist erosion.*
- Therefore, reasonable to accept that the REA86 Sandstone tensile strength is 295µε.



## Control Measures

- To cause effect to the site. I.e. cause any cracking to occur in the rock, it is necessary to flex the rock so that the tensile strain exceeds 295 $\mu\epsilon$ .  
*Lewandowski (1999)*
- The Peak Particle Velocity (Vibration) that will result in the Tensile Failure Strain is calculated to be **354mm/s**.

PPV (mm/s)	Sandstone Breaking Strain ( $\mu\epsilon$ )	Upper Anticipated Strain ( $\mu\epsilon$ )
<b>30mm/s</b> (Existing Approval)	<b>295</b>	25
<b>120mm/s</b> (Stage One)	<b>295</b>	100
<b>175 mm/s</b> (Stage Two)	<b>295</b>	146



# Protection of the Rock

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Geotechnical issues are commonly given a safety factor of two (and often less). This is common for competent high wall stability assessment, which allows people and equipment to work under and in close proximity.

Allowing for uncertainty factors associated with the Sandstone, RSO suggest a staged approach to increase the PPV (Vibration) limit.

RSO suggest a first stage PPV limit of 120mm/sec which is a safety factor of three for the anticipated sandstone tensile failure strain.

A higher stage two limit of 175mm/sec (safety factor of two) will be issued if monitoring and analysis of further results shows that there is no damage to the site.



## Control Measures

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- To date, RSO have been able to achieve the 30mm/sec limit within the technical blasting constraints by:
- - Commencing initial blasting further from the site
- - Reducing the maximum instantaneous charge (MIC); and
- - Adjusting blast pattern size and firing sequence.



## Other Structure Limits

- Blast Vibration limits of 100mm/sec are typically based on minor (Cosmetic) damage to structures. For Example cracks in plaster walls.
- Proposed blast vibration limits of 120mm/s to 175mm/s are consistent with other structures. For example; Railway lines, culverts and concrete pipes, bridges, roads and electricity power lines.
- Typical Limit for railway lines are 200 mm/s; and
- Typical limits for Electricity pylons is 100mm/s.