    

COALPAC CONSOLIDATION PROJECT

PREFERRED PROJECT REPORT

for

Coalpac Pty Limited

April 2013

Hansen Bailey

ENVIRONMENTAL CONSULTANTS

COALPAC CONSOLIDATION PROJECT

PREFERRED PROJECT REPORT

Prepared by:

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9 April 2013

For:

Coalpac Pty Limited

Castlereagh Highway

CULLEN BULLEN NSW 2790

PREFERRED PROJECT REPORT STATEMENT

	Submission of Preferred Project Report (PPR) Under Section 75H of the *Environmental Planning and Assessment Act 1979*
Prepared by	
Name	James Bailey
Qualifications	B. Natural Resources, MBA
Address	Hansen Bailey PO Box 473 SINGLETON NSW 2330
In Respect Of	Coalpac Consolidation Project
Proponent Name	Coalpac Pty Limited
Proponent Address	Castlereagh Highway CULLEN BULLEN NSW 2790
Land to be Developed	See Appendix B of the Coalpac Consolidation Project EA.
Proposed Development	Development and operation of Coalpac Consolidation Project and associated activities as outlined in **Section 2** of this PPR.
Environmental Assessment	The environmental assessment of the Coalpac Consolidation Project is contained in this PPR and the Coalpac Consolidation Project EA.
Certification	I certify that I have read and am aware of the terms of the *Expert Witness Code* of the Land & Environment Court of NSW. I further certify that I have prepared the contents of this PPR, and to the best of my knowledge: • It is in accordance with Sections 75E and 75F of the *Environmental Planning and Assessment Act 1979*; • It contains all available information that is relevant to the environmental assessment of the activity to which the statement relates; and • The information contained in the statement is neither false nor misleading.
Signature	
Name	James Bailey Director
Date	9 April 2013

EXECUTIVE SUMMARY

Coalpac Pty Limited (Coalpac) owns and operates Cullen Valley Mine and Invincible Colliery, located near Cullen Bullen, 25 km northwest of Lithgow, NSW. Each mine operates as an individual entity with separate planning approvals under the *Environmental Planning and Assessment Act 1979*.

In 2010, Coalpac lodged Project Application (10_0178) under Part 3A of the *Environmental Planning & Assessment Act 1979* seeking major Project Approval for the development and operation of the Coalpac Consolidation Project. The Project Application sought approval to consolidate and extend the coal mining operations and management of the Cullen Valley Mine and Invincible Colliery under a single planning approval to allow the continuation of mining operations for a further 21 years.

An Environmental Assessment for the Coalpac Consolidation Project (Hansen Bailey 2012) was submitted the NSW Department of Planning & Infrastructure in March 2012. Following the public exhibition of the Environmental Assessment (Exhibited EA) from April to June 2012 and response to the submissions provided during that time, the NSW Minister for Planning and Infrastructure requested that the NSW Planning Assessment Commission carry out a review of the Coalpac Consolidation Project. In response to this request, the NSW Planning Assessment Commission provided their Review Report for the Coalpac Consolidation Project in December 2012. Subsequent to the submission of the NSW Planning Assessment Commission Review Report, the Department of Planning and Infrastructure sought a response from Coalpac, which was provided in March 2013.

On 20 March 2013, the NSW Department of Planning & Infrastructure requested that Coalpac submit to the Director-General a Preferred Project Report for the Coalpac Consolidation Project, including:

1) *"A preferred project report that outlines any proposed changes to the project to minimise its environmental impact (section 75H(6)(b) of the Act); and*
2) *Any revised statement of commitments (section 75H(6)(c) of the Act) or environmental management and mitigation measures on the site."*

The proposed changes to further minimise the environmental impacts of the Coalpac Consolidation Project as assessed in the Exhibited EA are discussed in this Preferred Project Report and referred to as the Contracted Project. These changes for the Contracted Project include:

1. Removal of the Hillcroft mining area and associated access infrastructure (including the Wallerawang-Gwabegar Rail Line overpass bridge and Red Springs Road crossing);

2. Removal of the sand extraction component of the Exhibited Project located in the Cullen Valley mining area, including the requirement for associated crushing and screening infrastructure and the transport of product sand by road from the site to market;
3. Reduction of the open cut mining footprint to avoid the area of Clandulla Geebung habitat previously located in the north western mining area at Cullen Valley Mine;
4. Reduction of the open cut mining footprint in relation to the Significant Pagoda Landforms to improve ecological outcomes;
5. Reduction of the highwall mining footprint to avoid rock formations within the Significant Pagoda Landform to improve perceived ecological, heritage and geotechnical outcomes;
6. Implementation of a robust blast management system specifically tailored to further minimise the potential for blasting impacts to any Significant Pagoda Landforms and Sandstone Outcrops;
7. Enhancement of the Biodiversity Offset Strategy proposed for any residual ecological impacts; and
8. Commitments with regard to the monitoring, management and operation of the Contracted Project.

The area to be disturbed by open cut mining has contracted by approximately 196 hectares or 20% from that described in the Exhibited EA. Of this total, the removal of the Hillcroft mining area as described in the Exhibited EA represents a reduction in disturbance of approximately 107 hectares. Further, the removal of the Hillcroft mining area also results in the avoidance of a 74 hectares area of habitat for the Capertee Stringybark (listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* and *Threatened Species Conservation Act 1995*).

Removing the Hillcroft mining area as shown in the Exhibited Project mine plan has, however, resulted in this property also being removed as a component of the revised Biodiversity Offset Strategy for the Contracted Project. The Hillcroft offset will be replaced with an alternate property of similar of improved biodiversity values in the revised Biodiversity Offset Strategy to meet Coalpac's management commitments.

Removing the proposed sand extraction from within the Cullen Valley open cut mining area for the Contracted Project will result in improved environmental outcomes including elimination of 128 truck movements per day on the Great Western Highway and a reduction in Exhibited Project water demand of up to 50 Megalitres (ML) per annum during the years when sand extraction was proposed.

The above changes to the Exhibited EA mine plan for the Contracted Project are also predicted to result in a reduction in amenity impacts to private receptors surrounding the Project Boundary. This reduction was shown in the re-assessment of air quality and noise impacts for Year 2, which is representative of an interval in the Contracted Project mine plan when mining is closest to private receptors in Cullen Bullen and surrounding areas.

The Clandulla Geebung habitat located in the north-western section of the Cullen Valley mining area will be preserved by the Contracted Project resulting in impacts to over 320 individuals of the species being avoided.

The additional setback of open cut mining from the pagodas and gullies in the Significant Pagoda Landform results in a reduction in the open cut mining footprint of 9 hectares. The contraction in the open cut mining footprint also results in a reduction in the perimeter of the Contracted Project Disturbance Boundary of 5.4 km. Of this total reduction, the perimeter of the Contracted Project Disturbance Boundary adjacent to the Significant Pagoda Landform decreased by 1.5 km (or 25%), thus minimising edge effects adjacent to the Significant Pagoda Landform, including its associated rock formations and habitat areas.

To provide greater certainty in environmental outcomes, 66 hectares previously proposed for highwall mining has been removed from the Contracted Project mine plan in areas under pagoda complexes and cliff lines in the Significant Pagoda Landform. This has been undertaken in response to community and Planning Assessment Commission concerns.

To avoid impacts to the Significant Pagoda Landform and Sandstone Outcrops, a further review of the blast design, monitoring and response procedures has been undertaken by Terrock Consulting Engineers. This review provides a procedure that reflects industry standard blast management practices and includes consideration of local experience from Coalpac's existing operations. This strong knowledge base will be further enhanced with the implementation of a staged blast management and monitoring program designed to avoid any potential for impacts to the Significant Pagoda Landform and other Sandstone Outcrops.

Coalpac has held further meetings with NSW Office of Environment and Heritage and has committed to enhancing the Biodiversity Offset Strategy for the Contracted Project. This will occur by acquiring further offsets to a total area of at least 1,000 hectares in addition to the 2,000 hectares of offsets currently held by Coalpac. NSW Office of Environment and Heritage have provided further direction as to what quality these additional offset land purchases should provide so as to maximise the biodiversity outcome for the region and a list of potential offset properties in the region that may be suitable to form part of the Biodiversity Offset Strategy. The acquisition of the additional 1,000 hectares of offset land will achieve an overall offset ratio of at least 4:1 for forest and woodland vegetation.

The implementation of the above mine plan changes and environmental management controls will provide further certainty that outcomes for the Contracted Project, will be achieved The implementation of these controls will be undertaken by Coalpac in accordance with the revised Statement of Commitments for the Contracted Project.

The above changes to the Contracted Project mine plan represent an appropriate compromise to the 'Optimal Open Cut Mine Layout Plan' as discussed in the Exhibited EA (Hansen Bailey 2012) and justifiably sacrifice a material proportion of the remaining otherwise recoverable coal to meet environmental and social requirements. The Contracted Project provides significant economic benefits for the community of Australia and of NSW and the consolidation and continuation of mining by Coalpac will also enable the continued supply of an appropriate quality and priced thermal coal to the Mount Piper Power Station, at a time when there is uncertainty as to the cost effective availability of such coal from other suppliers.

The Contracted Project, when assessed and considered in accordance with the principles of Ecologically Sustainable Development and the objects of and the requirements under the *Environmental Planning and Assessment Act 1979*, is appropriate for and approvable on the basis that the resultant economic benefit of $1,330 M significantly outweighs the residual environmental and social costs.

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COALPAC CONSOLIDATION PROJECT (Application Number: 10_0178)

PREFERRED PROJECT REPORT

1 INTRODUCTION

1.1 BACKGROUND

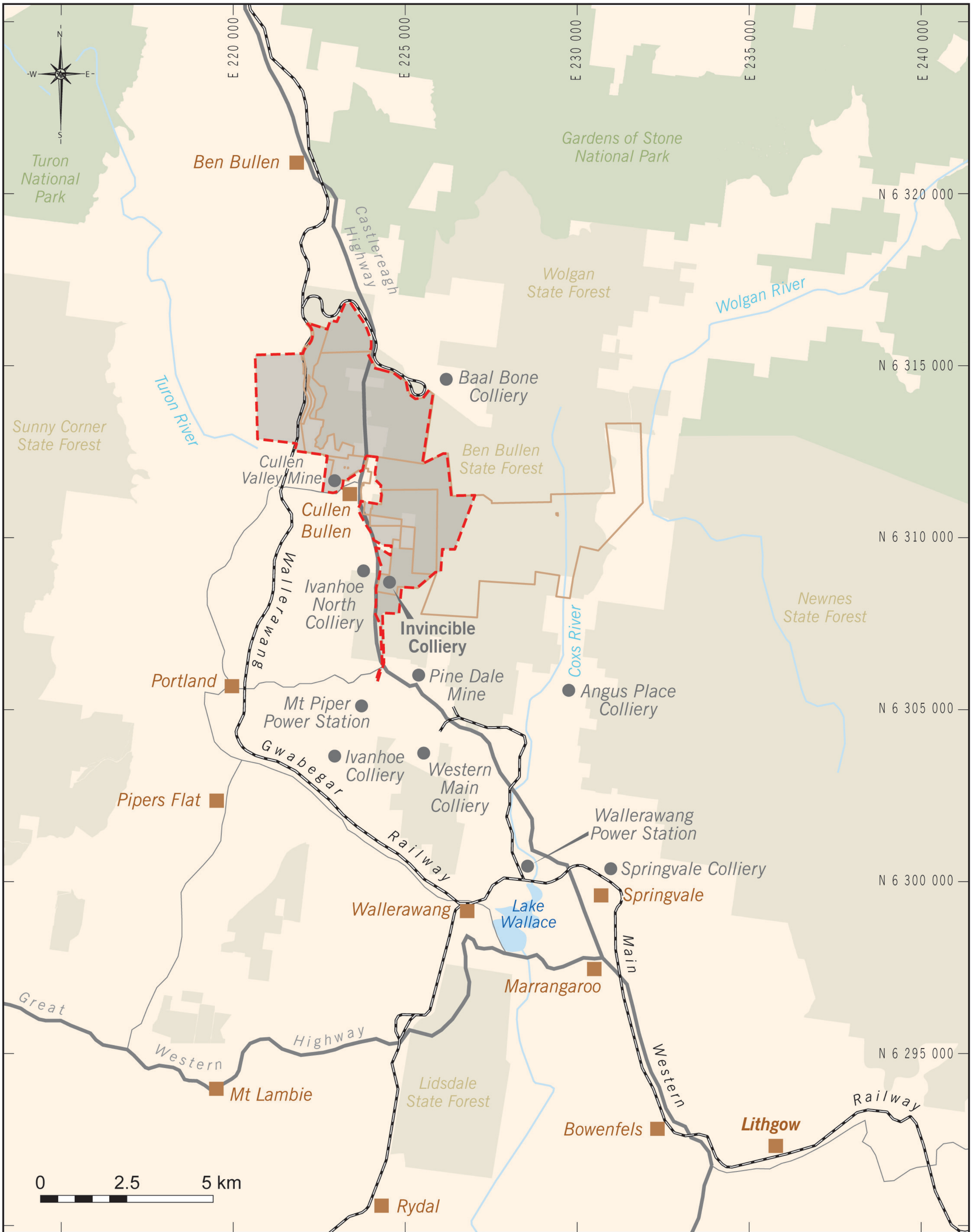
Mining commenced at what is now known as the Cullen Valley Mine in the late 1880s and coal mining operations (by both open cut and underground methods) have been conducted, under various names, for approximately 120 years since that time. Coal mining at Invincible Colliery commenced in 1901 with an underground operation occurring until 1998. Open cut coal mining commenced on the site at that time and continues today.

The existing Coalpac Pty Ltd (Coalpac) operations at Cullen Valley Mine and Invincible Colliery (Coalpac Mines) are open cut mines principally located within the Ben Bullen State Forest (BBSF), with some operations in adjoining privately owned land (see **Figure 1**). Impacts to the BBSF include disturbance for mine infrastructure areas, open cut mining activities, overburden emplacement and coal stockpiles, tailings and water management and other environmental management infrastructure. Rehabilitation is undertaken progressively, with some rehabilitated areas approaching 11 years in age.

Disturbance to the BBSF is partially an environmental cost for past coal recovery and is related to the ability to recover the remaining coal resource of some 108 Million tonnes Run of Mine (Mt ROM) identified in the *Coalpac Consolidation Project Environmental Assessment* (Hansen Bailey 2012) (Exhibited Project). Some of the environmental costs of the Project have already been incurred and the completion of the recovery of the remaining available coal resource will be at a lesser environmental cost than would otherwise be the case if this was a new development proposal.

The consolidation and the continuation of mining at the Coalpac Mines as proposed will deliver ongoing economic and social benefits to the local community, the region and the State.

Lithgow has been the centre of mining in the western coalfields for over 100 years and has provided the workforce, accommodation, infrastructure and other support services for the coal industry, along with its surrounding communities such as Cullen Bullen, Portland and Wallerawang.



Project Boundary

Coalpac Mining Authorities

HansenBailey

Coalpac Pty Ltd

COALPAC CONSOLIDATION PROJECT

Regional Locality

Filename: 0915 F01 General Location.ai	Date: 14.12.11	Drawn: BD	Figure 1

The Coalpac Mines are critical to the supply of coal for the operation of the Mt Piper Power Station (MPPS) which provide 11% of energy sold in the NSW region of the National Energy Market. The development of the power stations in the region was supported by the local resource of domestic quality coal. It is not practical or cost effective to haul coal by rail into the area and therefore locally supplied coal remains essential to the reliable and economic supply of feed coal to the MPPS and Wallerawang Power Station (WPS) facilities.

The recent closure in 2012 of the Centennial Coal operated Lamberts Gully Mine, Airly Mine and Ivanhoe North Mine and Xstrata's Baal Bone Colliery places further importance on the Coalpac Mines as a provider of local feed coal for the continued operation of MPPS and WPS.

There is no certainty that the other proposed coal mining developments in the vicinity of Coalpac Mine's existing operations will proceed. The Neubeck Coal Project proposed by Centennial Coal and Energy Australia's Pinedale Extension Project are both open cut mine proposals that are still in the very early stages of their assessment processes, having received Director-General's Requirements (DGRs) from the Department of Planning and Infrastructure (DP&I) in 2012.

NSW Treasury, in a document dated 31 January 2013 to the DP&I states the following:

> *"Apart from a relatively small supply from the Pine Dale coal mine, there are no other economic sources of coal supply to these power stations. The Centennial company would increase its market power over the local electricity generation in the event this Project did not proceed. In the future, this could push up offer prices for coal supply to the Mt Piper and Wallerawang stations and reduce the volumes on offer."*

In the same document NSW Treasury also concluded:

> *"Consumers will benefit from any reduction in electricity prices that is a consequence of Coalpac's supplying Delta Electricity. This is a desirable outcome. It is clearly a policy priority for both the NSW Government and the Commonwealth Government to try and reduce upward pressure on electricity prices."*

The progression of the assessment process to date has necessitated ceasing production at Cullen Valley Mine in December 2012 with the termination of 49 positions. Coal recovery ceased at Invincible Colliery at the end of March 2013 with both mines then being placed on Care and Maintenance status, resulting in the termination of a further 46 Coalpac employees and the suspension of existing service contracts which support some 60 jobs. With the loss of a total of 95 employees and the commensurate multiplier at 3:1 (conservatively) it is estimated that up to 276 job losses will result.

Closure of the Coalpac Mines under existing approvals would trigger the requirement for mine closure plans and the rehabilitation of both sites. Continuation of the Coalpac Mines will ensure the development of an optimal final landform and the completion of best practice rehabilitation that is compatible with the surrounding environment and ecology.

Rehabilitation would be completed to a level where the area could ultimately be contributed to the NSW conservation estate in the future.

1.2 ASSESSMENT PROCESS

This section provides a summary of the environmental planning assessment process of the Project to date, an overview of the Planning Assessment Commission (PAC) review process and the process for determination of the Project Application to date.

1.2.1 Project Application

The Coalpac Project Application (No. 10_0178) for the approval of the Project under Part 3A of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) was accepted by the then Minister for Planning in October 2010.

Despite the repeal of Part 3A of the EP&A Act, the environmental planning assessment of the Project continues under the former Part 3A as a 'transitional Part 3A project', consistent with the applicable transitional provisions.

1.2.2 Environmental Assessment

On 16 December 2010 the Director-General of DP&I issued his 'environmental assessment requirements' (DGRs) for the environmental assessment of the Exhibited Project.

The Exhibited Project was declared a 'controlled action' under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). The Commonwealth Department of Sustainability, Environment, Water, Populations and Communities (SEWPAC) accredited the NSW Part 3A assessment process for the Project resulting in the environmental assessment of the Project being required to satisfy the requirements of both the NSW and the Commonwealth legislation.

To ensure that the environmental assessment provided an appropriate consideration of relevant matters of National Environmental Significance, the Director-General of DP&I issued supplementary requirements for the environmental assessment under section 75F of the EP&A Act on 19 April 2011.

The *Coalpac Consolidation Project Environmental Assessment* (Exhibited EA) was prepared by Hansen Bailey (2012) in accordance with EP&A Act, the requirements of DP&I, the DGRs and in accordance with the relevant Government policies and guidelines.

The Exhibited EA relied upon specialist consultant reports to support the appropriate environmental planning assessment of the Exhibited Project, which involved extensive consultation with all relevant stakeholders, the local community, Lithgow City Council (LCC) and all relevant State and Commonwealth Government agencies. These reports were completed for the Exhibited EA in accordance with all statutory and regulatory requirements and relevant Government policies and guidelines as required by the DGRs and by applying current best practice.

Numerous exchanges occurred with Government agencies during the preparation of the Exhibited EA and the Response to Submissions (RTS) (see **Section 1.2.3**) to ensure that their respective assessment standards and required environmental outcomes would be achieved in the environmental planning assessment and operation of the Project.

Following consultation with other regulators, the DP&I determined that the Exhibited EA adequately addressed the DGRs, relevant NSW government policies, procedures and guidelines and placed the document on public exhibition on the 10 April 2012.

It is noted that, prior to the completion of the Exhibited EA, 27.6 Million tonnes (Mt) of potentially accessible Run of Mine (ROM) coal was sterilised to address DP&I and the Office of Environment and Heritage (OEH) concerns over amenity and ecological impacts. This coal sterilisation represented a projected loss of $1.2 billion dollars in revenue forgone to all stakeholders, including the NSW Government and the people of NSW.

1.2.3 Public Exhibition and Response to Submissions

The public exhibition of the Exhibited EA from 10 April 2012 to 1 June 2012 resulted in a total of 938 submissions from 15 government agencies and 899 individuals (composed of 10 “Comments”, 758 “Objectors” and 132 “Supporters”).

On 8 June 2012, DP&I requested that Coalpac provide its RTS. Coalpac and its experts consulted further with the community and Government agencies and the RTS document was submitted on 10 August 2012.

1.2.4 Minister’s Request for Review

On 22 July 2012 the NSW Minister for Planning and Infrastructure requested that the PAC:

1. *“Carry out a review of the Coalpac Consolidation Project, and:*
   - *(a) consider the Environmental Assessment of the project, all issues raised in submissions on the project, and any information provided on the project during the course of the review;*
   - *(b) assess the merits of the project as a whole, paying particular attention to the potential:*
     - *local health and amenity impacts of the project, particularly dust, noise and blasting impacts;*
     - *biodiversity impacts of the project;*
     - *water resource impacts of the project; and*
   - *(c) recommend appropriate measures to avoid, minimise and/or offset these impacts.*
2. *Conduct public hearings during the carrying out of the review.*

3. *Submit its final report on the review to me by 14 November 2012, unless the Director-General of the Department of Planning and Infrastructure agrees otherwise."*

1.2.5 PAC Review Report

On 14 December the PAC delivered its Review Report on the Coalpac Consolidation Project (PAC Review Report).

The PAC Review Report stated that *"The Commission has found that, when the merits of the project are considered as a whole, the benefits of the project are substantially outweighed by the breadth and potential magnitude of the impacts. The commission therefore recommends that the project should not be approved.*"

The PAC also stated that "*The Commission has provided a suite of recommendations under the individual sections of this review, and a summary list is provided at section 9.5. These recommendations were prepared as each individual issue was considered and before the commission determined its position on the merits of the project as a whole, which is that the project should not be approved".*

The PAC went on to state that *"The recommendations therefore represent minimum requirements or limitations that the Commission considers necessary to deal with the individual impacts identified"* and that *"Their existence responds to the Minister's request to the PAC to recommend appropriate measures to avoid, minimise and/or offset these impacts (Term of Reference 1(c)) and also recognises that this review is only one step in the assessment and determination process for this project.".*

1.2.6 The Remaining Process

In a letter dated 18 December 2012 to Coalpac, the DP&I sought a response to the PAC Review Report. Hansen Bailey was commissioned to prepare such a report and the *Coalpac Consolidation Project Response to PAC Review Report* (Response to PAC Review Report) was submitted to the DP&I on 8 March 2013. The Response to the PAC Review Report included a discussion on and clarification of matters raised by the PAC Review Report as well as a proposed reduction of the scale and intensity of the Exhibited Project (the Contracted Project).

1.2.7 Preferred Project Report

On the 20 March 2013, DP&I requested, in a letter to Coalpac, that they submit to the Director-General a Preferred Project Report (PPR) including:

1) *"A preferred project report that outlines any proposed changes to the project to minimise its environmental impact (section 75H(6)(b) of the Act); and*
2) *Any revised statement of commitments (section 75H(6)(c) of the Act) or environmental management and mitigation measures on the site."*

The letter goes on to state that '*the Preferred Project Report and revised statement of commitments must be submitted to the Director General no later than Wednesday 3 April 2013*'. Coalpac sought an extension from DP&I to submit the PPR on 8 April 2013. This request for extension was granted by DP&I on 28 March 2013.

A copy of the request that Coalpac prepare a PPR for the Contracted Project is included in **Appendix A**.

1.3 DOCUMENT PURPOSE

This PPR in respect of Project Application 10_0178 has been prepared in response to the request from the Minister for Planning and Infrastructure described in **Section 1.2.7** above.

This PPR describes the Contracted Project and in **Section 3** identifies the reduction of the impacts achieved by the Contracted Project as compared to the Exhibited Project and addresses the issues raised in the PAC Review Report.

The PPR provides additional studies conducted for the Contracted Project, which cover the following areas:

- Highwall mining and open cut mining stability;
- Air quality and greenhouse gas;
- Noise;
- Blasting;
- Ecology; and
- Economics.

1.4 DOCUMENT STRUCTURE

This document is structured as follows:

- **Section 2** describes the Contracted Project and the changes proposed to minimise environmental impacts;
- **Section 3** provides a summary of reduced environmental and social impacts from the Contracted Project when compared to the Exhibited Project as well as the proposed additional management methods for the Contracted Project;
- **Section 4** provides a revised Statement of Commitments for the Contracted Project;
- **Section 5** contains the environmental planning conclusion of the Contracted Project; and
- **Section 6** and **Section 7** provide a list of abbreviations and references, respectively.

2 PREFERRED PROJECT DESCRIPTION

This PPR has been developed in response to the request from DP&I dated 20 March 2013. The material changes to the Exhibited Project are shown on **Figure 2** and include:

1. Removal of the Hillcroft mining area and associated access infrastructure (including the Wallerawang-Gwabegar Rail Line overpass bridge and Red Springs Road crossing);
2. Removal of the sand extraction component of the Exhibited Project located in the Cullen Valley mining area, including the requirement for associated crushing and screening infrastructure and the transport of product sand by road from the site to market;
3. Reduction of the open cut mining footprint to avoid the area of Clandulla Geebung habitat previously located in the north western mining area at Cullen Valley Mine;
4. Reduction of the open cut mining footprint in relation to the Significant Pagoda Landforms (SPL) to improve ecological outcomes;
5. Reduction of the highwall mining footprint to avoid rock formations within the SPL to improve perceived ecological, heritage and geotechnical outcomes;
6. Implementation of a robust blast management system specifically tailored to further minimise the potential for blasting impacts to any SPL and Sandstone Outcrop;
7. Enhancement of the Biodiversity Offset Strategy (BOS) proposed for any residual ecological impacts; and
8. Commitments with regard to the monitoring, management and operation of the Contracted Project.

Plans showing the reduction in the proposed open cut and highwall mining footprint are presented below in **Figure 3** and **Figure 4** for the Cullen Valley and East Tyldesley mining areas and **Figure 5** and **Figure 6** for the Invincible mining area.

The Exhibited Project as described in the Exhibited EA is presented below in **Figure 7** (reproduced from the Exhibited EA). Revised layout plans for the Contracted Project, showing the maximum extent of the modified open cut mining and highwall mining footprints proposed are shown on **Figure 7A** and **Figure 7B** respectively. The area to be disturbed by open cut mining has contracted by approximately 196 ha or 20% from that described in the Exhibited EA.

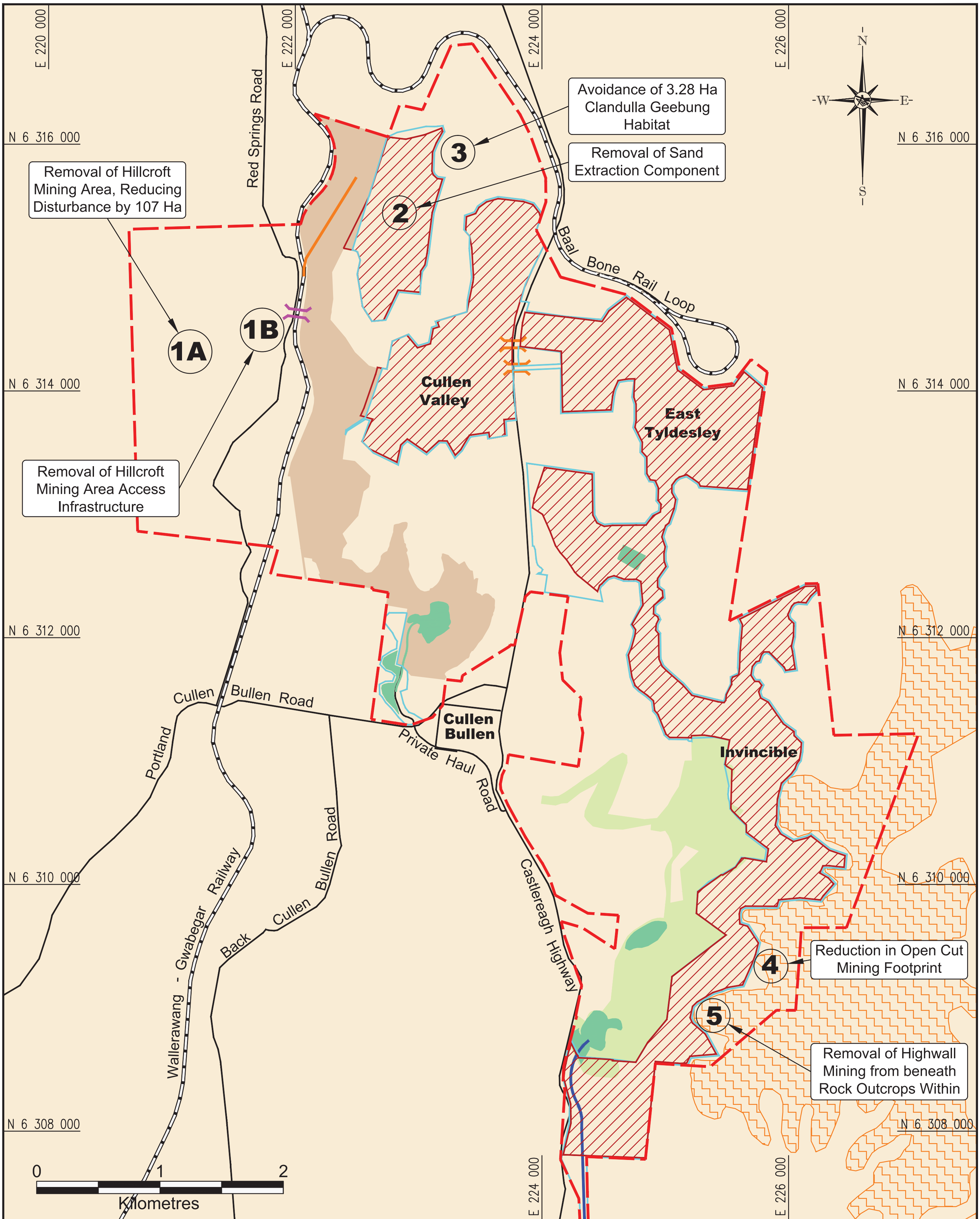
Further explanation of each of the changes made to the Exhibited Project for the Contracted Project is provided in **Section 2.1**.

The Contracted Project results in a reduction in the coal reserve proposed to be extracted of approximately 11.6 Mt ROM coal. This represents a reduction in the coal reserve by 10.7% of that in the Exhibited EA assessed by the PAC and a loss of up to $800 M (undiscounted) in revenue for Coalpac, which is represented below in **Table 1**.

Table 1
Contracted Project Coal Reserve Impacts

Mining Area(s) - Method	Open Cut ROM Coal Loss (Mt)	Highwall Mining ROM Coal Gain (Mt)[1]	Total ROM Coal Reduction (Mt)
Hillcroft - Open Cut	2.9	0.0	2.9
Hillcroft - Highwall Mining	0.8	0.0	0.8
Cullen Valley - Open Cut	0.7	0.2	0.5
Cullen Valley - Highwall Mining	0.1	0.0	0.1
East Tyldesley / Invincible - Open Cut	2.1	0.0	2.1
East Tyldesley / Invincible - Highwall Mining	5.6	0.4	5.2
TOTAL	**12.2**	**0.6**	**11.6**

1. Increase in highwall mining method reserves due to partial replacement of open cut mining with highwall mining



- Project Boundary
- Contracted Project Disturbance Boundary
- Existing Cullen Valley Mine
- Existing Invincible Colliery
- Infrastructure
- Rail Siding
- Indicative Conveyor Alignment
- Contracted Open Cut Coal Mining
- Single Bridge / Overpass (two highway overpass options shown)
- Significant Pagoda Landform
- Exhibited Project Hillcroft Bridge / Overpass Location

Hansen Bailey

Coalpac Pty Ltd

Coordinate System: MGA Zone 56

COALPAC CONSOLIDATION PPR

Mine Plan Changes for the Contracted Project

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Legend

- Project Boundary
- EA Open Cut Mining Design
- Contracted Project Open Cut Mining Design
- Open Cut Loss
- Existing Cullen Valley Mine

Cullen Valley & East Tyldesley Open Cut Method Comparison

Coalpac Pty. Ltd.
Proprietors of Invincible Colliery and Cullen Valley Mine

Figure: 3

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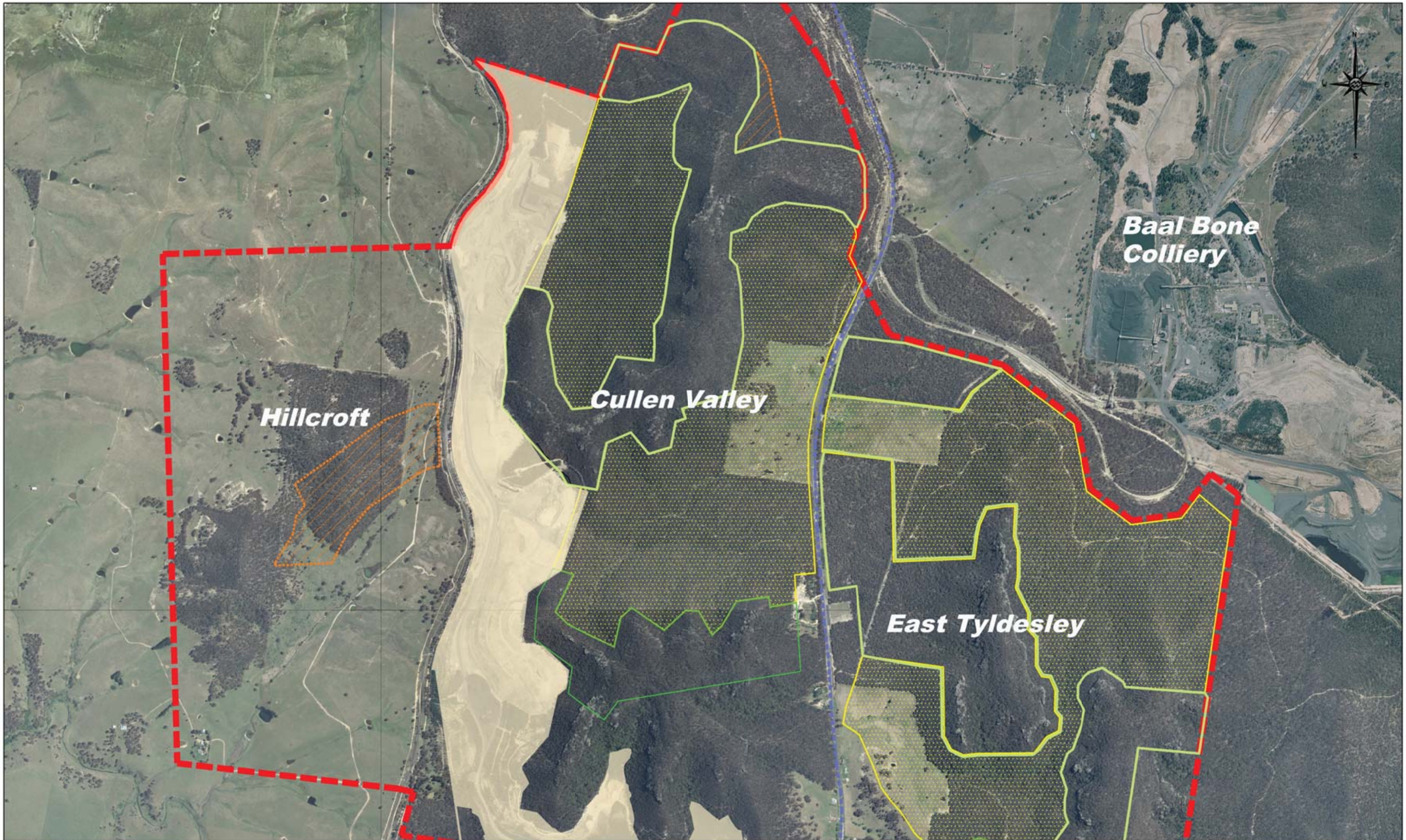

Legend

- Project Boundary
- Contracted Project Open Cut Design
- Highwall Mining Loss
- Contracted Project Highwall Mining Design (All Seams)
- Contracted Project Highwall Mining Design (KAT - IR Only)
- Existing Cullen Valley Mine

Cullen Valley & East Tyldesley
Highwall Mining Method Comparison

Coalpac Pty. Ltd.
Proprietors of Invincible Colliery and Cullen Valley Mine

Figure: 4

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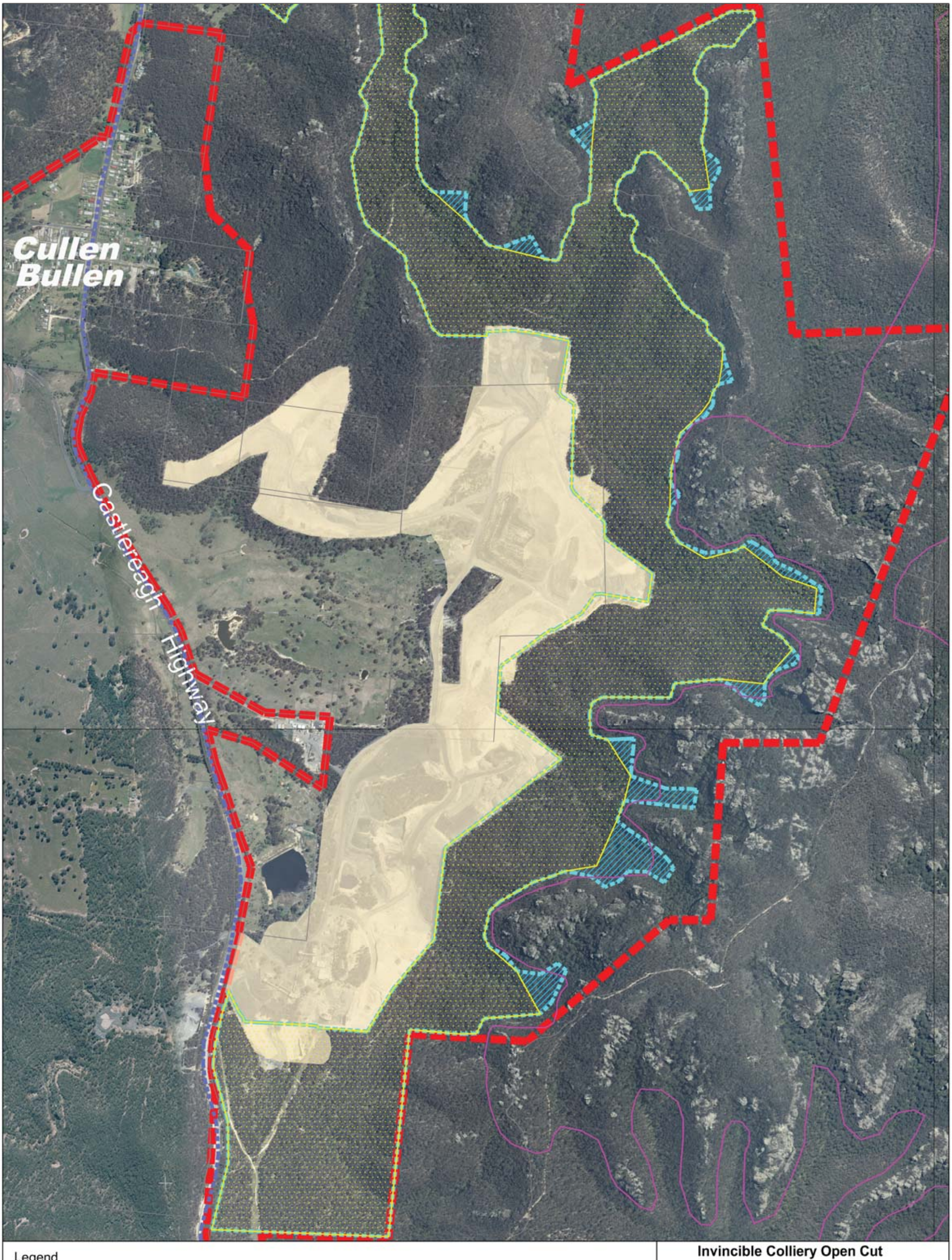

Legend

- Project Boundary
- EA Open Cut Mining Design
- Contracted Project Open Cut Mining Design
- Open Cut Loss
- Existing Invincible Colliery
- Significant Pagoda Landform

Invincible Colliery Open Cut Mining method Comparison

Coalpac Pty. Ltd.
Proprietors of Invincible Colliery and Cullen Valley Mine

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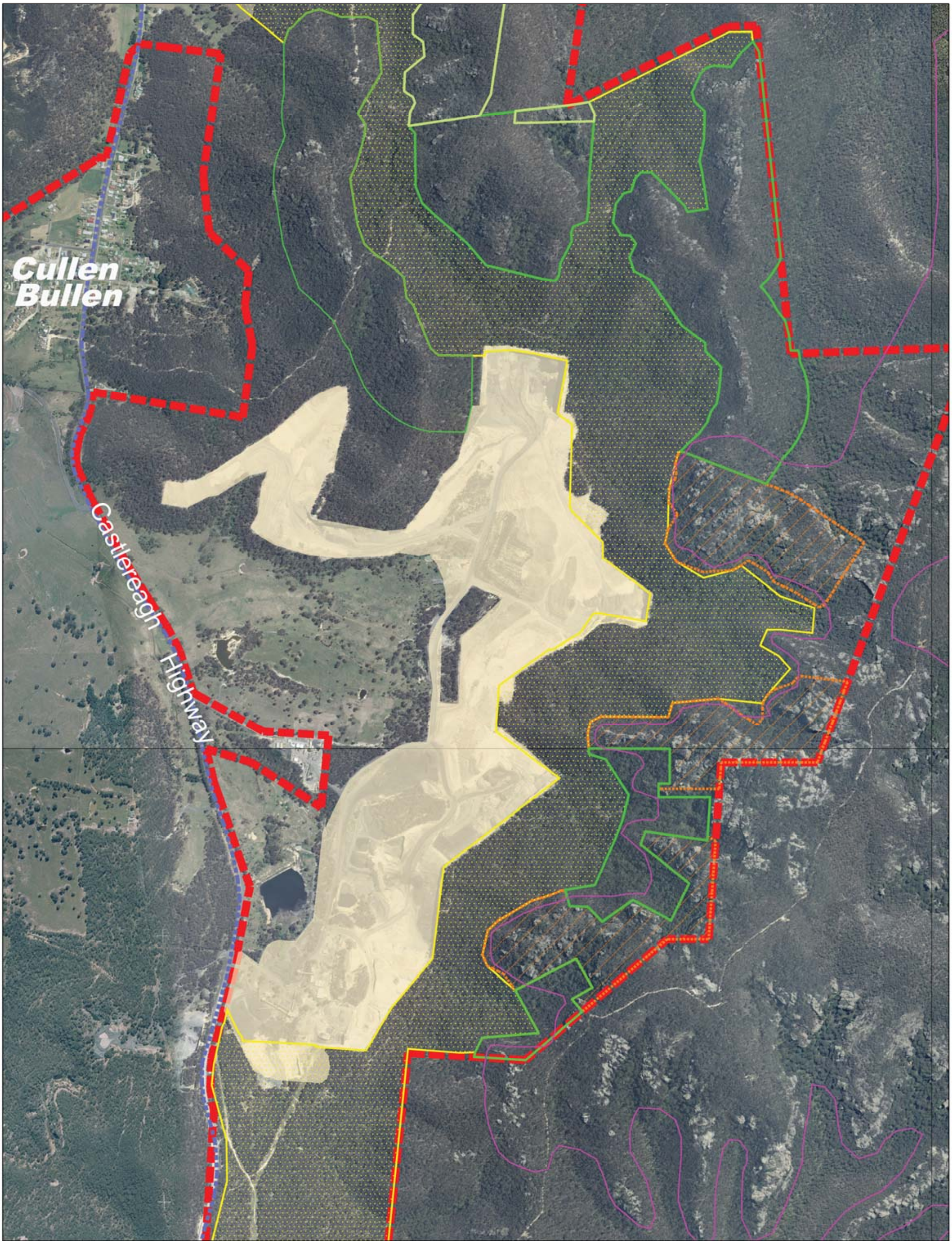

Legend

- Project Boundary
- Contracted Project Open Cut Design
- Highwall Mining Loss 68.9ha (66.2ha Loss Under SPL)
- Contracted Project Highwall Mining Design (All Seams)
- Contracted Project Highwall Mining Design (KAT - IR Only)
- Existing Invincible Colliery
- Significant Pagoda landform

Invincible Colliery Highwall Mining Method Comparison

Coalpac Pty. Ltd.
Proprietors of Invincible Colliery and Cullen Valley Mine

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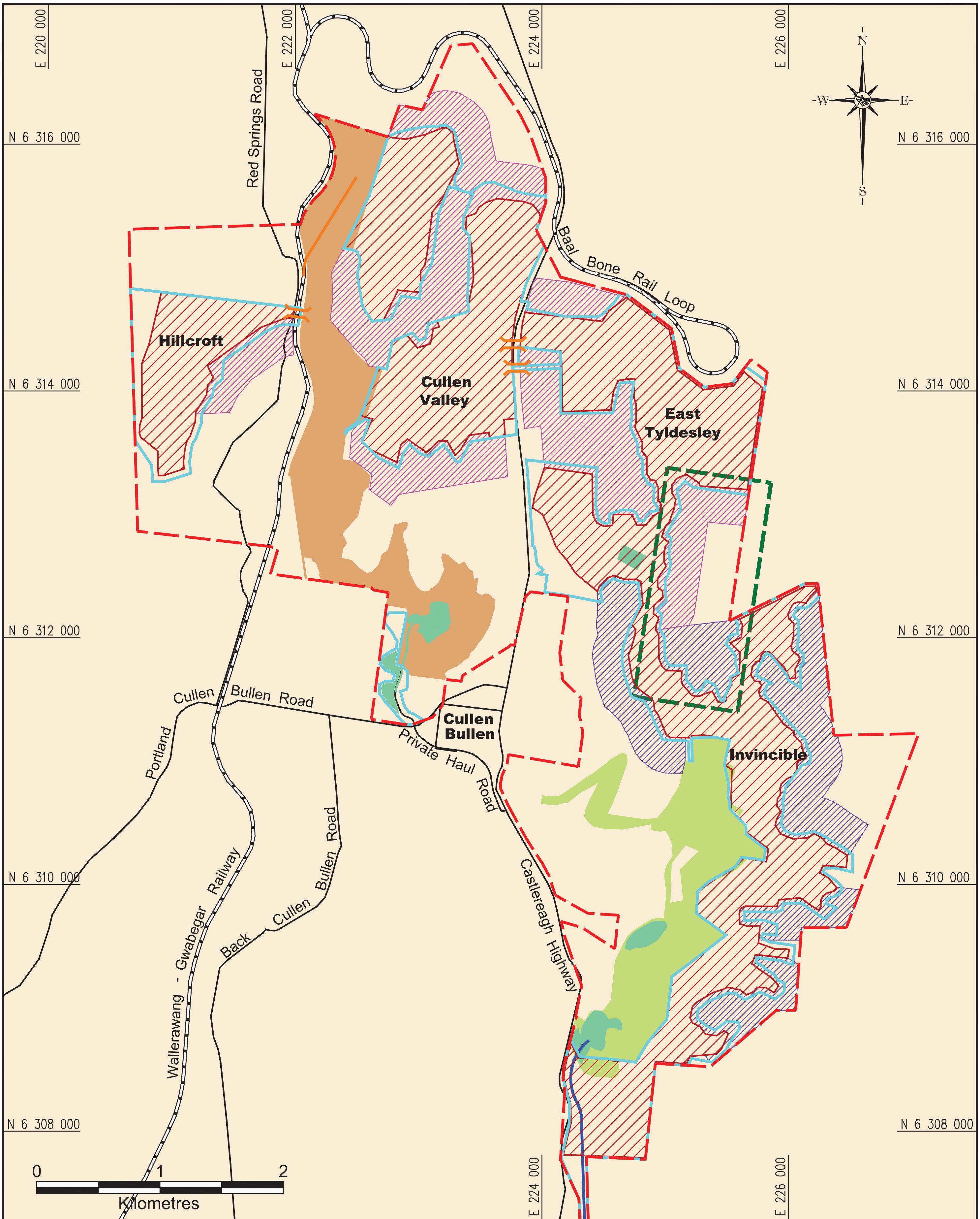


Project Boundary
Project Disturbance Boundary
Existing Cullen Valley Mine
Existing Invincible Colliery
Infrastructure
Rail Siding
Conveyor
Open Cut Coal Mining
Highwall Mining All Seams
Highwall Mining All Seams Except Lithgow
Subsidence Study Area
Bridge / Overpass

Hansen Bailey

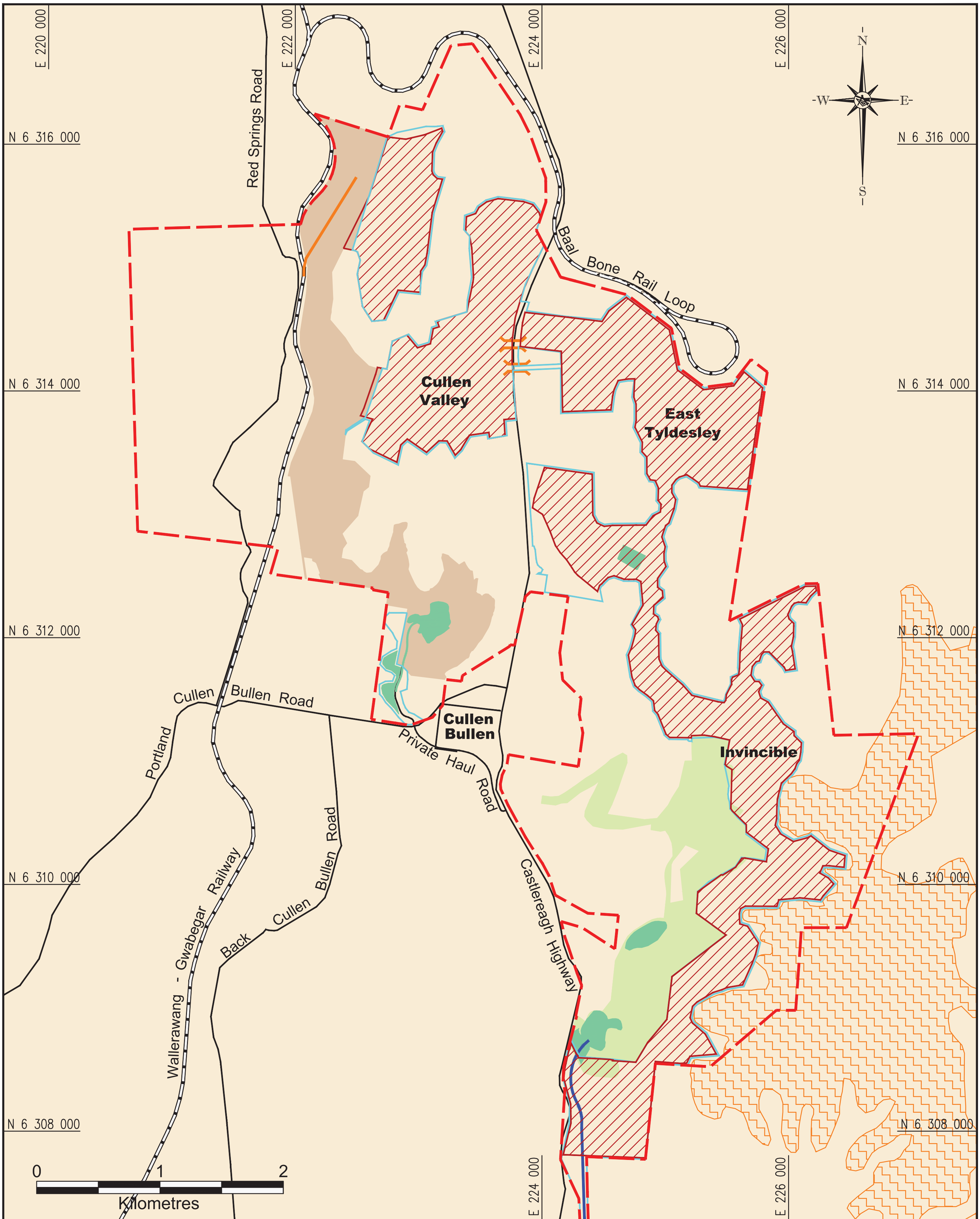
Coalpac Pty Ltd

Coordinate System: MGA Zone 56

COALPAC CONSOLIDATION PPR

Indicative Exhibited Project Layout - Coal

Cad File: 09167B.dwg	Date: 08.04.13	Drawn: JD	Figure 7



Project Boundary
Contracted Project Disturbance Boundary
Existing Cullen Valley Mine
Existing Invincible Colliery
Infrastructure
Rail Siding
Indicative Conveyor Alignment
Contracted Open Cut Coal Mining
Single Bridge / Overpass (two highway overpass options shown)
Significant Pagoda Landform

Hansen Bailey

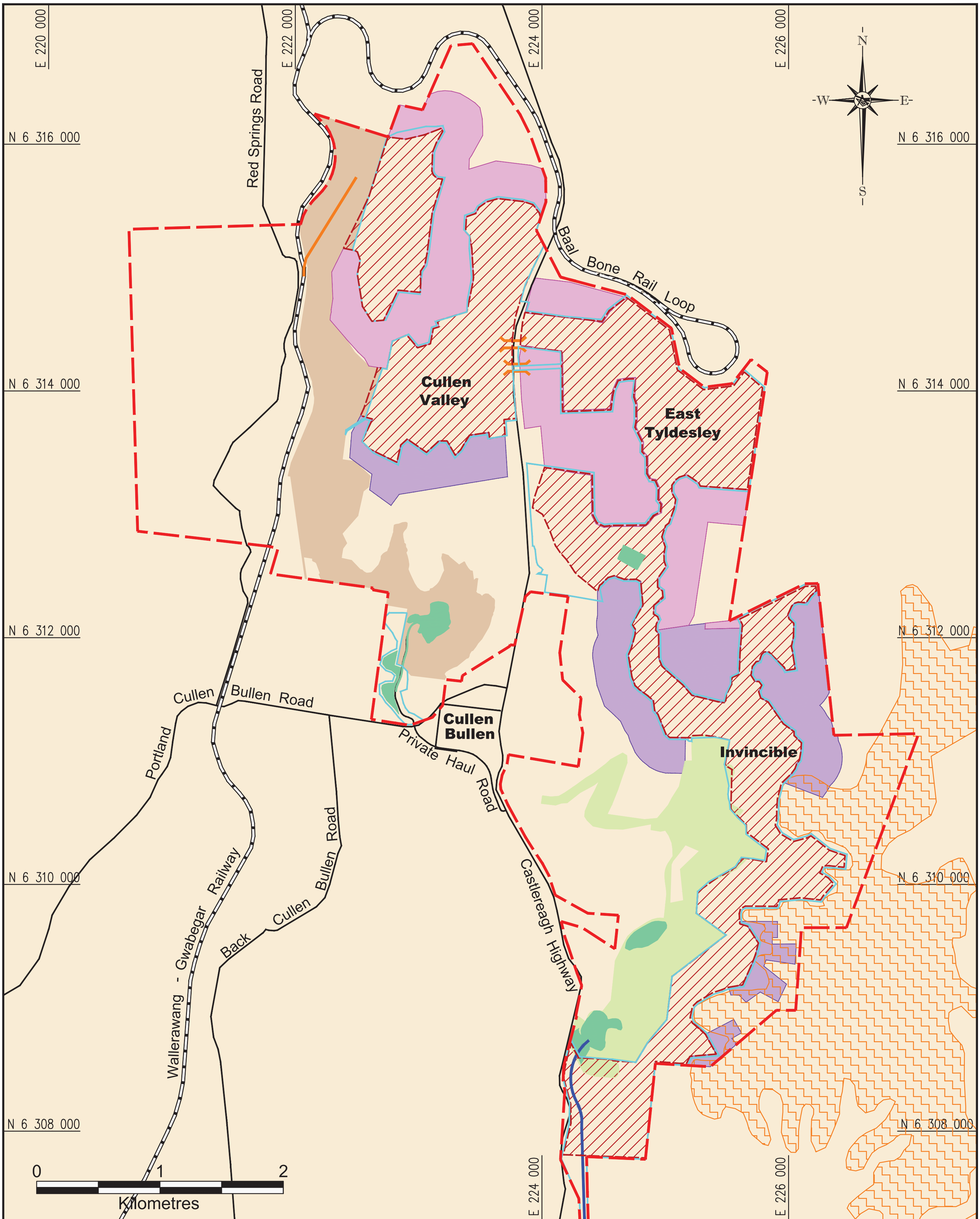
Coalpac Pty Ltd

Coordinate System: MGA Zone 56

COALPAC CONSOLIDATION PPR

Indicative Contracted Project Layout - Open Cut

Cad File: 09168B.dwg	Date: 05.04.13	Drawn: CP	Figure 7A



- Project Boundary
- Contracted Project Disturbance Boundary
- Existing Cullen Valley Mine
- Existing Invincible Colliery
- Infrastructure
- Rail Siding
- Indicative Conveyor Alignment
- Open Cut Coal Mining
- Contracted Highwall Mining All Seams
- Contracted Highwall Mining All Seams Except Lithgow
- Single Bridge / Overpass (two highway overpass options shown)
- Significant Pagoda Landform

Hansen Bailey

Coalpac Pty Ltd

Coordinate System: MGA Zone 56

COALPAC CONSOLIDATION PPR

Indicative Contracted Project Layout - Highwall Mining

Cad File: 09169A.dwg	Date: 25.03.13	Drawn: JD	Figure 7B

2.1 DETAILED DESCRIPTION OF THE CONTRACTED PROJECT

This section of the PPR describes the changes made to the Exhibited Project to constitute the Contracted Project. Each change is discussed further below and identifies the material reductions in environmental effects achieved by the Contracted Project as compared to the Exhibited Project.

2.1.1 Removal of the Hillcroft Mining Area

The Hillcroft mining area (which included both open cut and highwall mining operations in the Exhibited EA) is separated from the Cullen Valley mining area by both the Wallerawang – Gwabegar Railway Line and the Red Springs Road. Being located to the west of the Cullen Valley mining area, the removal of the Hillcroft mining area from the Exhibited Project mine plan will materially reduce a range of environmental impacts, including ecological impacts (**Section 3.14**), visual amenity (**Section 3.8**), dust generation (**Section 3.3**) and noise emissions (**Section 3.6**).

The removal of the Hillcroft mining area as described in the Exhibited EA reduces the total area of disturbance from the Exhibited Project by approximately 107 ha. Further, it results in the avoidance of a 74 ha area of habitat for the Capertee Stringybark tree (listed as Vulnerable under the EPBC Act and TSC Act).

It also reduces the coal produced from this mining area by 2.9 Mt ROM with a further highwall mining reserve loss of approximately 0.8 Mt ROM.

Removing the Hillcroft mining area as shown in the Exhibited Project mine plan has, however, resulted in the pastural property also being removed as a component of the proposed BOS. The Hillcroft offset will be replaced with an alternate property of greater biodiversity values in the revised BOS to meet Coalpac's management commitments, in response to concerns raised by OEH and noted in the PAC Review Report (see **Section 3.15**).

As noted in **Section 3.15**, the BOS commitments have also been revised to ensure that higher value biodiversity offsets will be put in place for the Contracted Project following the removal of the Hillcroft property. In revising and enhancing the proposed BOS, OEH has provided advice on 28 February 2013 regarding offset property selection which supports OEH's overall strategy for the protection of biodiversity in the region.

Construction of a connecting haul road to access the mining area and associated Wallerawang-Gwabegar Rail Line overpass and Red Springs Road crossing will no longer be required. The deletion of these works from the Exhibited Project will avoid disruption to local traffic during the construction period.

2.1.2 Removal of the Sand Extraction Component

Removing the proposed sand extraction from within the Cullen Valley open cut mining area for the Contracted Project will result in the following improved environmental outcomes as compared to those of the Exhibited Project:

- Removal of 128 truck movements per day on the Great Western Highway;
- Decreased noise and air quality impact due to:
  - Reduced equipment fleet and infrastructure operations that would otherwise have been utilised for sand extraction and processing; and
  - Reduced haulage of sand by trucks on internal haul roads;
- Avoidance of potential Acid Mine Drainage issues that may have been associated with the sand extraction and processing;
- A reduction in water consumption of up to 50 ML per annum during the years where the sand extraction was proposed in the Exhibited Project; and
- A reduction in Scope 1 greenhouse gas emissions associated with the sand extraction operation previously proposed for the Exhibited Project.

2.1.3 Reduction in the Cullen Valley Mining Area

The Clandulla Geebung habitat located in the north-western section of the Cullen Valley mining area will be preserved by the Contracted Project resulting in over 320 individuals of Clandulla Geebung being avoided.

This will occur due to the contraction in the open cut disturbance footprint of the Cullen Valley mining area by a further 3.28 ha (specifically undertaken to avoid this species).

This contraction to the mine plan reduces the coal produced from this mining area by 0.5 Mt ROM with a further highwall mining reserve loss of approximately 0.1 Mt ROM coal.

2.1.4 Modification to Open Cut Mining Footprint for Significant Pagoda Landforms

It is proposed that additional vegetated areas adjacent to the mapped SPL's will now be sterilised from open cut mining to further protect the potential foraging habitat of associated animal species and further ensure the stability of the pagodas. The open cut mining footprint proposed for the Contracted Project is shown on **Figure 5**. The additional setback of open cut mining from the pagodas and gullies in the SPL results in a reduction in the open cut mining footprint of 9 ha. The contraction in the open cut mining footprint results in a reduction in the perimeter of the Contracted Project Disturbance Boundary of 5.4 km. Of this total reduction, the perimeter of the Project Disturbance Boundary adjacent to the SPL decreased by 1.5 km (or 25%), and thus minimises edge effects adjacent to the SPL, including its associated rock formations and habitat areas (see **Figure 8**). This contraction of the open cut mining footprint sterilises 2.1 Mt of open cut mineable ROM coal.

Cumberland Ecology utilised the papers of Washington and Wray (2011) and Muir (2005) to review the geological features within the Project Boundary and identify key areas within pagoda assemblages that provide higher biodiversity values and habitat features for these threatened species.

Following this review, Cumberland Ecology (2013) have then identified the pagoda habitat within the Project Boundary as a Significant Pagoda Landform (SPL), defined as being:

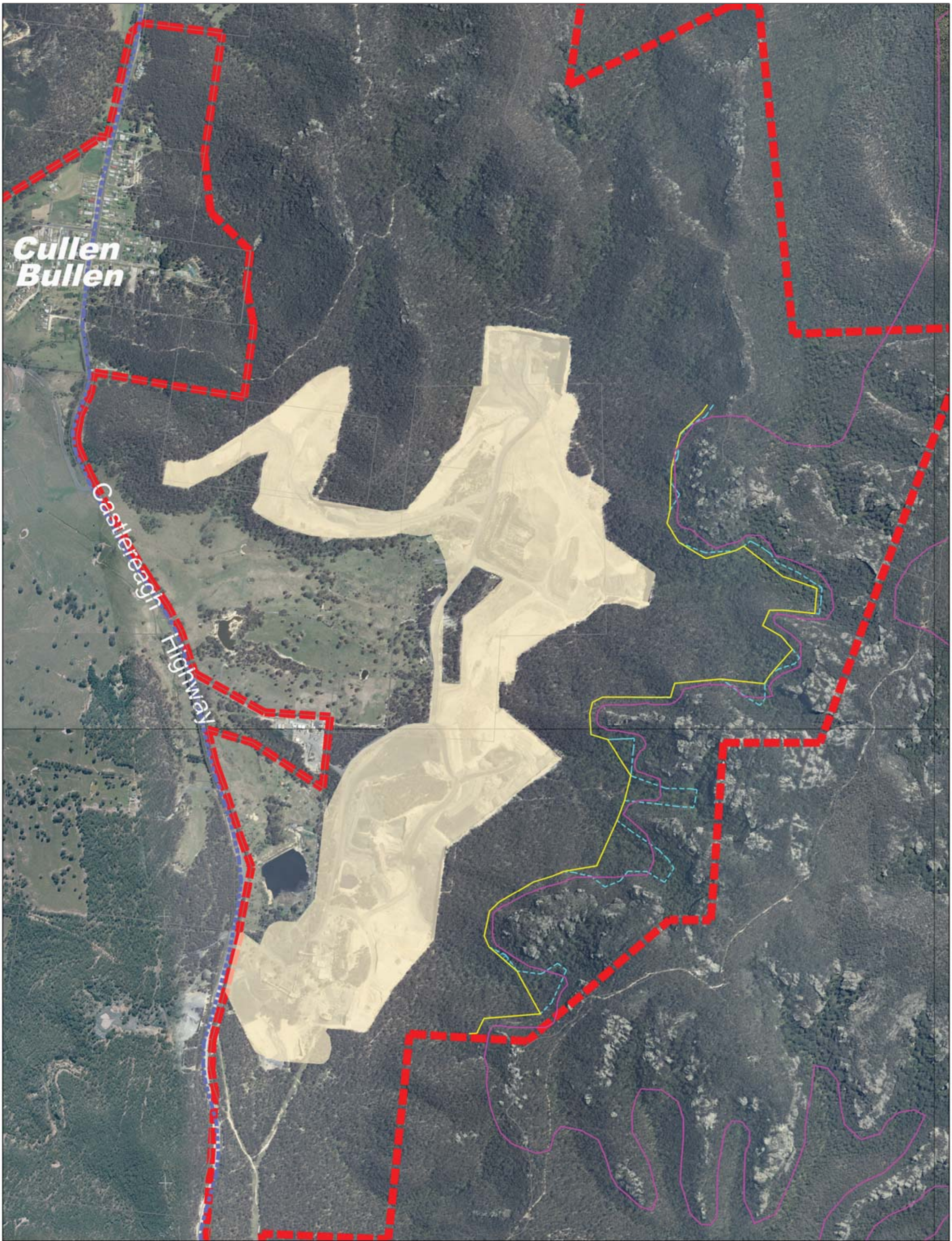
- *"A complex that creates a continuous landform over a substantial area (typically greater than 10 hectares), comprising (as a minimum):*
  - *Large, substantial in height (typically up to 60m but may be higher), towering pagodas (either platy or smooth), that are generally prominent rock formations with associated cliff faces and deeply dissected gullies, characterised by banded ironstone and associated rock structures containing numerous overhangs and crevices, with;*
  - *Associated deeply dissected wet gullies between the pagoda formations that contain a complex of habitat types for both flora and fauna, some species of which are rarely found elsewhere (e.g. Pagoda Daisy)."*

All other landforms not forming a SPL are defined by Cumberland Ecology (2013) as Sandstone Outcrops, which are defined as:

> *"Outcrops of sandstone that are in situ and form a discontinuous landform with individual continuous outcrop areas of less than 10 and greater than 0.1 hectares. These outcrops may exhibit geomorphological features such as cliffs, caves, rock towers and isolated pagodas that do not form an aggregate or have deeply dissected wet gullies (SPL)."*

Analysis of *"pagoda-dependent"* flora and fauna by Cumberland Ecology has shown that most such species are not restricted to pagoda landform habitats and actually occur much more widely in NSW. Those that do have a more restricted distribution are generally found outside the areas proposed for mining and are unlikely to be significantly impacted.

The predicted effects of mining on key fauna species were also found to be negligible, due to the absence of the Broad-headed Snake (BHS) and Brush-tailed Rock Wallaby (BRW) (as well as suitable habitat) in the Project Boundary, and habitat for Cave Roosting Bats species (CRB) being preserved for the Contracted Project. In addition, analyses show that neither the BHS nor the BRW are likely to be protected by further buffers between the proposed open cut mining areas and SPLs. Further, both bat species are widespread across the Blue Mountains, and in the case of the Eastern Bentwing-bat, across other landscapes further east extending to the coast. The vegetation types that support both bat species are well represented to the east of the site and within various National Parks, including the Gardens of Stone National Park and the Blue Mountains National Park.



Legend

- EA Project Boundary
- Cadastre
- Exhibited Project Open Cut Perimiter Adjacent SPL = 5,940m
- Contracted Project Open Cut Perimeter Adjacent SPL = 4,447m
- Significant Pagoda Landforms
- Existing Invincible Colliery

Invincible Colliery Open Cut Perimeter Adjacent Significant Pagoda Landform

Coalpac Pty. Ltd.
Proprietors of Invincible Colliery and Cullen Valley Mine

Figure: 8

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2.1.5 Modification to the Highwall Mining Footprint

The highwall mining footprint proposed for the Contracted Project is shown on **Figure 4** and **Figure 6**.

The Contracted Project mine plan removes 66 ha of highwall mining activity previously proposed in the Exhibited Project in areas under pagoda complexes and cliff lines in the SPL in response to community and PAC concerns.

On the basis of further expert advice and peer review, no changes to highwall mining design or methods to those described in the Exhibited EA are warranted to protect any sensitive features or proposed in the highwall mining areas proposed in the Contracted Project. In these areas no noticeable impact to any surface feature will occur. This has been confirmed by further peer review, and the inclusion of additional Project Commitments in **Section 4** of this document.

The highwall mining footprint proposed for the Contracted Project has been extended from that proposed in the Exhibited Project in some areas to compensate for the reduction of the open cut mining footprint.

Site specific coal strength data has been collected and reviewed by Geonet (2013) to confirm that the assumptions made in the subsidence impact assessment in the EA are appropriate and conservative (see **Section 3.1**).

2.1.6 Blast Management for Significant Pagoda Landforms & Sandstone Outcrops

In addition to the review of the reduced open cut and highwall mining areas proposed for the Contracted Project to avoid impacts to the SPL and Sandstone Outcrops, a further review of the blast design, monitoring and response procedures has been undertaken by Terrock Consulting Engineers.

This review also forms the basis for a procedure that reflects industry standard blast management practices augmented by proven local experience at the Coalpac Mines in the management of blasting and control of its effects. Confidence in the effectiveness of the procedures in achieving the required degree of certainty as to the effects of blasting is confirmed by reference to the detailed knowledge of the blasting effects at the Coalpac Mines from years of existing operations.

Coalpac commits to the implementation of a staged blast management and monitoring program designed to avoid any potential for impacts to the SPL and other Sandstone Outcrops.

This review is discussed further in **Section 3.7** and the proposed Blast Management Program allows the open cut disturbance footprint to be further limited by ground vibration controls.

2.1.7 Revision to the Biodiversity Offset Strategy

The BOS assessed in the Exhibited EA has been revised for the Contracted Project.

The Contracted Project BOS has further considered the biodiversity values predicted to be impacted by the Contracted Project and reviewed the potential offsets available in the region that could be used to enhance long term conservation outcomes.

Coalpac has held further meetings with OEH and has committed to enhancing the BOS for the Contracted Project. This will occur by acquiring further offsets to a total area of at least 1,000 ha in addition to the 2,000 ha of offsets currently held by Coalpac.

OEH have provided further direction as to the required characteristics of additional offset land to maximise the biodiversity outcome for the region. A list of potential offset properties in the region that may be suitable to form part of the BOS has been provided by OEH. The acquisition of the additional 1,000 ha of offset land will achieve an overall offset ratio of at least 4:1 for forest and woodland vegetation without any contribution from rehabilitation within the Project Boundary which is not included in the BOS for the Contracted Project.

The proposed BOS will provide a ratio of 12:1 for White Box Woodland. The assessment of the BOS proposed for the Contracted Project was completed by Cumberland Ecology and is discussed further in **Section 3.15**.

2.1.8 Commitments and Management Plans

The implementation of the controls proposed to achieve the reductions in environmental impacts and to ensure certainty of outcomes, particularly with regard to the SPL, will be achieved by the implementation of a revised Contracted Project Statement of Commitments. The environmental outcomes resulting from the implementation of the Contracted Project Statement of Commitments will be further assured by the legal requirement that terms of the Mining Operations Plan and Subsidence Management Plan (SMP) be prepared by Coalpac and approved by NSW Department of Trade and Investment, Regional Services Division of Resources and Energy (DTIRIS-DRE) prior to any open cut or highwall mining (open cut operations only requiring the former to commence).

A revised Statement of Commitments for the Contracted Project is presented in **Section 4**.

3 IMPACTS, MANAGEMENT AND MITIGATION

3.1 HIGHWALL MINING STABILITY

3.1.1 Background

Highwall mining will be performed with a continuous miner driving parallel tunnels into the coal seams beyond the final highwall position. The tunnels, known as drives, will be separated by web pillars which will provide support for the roof. Barrier pillars will be introduced to separate each panel, ensuring overall stability. Key design criteria for highwall mining will be the Factor of Safety (FoS) of the pillar design. An adequate FoS ensures the stability of the surface over highwall mining areas over the long term. Unlike other forms of underground mining, the stability of the surface is critical to the success of the highwall mining process. A fuller explanation of highwall mining is contained in the Section 8.1 of the Exhibited Project EA.

An Assessment of Stability and Subsidence was undertaken for the Exhibited Project by Geonet Consulting Group (Geonet) and included as Appendix F in the Exhibited EA. This assessment was undertaken in accordance with the intent detailed in the DTIRIS - DRE *Guideline for Applications for Subsidence Management Approvals* (DMR 2003), and *Mine Safety Operations Guideline, Coal Technical Reference CTR-001* (DPI 2008). It investigated the potential subsidence and stability impacts associated with the highwall mining component proposed for the Exhibited Project to enable the extraction of selective coal reserves from the target coal seams.

3.1.2 Impact Assessment

For the Contracted Project, Geonet completed reviews of site specific coal strength data and the highwall mining design proposed in the Exhibited Project (**Appendix B**).

As a result of this review, it was concluded that the mass coal strength used for the Geonet highwall mining study for the Exhibited EA was appropriate, and as such, it conservatively assessed the predicted subsidence impacts associated with that mining method. Specifically, Geonet stated that:

> *"…the original input parameters used for the EA* [Geonet 2012] *provide a conservative, absolutely plausible and defensible estimate of the coal strength. The results presented in the geotechnical stability assessment can therefore be considered to provide an accurate, best estimate of the anticipated deformation behaviour that may accompany highwall mining."*

The review of the highwall mining study of the Exhibited Project was undertaken by Professor Bruce Hebblewhite as part of the PAC Response Report, with an emphasis on the mining and geotechnical aspects of the Exhibited Project, particularly with regard to pillar design and stability issues, surface subsidence effects and impacts.

Professor Hebblewhite provided comment on the three design methodologies applied by Geonet for the Exhibited Project and confirmed that each was "...*highly appropriate and based on good geotechnical practice*". More specifically, it was noted that:

- That coal strength data assumptions used for highwall pillar design are based on sound principles appropriate for pillar design and are conservative;
- A FoS of 1.3 has been applied for web pillar designs (i.e. no pillars have a FoS below 1.3);
- The three stage pillar design approach (using empirical, 2D and 3D numerical design) is considered to be a very comprehensive and appropriate design methodology; and
- The design principle used for the critical span between barrier pillars to ensure that intervening web pillars are not overloaded is geotechnically appropriate for the region of the Contracted Project. As part of the Hebblewhite review, Geonet was asked to provide further information and explanation on two additional issues, being:
  - The FoS of the barrier pillars (being the larger squat pillars that separate individual panels or groups of parallel highwall mining drives), was calculated under worst case load conditions (i.e. with no contribution from the intervening web pillars); and
  - The definition of the actual FoS for each barrier pillar under worst case conditions to provide further certainty on the long term stability aspects of the highwall mining panels proposed and the effects of variable highwall mining pillar widths.

A response to these was provided by Geonet in the PAC Response Report, which noted that the extreme worst case loading condition consisted of the maximum overburden thickness (i.e. maximum pillar load) in the Contracted Project highwall mining area (i.e. the Geonet study area as described in the Exhibited EA) and an assumption that the web pillars between highwall mining drives provide no support. This worst case analysis is far more conservative than the actual highwall mining design proposed and provides a 'stress test' to confirm the barrier pillar design is more than adequate.

The results of this worst case loading condition scenario showed that the barrier pillar FoS ranged from 1.6 to 3.7. These calculated limiting FoS present the absolute minimum and are artificially low values since the presence of the web pillars (which are in fact included in the design) will provide additional support to the overburden under the stress arch. Knowing that the web pillars have a minimum FoS of 1.3 (and in most cases significantly higher than 1.3) the FoS for the individual barrier pillars was then calculated as part of the overall layout.

The results also showed that the FoS for the individual barrier pillars rise to in excess of 5 and range up to 10, with some very small localised areas between 4.4 and 5 when the contribution of the web pillars is included. Geonet concludes that the proposed designs will provide more than adequate long term stability.

Professor Hebblewhite concludes that an approval of the overall proposed mining operation is a suitable and recommended approach. He also notes that the highwall mining method does not carry any more significant risks than other underground mining methods.

In addition to all of the above, to provide additional certainty for the community and regulators in regard to the protection of the SPL, no highwall mining is now proposed under the pagoda and sandstone outcrop rock formations of the SPL within the Project Boundary.

3.1.3 Mitigation & Management

Coalpac will prepare a detailed Mining Operations Plan (MOP) for the Contracted Project in consultation with DTIRIS – DRE and to the satisfaction of DP&I. The MOP will contain information to address the requirement for specific design reports or an extraction plan giving scheduling each area prior to mining and geotechnical assessment of the highwall stability.

This information will be supplied for DTIRIS – DRE approval before the highwall mining operations in each area commences.

In addition, Coalpac will implement a number of mitigation and management measures to minimise subsidence associated with the Contracted Project and to ensure that it remains below the relevant 20 mm criteria. These shall be incorporated into a Highwall Mining Management Plan for the Contracted Project, which will include detail on the following procedures:

- Final highwall position and orientation assessment to take structural geology into account to promote stability in the exposed jointed highwalls;
- Limiting designed surface subsidence to below the relevant 20 mm criteria;
- Designing highwall mining panels to minimise the potential impact upon any nearby pagoda and escarpment formations;
- Designing of pillars to take into account the likely entry azimuth deviations based on Original Equipment Manufacturer's advice;
- Investigation of the groundwater table in the rock mass so as to be aware of potential releases that could occur in highwall mining drives and investigate the condition of the historic underground workings in the Lithgow Seam for their potential to have accumulated substantial groundwater volumes. Groundwater modelling for the Project (Section 8.10 of the Exhibited EA) confirmed that minor water inflows are expected from the Lithgow Seam;
- Highwall mining drives in the Lithgow Seam will maintain a minimum 20 m offset from the recorded position of previous underground mining operations in order to avoid breaching any flooded workings or initiating instability from previously damaged rock mass conditions;
- Conduct gas measurements from exploration bore cores prior to highwall mining to establish the background levels of gas and to confirm negligible risk;

- Leave at least one entry unmined to create long term stable barrier pillars and locate barrier pillars at the sub-critical spans to reduce overburden stress loading conditions to form a stable stress arch in the overburden to minimise subsidence of the surface strata as part of the overall design methodology; and
- Conduct and document regular surveys and inspections associated with the highwall joint condition, joint orientations and overall stability of the exposed highwalls, to be undertaken by appropriately qualified geotechnical specialists.

3.2 OPEN CUT MINING STABILITY

3.2.1 Background

A desktop review of the topographic slope types within the Project Boundary was undertaken by SCT Operations (SCT 2011) to assess the risks to these areas that may be associated with the mining operations proposed for the Exhibited Project. In particular, the review considered potential impacts that may result to the sandstone pagoda and escarpment features that are such a distinctive characteristic of the region.

3.2.2 Impact Assessment

Subsequent to the study of slope stability for the Exhibited Project, specialist consultant GeoTek Solutions reviewed and the slope stability of the SPL and Sandstone Outcrops next to the open cut mining areas proposed for the Contracted Project (see **Appendix C**). This assessment focussed on the geotechnical stability of the open cut highwalls and the SPL and Sandstone Outcrops immediately behind them while the open cut highwalls are at their maximum exposure (i.e. a worst case scenario).

Slope stability analyses considered potential failure mechanisms based on the known geology of the site, and the geometry of the excavation of highwalls proposed in the Contracted Project mine plan. A representative site was selected from within the mine footprint on the basis it would be a near-worst case scenario highwall (i.e. highest highwall and adjacent SPL within the Project Boundary). In this location, the highwall crest was positioned 60 m from the base of the cliff face of the SPL.

The analyses showed that the minimum global FoS for the profile assessed was 1.36. GeoTek Solutions noted that the normally accepted FoS for a short-term mining slope under which people will work is 1.2 and for a slope carrying critical infrastructure required for the life of mine the design FoS would be about 1.3.

This indicates that the near-worst case highwall design analysed by GeoTek Solutions, and which is proximate to the SPL, has been found to be stable, and have a FoS of 1.36 which is more conservative than the FoS of 1.3 typically applied to protect critical infrastructure. This FoS is further increased once the highwall is backfilled as part of the normal mining process.

GeoTek Solutions further notes that given that the final mining highwall proximal to the SPL is only expected to be fully exposed for periods of 8 to 12 weeks before backfilling begins, that the temporary highwall design (with the lowest FoS of 1.36 at the representative location assessed) is appropriate and will not lead to instability of the overlying cliffs.

3.2.3 Mitigation & Management

For the Exhibited Project, Coalpac committed to the implementation of a risk review buffer zone of 100 m to ensure potential risks from mining operations are managed, based on previous Coalpac mining operations at Cullen Valley Mine and Invincible Colliery. This zone will be used to indicate if further monitoring or analysis of sensitive areas is required.

To ensure slope stability for the Contracted Project, the following management measures will be implemented:

- Photo documentation of all visible cliff faces to form a baseline of the existing conditions;
- Detailed photo documentation of the pagodas and other potentially unstable rock formations (utilising digital 3D photography where possible);
- Establishing an adequate survey methodology, either by direct measurement if access is possible (or otherwise by remote sensing tools) on selected cliffs and pagodas as Project mining operations progress with resurvey to be undertaken on a schedule based on the advance of mining. This is to monitor any creep or tilt of the cliffs or escarpments;
- Risk assess the cliff faces and pagodas to predict the impact of mining and reassess any specific areas as required to determine if any response is needed to minimise or control any impacts;
- Construct hazard management plans for any sensitive areas deemed unsafe due to natural or induced instability; and
- Active monitoring of highwall development which will incorporate a detailed slope monitoring system to protect the Project workforce and equipment, especially if instability is detected.

In addition, the GeoTek Solutions review suggested method for the monitoring of SPL and Sandstone Outcrop exposures will be adopted by Coalpac for inclusion in the Contracted Project Slope Stability Management Plan. This suggested monitoring process was focused on the following key criteria:

- Rock strength;
- Bedding orientation and spacing;
- Joint orientation and spacing;
- Whether any faults are present and if so, their orientation;

- Groundwater seepage; and
- The nature and significance of any rockfalls in the advancing highwall.

This process will be undertaken by the mine geologist with support from statutory officials (including the Open Cut Examiner) as part of a specific checklist that would trigger specific action responses (or Trigger, Action, Response Plan (TARP)).

As all proposed open cut mining is down slope of any sensitive natural features, the only other concern over impacts upon rock structures as a consequence of open cut mining is the management of mine blasting impacts. A prescriptive process for the management of this activity so as to ensure negligible impacts to any sensitive feature is described in detail in **Section 3.7**.

3.3 AIR QUALITY

3.3.1 Background

An air quality impact assessment was undertaken for the Exhibited Project by PAEHolmes (now Pacific Environment). This study was undertaken in accordance with the OEH *Approved Methods for the Modelling and Assessment of Air pollutants in NSW*, with the assessment report included as Appendix G in the Exhibited EA.

The Exhibited Project air quality assessment included a quantitative evaluation of the potential impacts and included the following:

- Meteorological and climatic conditions and the existing air quality conditions within the region;
- The air quality criteria applicable to the Exhibited Project;
- Methods used to estimate dust emissions from the Exhibited Project for selected future years;
- Predicted dust dispersion patterns due to emissions from the Exhibited Project and cumulative impacts from other sources;
- Comparison between the predicted dust concentrations and deposition levels to relevant criteria; and
- Management and mitigation measures, as required.

3.3.2 Impact Assessment

For the Contracted Project, Pacific Environment reviewed the methodology, assumptions and background data used in the Exhibited Project air quality assessment and confirmed that these remained consistent with current air quality assessment criteria and guidelines.

Of the changes to the Exhibited Project mine plan for the Contracted Project, the most significant from an air quality impact perspective included:

- Removal of the Hillcroft mining area; and

- Removal of the sand extraction and processing.

Further to these reductions in the Exhibited Project mine plan (outlined in **Section 2.1**) the only other change to the air quality impact modelling approach was to include site specific data for silt and moisture content for haul roads, overburden emplacements, coal stockpiles, topsoil stockpiles and rehabilitation (as recommended by the PAC Review Report (PAC 2012) and measured on site in February 2013). As shown in **Table 2**, this site-specific data confirmed that the assumptions used for these factors in the Exhibited EA modelling were conservative. This site specific data was used in the reassessment of air quality impacts for Year 2 of the Contracted Project as presented below and shown in **Figure 9**.

A summary of those private residences that are predicted to receive air quality impacts in exceedance of the relevant criteria during Year 2 of the Contracted Project are provided below in **Table 3**. The impacts from dust emissions from the Contracted Project have materially reduced compared to those predicted for the Exhibited EA, however four residences are still predicted to receive significant air quality impacts. Importantly all of these four residences are either owned by Coalpac or have a formal impact agreement in place with Coalpac.

With the changes to the Contracted Project mine plan proposed, TSP emission impacts to Cullen Bullen are also predicted to be reduced from those worst case levels modelled in the Exhibited EA for Year 2. Pacific Environment also note that the Contracted Project would be expected to significantly reduce both 24-hour and annual average PM_{10} concentrations at Cullen Bullen. Predicted concentrations of PM_{10} in Cullen Bullen (for the Contracted Project) are well below the NSW Environment Protection Authority (EPA) criterion of 30 $\mu g/m^3$ and also, although not a NSW regulatory requirement, below the World Health Organisation annual goal of 20 $\mu g/m^3$ (an alternate criteria that has been suggested by NSW Health in their consultation with the PAC for this particular project).

A full comparison of the Year 2 air quality impact levels predicted in the Exhibited Project and Contracted Project is presented in **Appendix D**.

Table 2
Silt and Moisture Content Values Comparison

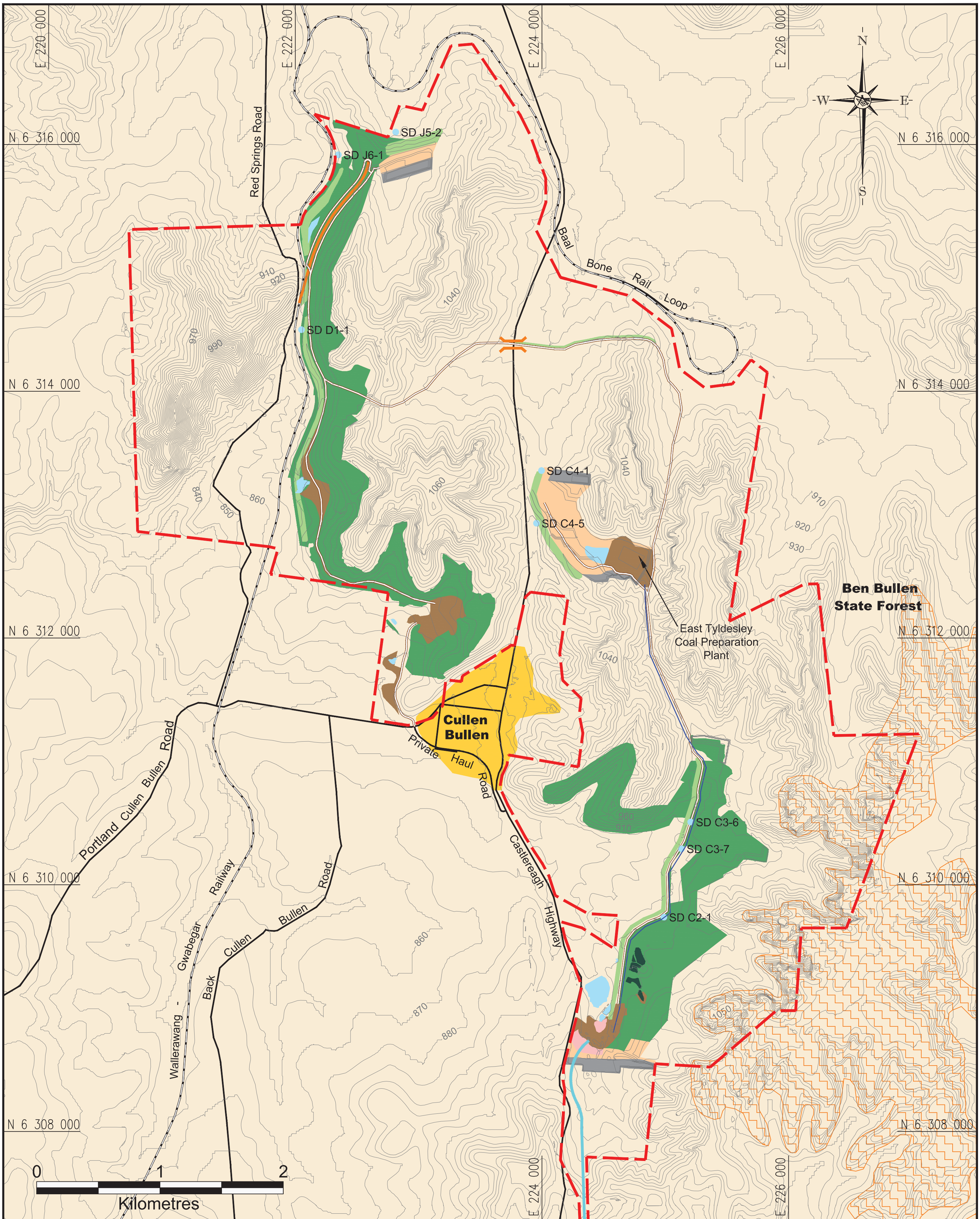
Area	As adopted in the Exhibited Project EA	As adopted in the Contracted Project	As adopted in the Exhibited Project EA	As adopted in the Contracted Project
	Moisture content (%)		Silt content (%)	
Haul roads	N/A	N/A	5	3.4 - 3.9
ROM coal	7	7 – 8	10	3
Product coal	7	5.3	N/A	N/A
Overburden	2	4 – 5	10	4 - 5
Topsoil	2	6 – 7	8	5 - 6
Rehab	2	5 – 6	10	5 - 6

Note: Values adopted for the East Tyldesley mining area are an average of Cullen Valley Mine and Invincible Colliery results

Table 3
Summary of Predicted Air Quality Exceedances – Contracted Project Year 2

Receiver ID	Description	PM_{10}		Total Suspended Particulates
		24 Hour, Maximum Project Alone (50 µg/m^3) days per year above criteria)	Annual, Project Alone and other sources (30 µg/m^3)	Annual, Project Alone and other sources(90 µg/m^3)
195	KJ Blackley*	191 (105 days above)	33	70
197	BE & CE Leisemann & IL & KID Follington* (Coalpac)	402 (189 days above)	62	140
198	DA Tilley*	199 (115 days above)	65	78
199	DA Tilley*	136 (115 days above)	29	65

** Agreement in place with landholder*



Project Boundary
Roads
Indicative Haul Road
Indicative 11kv Powerlines
Rail Siding
Indicative Conveyor Alignment
Indicative Bridge / Overpass Location
Infrastructure Area
Tailings Drying Area
Rehabilitation
Bunds
Water Storage
Coal Stockpile
Active Mining
Overburden Emplacement
Residential Area
Significant Pagoda Landform

Hansen Bailey

Coalpac Pty Ltd

Coordinate System: MGA Zone 56

COALPAC CONSOLIDATION PPR

Conceptual Year 2 Mine Plan

Cad File: 09166B.dwg	Date: 05.04.13	Drawn: CP	Figure 9

3.3.3 Mitigation and Management

In addition to the controls assumed to be in place in the modelling of air quality impacts, Coalpac is committed to leading practice dust management for the Contracted Project through the use of a real-time and proactive air quality management system. This will enable Coalpac to proactively manage the short term impacts of the Project and prevent or minimise dust impacts at sensitive receptors to the greatest practical extent.

Coalpac will develop an Air Quality Monitoring Program and Management Plan that monitors its operations and incorporates all reasonable and feasible dust minimisation management measures which will include (but not be limited to):

- Utilisation of a real-time air quality monitoring system (including predictive meteorological monitoring) to proactively manage operations in order to ensure that air quality emissions remain below the relevant criteria at all neighbouring receivers apart from those listed in **Table 3** above. This system will include a component to allow the prediction of meteorological conditions and air quality impacts to allow mining operations to be proactively managed. Air quality monitoring locations proposed for the Contracted Project will be finalised in consultation with EPA and will change over the life of the development as the mine progresses;
- Utilisation of the largest practical haul truck size for the Contracted Project fleet;
- Utilisation of the rail siding and the fully enclosed MPPS conveyor to reduce Contracted Project truck movements for product coal;
- Limiting the speed of all vehicles on internal roads and other exposed areas;
- Minimising drop heights from equipment for loading and dumping operations;
- Minimising overburden and ROM coal haul road haulage distances;
- Minimising disturbed surfaces and employing water carts during construction activities required for the Contracted Project;
- Utilising water to minimise dust impacts on all active areas where equipment is in operation;
- Implementation of dust suppression measures on all coal handling areas and stockpiles;
- Minimising disturbance ahead of mining and limiting the size of active out of pit emplacement areas (Overburden Emplacement Areas (OEAs));
- Rehabilitating disturbed areas as soon as practical following the completion of mining activities;
- Monitoring, management and reporting in the event of any incidences of spontaneous combustion for the Contracted Project; and

- Seeking a data sharing agreement with neighbouring industry to allow for the consideration of cumulative impacts and development of co-operative management responses as required.

To limit any potential for impacts associated with blast fumes, Coalpac will update the blast management documents in place for existing operations into a consolidated Blast Management Plan for the Project.

Blast management measures already adopted by Coalpac to mitigate potential for blast fume impacts, to good effect, include:

- Blasting under favourable wind conditions when wind will transport fume away from sensitive receptors;
- Blasts being delayed where possible during rainfall;
- Blast size and depth to be minimised;
- Bench heights to be reduced where practical; and
- Bench design to be constructed for effective water runoff.

A revised Statement of Commitments for the Contracted Project which reflects the above mitigation and management measures is provided in **Section 4**.

3.4 HISTORICAL SUBSURFACE HEATING

3.4.1 Background

Historical subsurface heating has been associated with the abandoned underground workings of the Tyldesley Colliery (now part of the Cullen Valley Mine) since the 1970s. The subsurface heating in the abandoned underground workings was relatively dormant up until the workings were intersected by the open cut excavation in 2003. In addition to the heating in the old underground workings, there are pockets of carbonaceous material located in the open cut backfilled areas that are actively heating at other locations at Cullen Valley Mine.

3.4.2 Impact Assessment

In the Exhibited EA, existing Coalpac monitoring, response and rehabilitation procedures for the existing subsurface heating issue were discussed including the development of a Plan of Works (referred to the Cullen Valley Mine Heating Response Plan in the Exhibited EA) to ensure the adverse impacts from the heating upon the local community and the environment will be appropriately mitigated. It was noted that the existing subsurface heating issue may continue to be prone to localised heating, resulting in minor odour and some impact to established rehabilitation within affected areas, requiring ongoing monitoring and management.

Subsequent to the submission of the Exhibited EA, Coalpac has developed a Plan of Works to address the subsurface heating issue which has been approved by DTIRIS-DRE as a variation to the current Cullen Valley Mine MOP. This Plan of Works will be included as a component of the MOP and EMS for the Contracted Project.

3.4.3 Mitigation and Management

Coalpac will retain the Plan of Works for the Contracted Project, with any modifications required to be made in consultation with DTIRIS – DRE and to the satisfaction of DP&I. This document will include the following mitigation and management measures:

- Development and maintenance of permanent vehicular access to areas prone to heating issues (completed);
- Ensure that dead vegetated material is removed from any vents or active heating areas (completed);
- Progressively excavate the venting along the interface between the crest of the old open cut highwall and the backfill. The area will then be backfilled and compacted in layers to restrict the ingress of oxygen and water (completed);
- The topographic profile of the central heating area will be lifted to also limit the ingress of water and to raise and cover the whole area to provide a long term stable profile that will incorporate drainage channels (in progress);
- Conduct regular thermographic imagery (ground and aerial) to monitor the lateral extent of the heating and the location of vents and hotspots (ongoing);
- Installation of 12 thermal probes to monitor temperatures at depth in key locations. Research will be conducted to determine the most appropriate design configurations for the thermal probes in order to maximise operating life and reliability (in progress);
- Installation of a further six thermocouples and a groundwater monitoring bore in the underground workings (in progress);
- Continued monitoring of the water level in Tyldesley Colliery underground workings (ongoing, additional monitoring point to be added);
- Conducting regular visual inspections and keeping records to detect and monitor any new vents (ongoing);
- Any areas found to produce any significant emissions indicating heating or elevated temperatures will be promptly addressed and subject to earthworks and progressively rehabilitated (ongoing); and
- Heating areas will be rehabilitated, leaving access for ongoing monitoring and maintenance activities. The performance of vegetation development in rehabilitated heating areas will be surveyed regularly to monitor its performance and rate of regrowth (pending and ongoing).

3.5 GREENHOUSE GAS

3.5.1 Background

A component of the air quality impact assessment undertaken by PAEHolmes for the Exhibited Project (Appendix G of the Exhibited EA) included the assessment of greenhouse gas impacts. The Exhibited Project greenhouse gas assessment was based upon the methods outlined in the following documents:

- The *World Resources Institute / World Business Council for Sustainable Development Greenhouse Gas Protocol*;
- *National Greenhouse and Energy Reporting (Measurement) Determination 2008*; and
- The Australian Government Department of Climate Change and Energy Efficiency (DCCEE) *National Greenhouse Accounts Factors 2010*.

Consideration was also given to the *Guidelines for Energy Savings Action Plans* (DEUS 2005). Three 'scopes' of emissions (scope 1, scope 2 and scope 3) are defined for greenhouse gas accounting and reporting purposes and were considered for the Exhibited Project in relation to the following greenhouse gases:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O); and
- Synthetic gases (HFCs, SF_6, CF_4, C_2F_6).

Emission factors are standardised and expressed as a carbon dioxide equivalent (CO_2-e) which is calculated by multiplying the individual gas emission factor by its respective Global Warming Potential (GWP).

3.5.2 Impact Assessment

In their assessment of greenhouse gas for the Exhibited Project, PAEHolmes considered the following emissions sources:

- Fuel consumption (diesel) during mining operations – Scope 1 emissions;
- Release of fugitive CH_4 during mining – Scope 1 emissions;
- Indirect emissions resulting from the consumption of purchased electricity – Scope 2 emissions;
- Indirect emissions associated with the production and transport of fuels – Scope 3 emissions;
- Indirect emissions associated with transmission and distribution losses from electricity supply – Scope 3 emissions;
- Emissions from coal and sand transportation – Scope 3 emissions; and

- Emissions from the burning of the product coal – Scope 3 emissions.

A comparison of the Year 2 greenhouse gas predictions in the Exhibited Project and for the Contracted Project is presented in **Appendix D**. Given that the quantity of ROM coal extraction did not change in the Year 2 of the Contracted Project from that assessed in the Exhibited Project, it is anticipated that the greenhouse has outcomes would also not significantly change. However, as noted in **Section 2.1**, there would now be no sand extraction in Year 2 and therefore Scope 3 emissions related to this activity would not exist for the Contracted Project.

When comparing the total estimated GHG emissions from the Exhibited Project to the Contracted Project, it is concluded that GHG emissions for the Contracted Project have decreased by 9,391 t CO2-e, representing a 0.13 % decrease. As Scope 1 emissions have not changed from that estimated in the Exhibited Project air quality impact assessment, there is no change to the direct contribution of the Contracted Project to Australia's commitment under the Kyoto Protocol and it is anticipated that any material effect on climate change would be minimal.

3.5.3 Mitigation and Management

Coalpac has plans and standards in place to minimise energy usage and GHG emissions from its operations, including those proposed for the Contracted Project. Reasonable and feasible measures will be implemented on-site to minimise greenhouse gas emissions of the Contracted Project and ensure it is energy efficient. These measures include objectives, commitments, procedures and responsibilities for:

- Monitoring and improving energy use and efficiency and reducing GHG emissions from the mining, processing and use of coal;
- Consideration of the use of alternative fuels where economically and practically feasible;
- Review of mining practices to minimise double handling of materials and ensuring that coal and overburden haulage is undertaken using the most efficient routes;
- Ongoing scheduled and preventative maintenance to ensure that diesel and electrically powered plant operate efficiently; and
- Developing targets for greenhouse gas emissions and energy use onsite and monitoring and reporting against these.

Coalpac has also committed to ensuring that certain GHG measures are implemented on-site, including:

- Ensuring that there are a dedicated number of trucks for each digging unit (i.e. front-end-loader and excavator) to minimise truck wait time;

- Ensuring that dump trucks are fully loaded for each load prior to hauling to maximise productivity and efficiency with regard to the amount of fuel used per unit of material moved. This is measured by the number of buckets loaded into each truck; and
- Reviewing haul road maintenance and sheeting materials used on main haul roads to reduce rolling resistance and decrease fuel consumption.

3.6 NOISE

3.6.1 Background

A noise impact assessment was undertaken for the Exhibited Project by Bridges Acoustics and included as Appendix H of the Exhibited EA.

The Exhibited Project noise impact assessment was undertaken in accordance with the following policies and guidelines:

- The *NSW Industrial Noise Policy* (INP) (EPA 2000) for operational and construction noise;
- The *NSW Road Noise Policy* (DECCW 2011) for road traffic noise and sleep disturbance criteria;
- The *Interim Construction Noise Guideline* (DECC 2009) provides criteria, recommended hours and methods for assessing noise from construction activities; and
- The *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (DECC 2007) for noise from train movements on the Wallerawang – Gwabegar Rail Line.

3.6.2 Impact Assessment

Prior to the reassessment of noise impacts of the Contracted Project, Bridges Acoustics completed a review of the noise assessment methodology used in the Exhibited EA (Bridges Acoustics, 2012). The purpose of this review was to confirm that the assessment for the Exhibited EA was completed in accordance with the DGR's and best accepted practices, standards, government policy guidelines and plans at that time and to confirm that the assessment methodology was appropriate for the Contracted Project. In particular, this review focussed on ensuring consistency and compliance with the assessment methodologies required by the NSW INP by adopting the following:

- Methods for the determination of background noise levels;
- Determination of appropriate Project Specific Noise Levels (PSNLs) for the day, evening and night periods according to the procedure defined in the NSW INP;
- Determination of prevailing weather conditions based on measured weather data from two local weather stations operated by Coalpac;

- Adopting all noise control and management measures that could reasonably be adopted;
- Calculation of predicted noise levels considering all operating plant and equipment operating simultaneously in reasonable worst case locations and the effect of prevailing weather conditions where relevant;
- Identification of all receivers that are predicted to experience noise levels over the adopted criteria during one or more time periods, after all reasonable noise control measures have been adopted;
- A review of the blasting history associated with the existing mining operations and prediction of vibration and noise effects from proposed blasts;
- An assessment of road traffic noise levels compared to currently approved traffic levels and relevant traffic noise criteria; and
- An assessment of rail traffic noise levels compared to relevant noise criteria.

Of the components of the Exhibited Project mine plan that had changed for the Contracted Project, the most significant from an acoustic perspective were considered to be:

- Removal of the Hillcroft mining area; and
- Removal of the sand extraction and processing.

To assess the above changes, noise levels for Year 2, as the period with highest potential impacts to receivers, of the Contracted Project were therefore recalculated for all receivers and properties. It was considered that the other changes of the Contracted Project mine plan were unlikely to have any significant effect on noise levels at any receiver locations, although as with the air quality reassessment, they would result in other minor reductions in predicted impacts.

The reassessment of noise impacts for Year 2 of the Contracted Project found that there would be a reduction in the number of impacted receivers and that some residences and properties would now be in a lower noise affectation category. A summary of the noise impact predictions for the Contracted Project is provided below in **Table 4** and **Table 5** for private receivers and properties, respectively. Each of the properties where significant noise impacts (i.e. greater than 5 dBA above the intrusive criteria) are predicted are either owned by, or are subject to an impact agreement with Coalpac. There are now no properties predicted to receive significant amenity impacts with which Coalpac does not have an agreement in place.

A comparison of the Year 2 noise levels predicted in the Exhibited Project and for the Contracted Project is presented in **Appendix E**.

Table 4
Predicted Noise Level Exceedance of Intrusive Criteria at Private Residences

Receiver ID	Description	Intrusive Criteria Day / Night	Predicted Maximum Noise Level
Significant Impact			
194	JGQ Nominees Pty Ltd*	37 / 35	45.3
195	KJ Blackley*	37 / 35	43.8
197	BE & CE Leisemann & IL & KID Follington* (Coalpac)	37 / 35	40.4
Moderate Impact			
144	DA & DM Muldoon	35	38.0
179	RK Dickens	35	39.7
198	DA Tilley*	37 / 35	39.7
199	DA Tilley*	37 / 35	39.5
201	Coalpac (formerly KD & RL Kellam)	37 / 35	39.4
217N	Crown	37 / 35	37.2
349	RM Crane	35	37.8
367	JR Gracey	35	38.9
372	RE Gilmore	35	39.3
392	IG Palmer	35	38.4
412	V & F Fava, C Rositano, F Tedesco & E Todorello	35	38.4
Mild Impact			
142	PG Desch & KC Farrugia	35	35.7
143	DB Speirs	35	36.4
364	JR Gracey	35	36.7
368	RA Fuller	35	35.8
373	WF Fitzgerald	35	36.6
383	BS Bretherton & B Chandwick	35	36.9

Receiver ID	Description	Intrusive Criteria Day / Night	Predicted Maximum Noise Level
384	A Tabone	35	35.9
385	Ceedive Pty Ltd	35	35.7
386	TJ Griffiths	35	37.0
388	VA McFadden	35	35.8
391	MG Bulkeley	35	36.7
403	BR & E Brown	35	36.0
404	BR & E Brown	35	35.6
426	JWJ & SM Taylor	35	36.3

** Agreement in place with landholder*

Table 5
Predicted Noise Level Exceedance of Intrusive Criteria over 25% Contiguous Property

Receiver ID	Description	Intrusive Criteria Day / Night	Predicted Maximum Noise Level
Significant Impact			
170	Coalpac (formerly BE Nakhle)	37 / 35	61.3
194	JGQ Nominees Pty Ltd *	37 / 35	46.7
195	KJ Blackley*	37 / 35	43.8
197	BE & CE Leisemann & IL & KID Follington* (Coalpac)	37 / 35	67.2
198,199	DA Tilley*	37 / 35	46.6
200	BE & CE Leisemann & IL & KID Follington*	37 / 35	49.1
217	Crown	37 / 35	41.5
Moderate Impact			
144	DA & DM Muldoon	35	38.7
201	Coalpac (formerly KD & RL Kellam)	37 / 35	39.4
205,206	D Dino & J Seraglio	35	38.9

Receiver ID	Description	Intrusive Criteria Day / Night	Predicted Maximum Noise Level
216	BM Emmott	37 / 35	37.6
349	RM Crane	37 / 35	37.1
370	JA, SE Byron & DC Hutton	35	38.2
371	MA & JL Taylor	35	37.2
372	RE Gilmore	35	37.5
374-376, 390,391	MG Bulkeley	35	38.0
392	IG Palmer	35	38.1
412-414	V & F Fava, C Rositano, F Tedesco & E Todorello	35	38.3
411,415,416, 420-425	SJ & DS Taylor	35	39.0
Mild Impact			
203,204,364, 365,367	JR Gracey	35	36.1
209	DJ Ryan	35	36.7
210	FC & K Tilley	35	35.2
348	RE Gilmore & MG & PJ Bulkeley	35	35.1
350	Tanwind Pty Ltd	37 / 35	35.2
362	RE Gilmore & MG & PJ Bulkeley	37 / 35	36.9
368,369	RA Fuller	35	36.5
373	WF Fitzgerald	35	36.5
383	BS Bretherton & B Chandwick	35	36.5
384	A Tabone	35	35.9
385	Ceedive Pty Ltd	35	35.2
386	TJ Griffiths	35	37.0
387	JR Embleton & KJ Kelly	35	36.6
388,409	VA McFadden	35	36.3
403-405	BR & E Brown	35	36.2

Receiver ID	Description	Intrusive Criteria Day / Night	Predicted Maximum Noise Level
406	P W Griffiths	35	36.0
408	RH Griffiths	35	35.3
410	PJ & SL McFadden	35	36.1
417-419	AP & KA Brown	35	36.6

** Agreement in place with landholder*

The Contracted Project has been predicted to have a reduced impact on the nearby community than the Exhibited Project. The Contracted Project will:

- Reduce the number of affected residences and properties by:
  - Up to a 25% reduction of those in the Significant impact category, and
  - Up to a 33% reduction of those in the Moderate and Mild impact categories.
- Reduce mining noise levels generally to the west and north-west of the Project Boundary which will place some residences and properties in a lower noise affectation category.

In regard to Cullen Bullen Public School, the predicted noise levels from the Contracted Project during day and evening periods under prevailing weather conditions will remain below 35 LAeq, 1 hour outside the classrooms and below 25 LAeq, 1 hour within the classrooms with windows and doors open. These levels will therefore remain at least 10 dBA below the recommended noise criteria relevant to the school.

3.6.3 Mitigation and Management

Noise management and mitigation measures for each aspect of the Contracted Project are presented below.

Operational Hours

To ensure that noise generating activities are minimised until the Contracted Project noise mitigation measures (outlined below) are in place and demonstrated to be working effectively by an independent acoustic expert, operating hours will be limited to:

- Monday to Saturday:
  - 7.00 am to 9:30 pm – for mining and coal processing activities;
  - 7.00 am to 9.30 pm – for haulage and transportation from Invincible Colliery exit;
  - 7.00 am to 5.30 pm Monday to Friday and 7.00 am to 5.00 pm on no more than 30 Saturdays annually – Coal haulage from the Cullen Valley Mine exit;

  - o 10.00 pm to 7.00 am – non-audible equipment (i.e. less than 35 dBA(LAeq15min) monitored at private receivers) maintenance activities; and
  - o 9.00 am to 5.00 pm - blasting.
- Sunday:
  - o 8.00 am to 6.00 pm – for mining and all associated activities;
  - o 6.00 pm to 7.00 am – non-audible equipment maintenance activities; and
  - o No blasting.
- And at no time on public holidays.

It should be noted that these times will be further restricted by specific commitments (provided in **Section 4**), for example near the Cullen Bullen General Cemetery.

The noise mitigation measures will include sound suppression on mobile plant and stationary equipment, progressive construction of earthen bund walls, construction of a conveyor to transport coal to MPPS, a bridge over the Castlereagh Highway, location of infrastructure within the Contracted Project footprint and the establishment of a real time monitoring and management system.

Operating hours will be limited to the following times after all noise mitigation measures have been implemented and certified by an independent acoustic expert that they result in the achievement of the predicted noise outcomes.

- Monday to Saturday
  - o 24-hours – for mining (other than blasting) and coal processing;
  - o 7.00 am to 9.30 pm – for haulage and transportation from Invincible Colliery exit;
  - o Coal haulage from Cullen Valley Mine exit only in emergencies with written notification to DP&I;
  - o 10.00 pm to 7.00 am – non-audible equipment maintenance activities; and
  - o 9.00 am to 5.00 pm - blasting.
- Sunday
  - o 24 hours – for mining (other than blasting) and coal processing;
  - o No road haulage;
  - o No blasting.

It should be noted that these operational times are subject to further restrictions in the specific commitments provided in **Section 4**.

Construction

- Construction of the large noise bund to the north of the rail siding will be undertaken using quieter, noise controlled mining machines rather than more typical construction machines supplied by a general contractor;
- Construction work associated with the rail siding and associated facilities will occur after completion of the adjacent noise bund to maximise the effectiveness of the bund;
- Pile driving associated with bridge construction will be minimised where possible. Alternatives to driven piles, such as vibrated piles or mass concrete foundations will be used if possible and practical. Pile driving will be completed during the hours 8:00 am to 4:00 pm Monday to Friday to minimise noise impacts to residences. Prior discussion with the owners of Properties 142 to 144 will be undertaken to advise of the intended work program, likely construction noise levels and anticipated working hours and to receive feedback from residents regarding any particularly sensitive dates or times that may be avoided;
- Construction of the bridge over the Castlereagh Highway and associated haul roads will occur as early in the construction program as possible to allow all future construction related traffic on the Cullen Valley Mine to use the Invincible Colliery access road rather than the Cullen Valley Private Haul Road or the Castlereagh Highway through Cullen Bullen;
- Construction of all noise bunds and other earthworks components will be undertaken using noise controlled mining machines, rather than using standard construction machines; and
- Where possible, noise bunds will be progressively constructed early in the construction program to control noise from future construction and mining activities.

Operation

- Zone 1 (see Figure 26 of the Exhibited EA): Mining activity within approximately 2,400 m from a receiver will include shielded OEAs for use at night, where the shielded areas are generally behind the OEA bunds. More exposed OEAs will be used during the day or only under favourable weather conditions during the night. Provision of suitably shielded OEAs and bunds will be considered as each mining area is developed;
- Zone 2 (see Figure 26 of the Exhibited EA): Mining within approximately 1,800 m from a receiver will include shielded OEA areas for use under all except neutral weather conditions during the day. Initial construction of a bund, and raising or extending the bund to keep up with the advancing mining area, will occur only under neutral weather conditions during the day;

- Zone 3 (see Figure 26 of the Exhibited EA): Mining within approximately 1,800 m from a residence where shielded operating areas cannot reasonably be provided due to unfavourable terrain will only occur under neutral weather conditions in the day;
- Real time weather monitoring will occur while mining is being completed in Zone 2 and Zone 3 to indicate the potential for noise enhancing weather conditions, while real time noise monitoring at representative receivers will be used to confirm mining noise levels during all years of operation; and
- Operation of the highwall miner will occur at any time and under any weather conditions, provided the miner is located in a suitably shielded area of the mining area when working in Zone 2 and Zone 3. Due to its operating geometry (i.e. low in the pit and well bunded) the highwall miner will be generally exempt from the management measures recommended for each Zone, however coal trucks associated with the highwall miner will comply with the noise management recommendations for each Zone.

Noise Monitoring Program

Coalpac will develop a leading practice noise monitoring network surrounding the site which is representative of the closest sensitive receivers, which will include:

- Quarterly attended real time noise monitoring (including a permanent directional noise monitoring system at a representative sensitive receiver);
- Regular correlation of real time noise monitoring results with the meteorological station to proactively manage operations during noise enhancing conditions when mining activities are approaching the intrusive criterion;
- A network of real time noise monitors; and
- A predictive meteorological component to allow pro-active and reactive management of these operations to minimise noise impacts at sensitive receptor locations and ensure compliance with the relevant Project Specific Noise Criteria.

Similar to the air quality monitoring system, trigger levels will be developed to generate alarms to notify the site Supervisors of noisy operations that may require attention.

Noise Management Plan

Coalpac will develop a comprehensive Noise Management Plan (NMP) that will incorporate practical noise minimisation, monitoring and management measures to the approval of DP&I for the construction and operation of the Contracted Project including:

- Mining trucks and water carts will be fitted with leading practice exhaust silencers to reduce noise emissions;

- The mobile overburden fleet will be directed to higher, exposed areas during favourable weather conditions (generally during the day) and to lower, more shielded areas during noise enhancing weather conditions (shown in Table 26 of the Exhibited Project EA);
- Tracked dozers will be operated at slow speed, particularly in reverse in exposed areas of the site during noise enhancing weather conditions to minimise audible track noise;
- Vehicle warning devices (e.g. reverse alarms, horns and start alarms) will be selected and installed to produce the lowest possible noise levels consistent with safe operation;
- Mobile and coal handling equipment will be maintained in good condition to minimise unnecessary noise and ensure that the attenuated Sound Power Levels are maintained;
- Noise suppression will be included on the conveyor system and transfer points, where practical;
- Specific measures will be implemented at the rail loadout system to minimise noise from this activity, including measures to minimise or avoid train wagon bunching noise during train movements;
- A real time noise monitoring system (including a predictive meteorological component) will be installed to assist with the proactive management of operations to minimise adverse noise impacts on neighbouring receivers. Indicative monitoring locations proposed during the life of the Project are shown in Figure 25 of the Exhibited Project EA;
- The development of a noise management procedure (to be used in conjunction with the real time monitoring and predictive meteorological monitoring system) that will provide practical operational controls that are available in each mining area under various weather conditions to manage potential noise impacts; and
- Notification to all land holders listed in **Table 4** that are predicted to exceed the relevant assessment criteria of their rights under the Project Approval.

Upon receipt of a written request from a private landholder of a receiver shown in **Table 4** predicted as receiving moderate noise impacts (where no Private Agreement is in place), Coalpac will install noise mitigation measures at the receiver in consultation with the landholder in accordance with the conditions of Contracted Project Approval.

For all other privately owned receivers not listed in **Table 4**, proactive and reactive noise minimisation practices will be implemented to ensure that the Project does not exceed the intrusive criteria.

3.7 BLASTING

3.7.1 Background

The noise and vibration impact assessment for the Exhibited Project was completed by Bridges Acoustics and included as Appendix H of the Exhibited EA. The blasting assessment was undertaken in accordance with the following policies and guidelines:

- The *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration, Australian and New Zealand Environment Council* (ANZEC 1990) for ground vibration and overpressure limits and time restrictions for blasting;
- *Australian Standard 2187.2 – 2006: Explosives – Storage and Use, Part 2: Use of Explosives* (AS 2187.2);
- *Assessing Vibration – a Technical Guide' (DEC 2006) for assessing construction vibration*; and
- *DIN 4150 Part 3 – Structural Vibration: effects of vibration on structures* (ISO 1999).

The assessment calculated the likely ground vibration and overpressure levels generated by blasting required for the Exhibited Project for each of the nearby receivers and sensitive features (including heritage sites) and for comparison with the relevant criteria.

3.7.2 Impact Assessment

Of the components of the Exhibited Project mine plan that have changed for the Contracted Project, the most significant from a blast impact perspective are considered to be:

- Removal of the Hillcroft mining area;
- Removal of the sand extraction and processing;
- Reduction in the Cullen Valley open cut mining footprint; and
- Modification to the open cut mining footprint for SPLs and Sandstone Outcrops.

As noted above in **Section 2.1.6**, a further review of the blast design, monitoring and response procedures has been undertaken by Terrock Consulting Engineers (Terrock 2013). This assessment provides additional detail on the management processes that will be implemented for the Contracted Project. This will allow a staged progression of open cut mining activities to occur up to the proposed open cut disturbance within the proposed 200 m blast management buffer in such a way as to avoid any potential for impacts to the SPL and other Sandstone Outcrops. Terrock also confirmed that the methodology, assumptions and background data used as a basis for the blast impact assessment in the Exhibited EA were undertaken in accordance with the DGRs, to current criteria and regulatory guidelines.

3.7.3 Mitigation and Management

The Terrock review is provided in **Appendix F** and includes an investigative management procedure to allow blasting to proceed with appropriate ground vibration limits for the protection of the SPL and Sandstone Outcrops to be determined. This has been termed the Site Factor Kv Exercise (Kv Exercise). The blast management program, described below, for will be included in the Blast Management Plan for the Contracted Project to ensure the protection of SPL and Sandstone Outcrops.

Blast Management Program

In their review, Terrock identified that the southern extension proposed for the Invincible mining area is a suitable location to further confirm and refine the site factor (Kv) for the representative strata without impacting upon the SPL and Sandstone Outcrops. This Kv Exercise will involve the deployment of additional arrays of blast monitors located to the east of the mining site to measure Peak Particle Velocity (PPV) for all blasts until sufficient data is obtained. In addition strain measurements will be made to confirm the relationship between PPV and strain on the various strata horizons as operations progress southwards on a similar basis.

The data will be gathered, collated and analysed to confirm and refine a Scaled Distance Site Law to increase the confidence of initial blast design when moving to the east towards the SPL in a comparable strata sequence.

Coalpac have determined (from past practice at their mines and review of vibration limits applied to public infrastructure) that 100 mm/s provides a non-damaging limit for SPL and Sandstone Outcrops. As part of the Contracted Project, Coalpac propose to conduct a multi-disciplinary investigation which includes analysing the effects of controlled and closely monitored blasts to demonstrate the appropriateness of this 100 mm/s non-damaging limit for the SPL and Sandstone Outcrops.

A program of reduced vibration limits and intensive monitoring (Non-damaging Limit Exercise) will permit a regulated, measured approach as each successive blast nears the SPL or Sandstone Outcrop.

Based on previous blasting experience, Terrock recommend that the Non-damaging Limit Exercise should commence with blasts at 200 m from the selected representative Sandstone Outcrop, with an interim PPV trigger level of 50 mm/s. The Non-damaging Limit Exercise will then move closer with successive blasts until the selected vibration trigger levels are achieved at the monitoring point and show that the rock mass is remaining stable.

Once blasting at the interim trigger level of 50 mm/s PPV has proven to have negligible impact, the target limit will be incrementally increased in 25 mm/s steps to 75 mm/s PPV and then 100 mm/s PPV whilst continuing the monitoring program.

Utilising information gathered from each of these blasts, and monitoring the response of the rock mass through mapping and photogrammetrics (as examples), blast designers can initiate design changes progressively as required to keep below trigger levels at all times. The stability of the Sandstone Outcrop in response to measured ground vibration levels will be established through a rock mechanics hazard map (Hazmap) assessment before advancing to a higher level of vibration.

Coalpac proposes to undertake these two exercises in the first year of operation of the Contracted Project. During this time other mining faces will be advanced concurrently but will not approach within 200 m of the SPL and Sandstone Outcrops before the blast management program is completed.

The data gathered in the proposed blasting exercises will be used to introduce a refined blast management program for all subsequent operations adjacent to the SPL and Sandstone Outcrops. The main steps of such a program are outlined below:

1. Collation and analysis of data gathered from the Site Factor Kv Exercise to provide reliable site specific parameters to support predictive modelling with confidence;
2. Predictive modelling will be carried out initially to guide blast design and limit predicted levels to 100 mm/s PPV or other agreed limit. These will be the trigger levels at which re-design or reduced design parameters will be implemented;
3. Establish the condition of the Sandstone Outcrop selected for the Non-damaging limit exercise and produce a Hazard Map to identify and classify zones in terms of stability;
4. Prior to advancing blasting towards the Sandstone Outcrops selected for the Non-damaging exercise to install vibration monitors on solid rock at the top and bottom of the rock face at the nearest point to the blasting face. Install strain gauges at the base of the rock face near the vibration monitor and record the rock mass response to blasting using photogrammetric techniques. The Non-damaging trigger levels exercise will be continued until sufficient confidence has been gained;
5. After the Non-damaging limit exercise at the Cullen Valley mining area to determine the relevant design criteria has been successfully completed, a similar exercise will be conducted while advancing towards the SPL at Invincible until sufficient confidence has been gained; and
6. Coalpac propose that an Independent Review Committee (established in collaboration with DP&I and DTIRIS-DRE) with suitable technical and regulatory representation will monitor the performance of the blast management program for any blast within 200 m of the SPL and Sandstone Outcrops but also with respect to Residences, Cullen Bullen General Cemetery, Aboriginal and Non-Aboriginal Heritage Sites on a quarterly basis for the first 2 years. It is proposed that the frequency of the meetings will reduce to biannual after 2 years.

By implementing the above approach proposed by Terrock as part of the Contracted Project Blast Management Plan, areas may be identified where the stand-off can be safely reduced to 50 m, if supported by the science and with appropriate management checks and controls.

Coalpac has also made a number of blast management commitments for the Contracted Project, as outlined in **Section 4**.

3.8 VISUAL AND LIGHTING

3.8.1 Background

Integral Landscape Architecture and Visual Planning completed an assessment of the potential visual and lighting impacts of the Exhibited Project. This is included as Appendix I of the Exhibited EA. This assessment was undertaken to identify the character of the existing surrounding visual landscape and determine management and mitigation measures required to address the visual impacts predicted for the Exhibited Project.

3.8.2 Impact Assessment

To determine the extent and significance of visual and lighting impacts to receptors surrounding the Exhibited Project Boundary, a Primary Viewing Catchment was defined, encompassing the area within which impacts from the Exhibited Project could occur. Within the Primary Viewing Catchment, views from each of the eastern, western, northern, southern and central sectors were assessed. The Exhibited Project assessment found that:

- Those receivers in the Northern View Sector in close proximity to the Project Boundary that are not screened by intervening topography or vegetation will experience high visual impacts until mitigation bunds at the northern extent of the Exhibited Project are constructed and rehabilitated in front of areas where active mining will be otherwise visible;
- While there is potential for high visual impacts to result for views from some areas of the Gardens of Stone National Park, such impacts would generally be reduced by the obstruction of views from the adjoining forested areas located between key viewing locations and the Project Boundary, the Baal Bone Colliery and by the viewing distance;
- Visual impacts on the Eastern View Sector are likely to be restricted to recreational users of the forest that have westerly views over existing and Exhibited Project mining areas from exposed escarpment edges;
- The Southern View Sector is dominated by low sensitivity rural land uses. However, it contains several sensitive rural residences and local roads, including Portland – Cullen Bullen Road and Back Cullen Road. Visual impacts in the Southern View Sector relate to mining areas both to the east and west of the Castlereagh Highway, both of which have the potential for high impact levels where active mining operations are visible.

Residences at greater distance from the Project Boundary in this sector and with a less prominent orientation towards the Exhibited Project mining areas will experience a moderate to low impact in the first instance during mining operations, and would decrease to low following rehabilitation establishment;

- The Western View Sector is dominated by rural lands and contains two rural residences and a section of Red Springs Road that has very limited public use. A high visual impact was predicted for both receivers for a period of up to three years from Exhibited Project commencement as operations located to the west of the Wallerawang – Gwabegar Rail Line occur in close proximity. These impacts will decline progressively as rehabilitation advances;
- The highest level of visual impacts associated with the Exhibited Project will be experienced in the Central View Sector for those residences north of Cullen Bullen township (the township itself is generally screened by existing vegetation and topography). High visual effects created by Exhibited Project elements would result in high visual impacts being experienced (without mitigation measures in place) in a number of locations in the Central View Sector at various stages of the Exhibited Project life, including for Cullen Bullen General Cemetery in the last few years of the Exhibited Project; and
- The main lighting effects due to the Exhibited Project will occur as a result of vehicle and train lights and the lighting of active mining areas during night time operations.

The changes to the Exhibited Project mine plan (Contracted Project) which will result in a material reduction in predicted visual impacts include the following:

- Removal of the Hillcroft mining area and associated access infrastructure. This will reduce visual impacts of the Contracted Project for those receivers in the Western and Southern View sectors due to the existing Cullen Valley mine rehabilitation representing the western extent of open cut disturbance in elevated areas not already shielded by intervening topography or vegetation. Avoidance of the Hillcroft mining area for the Contracted Project and the ongoing development of existing Cullen Valley Mine rehabilitation will reduce the visual impacts to low, for residential receivers with strongly oriented views to this area;
- Reduction of the open cut mining footprint to avoid the area of Clandulla Geebung habitat located in the north western mining area at Cullen Valley Mine. This reduction in the open cut mining footprint will reduce the level of visual impact to some receivers located to the north of the Project Boundary where views to other areas of the Contracted Project operations are not available; and

- Reduction of the open cut mining footprint in relation to the SPL to improve ecological outcomes. While visual impacts from the open cut mining of the more elevated areas in the east of the of the Invincible mining area have the potential to result in high visual impacts to receivers (particularly in the Eastern, Southern and Central View Sectors), the reduction in the open cut mining footprint will reduce these impacts for some residential receivers.

The above reduction in the open cut mining areas now proposed for the Contracted Project will also minimise the direct and diffuse night lighting effects.

3.8.3 Mitigation and Management

Mitigation measures proposed in relation to reducing visual impacts created by the Contracted Project include:

- Onsite treatments to reduce visual effects; and
- Offsite treatments at viewer locations to reduce visual sensitivity.

Onsite treatments will involve rehabilitation of disturbed landforms while offsite treatments will involve a range of treatments to screen views, filter views and / or reorientate primary views should these be needed. Onsite treatments are already incorporated in the design and operating plans for the Project as they relate to the OEA establishment and progressive rehabilitation.

Onsite Treatments

A number of onsite treatments will be maintained or implemented to mitigate visual impacts of the Contracted Project, including:

- Designing of outer faces of the OEAs and associated drainage structures in accordance with the surrounding landscape;
- Retaining a tree screen of existing vegetation between the Castlereagh Highway and all mining areas where possible, to supplement the visual bunds described below, up to 30 m in width, where practical;
- The early establishment and rehabilitation of the outer faces of the bunds and OEAs, especially in the eastern Cullen Valley mining areas and the western mining areas of the East Tyldesley and Invincible mining areas. Key locations where bunds will be developed to reduce visual effects are shown on Figure 10 to Figure 17 of the Exhibited EA and include:
  - Immediately west of the Exhibited Project rail siding, at least 9 m in height above the level of the railway siding track and extending to the north and south of the loading area to form an effective visual planted bund from receptors to the west;
  - Along the western side of the Cullen Valley Mine area infrastructure, at least 6 m in height above the main haul road;

  - Along the western side of the southern half of the haul road from the East Tyldesley Coal Preparation Plant (ETCPP) to the Invincible Coal Preparation Plant (ICPP) at a height of 5 m where it may be exposed to views;
  - Along both the eastern and western sides of the Castlereagh Highway at the edges of the Contracted Project Disturbance Boundary in closest proximity to receivers;
  - Commencing south of the Cullen Bullen General Cemetery and oriented parallel to the Castlereagh Highway, for further shielding of views to open cut mining areas;
  - On the western side of all OEAs to be established in the south south-east of the Invincible mining area where active operations may be visible; and
  - Along the northern extent of the OEAs in the East Tyldesley and eastern Cullen Valley mining areas, at a height of approximately 6 m;
- Ensure progressive rehabilitation is undertaken to reduce impacts to sensitive receptors;
- Establishment of visual and ecological forest planting patterns in rehabilitation areas to achieve landscape patterns that emulate existing forest colour and texture continuums in the surrounding environment of the Ben Bullen State Forest;
- Infrastructure for the ETCPP area and MPPS conveyor to be clad in natural tones (i.e. olive green, grey, etc.) to blend with the surrounding forest environment as far as possible;
- A simple bridge design for the Castlereagh Highway overpass to maintain visual clarity in the setting of that infrastructure;
- Establishing significant forest plantings to the adjoining approach roads to the bridge, providing screening to truck movement and lights; and
- Where possible and consistent with health and safety requirements, ensure lights are hooded or directed away from sensitive receptors to avoid direct light spillage from the ETCPP site.

Offsite Treatments

Offsite treatments will be implemented to mitigate visual impacts of the Contracted Project at specific external locations, and will include:

- Preparation and early implementation of a specific Landscape Management Plan for the Cullen Bullen General Cemetery in consultation with LCC and to the approval of DP&I which implements a plan for the establishment of additional plantings of suitable cultural vegetation within the vicinity of the cemetery as soon as possible following approval;

- Preparation and implementation of a consolidated Rehabilitation and Landscape Management Plan for the Contracted Project. This plan will be prepared to consider specific impact mitigation strategies for sensitive viewing locations, including:
    - Completing a site inspection at neighbouring residences upon request and where required, preparing reasonable landscape strategies for specific private receptors that will experience prolonged high levels of visual impact from the Contracted Project; and
    - Implementing landscape plantings to achieve visual screening of residences with a high visual impact in accordance with plans prepared and as agreed in consultation with the landholder.

3.9 SURFACE WATER

3.9.1 Background

A surface water impact assessment was undertaken for the Exhibited Project by WRM Water & Environment. This study was included as Appendix N of the Exhibited EA and included:

- A review of existing surface water catchments;
- Assessment of the revised Water Management System proposed for the Exhibited Project;
- A review of additional water management infrastructure proposed; and
- Development of a water balance for the Exhibited Project.

3.9.2 Impact Assessment

The potential impacts of the Exhibited Project on the local and regional surface water resources were considered to include:

- Potential shortfalls in meeting Exhibited Project water requirements, affecting water available for dust suppression;
- Adverse impacts on the quality of surface runoff draining from the Project Boundary to surrounding lands, including the catchments of Cullen Creek, Dulhuntys Creek and Jews Creek;
- Potential subsidence impacts and loss of catchment area during highwall mining activities;
- Adverse impacts on downstream water quality associated with possible overflows from the mine water dams affected by runoff from disturbed catchments;
- Loss of catchment area draining to Cullen Creek, Dulhuntys Creek and Jews Creek due to the capture of runoff within Project water storages or open cut mining areas. This could potentially reduce runoff volumes to the above watercourses; and

- Potential flooding impacts from minor tributaries and watercourses draining the Exhibited Project.

The changes to the Exhibited Project mine plan (Contracted Project) which will result in a material reduction in predicted surface water impacts include the following:

- Removal of the Hillcroft mining area and associated access infrastructure. The removal of this area will mean that sub-catchments D2, D3 and J7 will not be disturbed for the Contracted Project, avoiding impacts to a total drainage area of approximately 67 ha and 225 ha for the Jews Creek and Dulhuntys Creek catchments, respectively; and
- Removal of the sand extraction component of the Exhibited Project located in the Cullen Valley mining area. This will reduce the water demand of the Exhibited Project by up to 50 ML per annum for the period for which sand extraction was proposed under the Exhibited Project.

While other modifications to the Contracted Project mine plan result in a reduction to the Exhibited Project Disturbance Boundary, it is anticipated that these would not result in a significant change in predicted surface water impacts.

3.9.3 Mitigation and Management

Consistent with the existing commitments presented in the Exhibited Project, Coalpac are committed to the management and mitigation of the potential impacts of the Contracted Project on surface water resources. This will be achieved through the development and implementation of the following:

- Site Water Management System to control the flow and storage of water of varying qualities across the site;
- Erosion and Sediment Control Plan to manage and reduce potential sediment loads from disturbed areas; and
- Surface Water Monitoring Program to ensure that the Site Water Management System is meeting its objectives of no adverse impacts on receiving waters.

An overview of the proposed mitigation and management measures are provided in the following sections.

Water Management System

A key objective of the integrated mine Water Management System for the Contracted Project will be to minimise the risk of any uncontrolled discharges from mine site storages.

To achieve this objective, operation of the site Water Management System will continue to be based on the following principles:

- Diversion of clean surface water runoff away from any areas disturbed by mining activities, where possible;

- Collection of dirty water runoff in sediment dams for the control of suspended sediment prior to discharge from the Project Boundary or reuse in the mine Water Management System. All sediment dams and water management systems will be designed in accordance with relevant standards (Landcom 2004);

  The water quality of runoff will be regularly tested to ensure that it meets relevant standards prior to release from the site. If the quality of runoff from disturbed areas is not suitable for release, this water will be retained within the mine water management system;
- Transfer of mine water (groundwater inflows and surface runoff) from within the open cut mining areas to the mine water storage dams for reuse as process water supply;
- Collection of any contaminated water from infrastructure areas for treatment in an oil and grease separator prior to recycling in the mine Water Management System;
- Minimisation of water usage by recycling water from the mine Water Management System before taking additional water from the abandoned underground workings of Tyldesley Colliery or Old Invincible Colliery;
- No runoff from disturbed areas will be allowed to flow from the Project Boundary without treatment via a sediment dam; it will otherwise be collected and reused on site; and
- Release of runoff from rehabilitated catchments once rehabilitation is fully established to the satisfaction of DTIRIS – DRE.

Strategies to avoid discharges from the two new mine water dams proposed for the Contracted Project (MWD J6-3 and MWD C4-2) include the following:

- Ceasing to pump mine water from active mining areas and open cut pits into MWD J6-3 when the volume of water stored in MWD J6-3 exceeds 35 ML (total proposed dam volume is 75 ML);
- Ceasing to pump mine water from active mining areas and open cut pits into MWD C4-2 when the volume of water stored in MWD J6-3 exceeds 130 ML (total proposed dam volume is 250 ML);
- Excess mine water will be stored in open cut sumps until capacity is available in MWD J6-3 and MWD C4-2 for transfer. The transfer limit volume for each storage outlined above were adopted based on the water balance modelling for the Contracted Project, which identified the amount of freeboard required to prevent discharge from these storages, based on 121 years of climate data; and
- In emergency situations, water may be pumped from MWD J6-3 to Cullen Valley Mine Dam 4 (LD004) and from MWD C4-2 to the Invincible Colliery Main Dam (LD002) for discharge, provided it meets the appropriate EPL water quality limits.

Strategies for minimising the potential for releases of water from existing discharge points will also include:

- Increasing the capacity of the existing bore and pump connecting the Cullen Valley Mine Main Dam (Cullen Valley Dam 1) to the flooded Tyldesley Colliery. This may reduce future releases from Cullen Valley Mine licensed discharge points LD001 and LD004;
- Obtaining approval and installing pumping equipment to allow the transfer of water from the Invincible Colliery Main Dam into the abandoned Invincible Colliery and Old Invincible Colliery workings; and
- Constructing a second water storage upstream of the Invincible Colliery Main Dam following the completion of active open cut mining in this area between Years 2 and 8 of the Contracted Project. The open cut mining area immediately upstream of the Invincible Colliery infrastructure area will be retained and used as buffer storage, with captured runoff from the upstream rehabilitation areas seeping into the abandoned underground workings.

The proposed final water storages of the Site Water Management System are conceptually illustrated in **Figure 14**.

Through the development and management of a consolidated Water Management System for the Contracted Project, discharges of surface water from the Project Boundary are predicted to occur only in the following ways:

- As clean runoff, occurring from areas within the Project Boundary that are undisturbed by mining activities;
- Overflows from sediment dams. Sediment dams will be designed in accordance with Landcom (2004) and will spill regularly. Spills from appropriately designed sediment dams are considered to be clean runoff; and
- Discharge of mine water from the existing licensed discharge points at Invincible Colliery and Cullen Valley Mine. Mine water storages will be managed to limit the discharge of mine water from the Project Boundary. No additional licensed discharge points are proposed as part of the Contracted Project and the existing discharge point LD001 for Invincible Colliery has been surrendered. The two new proposed mine water dams, MWD C4-2 and MWD J6-2 will be designed as ‘zero release’ storages, and hence will not require additional licensed discharge points.

Erosion and Sediment Control

Coalpac will develop an Erosion and Sediment Control Plan for the Contracted Project to the approval of DP&I that will be based on existing management measures and the principle of ensuring that runoff from disturbed areas is separated from clean area runoff and collected in sediment dams for treatment while clean water from undisturbed catchments will be diverted away from disturbed areas, where practical.

Design of the erosion and sediment control measures will be based on the recommended design standards in *Managing Urban Stormwater, Soils and Construction* (Landcom 2004) and *Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries* (DECC 2008).

A number of sediment and erosion control measures are proposed within the Project Boundary, including sediment dams, dirty water drains and clean water diversions for each stage of mining. The size of the proposed sediment control structures assessed for the Contracted Project is outlined in **Table 6**. The ultimate sizing of these structures will be determined during the detailed design and will be undertaken in accordance with Landcom (2004).

Where Total Suspended Solids (TSS) concentration in sediment dams after a runoff event is less than the selected water quality objective, sediment dams may be dewatered to receiving waters outside the Project Boundary. Should TSS exceed the required water quality objective, the following management measures may be implemented should discharge of this water be required:

- Pumping water to another water storage dam with available capacity;
- Flocculated to reduce TSS to less than the water quality objective; or
- Retained within the mine Water Management System.

Surface Water Monitoring

Coalpac will develop a Surface Water Monitoring Program for the Contracted Project to the approval of DP&I which shall include monitoring at sites upstream, onsite and downstream of mining operations and within sediment dams and mine water storages. Monitoring of surface water quality both immediately adjacent and within the Project Boundary will form a key component of the Surface Water Management System. The monitoring regime will be developed in consultation with OEH and undertaken in accordance with the *Approved Method for Sampling and Analysis of Water Pollutants in NSW* (DEC 2004) and relevant licence conditions for parameters including pH, Electrical Conductivity (EC), TSS, Total Dissolved Solids (TDS) turbidity, major anions, major cations, alkalinity and metals.

Under the Surface Water Monitoring Program proposed for the Contracted Project, it should be noted that:

- Water quality will be monitored at locations where releases from proposed sediment dams may drain across the Project Boundary in order to identify locations where further sediment control measures may be required. Monitoring at these locations will only be undertaken during runoff events (>20 mm rainfall in 24 hours), as most of these drainage lines are ephemeral and only flow in the period immediately following a rainfall event;
- Monitoring of discharge points in sediment dam catchments will only be required once the catchment has been disturbed by Contracted Project operations;
- Sediment dam catchments that do not contain any disturbed areas (i.e. all completed rehabilitation areas within the catchment have been signed off by relevant regulators against the agreed rehabilitation criteria) will not require water quality monitoring;
- The water quality monitoring program for Cullen Creek and Dulhuntys Creek established in October 2011 will be continued to gather background data on downstream water quality and allow the impact of any releases from existing licensed discharge points to be quantified;
- Water quality monitoring will continue on a monthly basis (and during release events) for the retained licensed discharge points and Invincible Environmental Dam; and
- Water quality will also be monitored in the two new proposed mine water dams (MWD J6-2 and MWD C4-2) on a monthly basis. These dams will be operated such that no releases occur during the life of the Contracted Project.

Table 6
Indicative Water Storages for Modelling

Storage	Capacity (ML)	Maximum Surface Area (ha)
Main Colliery Dam	115	3.4
SD C3-1	10	0.5
SD C3-5	60	3.0
SD C5-2	5	0.2
SD C5-3	30	0.5
CV Main Dam (Cullen Valley Dam 1)	7	0.4
CV Dam 4	38	0.5
MWD C4-2	250	3.0
MWD J6-3	75	1.5

3.10 GROUNDWATER

3.10.1 Background

A groundwater impact assessment was undertaken for the Exhibited Project by Australasian Groundwater and Environmental Consultants (AGE). This study was included as Appendix O of the Exhibited EA. The key objectives of the groundwater impact assessment were to:

- Determine the existing groundwater environment with the development of an accurate conceptual model, and to identify any existing users and Groundwater Dependent Ecosystems (GDEs);
- Provide an assessment of potential groundwater impacts;
- Interpret data and report on groundwater seepage, drawdown and other impacts on connected groundwater associated with the Permian aquifer;
- Estimate groundwater discharge from the flooded underground workings of the Tyldesley Colliery, Invincible Colliery and Old Invincible Colliery into the adjacent (down hydraulic gradient) Baal Bone Colliery;
- Estimate groundwater inflow rates to the open pit developed during quarrying of the Marrangaroo Formation for the Exhibited Project;
- Describe any measures that would need to be implemented to avoid, minimise, mitigate and offset the impacts of the Exhibited Project (subject to more effective measures being identified in the future); and
- Determine groundwater management and monitoring protocols to be adopted to meet licensing conditions.

3.10.2 Impact Assessment

The potential impacts of the Exhibited Project on the local and regional groundwater resources were considered to include:

- Minor seepage from the Lithgow Seam, with an upper seepage limit (per 1,000 m of coal seam) of 10 ML/year;
- A range of seepage from the flooded underground workings from 0.025 m^3/day/m, up to about 0.07 m^3/day/m. Mining of the Lithgow Seam will not intersect the flooded underground workings in the Tyldesley Colliery and a barrier of solid coal of approximately 50 m was committed to be left in place between the flooded underground mine and the open cut pits;
- Total groundwater inflow for all highwall drives was assessed to be approximately 12 m^3/day, assuming a hydraulic conductivity of about 0.09 m^3/day and have a void volume of about 375 ML;

- The total volume of highwall drives will fill by groundwater seepage from the Lithgow seam in approximately 86 years;
- Groundwater inflow to the Cullen Valley mining area pit to range between 0.8 ML/year to about 13 ML/year;
- Minor localised impacts on groundwater, limited mostly to the northern areas of the Project Boundary;
- The mining operation generating a localised zone of depressurisation in the coal seams, but this is not expected to impact on adjacent landholders' bores or the alluvial aquifers in the vicinity of the Project Boundary;
- The volume of water stored within the flooded workings of the Old Invincible Colliery remaining unaffected by the Exhibited Project, with this water being used to augment surface water supplies to meet the Exhibited Project water requirements;
- No impacts to GDEs. No GDE have been identified within the Project Boundary and there are no known springs within the Project Boundary that are fed by groundwater around which GDEs may have developed; and
- The Coxs River Swamp and Jews Creek Swamp are considered to be the GDE in closest proximity to the Exhibited Project but are located approximately 2 km and 3.5 km outside the Project Boundary, respectively. Discharges will not occur from the Exhibited Project to this area and hence the Exhibited Project will not affect these swamps.

The changes to the Exhibited Project mine plan (Contracted Project) which will result in a material reduction in predicted groundwater impacts include the following:

- Removal of the Hillcroft mining area. The removal of this area will result in a reduction of groundwater inflows from open cut and highwall mining; and
- Removal of the sand extraction component of the Exhibited Project located in the Cullen Valley mining area. This will reduce the inflows into the sand extraction area of up to 13 ML/year for the period for which sand extraction was proposed under the Exhibited Project.

While other modifications to the Contracted Project mine plan result in a reduction to the Project Disturbance Boundary assessed in the Exhibited Project, it is anticipated that these will not result in a significant change in predicted groundwater impacts.

3.10.3 Mitigation and Management

Consistent with the existing commitments presented in the Exhibited Project, Coalpac are committed to the management and mitigation of the potential impacts of the Contracted Project on groundwater resources.

Coalpac will develop a consolidated Water Management Plan in consultation with relevant Government departments and to the satisfaction of DP&I. The Water Management Plan will assist in ensuring that the existing groundwater monitoring network is enhanced and is well maintained so that the modelled predictions and assumptions can be verified and any potential unforeseen groundwater impacts can be quickly identified and managed.

The consolidated Water Management Plan will incorporate the following management and mitigation measures:

- The existing water monitoring bores that are not within the footprint of the Contracted Project will remain in place and will not be disturbed during the life of the mine to monitor for depressurisation, principally in the Lithgow Seam on an ongoing basis;
- The existing Coalpac monitoring bores will be supplemented with an additional two bores and the replacement of a further four bores during the life of the Contracted Project (as these are predicted to be depressurised or impacted by mining). These bores will continue to be monitored for depressurisation, principally within the Lithgow Seam, in accordance with the Australian Guidelines;
- Four private bores registered with NSW Office of Water (NOW) (GW106258, GW064530, GW064531 and GW062283) are predicted to be impacted by the Contracted Project. The landholders will be consulted in relation to the installation of automatic water level pressure transducers at these locations and if agreed, they will be installed. These water level pressure sensors will be set to record water levels on an ongoing basis and any groundwater level data collected from private bores will be assessed annually;
- Coalpac will seek a data sharing agreement with Xstrata to access monitoring data from the monitoring bores for Baal Bone Colliery located along the Coxs River Swamp. Other groundwater monitoring data will be sought from other surrounding industry, if available;
- An application for a water licence under the *Water Management Act 2000* to account for the predicted seepage rates from the coal seam will be made in accordance with the relevant Water Sharing Plans;
- Annual monitoring of water samples from all monitored bores for major cations and anions, ammonia, nitrate, nitrite along with heavy metals including iron, lead, chromium, cadmium, zinc, arsenic, copper and nickel. ANZECC water quality guideline trigger values for stock watering will be utilised until site specific trigger values are available;
- Implementation of an appropriate method for the calculation of groundwater seepage rates into the open cut mining areas for the Contracted Project; and

- An annual review of groundwater monitoring data to identify trends and any adverse impacts in addition to those predicted for the Contracted Project and the implementation of further monitoring and mitigation actions, if required.

3.11 GEOCHEMICAL

3.11.1 Background

A geochemical impact assessment was undertaken for the Exhibited Project by RGS Environmental Pty Ltd (RGS). This study was included as Appendix P of the Exhibited EA. It involved a geochemical characterisation process and the assessment of overburden and potential coal reject materials associated with the open cut and highwall mining of the target coal seams for the Exhibited Project.

In addition, the geochemical assessment of the basal Marrangaroo Formation underlying the Lithgow Seam was included to confirm its suitability for extraction. The results of the characterisation were used to develop additional environmental management measures related to overburden and coal reject emplacement for the Exhibited Project, in addition to those procedures already put in place by Coalpac for their existing operations.

3.11.2 Impact Assessment

The potential impacts of the Exhibited Project indicated that the majority of overburden materials are likely to have negligible (< 0.2%) total sulphur content and low to moderate Acid Neutralising Capacity (ANC) and were therefore classified as Non Acid Forming (NAF) barren. One sample from the Marrangaroo Sandstone contained significantly elevated total sulphur content (0.82%) to Maximum Potential Acidity and consequently, was considered to have an increased risk of acid generation.

Most potential coal reject materials were found to have negligible total sulphur content (< 0.1%) and are therefore classified as NAF barren. These materials have a high Factor of Safety with respect to potential acid generation. A small proportion of the potential coal reject materials associated with the Lithgow Seam have a relatively higher total sulphur content and negligible buffering capacity (and hence a low Factor of Safety) and are classified as Potentially Acid Forming (PAF) - High Capacity.

In contrast, the tailings materials that were tested from processing the Lithgow Seam at the ICPP were NAF. This demonstrates that not all reject material from the Lithgow seam is PAF.

The concentration of total metals in potential coal reject solids is well below the applied guideline criteria for soils and is unlikely to present any environmental issues associated with the rehabilitation and the final closure of the mine. However, PAF coarse reject materials from the Lithgow Seam may have some potential to generate acidic and more saline runoff and seepage if exposed to oxidising conditions.

The changes to the mine plan for the Contracted Project are not anticipated to result in a material reduction in predicted geochemical impacts for coal extraction as described above.

While the reduction in the Exhibited Project Disturbance Boundary and highwall mining footprint will result in extraction of a lesser coal resource, it is anticipated that these changes will not result in a significant change in predicted geochemical impacts.

The more significant reduction in potential geochemical impacts will result from the removal of the sandstone extraction component of the Exhibited Project. The Contracted Project will not include the extraction of the Marrangaroo Sandstone within the Cullen Valley Mining area as proposed in the Exhibited EA.

3.11.3 Mitigation and Management

Coalpac are committed to the management and mitigation of the potential geochemical impacts of the Contracted Project. The ongoing management of overburden will consider the geochemistry of these materials with respect to its potential risk to cause harm to the environment and their suitability for use in construction and revegetation. Coalpac will undertake:

- Pre-stripping topsoil from areas to be mined for use in final rehabilitation activities (surface cover or vegetation growth medium) consistent with that described in the Exhibited Project Soil and Landscape Impact Assessment;
- Placement of overburden within the OEAs in a manner that limits the risk of surface erosion; and
- Field trials to identify the most appropriate topsoil and overburden materials for the revegetation and rehabilitation of final landforms.

Further to the above, surface water and groundwater monitoring associated with runoff or seepage from the emplacement areas will be incorporated into the Environmental Management Plan (EMP) and monitored on a regular basis for pH, EC, TSS and dissolved metals (including arsenic, molybdenum and selenium).

The ongoing management of coal reject materials will consider the geochemistry of the materials with respect to their potential risk to cause harm to the environment and their suitability for use in construction and revegetation. Coalpac will implement the following management measures:

- Placement of NAF coal rejects materials in the open pit and / or co-disposal with overburden. For the co-disposal method, placement of NAF coarse reject material in a manner that limits the risk of erosion;
- Deep (in-pit) burial of PAF coal reject materials from the Lithgow Seam;
- PAF coarse rejects will be covered as soon as practical (within a few weeks) with 5 m of NAF overburden material to minimise the length of exposure time to oxidising conditions (and minimise the potential for Acid Mine Drainage);

- The time for covering PAF coarse reject materials and the depth of cover will be optimised by using data from kinetic leach column tests and cover design investigations; and
- Ongoing consideration of the geochemistry of coal rejects materials generated by the ICPP and ETCPP in relation to potential impact risk from these materials.

3.12 ABORIGINAL HERITAGE

3.12.1 Background

An Aboriginal cultural heritage impact assessment was undertaken for the Exhibited Project by AECOM and included as Appendix K of the Exhibited EA. The objectives of the assessment were to review and assess the nature of the archaeological landscape of the Project Boundary and assess the potential impacts that the Exhibited Project may have on Aboriginal cultural heritage values, in consultation with representatives of the local Aboriginal community.

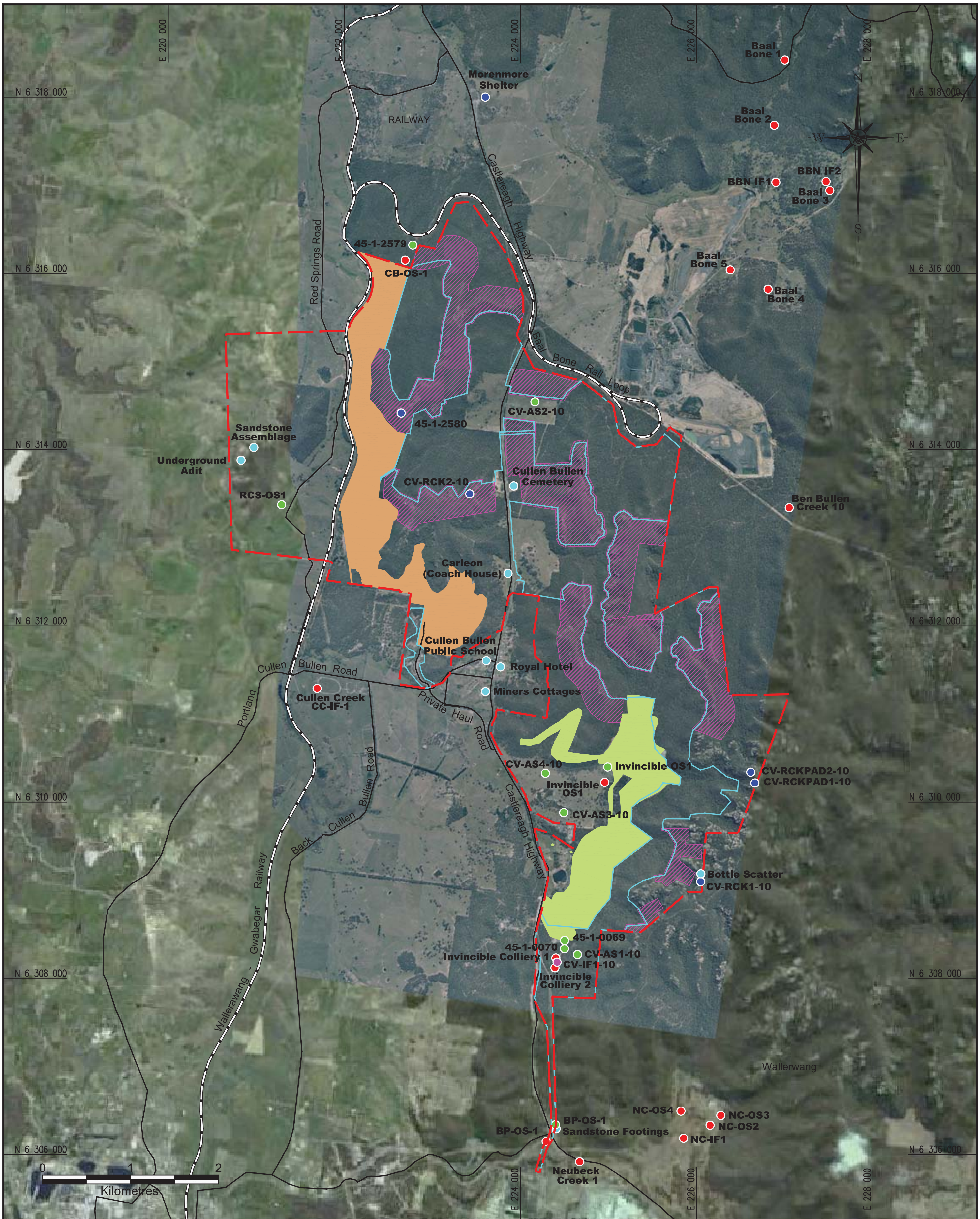
3.12.2 Impact Assessment

The Exhibited Project assessment identified a total of 15 Aboriginal sites that were located within the Project Boundary, including a number that had been recorded by previous assessments in the local area of the existing Cullen Valley Mine and Invincible Colliery operations (see **Figure 10**). The majority of Aboriginal sites located during the Exhibited Project survey were stone artefact sites, with nine artefact scatters and a single isolated find identified. In addition to these, three rock shelter sites were definitively identified, along with two rock shelters that were considered to have some archaeological potential. All rock shelter sites were located outside of the Exhibited Project Disturbance Boundary.

Of these sites, it is proposed that five open artefact scatters and the isolated find, all of which were assessed to be of low scientific significance, will be subject to a surface collection prior to disturbance. This process will be undertaken in consultation with the local Aboriginal community. The five rock shelter sites (including both the known and potential sites) will be regularly monitored through the life of the Exhibited Project to ensure the potential for indirect impacts are appropriately managed.

Table 7 provides a summary of Aboriginal sites identified within the Project Boundary, notes their significance, the likely impact of the Contracted Project on each site and the respective management measures.

In addition to the sites identified in the Exhibited Project assessment, notification of an additional rock shelter site of Aboriginal heritage significance being discovered within the Project Boundary was provided to Coalpac in September 2012. Coalpac personnel took part in the inspection of this new site with OEH and members of the local Aboriginal community and it was determined that this site would not be directly impacted by the Contracted Project being located some 400 m outside of the Project Disturbance Boundary.



- Project Boundary
- Project Disturbance Boundary
- Existing Cullen Valley Mine
- Existing Invincible Colliery
- Indicative Highwall Mining
- Non Indigenous Heritage Site

Aboriginal Heritage Site

- Open Camp Site
- Shelter with Deposit
- Isolated Find
- Artefact Scatter

Hansen Bailey

Coalpac Pty Ltd

Coordindate System: MGA Zone 56
Source: AECOM 2011

COALPAC CONSOLIDATION PPR

Heritage Sites

Cad File: 09170C.dwg | Date: 05.04.13 | Drawn: CP

Figure 10

In response to a request from local Aboriginal community stakeholders, the location of this site is not provided on **Figure 10**; however it will be monitored and managed in accordance with the approved procedures under the proposed Aboriginal Archaeology and Cultural Heritage Management Plan (AHMP).

The changes to the Exhibited Project mine plan will not result in any changes to the predicted impacts to Aboriginal heritage items.

Table 7
Contracted Project Impacts on Aboriginal Heritage Sites

Site Type	Site Name	Scientific Significance	Contracted Project Impact	Management
Isolated find	CV-IF-1	Low	Open Cut Mining Direct Impact	Surface collection of artefacts
Open Artefact Scatter	Invincible Colliery Site 1	Low	Open Cut Mining Direct Impact	Surface collection of artefacts
	Invincible Colliery Site 2	Low	Open Cut Mining Direct Impact	Surface collection of artefacts
	BP-OS-1	Low	Infrastructure Direct Impact	Surface collection of artefacts
	CV-AS1-10	Low	Open Cut Mining Direct Impact	Surface collection of artefacts
	CV-AS2-10	Low	Open Cut Mining Direct Impact	Surface collection of artefacts
	CV-AS3-10	Low	Not Impacted	N/A
	CB-OS-1	Moderate	Not Impacted	N/A
	CV-AS4-10	Moderate	Not Impacted	N/A
	Invincible OS1	High	Not Impacted	N/A
Potential Aboriginal rock shelter site	CB-S-1	Low	Indirect, Potential Vibration and Subsidence Impact	Monitoring and reporting, Blast protocol as per **Section 3.7**
	CV-RCK2-10	Low	Indirect, Potential Vibration and Subsidence Impact	Monitoring and reporting
Rock shelter with Potential Archaeological Deposit	CV-RCKPAD2-10	Low	Indirect, Potential Vibration Impact	Monitoring and reporting
	CV-RCKPAD1-10	Moderate	Indirect, Potential Vibration Impact	Monitoring and reporting

Site Type	Site Name	Scientific Significance	Contracted Project Impact	Management
Rock shelter with deposit	CV-RCK1-10	Moderate	Indirect, Potential Vibration Impact	Monitoring and reporting
Rock shelter with art stencils	-	-	Indirect, Potential Vibration Impact	Monitoring and reporting

3.12.3 Mitigation & Management

Coalpac will develop an AHMP for the Contracted Project, to be prepared in consultation with Aboriginal community stakeholders and OEH to the approval of DP&I. The AHMP will be guided by specific policies and procedures to manage Aboriginal archaeological sites within the Project Boundary.

The AHMP will be developed consistent with the predicted impacts and management commitments included in **Table 7** and would be periodically reviewed in consultation with Aboriginal stakeholders and OEH. The AHMP will include provisions for at least the following:

- Protection of sites prior to salvage;
- Protection of sites prior to direct impacts or indirect predicted impacts, including development of appropriate monitoring strategies for vibration and to confirm that no subsidence impacts occur;
- Protection of sites that are not impacted by the Contracted Project by means of fencing or other management controls;
- Detailed salvage methodologies to be carried out prior to impact;
- Development of protocols for the monitoring of earth works, as required;
- Identification of an appropriate storage location and procedure for the care and control of salvaged artefacts in accordance with *Code of Practice for Archaeological Investigation for Aboriginal Objects in New South Wales* (OEH 2010b); and
- Implementation of comprehensive monitoring regime for the five rock shelter sites identified within the Contracted Project area. All five sites are to be monitored before, during and following proposed open cut and highwall mining operations within the Contracted Project area. Specifically, the following provisions will be incorporated into the AHMP:
    - o A subsidence and vibration model, consistent with the SMP process and Blast Management Plan, will be developed for each rock shelter site prior to the commencement of any mining operations within 500 m of the identified sites;

- o Blast management procedures to limit potential for indirect impacts, as discussed in **Section 3.7**;
- o Impact assessment and monitoring of the sites will be conducted throughout the life of the Contracted Project;
- o Upon completion of open cut and highwall mining operations within the Project Boundary, a final impact assessment for identified rock shelter sites will be undertaken; and
- o In the event that there are subsidence or vibration impacts to any of the rock shelters being monitored, management strategies specific to the impact identified shall be developed in consultation with registered Aboriginal stakeholder groups for the Contracted Project, OEH and the DP&I and implemented in accordance with current conservation practice.

Coalpac will also establish and manage a Keeping Place during the life of the Contracted Project. The Keeping Place will be developed in consultation with the Aboriginal community and OEH. It will house the artefacts salvaged prior to Contracted Project impacts and will be accessible to appropriately trained Aboriginal Community Representatives, or those otherwise agreed with the local Aboriginal community.

3.13 NON-ABORIGINAL HERITAGE

3.13.1 Background

A Non-Aboriginal heritage impact assessment was undertaken for the Exhibited Project by AECOM. This study was included as Appendix M of the Exhibited EA and the assessment consisted of several components to ensure that all relevant Non-Aboriginal heritage items that had the potential to be impacted by the Exhibited Project were considered. These included:

- A review of historical and archival research and searches of the relevant Commonwealth and State heritage lists to identify any known heritage items of significance within 10 km of the Project Boundary that may have the potential to be impacted by the Exhibited Project. Two historic heritage items registered within the Project Boundary were identified during these searches, including the Cullen Bullen General Cemetery and the Carleon Coach House;
- A desktop review of previous Non-Aboriginal Heritage assessments of the Project Boundary and surrounds, including an assessment of Parish Maps and searches of the NSW State Library and online State records;
- Liaison with the LCC Heritage Adviser and the Lithgow & District Family History Society to ascertain any knowledge in relation to the historical significance of area within the Project Boundary;

- A field survey undertaken from 15 November 2010 to 10 December 2010 by AECOM archaeologists over the areas identified as having the potential to contain evidence of any historical items of interest based on the devised predictive model and information obtained during the course of the historical and archival research; and
- A Cultural Heritage Landscape Heritage Assessment. This component of the study was undertaken to assess interaction of humans and the natural environment.

3.13.2 Impact Assessment

Five sites within the Project Boundary, with a further four sites identified within 500 m of the Project Boundary (see **Figure 10**). All identified sites and their significance are listed in **Table 8**.

The Exhibited Project was found to directly impact upon two historic heritage sites, consisting of the Underground Mine Adit and the Sandstone Assemblage which lie within the open cut footprint. The Exhibited Project was also considered to have the potential to indirectly impact upon three historic heritage sites, including the Cullen Bullen General Cemetery, Carleon Coach House and Sandstone Footings. The remaining four sites were not considered to have any potential to be impacted by the Exhibited Project.

The changes to the mine plan for the Contracted Project will result in a material reduction in predicted Non-Aboriginal heritage impacts. The removal of the Hillcroft mining area will result in both the Sandstone Assemblage and the Underground Mine Adit sites not being impacted by the Contracted Project.

As a result of the Contracted Project, there will be no direct impacts to any Non-Aboriginal heritage sites. However, the Contracted Project still has the potential to indirectly impact upon three Non-Aboriginal heritage sites, including the Cullen Bullen General Cemetery, Carleon Coach House and Sandstone Footings.

3.13.3 Mitigation and Management

Table 8 provides a summary of the proposed management strategies to indirect impacts of the Contracted Project on Non-Aboriginal heritage sites.

Coalpac will develop a Historic Heritage Management Plan (HHMP) for the Project in consultation with the relevant authorities and to the satisfaction of DP&I. The HHMP will include, but not be limited to:

- A Statement of Heritage Impact, along with archival recording to establish a baseline for monitoring, and a program of site monitoring will be undertaken prior to blasting within 500 m of the Cullen Bullen General Cemetery and the Carleon Coach House;
- Provisions that will enable the Sandstone Buildings Footings site to be signposted and fenced during construction of the MPPS conveyor, including an appropriate buffer;
- Proposed strategies for assessing and rectifying any adverse impacts from blasting to heritage items, along with procedures for ongoing monitoring; and

- Measures for the monitoring of issues that may impact the Cullen Bullen cultural heritage landscape, including potential blasting, subsidence and visual aspects that may impact the landscape values in the area.

Table 8
Non-Aboriginal Heritage Sites

Site Name	Site Description	Significance	Management Action
Located within the Project Boundary			
Cullen Bullen General Cemetery	Located on the Castlereagh Highway between Lithgow and Capertee, and approximately 1 ha in size and dates back to 1917. The cemetery remains in use today and is administered by the LCC	Local	Indirect impact as a result of blasting, a Statement of Heritage Impact, archival recording and monitoring of blasts within 500 m of the site
Carleon 'Coach House'	Located approximately 700 m north of Cullen Bullen town on the western side of the Castlereagh Highway, Carleon was originally built in 1873 from sandstone blocks and a shingle roof	Local	Indirect impact as a result of blasting, a Statement of Heritage Impact, archival recording and monitoring of blasts within 500 m of the site
Underground Mine Adit	A disused underground adit was recorded on the Hillcroft property, located at the western extent of the Project Boundary dating back to c. 1903. Six timber props lining the side walls were visible from the entrance way; however, a determination as to the extent and depth of the adit was not possible due to it being in-filled and immersed in water	Local	Site not impacted by the Contracted Project
Sandstone Assemblage	Located approximately 220 m north of the disused adit, the assemblage consisted of two single layered parallel lines of natural uncut sandstone blocks, approximately 1.1 m apart and 2.25 m long, running in a north / south direction	To be confirmed	Site not impacted by the Contracted Project
Bottle Scatter CV-RCK1-10	Recorded at Aboriginal Site CV-RCK1-10. CV-RCK1-10 approximately 20 glass bottle fragments are scattered across the surface of shelter	Local	Not impacted therefore no management action required
Located Outside the Project Boundary			
Sandstone Building Footings	Located south of the Project Boundary, are the sandstone footings of a building with dimensions of 9.8 x 8.5 m. Sandstone blocks forming the footings are irregularly shaped and ranging in size from approximately 70 cm in length to small stone rubble. There is a high potential for subsurface material at the Site	To be confirmed	Potential for impacts during construction of the MPPS conveyor. Site will be temporarily fenced to include a 20 m buffer during construction
Miners Cottages	Located in Cullen Bullen and consisting of weatherboard fronts, fibro clad rears and sides, and brick foundation walling (c1890 - 1900). A gabled iron roof lies over two	Local	Not impacted therefore no management action required

Site Name	Site Description	Significance	Management Action
	rooms and skillions at the rear, and a bull-nosed veranda fronts the Cottages		
Cullen Bullen Public School	Located in Cullen Bullen and consisting of a group of three buildings dating from 1875 the first with timber cladding and gabled roofs. A second building was constructed in the 1920s, comprising of two rooms and a fireplace and the third building is a modern demountable structure placed between the first two structures	Local	Not impacted therefore no management action required
Royal Hotel	Located in Cullen Bullen the Victorian styled hotel was built in two stages along roadside frontage. The first southern section of the hotel was constructed in 1890. The second section consists of dry pressed brick with smaller pane windows. A two storey Edwardian verandah continues along the entire street facing facade	Local	Not impacted therefore no management action required
Beaumaris	Located south of Cullen Bullen, Beaumaris was the first settlement in the area and includes the remains of an early 1820s homestead	Local	Not impacted therefore no management action required
Blackmans Flat Roman Catholic Cemetery	Located south of the Project Boundary the Blackmans Flat Roman Catholic Cemetery has been in use since 1877 and is associated with the families in the area	Local	Not impacted therefore no management action required
Cottage	Located south of Cullen Bullen the Cottage is an example of an early 20th century miners home that reflects the socio-economic situation of the occupants	Local	Not impacted therefore no management action required
Cottage 2	Located south of Cullen Bullen Cottage 2 is an example of an early 20th century miners home that reflects the socio-economic situation of the occupants	Local	Not impacted therefore no management action required
Cullen Bullen Landscape	Includes the cultural and natural elements of the landscape such as the location of Cullen Bullen, views to surrounding areas and sandstone outcrops that the local community has strong associations with.	Local	Management and mitigation measures for landscape elements (i.e. for visual, subsidence and blast impacts) to be included in the HHMP

3.14 ECOLOGY

3.14.1 Background

An ecological impact assessment was undertaken for the Exhibited Project by Cumberland Ecology and included as Appendix J of the Exhibited EA. This study included the assessment of biodiversity values within the Project Boundary, including Threatened species, populations and protected ecological communities as listed under the *Environment Protection and Biodiversity Conservation Act 1999* and Threatened species and communities as listed under the NSW *Threatened Species Conservation Act 1995*. The Exhibited Project assessment consisted of:

- A review of the extensive body of relevant literature that discusses the biodiversity values of the Project Boundary and surrounding regions and Threatened species;
- Field surveys within the Project Boundary and proposed biodiversity offsets to gain an understanding of the flora and fauna species (with a focus on Threatened species), and habitat present; and
- Field surveys to assess and map the extent of each vegetation community present within the Project Boundary.

3.14.2 Impact Assessment

The changes to the Exhibited Project mine plan (Contracted Project) which will result in a material reduction in predicted ecological impacts include the following:

- Removal of the Hillcroft mining area;
- Removal of the sand extraction and processing;
- Reduction in the Cullen Valley open cut mining footprint; and
- Modification to the open cut mining footprint for SPLs.

The methodology used for the assessment of the ecological impacts associated with the Contracted Project by Cumberland Ecology (see **Appendix G**) included a number of components in order to consider the predicted reduction in impacts, including:

- An additional literature review of various documents either referred to or considered in the PAC Review Report for the project (PAC 2012);
- Database analysis of public records held for species associated with pagoda habitat that had been discussed in the PAC Review Report;
- Definition, review and mapping of SPL;
- Testing the assertions made by the PAC and other regulatory agencies;
- Additional site inspections; and
- Consultation with experts and peer reviewers.

Impacts on Significant Pagoda Landform Ecology

In order to complete an assessment of the potential impacts of the Contracted Project on SPL, Cumberland Ecology (2013) reviewed the extent of these features in the region. This assessment showed that at least 25,800 ha of SPL as defined by Cumberland Ecology are present in the region, extending from Northern Wollemi Park to Lithgow. Of the total area of SPL mapped in the region, approximately 113 ha (0.44%) occurs within the Project Boundary.

The proposed open cut mining footprint of the Contracted Project will not disturb the area of SPL mapped within the Project Boundary and will not disturb other areas of sandstone cliffs, caves and rock outcrops. Buffer zones between the cliff and pagoda features within the SPL and the maximum open cut and highwall mining footprints proposed for the Contracted Project have also been provided to reduce the risk of indirect impacts to SPL from blasting and subsidence.

Impacts on Biodiversity

The Contracted Project will result in a 196 ha reduction in the removal of native vegetation from the communities listed below in **Table 9** and shown on **Figure 11** compared to the Exhibited Project (approximately 762 ha compared to 958 ha). The threatened flora species and Rare or Threatened Australian Plant (ROTAP) species recorded from within the Project Boundary or with the potential to occur are not predicted to experience significant impacts from the Contracted Project following the implementation of proposed impact mitigation and compensatory measures.

In particular, the Contracted Project avoids the Clandulla Geebung habitat located in the north-western section of the Cullen Valley mining area and protects the deep gully vegetation associated with the SPL.

Table 9
Vegetation Disturbance within the Contracted Project Disturbance Boundary

Vegetation Community (Status)	Area of Vegetation within Project Boundary (ha)	Total to be cleared within the Contracted Project Disturbance Boundary (ha)	Total Avoided (%)
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest	0.9	0.0	100%
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland	23.4	0.0	100%
Tableland Gully Ribbon Gum Blackwood Applebox Forest	111.8	91.2	18%
Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland	16.6	15.0	10%
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC)	46.2	15.0	68%
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC)	0.3	0.3	0%
Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy	0.1	0.1	6%
Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	2.0	2.0	2%
Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	679.1	295.2	57%
Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest	332.4	74.8	77%
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland	13.7	0.0	100%
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark	215.2	0.0	100%

Vegetation Community (Status)	Area of Vegetation within Project Boundary (ha)	Total to be cleared within the Contracted Project Disturbance Boundary (ha)	Total Avoided (%)
Grassy Woodland Low Diversity Derived Native Grassland			
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	260.9	182.9	30%
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland	57.1	49.2	14%
Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	51.7	18.0	65%
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland	12.8	12.4	3%
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland	2.8	0.9	70%
Cox's Permian Red Stringybark - Brittle Gum Woodland	92.0	5.1	95%
Pagoda Rock Sparse Shrubland	32.9	0.0	100%
TOTAL	**1,951.9**	**761.9**	**61%**

As a result of the reduction in the total area of disturbance of 196 ha (or 20% from that assessed for the Exhibited Project), the Contracted Project will incur materially less direct impacts to Threatened flora and fauna species. However, a number of Threatened flora and fauna species either occur, or have the potential to occur within the Project Boundary and may be impacted by the Contracted Project (see **Table 10** and **Table 11**). Locations where threatened species were identified in field surveys for the Contracted Project are shown on **Figure 12**.

For the species of fauna of particular concern listed in the PAC Report, the following specific conclusions are formed:

- **Brush-tailed Rock Wallaby -** The Contracted Project will not impact on a population of the BRW and in fact the commitment to annual fox baiting program may encourage its re-colonisation of the SPL over time.
- **Broad Headed Snake -** While the BHS was not recorded within the Project Boundary, it is one of a number of species that was considered to have the potential to occur within the Contracted Project area of disturbance. Consultations with experts and additional targeted surveys have failed to confirm its presence. Further, the habitat within the Contracted Project Boundary has been confirmed by the pre-eminent experts to be of poor quality for the BHS. It is concluded that the Contracted Project will have no significant impact on the distribution and survival of the BHS. Further, it is concluded that the habitat preservation resulting from the contraction of the open cut footprint from within the SPL, and more specifically the proposed habitat enhancements which form part of the Contracted Project may encourage its re-habitation of the SPL.

- **Cave Roosting Bats -** The Contracted Project will not impact directly (or in any significant way) on the roosting habitat of cave dwelling bats. Further, as these bats' foraging habitat is so widespread and the disturbance to such habitat by the Contracted Project so limited, Cumberland Ecology are of the view that any local population of cave dwelling bats will not be significantly impacted by the Contracted Project.

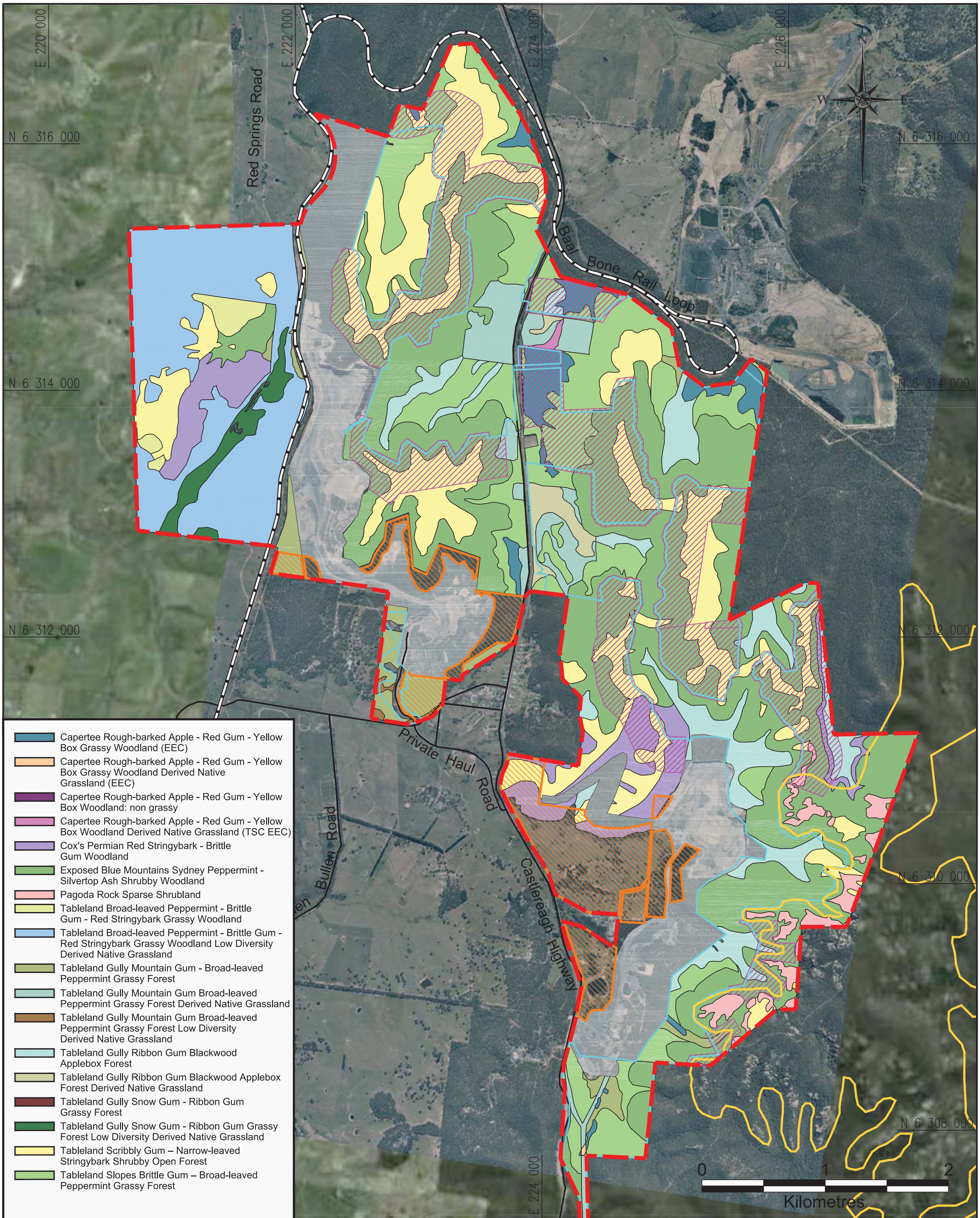
Table 10
Threatened flora species known or with potential to occur in the Project Boundary

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Occurrence within Project Boundary
Eucalyptus cannonii	Capertee Stringybark	V	V	Known
Persoonia marginata	Clandulla Geebung	V	V	Known
Eucalyptus pulverulenta	Silver-leaved Mountain Gum	V	V	Potential
Grevillea evansiana	Evans Grevillea	V	V	Potential
Grevillea obtusiflora subsp. Obtusiflora	-	E	E	Potential
Grevillea obtusiflora subsp. Fecunda	-	E	E	Potential
Prostanthera cryptandroides subsp. cryptandroides	-	V	V	Potential
Eucalyptus aggregata	Black Gum	V		Known
Derwentia blakelyi	-	V		Potential

Table 11
Threatened fauna species known or with potential to occur in the Project Boundary

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Occurrence within the Project Boundary
Birds				
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Known
Climacteris picumnus	Brown Treecreeper	V		Known
Petroica boodang	Scarlet Robin	V		Known
Chthonicola sagittata	Speckled Warbler	V		Known
Daphoenositta chrysoptera	Varied Sittella	V		Known
Lophoictinia isura	Square-tailed Kite	V		Known
Ninox strenua	Powerful Owl	V		Known
Glossopsitta pusilla	Little Lorikeet	V		Potential
Melithreptus gularis	Black-chinned Honeyeater	V		Potential

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Occurrence within the Project Boundary
Grantiella picta	Painted Honeyeater	V		Potential
Anthochaera phrygia	Regent Honeyeater	CE	E	Potential
Lathamus discolor	Swift Parrot	E	E	Potential
Pomatostomus temporalis	Grey-crowned Babbler	V		Potential
Neophema pulchella	Turquoise Parrot	V		Potential
Melanodryas cucullata	Hooded Robin	V		Potential
Stagonopleura guttata	Diamond Firetail	V		Potential
Calyptorhynchus lathami	Glossy Black-cockatoo	V		Potential
Tyto novaehollandiae	Masked Owl	V		Potential
Ninox connivens	Barking Owl	V		Potential
Mammals				
Dasyurus maculatus	Spotted-tail Quoll	E	V	Potential
Petrogale penicillata	Brush-tailed Rock-wallaby	V	E	Potential
Phascolarctos cinereus	Koala	V		Potential
Petaurus norfolcensis	Squirrel Glider	V		Known
Cercartetus nanus	Eastern Pygmy-possum	V		Potential
Petaurus australis	Yellow-bellied Glider	V		Potential
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V		Known
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Known
Mormopterus norfolkensis	Eastern Freetail-bat	V		Potential
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Potential
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Potential
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Known
Reptiles				
Hoplocephalus bungaroides	Broad-headed Snake	V	E	Potential
Varanus rosenbergi	Rosenberg's Goanna	V		Potential



Project Boundary
Project Disturbance Boundary
Approved Coalpac Operations
Highwall Mining
Existing Conservation & Offset Areas
Significant Pagoda Landform

Hansen Bailey

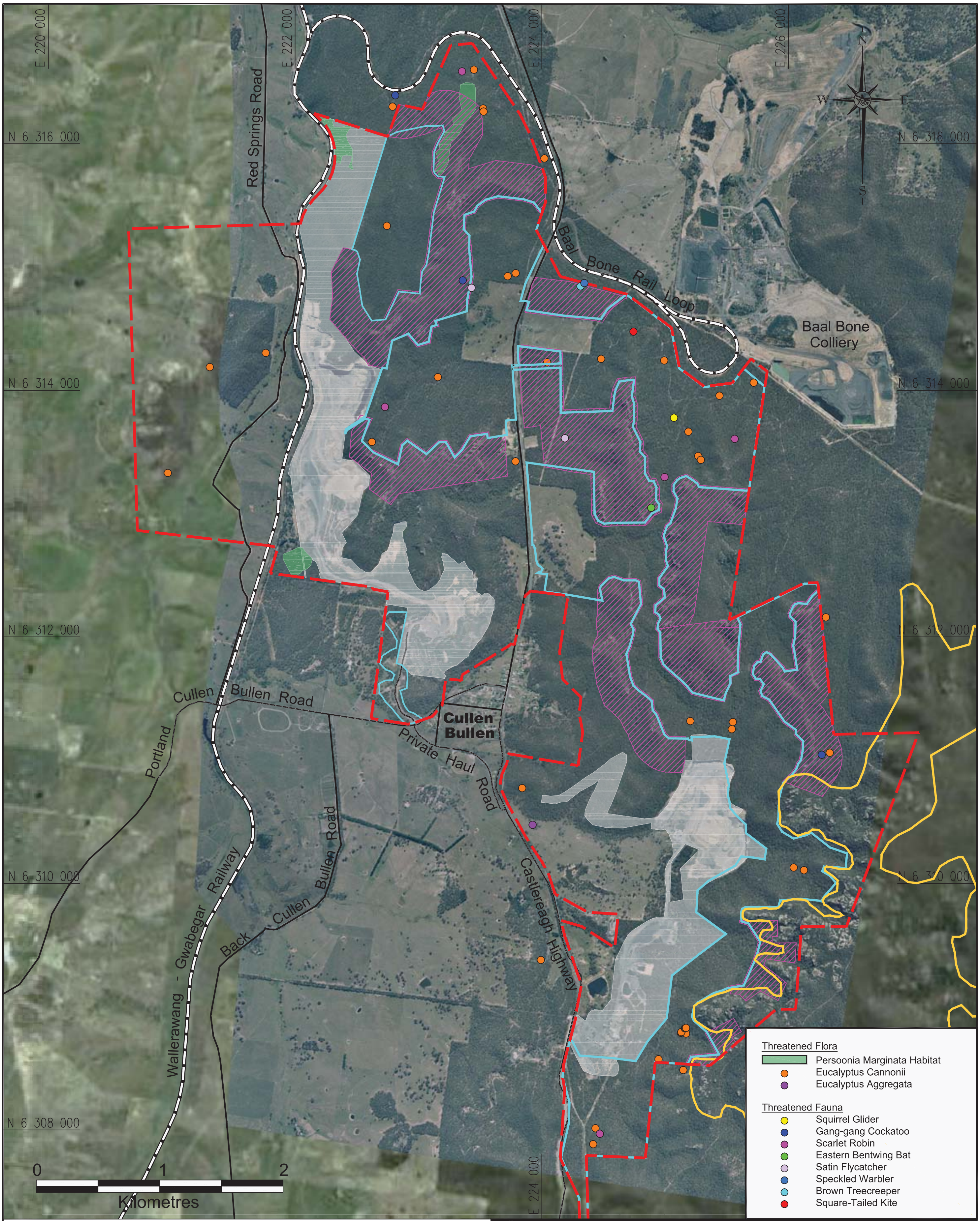
Coalpac Pty Ltd

Coordinate System: MGA Zone 56
Source: Cumberland Ecology 2011

COALPAC CONSOLIDATION PPR

Vegetation Communities

Cad File: 09171B.dwg	Date: 05.04.13	Drawn: CP	Figure 11



Hansen Bailey

Coalpac Pty Ltd

Coordinate System: MGA Zone 56
Source: Cumberland Ecology 2011

COALPAC CONSOLIDATION PPR

Threatened Flora and Fauna

Cad File: 09172C.dwg	Date: 05.04.13	Drawn: CP	Figure **12**

3.14.3 Mitigation & Management

Coalpac have committed to a range of management measures for the Contracted Project in accordance with the OEH *Draft Guidelines for Threatened Species Assessment* (DEC 2005), with the aim to avoid, mitigate or offset all identified impacts, as follows:

- Avoid: to the extent possible, developments should be designed to avoid or minimise ecological impacts;
- Mitigate: where certain impacts are unavoidable through design changes, mitigation measures should be introduced to ameliorate the ecological impacts of the proposed development; and
- Compensate: the residual impacts of the Contracted Project should be compensated for in some way.

Each of the above principles have been applied to the Contracted Project and addressed in the management and mitigation of ecological impacts.

Avoid

As discussed in **Section 2**, the Exhibited Project mine plan was revised through the consideration of a number of alternatives which were developed to reduce the potential for adverse impacts to the environment, including specific impacts on Threatened communities and flora and fauna species.

Coalpac's commitment to avoiding impacts on Threatened species has resulted in the redesign of the mining areas described in the Exhibited Project EA to further avoid impacts to threatened species and ecological communities.

The predicted ecological impacts of the Exhibited Project have been further reduced by the avoidance of a number of additional key areas that were previously proposed to be impacted by open cut mining operations. In summary, the Contracted Project includes impacts to:

- Approximately 15.24 ha of Box Gum Woodland and 0.27 ha of Derived Native Grassland, listed under the TSC Act and the EPBC Act (a reduction of approximately 7% of the impacts predicted in the Exhibited Project Ecological Impact Assessment (EIA));
- Approximately 1.96 ha of Box Gum Woodland Derived Native Grassland listed under the TSC Act only;
- 204 ha of known and potential Eucalyptus cannonii habitat, constituting an estimated 15,428 individuals (a reduction of approximately 27% from the impacts predicted in the Exhibited Project EIA);
- 762 ha of native forest, woodland and grasslands, habitat for various fauna species known to occur or considered to potentially occur will be removed (a reduction of approximately 20% from the impacts predicted in the Exhibited Project EIA); and

- No direct impact to *Persoonia marginata*.

Coalpac will implement a revised Land Disturbance Protocol for the Contracted Project. This Protocol requires the Environmental Manager (or delegate) to carry out an inspection of any proposed disturbance areas prior to any mining activities occurring and is further described in Section 8.24.4 of the Exhibited EA. This Protocol shall continue to provide a process to ensure that compliance with relevant licences and approvals is maintained, that sensitive ecological habitat and communities are not impacted upon directly without approval, and that appropriate mitigation is in place.

This Protocol will also include procedures for the collection and management of timber cleared in advance of mining operations in consultation with Forestry Corporation of NSW (FCNSW).

Mitigate

As part of its EMS, Coalpac will develop and implement a Biodiversity Management Plan (BMP) prior to the commencement of activities for the Contracted Project that will be prepared to the satisfaction of DP&I. This BMP will incorporate a number of management and mitigation measures to minimise any adverse impacts to sensitive flora and fauna. These management and mitigation measures will build on current practice and will include:

- An enhanced Land Disturbance Protocol for the Contracted Project that sets out the process for the Environmental Manager (or Delegate) to sign off on the staged clearing activities that will be required for the Project;
- Limiting the disturbance of vegetation to the minimum necessary for each stage pre-stripping in advance of mining operations;
- Limits of clearing being delineated to avoid unnecessary vegetation and habitat removal;
- Implementation of a pre-clearing Protocol for all tree clearing to minimise impacts to resident fauna, which may need to be relocated to surrounding habitat prior to disturbance;
- Scheduling the clearing of vegetation to times where it is possible to optimise seed collection;
- Collecting and propagating native seed for use in rehabilitation areas and other disturbed areas;
- Translocating habitat features such as large logs and boulders to rehabilitation areas where safe and practically feasible;
- Trialling and developing regeneration methodologies and strategies with a particular emphasis on Threatened species and species that are part of the Box Gum Woodland CEEC;

- Progressively rehabilitating mined areas and Contracted Project biodiversity offsets (see **Section 3.15**). This will include the re-establishment of Threatened flora species in rehabilitated vegetation communities at similar densities to those that currently occur within the Project Boundary;
- Implementation of the Biodiversity Offset Management Plan (BOMP) to provide specifications for the restoration and management of the Biodiversity Offset Areas as detailed in **Section 3.15**;
- Implementation of an annual flora and fauna monitoring program for rehabilitation and Threatened species remaining within the Project Boundary to improve the understanding of impacts and assist with rehabilitation efforts;
- Outlining management strategies for the effective control of weeds and feral animals;
- Implementing appropriate vehicle driving polices including speed restrictions and signposting of known fauna crossing locations to minimise the risk to fauna species; and
- Providing linkages and or crossing zones between isolated vegetation remnant patches, where feasible.

Additional species-specific mitigation measures will also be implemented for the Contracted Project to mitigate potential impacts to key threatened species. This will include the implementation of indirect impact mitigation measures, including contributions towards recovery actions for:

- The Broad-headed Snake;
- The Brush-tailed Rock Wallaby;
- Threatened Woodland birds; and the
- Koala.

Compensate

A Biodiversity Offset Strategy was proposed for the Exhibited Project to provide mitigation and compensation measures arising from the predicted impacts. The strategy proposed has subsequently been revised and enhanced for the Contracted Project to provide additional compensation for predicted ecological impacts and is described below in **Section 3.15**.

Coalpac will develop a BOMP that will be implemented prior to the commencement of the Contracted Project that will provide specifications for the restoration and management of Biodiversity Offset Areas (see **Section 3.15**).

With the implementation of the above mitigation measures in conjunction with the proposed BOS it is apparent that although the habitat for the Threatened flora and fauna within the Project Boundary will be adversely affected, the Contracted Project is likely to produce an ecologically sustainable mining outcome in which ecological values are maintained or improved in the long term.

3.15 BIODIVERSITY OFFSET STRATEGY

3.15.1 Background

As a component of the ecological impact assessment for the Exhibited Project, Coalpac developed the BOS in conjunction with Cumberland Ecology. This was included in Appendix J of the Exhibited EA and was undertaken in response to the predicted biodiversity impacts of the Exhibited Project, particularly on Threatened ecological communities and habitat for Threatened species.

The Exhibited Project BOS proposed the conservation of existing Coalpac lands and the acquisition and conservation of additional properties suitable to compensate for predicted ecological impacts. This strategy was developed in accordance with the offsetting principles and objectives of the relevant NSW and Commonwealth regulators and guidance documents, including the:

- *Principles for the Use of Biodiversity Offsets in NSW* (DECC 2008); and
- *Draft Policy Statement: Use of Environmental Offsets under the Environment Protection and Biodiversity Conservation Act 1999* (DEWR 2007).

3.15.2 Impact Assessment

As a result of the changes to the Contracted Project described above in **Section 2.1**, the proposed BOS has been revised by Cumberland Ecology (**Appendix G**).

With the exclusion of the Hillcroft pastural property (proposed as a component of the Exhibited Project BOS), a total area of 2,040 ha is currently held by Coalpac to provide offsets for the Contracted Project. Coalpac has consulted with OEH over the purchase of additional targeted properties to achieve a total offset ratio excluding mine rehabilitation of 4:1 for native vegetation and is currently reviewing the list of properties in the region that are considered suitable for conservation as provided by OEH. This will require the acquisition and offsetting of at least an additional 1,007 ha of land to increase the total Contracted Project Biodiversity Offset Package to 3,047 ha (rounded down) as summarised in **Table 12**.

To ensure that the additional offset properties provide the greatest conservation value in the long term to mitigate biodiversity impacts of the Contracted Project, the following values noted by the PAC and OEH will be targeted:

- Areas of forest and woodland present on the site would preferably correspond to vegetation classes Tableland Wet Sclerophyll Forest and Southern Tableland Dry Sclerophyll Forest as classified by Keith (2004);
- Property located predominantly on Permian sediments;

- Property adjacent to or have connectivity with existing NSW conservation estate;
- Property with the potential to provide habitat for the:
  - Broad-headed Snake;
  - Cave-dwelling bats (Large-eared Pied Bat and Eastern Bentwing-bat); and the
  - Brush-tailed Rock Wallaby;
- Property that provides habitat for fauna species potentially impacted by the Contracted Project.

Following the completion of the Contracted Project mine plan and revision of the BOS, Coalpac have undertaken a high level review of a number of potential offset properties in the region with appropriate values that could potentially be acquired for inclusion.

A list of the properties that have been considered in this review and the respective values of each are provided below in **Table 13** and shown on **Figure 13**. The commitment to achieve a 4:1 offset ratio is comparable to other recently approved mining projects in NSW, including Ulan Coal Mine (4:1 ratio), Duralie Coal Mine (3.3:1 ratio) and Maules Creek Coal Mine (4.3:1 ratio).

In addition to the properties listed in **Table 13**, OEH has also provided Coalpac with a list of an additional 25 properties that they have variously prioritised for addition to the NSW conservation estate.

Table 12
Revised Biodiversity Offset Package (without mine rehabilitation)

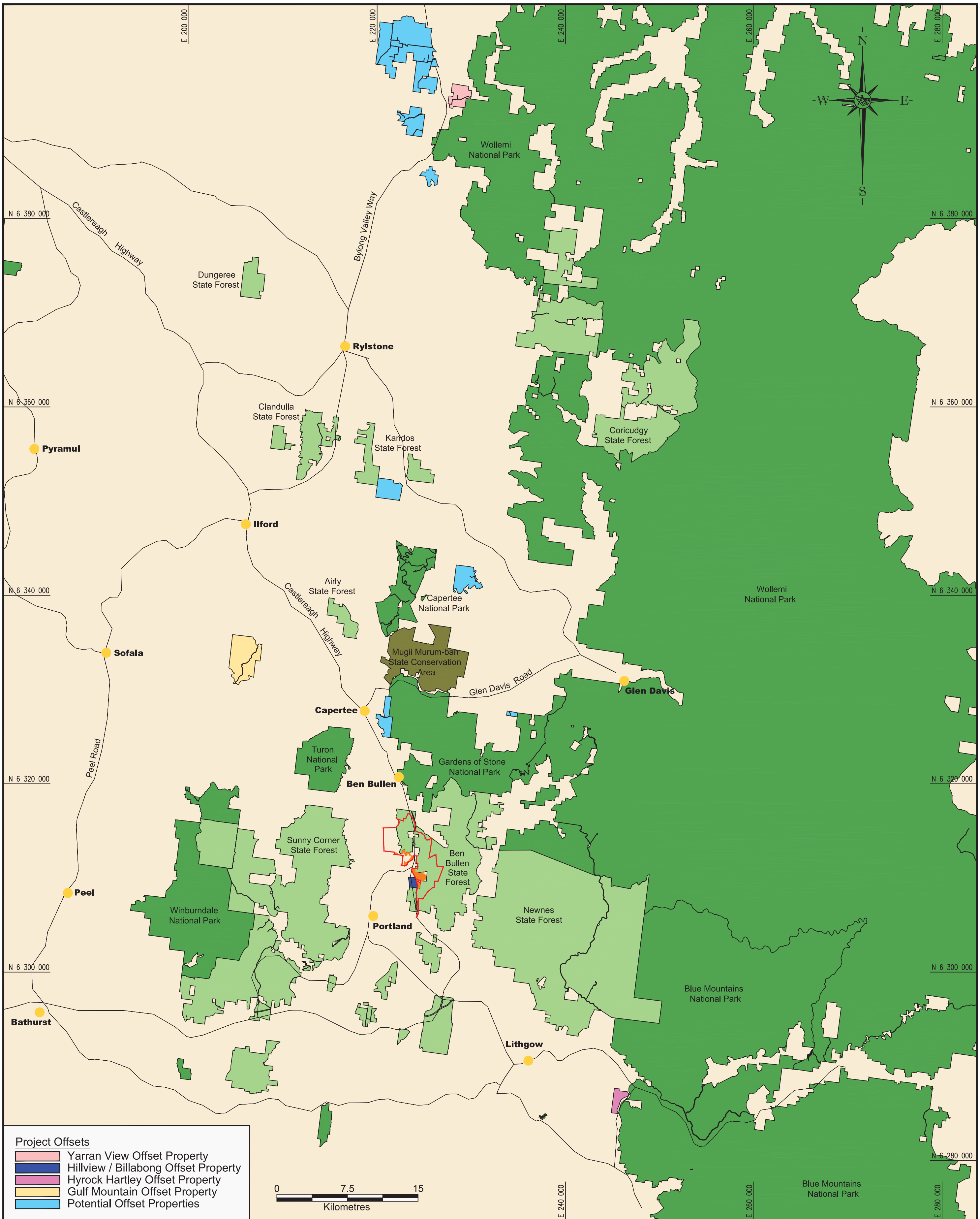
Vegetation Type	Contracted Project Disturbance Boundary (ha)	Proposed Offset (ha)	Proposed Offset Ratio
CEEC & EEC	17.2	221.7	12.9
Non CEEC & EEC (native only)	744.7	2,825.7	3.8
Total	**761.9**	**3,047.4**	**4.0**

Table 13
Potential Offset Properties for Contracted Project BOS

Property Reference*	Ecological Values
1.	This property is 200 ha in size and does not border a National Park. It contains approximately 140 ha of intact vegetation and 60 ha of cleared and semi-cleared land. The intact vegetation does not correspond to any impacted vegetation classes by Keith (2004). Property occurs on Permian and Triassic sediments. The BHS and BRW have been recorded within 5 km of the property.

Property Reference*	Ecological Values
2.	This property is 540 ha in size and does not border a National Park, but is adjacent to Crown Land with Sandstone Outcrops. Property occurs on Permian and Triassic sediments. Property contains approximately 260 ha of intact vegetation and 280 ha of cleared land. Vegetation classes do not correspond to impacted vegetation classes in the Project Boundary and valleys would require revegetation. *Eucalyptus cannonii* has been recorded within 5 km of the property.
3.	This property is 580 ha in size and does not border a National Park, but is adjacent to Crown Land with Sandstone Outcrops and occurs on Permian and Triassic sediments. It contains approximately 135 ha of intact vegetation and 409 ha of cleared land. Vegetation classes do not correspond to impacted vegetation classes in the Project Boundary and valleys would require revegetation. This property adjoins vegetation with rock outcrops occurring between this property and another potential property nearby (property 2). *Eucalyptus cannonii*, BHS and BRW have been recorded within 5 km of the property.
4.	This property is 579 ha in size and does not border a National Park, though adjoins intact vegetation that connects to Capertee National Park. The property contains approximately 529 ha of intact vegetation and 50 ha of cleared land. Property occurs on Permian and Lower to middle Devonian. Vegetation classes do not correspond to impacted vegetation classes in the Project Boundary.
5.	This property is 2,559 ha in size and does not border a National Park though is of adequate size to become one in its own right. Property is adjacent to Crown Land with Sandstone Outcrops and occurs on Tertiary, Triassic and Quaternary (overlying Permian) geology.). The majority of the valley floor is cleared and covers 1200ha and would require revegetation. The slopes and higher country have not been cleared and cover 1359 ha of native vegetation. Some of the vegetation corresponds to Southern Tableland Dry Sclerophyll Forest, an impacted vegetation class in the Project Boundary.
6.	This property is 50 ha in size and borders on Gardens of Stone National Park. Property occurs on Permian and Lower to middle Devonian. This property is completely forested. Vegetation classes on the property do not correspond to impacted vegetation classes in the Project Boundary. *Eucalyptus cannonii,* Large-eared Pied Bat has been recorded within 5km of the property.
7.	This property is 236 ha in size, borders Kandos State Forest and occurs on Permian and Lower to middle Devonian. It contains approximately 20 ha of cleared land and 216 ha of native vegetation. Some of the vegetation on the property corresponds to Southern Tableland Dry Sclerophyll Forest, a class of vegetation impacted by the Contracted Project. *Eucalyptus cannonii*, Eastern Bentwing-bat and Large-eared Pied Bat has been recorded within 5 km of the property.
8.	This property is 400 ha in size and borders Gardens of Stone National Park. It is approximately 8km north of the Project Boundary and occurs on Permian and Lower to middle Devonian sediments. It contains approximately 93 ha of cleared land and 306.83 ha of native vegetation. Some vegetation present corresponds to Southern Tableland Dry Sclerophyll Forest, a community impacted by the Contracted Project. Valleys would require revegetation. *Eucalyptus cannonii* has been recorded within 5 km of the property.

** Property names withheld due to commercial sensitivity; these are available to regulators on request*



Project Boundary
Existing Conservation & Offset Areas
State Forest
National Park
State Conservation Area

Hansen Bailey

Coalpac Pty Ltd

Coordinate System: MGA Zone 56
Source: Colong Foundation, 2006

COALPAC CONSOLIDATION PPR

Contracted Project Offsets in Regional Setting

Cad File: 09173C.dwg	Date: 05.04.13	Drawn: CP	Figure 13

3.15.3 Mitigation and Management

As a component of the BMP for the Contracted Project, Coalpac will also prepare a BOMP that will be implemented prior to the commencement of the Project to provide specifications for the restoration and management of the Biodiversity Offset Areas in accordance with State and Commonwealth Offset Principles.

Direct Offsets

The BOMP will be prepared to guide restoration and management of the biodiversity offset properties and will include:

- Management of existing Compensatory Habitat and Biodiversity Offset Areas in place for Cullen Valley Mine and Invincible Colliery;
- Management of proposed offset properties for the Contracted Project;
- Management of land that contains and / or can be regenerated to provide Box Gum Woodland at a ratio of approximately 13 ha of conserved land for each hectare to be disturbed for the Contracted Project;
- Provision of land that contains or could be regenerated to provide Tableland Gully Ribbon Gum - Blackwood - Applebox Forest, Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest and other non-C/EECs;
- Provision of land that includes habitat for all relevant Threatened flora and fauna species that could be impacted by the Contracted Project;
- Revegetation of cleared or degraded areas, fire management, maintenance of tracks and trails, weed and feral animal control and management of the habitats of Threatened species of flora and fauna;
- Measures to ensure that any potential impacts to Aboriginal heritage during revegetation works will be minimised;
- Provision of land that contributes to an existing regional conservation area;
- Re-establishment and maintenance of habitat linkages to existing areas of habitat in the locality including existing native vegetation within and closely adjacent to the Project Boundary and the western portion of the Great Dividing Range; and
- Procedures for monitoring the development and performance of rehabilitation in offset properties for the Contracted Project and responding to any issues that require active management.

The BMP and BOMP will prescribe the management of existing vegetation within the Project Boundary, revegetation of cleared or degraded areas, fire management, maintenance of tracks and trails, weed and feral animal control and management of the habitats of Threatened species of flora and fauna.

With the implementation of the above mitigation measures, it is apparent that although the habitat for the Threatened flora and fauna within the Project Boundary will be adversely affected, the Project Biodiversity Offset Strategy will result in a net improvement in the biodiversity conservation values within the Central West Region in the long term. It is also noted that there is no current Government policy in place to reserve the land to be disturbed by the Contracted Project in the NSW conservation estate.

Indirect Offsets

As part of the Revised Biodiversity Offset Strategy for the Contracted Project, Coalpac commits to providing indirect offsets through contributions towards recovery actions for the following threatened species:

- Broad Headed Snake;
- Brush-tailed Rock Wallaby;
- Woodland Birds; and the
- Koala.

Coalpac will provide support to the indirect offset measures outlined above totalling $300,000 to be spent equally for these four species in the first five years of the Project.

In addition to the impact mitigation commitments made in the Exhibited EA and RTS, Coalpac has also increased measures to further reduce impacts to key species of concern to OEH and noted in the PAC Review Report (2012). Additional considerations to reduce potential impacts to the BHS include:

- Conducting preclearance surveys in selected areas in winter when snakes may be sheltering under rocks;
- Ensuring that there remains undisturbed forest around pagodas within the SPL to allow animal movement and foraging (as there will be to the north, east and south of the proposed mining area);
- The placement of artificial shelter sites on Sandstone Outcrops and in the SPL as these have been shown to increase the occurrence of both snakes and their preferred food, the Velvet Gecko;
- Maintaining some hollow trees at the bases of the Sandstone Outcrops and the SPL (Cumberland Ecology have verified that hollow trees will remain within the standoff zone between the Sandstone Outcrops and the SPL and the edge of the proposed open cut); and
- Developing vegetation communities in rehabilitation within the mined areas in an attempt to replicate the vegetation cleared.

A fox baiting program will be implemented for the life of the mine so as to reduce fox predation pressure on small native mammals, including, potentially, the BRW, if it recolonises the SPL habitat or other Sandstone Outcrops in the Project Boundary.

All of the major cliff lines and caves associated with the Sandstone Outcrops and all of the SPL habitats for bat species will be protected from direct and indirect impacts of mining operations. Foraging habitats cleared by mining will be rehabilitated so that in the long term the species is able to reuse disturbed areas. Monitoring will be conducted over the life of the Contracted Project to verify that cave-dwelling bat species remain and utilise the habitats within the Project Boundary and in adjacent areas.

Long-term Security

Coalpac will establish long term security for the Existing and Project Biodiversity Offset Areas within two years following Project Approval. Mechanisms being considered by Coalpac to permanently secure the Project offset properties for conservation include the following:

- Voluntary Conservation Agreements, which are a joint agreement between landowners and the Minister for the Environment under the *National Parks and Wildlife Act 1974*;
- Conservation covenants under Section 88 of the *Conveyancing Act 1919*. This would be a joint agreement between the landowner and an authorised body;
- Application to change zoning regulation that dictates land use (including an option to retain limited areas for ‘life-style’ habitation blocks and the remainder conserved);
- Dedication of land to the National Parks reserve estates; and
- Management of the land under private ownership with condition commitments.

3.16 TRAFFIC AND TRANSPORTATION

3.16.1 Background

A traffic and transport impact assessment was undertaken for the Exhibited Project by Hyder Consulting in accordance with the Roads and Maritime Services *Guide to Traffic Generating Developments* (RTA 2002). This study was included as Appendix Q of the Exhibited EA and included:

- A review of the existing traffic data, assessments and reports completed in the vicinity of the Project Boundary to calculate the traffic growth per annum for background traffic;
- A traffic survey conducted between 29 April 2010 and 5 May 2010 to assess the existing road network conditions;
- An assessment of the predicted traffic volumes generated by the construction and operational phases of the Exhibited Project and any associated impacts to the surrounding road network;

- An assessment of the potential road safety impacts of relevant parts of the road network surrounding the Project Boundary;
- An assessment of the existing rail network capability, constraints and ability to accommodate additional rail movements associated with the Exhibited Project; and
- Identification of any management and mitigation measures that may be necessary for the Exhibited Project.

3.16.2 Impact Assessment

Results from the Exhibited Project traffic and transport impact assessment found that the Project would not have any significant road or rail transport impacts in addition to those approved under existing Coalpac development approvals for Cullen Valley Mine (DA 200-5-2003) and Invincible Colliery (PA 07_0127).

The changes to the Exhibited Project mine plan (Contracted Project) which will result in a material reduction in predicted traffic impacts include the following:

- Removal of the Hillcroft mining area and associated access infrastructure. The removal of this area will mean that bridge infrastructure to cross the Wallerawang-Gwabegar Rail Line and Red Springs Road will no longer be required; and
- Removal of the sand extraction component of the Exhibited Project located in the Cullen Valley mining area. This will reduce the requirement to haul product sand by road via from the Contracted Project site to market via the Castlereagh Highway and the Great Western Highway. This will result in the reduction of internal haul truck movements and up to 64 one-way truck movements from the site per day to Sydney via the Castlereagh Highway and Great Western Highway no longer being required.

The peak construction period for the Contracted Project will generate up to 60 one-way car trips associated with journey to work trips for construction workers. Consistent with the assessment of the Exhibited Project, this is forecast to occur in month four of the 15 month construction program.

Overall, the Contracted Project will result in a further reduction of the total truck movements on public roads generated under current Coalpac approvals (reduced to 51 one-way truck movements per day from the 202 one-way truck movements per day currently approved) away from Cullen Bullen. This reduction will lead to greater road intersection performance and road safety on the local road traffic network.

3.16.3 Mitigation and Management

Coalpac will develop a Traffic and Transport Management Plan to manage possible impacts resulting from construction and to ensure that the traffic network can be managed throughout the life of the Contracted Project.

The Traffic and Transport Management Plan will be prepared in consideration of the management and mitigation measures below.

Roads and Intersections

- The overland conveyor to MPPS will be built as soon as it is feasible following approval to immediately reduce the demand for road hauls to MPPS;
- Once the conveyor is complete, road haulage of coal to MPPS should only occur for a minimal period in emergency situations where that infrastructure cannot be used. Coalpac will seek approval to transport coal by road during agreed and well defined emergency situations with appropriate notification to relevant regulatory agencies and the local community;
- The Castlereagh Highway overpass bridge between the eastern and western sides of the site will be built as soon as possible, post-approval, to consolidate access to the Project at one point, which will reduce the number of truck trips on the public road system and reduce the associated noise impacts to the adjacent village of Cullen Bullen due to truck haulage on the Cullen Valley Mine Private Haul Road;
- Haulage of product coal by road will be undertaken using covered trucks within daily timeframes approved for the Contracted Project and the minimisation of any haulage during the identified AM and PM peak times, where practical. All haulage of coal by road will continue to be monitored to record product volumes and the number of movements and reported in the Annual Review;
- Consultation with the LCC, RMS and other local authorities as required prior to the movement of oversize loads on public roads;
- Regular training of workforce and contractors in relation to safe interactions with the local community; and
- The encouragement of car-pooling amongst the Contracted Project workforce.

Road Safety

The Road Safety Assessment concluded that it is unlikely there will be any increased safety impacts as a result of the Exhibited Project. Due to the reduction in the number of truck hauls of product coal and the consolidation of access into one point, there was no significant increase in crash risk. Coalpac will continue to ensure all reasonable and feasible measures are taken to minimise any road safety risks for the Contracted Project. In consultation with RMS, this will include:

- Implementing appropriate mitigation treatments to reduce hazardous overtaking practices over an interim period until the Castlereagh Highway overpass bridge is constructed, in consultation with the RMS. This may include improvements to the delineation of the centreline and installation additional signs advising of the commencement of the overtaking lane at the Castlereagh Highway / Invincible Colliery site access road intersection;

- Now that the Ivanhoe North Colliery has ceased mining operations, it may be possible to adjust the line markings to provide an indented left-turn lane into the Invincible Colliery site access road, with approval from the relevant regulators;
- Undertake road safety improvement works for the Invincible Colliery site access road identified in any future road safety audits commensurate with the impacts of the Contracted Project; and
- Implementing appropriate design parameters in the construction of Contracted Project infrastructure that will cross over the public road network (i.e. the Castlereagh Highway overpass and MPPS conveyor), to meet safety requirements.

Rail Transport

The review conducted as part of the Exhibited EA Traffic and Transport Impact Assessment indicated that there are a number of existing opportunities and constraints on the rail network between the Exhibited Project rail siding and Port Kembla. Whilst the two train paths per day proposed by the Contracted Project are not envisaged to significantly impact the rail network, the following mitigation and management measures will be undertaken:

- Continued liaison with the Australian Rail Track Corporation and DP&I regarding the planning and scheduling of the rail network improvements, including the Enfield ILC project, SSFL, Maldon to Dombarton link and Port Kembla expansion;
- Liaison with Port Kembla Coal Terminal regarding the transportation of product coal to this facility; and
- Maintain flexibility for using both the primary route via the Illawarra Line as well as the secondary route via the Moss Vale to Unanderra route.

3.17 BUSHFIRE

3.17.1 Background

Coalpac currently manage the potential risk of bushfires for their existing operations in accordance with approved management plans for Cullen Valley Mine and Invincible Colliery. These documents outline fire management strategies that have been implemented to minimise fire risk and assist in the protection of Coalpac lands and adjacent properties from the threat of bushfires.

The Contracted Project is located partially within the Ben Bullen State Forest, which covers an area of approximately 6,783 ha and is dominated by dry sclerophyll forest communities. There are several other State Forests and National Parks located in the regions adjacent to the Ben Bullen State Forest, including the Gardens of Stone National Park (approximately 2 km north of the Project), the Wolgan State Forest (approximately 8 km to the north-east of the Project) and the Newnes State Forest (located approximately 12 km to the south-east).

3.17.2 Impact Assessment

The Bushfire Risk Assessment completed by Coalpac identified a low to moderate bushfire risk associated with the Exhibited Project operations, provided that the implementation of risk prevention and management measures occurs. It was also assessed that there is a potential risk for offsite bushfires to cross into the Project Boundary due to its location within the Ben Bullen State Forest (which is in turn linked to other larger forest reserves).

The changes to the Exhibited Project by reducing the quantity of open cut and highwall mining activity (Contracted Project) will result in a minor reduction in potential for bushfires to occur due to the lesser area proposed to be disturbed.

3.17.3 Mitigation and Management

Consistent with the existing commitments presented in the Exhibited Project, Coalpac are committed to the management and mitigation of the potential bushfire impacts associated with the Contracted Project.

Coalpac will continue to operate in accordance with the management procedures outlined below which will be reviewed and consolidated for the Contracted Project to the satisfaction of DP&I and in consultation with the NSW Rural Fire Service, NSW Forests and other relevant regulators. These procedures will be provided in a Bushfire Management Plan for the Contracted Project, which shall include measures to respond to both internal and external fire events. Specifically, Coalpac will implement the following controls and emergency systems safeguards to manage potential bushfire hazards for the Contracted Project and to prevent the potential for any such event spreading from the Project Boundary to adjacent lands:

- All Coalpac employees and contractors to be made aware of emergency procedures and responses in the case of a fire event;
- Use of official warnings broadcasts to evacuate in the event of a bushfire and notify the relevant authorities;
- Advising the local Rural Fire Service, other authorities and / or neighbours of any fire within the Project Boundary or immediate surrounding area;
- Communicate with Fire Captain (services) to offer assistance of trained persons / equipment in the event of an encroaching bushfire within the Ben Bullen State Forest;
- Maintaining, in conjunction with the FCNSW, fire trails or access roads at the extremities of the Project Boundary in the Ben Bullen State Forest, to serve as access for fire fighting services in the event of a fire, as well as a means for establishing fire breaks, if required. Monitoring of these fire trails and access roads will include regular inspections during periods of high bushfire risk;
- Undertaking back burning as required in consultation with the local Rural Fire Service, FCNSWFCNSW and neighbouring landowners;

- Ongoing support of the Cullen Bullen brigade of the Rural Fire Service;
- All roads and water infrastructure within the Project Boundary will be maintained for access and use by emergency services in the event of a fire;
- Internal monitoring and communication of specific fire danger risks. No hot work will be undertaken in extreme weather conditions;
- Regular checking and maintenance of all fire management equipment to ensure ongoing effectiveness;
- The area impacted by the subsurface heating will continue to be monitored in accordance with the approved MOP;
- Monitoring and maintenance of areas and equipment where bushfire hazards are present to prevent or minimise the potential outbreak of bushfire, particularly the specific locations identified as presenting potential bushfire hazards;
- Fitting of fire extinguishers to all mobile equipment and training of staff in their operation;
- Modification of water carts to allow for fire extinguishing;
- Training of water cart operators / handlers in fire response;
- Fitting and maintaining efficient exhaust systems to mobile equipment;
- Ensuring that vehicles with low level exhaust systems do not leave defined access tracks in conditions likely to lead to ignition of combustible plant material; and
- Segregation and secure storage of all flammable materials at workshop and infrastructure areas in accordance with Work Cover Licence to Store.

3.18 SOILS AND LAND CAPABILITY

3.18.1 Background

A Soils and Land Capability impact assessment was undertaken for the Exhibited Project by Ecobiological Pty Limited (Ecobiological). This study was included as Appendix R of the Exhibited EA and the main objectives of this assessment were to:

- Review relevant existing soils and land capability information;
- Define the soil types present within the Project Boundary;
- Provide a description of the land classifications;
- Provide a description of pre and post-mining land capability within the Project Boundary;
- Provide a description of pre and post-mining agricultural suitability within the Project Boundary;

- Conduct an assessment of available topsoil and subsoil resources; and
- Determine appropriate selective topsoil and subsoil management measures.

3.18.2 Impact Assessment

The Exhibited Project assessment identified four soil types within the Project Boundary, 70% of which was classified as Deep Orange Clay Loam. Shallow Brown Clay Loam, Skeletal Sandy Loam and Deep Dark Sandy Loam comprise the remainder of the area.

When considering the topsoil stripping depths appropriate for each soil type and the area of the Project Disturbance Boundary, the estimated total volume of suitable topdressing materials available is 2.3 Million cubic metres, which was considered to be adequate for the rehabilitation requirements of the Exhibited Project.

The land capability assessment determined that the majority (90%) of the Project Boundary is Class V land, with the remainder Class VIII. The agricultural suitability of the existing environment within the Project Boundary is generally low and follows the same breakdown as for land capability, with most of the lands assessed to be Class 4 (the remainder being Class 5).

All areas which are not proposed to be disturbed by open cut mining will retain the same land capability and agricultural suitability class as the pre-mining condition.

The reductions in the Exhibited Project open cut mine plan described above in **Section 2.1** will also reduce the predicted impacts to soil resources. When compared to the total area of disturbance for the Exhibited Project of approximately 958 ha, the Contracted Project Disturbance Boundary now covers a smaller area of approximately 762 ha, a reduction of 196 ha. Of the total reduction in the area of disturbance for the Contracted Project, approximately 107 ha is reduced by avoiding open cut operations within the Hillcroft mining area.

3.18.3 Mitigation and Management

In order to reduce the potential for degradation within the Project Boundary and adjoining lands, the following strategies will be implemented during operations and rehabilitation to achieve the desired post-mining land capability and agricultural suitability:

- Materials will be stripped to indicated levels. Where possible, materials will not be stripped in excessively dry or wet conditions;
- Topsoil materials will be spread directly onto reshaped areas to a minimum depth of 0.1 m where practical to avoid stockpiling;
- Where topsoil must be stockpiled, efforts will be made to reduce compaction by keeping soil in as coarsely textured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established and to prevent anaerobic zones forming;

- Stockpiles will be a maximum of 3 m in height and if stored for greater than 12 months seeded and fertilised and treated for weeds prior to respreading;
- An inventory of designated areas and available soil will be maintained to ensure adequate topsoil materials are available for planned rehabilitation activities;
- Thorough seedbed preparation will be undertaken to ensure optimum establishment and growth of vegetation with all topsoiled areas lightly contour ripped to create a “key” between the soil and the spoil. Ripping will be undertaken on the contour, preferably when soil is moist. The respread topsoil surface will be scarified prior to, or during seeding, to reduce runoff and increase infiltration via tilling with a fine tyned plough or disc harrow;
- Re-grading will be undertaken where required to produce slope angles, lengths and shapes that are compatible with the proposed land use and not prone to an unacceptable rate of erosion. This will be done in integration with drainage structures and dams capable of conveying runoff from the newly created catchments whilst minimising the risk of erosion and sedimentation (including contour furrows or contour banks at intervals down the slope, contour ripping across the grade, and graded banks where required); and
- Engineered waterways, spillways and sediment control dams (using erosion blankets, ground cover vegetation and / or rip rap) will also be implemented to capture sediment laden runoff prior to offsite release and designed and located so as to safely convey the maximum anticipated discharge.

Coalpac will develop an internal Soil and Land Capability Procedure for management of its soil resources, in consideration of the above mitigation and management measures.

3.19 PRELIMINARY HAZARDS ANALYSIS

3.19.1 Background

Hansen Bailey completed a Preliminary Hazards Analysis (PHA) for the Exhibited Project. This study was included as Appendix S of the Exhibited EA and aimed at identifying potential hazards associated with the Exhibited Project, assessing the significance of each and developing possible management and control procedures as outlined in the relevant legislation.

3.19.2 Impact Assessment

The key bulk storage locations in the hazards review for existing operations that were to be utilised in the Exhibited Project included the:

- Explosives Storage Facility;
- Explosive Precursor Storage Facility;
- Diesel Storage Facilities; and

- Other Potentially Hazardous Materials Storage.

Coalpac holds a Licence to Store explosive materials (07-100153-004) for the existing explosive precursor storage facility and explosives storage facility located at Cullen Valley Mine. These existing explosives precursor and explosives storage facilities are located 544 m from the closest private residence.

The existing main diesel storage facilities required for the Exhibited Project were considered to include:

- A 75,000 Litre (L) bunded diesel storage tank within the Cullen Valley Mine infrastructure area;
- A 10,000 L bunded diesel storage tank approved for the explosives storage facility at Cullen Valley Mine;
- A 40,000 L underground diesel storage tank located near the existing Invincible Colliery infrastructure area;
- A 75,000 L bunded diesel storage tank located near the Invincible Colliery infrastructure area; and
- Up to 12 oil storage pods at the infrastructure and workshop areas of Cullen Valley Mine and Invincible Colliery, which will also continue to be stored and transported within self-bunded containers.

Up to four additional self-bunded diesel storage tanks of 75,000 L capacity were proposed to be used for the Exhibited Project (one for each of the four mining areas of Hillcroft, Cullen Valley, East Tyldesley and Invincible). These storages would be periodically relocated as open cut operations in each area progressed during the life of the Exhibited Project.

Each hazard identified for the Exhibited Project was assessed according to qualitative risk assessment criteria to determine the scale, likelihood and consequence of potential risks to assist in the development of additional management measures including:

- Transportation to the Project site;
- Loading storage facilities on-site;
- Storage of goods on-site;
- Re-loading and transportation of goods within the Project site; and
- Exhibited Project operations.

The changes to the Exhibited Project mine plan associated with the removal of the Hillcroft mining area will result in the elimination of one of the four self-bunded diesel storage tanks of 75,000 L capacity that would have been required to support this mining area.

While other modifications to the Contracted Project mine plan result in a reduction to the Project Disturbance Boundary assessed in the Exhibited Project, it is anticipated that these modifications would not result in a significant alteration to storage requirements and or quantities of hazardous materials necessary for Contracted Project operations.

3.19.3 Mitigation and Management

The Contracted Project will continue to be managed in accordance with existing management measures and procedures in place for existing Coalpac operations and the specific management plans for the Cullen Valley Mine explosives storage and explosives precursor storage facilities.

The Exhibited Project risk assessment identified a need for the following preventative measures which will also be applied for the Contracted Project:

- Personnel entering the explosive precursor and explosives storage facilities will be authorised to do so and trained in relevant procedures for the loading, transport and preparation of hazardous substances. Any visitors entering this area must be site inducted and will need to 'sign on';
- A review of Coalpac Waste Management Plans and management procedures for infrastructure and workshop areas is required to minimise the chance of a hazardous incident occurring for the Contracted Project as a result of operations in these areas; and
- An Emergency Response Plan prepared by the explosive supplier for the existing explosives and precursor storage facilities will be put in place for the Contracted Project and reviewed on at least a five yearly basis.

Coalpac will also update the relevant management plans in place for existing operations to manage other hazards and risks associated with the Contracted Project. In particular, this will include revising the Waste Management Plans and the Coalpac Environmental Management Strategy to reflect the hazards and risks associated with the Contracted Project.

3.20 WASTE MANAGEMENT

3.20.1 Background

Coalpac has an existing Waste Management System (WMS) which was developed to manage the disposal, tracking and reporting of all waste generated onsite. The WMS will be enhanced to meet both legislative and internal Coalpac requirements for the Contracted Project.

3.20.2 Impact Assessment

The Exhibited Project waste management review identified four main waste steams including:

- General waste;
- Recycle waste;
- Workshop waste; and
- Mining and rejects waste.

The volume of waste that was to be generated by the Exhibited Project was expected to increase due to the increased workforce and mining operations sought, in comparison to approved Coalpac operations at Cullen Valley Mine and Invincible Colliery. However, any potential for increase in waste volumes would have also been minimised, where practicable, by the implementation of more efficient strategies for reuse and recycling.

While modifications to the Contracted Project mine plan result in a reduction to the Project Disturbance Boundary assessed in the Exhibited Project, it is anticipated that these modifications would not result in a significant alteration to the quantity of waste generated by the Contracted Project.

3.20.3 Mitigation and Management

The Coalpac WMS procedures will continue to be utilised for the Contracted Project and enhanced as required to reflect the additional workforce and operational areas required. This will include a revision of current procedures to reflect the operations and workforce proposed for the Contracted Project to ensure that all waste materials are tracked, stored, transported disposed of and reported in accordance with relevant legislative requirements.

Training of all personnel will continue in the minimisation of waste streams, procedures for the reuse and recycling of waste materials and the management strategies for each major waste stream relevant to key work areas. Irrigation of treated wastewater will continue to be monitored in accordance with the consolidated Environment Protection Licence to be sought for the Contracted Project and the *Environmental Guideline for the Utilisation of Treated Effluent* (DEC 1995).

Ablution tanks required for the Contracted Project will continue to be pumped out by a licensed contractor and transported to the LCC waste water treatment facility for processing.

3.21 SOCIAL

3.21.1 Background

A social impact assessment was undertaken for the Exhibited Project by Hansen Bailey. This study was included in Section 8.21 of the Exhibited EA and included:

- Development and analysis of the existing local socio-economic setting based on a review of existing information;

- Development and analysis of the Exhibited Project workforce profile and workforce residential pattern;
- Consultation with the local community;
- Assessment of potential social impacts of the Exhibited Project on the local area, including the social impacts associated with the additional workforce;
- Assessment of potential social impacts associated with the Exhibited Project with reference to surrounding industry; and
- Development of appropriate mitigation and management measures for any adverse social impacts.

3.21.2 Impact Assessment

The social impact assessment of the Exhibited Project found the following:

- The population increase of approximately 7.5 persons was predicted to have a negligible impact on the population of the local area;
- The minor permanent population increase in the local area will generate demand for approximately three dwellings across the local area. It is considered unlikely that the Exhibited Project will impact housing affordability or availability within the Lithgow Local Government Area;
- The number of people potentially available for employment across the local area far exceeds the required 30 new hires for the Exhibited Project. If the required skilled labour is not available to fill positions, Coalpac will train local residents to the required skill level or source the required employees from outside the local area. It is unlikely the Exhibited Project will place significant additional pressure on the skilled labour force in the local and wider area; and
- The local and wider area is currently serviced by a range of community facilities and services. There is available capacity in local infrastructure, services and facilities to accommodate the potential minor population increase associated with the Exhibited Project. Education and health services are likely to have the capacity to meet the additional demand generated by the Exhibited Project.

3.21.3 Mitigation & Management

As outlined in the commitments for the Exhibited EA, Coalpac will employ the following management strategies for the Contracted Project to mitigate social impacts on the community:

- Implementation of a Voluntary Planning Agreement in accordance with Section 94 of the EP&A Act with Lithgow City Council which provides funds for infrastructure works and projects in the local area (i.e. Cullen Bullen) in consideration of the needs of the local community;

- Continuation of the Coalpac sponsorship and donations program with a focus on the local community (e.g. Cullen Bullen Public School and Cullen Bullen Progress Association Hall);
- Coalpac will continue to support local businesses as their preferred source of supply;
- As part of its Employment Strategy, Coalpac will use its best endeavours to:
  - Source additional employees from the local area, followed by regional areas;
  - Encourage any externally sourced employees to reside in the local area (particularly Cullen Bullen which has a declining population);
  - Engage at least one apprentice / trainee from the local area on an annual basis, followed by regional area; and
  - Engage employees from neighbouring mine closures from the local area, followed by regional areas.
- Continue to engage with its local and regional area community through mechanisms such as:
  - Employment of a dedicated Community Liaison Officer;
  - Operation of a combined Community Consultative Committee;
  - Collation and distribution of its Annual Environmental Management Report; and
  - Distribution of newsletters, information sheets and hold open days, as appropriate.

3.22 ECONOMICS

3.22.1 Background

An Economic Impact Assessment was undertaken for the Exhibited Project by Gillespie Economics and is reproduced in Appendix T of the Exhibited EA.

The Exhibited Project Economic Impact Assessment was primarily concerned with the determination of the following two issues:

- The economic efficiency of the Exhibited Project (i.e. consideration of economic costs and benefits). The methodology employed for this assessment was Benefit Cost Analysis (BCA); and
- The economic impacts of the Exhibited Project (i.e. the economic stimulus that the Exhibited Project will provide to the regional and State economy). The methodology employed for this assessment was input-output modelling (economic impact assessment).

3.22.2 Impact Assessment

Gillespie Economics completed an Economic Impact Assessment of the Contracted Project which is included in **Appendix H**. This was based on a revised financial model of the Contracted Project provided by Coalpac and information from Hansen Bailey on the environmental impacts of the Contracted Project.

The Economic Impact Assessment for the Contracted Project utilised the same methodology as that applied to the Exhibited Project in the Coalpac Consolidation Project EA.

The BCA of the Contracted Project confirmed that it is estimated to have net benefits to Australia of in the order of $1,330 Million and hence is desirable and justified from an economic efficiency perspective.

Further, the Contracted Project would provide an ongoing stimulus to the economy of the Lithgow and Bathurst region for the life of the Contracted Project. The annual regional economic impact associated with the Contracted Project is estimated at up to:

- $219 Million in annual direct and indirect regional output or business turnover;
- $105 Million in annual direct and indirect regional value added;
- $30 Million in annual direct and indirect household income; and
- 293 direct and indirect jobs.

The annual NSW economic impact associated with the Contracted Project is estimated at up to:

- $275 Million in annual direct and indirect regional output or business turnover;
- $133 Million in annual direct and indirect regional value added;
- $48 Million in annual direct and indirect household income; and
- 519 direct and indirect jobs.

These estimated annual regional and NSW impacts would be felt for the life of the Contracted Project.

A peer review of the Gillespie Economics report for the Contracted Project was conducted by Dr Jeff Bennett and is presented in **Appendix H**.

Dr Bennett supports the methodology and conclusions in the Economic Impact Assessment and concludes his peer review of the Gillespie Economics report by stating that:

> *"In summary, the Gillespie Economics economic assessment of the Contracted Project has used conceptually appropriate tools of economic analysis and that those tools have been applied in an acceptable manner. I therefore find that the assessment delivers an accurate picture of the economic impacts of the proposed mine. My opinion is that the environmental costs of the Contracted Project that are not incorporated into the Gillespie Economics CBA are less than the $1.3b net social benefit estimated by that CBA of the proposed mine."*

3.23 FORESTRY VALUES

3.23.1 Background

A Forestry Assessment was undertaken for the Exhibited Project by GHD Pty Ltd (GHD). This study was included as Appendix U of Exhibited EA and was primarily concerned with the following issues:

- Determination of the previous values of the forestry resource from within the Ben Bullen State Forest from a review of existing literature;
- The maximum potential of areas of the Ben Bullen State Forest located within the Project Boundary that could be utilised as a commercial forestry resource; and
- The potential maximum value of forestry that could be harvested from the resource.

3.23.2 Impact Assessment

The Forestry Assessment for the Exhibited Project conducted a review of regional forestry operations and products. It was considered that any harvesting within the Ben Bullen State Forest could include saw logs for construction purposes, mine prop material for use in underground mining operations and firewood / fuel wood. A range of stumpage values was then assigned to each product type for use in calculation of the assessment of each of two operational scenarios.

The forestry value of each of the assessed vegetation communities was also estimated and this value was used in assessment of the following two scenarios to derive an assessment of the total forestry resource:

- A Salvage Scenario - assuming all accessible timber products within the Ben Bullen State Forest and the Project Boundary are recovered during a pre-clearing salvage harvest operation; and
- A Sustained Yield Scenario - assuming the current status of management of the forest is ongoing, with a planned sustainable harvest scheduled to occur within an immediate timeframe and under the forest's current condition. Subsequent to this harvest, it is envisaged that the forest would not be re-harvested within a nominal 50 year life cycle or rotation.

The Forestry Assessment found that the forestry resources impacted by the Exhibited Project would range from $0.25 M up to a maximum of $0.47 M.

While the minimisation of disturbance as a result of the Contracted Project mine plan will result in a reduction of 196 ha to the overall Project Disturbance Boundary within Ben Bullen State Forest, the forestry values determined for the Exhibited Project will remain appropriate, being calculated from the vegetation communities within the Project Boundary, which has not changed.

3.23.3 Mitigation & Management

No mitigation and management measures are proposed based on the results of the Forestry Assessment.

Lands within the Project Disturbance Boundary will otherwise be rehabilitated as discussed in **Section 3.24**. The results of the forestry assessment were used to assist in the preparation of the Economic Impact Assessment for the Contracted Project undertaken by Gillespie Economics to allow a comparison of the maximum value of different land use types within the Project Boundary (**Section 3.22**).

3.24 REHABILITATION AND FINAL LANDFORM

3.24.1 Background

Rehabilitation at Cullen Valley Mine and Invincible Colliery is currently undertaken in accordance with a series of approved management plans. Coalpac has a history of successfully establishing and developing rehabilitation areas for existing operations to the satisfaction of relevant government regulators, with well-developed areas of rehabilitation up to 11 years in place at Cullen Valley Mine.

In 2010, an independent review of rehabilitation performance at Cullen Valley Mine and Invincible Colliery found that the rehabilitation was considered to generally be of good quality (Ecobiological 2010).

3.24.2 Impact Assessment

The objectives of the rehabilitation strategy prepared for the Exhibited Project (included as Section 8.24 in the Exhibited EA) were as follows:

- To create a stable final landform;
- Return the post-mining landscapes of Cullen Valley Mine and Invincible Colliery to emulate the pre-mining land capability and vegetation communities;
- Enhance local and regional ecological linkages across the site and with adjacent areas of the Ben Bullen State Forest;
- Continue to undertake re-forestation to develop vegetation communities that are generally consistent with the surrounding landscape, aiming to connect remnant native vegetation communities with re-established habitat areas; and

- Focus on promoting biodiversity and the establishment of habitat for Threatened flora and fauna species.

The Exhibited EA outlined key rehabilitation principles, techniques and strategies for the Exhibited Project including:

- Conducting rehabilitation works on a progressive basis, as soon as practical after mining disturbance;
- Using a combination of direct seeding and tube stock planting involving a range of native tree and shrub species to promote the development of sustainable vegetation communities; and
- Focussing on the re-establishment of Box Gum Woodland and utilising individuals of the Capertee Stringybark in the development of rehabilitation areas.

These rehabilitation principles, techniques and strategies will remain applicable to the Contracted Project.

The final landform design for the Exhibited Project promoted linkages to surrounding offset areas and local State Forest and National Park areas (including the Gardens of Stone National Park which is 2.5 kilometres to the north of the Project Boundary). This was primarily achieved by a North-South and East-West wildlife corridor, as shown on Figure 50 of the Exhibited EA.

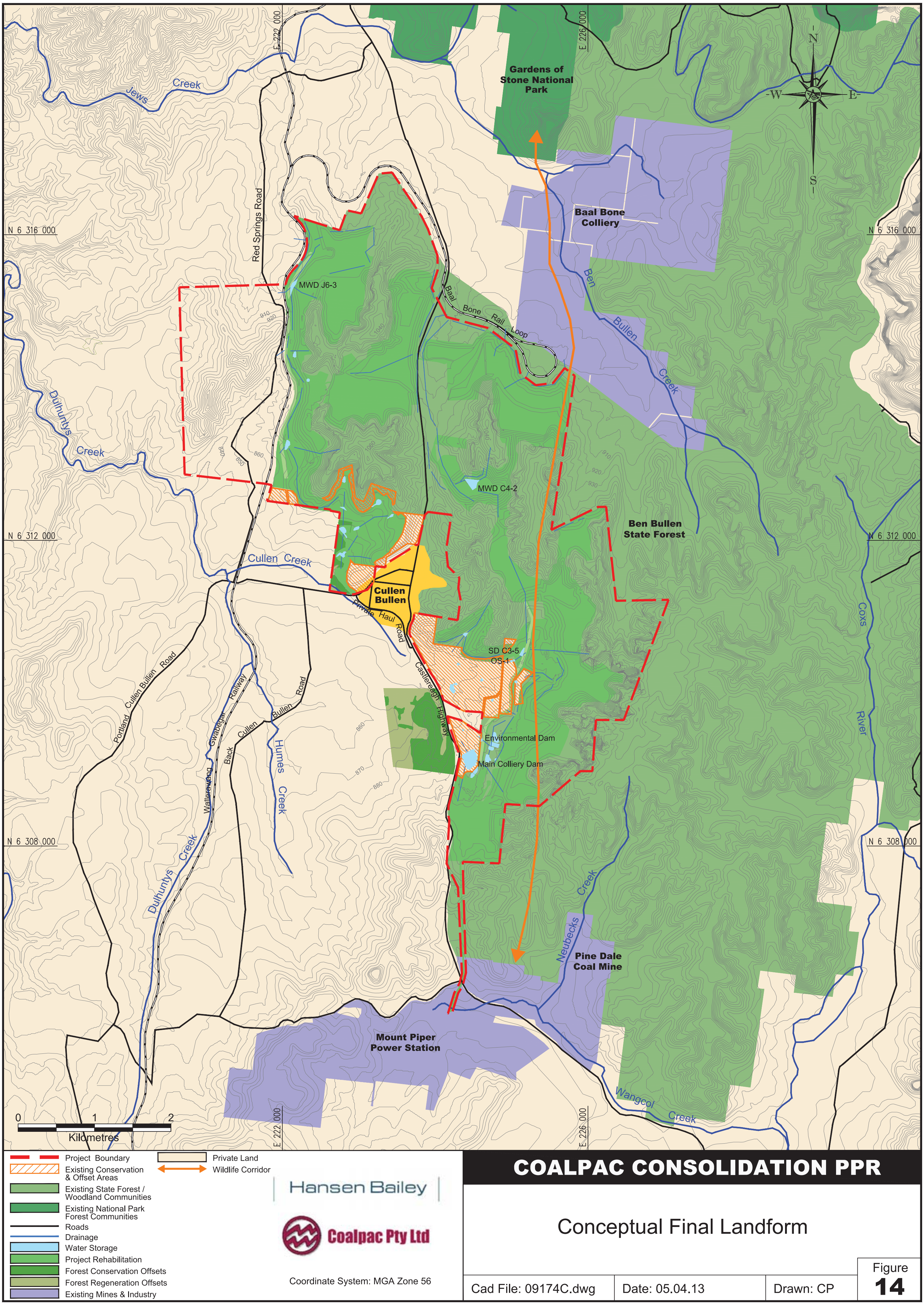
The reductions in the Exhibited Project open cut mine plan described above in **Section 2.1** reduce the area available for rehabilitation and East-West wildlife corridors. When compared to the total area of rehabilitation for the Exhibited Project of approximately 958 ha, the Contracted Project now covers a smaller rehabilitation area of approximately 762 ha, a reduction of 196 ha. The amendments to the Contracted Project also reduce the ability to achieve the East-West wildlife corridor due to the removal of the Hillcroft mining area. The revised final landform for the Contracted Project is shown on **Figure 14**.

3.24.3 Mitigation and Management

Consistent with the commitments outlined in the Exhibited EA, Coalpac will develop a consolidated Rehabilitation and Landscape Management Plan (RLMP). The RLMP will include provision for the monitoring of rehabilitated lands on a regular basis to ensure that rehabilitation objectives and targets are being met and that sustainable revegetation and landform sustainability is achieved in the long term.

Rehabilitation maintenance works will be completed as required to address any issues of concern identified during monitoring reviews.

The results of rehabilitation and landform monitoring and the effectiveness of any maintenance activities will be assessed and utilised in the continual refinement of rehabilitation techniques and reported against in the AEMR.



COALPAC CONSOLIDATION PPR

Conceptual Final Landform

Cad File: 09174C.dwg | Date: 05.04.13 | Drawn: CP

Figure 14

4 REVISED STATEMENT OF COMMITMENTS

A revised Statement of Commitments for the Contracted Project is presented below in **Table 14**.

Table 14
Contracted Project Revised Statement of Commitments

Ref	Commitment	Section
Mining Operations		
1.	Coalpac will extract coal via open cut and highwall mining methods at a rate of up to 3.5 Mtpa product coal for up to 21 years from the grant of the relevant mining authorities, generally in accordance with the EA, RTS & Response to PAC Review Report.	EA 4
2.	Coalpac will ensure that open cut mining in the Lithgow Seam does not encroach within 50 metres of the Tyldesley Colliery Workings and that the water extraction from these workings will be managed to assist with mitigation of the localised subsurface heating at Cullen Valley Mine.	EA 8.10
3.	Coalpac will design and undertake highwall mining operations generally as described in the EA. All highwall mining will be designed with a minimum FOS of 1.3 for web pillars and 3.0 for barrier pillars to ensure negligible surface subsidence (i.e. less than 20 mm at the surface).	EA 4.4.3 & 8.1 & PAC Rec 15 & 46
4.	No highwall mining will be conducted under the sandstone rock outcrops within the Ben Bullen SF SPL as identified in **Section 3.1** of this PPR.	3.6
5.	The total area of active open cut mining in any given year will be limited to less than 100 ha over the life of the Project.	EA 4 PAC Rec 7
6.	The Project will include a standoff zone from any open cut highwall crest of at least 50 m from all rock formations in the SPL.	EA 4.4.3 & PAC Rec 45
7.	The Slope Stability Management Plan will include provision to satisfy the recommendations of GeoTek Solutions (2013) for the monitoring of open cut highwall stability.	RTS
8.	Coalpac will obtain the appropriate licences and approvals as relevant to the Project and listed in Table 12 of the EA.	EA 5.8
9.	Coalpac will surrender its existing planning approvals as listed in Table 12 of the EA following the grant of the Project Approval at a time mutually agreeable with DP&I.	EA 5.8
10.	No open cut mining operations will occur within 500 m of an existing occupied residence without prior agreement between Coalpac and the landholder.	RTS

Ref	Commitment	Section
11.	The Project Highwall Mining Management Plan (see EA SOC Ref 8) will include at least the preparation of: • A Hazard Map (vertical elevation) of the highwall, defining and locating any significant hazards and potential zones of localised (small scale) instability. The highwall mining layout will be aligned with a surveyed baseline. This baseline will be set out and validated by the mine surveyor. Any other localised hazards or restrictions to work practices shall be included on the Hazard Map; • A Highwall Mining Plan (plan view) showing the web pillars and barrier pillars, survey baseline, toe position, crest position, surface features including pagodas and escarpments/cliffs and any other significant features; and • A Risk Assessment specifically addressing the risk of instability of the highwall (large scale) that could threaten any SPL or Sandstone Outcrops, and the risk of pillar instability and surface subsidence >20 mm (the design criteria).	RTS
Environmental Management		
12.	Coalpac will develop and implement an Environmental Management System in consultation with the relevant regulators (and the Aboriginal community where relevant) consistent with Section 6 of the EA to the approval of DP&I which shall comprise: • Environmental Management Strategy; • Environmental Monitoring Program (incorporating air quality, noise, blasting, surface water and groundwater); • Air Quality Management Plan; • Noise Management Plan; • Blast Management Plan; • Highwall Mining Management Plan (incorporating Subsidence Management Plan); • Subsurface Heating Management Plan (including odour management controls); • Biodiversity Management Plan (including Land Disturbance Protocol); • Biodiversity Offsets Management Plan; • Rehabilitation and Landscape Management Plan (including consideration of Cullen Bullen General Cemetery); • Water Management Plan (including groundwater and surface water); • Aboriginal Cultural Heritage Management Plan; • Historic Heritage Management Plan; • Bushfire Management Plan; • Traffic and Transport Management Plan (including coal haulage); • Waste Management Plan (including for hazardous materials); • Slope Stability Management Plan; and • SPL Risk Analysis Procedure (including all commitments from blast, slope analysis, Aboriginal heritage assessments into one checklist form).	EA 8 & PAC Rec 66
13.	Coalpac will seek an environmental monitoring data sharing agreement with neighbouring industry to allow for the assessment of cumulative impacts and the development of co-operative management measures.	EA 8.3 & 8.10
Air Quality and Greenhouse		
14.	Coalpac will utilise technologies and initiatives to achieve the air quality outcomes described in the EA and this PPR. Having exhausted other controls, Coalpac will restrict operating hours or shut down relevant activities to ensure ongoing compliance with Project Approval air quality goals at private receivers.	EA 8.3 & 8.5 & PAC Rec 8,9,10, 11 & 83
15.	Coalpac will undertake calculations of greenhouse gas emissions and annually review energy efficiency initiatives to ensure that Scope 1 greenhouse gas emissions per tonne of product coal are kept to the minimum practicable level.	
16.	Coalpac will install a real-time air quality monitor in consultation with the EPA.	
17.	Coalpac will install a real-time meteorological monitoring station with predictive air quality modelling software capabilities at a location selected in consultation with the EPA. The operational conditions of this system will be sufficiently rigorous to ensure that data will be available to assess compliance.	

Ref	Commitment	Section
18.	A predictive real-time air quality monitoring system will be installed prior to increasing production above 2.2 Mtpa of product coal. The system will be audited to confirm that further management responses are not required.	RTS, PAC Rec 9
19.	The predictive meteorological component of the Air Quality Management System will be used to proactively identify the areas of the site where operations may need to be modified to meet air quality criteria.	RTS
20.	Coalpac will manage dust emissions from haul trucks travelling on the internal haul road by the use of water carts (including at least Level 2 watering).	RTS
21.	Coalpac will revise its Air Quality Management Plan (AQMP) in consultation with the EPA such that it includes key performance indicators and outcomes across the full range of potential sources of air emissions and to the approval of DP&I. Air quality management KPIs will be developed to ensure performance outcomes as specified in Table 23 and Table 24 of the EA and **Table 3** of this PPR document.	RTS, PAC Rec 6
22.	Coalpac will implement the air quality management controls for the MPPS conveyor and haul truck sizes as assessed in the EA.	RTS
Noise and Blasting		
23.	Coalpac will utilise the noise control and management measures listed in Section 8.6.4 of the EA to achieve compliance with the relevant noise criteria as listed in Table 25 of the EA where an agreement with Coalpac is not in place.	EA 8.6
24.	Coalpac will provide the DP&I and LCC with the construction schedule for the noise and visual mitigation bunds as well as specifications and other technical details prior to construction. Construction activities will be limited to day and evening periods only.	PAC Rec 41 & 44
25.	Coalpac will have all new mining equipment independently tested by an acoustic engineer against predicted sound power levels. Specified sound power levels will be achieved during commissioning.	PAC Rec 24
26.	Coalpac will ensure that operational noise from the rail loading facility will not cause or contribute to exceedance of the relevant noise criteria at any time.	PAC Rec 21
27.	Coalpac will demonstrate compliance with the predicted noise levels from the rail loading facility within six months of commencement of operations at the facility. If evening or night time noise criteria are exceeded then loading will not occur in evenings or at night until rectification is complete and the noise criteria can be met.	PAC Rec 22 & 23
28.	Coalpac will install a real-time noise monitoring system with monitors at locations selected in consultation with the EPA. There shall be no increase in production levels above 2.2 Mtpa product coal until the Real Time Noise Management System is established and demonstrated to be operating effectively under a variety of weather conditions, including temperature inversions.	EA 8.6 & PAC Rec 30
29.	The effectiveness of the Real Time Noise Management System in maintaining noise levels within the relevant criteria in all meteorological conditions shall be audited as part of the Project Approval independent compliance auditing process. The independent auditor will be required to report to the DP&I on additional measures available to mitigate impacts.	PAC Rec 32
30.	Mining will only proceed in stages as it is demonstrated that compliance is achieved with the Project Approval noise criteria (as specified in Commitments 31 and 32 below).	PAC Rec 33
31.	Operating hours will be limited to the following times until the relevant noise mitigation measures referred to in Commitment No. 32 have been implemented and demonstrated to be effective and certified by an independent acoustic expert that they meet the noise criteria. These noise mitigation measures include; the noise sound suppression on mobile plant and stationary equipment, earthen bund walls, conveyor, bridge over the Castlereagh Highway, location of infrastructure within the project footprint and the real time monitoring and management system. • Monday to Saturday: ➢ 7.00 am to 9:30 pm – for mining & coal processing activities;	PAC Rec 25

Ref	Commitment	Section
	➢ 7.00 am to 9.30 pm – for haulage and transportation from Invincible Colliery exit; ➢ 7.00 am to 5.30 pm Monday to Friday and 7.00 am to 5.00 pm on no more than 30 Saturdays annually – Coal haulage from the Cullen Valley Mine exit; ➢ 10.00 pm to 7.00 am – non-audible equipment maintenance activities; ➢ 9.00 am to 5.00 pm – blasting; • Sunday: ➢ 8.00 am to 6.00 pm – for mining and all associated activities; ➢ 6.00 pm to 7.00 am – non-audible equipment maintenance activities; ➢ No blasting; • And at no time on public holidays. Note: these times will be further restricted by specific recommendations, for example near the Cullen Bullen cemetery (see Commitment 46). Note: "non-audible" is taken to mean: less than 35 dBA(LAeq15min) monitored at private receivers.	
32.	Operating hours will be limited to the following times **after** all noise mitigation measures (subject to the notes below) have been implemented and certified by an independent acoustic expert that they meet the predicted noise outcomes. These noise mitigation measures include; the noise sound suppression on mobile plant and stationary equipment, earthen bund walls as per the EA mine plan, bridge over the Castlereagh Highway, location of infrastructure within the project footprint and the real time monitoring and management system. • Monday to Saturday: ➢ 24-hours – for mining (other than blasting) and coal processing; ➢ 7.00 am to 9.30 pm – for haulage and transportation from Invincible Colliery exit; ➢ Coal haulage from Cullen Valley Mine exit only in emergencies with written notification to from DP&I; ➢ 10.00 pm to 7.00 am – non-audible equipment maintenance activities. ➢ 9.00 am to 5.00 pm – blasting;. • Sunday: ➢ 24 hours – for mining (other than blasting) and coal processing; ➢ No road haulage; and ➢ No blasting. Notes: • Temporary night time operation will be permitted only after an initial compliance certification following three months operation. This will be repeated and reconfirmed following twelve months of operation before longer term night time operation is permitted. • Where mining is carried out in different sectors and some sectors show compliance and others show non-compliance then the above night operating times will be permitted for those sectors only where there is full compliance with the noise criteria. • Road haulage will continue at the limit imposed under Commitment 31 until the MPPS conveyor is commissioned. • These times may be further restricted by specific recommendations, for example in relation to the Cullen Bullen cemetery (see Commitment46). • Note: "non-audible" is taken to mean: less than 35 dBA(LAeq15min) monitored at private receivers.	PAC Rec 26
33.	Coalpac will modify operations where real time predictive monitoring forecasts exceedances due to noise enhancing weather conditions and stop relevant operations where noise criteria are exceeded. In the unlikely event of a noise exceedance still occurring, Coalpac will report on this in its AEMR.	PAC Rec 16 & 29
34.	The additional noise attenuation works for the ICPP as described in the AIA and EA will be undertaken by Year 2 of the Project.	RTS
35.	Any plant and equipment found to have defective or missing sound attenuation components will not be used operationally until repaired/reinstated.	RTS
36.	Coalpac will implement leading practice management measures to ensure that residences and properties predicted to receive mild noise impacts during at least one modelled year for the Project do not receive noise impacts above 35 dBA (whilst ever an Agreement is not in place).	RTS
37.	Coalpac will regularly revise the Noise Management Procedure for the Project in consultation with EPA as the mine progresses.	RTS
38.	Coalpac will implement negotiated agreements, additional (at-receiver) noise mitigation measures or property acquisition consistent with the criteria in Table 5-11 of the PAC Review Report.	PAC Rec 28

Ref	Commitment	Section
39.	Coalpac will cooperate with rail managers and train operators, in consultation with the EPA, to develop a regional train noise study.	PAC Rec 20
40.	Coalpac will design all mine blasts through utilising the control and management measures in the EA and **Section 3.7** of this document to comply with the vibration and overpressure criteria for all sensitive surface features listed in the EA (see Table 30 of the EA). A Blast Management Plan will be developed to demonstrate how blasting can occur with no noticeable mining-induced damage of the Aboriginal rock shelter RCK2-10 and that no noticeable blast induced damage is caused to any grave or gravestones at the Cullen Bullen cemetery or to Carleon Coach House.	EA 8.7 PAC Rec 34, 35 & 81
41.	Coalpac will design all blasts such that there shall be negligible impact or damage to SPL and Sandstone Outcrops. As mining advances towards these features, blast monitoring will be conducted with the aim of determining 'safe' or 'non-damaging' vibration levels at the SPL and Sandstone Outcrop beginning 200 m from their base. Prior to the eastern advance of the Invincible mining area toward the SPL, the stability of the rock mass will be assessed and a Hazard Map produced to identify unstable features.	PAC Rec 38
42.	Coalpac will implement blast monitoring procedures to detect any blasting-induced impacts to SPL and Sandstone Outcrops as discussed in **Section 3.7**. These measures will be included in the Blast Management Plan.	PAC Rec 39
43.	Coalpac will implement a real-time meteorological monitoring system for the Project, enabling blast management decisions to be made as weather conditions change. Blasting will only be conducted when the system confirms that the wind will not transport fumes towards the Cullen Bullen school, Cullen Bullen village and any private residences within 2 km of blasting.	RTS, PAC Rec 5
44.	Coalpac will offer all private residences within 2 km of active blast areas for the Project an independent baseline structural survey prior to Project mining upon receipt of a written request from the landowner. The independent assessor would be approved by DP&I prior to the surveys being undertaken.	RTS
45.	Coalpac will not exceed the ANZECC guideline for blasting frequency (i.e. there will be no more than 1 blast event per permissible blast day).	PAC Rec 37
46.	Blasts required for any mining activities within 500 m of the Cullen Bullen General Cemetery (the closest point being a distance of 250 m from the centre of the cemetery) will be designed to manage vibration and overpressure levels. No blasting will occur on days when formal services are scheduled at Cullen Bullen General Cemetery; and no mining or coal haulage within a 1,500 m radius will occur within two hours of formal services at Cullen Bullen General Cemetery. No mining operations will occur on weekends and Public Holidays within a radius of 350 m distance from centre of the Cullen Bullen General Cemetery.	RTS & PAC Rec 36
Visual		
47.	Visual bunds will be constructed generally in accordance with Figure 10 to Figure 13 in the EA to reduce visual impacts of private receivers and where practical, along the Castlereagh Highway.	EA 8.8
48.	Infrastructure lighting will consist of horizontal lights with hoods and louvres in elevated and exposed areas utilising low brightness lights to the level necessary for operational and safety requirements to minimise adverse night lighting impacts.	EA 8.8
49.	Specific mitigation measures will be developed and implemented by Year 2 for the Cullen Bullen General Cemetery to reduce visual impacts from mining in consultation with LCC to the approval of DP&I.	EA 8.8.4
50.	Should a landholder with a residence (constructed prior to grant of the Project Approval) within 5 km of the active mining area consider they are experiencing high visual impact as a result of the Project, Coalpac will carry out a specific visual assessment from the residence and develop a tree screening strategy for the residence on the property in consultation with the landholder and to the satisfaction of the DP&I.	EA 8.8

Ref	Commitment	Section
Ecology		
51.	Coalpac will progressively rehabilitate mined areas and regenerate cleared areas with a focus on the re-establishment of Capertee Stringybark, Clandulla Geebung and Box Gum Woodland as habitat for the region's Threatened wildlife species.	EA 8.15
52.	Coalpac will establish the Biodiversity Offset Strategy in consultation with the OEH and as described in **Section 3.15** of this PPR for the purpose of initially maintaining and ultimately improving the ecological values of the region. This will result in an offset ratio of at least 4:1 for native forest and woodland vegetation.	EA 8.15 & PAC Rec 49 & 50
53.	As part of the Revised Biodiversity Offset Strategy, Coalpac commits to providing indirect offsets through contributions towards recovery actions for the following threatened species: • Broad Headed Snake; • Brush-tailed Rock Wallaby • Woodland Birds; and the • Koala. Coalpac will provide support to the indirect offset measures outlined above totalling $300,000 to be spent equally for these four species in the first five years of the Project.	RTS
54.	Targeted searches for the Squirrel Glider will be conducted on Biodiversity Offset Properties as part of the BOMP. In addition, nest boxes targeted to provide den sites for the species will be used in mine rehabilitation.	RTS
55.	The Project Biodiversity Offset Properties will be permanently conserved via a Voluntary Conservation Agreement (VCA), or other suitable arrangement to protect flora and fauna values in the long term within two years of Project Approval.	RTS
56.	Coalpac will also engage a dedicated Biodiversity Offset Manager to implement the BOMP commitments for both existing Compensatory Habitat Areas and the offset properties proposed for the Project under the Revised Biodiversity Offset Strategy. Coalpac will liaise with traditional owners of the land to encourage their involvement in restoration practices.	RTS
Aboriginal Archaeology and Cultural Heritage		
57.	The salvage or protection of all known Aboriginal objects within the Contracted Project Disturbance Boundary will be managed in accordance with an AHMP to be developed in consultation with the Aboriginal community and the OEH.	EA 8.12 & PAC Rec 80
58.	Coalpac will establish, in consultation with the Aboriginal community and Office of Environment and Heritage, a keeping place for the purpose of housing salvaged Aboriginal artefacts from the local area.	
59.	Coalpac will conduct a detailed assessment of rock shelters in consultation with the Aboriginal community prior to the commencement of mining operations within 500 m of each site to comply with the criteria in Table 30 of the EA. Safe access tracks will be installed to facilitate this in accordance with the Land Disturbance Protocol to the approval of relevant regulators.	EA 8.7 & 8.12 & PAC Rec 76
60.	The Aboriginal Cultural Heritage Management Plan and the Blast Management Plan will contain measures to ensure negligible mining-induced impacts to Aboriginal rock shelter sites.	PAC Rec 77
61.	A monitoring regime will be put in place that establishes the current condition of the rock shelters, that is capable of detecting any mining induced impacts and that includes comprehensive reporting requirements.	PAC Rec 78
Non-Aboriginal Heritage		
62.	Coalpac will complete an archival recording of the Heritage items predicted to be disturbed by the Project as described in Table 41 in consultation with the NSW Heritage Office. The sandstone footings adjacent to the proposed conveyor alignment will be fenced prior to its construction.	EA 8.13 & PAC Rec 82

Ref	Commitment	Section
63.	Coalpac will undertake a detailed archival recording and structural inspection of the Cullen Bullen General Cemetery in accordance with relevant guidelines prior to the commencement of coal extraction under this EA in consultation with LCC.	EA 8.13
64.	Coalpac will ensure negligible impact to both the Carleon Coach House and the Cullen Bullen General Cemetery as a consequence of its blasting activities. The methodology to ensure the achievement of these criteria will be specified in the Blast Management Plan. This aspect of the plan will be audited by a recognised expert before any blasting is conducted within 500 m of these two items.	PAC Rec 81
Water Resources		
65.	The existing Water Quality Management Plan will be updated to incorporate the management of impacts from the construction and operation of the conveyor to the MPPS.	PAC Rec 57
66.	Coalpac will reconfirm predicted depressurisation and groundwater inflows, in consultation with NOW, to provide a greater level of confidence that problems will not arise with groundwater or surface water resources.	PAC Rec 58
67.	Coalpac will consider the predicted changes in weather due to climate change in NSW in its ongoing water balance modelling for the life of the project.	PAC Rec 63
68.	Coalpac will undertake groundwater and surface monitoring for the Project in consultation with relevant regulators, including the installation of two additional bores and four replacement bores.	EA 8.9 & 8.10
69.	Coalpac will design and construct a consolidated Water Management System for the Project in consultation with relevant regulators and to the approval of DP&I to ensure that water quality in the surrounding catchments is not degraded by the Project.	
70.	Groundwater monitoring will continue to confirm the assessment of the condition of the historic flooded underground workings of Old Invincible Colliery and that this storage will not be significantly impacted by the Project. This data (for a total period of at least two years) will be used to confirm the key findings of the surface water and groundwater assessments undertaken for the Project.	RTS
71.	Coalpac has surrendered its EPL licenced water discharge point LD001 for Invincible Colliery and does not seek to discharge mine water at that point as part of the Contracted Project.	PAC Recs 56 & 60-63
72.	Coalpac will provide reasonable compensation in consultation with the relevant landowner if a groundwater monitoring program confirms that the Project has adversely impacted on a private receiver's licenced groundwater bore.	RTS & PAC Rec 59
Rehabilitation		
73.	Bunds in key sensitive locations will be treated as quickly as possible to promote the rapid establishment of rehabilitation.	EA 4.4.3
74.	Coalpac will include PAF material management measures and provide details on PAF monitoring and management in the Rehabilitation and Landscape Management Plan for the Project. This plan will be prepared in accordance with the most recent version of the DRE Mining Operations Plan Guideline.	RTS
75.	Local native species will be used during the rehabilitation and seed collection programs to ensure collection from a suite of species to encourage species diversity.	RTS
76.	Coalpac will report on the implementation of rehabilitation and mitigation measures in its AEMR.	PAC Rec 43
77.	Coalpac will remediate the potentially acid generating coarse reject material located at the existing Invincible Colliery Tailings Drying Area in consultation with DRE and in accordance with the approved Rehabilitation Management Plan.	PAC Rec 64

Ref	Commitment	Section
78.	Coalpac will continue to separate potentially acid forming washery reject material and manage this separately from general overburden emplacement in accordance with the Rehabilitation Management Plan.	PAC Rec 65
79.	Coalpac will implement a Plan of Works as agreed with DRE for the management of historical subsurface heating in overburden emplacement areas and underground mine workings.	PAC Rec 67
80.	Coalpac will establish an appropriate Rehabilitation Security Deposit for the Project, to the approval of DRE. Coalpac will inform LCC through the AEMR.	RTS
Geochemical		
81.	Potentially acid forming coarse rejects generated by the Contracted Project will be covered as soon as practical with at least 5 metres of Non Acid Forming overburden material to minimise the length of exposure time to oxidising conditions and minimise the potential for acid mine drainage.	EA 8.11
Traffic		
82.	Coalpac will construct the MPPS conveyor by the end of Year 2 of the conduct of the Contracted Project to reduce haulage of product coal by road from Invincible Colliery site access road. There will be no increase in currently approved truck movements whilst this is being constructed.	EA 8.16 & PAC Rec 17, 18, 19, 69, 70, 72, 74 & 75
83.	Coalpac will maintain a tyre wash for trucks leaving the project site to travel on public roads.	EA 8.16 & PAC Rec 17, 18, 19, 69, 70, 72, 74 & 75
84.	All trucks leaving the project site will have their loads covered so as to prevent the spillage of coal and emission of coal dust.	EA 8.16 & PAC Rec 17, 18, 19, 69, 70, 72, 74 & 75
85.	Haulage of product coal by road to WPS and MPPS (following the construction of the MPPS conveyor) for emergency supply will only be undertaken on a limited basis and with prior notification to DP&I and the local community.	EA 8.16 & PAC Rec 17, 18, 19, 69, 70, 72, 74 & 75
86.	Upon completion of the rail siding, all export bound coal will be transported via rail to Port Kembla.	EA 8.16 & PAC Rec 17, 18, 19, 69, 70, 72, 74 & 75
87.	All heavy vehicles for the Project, with the exception of those required for deliveries to Cullen Valley Mine via the Private Haul Road, will enter site via the Invincible Colliery access road intersection with the Castlereagh Highway following the construction of the Castlereagh Highway overpass bridge and associated internal access roads.	EA 8.16 & PAC Rec 17, 18, 19, 69, 70, 72, 74 & 75
88.	Coalpac will ensure that appropriate management measures for Castlereagh Highway traffic will be put in place during the construction of the overpass bridge infrastructure, in consultation with RMS.	RTS
89.	Coalpac will obtain the relevant approvals under Section 138 of the *Roads Act 1993* prior to the construction of the haul road bridge over the Castlereagh Highway.	
90.	During the life of the Project, Coalpac will maintain the existing access point in the south of the Project Boundary for the Gardeners Gap Track (as shown on Figure 5 of the EA).	RTS

Ref	Commitment	Section
	Coalpac will also create a northern access route within the Project Boundary to allow for public access to the Ben Bullen State Forest, in consultation with Forests NSW.	
Community		
91.	Prior to entering into any tenancy agreement for any land owned by the Proponent that is predicted to experience exceedances of the dust criteria or the noise criteria specified in the Project Approval Coalpac will: (a) Advise the prospective tenants of the potential health and amenity impacts associated with living on the land and give them a copy of the NSW Health fact sheet entitled "Mine Dust and You" (as may be updated from time to time); (b) Advise the prospective tenants of the rights they would have under this approval (including the statement of commitments); and (c) Within 2 weeks of obtaining monitoring results showing an exceedance of the relevant criteria, notify any affected tenant in writing of the exceedance and provide regular monitoring results to the relevant tenant(s) until the project is complying with the relevant criteria again.	PAC Rec 4
92.	Coalpac has entered into a VPA with LCC. Coalpac proposes to develop a Community Fund centred on Cullen Bullen (and the wider local area). This proposed fund will be supported by contributions from Coalpac over the 21 year life of the Project to be overseen by a committee comprising local residents, LCC officials and Coalpac staff.	EA 8.21
93.	Coalpac will consolidate the two existing Communities Consultative Committees for the Project in consultation with them, LCC and DP&I.	EA 6.6
94.	Coalpac has agreements in place with all receivers predicted to experience significant noise impacts. Coalpac will seek to enter into agreement with landholders identified in the EA as being predicted to receive moderate noise impacts. These include those private residences and properties discussed in **Section 3.6** of this document. Formalised agreements will be provided to the DP&I and LCC (without commercially in-confidence information) with the permission of the private landholder.	RTS
95.	Coalpac will continue to work with relevant individuals to minimise any inconvenience due to blasting required within a 500m radius of a residence. Relevant landholders will be notified of any blasting event within this radius within seven days and any inconvenience on the day of the blast shall be limited to no more than one hour.	RTS 4.22.6.6
Waste		
96.	Coalpac will commission an audit to identify any required upgrade to the existing mine sewage system to facilitate the additional workforce and operational areas proposed. This audit will be undertaken by an independent specialist in consultation with LCC.	RTS
Training and Reporting		
97.	Coalpac will induct and provide regular, relevant training to all employees and contractors in relation to the commitments in the Project Approval.	EA 6.6
98.	Coalpac will prepare an Annual Review report (which summarises monitoring results and reviews performance against the predictions and commitments in the EA and other relevant documents) and distribute it to the relevant regulatory authorities and the CCC.	EA 6.6

5 CONCLUSION

5.1 OVERVIEW

This PPR for the Contracted Project is provided as required by the Director General of the DP&I under section 75H(6) of the EP&A Act.

In comparison to the Exhibited Project, the Contracted Project has:

- Reduced the scale and intensity of the Exhibited Project by removing mining in the Hillcroft area, removing the sand mining component and contracted operations from areas of more sensitive biodiversity (see **Appendix G**);
- Adopted new or varied Commitments to achieve certainty of outcomes and to ensure the use of best practice measures to minimise impacts (see **Appendix D**, **Appendix E** and **Appendix F**); and
- Enhanced the biodiversity offset package committing to the purchase of additional lands with appropriate 'like for like' biodiversity values as well as the protection of the biodiversity values of that land in perpetuity and potentially for its dedication to the public (see **Appendix G**).

As reported by the relevant expert consultants in their respective reports provided for this PPR, it is concluded that when compared to the Exhibited Project, the Contracted Project results in:

- Improved and reduced air quality impacts surrounding the Project Boundary including in Cullen Bullen (see **Appendix A**);
- Reduced noise emissions generally to the north-west and around Cullen Bullen (see **Appendix E**);
- Avoidance and further protection of SPLs, particularly the rock formations, and the immediately adjacent habitat for key threatened species (see **Appendix G**); and
- Protection of an additional 3.2 hectares of critically endangered Clandulla Geebung species and 74 ha of the vulnerable Capertee Stringybark (see **Appendix G**).

These improved environmental outcomes are achieved by the reduction of the open cut mining area proposed by the Exhibited Project of 196 ha to a total of 762 ha within the Contracted Project Disturbance Boundary (a 20% reduction). This reduction results in the sterilisation of 11.6 Mt of ROM coal previously proposed for recovery in the Exhibited Project and also reduces the economic benefits that would have resulted from the conduct of the Exhibited Project.

Overall, the Benefit Cost Analysis found that the economic impacts from the Contracted Project are reduced as compared to the Exhibited Project, but are still of Regional, State and National significance producing a benefit of $1,330M.

The annual regional economic impact associated with the Contracted Project is estimated at up to:

- $219M in annual direct and indirect regional output or business turnover;
- $105M in annual direct and indirect regional value added;
- $30M in annual direct and indirect household income; and
- 293 direct and indirect jobs.

The annual NSW economic impact associated with the Contracted Project is estimated at up to:

- $275M in annual direct and indirect regional output or business turnover;
- $133M in annual direct and indirect regional value added;
- $48M in annual direct and indirect household income; and
- 519 direct and indirect jobs.

5.2 ENVIRONMENTAL PLANNING

The Contracted Project is an appropriate compromise to the 'Optimal Open Cut Mine Layout Plan' as discussed in the Exhibited EA and justifiably sacrifices a material proportion of the remaining otherwise recoverable coal to meet environmental and social requirements.

The continuation of mining at the Coalpac Mines enables continuity and security of coal supply of an appropriate quality and priced thermal coal to the MPPS, at a time when there is uncertainty as to the cost effective availability of such coal from other suppliers. Ensuring stability of low cost coal supply to MPPS is important to ensure secure and cost competitive supply of power to the NSW electricity grid. Additionally, it is important for ensuring continuity of supply to other domestic customers. It also provides access to export markets, the sales from which further increase the benefit of extracting the coal resource for the community.

In part, the environmental costs of recovering the coal proposed to be extracted by the Contracted Project have already been born by past mining activities at the Coalpac Mines.

Continued mining as proposed in the Contracted Project will enable the optimal recovery of the mineable coal resource and facilitate the completion of rehabilitation of the whole of the area of the Coalpac Mines.

The environmental and social costs of the operation of the Contracted Project are identified with certainty and are shown to be capable of being acceptably managed by:

- Avoidance of specific areas through mining exclusion areas;
- Operational controls;
- Offset land acquisition; and

- Management plans to be established, and approved by the DP&I and other Government agencies.

Ecological costs are minimised and are offset by a comprehensive BOS.

It is noted that there is no current Government policy in place to reserve the land to be disturbed by the Contracted Project in the NSW conservation estate.

The Contracted Project, when assessed and considered in accordance with the principles of Ecologically Sustainable Development and the objects of and the requirements under the EP&A Act, is appropriate for and approvable on the basis that the resultant economic benefit of $1,330 M significantly outweighs the residual environmental and social costs.

6 ABBREVIATIONS

Abbreviation	Description
AEMR	Annual Environmental Management Report
AHMP	Aboriginal Archaeology and Cultural Heritage Management Plan
ANC	Acid Neutralising Capacity
BBSF	Ben Bullen State Forest
BCA	Benefit Cost Analysis
BHS	Broad-headed Snake
BMP	Biodiversity Management Plan
BOMP	Biodiversity Offset Management Plan
BOS	Biodiversity Offset Strategy
BRW	Brush-tailed Rock Wallaby
CEEC	Critically Endangered Ecological Community
CRB	Cave Roosting Bats
Coalpac Mines	Existing Coalpac mining operations at Cullen Valley Mine and Invincible Colliery
DP&I	NSW Department of Planning and Infrastructure
DTIRIS-DRE	NSW Department of Trade and Investment, Regional Services - Division of Resources and Energy
EA	Environmental Assessment
EIA	Ecological Impact Assessment
EC	Electrical Conductivity
EMS	Environmental Management System
EMP	Environmental Management Plan
EPA	NSW Environment Protection Authority
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ETCPP	East Tyldesley Coal Preparation Plant
Exhibited EA	Coalpac Consolidation Project Environmental Assessment (Hansen Bailey, 2012)
Exhibited Project	Coalpac Consolidation Project as described in the *Coalpac Consolidation Project Environmental Assessment* (Hansen Bailey, 2012)
FCNSW	Forest Corporation NSW
FoS	Factor of Safety
GDE	Groundwater Dependent Ecosystem
HHMP	Historic Heritage Management Plan
ICPP	Invincible Coal Preparation Plant
LCC	Lithgow City Council

Abbreviation	Description
MOP	Mining Operations Plan
MPPS	Mount Piper Power Station
NAF	Non Acid Forming
NMP	Noise Management Plan
NOW	NSW Office of Water
OEA	Overburden Emplacement Area
PAC	NSW Planning Assessment Commission
PAC	Potentially Acid Forming
PHA	Preliminary Hazards Analysis
RLMP	Rehabilitation and Landscape Management Plan
ROTAP	Rare or Threatened Australian Plant
RTS	Response to Submissions
SEWPAC	Federal Department of Sustainability, Environment, Water, Populations and Communities
SMP	Subsidence Management Plan
SPL	Significant Pagoda Landform
TARP	Trigger, Action, Response Plan
TDS	Total Dissolved Solids
TSC Act	NSW *Threatened Species Conservation Act 1995*
TSS	Total Suspended Solids
WMS	Waste Management System

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APPENDIX A

REGULATORY CORRESPONDENCE

Planning & Infrastructure
NSW GOVERNMENT

Development Assessment
Systems and Approvals
Mining & Industry Projects
Contact: Mike Young
Phone: 02 9228 6091
Fax: 02 9228 6466
Email: mike.young@planning.nsw.gov.au

Dr Ian Follington
Chief Executive Officer
Coalpac Pty Limited
Invincible Colliery
Castlereagh Highway
CULLEN BULLEN NSW 2790

Dear Dr Follington

Coalpac Consolidation Project (10_0178)

In accordance with section 75H(6) of the *Environmental Planning and Assessment Act 1979* ("Act"), as it applies to the project, the Director-General requires the proponent, Coalpac Pty Limited, to submit to the Director-General:

1) a preferred project report that outlines any proposed changes to the project to minimise its environmental impact (section 75H(6)(b) of the Act); and
2) any revised statement of commitments (section 75H(6)(c) of the Act) for environmental management and mitigation measures on the site.

The preferred project report and revised statement of commitments must be submitted to the Director-General no later than **Wednesday 3 April 2013**.

If you wish to discuss this matter further, please contact Mike Young on 9228 2091.

DKitto 20/3/13

David Kitto
Director
Mining & Industry Projects
(as delegate of the Director-General)

APPENDIX B

HIGHWALL MINING ASSESSMENT AND REVIEW

GEONET *Consulting Group*
124 Ironbark Road
Chapel Hill
QLD 4069
Australia

Mining Geomechanics and Materials Engineering

A.B.N. 40 056 752 606

Tel: (07) 3878 1152
Mob: 0400 939 728
Email: geonetcg@ozemail.com.au

23 January, 2013

Coalpac Pty Ltd
42 Morrow Street
Taringa
QLD 4068

Attention: Ian Follington, Bret Leisemann

Dear Ian & Bret,

RE: REVIEW OF COAL UCS DATA: INVINCIBLE COLLIERY

Thank you for inviting GEONET to review the Invincible Colliery coal strength data measured by Maquarie Geotechnical Laboratory. Your specific request was to review the coal strength data in relation to the material properties input used for the geotechnical modelling of the Coalpac Consolidation Project.

In this letter report the method of estimation of the coal strength used in the original analysis is summarised [1]. Then the updated laboratory testing data will be analysed. Finally a discussion of the new data will be made in relation to the original input parameters.

Original Estimation of Coal Mass Strength

Material properties for the various coal seams are required to analyse stability of coal pillars formed during SHM highwall mining. Since no specific mechanical strength data was available for any of the coal seams an estimate of the typical composite coal seam strength was made based on the strengths of the different coal types and stone bands logged within corresponding seam horizons at Ulan Mine.

Generally the strength of coal in these strata is competent with unconfined compressive strengths in the range 15 MPa to 20 MPa [2]. However, given the shallow cover depths in some areas and the generally deeply incised topography it was estimated that the coal mass strength should be reduced from the intact unconfined compressive strength.

The actual peak strength of the composite coal seam depends on its geometry, particularly the width to height ratio. In a previous report the stress-strain behaviour of Irondale coal was simulated for a pillar with W:H=0.5. The modelled result predicts the limit of elastic behaviour stress at 7.0 MPa and the peak strength at 8.2 MPa. The lower bound value of 7.0 MPa represents the limit beyond which time dependent deformation will occur. For long term stability it is recommended to design pillars which remain within the limit of elastic deformation.

Visual inspection of the Moolarben seam exposures suggests that the coal is similar in its strength attributes as the Irondale seam. The Lithgow seam has a well developed section of bright coal and a substantial section of stone. Based on the geological log, the seam strength was simulated to show the limit of elastic behaviour at 7.2 MPa and the peak strength at 7.5 MPa, Figure 1(a).

Based on the simulated strength of the different coal seams it is concluded that their seam strength properties (as represented by the limit of elastic behaviour) are all similar at about 7 MPa. However, previous experience with a pillar failure in CHM mining panels at Ulan Mine back-analysed the seam strength (i.e. W:H=0.5) to 5.9 MPa [3]. This is in contrast to the original design strength estimate of 8 MPa [4]. Since the Ulan coal is effectively an extension of the Lidsdale/Lithgow seam and the coal seams in the current project area may be affected locally by previous underground mining, it was considered that the SHM design should be based on a lower bound coal mass strength of 6 MPa.

Figure 1(b) shows the simulated strength that was used for coal seams in the Coalpac Consolidation Project mining area. The coal strength (as represented by the limit of elastic behaviour) is 6.0 MPa and the peak strength is 6.2 MPa. The post peak behaviour is notably strain softening down to a residual strength of 2.4 MPa.

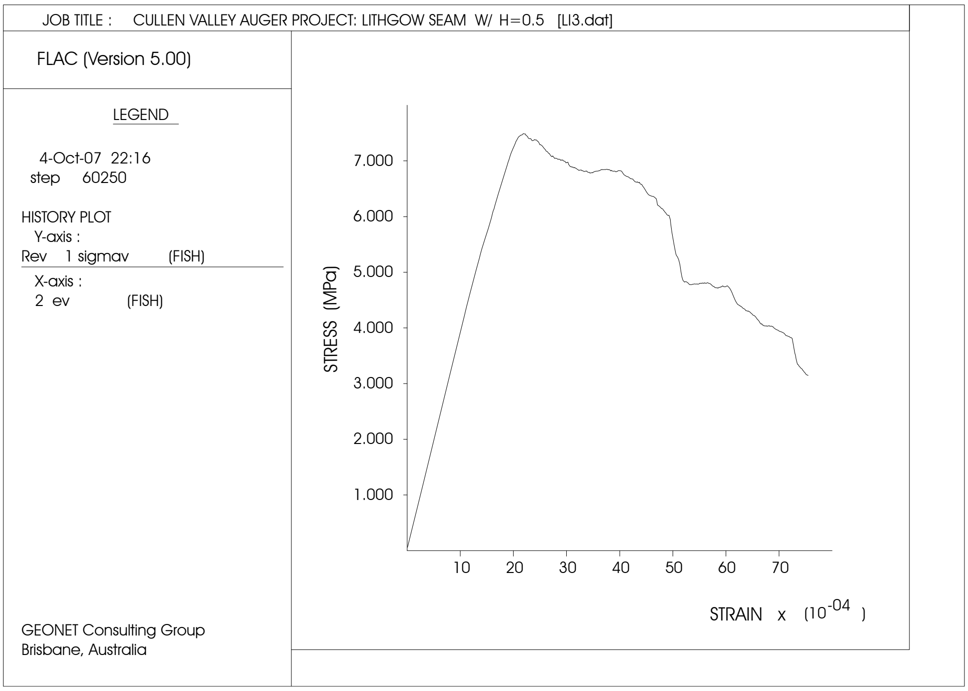

Figure 1(a): Simulated Lithgow coal seam stress-strain behaviour W:H=0.5

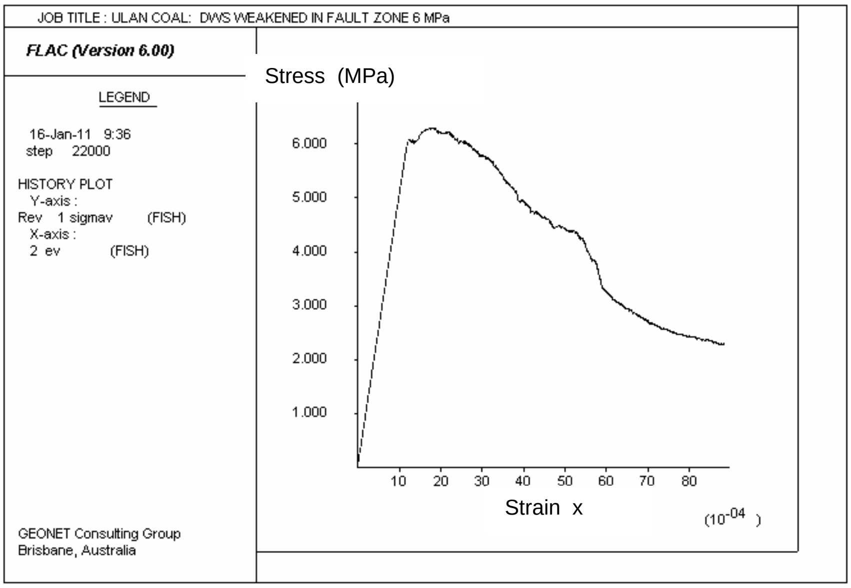

Figure 1(b): Simulated coal seam stress-strain behaviour W:H=0.5

Review of Invincible Coal UCS Data

A total of 37 coal samples were tested by Maquarie Geotech to measure the UCS. Standard testing procedures require that the sample aspect ratio is at least 2.0 and a maximum of 3.0. The ISRM standard testing procedures recommend an aspect ratio of 2.5. The reason for these recommendations is that the measured sample strength will be affected by the sample aspect ratio. Aspect ratios greater than 2.0 ensure that the shear strength of the sample is invoked whereas aspect ratios less than 2.0 induce platen confining effects which effectively increase the strength.

The measured UCS from Invincible coal samples is presented in Figure 2 as a function of the aspect ratio. The results show a wide spread of UCS ranging from 6.8 MPa to 43.6 MPa.

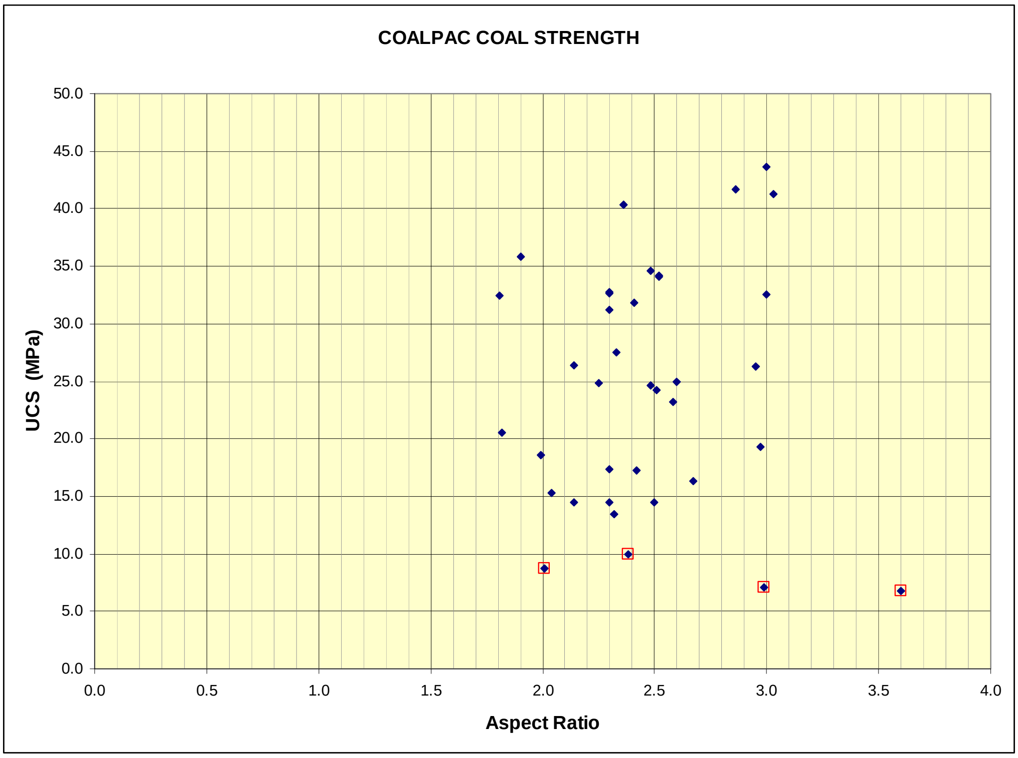

Figure 2: Presentation of coal UCS data as a function of the sample aspect ratio.

I do not believe that there is any relevance to calculate an average strength (and standard deviation) from these data. Rather, the data are used to define the limits, viz:

Intact coal strength: 43.6 MPa

Joint shear strength: 6.8 MPa.

These limits are absolutely relevant to the assigned modelling methodology used for the Coalpac Consolidation Project where a ubiquitous joint constitutive model was used to define the various rockmass units' deformation behaviour.

In Figure 2 the samples which sheared along pre-existing structure within the sample are marked with a red square. Typically these sample results would be discarded as being non-representative. However, it is interesting to note that the lowest value, 6.8 MPa, corresponds directly with the estimated coal seam (rockmass) strength described in the previous section.

It is concluded that the original input parameters used for the Coalpac Consolidation Project provide a conservative, absolutely plausible and defensible estimate of the coal strength. The results presented in the geotechnical stability assessment can therefore be considered to provide an accurate, best estimate of the anticipated deformation behaviour that may accompany highwall mining.

I trust that this brief overview of the recent UCS coal strength data provides you with further confidence that the original geotechnical modelling analysis was based on representative material properties.

Yours faithfully,

GEONET *Consulting Group*

Dr Ian H. Clark

Principal Consultant, Director

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Review of Highwall Mining Component – Coalpac Consolidation Project (CCP)

REPORT NO: 1301/01.2

PREPARED BY: BRUCE K. HEBBLEWHITE

DATE: 1st April, 2013

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EXECUTIVE SUMMARY

This report was commissioned by Hansen Bailey to provide a review of the highwall mining component of the Coalpac Consolidation Project (CCP), with emphasis on the mining and geotechnical aspects of the project proposal – in particular with regard to pillar design and stability issues, and surface subsidence effects and impacts. The report provides some background on the project and on highwall mining (HWM); it includes a peer review of the GEONET Consulting Group geotechnical report on aspects of HWM design; and recommendations concerning the forward approval and management processes. Some of the key findings of the report are summarised below:

Australian mining practice

- A major area of advance in the Australian underground mining industry has been in mining operating systems and management practices. Mining companies now are far more proactive in identifying inherent risks, be they geotechnical or other, and adopting a proactive risk management approach to the mining operation. Australia leads the world in the adoption of modern risk management approaches to mine management.

- The result of many technical, scientific and management advances across the Australian underground mining industry is that a modern mining operation can be successfully conducted in an environment containing a range of complex hazards; where inter-related performance measures are put in place to ensure that all appropriate stakeholder considerations are linked into the management systems and the mine performs according to agreed compliance measures.

GEONET Report Review

- The report notes that *"only rare isolated faults and fault zones have been encountered in local open cut mining operations".* This is obviously a good sign of what may be expected in new areas, although there should be ongoing forward exploration to maintain good awareness of any potential geologically disturbed regions. Given that open cut mining is conducted in advance of highwall mining, good exposure is provided and should be carefully recorded as operations advance. Further, the extensive existing underground mining within the Project Area, with minimal roof support, provides important information regarding ground conditions and structure beyond the area accessible by open cut mining and should be considered as part of this forward exploration process. This process should be directed by a Management Plan to ensure adequate assessment of ground conditions in advance of operations.

- Coal strength data for pillar design - The principle adopted by GEONET to work with strength limits below the elastic limits of the coal properties is a sound principle and appropriate for pillar design.

- Coal strength database – At the time of the original submission for the project there was only very limited coal strength data available. However additional strength data has now been obtained from within the project area. The conclusion from a January 2013 GEONET review of the new actual site data is that the data used in the original design studies was quite appropriate and represented conservative but appropriate values based on the new information.

- Pillar stability design – based on extensive past experience, a minimum Factor of Safety (FOS) of 1.3 has been applied for web pillars (i.e. no pillars have a FOS below 1.3).

- The report notes that although the minimum 1.3 FOS has been suggested by CSIRO for long term stability, it may not be adequate to ensure long term stability and minimal subsidence in areas of unknown geological variation and other operational variations. (GEONET subsequently applies more conservative pillar designs in such areas. For example Katoomba seam pillar widths have been increased from 2.6m to 3.6m wide (with corresponding FOS increase) to allow for the impact of geological conditions which might result in roof falls).

- Pillar loading has been calculated based on maximum overburden depth in each location even though this will obviously not apply to the entire pillar length, and will in fact be reduced by the protection effect offered by the regularly spaced barrier pillars.

- GEONET has adopted a three stage pillar/mine design approach - empirical, 2D and 3D numerical – this is considered to be a very comprehensive, legitimate and appropriate design methodology.

- The critical span between barrier pillars has been defined as a maximum of twice the overburden (or interburden) thickness, to ensure that the intervening web pillars are not overloaded. This is considered as appropriate and adequate for regional stability. A principle of permanently stable barrier pillars with width:height ratios >5 has been adopted. These design principles are considered to be geotechnically sound.

- As an overall conclusion of the geotechnical design methodology and results of the GEONET design studies, it is considered that the approach that has been adopted is highly appropriate, and is well founded in good geotechnical practice. The use of multiple design methodologies to confirm or refine design parameters is highly commendable. The results of the design work are therefore considered to be suitable for a project study at this stage of an operation. Clearly these results and design parameters should be further refined once actual operating experience is gained and geotechnical performance feedback can be achieved. Such an approach is standard good geotechnical practice.

Other Considerations

- The issue of final highwall slope design will be considered as part of the ongoing mine design process. The geotechnical design approach undertaken in relation to the actual HWM operation has been rigorous and appropriate, using multiple design methodologies to assess the various design parameters of the mining operations to mitigate pillar instability and overlying subsidence risk.

- It would be highly appropriate to incorporate a management technique involving geotechnical monitoring and decision-making based on monitoring data which could provide an appropriate stop point before mining causes any adverse impact on critical surface structures.

- Coalpac has conducted further rock testing and obtained an additional suite of site strength data for each seam. This new data has been reviewed by GEONET (in January 2013) and has validated the current assumptions in the design studies.

- Pillar stability due to drivage deviation – a figure of ± 20cm for each pillar has been quoted, based on manufacturer data derived from actual mining trials. It is understood that this amount of potential deviation has been incorporated into the pillar design dimensions.

Overall Conclusions and Recommendations

- It is argued that an approval of the overall proposed mining operation is a suitable and recommended approach. The mining method does not carry any excessively more significant risks than other underground mining methods.

- The issues of protection of the critical surface landforms relates to specific locations within the mining lease, and to specific rock formations within those locations. It is an appropriate strategy to develop further data on the surface impact of the HWM system in this regional geology in areas well away from Significant Pagoda Landforms (SPL) in the early stages of mining.

- Specific final highwalls and HWM layouts can be designed according to the final highwall position (determined via Slope Stability and Blast Management Plans) and the local geology in each location.

- Monitoring of the subsidence effects of the HWM operation ahead and away from the HWM extremities can be implemented as operations approach the SPL. Such monitoring can be incorporated into a Subsidence Management Plan which empowers and in fact binds the mine operator to comply with SPL protection, with mining restrictions applied in response to any "early warning" of subsidence developments. Such an approach will ensure that any impacts of mining are restricted to a safe distance from any SPL, such that even if a HWM pillar failure did occur at some point in the future (deemed as highly unlikely), the impact of such failure would still fall into a region that was outside the zone which might impact the SPL.

1. INTRODUCTION

1.1 Scope of Work

The following is an extract from the scoping document for this report, as provided by Coalpac in the document titled "Scope for Review of Highwall Mining Component of Coalpac Consolidation Project" (CCP), dated 7 January, 2013:

> *"The proposed scope for the review is to critique the approach design and assessment approach taken for the CCP and specifically to provide independent expert opinion on the suitability of the application of the "normal" State regulatory process regarding the generation and approval of Subsidence Management Plans taking into account the relevant geotechnical, geometric and geological factors as they apply across the Project Area over the life of the mine.*
>
> *Specifically we need commentary on what controls and conditions could be applied to allow highwall mining to proceed whilst giving the regulators the appropriate points of measurement for control of the activity (i.e. steps in ongoing planning and approval of a highwall programme through a complex geotechnical and geometrical environment to manage any impact upon the overlying and adjacent rock formations)."*

In addition to the scoping document identified above, the following key documents were provided by Coalpac to aid with this peer review:

- GEONET Consulting Group (December 2011) – *Assessment of stability and subsidence: SHM highwall mining, Coalpac Consolidation Project.* (This report was included in the project Environmental Assessment documentation as Appendix F).
- Coalpac Consolidation Project Environmental Assessment, March 2012.
- NSW Planning Assessment Commission (PAC), (December 2012) – *Coalpac Consolidation Project Review: Main Report.*
- NSW Trade and Investment, Resources and Energy Branch – various letters to the PAC, dated 31/5/12 and 4/10/12, signed by Mr William Hughes, A/Director, Minerals Operations.
- GEONET (23 January, 2013) – letter to Coalpac, headed *"Review of coal UCS data: Invincible Colliery*", signed by Dr Ian Clark, Principal Consultant.
- Caterpillar (31 January, 2013) – *Caterpillar Highwall Mining Systems – Cutter Module Navigation and Steering System.*
- GEONET (18 February, 2013) – letter to Coalpac, headed *"Definition of Barrier Pillar Stability",* signed by Dr Ian Clark, Principal Consultant.
- plus a number of individual plans, diagrams and other data sources.

As indicated above, the peer review is focused on the Highwall Mining (HWM) component of the project and excludes any open-cut related issues. The review is primarily focused on geotechnical issues associated with the proposed HWM aspects of the project, which centre on underground stability considerations, and surface subsidence effects and impacts.

As the author of this peer review, I offer the following comments on the geotechnical aspects of underground stability and subsidence, on the basis of my relevant professional qualifications, experience and background (see Summary CV in Appendix A). A comprehensive CV containing a full list of publications is available on request.

My background relevant to the subsidence aspects of this project includes a close association with a number of different coal mining projects across NSW, Qld and internationally – from various perspectives, including mine design and audit on behalf of coal companies; and consulting/review studies on behalf of government and agencies (eg NSW Dept of Planning and Infrastructure; Dept of Primary Industry; NSW Dams Safety Committee; Qld Government Crown Law; Government of Pennsylvania, USA); a recent such study being as Chair of the Independent Expert Panel of Review into *"Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield"* (jointly for the NSW Dept of Planning & Dept of Primary Industry, 2006-2008).

I will make use of the following subsidence-related terms in this peer review - specifically, subsidence effects, impacts and consequences - and so offer the following definitions which were published in the above Southern Coalfield Report, see extract below.

> *"The Panel has used the term "**subsidence effects**" to describe subsidence itself – ie deformation of the ground mass caused by mining, including all mining-induced ground movements such as vertical and horizontal displacements and curvature as measured by tilts and strains.*
>
> *The term "**subsidence impacts**" is then used to describe the physical changes to the ground and its surface caused by these subsidence effects. These impacts are principally tensile and shear cracking of the rock mass and localised buckling of strata caused by valley closure and upsidence but also include subsidence depressions or troughs.*
>
> *The environmental "**consequences**" of these impacts include loss of surface flows to the subsurface, loss of standing pools, adverse water quality impacts, development of iron bacterial mats, cliff falls and rock falls, damage to Aboriginal heritage sites, impacts on aquatic ecology, ponding, etc."*

1.2 CCP Project Background

The following is a brief overview of the CCP project, to provide some context for the contents of this peer review report. This background information is extracted from the CCP Scope for Review document already referenced above:

> *"Coalpac is seeking Project Approval from the Minister for Planning and Infrastructure under Part 3A of the EP&A Act to consolidate the operations and management of the Cullen Valley Mine and Invincible Colliery under a single, contemporary planning approval. The Project will allow coal mining operations largely within Coalpac's current mining authorities to continue for a further period of 21 years within the Project Boundary, see Figure 2. Opportunistic sand extraction is also proposed within the coal seam stratigraphy.*
>
> *The Project generally comprises the following:*
> - *Consolidation and extension of the existing Cullen Valley Mine and Invincible Colliery operations to produce up to a total of 3.5 Mtpa of product coal, including:*
>   - *The continuation of mining operations at Cullen Valley Mine (the area west of the Castlereagh Highway) via both open cut and highwall mining methods to access an additional resource of approximately 40.1 Mt ROM; and*
>   - *The continuation of mining operations at Invincible Colliery (including an extension north into the East Tyldesley area) via open cut and highwall mining methods to access an additional resource of approximately 68.4 Mt ROM;*

- *Mining and coal processing 24 hours per day up to seven days per week with approximately 120 full time personnel plus contractors;*
- *Continuation of coal supply to the local MPPS via a dedicated coal conveyor over the Castlereagh Highway (to be constructed), and emergency supply to MPPS and WPS (via road), with flexibility for supply to additional domestic destinations and Port Kembla (via rail) for export;*
- *Upgrades to existing Invincible Coal Preparation Plant, administration and other infrastructure;*
- *Construction and operation of additional offices at Cullen Valley Mine;*
- *Construction and use of the East Tyldesley Coal Preparation Plant (incorporating the previously approved CDP at Cullen Valley Mine);*
- *Construction and operation of a bridge and haul road across the Wallerawang - Gwabegar Railway Line to permit access to mine the previously approved Hillcroft resource;*
- *The extraction of the Marangaroo Sandstone horizon from immediately below the Lithgow Coal Seam in the northern coal mining area of Cullen Valley Mine. This material will be trucked to an onsite crushing/screening station prior to sale into the Sydney (and surrounds) industrial sand market;*
- *Construction of a rail siding and associated infrastructure to permit transport of coal and sand products;*
- *Integration of water management infrastructure on both sites into a single system; and*
- *Integration of the management of mine rehabilitation and conceptual final landform outcomes for Cullen Valley Mine and Invincible Colliery.*

Pagodas:
'Pagodas' is the common name given to the distinctive sandstone formations found in a limited area on the western escarpment of the Blue Mountains north-west of Sydney. There are two forms: smooth, beehive-like structures (smooth pagodas) and stepped, terraced structures known as platy pagodas. Platy pagodas are the ones potentially impacted by the proposed project. Platy pagodas are massive, intricately patterned Triassic sandstone formations with ironstone banding, see Figures 3, 4 and 5."

The following diagrams and photographs are reproduced from the same "Scope for Review" document, to provide further context for this report. The Figure numbers are those referred to in the above extracted text – Figures 2, 3, 4 and 5 (consequently, there is no Figure 1 in this report).

Figure 2 shows an overall plan of the proposed project location, indicating existing mining operations; proposed open-cut operations; and proposed highwall mining operations, within the CCP lease boundary taken from the CCP Environmental Assessment.

Figure 3 contains photographs of typical pagoda rock formations. Figure 4 is an aerial view of the overall location (dated October 2011), showing mining and town infrastructure plus the natural topography of the area, with the Ben Bullen Significant Pagoda Landform (SPL) in the lower right (south east) of the photograph. Figure 5 is a further photograph looking across some of the existing Invincible Colliery open cut workings and rehabilitation with the Ben Bullen SPL in the background.

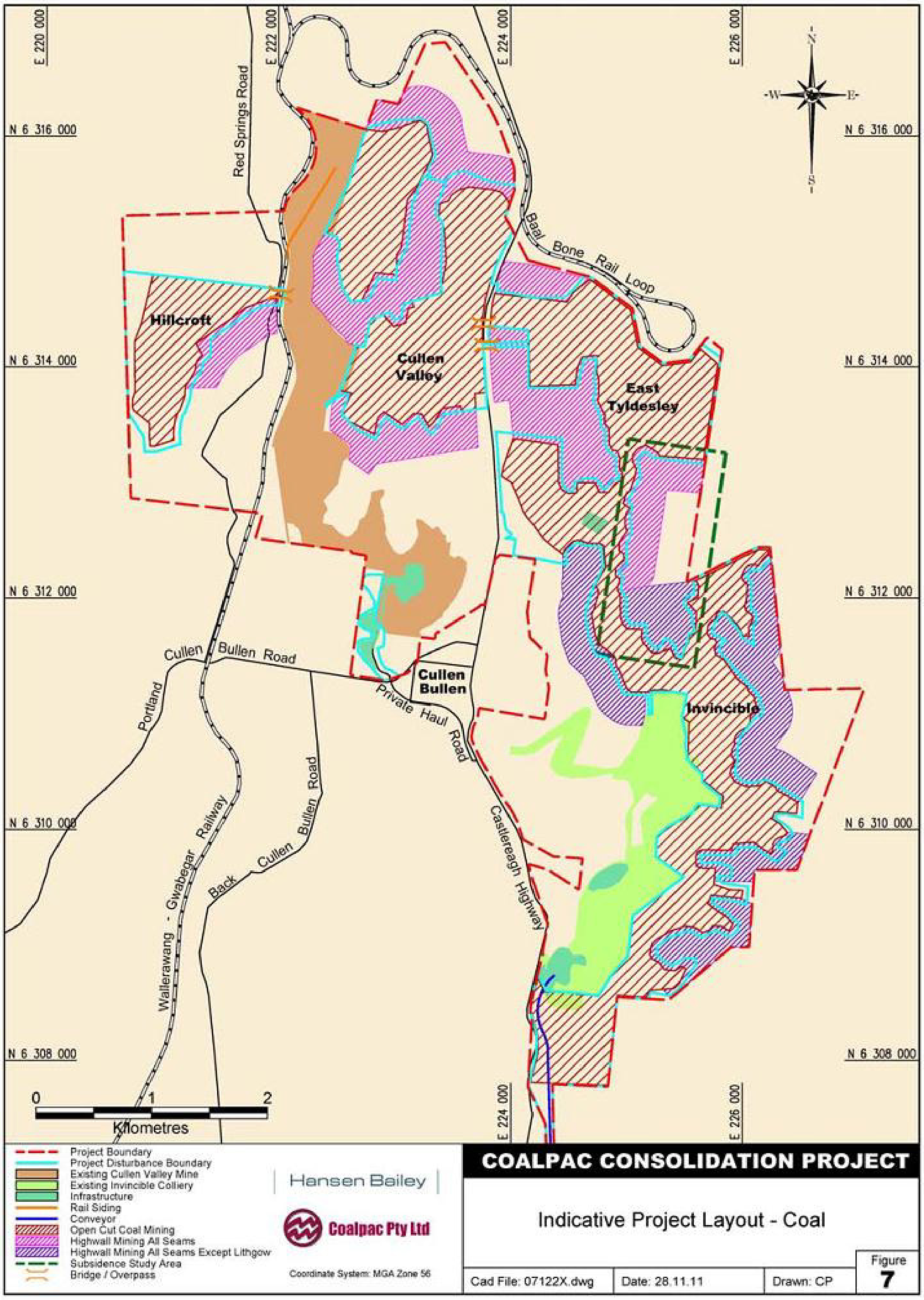

Figure 2. Project Area and Area of Coal Extraction
(source: Coalpac Consolidation Project, Environmental Assessment)

Figure 3. Pagodas (smooth & platy in left picture, platy in the right)
(source: Coalpac Scope for Review document)

Figure 4. Aerial photograph of Cullen Valley Mine and Invincible Colliery showing extent and form of pagodas *(source: Coalpac Scope for Review document)*

Figure 5. Ben Bullen SPL in the background due east of Invincible Colliery (looking Southeast)

(source: Coalpac Scope for Review document)

Figure 6 is a conceptual forward production schedule for the CCP taken from the CCP Environmental Assessment. This indicates the proposed progressive development of the mine – note that all HWM follows open-cut operations in each location – either from existing open-cuts, or from the proposed new open cut areas. On the basis of this schedule, it is clear that there is no planned HWM in areas adjacent to the Ben Bullen SPL in the south-east corner of the lease for at least three or four years.

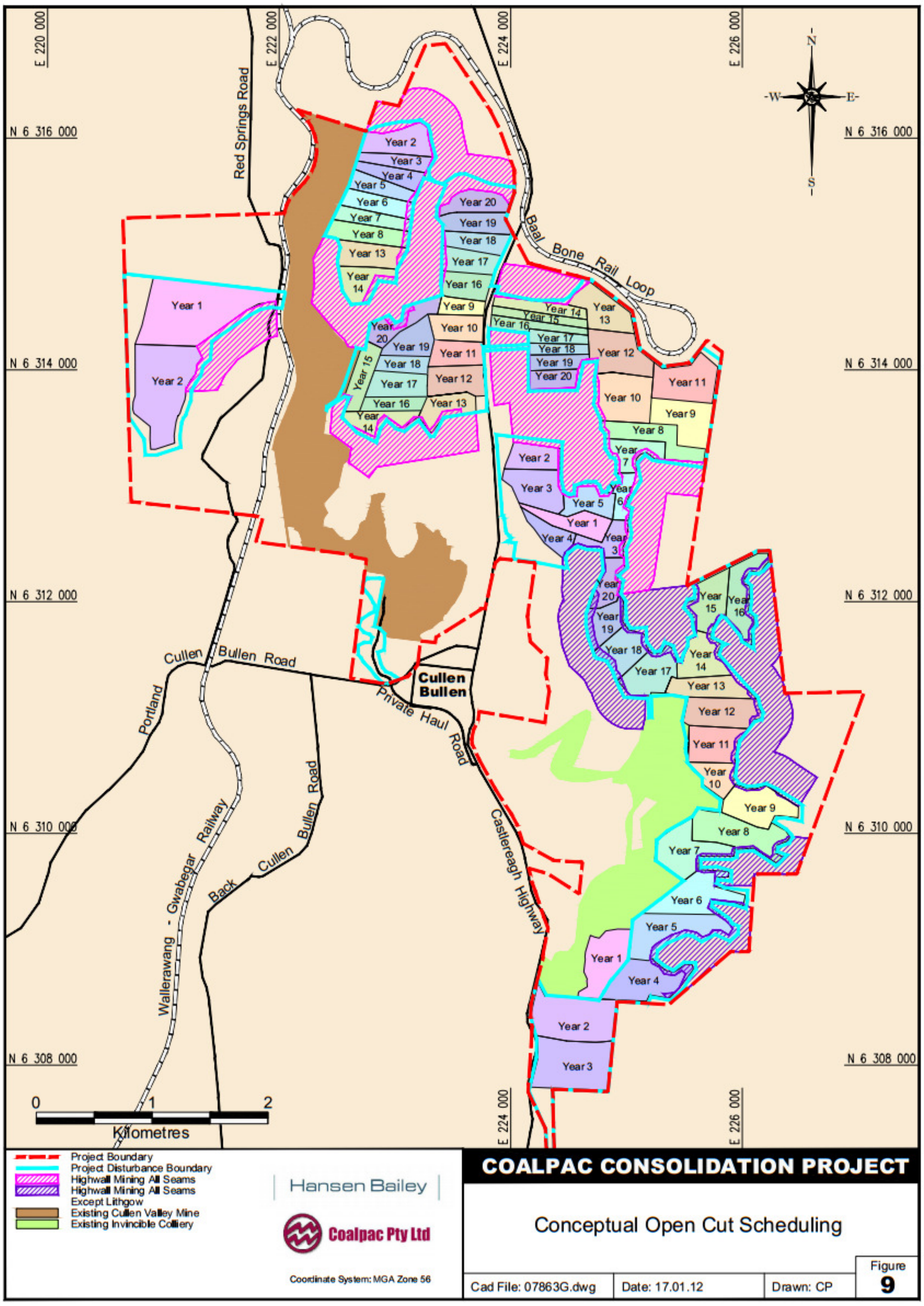

Figure 6. Conceptual open cut production location schedule from Exhibited Project mine plan (*source: Coalpac Consolidation Project, Environmental Assessment)*

1.3 Highwall Mining

This section is a brief discussion of the highwall mining system, and particularly some of the geotechnical factors and considerations considered relevant to this review. The first point to make with respect to HWM is that although it is often classified as a surface mining technique, this is technically incorrect. From a technical perspective, it is an underground mining method, albeit that the mining operation is conducted from a surface location, in terms of all personnel and equipment controls are located on the surface and the underground operation is a totally unmanned mining system – hence the surface mining classification.

Figure 7 is a photograph of a Caterpillar highwall mining system of a kind that is proposed for use by Coalpac in this project. Figure 8 shows the conceptual Coalpac mine layout including the highwall access and the multi-seam HWM operations included as Figure 16 in the CCP Environmental Assessment. Several features of the method seen in this Figure should be noted. Firstly, the HWM equipment punches drives into the coal seam from the highwall, for a proposed distance of up to 305m (for this particular equipment). Secondly, a series of drives are mined from the highwall, in parallel, resulting in long narrow continuous "web pillars" of coal between each punch. Thirdly, after a certain number of such drives, a wider "barrier pillar" is left, before the next group of drives is mined. The role of these barrier pillars is critical in ensuring not only highwall stability, but regional stability for the overburden above the production drives.

Figure 7. Typical HWM equipment and mine cross-section (*source: Coalpac)*

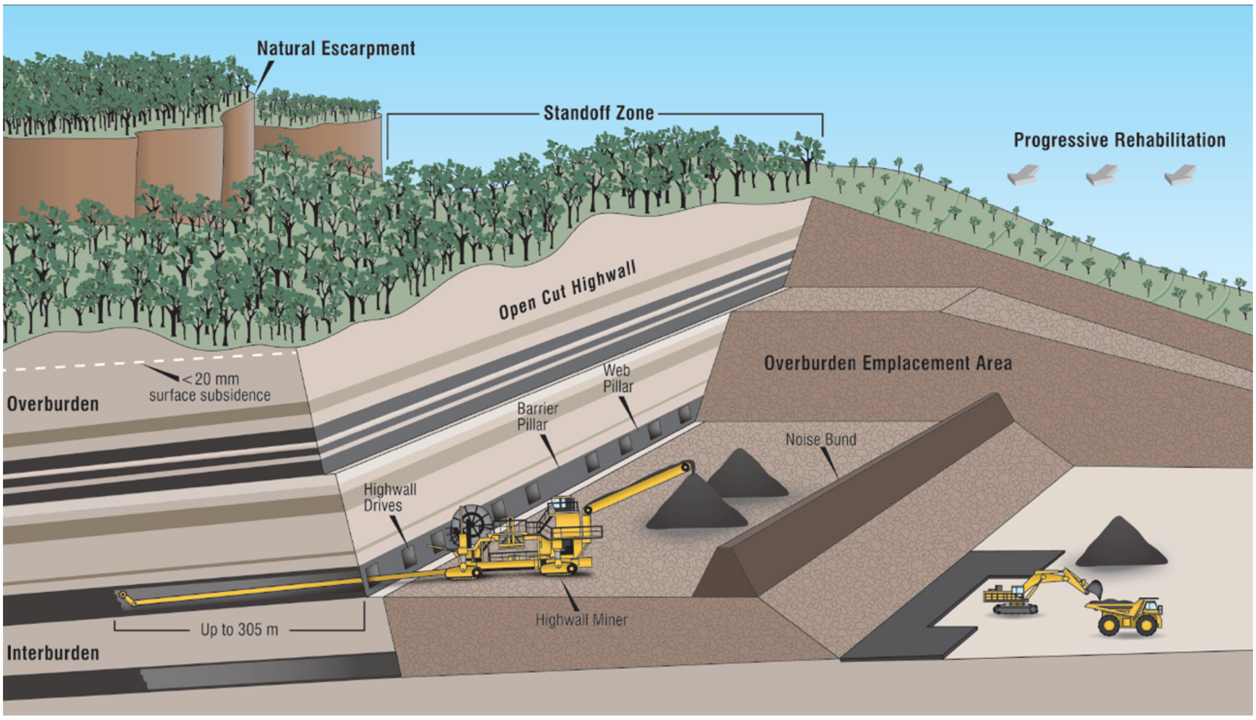

Figure 8. Conceptual multi-seam HWM mine layout *(source: Coalpac Consolidation Project, Environmental Assessment)*

Figure 8 also shows the placement of overburden spoil from the open-cut operations against the highwall. It is understood that this is the intention of the ongoing CCP operation – to place spoil against the highwall on completion of HWM. This practice will clearly eliminate any ongoing concern about time-dependent highwall instability.

In reviewing the design of the highwall mining operation from a geotechnical perspective, it is critical that the performance of both the web pillars and the barrier pillars are considered in combination, and not in isolation. A key element of the geotechnical design is that the barrier pillars carry a proportion of the regional overburden load over the production areas, such that the loading on the intervening web pillars is reduced to a value below the normal overburden "tributary area" loading. The amount of such load reduction is a function of the overall mine and overburden geometry and the coal seam and overburden geology and geotechnical properties.

Another important consideration when discussing highwall mining as an underground mining method is to understand that, as with any underground mining – bord and pillar first workings, pillar extraction or longwall mining – once coal is removed and an underground excavation is created, the surrounding rock mass deforms to a certain extent as the stresses in the rock mass are redistributed to establish a new state of equilibrium in the ground. Any form of underground excavation behaves in this manner – in mining and in civil tunnelling. It is a fundamental aspect of Newtonian physics applied to the behaviour of rock masses subjected to stress fields.

The difference in the response of the ground to different mining methods is one of scale. In the case of pillar extraction, or longwall mining, where excessive underground excavation spans are created, the span exceeds the supporting strength of the overlying rock mass, leading to rock failure, downward deformation of the roof and overlying rock mass and subsequent significant amounts of downward subsidence of the ground surface. The amount of surface subsidence is a function of the span and height of the excavation and the depth of the overburden.

In the case of bord and pillar first workings, or in fact highwall mining (which is just another form of bord and pillar workings from a regional geotechnical perspective), the span of each excavation is greatly reduced (with HWM using even narrower spans (3 to 3.5m) than bord and pillar roadways (5.5 to 6m)). The result is that the response of the rock to the mining process is a very minor amount of relaxation of the immediate rock mass around the drive or heading. This relaxation of the rock mass, combined with a small amount of elastic compression of the intervening pillars due to the increasing load imposed on them by the mining process may cause a very small amount of surface subsidence – a maximum of approximately 10-20mm, for typical pillar heights and layouts. This type of minimal overburden deformation is part of the elastic redistribution in the rock mass and occurs at the time of mining and then stabilises. Consequently, the surface subsidence effects above typical bord and pillar first workings mining or highwall mining are minimal, such that there are no adverse subsidence impacts on any natural or man-made infrastructure.

Highwall mining has been successfully practised around the world for many decades now, having had its origins in the eastern parts of the USA. HWM operations have taken place in Australia since the late 1980s (in NSW, Queensland and WA), using both remote drum-type mining cutter heads resulting in a rectangular excavation profile, or using single or double auger cutter heads producing circular entry profiles. Technology has improved considerably since the early introduction of HWM. In particular, the control of the cutting horizon, and the directional control of the cutter head – linked with accurate sensing/navigation instrumentation – have made great advances in recent decades. Control of the cutting horizon is obviously important to ensure maximum coal recovery and minimal dilution from roof or floor rock. Control of the azimuth or drive direction is critical to ensure straightness of the drives for their full 305m maximum length so that the web pillars between each drive maintain their designed thickness and do not become too narrow and hence potentially unstable.

The navigation system used by Caterpillar in the Coalpac-proposed equipment package is a fibre-optic gyroscopic (FOG) system of inertial navigation. The FOG system provides a continual or incremental three-dimensional sensing of the cutter-head location and can be used to then steer the machine to correct any deviation detected. Actual field tests by Caterpillar using a Joy continuous miner cutter head, in both Australia and the USA, have shown that the system is steerable within a tolerance of $\pm$10cm either side of the target direction or azimuth of the drive direction (ref. Caterpillar Highwall Mining Systems – 31 January, 2013). This means that the actual mined web pillar dimensions should be achievable within $\pm$20cm of design width, allowing for drive deviation on each side of the pillar. This is as good as, if not far better than conventional underground mining directional control, and is considered an acceptable tolerance that has been factored into the design calculations, with a further factor of safety applied if required.

Underground mining methods and systems of all types have improved dramatically over the past thirty to forty years. This has been a combination of major advances in mining technology and equipment – and HWM is no exception in this regard – but also in terms of geotechnical knowledge, from the starting point of exploration and data collection, through to geotechnical design and performance monitoring. A further major area of advance has been in mining operating systems and management practices. Mining companies now are far more proactive in identifying inherent risks, be they geotechnical or other, and adopting a proactive risk management approach to the mining operation. Australia leads the world in the adoption of modern risk management approaches to mine management.

The result of all of these technical, scientific and management advances is that a modern mining operation can be successfully conducted in an environment containing a range of complex hazards; where inter-related performance measures are put in place to ensure that all appropriate stakeholder considerations are linked into the management systems, and the mine performs according to agreed compliance measures.

2 PEER REVIEW OF HIGHWALL MINING COMPONENTS OF PROJECT

This section of the report is focused on the content of the GEONET "Assessment of stability and subsidence" report, which formed Appendix F of the Environmental Assessment. In the form that the report was provided as Appendix F of the EA document, it also contained a separate peer review report by Boyd Mining Pty Ltd, as an Appendix to the GEONET document. The following comments are raised in the order that they appear in the report. Page and section numbers refer to the GEONET report.

- Sections 1 and 2 provide introduction to the project, and describe both the background investigations into HWM technologies, as well as the site geology in the Invincible area. It is noted that HWM is proposed in various locations in the Katoomba, Moolarben, Irondale and Lithgow Seams (in descending order).

- P10, section 2.2 notes that *"only rare isolated faults and fault zones have been encountered in local open cut mining operations".* This is obviously a good sign for what may be expected in new areas, although there should be ongoing forward exploration to maintain good awareness of any potential geologically disturbed regions. Given that open cut mining is conducted in advance of highwall mining, good exposure is provided and should be carefully recorded as operations advance. Further, the existing extensive underground mining within the Project Area, with minimal roof support, provides important information regarding ground conditions and structure beyond the area accessible by open cut mining and should be considered as part of this process. This process should be directed by a Management Plan to ensure adequate assessment of ground conditions in advance of operations.

- It is understood that HWM of the upper seams will take place in some areas above old underground mine workings in the Lithgow seam. On p16 the statement is made *"Recent geotechnical assessment of the pillars [3] confirmed their stability with Factors of Safety in excess of 5".* This statement refers to a report prepared by consulting firm Strata Engineering. This report contains an analysis of pillar dimensions based on mine plan data. It is also understood that Coalpac have already excavated a large number of pillars from old Invincible underground workings and confirmed good correlation between mine plan records and actual dimensions. It is therefore accepted that there is a reasonable and acceptable understanding of the dimensions and hence stability of the old Invincible pillars. Mining above these areas should be able to proceed safely, with normal precautions applied to manage the associated risks.

- Section 2.4 discusses coal strength data, albeit on an initially scarce data availability - essentially sourced from Ulan Mine published data. The principle adopted by GEONET to work with strength limits below the elastic limits of the coal properties is a sound principle and appropriate for pillar design. GEONET acknowledges that there was only a scarce amount of available data to use for design, although it is know that subsequent to this report, additional data has been sourced from the Invincible Colliery area. This new data was reviewed by GEONET and reported to Coalpac on 13 January 2013. The conclusion from the review of the new actual site data is that the data used in the original design studies was quite appropriate and represented conservative but appropriate values based on the new information.

- Section 3 discusses pillar dimension design. Pillar strength is a function of the all-important pillar width:height ratio. Strength is therefore greatly enhanced when pillar widths are increased, or heights decreased. Factor of Safety (FOS) is a function of strength relative to pillar load or applied stress. GEONET have reviewed previous HWM practice and local geological variations to feed into their design approach. Based on past experience, a <u>minimum</u> Factor of Safety (FOS) of 1.3 for web pillars has been adopted (relying on extensive HWM industry research conducted for ACARP by CSIRO). Pillar loading has been calculated using maximum overburden depth (and hence pillar load) in each location even though this will obviously not apply to the entire pillar length, and will in fact be reduced by the protection effect offered by the regularly spaced barrier pillars. It is noted that a maximum cutting width of 3.5m is used, but can be reduced to 3.0m where lower seam sections are recovered and a lower cut height cutterhead is employed. An empirical pillar strength formula has been used for preliminary calculations, based on a power law formula, linking strength to the width:height ratio (note that these formulae do not rely on local site-specific strength data). Pillars have been designed to provide long-term stability based on available database information. It is noted on p23 (section 3.3) that although the minimum 1.3 FOS has been suggested by CSIRO for long term stability, that it may not be adequate to ensure long term stability and minimal subsidence in areas of unknown geological variation and other operational variations.

- Section 4 outlines the further design approach taken to reinforce or refine the empirical design work by undertaking a two dimensional numerical modelling design methodology using the finite difference method (FLAC), incorporating the vertical and horizontal stresses; the actual surface topographic variations; and the surrounding rock mass properties. This work confirmed the empirical pillar design dimensions, and the 1.3 FOS as an appropriate starting point for the design process.

- Section 5 reports on a third design stage adopting a three dimensional modelling study (FLAC3D) used to more fully evaluate the complex geometries of mining sequences and topography. Section 5.3 considers the issue of underlying Lithgow seam workings and their potential impact on reducing overburden rock properties. This work indicates some minor localised effects, although it is not considered to be a HWM limiting factor.

- Section 6 discusses the overall findings of the three design approaches – empirical, 2D and 3D numerical – which is a very comprehensive, legitimate and appropriate design methodology. Arising from this three level study, original pillar dimensions have been modified accordingly. For example, Katoomba seam pillar widths have been increased from 2.6m to 3.6m to allow for roof falls which may cause increased pillar height, hence reduced pillar strength, if not compensated for by increased width.

- Section 7 describes the design approach adopted for barrier pillars. A principle of permanently stable barrier pillars with width:height ratios >5 has been adopted. Pillars exceeding w:h ratios in excess of 5 are known as "squat pillars" and possess significantly greater strength than those with w:h ratios below 5. The critical span between barrier pillars has been defined as a maximum of twice the overburden (or interburden) thickness, to ensure that the intervening web pillars are not overloaded. Both of these design principles are considered to be geotechnically sound.

- The overall report conclusions indicate that maximum subsidence above the multi-seam HWM operations will be less than 20mm, other than one localised region at the southern point of the western highwall which does not impact any surface landscape sensitive areas.

- As an overall conclusion of the geotechnical design methodology and results of the GEONET design studies, it is considered that the approach that has been adopted is highly appropriate, and is well founded in good geotechnical practice. The use of multiple design methodologies to confirm or refine design parameters is highly commendable. The results of the design work are therefore considered to be suitable for a project study at this stage of an operation. Clearly these results and design parameters should be further refined once actual operating experience is gained and geotechnical performance feedback can be achieved. Such an approach is standard good geotechnical practice.

3 DISCUSSION OF OTHER ISSUES

This section includes a discussion of some further issues considered relevant, including those associated with the open-cut operations which are not directly considered in this review report, such as open-cut slope stability. It is also worth noting that approval had previously been given for some HWM in sections of the lease, prior to the current request for consolidation under the CCP.

- Final highwall stability – The EA describes part of a design process where it is stated that *"more detailed investigation is required at final highwall design stage in order to fully delineate these features and risk assess their stability".* This statement is considered appropriate for ongoing mine design, on a site by site basis as the mine progresses. It is not considered appropriate as a blanket design study for the entire project at initial approval stage, as it would not be possible to incorporate all the relevant details of local site geological variations – many of which are not even known at this stage of the project. Therefore it is recommended that this requirement is appropriate to be incorporated into the project approval, as part of the ongoing project management responsibility – in line with good risk management design practice.

- Slope stability - This is a very complex geotechnical environment that cannot be fully defined by a generic set of designs and risk assessments. Once again, it can only be assessed on a section by section analysis of each mining operation relative to the actual nature of the slopes and rock formations present. This will be done in an ongoing mine design approach.

More importantly, the best control of these "unknown" risks is to implement an appropriate geotechnical monitoring regime on the surface in the regions between mining and various surface landforms, to gather data on the impact of approaching mining on such surface features, and develop a sound knowledge of the ground response to mining – well before mining approaches any critical rock formations.

It would be highly appropriate to incorporate a management technique involving geotechnical monitoring and decision-making based on monitoring data which could provide an appropriate stop point before mining causes any adverse impact on critical surface structures.

- Mine instability and subsidence – Coalpac has modified the HWM plans, subsequent to the plans that were originally submitted in the Exhibited Project EA. Under the Contracted Project mine plans, there is no proposed HWM beneath any significant pagoda landforms (SPL). Figures 9 and 10 indicate the Contracted Project mine plans excluding any mining beneath SPLs. The planned HWM locations are positioned to avoid the Ben Bullen SPL and to incorporate a stand-off distance – again determined on a site by site basis, to ensure no adverse impacts on the Ben Bullen SPL.

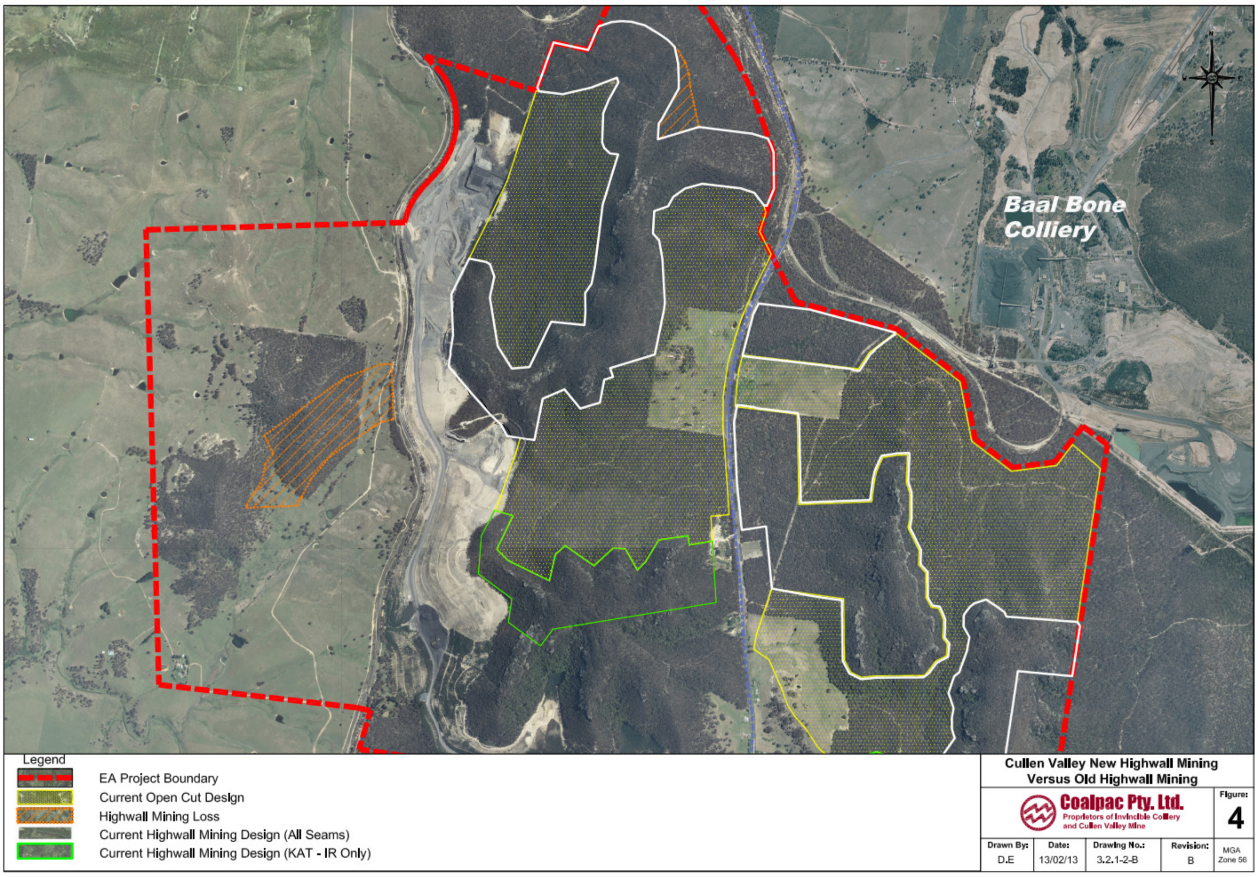

Figure 9. Contracted Project Cullen Valley HWM Layout *(source: Coalpac)*

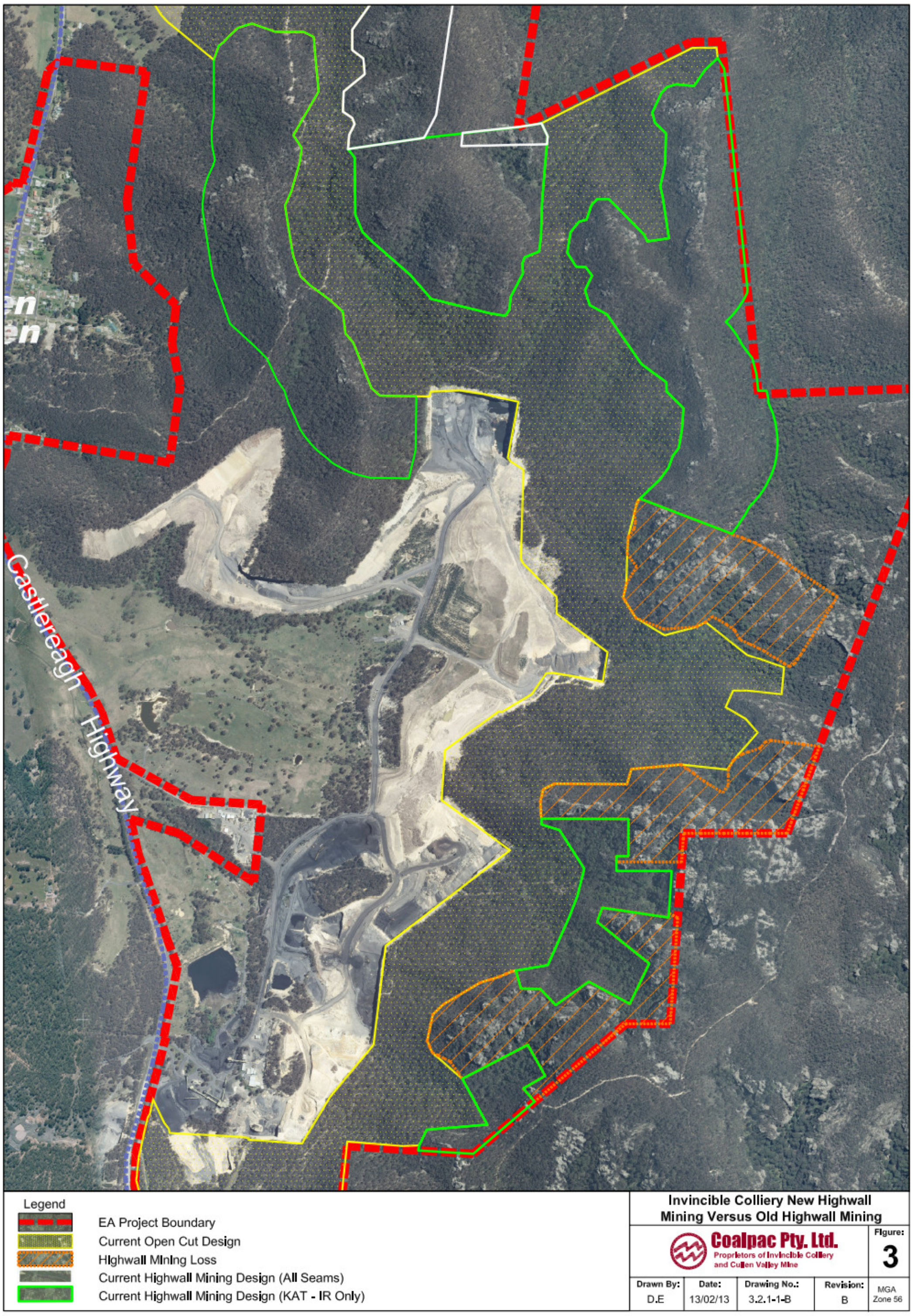

Figure 10. Contracted Project Invincible Colliery HWM Layout *(source: Coalpac)*

- Coal strength - In relation to site coal strength data, Coalpac has obtained an additional suite of site strength data for each seam. This new data has been reviewed by GEONET (in January 2013) and has validated the current assumptions in the design studies.

  By adopting numerical modelling studies in addition to empirical designs, the CCP pillar dimensions have already been increased where necessary to take account of potential roof falls (and thereby increasing the effective FOS value above the minimum design standards).

  It is therefore considered that these issues have been adequately dealt with and do not pose inadequately defined or inappropriate risks.

- Pillar Stability - A minimum value of 1.3 has been adopted for FOS (emphasis added), such that no pillars have an FOS below 1.3, but certainly some are higher. GEONET has also stated that 1.3 may not be adequate in some areas of geological variations, to maintain long term stability and hence minimise subsidence.

  GEONET has then applied this principle by significantly increasing some of the pillar dimensions (and hence FOS), which had been originally sized in the first-pass empirical design. Where geological conditions were suspect, such as in poorer roof conditions in the Katoomba seam, numerical modelling was used to determine more appropriate and higher value FOS pillar dimensions. Furthermore, the barrier pillars which are an integral part of the overall design across the mine clearly have an FOS value much greater than 1.3.

  Subsequent advice obtained from GEONET (report to Coalpac dated 18 February, 2013) confirms that the FOS values for the proposed barrier pillars are all in excess of 4, which would indicate that they are virtually indestructible based on known pillar experience (see Table below (*sourced from GEONET Report (18 Feb 2013)*)).

Summary of barrier pillar stress conditions and calculated actual Factor of Safety.

Seam	RL (m)	$Sigma_1$ (MPa)	$Sigma_3$ (MPa)	FoS_{max}	FoS_{min}
Katoomba	960	3.25 - 4.73	1.6 - 1.74	8.34	4.83
Moolarben	940	3.5 - 6.18	2.2 - 2.53	12.80	5.00
Irondale	905	5.1 - 8.20	3.1 - 3.86	10.50	5.69
Lithgow	885	6.1 - 14.0	3.6 - 6.00	9.37	4.38

- Pillar stability due to drivage deviation – the issue of equipment directional monitoring and deviation control has been discussed earlier. A figure of $\pm$ 20cm for each pillar has been quoted, based on manufacturer data based on actual mining trials. This amount of potential deviation has been incorporated into the pillar design dimensions.

- On the basis of the above discussion points, it is argued that an approval of the overall proposed mining operation is a suitable and recommended approach. The actual mining system does not carry excessively more significant risks than other underground mining methods. The issues of protection of the critical surface landforms relates to specific locations within the mining lease, and to specific rock formations within those locations.

It is an appropriate strategy to develop further data on the surface impact of the HWM system in this regional geology in areas well away from Ben Bullen SPL in the early stages of mining.

Specific final highwalls and HWM layouts can be designed according to local geology in each location. Monitoring of the subsidence effects of the HWM operation ahead and away from the HWM extremities can be implemented as operations approach Ben Bullen SPL.

Such monitoring can be incorporated into a Subsidence Management Plan which empowers and in fact binds the mine operator to comply with SPL protection, with mining restrictions applied in response to any "early warning" of subsidence developments.

Such an approach will ensure that any impacts of mining are restricted to a safe distance from SPL, such that even if a HWM pillar failure did occur at some point in the future (deemed as highly unlikely), the impact of such failure would still fall into a region that was outside the zone which might impact the SPL.

4 RECOMMENDED APPROACH – MANAGEMENT CONTROLS

The recommended way forward for this project has been indicated in the above discussion. There are a number of stages to this approach.

Firstly, in the light of this report, and any other information obtained, hopefully a number of misunderstandings or concerns can be alleviated. This report has attempted to identify a number of these issues in the HWM and geotechnical space.

The critical second step, premised on accepting that the risks posed by the project are not excessive, and are manageable, is to adopt an approval approach that provides overall approval to the project, but with a number of caveats or consent restrictions.

These restrictions can be written into the approval document requiring the mine operator to produce a (Subsidence) Management Plan which incorporates incremental design and further review steps, and specifically some management system guidelines and requirements.

There are a number of precedents for this approach. By way of example, I will briefly describe one such example with which I am familiar and closely involved in, and which I believe is held as an exemplar of “best practice” in terms of subsidence management – at least by the Subsidence Branch of the NSW Dept of Trade and Investment (Resources and Energy), and possibly also by representatives of the Dept of Planning and Infrastructure.

The project is the Dendrobium Mine – Area 3 approval, granted to BHP Billiton, Illawarra Coal. Within the surface above the proposed mining area there is a particularly sensitive feature, known as the Sandy Creek Waterfall. This was identified during the approval process as a significant natural feature that must be protected from any adverse impacts of mining (the identification by the mine and appropriate authorities of significant natural features was consistent with the recommendations from the Southern Coalfield Inquiry). It consisted of a 25m high concave sandstone cliff face with a 20m overhang. Figures 11 and 12 show photographs taken from in front and beneath the waterfall overhang.

The Development Consent provided for the mining area stated:

> 1. *The Applicant shall ensure that, as a result of the development:*
>   *(a) no rock fall occurs at Sandy Creek Waterfall or from its overhang;*
>   *(b) the structural integrity of the waterfall, its overhang and its pool are not impacted;*
>   *(c) cracking in Sandy Creek within 30 m of the waterfall is of negligible environmental and hydrological consequence; and*
>   *(d) negligible diversion of water occurs from the lip of the waterfall*
>   *to the satisfaction of the Director-General.*

It should be noted that the Consent did not provide any prescriptive measures regarding mining set-backs or other measures, but relied on the mine and their resultant Subsidence Management Plan proactively managing the risk. There were at least three separate longwall panels that were proposed to be mined towards the location of the waterfall – Longwalls 6, 7 and 8.

In 2007 Illawarra Coal (IC) applied to modify the Development Consent for Dendrobium Mine. In December 2008 the Development Consent was modified by the Minister for Planning. The amended Statement of Commitments prepared by IC included the following requirements in relation to Sandy Creek Waterfall:

> *6. Sandy Creek Waterfall*
> *Prior to the commencement of mining within Dendrobium Area 3A, Illawarra Coal will:*
> - *establish a "technical committee" that includes BHPB, DPI, MSEC, and independent subsidence and geotechnical experts to advise on Sandy Creek Waterfall,*
> - *develop and implement detailed management outcomes such as a Trigger, Action, Response Plan (TARP), triggers and detailed monitoring where Longwalls 6-8 extract coal within 400 m of the Sandy Creek Waterfall;*
>
> *The detailed management outcomes will be determined in the SMP process.*

Figure 11. View from in front of Sandy Creek Waterfall

The above system has worked effectively and successfully for the period of extraction of all three longwalls. The company has installed a comprehensive surveying and geotechnical monitoring system between the mining location and the waterfall (on the advice of the Technical Committee). The Technical Committee (of which I am an independent geotechnical advisor, and Dr Gang Li, the NSW Principal Subsidence Engineer, is an attendee with observer status) has met regularly over the duration of the three longwall extraction periods. Monitoring data is regularly reviewed against a decision-making matrix. For longwalls 7 and 8, a separate Illawarra Coal management Steering Committee was formed. The Technical Committee provides advice to the Steering Committee who ultimately has the responsibility under the Consent provisions, and the authority to stop or continue mining. Such decisions therefore rest with the Steering Committee.


Figure 12. View from beneath Sandy Creek Waterfall overhang

The process has worked extremely well over this period. Cessation of longwall mining in each panel has been driven by the performance of the "management system" for protection of the waterfall. The management system is embedded in the Subsidence Management Plan. Formal reports on the process have been submitted to both government departments after the completion of each longwall panel.

Whilst there are differences between this and the CCP project (including a different, lower impact type of mining, and the fact that CCP involves multiple natural features, rather than one single one), the model is considered an appropriate one for consideration by the relevant authorities.

Bruce Hebblewhite
1st April, 2013

APPENDIX A

Attached is a summary Curriculum Vitae for the author of this report, Bruce Hebblewhite. Bruce Hebblewhite has worked within the Australian mining industry from 1977 to the present time, through several different employment positions. Throughout this period, he has been actively involved in all facets of mining industry operations. In addition, he has visited and undertaken consulting and contract research commissions internationally in such countries as the UK, South Africa, China, New Zealand and Canada. For the majority of his 17 year employment period with ACIRL Ltd he had management responsibility for ACIRL's Mining Division which included specialist groups working within both the underground and surface coal mining sectors, and the coal preparation industry– actively involved in both consulting and research in each of these areas.

In his current employment position with The University of New South Wales, Bruce Hebblewhite is involved in academic management, undergraduate and postgraduate teaching and research, and contract industry consulting and provision of industry training and ongoing professional development programs – for all sectors of the mining industry – coal and metalliferous.

Both past and present employment positions require regular visits, inspections and site investigations throughout the Australian mining industry, together with almost daily contact with mining industry management, operations and production personnel.

SUMMARY CURRICULUM VITAE

Bruce Kenneth Hebblewhite

(Professor, Chair of Mining Engineering)

Head of School and Research Director,
School of Mining Engineering, The University of New South Wales

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DATE OF BIRTH 1951

NATIONALITY Australian

QUALIFICATIONS

1973: Bachelor of Engineering (Mining) (Hons 1) School of Mining Engineering, University of New South Wales
1977: Doctor of Philosophy, Department of Mining Engineering, University of Newcastle upon Tyne, UK
1991: Diploma AICD, University of New England

PROFESSIONAL MEMBERSHIPS; APPOINTMENTS & SPECIAL RESPONSIBILITIES

Member - Australasian Institute of Mining and Metallurgy
Member - Australian Geomechanics Society
Member – Society of Mining and Exploration (SME), USA
Member - International Society of Rock Mechanics (President – Mining Interest Group (2004 – 2011))
Secretary General (and Council Member) – International Society of Mining Professors (President for 2008/09)
former Executive Director – Mining Education Australia (July 2006 – December 2009)

Expert Witness assisting Coroner: Coronial Inquest (2002-2003): 1999 Northparkes Mine Accident
Member (2005 – 2008): Independent Expert Review Panel (Dendrobium Mine), NSW Dept of Planning
Expert Witness assisting Coroner – Coronial Inquest (2007): 2004 Sydney Cross City Tunnel Fatality
Chair: 2007-2008 Independent Expert Panel of Review into Impact of Mining in the Southern Coalfield of NSW (Dept of Planning & Dept of Primary Industries)
Member, Scientific Advisory Board, Advanced Mining Technology Centre, University of Chile.

PROFESSIONAL EXPERIENCE

2003-present University of New South Wales, School of Mining Engineering
Head of School and Research Director,
(Professor, Kenneth Finlay Chair of Rock Mechanics (to 2006);

	Professor of Mining Engineering (from 2006))
2006 – 2009	Mining Education Australia (a national joint venture between UNSW, Curtin University of Technology, The University of Queensland & The University of Adelaide) Executive Director (a concurrent appointment with UNSW above).
1995-2002	University of New South Wales, School of Mining Engineering Professor, Kenneth Finlay Chair of Rock Mechanics and Research Director, UNSW Mining Research Centre (UMRC)
1983-1995	ACIRL Ltd, Divisional Manager, Mining - Overall management of ACIRL's mining activities. Responsible for technical and administrative management of ACIRL's Mining Division covering both research and consulting activities in all aspects of mining and coal preparation.
1981-1983	ACIRL Ltd, Manager, Mining - Responsibility for ACIRL mining research and commissioned contract programs.
1979-1981	ACIRL Ltd, Senior Mining Engineer - Assistant to Manager, Mining Research for administrative and technical responsibilities. Particularly, development of geotechnical activities in relation to mine design by underground, laboratory and numerical methods.
1977-1979	ACIRL Ltd, Mining Engineer Project Engineer for research into mining methods for Greta Seam, Ellalong Colliery, NSW. Also Project Engineer for roof control and numerical modelling stability investigations.
1974-1977	Cleveland Potash Ltd, Mining Engineer and Department of Mining Engineering, University of Newcastle-upon-Tyne, UK - Research Associate. Employed by Cleveland Potash Limited to conduct rock mechanics investigations into mine design for deep (1100m) potash mining, Boulby Mine, N Yorkshire (subject of Ph.D. thesis).

SPECIALIST SKILLS & INTERESTS

- Mining geomechanics
- Mine design and planning
- Mining methods
- Mine safety and training
- Mine system audits and risk assessments
- Education and training

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18 February, 2013

Coalpac Pty Ltd
42 Morrow Street
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QLD 4068

Attention: Ian Follington, Bret Leisemann

Dear Ian & Bret,

RE: DEFINITION OF BARRIER PILLAR STABILITY

In response to your request of last Friday to address specific aspects referred to in the draft document entitled "Review of highwall mining component – Coalpac Consolidation Project" by Bruce Hebblewhite [1] this letter provides further discussion on the following two topics:

a) Definition of the actual Factor of Safety for each barrier pillar under worst case conditions, and
b) Effect of variable pillar width.

Barrier Pillar Factor of Safety (FoS)

In order to define the barrier pillar stability the same design method described in the GEONET report [2] to estimate the stability of highwall mining pillars has been modified. In this case the stability is calculated in relation to the width of the barrier pillar (Wp) and the span between barrier pillars (equivalent to the highwall mining opening dimension). This approach presents an absolute limiting condition in that it assumes that there are no highwall mining (web) pillars between barrier pillars. The calculation therefore is calculating the stability of the barrier pillar subject to loading induced by the overburden stress arch that would form between adjacent barrier pillars.

Using the appropriate variables for each coal seam, viz. overburden thickness (O/B), extraction height (Hp), pillar width (Wp) and span between barrier pillars (Sp) the limiting Factor of Safety is calculated. The results are presented as design charts in Figures 1(a), 2(a), 3(a) and 4(a) for each seam, respectively, and summarised for the recommended barrier pillar width in Table 1.

Table 1: Summary of barrier pillar dimensions and calculated limiting Factor of Safety.

Seam	O/B (m)	Hp (m)	Wp (m)	Sp (m)	Limit FoS
Katoomba	80 - 110	2.0	10.7	17.7	3.69 – 2.68
Moolarben	80 – 135	1.0	7.2	23.4	2.90 – 1.72
Irondale	100 – 165	0.9	7.8	27.0	2.57 – 1.56
Lithgow	150 - 185	2.2	12.7	19.7	2.17 – 1.76

These calculated limiting Factors of Safety present the absolute minimum and indeed artificially low values since the presence of the highwall mining web pillars will provide additional support to the overburden under the stress arch. In order to provide a more realistic estimate of the actual Factors of Safety that will be presented we have interrogated the original geotechnical model for stress conditions at the elevation of each seam.

The Factor of Safety (FoS) in any zone within the model may be calculated according to the local stress conditions and assigned shear strength properties using the following relationship:

$$FoS = (\sigma_{1critical} - \sigma_3) / (\sigma_1 - \sigma_3)$$

where

$$\sigma_{1critical} = [2c \cdot \cos\varphi \ / (1 + \sin\varphi)] + \sigma_3 \cdot [(1 + \sin\varphi) / (1 - \sin\varphi)]$$

where

φ is friction angle, *c* is cohesion,
σ_1 and σ_3 are the major and minor principal stresses, respectively.

The calculated Factor of Safety at the elevation of each coal seam, based on insitu stress conditions, is plotted in Figures 1(b), 2(b), 3(b) and 4(b) for each of the coal seams, respectively. On these plots the contour interval is 0.2 between the values 1<FoS<5. If the calculated FoS is greater than 5 then the contour is coloured white (appears grey in Figures). It can be seen that the range of FoS varies depending on overburden topography. Quite clearly the calculated FoS values are predominantly in excess of 5.0 with very small localisations of reduced values.

In the area of proposed highwall mining, Table 2 summarises the predicted upper bound principal stress magnitudes in each coal seam and tabulates the calculated representative Factor of Safety. If the average stress levels are considered then the FoS values are up around 10.

Table 2: Summary of barrier pillar stress conditions and calculated actual Factor of Safety.

Seam	**RL (m)**	**σ_1 (MPa)**	**σ_3 (MPa)**	**FoS**
Katoomba	960	4.73	1.74	4.83
Moolarben	940	6.18	2.53	5.00
Irondale	905	8.20	3.86	5.69
Lithgow	885	1.40	6.00	4.38

It is concluded that the proposed barrier pillar designs for each of the coal seams will provide more than adequate long term stability.

Effect of Variable Pillar Width

Highwall Mining Equipment manufacturers quote that the onboard directional monitoring controls should maintain accuracy of approximately 100mm either side of the target direction. This suggests that pillar dimensions should be accurate within 200mm of design width. The overall effect of a deviation from target direction may be either thinning or thickening of the immediate pillar depending on direction of deviation. However, accompanying this thinning or thickening of the pillar will be a corresponding thickening or thinning of the next pillar.

The number of web pillars which may be affected by directional offset will be limited by the barrier pillar spacing. It was shown in the previous section that the absolute limiting FoS of the barrier pillars will provide sufficient stability to arrest any instability that may arise from web pillar variations. This design precaution will provide more than sufficient pillar width to cope with a possible 200mm offset in pillar dimension.

These conclusions have been analysed in previous studies where pillar deviation and azimuth offset only impacted on the pillar strength once there was significant deviation from design layout. In this regard lateral deviations of 10% pillar width and vertical offsets of 30% opening height could be tolerated in a highwall mining panel layout.

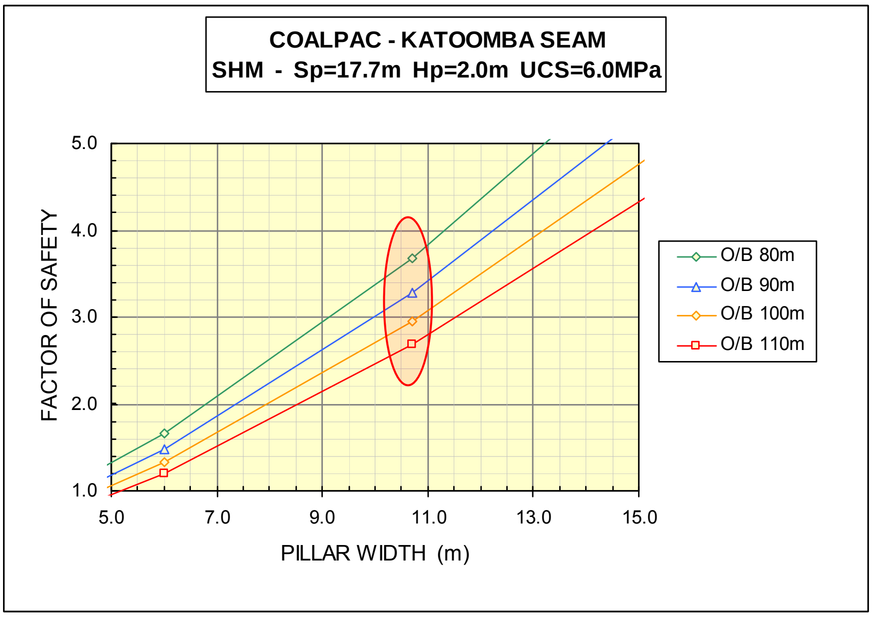

Figure 1(a): Limiting Factor of Safety in Katoomba seam highwall mining panels.

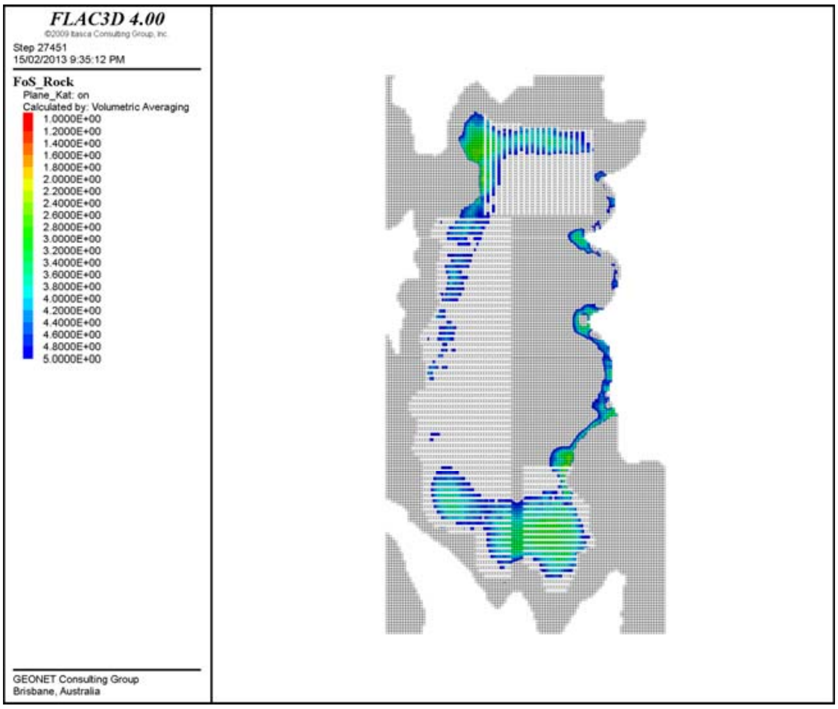

Figure 1(b): Simulated Factor of Safety in Katoomba seam highwall mining panels.

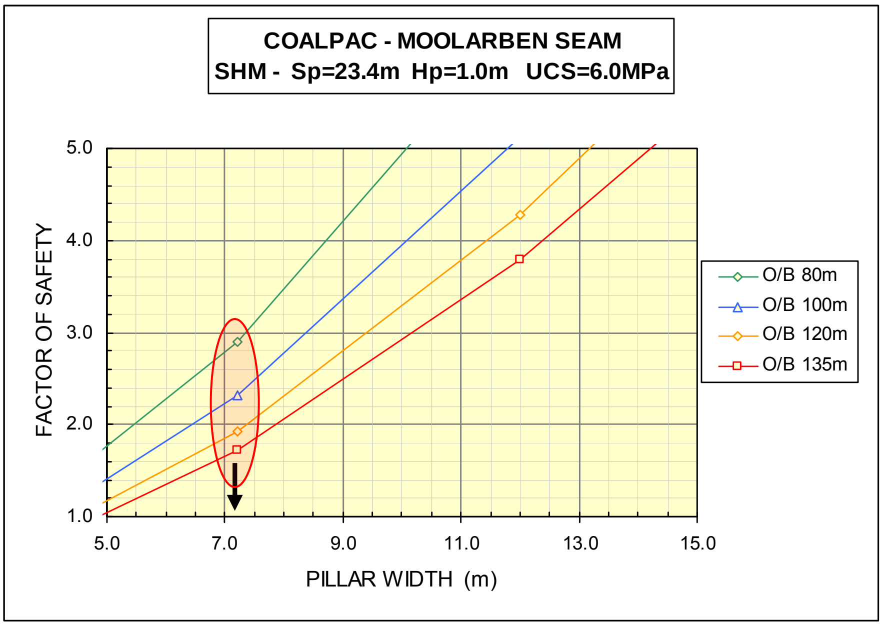

Figure 2(a): Limiting Factor of Safety in Moolarben seam highwall mining panels.

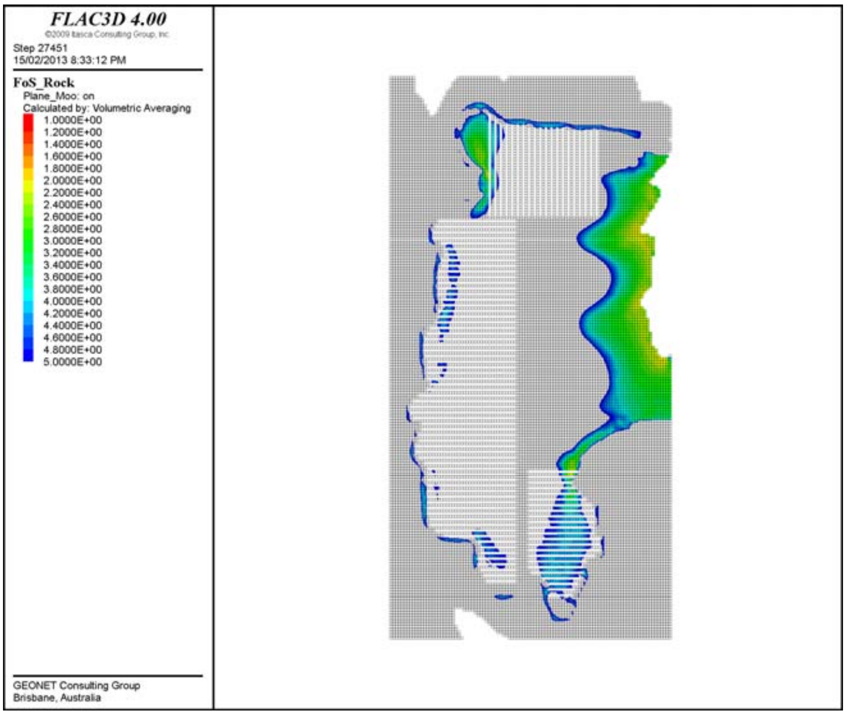

Figure 2(b): Simulated Factor of Safety in Moolarben seam highwall mining panels.

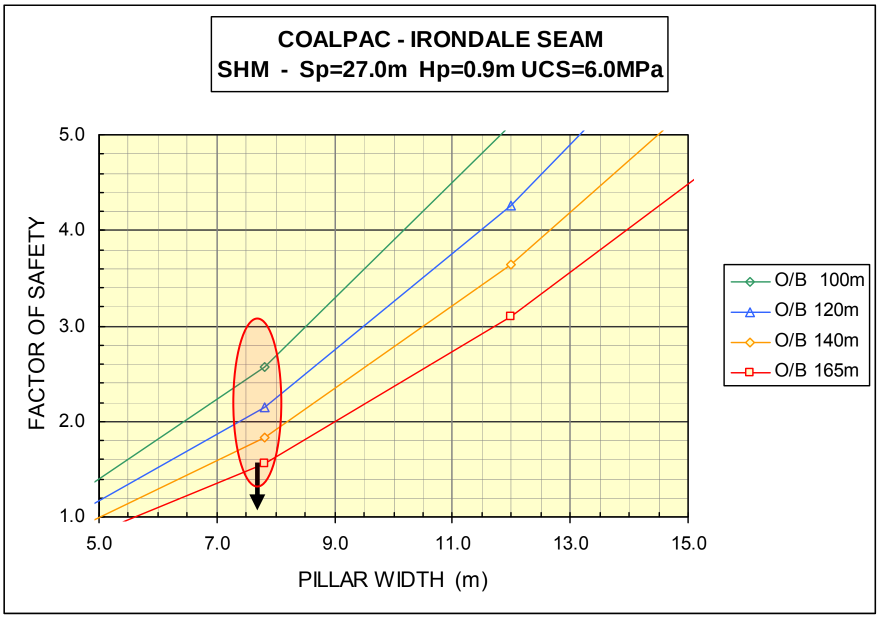

Figure 3(a): Limiting Factor of Safety in Irondale seam highwall mining panels.

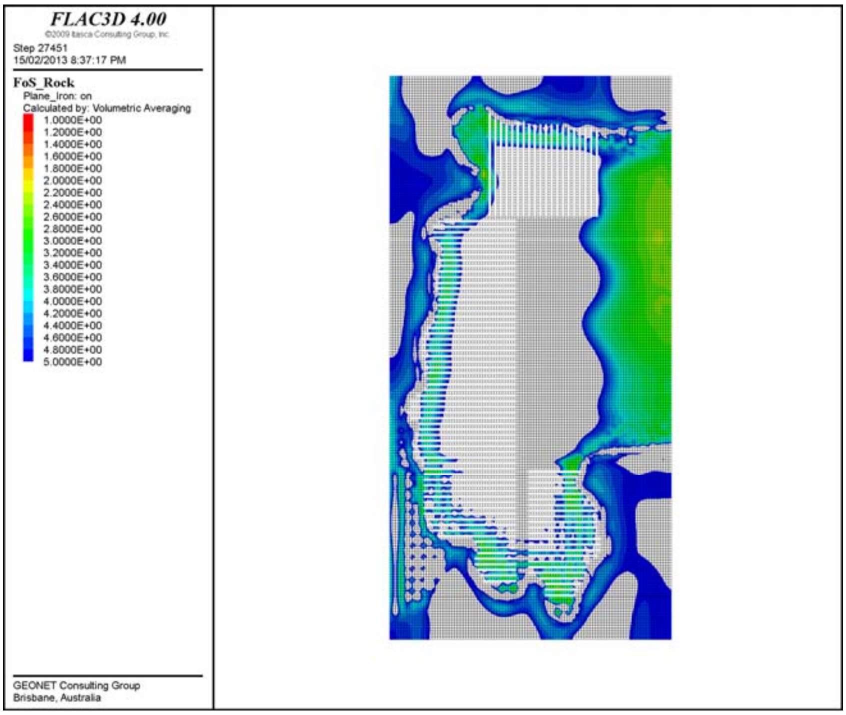

Figure 3(b): Simulated Factor of Safety in Irondale seam highwall mining panels.

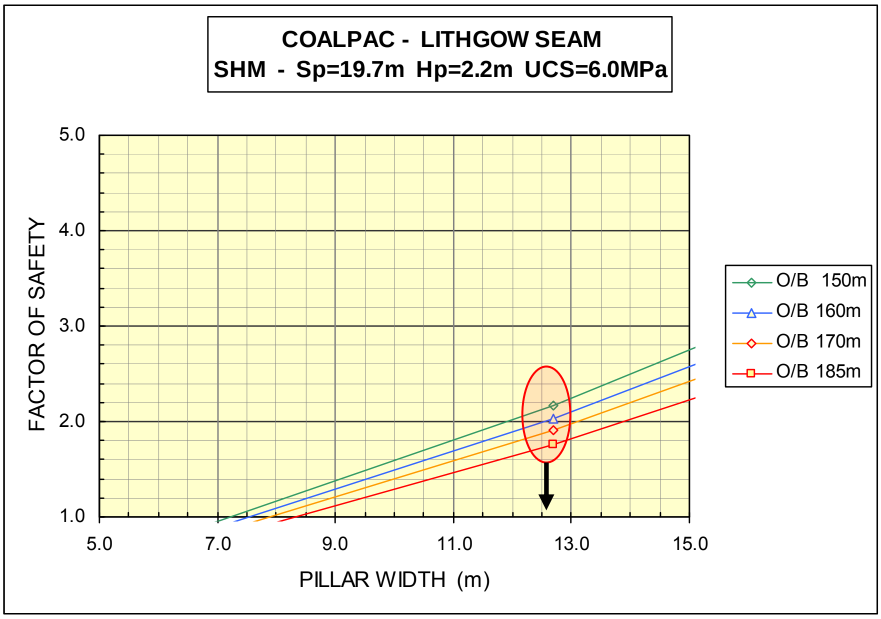

Figure 4(a): Limiting Factor of Safety in Lithgow seam highwall mining panels.

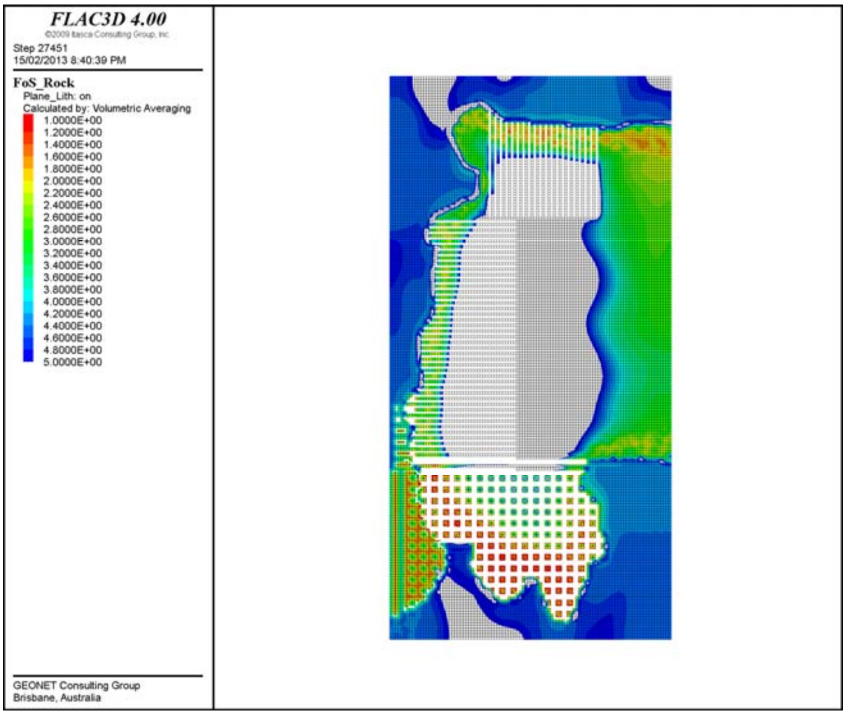

Figure 4(b): Simulated Factor of Safety in Lithgow seam highwall mining panels.

I trust that this brief review of the barrier pillar design stability provides you with the explanations called for to explain aspects of the original geotechnical modelling report.

Yours faithfully,

GEONET *Consulting Group*

Ian Clark

Dr Ian H. Clark
Principal Consultant, Director

REFERENCES

1. Hebblewhite, Bruce K., 2013. Review of highwall mining component – Coalpac Consolidation Project. Draft report to Coalpac, 14 February 2013.
2. GEONET Consulting Group, 2011. Assessment of Stability and Subsidence SHM Highwall Mining, Coalpac Consolidation Project.

APPENDIX C

SLOPE STABILITY ASSESSMENT

QCAT Technology Transfer Centre
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Geotechnical & Geological Engineers

ABN 84 090 367 409

Our ref.: 21305-1

27 February, 2013

Coalpac Pty Ltd
42 Morrow Street
Taringa QLD 4068
Attention: Ian Follington, Bret Leisemann

Dear Dr Follington and Mr Leisemann,

Slope Stability Assessment of Sandstone Cliffs Next to Proposed Open Cut Mining, Invincible and Cullen Valley Mines

1 Introduction

This report presents an assessment of the slope stability of the sandstone cliffs next to proposed open cut mining to be carried out as part of the Coalpac Consolidation Project (CCP), and a suggested method for monitoring the cliffs that may form part of the mine's Slope Stability Management Plan.

As shown in Figure 3, open cut mining may approach to within 60 m of the sandstone cliffs and create temporary mine highwall rock faces up to 100 m in height for short periods before they are backfilled and rehabilitated. This assessment has focussed on the stability of the open cut highwalls and the cliffs behind them while the highwalls are at their maximum exposure (i.e. a worst case scenario).

2 Qualification to Provide this Assessment

My qualification to carry out this assessment is based on:

- Formal qualifications
- Extensive geotechnical experience
- Specific involvement with the Invincible and Cullen Valley open cut mines since 2007.

My résumé is appended to this report.

My formal qualifications are:

- BSc in geology awarded by the UNSW
- MEngSc in geotechnical engineering awarded by UNSW

I am a member of the Institution of Engineers Australia, Australasian Institute of Mining and Metallurgy and a Chartered Professional Engineer.

My general geotechnical experience spans over 30 years. For the last 12 years I have been the owner of GeoTek Solutions Pty Ltd (GTS), a geotechnical consultancy that specialises in open cut mining slope stability. The greatest number of projects undertaken by GTS have been for open cut coal mines in NSW and Queensland.

Since 2007, I have been engaged by Coalpac to carry out routine inspections of the Invincible and Cullen Valley open cut mines. These inspections are part of Coalpac's Slope Stability Management Plan and have never been triggered by any untoward event.

The current geotechnical inspection regime is for an inspection to be carried out at approximately annual intervals. This interval has been selected because of the benign geological conditions that pertain to the Project. During these inspections the whole of the Project is inspected, usually over a two day period, with a particular emphasis on the condition of the pit highwalls and dumps. At the conclusion of the inspection a report is prepared.

3 Geology

The Project is located on the western margin of the Sydney Basin. The rocks exposed in the Project area comprise a variable thickness capping of Triassic age sandstone belonging to the Narrabeen Group. The Narrabeen Group unconformably overly interbedded sandstone and mudstone belonging to, in descending order, the Wallerawang, Charbon and Cullen Bullen Subgroups within the Illawarra Coal Measures of Permian age (Yoo et al, 2001)

The sandstone capping consists mostly of well-cemented, cross-bedded, medium and coarse grained sandstone composed mainly of quartz grains and subsidiary lithic fragments. The intact rock is generally of medium strength (estimated UCS typically 25 to 35 MPa). By way of comparison, the required strength for house-slab concrete is typically 20 to 25 MPa. The sandstone is usually dissected by very widely spaced, near-vertical joints and, because the rock is so strong, it forms cliffs rather than weathering to a much flatter slope like the underlying Permian strata. The cliff lines tend to follow the dominant joint directions. Where the sandstone is sufficiently thick, cliff faces are generally 40 to 60 m high but may, locally, be higher. A typical cliff is shown in Figure 1.

Figure 1 Typical cliff in Narrabeen Group sandstone.

The underlying, Permian age, coal measures rocks consist of sandstone, mudstone, tuff and coal seams. The estimated intact strength of the coal measures rocks vary with rock type but typically, range from 15 to 25 MPa.

The strength of the intact coal measures rocks is, on average, slightly less than that of the Narrabeen Group sandstone. However, as can be seen in Figure 2, the strength of the rock mass is more than adequate to support an 80 m high, sub-vertical highwall.

The two main structural features of the coal measures strata are:

- Bedding, which dips on average, at a gradient of about 1 in 80 in an easterly direction, consistent with the Project being located on the western margin of the Sydney Basin,
- Joints, predominantly orientated parallel and perpendicular to the strike of the coal seams but with other orientations in addition.

The joints are more frequent and more closely spaced in the weaker, less-brittle coal measures rocks than in the stronger, more-brittle Triassic sandstones. A consequence of this is that if a failure does occur on a joint plane in the coal measures, then it is likely to be of limited extent, as the failure surface quickly terminates against intact rock.

There are a few very small (<0.2 m in displacement) faults within the Permian strata at Cullen Valley Mine and Invincible Colliery, but generally the strata are undisturbed by geological structure.

Figure 2 Cullen Valley showing a stable, 80 m highwall face cut at an angle of approximately 80°.

When subject to weathering and erosion over geological time, the coal measures rocks are much less resistant than the Triassic sandstone and tend to break down to a soil that is transported downhill, thereby forming the gentle side slopes leading down into the valleys. In so doing, this undercuts the Triassic sandstone cliffs, eventually causing slabs of rock to break off, usually along pre-existing joints, to form piles of rubble in front of the cliff face. Initially, the rubble rests at angles of 30° to 35°. In the short term these slopes are stable but, in the long term, i.e. tens and hundreds of years, the colluvium slowly creeps downhill, as can be inferred from the frequent tilted trees that can be seen around the base of the cliffs. This process of slope development and valley retreat is occurring much more slowly now than during the geological, past when there were periods of much higher rainfall.

Apart from valley side slope retreat, there are a variety of other weathering and erosion processes at work that are degrading the in situ rock and transporting the resultant soils towards the valley floors. However, in the context of the current mining proposal, the key feature is that within the framework of our geological and engineering knowledge, and observationally, the Triassic sandstone cliffs are essentially stable, and properly excavated highwalls in the Permian strata are also stable.

In the following sections, the results of 2D limit equilibrium slope stability analyses are produced to further support the assertion that slopes are stable in the short term.

4 Highwall Design for CCP

Figure 3 shows a cross section when the mining highwall under the proposed CCP is at its closest to the sandstone cliffs.

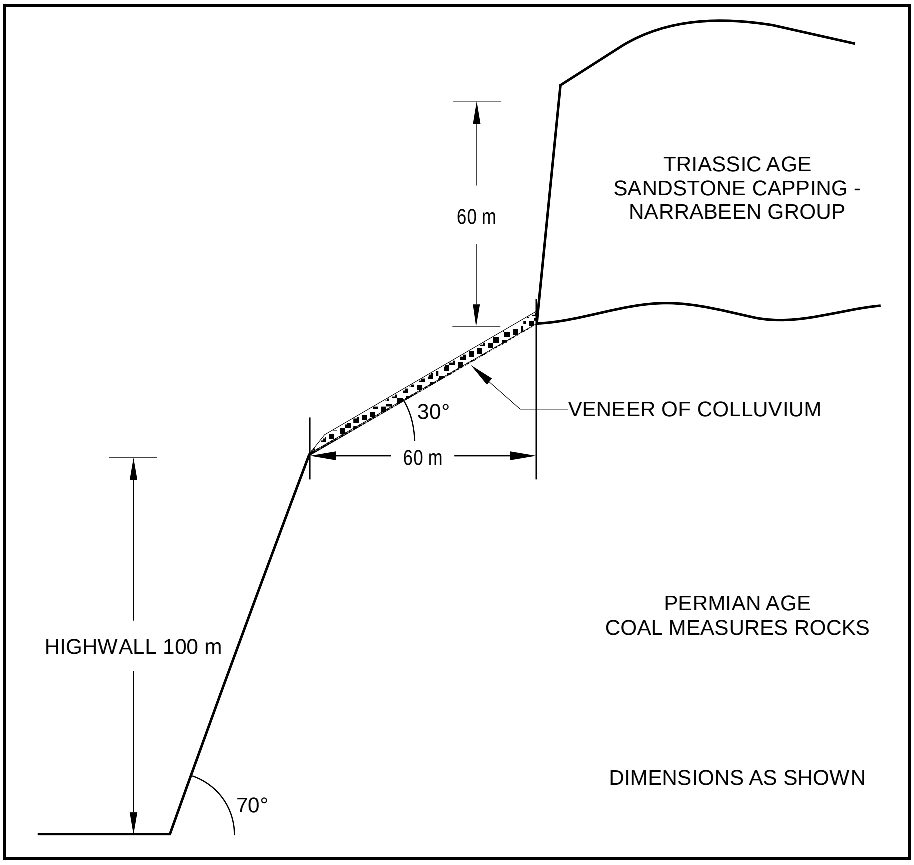

Figure 3 Cross section showing relationship between cliff-forming sandstone, coal measures rock and mining highwall under the proposed CCP.

Key features shown in the cross section are:

- The Triassic sandstone cliff face is 60 m distant from the highwall crest
- The colluvium slope has a maximum angle of 30°
- The highwall slope angle is 70°. (Note, while slopes between bench levels are 80°, the overall slope becomes 70° once catch-benches are included). It is excavated wholly within the coal measures rocks and, as shown in Figure 2, these are perfectly capable of standing upright to heights in excess of 100 m, provided that they do not contain any unfavourable geological structures, which is the normal situation.)

5 Slope Stability Analyses

A number of slope stability analyses were undertaken using the program Slide (Rocscience, 2013). The General Limit Equilibrium (GLE) method was used as the primary method of analysis and results were checked for reasonableness by also running the analysis using the Bishop Simplified method. The results are shown in the output plot in Figure 4 below.

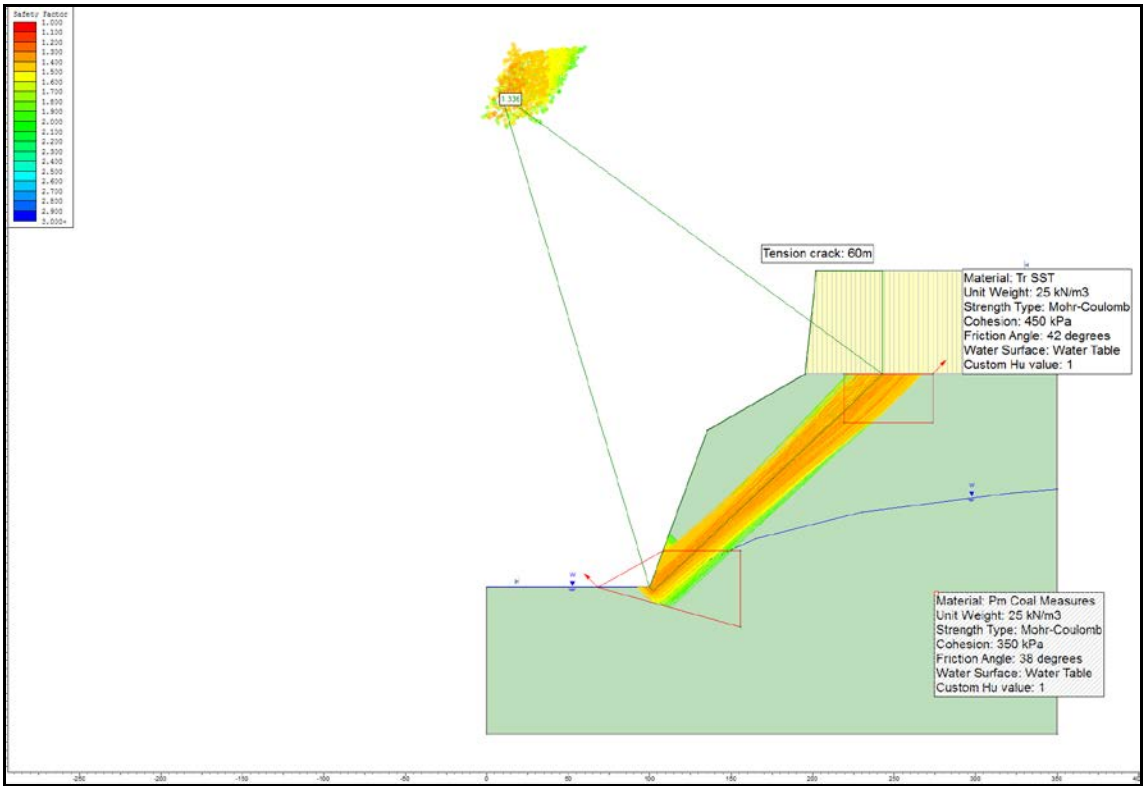

Figure 4 Output from slope stability analysis.

The GLE method was used to analyse randomly generated non-circular failure paths using blocks, which are shown in Figure 4, to define broad zones for the crests and toes of the failure paths.

An anisotropic strength model was trialled because the coal measures rocks are so well bedded. However, this made little difference to the calculated factor of safety (FOS) because the bedding is so flat within the Project area.

The results show that the minimum global factor of safety for the selected profile is 1.36. To put this in context, the normally accepted FOS for a short-term mining slope under which people will work is 1.2, and for a slope carrying critical infrastructure required for the life of mine the design FOS would be about 1.3. Given that the final mining highwall proximal to the cliff line is expected to be fully exposed for periods on the order of 8 to 12 weeks before backfilling begins, it is considered that the temporary highwall design, as shown in Figure 3 and Figure 4, is appropriate and will not cause a failure of the overlying cliffs. Backfilling the highwalls is part of the normal excavation and dumping sequence that has been utilised for over 10 years at these mines. Backfilling ensures the stability of the excavated highwall face by acting as a buttress, effectively and proactively supporting the newly created excavation, and increasing the FOS on the highwall slope.

As in all mining operations, regular checks for conformance of field conditions with design assumptions is a necessary and routine requirement. Excavation of these highwalls is no exception and the following section provides guidelines for monitoring the highwalls and the cliff faces.

6 Impact of Existing Underground Workings

Before Coalpac commenced open cut mining at the Invincible Colliery extensive underground mining had been carried out using bord and pillar methods within the Lithgow Seam. These historical underground mine workings extend on the order of 2 km beyond the Triassic sandstone cliff line in places. The recovery from this method of mining is relatively low and the width of the pillars left behind ensures the stability of the workings. I have inspected sections of the Triassic Cliffs on two occasions on foot, in 2008 and in 2012. On those occasions I observed no evidence mining induced rockfalls.

The observed cliff behaviour is consistent with my observations during routine geotechnical inspections that the damage to the strata above the old bords (tunnels) rarely extends more than 3 or 4 times the height of the bord, as shown, for example in Figure 5. There may be some immediate roof collapse as shown in the LHS of Figure 5 but not above the old bord on the RHS of the figure. Within a short distance above the roof, arching has occurred, and no further deformation of the roof strata occurs.

Figure 5 View of highwall intersecting old coal mine workings.

The strength and arching behaviour of the roof strata and the relatively low coal recovery from the historical workings, together with the benign structural geological conditions within the Project area also explain why there has never been a recorded failure caused by a highwall intercepting old workings.

7 Monitoring Guidelines

7.1 Highwall Monitoring

Three principal recommendations are made for monitoring the highwalls.

1. The mine geologist should carry out a detailed inspection of the highwall on a minimum weekly basis and record their observations in a permanent record once a highwall is within 150 m of a sandstone cliff. This record would be in addition to the current inspection reports provided by the OCE and would focus specifically on the geological and geotechnical conditions that were being exposed in the advancing highwall, including:
   - Rock strength
   - Bedding orientation and spacing
   - Joint orientation and spacing
   - Whether any faults are present and if so, their orientation
   - Groundwater seepage
   - The nature and significance of any rockfalls in the advancing highwall.
2. Develop a site-specific check list with objective parameters and criteria that would trigger specified action responses. The responses would range from “do nothing” to “obtain specialist external advice on-site within one week”.
3. Increase the routine geotechnical inspections from the current annual interval to quarterly. Additional inspections would be carried out should a response to a trigger action, referred to above, require it.

7.2 Sandstone Cliff Monitoring

It is recommended to create a cliff line condition geographical information system (GIS). The GIS would facilitate the recording, managing, analysing and displaying of the condition of the sandstone cliffs proximal to the CCP. To generate the data required by such a GIS it will be necessary to record the location and condition of each element of the cliff line in sufficient detail that the condition survey can be replicated. A combination of a handheld GPS, a photographic record, inspection check lists and appropriate maps should be sufficient to build up the cliff line condition GIS.

Initially the cliff line condition should be assessed annually. As mining approaches to within 200 m of a section of cliff line, that section of the cliff line should be assessed every 3 months. Once mining has moved away from a section of cliff line and the highwall has been backfilled, the inspections should revert to annual assessment.

Two years from the completion of final rehabilitation of an affected section of cliff line, provided no damage has been observed, the inspection frequency can be reduced to every two years.

8 Conclusions

I have concluded, on the basis of geological engineering principles and 5 years direct experience with the Cullen Valley Mine and Invincible Colliery, that the proposed highwall designs are adequate to prevent mining induced damage of the Triassic sandstone cliffs.

A limit equilibrium slope stability analysis has been carried out of the worst-case mining scenario and this calculated a minimum global factor of safety equal to 1.36, which is more than acceptable for a temporary mining slope with people working below it.

A highwall monitoring procedure has been recommended requiring weekly inspections when a highwall is within 150 m of sandstone cliffs, the development of site specific trigger action responses, and an increase in the frequency of inspection by a geotechnical expert from the current level of annual inspections to quarterly inspections.

A cliff line condition monitoring procedure has been recommended that involves regular, documented surveys of the condition of the Triassic sandstone cliffs and recording those observations in a geographical information system (GIS).

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Principal, GeoTek Solutions Pty Ltd

9 References

1. Yoo, E.K., Tadros, N.Z., Bayly, K.W., 2001. A Compilation of the geology of the Western Coalfield. Notes to accompany the Western Coalfield Geology maps. NSW Department of Primary Industries.
2. Rocscience, 2013. Slide v6.02.

Résumé for Paul Maconochie
Highlighting Open Pit Coal Mining Projects

1 QUALIFICATIONS

1984 Master of Engineering Science (UNSW)
1976 Bachelor of Science (UNSW)

2 PROFESSIONAL REGISTRATIONS

2000 Registered Professional Engineer of Queensland
1988 Chartered Professional Engineer

3 AFFILIATIONS

1977 Member, Australian Geomechanics Society
1977 Member, International Society of Rock Mechanics
1977 Member, International Association of Engineering Geologists
1988 Member, Institution of Engineers, Australia
1992 Member, Australasian Institute of Mining and Metallurgy

4 EMPLOYMENT

1999 – Present
Director GeoTek Solutions Pty Ltd, Brisbane

GeoTek Solutions (GTS) provides geotechnical and engineering geology consulting services to mining and civil engineering projects. Paul Maconochie's core competency is in geotechnical engineering for open pit mining. In his role at GeoTek Solutions, Paul has carried out projects at hard and soft rock mines in Australia, Papua New Guinea, Fiji, the Solomon Islands, the Philippines, Indonesia and Brazil.

Before starting GeoTek Solutions in 1999, Paul held the following positions:

1998 – 1999	Senior Geotechnical Engineer, Cutting Edge Technology Pty Ltd
1996 – 1998	Manager, CSIRO Minesite Rehabilitation Research Program
1996 – 1998	Manager Mining Science CSIRO Division of Exploration and Mining,
1995 – 1996	Acting Manager, Coal Mining CSIRO Division of Exploration and Mining,
1993 – 1995	Research Engineer and Group Research Manager CSIRO Division of Exploration and Mining,
1992 – 1993	Acting and Registered Mine Manager, Ok Tedi Mining Ltd, PNG
1987 – 1993	Senior Geotechnical Engineer and Geotechnical Superintendent, Ok Tedi Mining Ltd, PNG
1976 – 1987	Engineering Geologist/Senior Engineering Geologist, Douglas Partners Geotechnical Consultants, Sydney.

Selected coal projects in which Paul has been the sole or lead geotechnical engineer are listed and described briefly below.

Year	Project	Client	Description
2009-2012	Alpha	Hancock Prospecting	Geotechnical analysis and design for 30 Mtpa mine
2009-2013	Commodore	Downer Edi	Ongoing review of Commodore mine
2008-2013	Sonoma	Leighton	Ongoing review of Sonoma mine
2001-2011	Foxleigh	Foxleigh Mining, Anglo Coal	Ongoing design and review of Foxleigh mine
2000-2011	Coppabella	Thiess, Roche and Macarthur	Ongoing design and review of Coppabella mine
2000-2011	Moorvale	Leighton and Macarthur Coal	Ongoing design and review of Moorvale mine
2010-2011	Kevin's Corner	Hancock Prospecting	Commenced geotechnical analysis and design
2010	Maryborough	Northern Energy Corp.	Geotechnical design for Maryborough mine
2010-2011	Minerva	Felix Resources	Review of mine and analysis of proposed new highwall
2009	Cameby Downs	Thiess	Geotechnical review for preparation of tender
2007	Anvil Hill	Thiess	Geotechnical review
2007	Hail Creek	RTCA	Site investigation for Hail Creek East geotechnical investigation
2007	Kestrel	RTCA	Field work for Kestrel 400 Series Extension
2007	Millenium	Thiess	Third party review of geotechnical baseline report
2007	Mt Pleasant	RTCA	Site investigation for Mt Pleasant coal mine
2007	Pakri Barwadih, India	Thiess	Geotechnical review
2006	Isaac Plains South	Isaac Plains Coal	Geotechnical design for Isaac Plains open pit mine
2005	Clermont	RTCA	Site investigation for 2005 supplementary geotechnical investigation
2005	KPC, Indonesia	PT Thiess	Review of geotechnical procedures and data relating to mining of Melawan and J Pits.
2005	Suttor Creek	Xstrata	Geotechnical design for new mining area at Newlands
2004	Hail Creek	RTCA	Site investigation for Elphinstone geotechnical investigation
2004	Lake Vermont	Thiess	Geotechnical assessment
2003	Mt Thorley	RTCA	Investigation of geotechnical aspects of a mine accident
2002	Rolleston	MIM	Final geotech review prior to board submission for approval
2001	Blackwater	BHP	Investigation of large dragline spoil dump failure

5 PUBLICATIONS

5.1 Papers

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2. Rosengren, K., Simmons, J.V., **Maconochie, A.P.** and Sullivan, T.P., 2010. Geotechnical investigations for open pit mines – 250m and beyond. In Beeston, J.W. ed*., Bowen Basin Symposium 2010 – Back in (the) black.* Geological Society of Australia Inc. Coal Geology Group and the Bowen Basin Geologists Group, Mackay, October 2010, 169-180.
3. Simmons, J.V., Simpson, P., McManus, D., **Maconochie, A.P.**, and Soole, P., 2005. Geotechnical design and performance of the Crinum East highwall trench. In Beeston, J.W. ed., *Bowen Basin Symposium 2005 – The future for coal – Fuel for thought.* Geological Society of Australia Inc. Coal Geology Group and the Bowen Basin Geologists Group, Yeppoon, October 2005, 253-266.
4. Smith, R.E.W., Wruck, G., Velasquez, A., Cuff, C., Sahami, A., **Maconochie, A.P.**, Spain, A., Graham, T., Merrett, D., and Visco, R. 2002. Environmental Assessment and Rehabilitation Investigation for the Atlas Copper Mine, Philippines. *Proc of MCA Environmental Workshop, Newcastle, NSW 2002.*
5. Cheung, L.C.C., Poniewierski, J., Ward, B., LeBlanc, D., Thurley, M.J. and **Maconochie, A.P.**, 1996, SIROJOINT and SIROFRAG - new techniques for joint mapping and rock fragment size distribution measurement, *FRAGBLAST'5, Proc. 5th Int. Symp. of Rock Fragmentation by Blasting.*
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7. **Maconochie, A.P.**, 1992, Geotechnical engineering at Ok Tedi - a multidisciplinary approach, *Proc. AusIMM Annual Conference*.
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9. Jones, T.R.P. and **Maconochie, A.P.**, 1990, Twenty five million tonnes of ore and ten metres of rain, *Proc. Mine Geologists' Conference*, AusIMM.
10. Douglas, D.J., McMahon, B.K., and **Maconochie, A.P.**, 1987, Slip failure in Ashfield Shale at Artarmon, Sydney. In Walker, B.F. and Fell, R.F., eds., *Soil Slope Instability and Stabilisation, Proc. Extension Course.*

5.2 Research Reports

1. Duncan-Fama, M., Shen, B. and **Maconochie, A.P.**, 2001. Optimal design and monitoring of layout stability for highwall mining. Report to ACARP for Project C8033 by CSIRO Exploration and Mining and GeoTek Solutions.
2. Shen, B., Duncan-Fama, M., Boland, J., Adhikary, D., **Maconochie, A.P.** and Hill, D., 2000, Monitoring and Stability Assessment of Entries for punch Longwall mining using HWMT. Report to ACARP for Project C9007 by CSIRO Exploration Mining, GeoTek Solutions and Strata Engineering.

APPENDIX D

AIR QUALITY AND GREENHOUSE GAS IMPACT ASSESSMENT

8 April 2013

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COALPAC CONSOLIDATION PROJECT
PREFERRED PROJECT REPORT

1 INTRODUCTION

1.1 Background

In 2011, Pacific Environment (then PAEHolmes) completed an air quality impact assessment (AQIA) for the Coalpac Consolidation Project, which included an estimation of greenhouse gas emissions for the project. That AQIA formed part of the Environmental Assessment (EA), referred to in the following sections as the Exhibited Project.

Since that time, Coalpac have made a number of changes to the Exhibited Project, including variations to mine plans, referred to now as the Contracted Project. The most significant changes, in terms of air quality, were made to the proposed Year 2 operations in order to reduce predicted particulate concentrations, particularly in the vicinity of Cullen Bullen. Year 2 is representative of an interval in the mine plan when mining is closest to Cullen Bullen. Pacific Environment have assessed the Contracted Project in Year 2, and this report quantifies the improvements in air quality predicted to be realised from the Contracted Project as compared to the Exhibited Project.

Years 8, 14 and 20 considered in the AQIA for the Exhibited Project have not been re-assessed for the Contracted Project. No increase in the predicted air quality impacts presented in the Exhibited Project AQIA is anticipated in those years as none of the changes made in the Contrated Project described below would increase dust generation.

This report provides a summary of the mine plan changes, methodologies used and updated modelling results for the Contracted Project.

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1.2 Contracted Project Description

The Contracted Project has been developed in response to the Planning Assessment Commission (PAC) review of the Exhibited Project. Changes have been made in order to further reduce the environmental impacts described in the Exhibited Project. These are listed below:

1. Removal of the Hillcroft Mining Area and associated access infrastructure.
2. Removal of the sand extraction component of the Exhibited Project located in the Cullen Valley mining area, including the requirement for associated crushing and screening infrastructure and the transport of product sand by road from the site to market.
3. Reduction of the open cut mining footprint to avoid the area of Clandulla Geebung habitat previously located in the north western mining area at Cullen Valley Mine.
4. Reduction of the open cut mining footprint in relation to the Significant Pagoda Landforms (SPL) to improve ecological outcomes.
5. Reduction of the highwall mining footprint to avoid rock formations within the SPL to improve perceived ecological, heritage and geotechnical outcomes.
6. Implementation of a robust blast management system specifically tailored to further minimise the potential for blasting impacts to any SPL and Sandstone Outcrop.
7. Enhancement of the BOS proposed for any residual ecological impacts (not specifically related to air quality).
8. Commitments with regard to the monitoring, management and operation of the Contracted Project.

2 ASSESSMENT CRITERIA

The relevant air quality criteria, against which predictions resulting from the Contracted Project have been assessed, are listed below. **Table 2.1** lists the NSW EPA assessment criteria, while **Table 2.2** lists the criteria applied by the Department of Planning and Infrastructure (DP&I) to properties eligible for acquisition. Assessment criteria provide benchmarks, which are intended to protect the community against the adverse effects of particulates. These criteria reflect current Australian standards for the protection of health and protection against nuisance effects.

Table 2.1: Air quality assessment criteria

Pollutant	Criterion	Averaging Period	Application	Source
TSP	90 µg/m³	Annual	Cumulative	NHMRC (1996)
PM_{10}	50 µg/m³	24-hour	Cumulative	NEPC (1998)
	30 µg/m³	Annual	Cumulative	NSW EPA (1998)
Deposited Dust	2 g/m²/month	Annual	Incremental	NERDDC (1988)
	4 g/m²/month	Annual	Cumulative	NERDDC (1988)

Table 2.2: Air quality acquisition criteria

Pollutant	Criterion	Averaging Period	Application
TSP	90 µg/m³	Annual	Cumulative
PM_{10}	150 µg/m³	24-hour	Cumulative
	50 µg/m³	24-hour	Incremental
	30 µg/m³	Annual	Cumulative
Deposited Dust	2 g/m²/month	Annual	Incremental
	4 g/m²/month	Annual	Cumulative

3 ASSESSMENT METHODOLOGY

3.1 Meteorology

In terms of the preparation of the meteorological data used in the dispersion modelling, this remains unchanged from the Exhibited Project. The TAPM and CALMET models (as defined below) were used in conjunction with surface observations from five sites, as well as local terrain data, to provide a three-dimensional representation of the meteorology within the modelling domain. This methodology is described in detail in Section 5 of the Exhibited Project AQIA. In summary, the modelling system works as follows:

- TAPM is a prognostic meteorological model that generates gridded three-dimensional meteorological data for each hour of the model run period.
- CALMET, the meteorological pre-processor for the dispersion model CALPUFF, calculates fine resolution three-dimensional meteorological data based upon observed ground and upper level meteorological data, as well as observed or modelled upper air data generated for example by TAPM.
- CALPUFF then calculates the dispersion of plumes within this three-dimensional meteorological field.

3.2 Emissions estimation

As discussed in **Section 1.1**, this air quality assessment involves remodelling Year 2 operations, as this was the year of highest potential impact for Cullen Bullen in the Exhibited Project, and the year when the most significant changes to dust generating activities are proposed for the Contracted Project. The two major changes for the Contracted Project mine plan include the removal of the Hillcroft Mining Area and associated access infrastructure, and the removal of the sand extraction component in the Cullen Valley mining area. The removal of the sand mining component also involves the removal of the associated crushing and screening infrastructure and the transport of product sand by road.

In addition to eliminating these activities in the Contracted Project, revisions were made to the emission estimation techniques for wind blown dust emissions. Site specific silt and moisture content measurements were also made in order to populate the emission estimate equations, which replaced the conservative estimates used in the Exhibited Project AQIA.

3.2.1 Site specific parameterisation

Site specific parameterisation refers to taking samples of on-site material and analysing them to determine parameters such as silt and moisture content. These results are then used in emissions estimation equations (emission factors) to calculate emission rates for individual mining activities.

Much of the current discussion around the requirement for site specific parameters to use in emission factors has arisen since the implementation of the NSW EPA's Dust Stop Pollution Reduction Program (PRP) process in 2011/2012. The Exhibited Project AQIA was completed well in advance of this process, and so a high level of conservatism was applied to the modelling at that time.

These measurements were subsequently carried out on 31 January 2013 for both Cullen Valley Mine and Invincible Colliery. The monitoring reports for these measurements are attached in **Appendix A**. As expected, the values used in the Exhibited Project AQIA modelling were conservative. Using the site specific data has led to considerable reductions in emission estimates for the Contracted Project.

Table 3.1 summarises the values used in both the Exhibited and Contracted Project. With the exception of product coal[1], it can be seen that all the Exhibited Project AQIA assumptions were conservative (higher moisture content and lower silt content than the site specific data used in the Contracted Project AQIA).

Table 3.1: Assumed and measured silt and moisture contents

Area	As adopted in the Exhibited Project	As adopted in the Contracted Project	As adopted in the Exhibited Project	As adopted in the Contracted Project
	Moisture content (%)		Silt content (%)	
Haul roads	N/A	N/A	5	3.4 - 3.9
ROM coal	7	7 - 8	10	3
Product coal	7	5.3	N/A	N/A
Overburden	2	4 - 5	10	4 - 5
Topsoil	2	6 - 7	8	5 - 6
Rehab	2	5 - 6	10	5 - 6

Note: A range of values occur as measurements were taken at both Cullen Valley Mine and Invincible Colliery. Values adopted for East Tyldesley mining area were taken as the average of the two.

3.2.2 Wind blown dust emissions

Wind blown dust emissions refer to those particulate emissions arising from erosion of exposed areas such as the pit or active dumping or rehabilitation areas. The amount of particulate lift-off is dependent on a number of factors which include the threshold friction velocity (the wind velocity necessary to initiate soil erosion).

There are a number of different emission estimation techniques that can be used to determine wind blow dust emissions. One such technique is the US EPA AP-42 factor (US EPA (2006) Chapter 13.2.5) which takes into account site specific wind data and erodible material properties.

Experience has shown that this method can result in very low emission estimates for wind erosion, which are not realistic. The older and more conservative factor of 0.4 kg/ha/hr (SPCC, 1983) was therefore used to represent these emissions in the Exhibited Project AQIA modelling.

To confirm this, a site specific measurement for threshold friction velocity (TFV) was made at the Invincible Colliery on 31 January 2013, to determine the wind blown dust from exposed areas. **Table 3.2** below presents the measured data relevant to the equation.

Table 3.2: Measurements of threshold friction velocity from Invincible Colliery

Cullen Valley Mine	
Area measured	**Threshold friction velocity (cm/s)**
Overburden Dump Pit 105	100
Overburden Dump Pit 106	100
Invincible Colliery	
ROM Coal Inpit A	100
ROM Coal Inpit B	76
Overburden Current Dump (average)	72

Not all exposed areas will be active constantly, meaning that dust will only be generated if the wind velocity is sufficient to lift dust from the surface. This occurs when the surface wind velocity is greater

[1] It should be noted that emissions from product coal do not form a significant percentage of the total emissions from the site (approximately 0.04%), and the difference between assumption and measurement is also small (1.7%).

than the TFV of the material. Surfaces with a low TFV have greater propensity for fine particles to be lifted at relatively low wind speeds. Since larger material and other non-erodible elements (e.g. crusting of stockpiles) add protection against wind erosion, they act to raise the TFV if they are present on the surface.

The US EPA AP-42 emission factor (Chapter 13.2.5) takes into account site specific wind data, erodible material properties (TFV, particulate size distribution of the material eroded) and the frequency of material disturbance.

Using the site-specific measurements (**Table 3.1**) and adopting this approach would result in almost no wind initiated dust lift-off emissions from exposed areas, which is unrealistic. For this reason, we have not used this result, but have adopted the US EPA's AP42 factors of 0.1 kg/ha/hr factor (for exposed areas) and [1.8 x wind speed] kg/ha/hr (for active stockpiles) for modelling the Contracted Project.

3.2.3 Summary of emissions

Table 3.3 shows a comparison between the annual total suspended particulate (TSP) calculated for both the Exhibited and Contracted Project in Year 2. The values for the Contracted Project include changes due to the use of site specific parameters and also the updated wind blown dust equation.

As expected, emissions calculated for the Contracted Project are significantly lower than for the Exhibited Project.

Table 3.3: Comparison of Exhibited and Contracted Project TSP emissions calculated for Year 2

Estimated TSP in kg/year for Year 2	Exhibited Project (Conservative Assumptions Made)	Contracted Project (Site Specific Inputs Adopted)	Percentage change
Cullen Valley Mine	371,719	430,587	+ 16%
Hillcroft Mine	966,310	-	- 100%
East Tyldesley Mine	757,984	487,977	- 36%
Invincible Colliery	771,266	523,430	- 32%
TOTAL	**2,867,279**	**1,441,993**	**- 50%**

Note: Cullen Valley Mine extracted sand only in the Exhibited EA modelling and extracts coal in the Contracted Project.

3.3 CALPUFF dispersion modelling

Once the TSP emissions were estimated for each activity and for each mining operation, these activities were assigned locations based on their likely positions throughout the course of the Year 2 Contracted Project operations. **Figure 3.1** shows these locations, as modelled for this assessment.

The only difference in the CALPUFF modelling inputs between the Exhibited Project and the Contracted Project are the emission estimation values and the source locations. All other settings remain unchanged from the Exhibited Project AQIA.

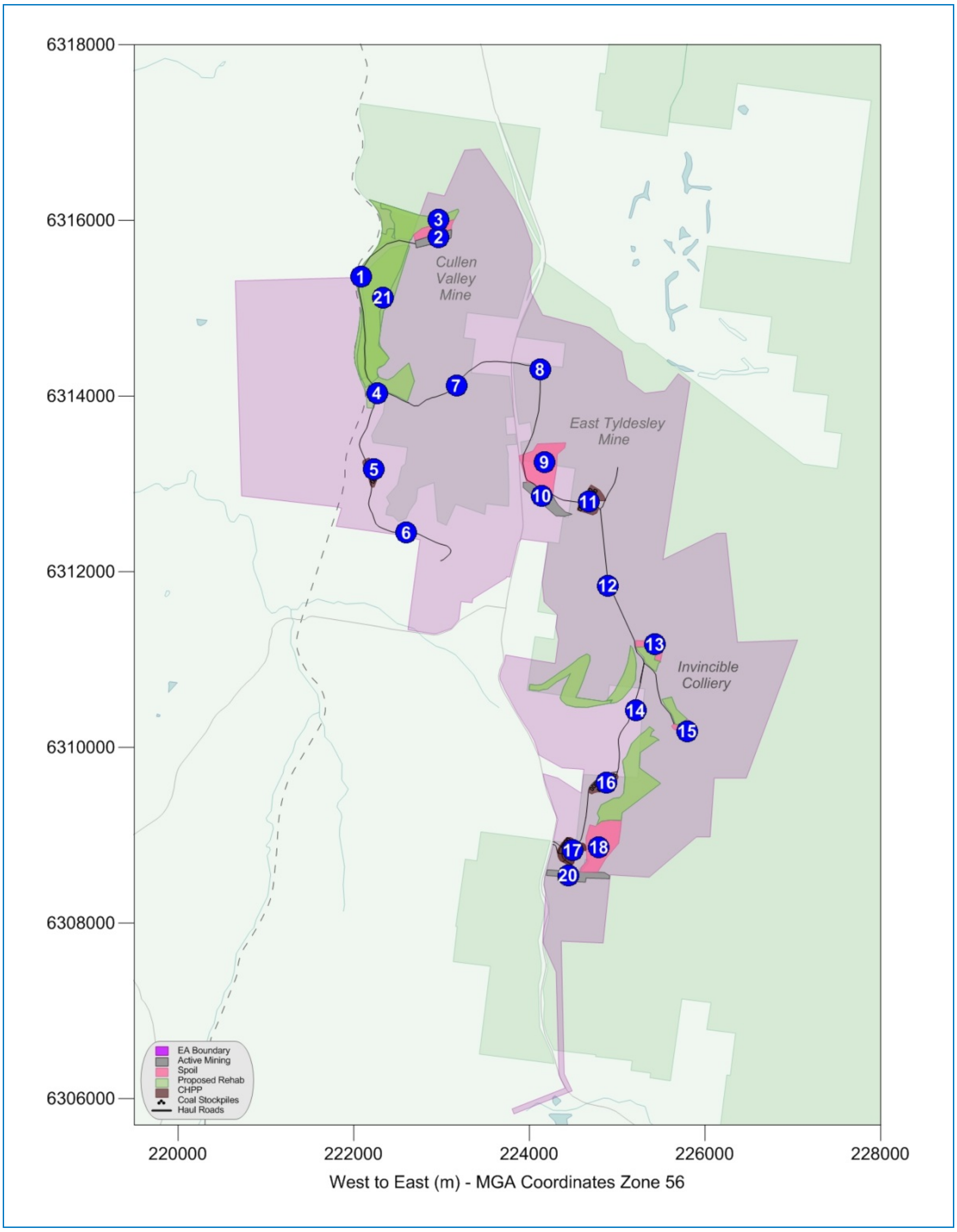

Figure 3.1: Indicative source locations for the Contracted Project

4 AIR QUALITY IMPACT ASSESSMENT FOR THE PREFERRED PROJECT

4.1 Modelling results

Using the site specific measurements and updated wind erosion equation, discussed in **Section 3.2**, to compile new emissions inventories in combination with the other changes to the exhibited EA Project, further dispersion modelling was carried out for Year 2 (considered to be the highest potential impact year for Cullen Bullen).

Table 4.1, **Table 4.2** and **Table 4.3** provide comparisons of the predicted ground level concentrations for the Exhibited and Contracted Projects, for those residences where exceedances of the air quality criteria are predicted. As shown, there are significant reductions predicted at all locations where exceedances of the air quality criteria were predicted in the Exhibited Project AQIA for both PM_{10} and TSP. Privately owned properties are in bold text.

Table 4.1: Comparison of modelling results – 24-hour average PM_{10}

ID	Ownership Details	Exhibited Project		Contracted Project	
		Max 24-hour Average PM_{10} Mine Alone (µg/m³)	Number of days over 50 µg/m³	Max 24-hour Average PM_{10} Mine Alone (µg/m³)	Number of days over 50 µg/m³
		Assessment criteria			
		50	*N/A*	*50*	*N/A*
169[b]	Portland Road Pastoral Co Pty Ltd	62	7	26	0
171[b]	Portland Road Pastoral Co Pty Ltd	64	4	25	0
195[cd]	KJ Blackley	191	105	114	28
196[ac]	Crown-owned	173	81	101	18
197[bc]	BE & CE Leisemann & IL & KID Follington	402	189	255	153
198[cd]	DA Tilley	199	115	126	50
199[cd]	DA Tilley	136	71	84	17
217b[a]	Crown-owned	52	1	28	0
327	**RG Wright & KL Norris**	**54**	**1**	**28**	**0**
394[b]	Coalpac	79	12	55	1
396[b]	Coalpac	90	24	69	4
426	**JWJ & SM Taylor**	**62**	**3**	**40**	**0**

[a] Crown-owned, [b] Coalpac-owned, [c] Located within Project boundary, [d] Under agreement

Table 4.2: Comparison of modelling results – annual average PM_{10}

ID	Ownership Details	Annual Average PM_{10} Mine & Other Sources (µg/m³) Exhibited Project	Annual Average PM_{10} Mine & Other Sources (µg/m³) Contracted Project
		Assessment criteria	
		30	
195[cd]	KJ Blackley	49	33
196[ac]	Crown-owned	45	30
197[c]	BE & CE Leisemann & IL & KID Follington	90	62
198[cd]	DA Tilley	49	65
199[cd]	DA Tilley	40	29

[a] Crown-owned, [b] Coalpac-owned, [c] Located within Project boundary, [d] Under agreement

Table 4.3: Comparison of modelling results – annual average TSP

ID	Ownership Details	Annual Average TSP Mine & Other Sources (µg/m³) Exhibited Project	Annual Average TSP Mine & Other Sources (µg/m³) Contracted Project
		Assessment criteria	
		90	
195[cd]	KJ Blackley	125	70
196[ac]	Crown-owned	115	65
197[c]	BE & CE Leisemann & IL & KID Follington	231	140
198[cd]	DA Tilley	125	78
199[cd]	DA Tilley	102	65

[a] Crown-owned, [b] Coalpac-owned, [c] Located within Project boundary, [d] Under agreement

Table 4.4 provides the same comparison of results for residences within the township of Cullen Bullen specifically. These results show predicted reductions at every residence in Year 2, with all annual average PM_{10} predictions reducing from that predicted in the Exhibited Project and remaining below 20 µg/m³.

Table 4.4: Predicted Ground Level Concentrations at Cullen Bullen from the Exhibited Project compared to the Contracted Project (Year 2)

ID	Ownership Details	Max 24-hour Average PM_{10} Mine & Other Sources (µg/m³)		Annual Average PM_{10} Mine & Other Sources (µg/m³)	
		Exhibited Project	Contracted Project	Exhibited Project	Contracted Project
		Assessment criteria			
		50		*30*	
216	BM Emmott	42	29	23	19
217a	Crown	46	25	21	18
217b	Crown	**52**	28	21	17
220	KL Bunyon	21	10	17	15
223	RJ Whittaker & SR Burrows	23	11	17	15
225	JR Tilley	23	11	17	15
227	RG Wright & KL Norris	23	11	17	15
228	AA Woods , EJ Nicholls & LH Field	23	11	17	15
229	AA Woods , EJ Nicholls & LH Field	23	11	17	15
230	CM & BA Gilbert	23	12	17	15
231	J Fuller	24	12	17	16
232	RM Pyne	24	12	18	16
235	RK & SM Lane	28	14	18	16
235	RK & SM Lane	30	15	18	16
236	TJ & KO Tilley	33	17	18	16
237	MC Crane	28	14	18	16
238	DP Rochester	29	15	18	16
238	DP Rochester	32	16	18	16
239	SG Tweedie	29	15	18	16
240	DW & GJ Mccann	31	16	18	16
242	WF Fitzgerald	31	16	19	16
243	Unknown	31	16	19	16
245	M Botfield	34	17	19	16
247	KO & SL Rochester	26	13	18	16

ID	Ownership Details	Max 24-hour Average PM_{10} Mine & Other Sources (µg/m³)		Annual Average PM_{10} Mine & Other Sources (µg/m³)	
		Exhibited Project	Contracted Project	Exhibited Project	Contracted Project
		Assessment criteria			
		50		*30*	
248	PB Draper	27	13	18	16
250	GER Young	28	14	18	16
251	GER Young	26	13	18	16
253	M Pasztor	26	13	18	16
254	RW Selmes	27	13	18	16
254	RW Selmes	29	15	18	16
255	GE Lane	29	14	18	16
256	GE Lane	32	16	18	16
257	DJ Tilley	34	17	18	16
258	S & H Filla	49	26	20	17
262	Crown	18	9	17	15
263	M Stone	19	10	17	15
264	RD & DJ Blackley	19	10	17	15
267	AW Gleeson & SA Muldoon	20	10	17	15
268	EA & DM Lane	21	10	17	15
270	RD Blackley	19	10	17	15
270	RD Blackley	19	10	17	15
271	CD & JD Mccann	21	11	17	15
272	Crown (School)	23	11	17	15
272	Crown (School)	24	12	17	15
272	Crown (School)	24	12	17	15
272	Crown (School)	24	12	17	15
273	GJ & TA Hutchison	15	8	16	15
273	GJ & TA Hutchison	15	8	16	15
275	JL & MB Howden	15	9	16	15
276	KJ Blackley (Perpetual Lease)	16	9	16	15
276	KJ Blackley (Perpetual Lease)	16	9	16	15
277	RJ Tilley	16	9	16	15
278	FS Gilson	16	9	16	15
279	N & JA Anderson	17	9	16	15
280	SR Williams	17	9	16	15
281	Jj Brooks	17	9	16	15
283	MW Mercer	19	10	17	15
284	VN & E Deveigne	20	10	17	15
285	E Banks	21	11	17	15
288	MB Banks	22	11	17	15
289	NG Harradine	23	11	17	15
291	A & R Inzitari	27	13	18	15
296	PF Kendall	30	15	18	16
297	PF & DM Toner	30	15	18	16
298	BJ Scott	30	15	18	16
301	CM O'Neill	33	17	18	16
302	CJ Conroy	33	17	18	16
304	AI Miller & BS Wilson	33	17	18	16
305	AI Miller & BS Wilson	34	17	18	16

ID	Ownership Details	Max 24-hour Average PM_{10} Mine & Other Sources (µg/m³)		Annual Average PM_{10} Mine & Other Sources (µg/m³)	
		Exhibited Project	Contracted Project	Exhibited Project	Contracted Project
		Assessment criteria			
		50		*30*	
306	Al Miller & BS Wilson	36	18	18	16
308	T Bates	36	19	19	16
309	ME Stewart	36	19	19	16
311	WG Brown	42	22	19	16
312	LM Mcdonald	42	22	19	16
313	N Viaphay	41	21	19	16
314	KR Waters	43	23	19	16
315	KL Godden	28	14	18	15
315	KL Godden	30	15	18	16
316	CE & SM Davis	27	13	17	15
317	CE & SM Davis	26	13	17	15
318	AW Hall	27	13	17	15
321	N Thorne	33	16	18	16
325	SP & SA Duggan	44	23	19	16
326	The Minister For Energy & Utilities	49	25	20	16
327	J Playford	**54**	28	21	17
328	RP Harris	14	8	16	15
329	R Bailey	14	8	16	15
330	DJ Annesley	13	8	15	14
331	GJ & VC Walsh	12	7	15	14
332	BN Rochester	12	7	15	14
333	RP Doyle	12	7	15	14
335	P Warner & Ya Harris	12	7	15	14
342	GJ Williams	12	7	15	14
343	AG & RL Williams	12	7	15	14
344	RT & VE Dobson	12	7	15	14
345	DK & K Northey	13	7	15	14
347	DJ Annesley	13	8	15	14
350	Tanwind Pty Ltd	14	8	16	15
350	Tanwind Pty Ltd	15	8	16	15
350	Tanwind Pty Ltd	15	9	16	15
350	Tanwind Pty Ltd	16	9	16	15
350	Tanwind Pty Ltd	16	9	16	15
352	RS Speirs	17	9	16	15
352	RS Speirs	19	10	16	15
353	RJ Duncan	17	9	16	15
354	ST & CP Wilson	17	9	16	15
355	DC & KT Claydon & JD Garrett	17	9	16	15
356	MS Ivey	17	9	16	15
357	E Fabits	16	9	16	15
358	JM Ellis	16	9	16	15
360	Crown	28	14	17	15

Figure 4.1, **Figure 4.2** and **Figure 4.3** provide isopleths showing the changes in predicted ground level concentrations in Year 2, due to the Contracted Project. The blue contour shows the predictions from the Exhibited Project in Year 2 and red contour indicates predicted levels from the Contracted Project in Year 2. The predictions are clearly lower for the Contracted Project, except for the area immediately to the west of the Cullen Valley CHPP where activities are increased due to mining of coal rather than sand.

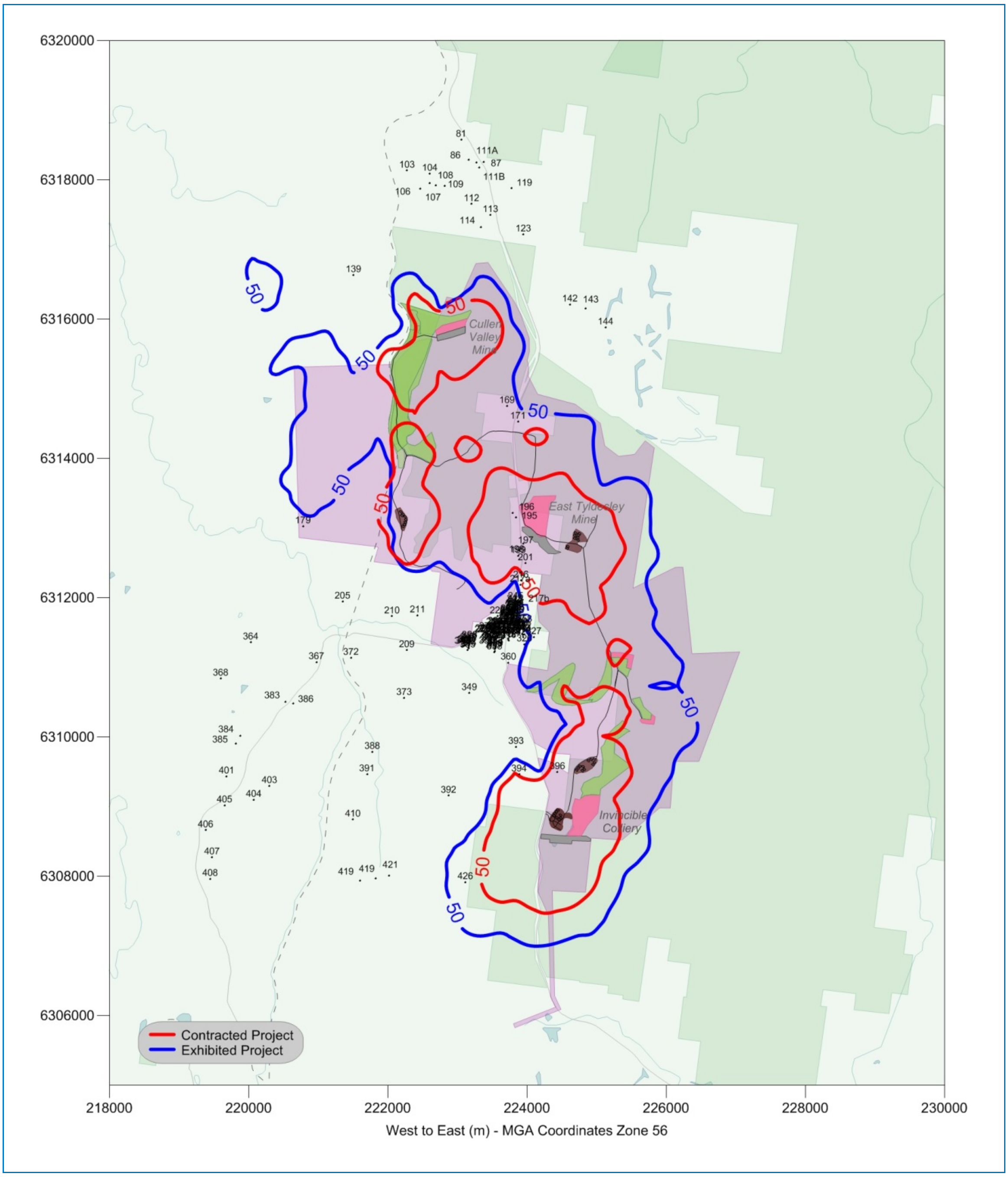

Figure 4.1: Comparison of Year 2 modelling results – 24-hour average PM_{10} ($\mu g/m^3$)

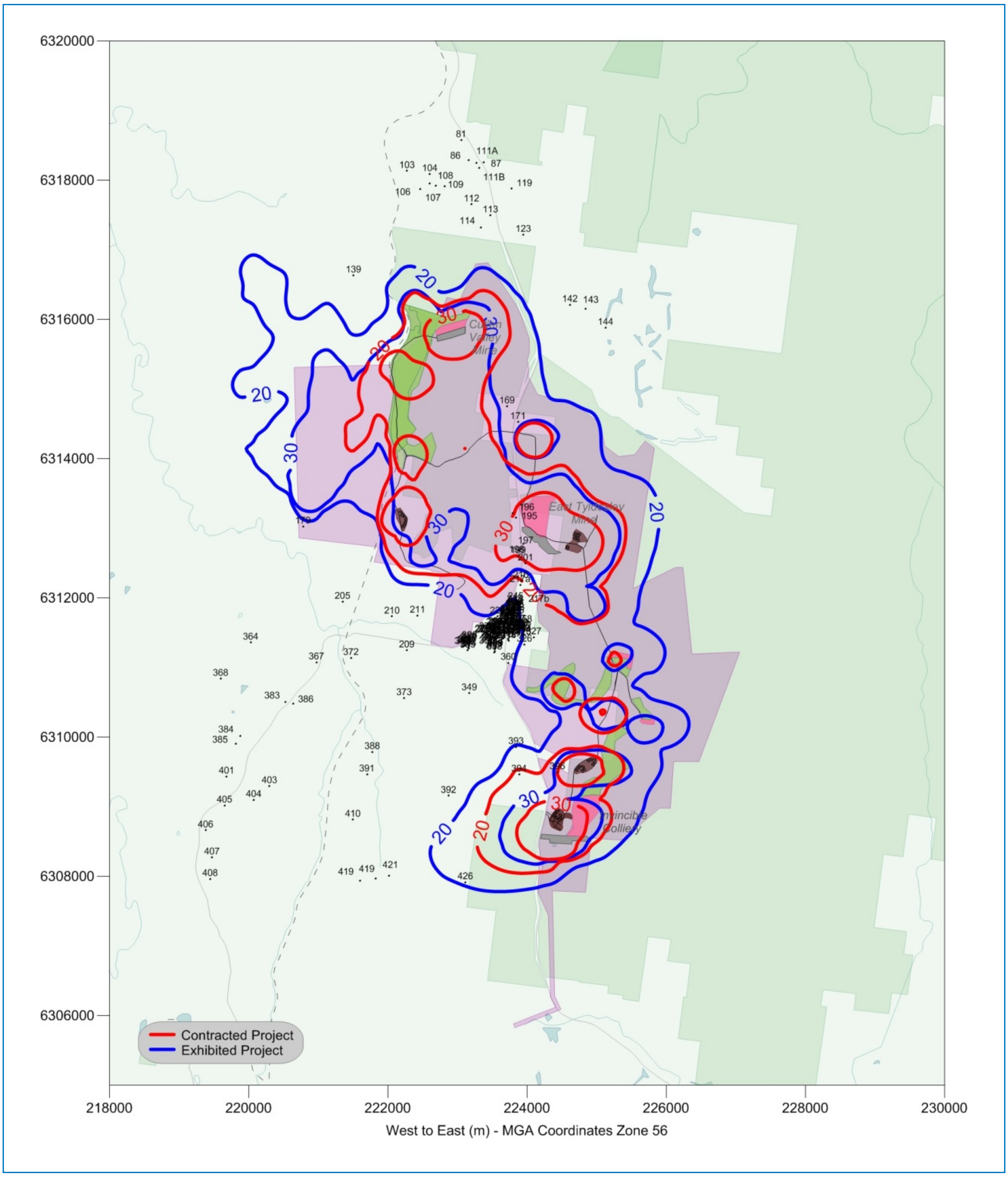

Figure 4.2: Comparison of Year 2 modelling results – annual average cumulative PM_{10} (µg/m³)

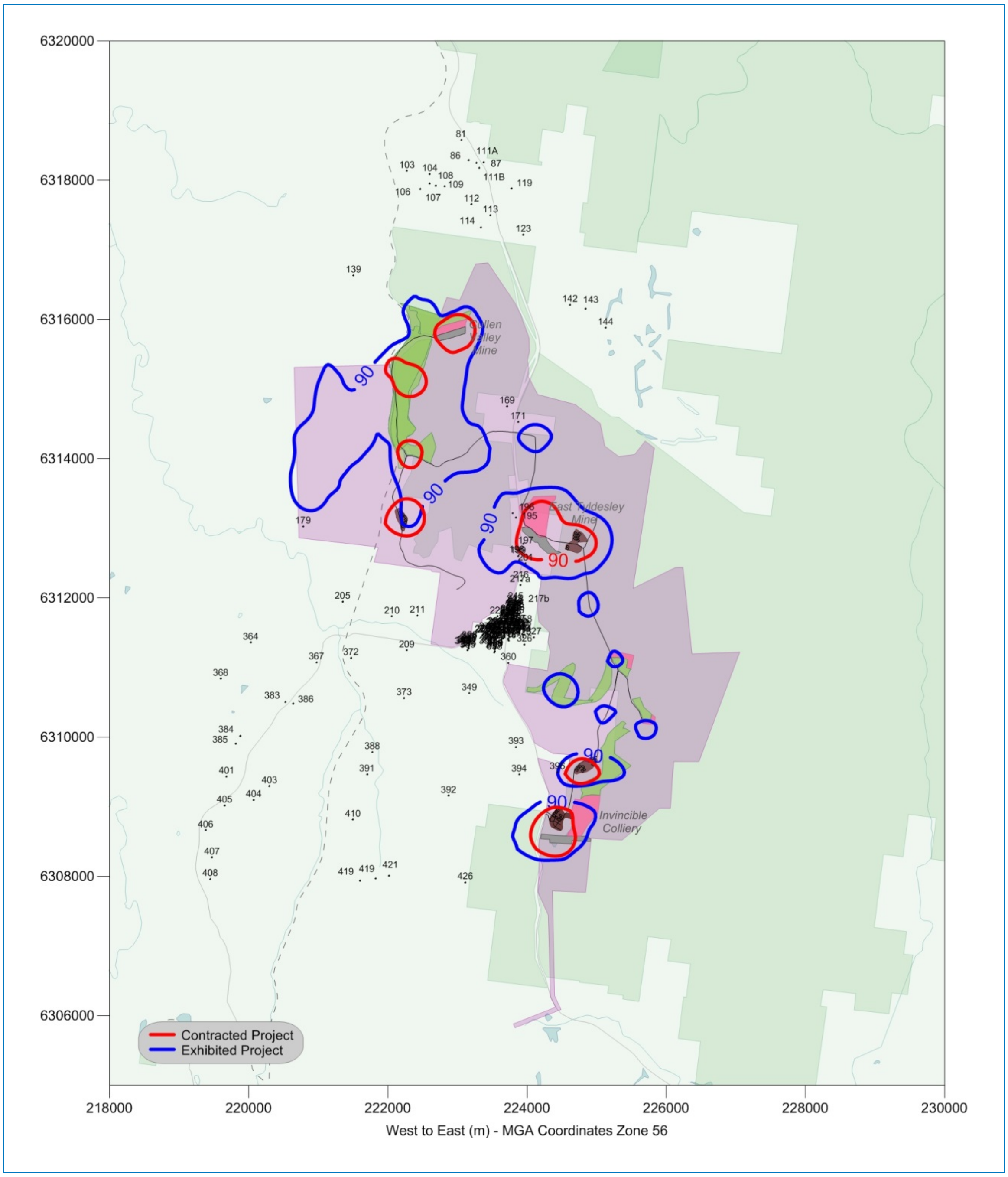

Figure 4.3: Comparison of Year 2 modelling results – annual average cumulative TSP (µg/m³)

4.2 Management and mitigation measures

The Project has the potential to generate dust. It is therefore necessary to take reasonable and practicable measures to prevent or minimise dust impacts at sensitive receptors.

In addition to current dust suppression measures such as the watering of haul roads which have been included in the modelling outlined in this report, Coalpac is committed to leading practice dust management for the Contracted Project through the use of a real-time air quality management system (RTAQMS). This would enable Coalpac to proactively manage the short-term impacts, by reducing emissions at the source, and prevent or minimise dust impacts at sensitive receptors to the greatest practical extent. The improvements to short term impacts delivered by the RTAQMS will further approve outcomes for receptors over and above the modelled levels shown in the report. Full details of the dust management measures would be outlined in an Air Quality Management Plan and Air Quality Environmental Monitoring Program, which would be consolidated and updated prior to the commencement of the Contracted Project activities.

An outline of this RTAQMS is given in **Section 4.2.1**. This system will also be used to mitigate impacts from blasting, by identifying unfavourable meteorological conditions under which blasting cannot take place.

4.2.1 Real-time air quality management plan

Coalpac proposes to implement a system that includes the following components:

- Meteorological forecasting data.
- Real-time air quality management system.
- Reactive and proactive mitigation measures.

Each of the components proposed for the Contracted Project air quality management system is discussed further below.

Meteorological Forecasting Data

Coalpac proposes to implement a predictive meteorology capability, where an hourly weather forecast is generated every day for a period of two days ahead to identify weather conditions with high dust risks before they occur.

Weather forecast models are available that can be set up specifically for the region and include detail for the local area around the Project. These models can operate in a system to provide hourly forecasted weather predictions, two days in advance, and an automated report can be regularly delivered to the operations.

Real-time Air Quality Management System

Real-time monitors will be set up at locations between open cut / surface operations and the nearest private receivers, specifically for the purpose of day to day dust management.

Coalpac will install up to six real-time PM_{10} monitors (such as E-Samplers or BAM1020) at suitable locations between operations and nearest receptors. The sites of all air quality monitoring instruments would comply with Standards Australia AS3580.1.1:2007: *Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment* and be sited by a suitably qualified air quality professional to ensure that sites comply with the EPA's requirements.

Particular note will be made to ensure that there are no extraneous sources of dust within the vicinity of the instruments, including possible vehicle generated dust from private dirt roads. Proximity of monitoring instruments to buildings and trees should follow those guidelines described in AS 3580.1.1:2007.

Some of the real-time monitors will also be suitable to be used for compliance monitoring, one of which would be placed in the township of Cullen Bullen. Others may be mobile units to enable relocation as the Project proceeds.

Reactive and Proactive Mitigation Measures

Real-time monitoring data and predictive meteorology data will be transmitted to a central data repository and analysed. The analysis will inform the Triggered Action Response Plan (TARP), set up with pre-defined triggers, and send notifications to alert operations personnel when a dust risk is predicted.

The system will also recommend dust control options for consideration depending on the data analysis. The TARP will be updated as the system implementation progresses and adverse conditions for various operations and mining areas are identified.

5 GHG ASSESSMENT FOR THE PREFERRED PROJECT

5.1 Emission calculations

Pacific Environment completed a Greenhouse Gas (GHG) Assessment as part of the Exhibited Project AQIA document. Project-related GHG sources included in the assessment were as follows:

- Fuel consumption (diesel) during mining operations – Scope 1.
- Release of fugitive CH4 during mining – Scope 1.
- Indirect emissions resulting from the consumption of purchased electricity – Scope 2.
- Indirect emissions associated with the production and transport of fuels – Scope 3.
- Indirect emissions associated with transmission and distribution losses from electricity supply – Scope 3.
- Emissions from coal and sand transportation – Scope 3.
- Emissions from the burning of the product coal – Scope 3.

Site specific data such as quantities of fuel, electricity and explosives were provided by Coalpac for an existing year of operations. These data were then used in conjunction with ROM coal mined at the site at the same time to calculate a derived intensity rate per tonne of ROM coal to estimate future use of electricity, fuel and explosives.

Given that the quantity of ROM coal has not changed in the Year 2 Contracted Project from the original Exhibited Project, it is anticipated that the GHG outcomes would also not significantly change. As previously discussed, there would now be no sand extraction in Year 2 and therefore Scope 3 emissions related to this activity would not exist for the Contracted Project.

Table 5.1 presents a summary of the revised GHG calculations for the Contracted Project Year 2 and compares total (all scopes) to that calculated in the Exhibited Project AQIA. **Table 5.1** shows that GHG calculations without the inclusion of sand transportation in the Contracted Project Year 2, there has been a slight decrease in total emissions.

When comparing the total estimated GHG emissions from the Exhibited Project, GHG emissions for the Contracted Project have decreased by 9,391 t CO_2-e, representing a 0.13 % decrease. As Scope 1 emissions have not changed from that estimated in the Exhibited Project AQIA, there is no change to the Project's direct contribution to Australia's commitment under the Kyoto Protocol and it is anticipated that any material effect on climate change would be minimal.

Table 5.1: Comparison of estimated GHG emissions for the Exhibited and Contracted Project (Year 2)

			Contracted Project (Year 2)		Exhibited Project (Year 2)
Emission Source	**Scope 1**	**Scope 2**	**Scope 3**	**Total**	**Total**
	CO_2-e / annum (t)				
Diesel	60,355	-	4,576	64,931	64,931
Electricity	-	5,842	1,181	7,023	7,023
Explosives	606	-	-	606	606
Fugitive Emissions	2,994	-	-	2,994	2,994
Coal Transportation	-	-	2,348	2,348	2,348
Off-site Sand Transportation	-	-	9,391	-	9,391
Coal Burning	-	-	7,113,581	7,113,581	7,113,581
Total:	**63,955**	**5,842**	**7,131,078**	**7,191,483**	**7,200,874**

5.2 Management and mitigation measures

Coalpac has plans and standards in place to minimise energy usage and GHG emissions from its operations, including the Coalpac Consolidation Project. Reasonable and feasible measures will be implemented on-site to minimise greenhouse gas emissions of the Contracted Project and ensure it is energy efficient. These measures include objectives, commitments, procedures and responsibilities for:

- Researching and promoting low emission coal technologies.
- Monitoring and improving energy use and efficiency and reducing GHG emissions from the mining, processing and use of coal.
- Consideration of the use of alternative fuels where economically and practically feasible.
- Review of mining practices to minimise double handling of materials and ensuring that coal and overburden haulage is undertaken using the most efficient routes.
- Ongoing scheduled and preventative maintenance to ensure that diesel and electrically powered plant operate efficiently.
- Developing targets for greenhouse gas emissions and energy use onsite and monitor and report against these.

Coalpac has committed to ensuring that certain GHG measures are implemented on-site. These site specific measures are listed in **Table 5.2** and will continue to be implemented during the life of the Contracted Project, along with ongoing consideration of the reasonable and feasible measures listed above.

Table 5.2: Greenhouse Gas Management Measures

Management Measure	Implementation Date
Ensuring that there is a dedicated number of trucks for each digging unit (i.e. front-end-loader and excavator) to minimise truck wait time.	On-going
Ensuring that dump trucks are fully loaded for each load prior to hauling to maximise productivity and efficiency with regard to the amount of fuel used per unit of material moved. This is measured by the number of buckets loaded into each truck.	On-going
Review haul road maintenance and materials used in main haul roads to reduce rolling resistance and decrease fuel consumption.	On-going

Coalpac will undertake calculations of GHG emissions and annually review energy efficiency initiatives to ensure that Scope 1 GHG emissions per tonne of coal are kept to the minimum practicable level.

6 CONCLUSION

The Contracted Project results in significant reductions for Year 2 in both 24-hour and annual average predicted ground level PM_{10} concentrations. These reductions are a result of mine plan changes and the use of site specific measurements of parameters in the calculation of total emissions from Contracted Project mining activities.

Predicted concentrations of PM_{10} in Cullen Bullen (for the Contracted Project) are below 20 µg/m³ in Year 2, well below the NSW EPA annual criterion of 30 µg/m³.

The model predictions in this report and the Exhibited Project AQIA do not assume or include any further reductions in emissions which may be achieved either by additional mitigation and controls on emission sources (other than those modelled), or by the implementation of the RTAQMS. Any reductions in emissions from individual sources from such control measures would be expected to further reduce predicted concentrations.

7 REFERENCES

PAEHolmes (2011)
"Air Quality and Greenhouse Gas Assessment for the Coalpac Consolidation Project", prepared for Hansen Bailey, December 2011.

US EPA (2006)
"Compilation of Air Pollutant Emission Factors", AP-42, United States Environmental Protection Agency, Office of Air and Radiation Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711.

SPCC (1983)
Air Pollution from Coal Mining and Related Developments, State Pollution Control Commission.

APPENDIX A: Monitoring reports for site specific measurements made for the Contracted Project

Environmental - Dust Emissions

Client Coalpac Invincible
Job No 13-001
Report number 1597
Sample point Invincible

Date sampled 25/01/2013
Date sample received 25/01/2013
Sampled in accordance with AS4264.1 NA
Sampled by: *** Macgeo

Sample date	Client Sample Identification	Moisture In Analysis* % EPA AP42 C2	Silt Content* % EPA AP42 C2	Velocity* cm/s EPA AP 42 13.2.5			Macgeo sample no.
25/01/2013	ROM COAL A	20.3	4.7	<43			L13-5886
25/01/2013	PRODUCT COAL STOCKPILE A	5.2	15.1	100			L13-5887
25/01/2013	ROM COAL INPIT A	10.0	2.9	100			L13-5888
25/01/2013	ROM COAL B	6.1	1.9	100			L13-5889
25/01/2013	PRODUCT COAL STOCKPILE B	5.3	3.2	100			L13-5890
25/01/2013	ROM COAL INPIT B	7.8	2.7	76			L13-5891
25/01/2013	WASTE INPIT A	3.2	5.2	<43			L13-5892
25/01/2013	WASTE INPIT B	7.2	3.8	76			L13-5893
25/01/2013	OVERBURDEN CURRENT DUMP NORTH	6.2	5.5	<43			L13-5894
25/01/2013	OVERBURDEN CURRENT DUMPING SOUTH	4.6	2.1	100			L13-5895
25/01/2013	TOP SOIL NORTH PIT 203	6.5	6.4	<43			L13-5896
25/01/2013	TOP SOIL PIT 203	8.3	4.3	<43			L13-5897
25/01/2013	HAUL ROAD @ OVERBURDEN DUMP	0.7	4.7	76			L13-5898
25/01/2013	HAUL ROAD @ CRIB HUT	1.1	4.4	<43			L13-5899
25/01/2013	HAUL ROAD @ OFFICE	0.9	2.7	100			L13-5900

* Non accredited tests
*** MacQuarie Geotech takes no responsibility for correctness of sampling if sampled by client

Authorised signatory ____________________
R. Cox
Date 31/01/2013

NATA Accredited Laboratory Number: 14874

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Issue 1 revision D 16/06/09

Environmental - Dust Emissions

Client Coalpac Cullen Valley
Job No 13-001
Report number 1598
Sample point Cullen Valley

Date sampled 25/01/2013
Date sample received 25/01/2013
Sampled in accordance with AS4264.1 NA
Sampled by: *** Macgeo

Sample date	Client Sample Identification	Moisture in Analysis* % US EPA AP42 C2	Silt Content* % US EPA AP42 C2	Velocity* cm/s EPA AP 42 13.2.5			Macgeo sample no.
25/01/2013	CV ROMCOAL STOCKPILE WESTERN	6.8	3.0	100			L13-5901
25/01/2013	CV ROMCOAL STOCKPILE NORTHERN	6.6	3.8	100			L13-5902
25/01/2013	WASTE INPIT WEST SIDE	4.8	4.4	76			L13-5903
25/01/2013	WASTE INPIT EAST SIDE	6.9	5.2	100			L13-5904
25/01/2013	OVERBURDEN DUMP PIT 105	3.9	3.6	100			L13-5905
25/01/2013	OVERBURDEN DUMP PIT 106	4.0	3.8	100			L13-5906
25/01/2013	TOPSOIL NOISE BUND	5.8	3	100			L13-5907
25/01/2013	TOPSOIL NEW REHAB EASTERN SIDE	5.3	9.6	<43			L13-5908
25/01/2013	HAUL ROAD 0.7km FROM W/SHOP	0.8	1.9	76			L13-5909
25/01/2013	HAUL ROAD 1.5km FROM W/SHOP	1.0	3.3	>100			L13-5910
25/01/2013	HAUL ROAD 2.3km FROM W/SHOP	0.8	3.1	76			L13-5911

* Non accredited tests
*** MacQuarie Geotech takes no responsibility for correctness of sampling if sampled by client

Authorised signatory
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Date 31/01/2013

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MACQUARIE GEOTECH

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APPENDIX E

NOISE IMPACT ASSESSMENT

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8 April 2013
Ref: J0130-29-L5

Hansen Bailey Pty Ltd
P.O. Box 473
SINGLETON NSW 2330

Attn: Mr. Dorian Walsh

Dear Dorian,

RE: COALPAC CONSOLIDATION PROJECT -

PREFERRED PROJECT REPORT - ACOUSTICS

1. INTRODUCTION

Bridges Acoustics has been commissioned by Hansen Bailey on behalf of Coalpac Pty Ltd (Coalpac) to provide an acoustic assessment for inclusion in a Preferred Project Report (PPR) for the Coalpac Consolidation Project (the Exhibited Project). The Exhibited Project as described in the *Coalpac Consolidated Project Environmental Assessment* (Exhibited EA) and associated Acoustic Impact Assessment (AIA) (Bridges Acoustics, 2011) included:

- Consolidation and expansion of the existing Cullen Valley Mine and Invincible Colliery operations to produce up to a total of 3.5 Million tonnes per annum (Mtpa) of product coal;
- Continuation of coal supply to the local Mount Piper Power Station (MPPS) via a dedicated coal conveyor over the Castlereagh Highway (to be constructed) and emergency supply to Wallerawang Power Station (WPS) via road, with flexibility for supply to additional domestic destinations and Port Kembla for export;
- Upgrades to existing administration, transport and other infrastructure;
- Construction and operation of additional offices at Cullen Valley Mine;
- Construction and use of the previously approved Coal Deshaling Plant (CDP) at Cullen Valley Mine;
- Construction and use of a bridge over the Castlereagh Highway to link operations east and west of the Highway and the development of required access roads to the East Tyldesley area;
- Construction and operation of a bridge and haul road across the Wallerawang - Gwabegar Railway Line to permit access to mine the previously approved Hillcroft resource;
- Extraction of the Marangaroo Sandstone horizon from immediately below the Lithgow Coal Seam in the northern coal mining area of Cullen Valley Mine. This material would be trucked to an onsite crushing station prior to sale into the Sydney (and surrounds) industrial sand market;
- Construction of a rail siding with associated infrastructure to permit transport of coal and sand products;
- Integration of the water management of both sites into a single system; and
- Integration of the management of mine rehabilitation and conceptual final landform outcomes for Cullen Valley Mine and Invincible Colliery.

Since that time, Coalpac have made a number of material changes to the Exhibited Project in response to the Planning Assessment Commission review to reduce environmental impacts (referred to as the Contracted Project). Changes made for the Contracted Project include:

1. Removal of the Hillcroft mining area and associated access infrastructure (including the Wallerawang-Gwabegar Rail Line overpass bridge and Red Springs Road crossing);
2. Removal of the sand extraction component of the Exhibited Project located in the Cullen Valley mining area, including the requirement for associated crushing and screening infrastructure and the transport of product sand by road from the site to market;
3. Reduction of the open cut mining footprint to avoid the area of Clandulla Geebung habitat previously located in the north western mining area at Cullen Valley Mine;
4. Reduction of the open cut mining footprint in relation to the Significant Pagoda Landforms (SPL) to improve ecological outcomes;
5. Reduction of the highwall mining footprint to avoid rock formations within the SPL to improve perceived ecological, heritage and geotechnical outcomes;
6. Implementation of a robust blast management system specifically tailored to further minimise the potential for blasting impacts to any SPL and Sandstone Outcrop;
7. Enhancement of the BOS proposed for any residual ecological impacts; and
8. Commitments with regard to the monitoring, management and operation of the Contracted Project.

This assessment quantifies the reduction in received noise levels that will be realised from the Contracted Project, including the changes listed above, compared to the Exhibited Project.

2. ASSESSMENT METHODOLOGY

2.1 The Exhibited Project

The AIA in the Exhibited EA was completed according to the Director General's Requirements (DGRs), with particular attention to and in compliance with the INP by adopting the following processes:

- Measurement of existing background noise levels at four representative receiver locations. Measured background noise levels, excluding any noise from existing Coalpac operations and atypical sources, were over 32 dBA during the day and evening due to traffic on the Castlereagh Highway for receivers within 500 m of the Highway, 30 to 32 dBA during the day and evening at receivers more than 500 m from the Castlereagh Highway, and in the range 27 to 29 dBA during the night due primarily to distant Highway traffic noise with some contribution from other sources such as birds;
- Determination of appropriate Project Specific Noise Levels (PSNLs) for the day, evening and night according to the procedure defined in the INP, considering measured background noise levels, the character of the receiver area and the minimum default background level of 30 dBA as recommended in the INP. The PSNLs developed in the Exhibited EA were:
  - 37 LAeq,15min during the day at all receivers within 500 m of the Castlereagh Highway; and
  - 35 LAeq,15min at other times and at all other receivers.
- Determination of prevailing weather conditions based on measured weather data from two local weather stations operated by Coalpac;
- Adopting all noise control and management measures that could reasonably be adopted, including a comprehensive noise barrier strategy, best practice equipment noise control and operating hours restrictions in various areas close to receivers where necessary;

- Calculation of predicted noise levels considering all operating plant and equipment operating simultaneously in reasonable worst case locations and the effect of prevailing weather conditions where relevant;
- Identification of all receivers that are predicted to experience noise levels over the adopted criteria under worst case conditions during one or more time periods or Project stages, after all reasonable noise control measures were adopted;
- A review of the blasting history associated with the existing mining operations and prediction of vibration and noise effects from proposed blasts;
- An assessment of road traffic noise levels compared to currently approved traffic levels and relevant traffic noise criteria; and
- An assessment of rail traffic noise levels compared to relevant noise criteria.

2.2 The Contracted Project

The Contracted Project includes changes to the early years of the Exhibited Project which only affect predicted noise levels described in the Exhibited EA in Year 2 due to removal of mining in the Hillcroft mining area and changes to the northern Cullen Valley mining area. Predicted noise levels for Years 8, 14 and 20 of the Contracted Project would not increase above the levels described in the AIA and have therefore not been reassessed.

Noise levels from the Contracted Project in Year 2 have been assessed using a modified version of the noise model used to calculate noise levels for the Exhibited Project, including the following changes in Year 2 only:

- The terrain file has been changed by:
  - Replacing the disturbed terrain within the Hillcroft mining area with the existing ground surface in this area; and
  - Slightly reducing the northern Cullen Valley mining area to avoid an area of Clandulla Geebung habitat.
- The noise sources have been changed by:
  - Relocating the Highwall Miner from the Hillcroft mining area to the northern Cullen Valley mining area, which affects noise levels in all time periods and weather conditions;
  - Removing all other mobile plant sources associated with the Hillcroft mining area. As the Exhibited Project included mining within the Hillcroft mining area only during the day under neutral weather conditions, removal of this plant does not affect Project noise levels under day/evening prevailing or night prevailing conditions; and
  - Adjusting the mining noise sources in the northern Cullen Valley mining area to suit the adjusted terrain in this area while maintaining the same or a similar elevation and level of acoustic shielding for all sources.

The Exhibited Project noise model included haul truck noise sources for combined coal and sand transportation. As the Contracted Project does not include sand mining, the trucks are assumed to only haul coal and have not been removed from the model. All other noise model parameters, including prevailing weather conditions in each time period, have not been changed.

The Exhibited Project included sand mining and associated truck movements on the Castlereagh Highway and the Great Western Highway that are not proposed as part of the Contracted Project. Traffic noise levels from the Castlereagh Highway have been recalculated without the sand truck movements, using the same Calculation of road Traffic Noise (CoRTN) method that was used in the Exhibited EA.

3. ASSESSMENT RESULTS

3.1 The Exhibited Project

Noise levels were assessed in the Exhibited Project AIA in Years 2, 8, 14 and 20. The Exhibited Project AIA reported predicted noise levels at all residences and properties that may receive noise levels over relevant PSNLs. Blast effects and road and rail traffic noise levels were also calculated and reported at closest receivers. Specifically:

- 4 rural residences were predicted to receive significant noise impacts of more than 5 dBA above the adopted PSNLs;
- 18 rural residences were predicted to receive moderate noise impacts of 2 to 5 dBA above the adopted PSNLs;
- 14 rural residences were predicted to receive mild noise impacts of up to 2 dBA above the adopted PSNLs;
- All residences in Cullen Bullen were predicted to receive noise levels within the adopted PSNLs in all time periods and Project stages; and
- Noise levels inside Cullen Bullen School classrooms would be at least 10 dBA below the INP recommended noise criterion of 35 LAeq,1hr;
- With adopted management measures, blast effects were predicted to comply with relevant vibration and overpressure criteria at all receivers;
- Road traffic noise levels would in general be lower than permitted under the existing approvals for Cullen Valley Mine and Invincible Colliery, with the majority of Project coal to be transported by conveyor to MPPS or by rail rather than the current road transport fleet. Occasional periods of emergency coal transport by road, due to unavailability of the coal conveyor or rail transport, would produce road traffic noise levels no greater than permitted under the existing approvals. Road traffic noise levels would comply with the NSW Road Noise Policy (RNP) traffic noise criteria of 60 LAeq,15hr day and 55 LAeq,9hr night at all assessed receivers; and
- Noise from proposed train movements would have a minor effect on average rail noise levels to all receivers near the Wallerawang - Gwabegar Railway Line and no effect on maximum train pass by levels.

3.2 The Contracted Project

As the Contracted Project mainly differs from the Exhibited Project in Year 2 specifically due to removal of mining in the Hillcroft mining area and changes to the northern Cullen Valley mining area, changes in noise levels between the Exhibited Project and the Contracted Project would occur only in Year 2. Year 2 noise levels have therefore been recalculated for the Contracted Project (without mining in the Hillcroft area or sand mining operations in the Cullen Valley mining area) and are presented in Tables 1 and 2 for direct comparison with the predicted Exhibited Project Year 2 noise levels assessed in the Exhibited EA.

Table 1: Operational Noise Levels at Residences, Year 2, LAeq,15min

Owner ID	Residence ID	Predicted Year 2 Noise Level, LAeq,15min						Criteria Day/ Evening/ Night
		Day/Evening Neutral		Day/Evening Prevailing		Night Prevailing		
		Exhibited Project	Contracted Project	Exhibited Project	Contracted Project	Exhibited Project	Contracted Project	
2	217N	31.2	31.1	36.1	36.1	37.2	37.2	37/35/35
	217S	28.7	28.6	33.0	33.0	34.3	34.3	37/35/35
5	139	29.5	28.3	29.5	29.0	33.1	33.1	35/35/35
6	179	37.4	28.7	37.8	36.7	39.7	38.5	35/35/35
8	364	31.9	24.8	36.4	34.7	38.7	36.7	35/35/35
	367	31.3	25.7	36.6	35.6	38.9	37.9	35/35/35
9	205	33.0	27.6	38.4	36.6	40.6	38.7	35/35/35
10	368	29.4	23.6	34.7	33.7	37.1	35.8	35/35/35
11	383	29.6	24.9	35.5	34.8	37.7	36.9	35/35/35
13	384	28.7	24.1	34.4	33.9	36.6	35.9	35/35/35
14	385	28.5	24.0	34.2	33.8	36.3	35.7	35/35/35
17	386	28.9	25.5	35.5	34.9	37.7	37.0	35/35/35
23	403	27.1	24.5	34.5	34.3	36.4	36.0	35/35/35
	404	26.3	23.7	34.3	34.1	35.9	35.6	35/35/35
30	198	36.2	36.1	39.3	39.3	39.7	39.7	35/35/35
	199	35.1	35.1	38.9	38.9	39.5	39.5	37/35/35
31	197	37.7	37.7	40.1	40.1	40.4	40.4	35/35/35
32	201	35.3	35.3	38.9	38.9	39.4	39.4	37/35/35
33	195	41.2	41.2	42.5	42.5	43.8	43.8	37/35/35
34	194	41.5	41.5	43.1	43.1	45.3	45.3	37/35/35
50	114	27.8	27.7	32.2	32.2	31.2	31.2	37/35/35
51	113	27.0	26.9	32.5	32.5	31.9	31.9	37/35/35
52	112	26.1	25.9	29.1	29.1	30.9	30.9	37/35/35
53	109	25.6	25.2	26.1	25.9	29.8	29.8	35/35/35
54	108	25.7	25.2	26.0	25.6	29.7	29.7	35/35/35
56	106	26.1	25.6	26.2	25.7	30.0	30.0	35/35/35
65	142	26.1	26.0	35.0	35.0	35.7	35.7	35/35/35
66	143	26.7	26.7	35.3	35.3	36.4	36.4	35/35/35
67	144	29.3	29.3	36.4	36.4	38.0	38.0	35/35/35
68	209	28.7	26.4	32.2	31.5	35.1	33.9	35/35/35
72	349	32.0	31.6	34.7	34.7	37.8	37.7	35/35/35
73	391	28.0	26.4	35.1	34.9	36.9	36.7	35/35/35
75	392	30.6	30.1	37.4	37.3	38.4	38.3	35/35/35
76	372	31.0	26.2	36.5	35.7	39.3	38.5	37/35/35
77	373	30.0	28.5	35.0	34.6	37.1	36.6	35/35/35
78	388	28.7	27.1	34.0	33.6	35.8	35.4	35/35/35
80	412	27.3	26.2	36.1	36.0	38.4	38.3	35/35/35
85	426	27.7	27.2	34.5	34.4	36.3	36.3	35/35/35
Number of Affected Residences Total		7	6	19	15	30	29	
Significant		2	2	3	3	4	3	
Moderate		2	1	6	4	16	12	
Mild		3	3	10	8	10	14	

Table 2: Operational Noise Levels over 25% of Properties, Year 2, LAeq,15min

Owner ID	Property ID	Year 2 Predicted Noise Level, LAeq,15min						Criteria Day/ Evening/ Night
		Day/Evening Neutral		Day/Evening Prevailing		Night Prevailing		
		Exhibited Project	Contracted Project	Exhibited Project	Contracted Project	Exhibited Project	Contracted Project	
2 Crown	192 Waste	45.3	45.3	48.8	48.8	51.0	51.0	70/ - / -
	193 Cemetery	48.3	48.3	48.9	48.9	52.8	52.8	65/ - / -
	196 Vacant	42.8	42.8	45.1	45.1	46.9	46.9	- / - / -
	217	35.9	35.9	40.9	40.9	41.5	41.5	37/35/35
5	97-102, 138-141	32.7	29.1	33.9	32.8	34.3	33.4	35/35/35
6	173-175, 178-186	39.4	23.8	40.7	30.5	41.1	32.3	35/35/35
7	176	34.4	20.6	37.8	29.4	40.0	31.4	35/35/35
8	203,204,364, 365,367	32.3	23.6	36.4	34.0	38.6	36.1	35/35/35
9	205,206	37.0	26.8	40.6	36.6	42.9	38.9	35/35/35
10	368,369	30.0	24.3	35.6	34.6	37.8	36.5	35/35/35
11	383	29.1	24.2	35.1	34.4	37.3	36.5	35/35/35
13	384	28.7	23.9	34.4	33.9	36.6	35.9	35/35/35
14	385	27.6	23.5	33.8	33.4	35.7	35.2	35/35/35
15	371	30.4	25.9	35.7	34.8	38.1	37.2	35/35/35
16	370	31.6	26.0	36.5	35.4	39.1	38.2	35/35/35
17	386	28.9	25.8	35.5	34.9	37.7	37.0	35/35/35
18	387	28.3	26.1	34.9	34.6	37.1	36.6	35/35/35
23	403-405	27.1	24.8	34.6	34.4	36.5	36.2	35/35/35
24	406	25.8	23.3	34.6	34.5	36.2	36.0	35/35/35
26	408	24.8	22.3	34.0	33.9	35.4	35.3	35/35/35
29	170	60.4	60.4	61.2	61.2	61.3	61.3	37/35/35
30	198,199	37.6	37.6	45.6	45.6	46.6	46.6	37/35/35
31	197	67.6	67.6	68.1	68.1	67.2	67.2	37/35/35
32	201	35.3	35.3	38.9	38.9	39.4	39.4	37/35/35
33	195	41.2	41.2	42.5	42.5	43.8	43.8	37/35/35
34	194	42.8	42.8	44.0	44.0	46.7	46.7	37/35/35
35	200	46.0	46.0	49.6	48.6	49.1	49.1	37/35/35
50	114	28.2	28.1	34.1	34.1	31.7	31.7	35/35/35
51	113	27.3	27.1	32.0	32.0	31.7	31.7	37/35/35
52	110,112	26.2	26.0	29.5	29.5	31.2	31.2	37/35/35
53	109	26.8	26.6	27.4	27.4	29.9	29.9	35/35/35
54	108	27.3	27.0	27.6	27.4	29.9	29.9	35/35/35
55	107	28.3	28.1	28.9	28.7	30.0	30.0	35/35/35
56	105,106	27.7	27.0	27.7	27.0	29.8	29.8	35/35/35
58	111	25.0	24.8	28.1	28.1	30.7	30.7	37/35/35
61	119	24.8	24.7	30.7	30.7	31.6	31.6	37/35/35
62	122	25.3	25.2	33.3	33.3	32.6	32.5	37/35/35
65	142	25.2	25.1	33.1	33.1	34.1	34.1	35/35/35
66	143	26.0	26.0	34.6	34.6	33.9	33.9	35/35/35
67	144	30.6	30.6	37.0	37	38.7	38.7	35/35/35
68	209	33.0	28.7	36.1	34.5	38.5	36.7	35/35/35
69	210	31.4	28.2	33.5	32.7	36.1	35.2	35/35/35
71	348	29.4	28.9	31.0	31.0	35.2	35.1	35/35/35
	362	31.3	30.9	32.3	32.3	37.0	36.9	37/35/35
72	349	31.5	31.0	34.4	34.2	37.2	37.1	37/35/35
73	374-376, 390,391	31.5	31.0	35.2	35.1	38.1	38.0	35/35/35
75	392	31.5	31.2	37.3	37.2	38.2	38.1	35/35/35

Owner ID	Property ID	Year 2 Predicted Noise Level, LAeq,15min						Criteria Day/ Evening/ Night
		Day/Evening Neutral		Day/Evening Prevailing		Night Prevailing		
		Exhibited Project	Contracted Project	Exhibited Project	Contracted Project	Exhibited Project	Contracted Project	
76	372	30.2	26.8	35.6	34.8	38.3	37.5	35/35/35
77	373	29.9	28.5	34.8	34.4	37.0	36.5	35/35/35
78	388,409	28.9	27.4	34.7	34.5	36.6	36.3	35/35/35
79	410	26.8	25.5	34.4	34.3	36.4	36.1	35/35/35
80	412-414	28.3	27.4	36.3	36.2	38.4	38.3	35/35/35
81	417-419	26.5	25.3	34.9	34.8	36.7	36.6	35/35/35
82	411,415,416, 420-425	29.8	29.4	38.0	37.9	39.0	39.0	35/35/35
97	220	27.3	27.1	31.9	31.9	33.2	33.2	35/35/35
128	350	29.0	28.7	31.5	31.5	35.2	35.2	37/35/35
137	216	31.9	31.9	36.6	36.6	37.6	37.6	37/35/35
Number of Affected Properties Total		10	8	25	16	40	32	
Significant		5	5	9	7	9	7	
Moderate		2	1	4	3	18	12	
Mild		3	2	12	6	13	19	

The comparisons in Tables 1 and 2 between the Exhibited Project and Contracted Project noise levels indicates the Contracted Project would:

- Materially reduce noise levels by 0.5 dBA or more at 32% of potentially affected residences and 30% of potentially affected properties in Year 2;
- Reduce the number of significantly affected residences by 25% and the number of significantly affected properties by 22%;
- Significantly reduce mining noise levels generally to the north west of the Project Boundary, by up to 9 dBA over the worst affected property, which would place 7 residences and 9 properties in a lower noise affectation or unaffected category; and
- Not result in a noise level increase at any residence or property.

The Contracted Project would therefore have a positive effect on community noise levels compared to the Exhibited Project as assessed in the Exhibited EA.

3.3 Traffic Noise Levels

Table 3 shows calculated traffic noise levels on the Castlereagh Highway for the Exhibited Project and for the Contracted Project. The Average Annual Daily Traffic (AADT) parameters shown in Table 3 are for the Contracted Project without 128 sand truck movements that are not required. Noise levels for the Exhibited Project, taken from Table 23 in the Project AIA, are shown in italic font for comparison with the Contracted Project noise levels.

Table 3 shows a traffic noise reduction from the Castlereagh Highway for the Contracted Project compared to the Exhibited Project at all distances from the highway. A reduction of 0.5 to 0.6 LAeq,15hr is predicted for base traffic plus Contracted Project traffic, and a reduction of 0.3 to 0.4 LAeq,15hr is predicted if occasional and brief periods of emergency coal transport are included.

Closest residential receivers south of the Invincible Colliery access are located approximately 1 km from the Castlereagh Highway and would therefore receive traffic noise levels significantly lower than the levels shown in Table 3 for both the Exhibited Project and the Contracted Project.

Table 3: Calculated Castlereagh Highway Traffic Noise Levels, Contracted Project.

Scenario	AADT				Calculated LAeq,15hr at Distance from the Road			
	Base Excluding Contracted Project	Contracted Project Trucks	Contracted Project Cars	Total Base Plus Contracted Project	Contracted Project		*Exhibited Project*	
					50m	100m	*50m*	*100m*
Existing Traffic	3006	404	90	3500	58.7	55.0	*58.7*	*55.0*
Existing Traffic +Construction	3006 0	404 5	90 120	3625	58.7	55.1	*58.7*	*55.1*
Base Traffic +Contracted Project	3006 0	0 100	0 120	3226	57.5	53.9	*58.1*	*54.4*
Base Traffic +Contracted Project +Emergency Coal	3006 0 0	0 100 224	0 120 0	3450	58.4	54.8	*58.8*	*55.2*
Base Traffic Year 20 +Contracted Project +Emergency Coal	4460 0 0	0 100 224	0 120 0	4904	59.7	56.1	*60.0*	*56.4*

3.3 Blast Effects

Blast effects from the Exhibited Project were assessed in the Exhibited EA to closest residential receivers and to the closest Aboriginal heritage rock shelter sites. Table 25 in the AIA indicated blast effects would meet the adopted criteria at all assessed locations with a reduced Maximum Instantaneous Charge (MIC) when blasting near Residential Receivers 179 and 199 and near two Aboriginal heritage rock shelter sites.

The Contracted Project excludes the Hillcroft mining area and therefore no longer affects Receiver 179. A reduced MIC would no longer be required for blasting near this receiver.

Receiver 199 is located near the East Tyldesley mining area and would continue to require a lower MIC or other blast control measures to meet the criteria for closest blasts.

The Contracted Project proposes an increased setback distance for open cut mining from the closest Aboriginal rock shelter sites which are generally located near the Invincible and Cullen Valley mining areas.

An updated Blast Management Plan is proposed under the Contracted Project to comprehensively address blast effects to closest receivers, including detailed blast control measures to protect residences, significant landforms and other heritage features. The additional blast management procedures and commitments for the Contracted Project are discussed by Terrock (2013) and are appended to the PPR.

4. NOISE CONTROL AND MANAGEMENT MEASURES

4.1 The Exhibited Project

Section 4.4 of the Coalpac AIA details the proposed engineering noise control and noise management measures for the Exhibited Project. In summary, the proposed measures include:

- Significant engineered noise barriers in the most sensitive mining areas and adjacent to the most sensitive haul routes. The location of bunds was determined by detailed noise modelling, while the height of bunds has been determined by a combination of noise modelling and consideration of reasonably achievable bund heights.

The Coalpac AIA also includes detailed consideration of bund construction noise, including a strategy to construct the bunds in the less acoustically sensitive time periods and work behind the bunds during these more sensitive periods. These measures were put in place to minimise the chance of unexpected issues while implementing the proposed noise management strategy;

- Current best practice noise control modifications to all acoustically significant mining equipment. The proposed modifications, and adopted mobile equipment sound power levels expected to be achieved as a result of those modifications, are based on experience at other coal mines in the Hunter Valley. Examples of such mines include Bengalla Mine managed by Coal & Allied, and Mt Arthur Coal Mine owned and managed by BHP Billiton. The adopted measures have been demonstrated to be technically achievable in the long term, although they require an increase in capital expenditure and maintenance effort;
- Current best practice noise control modifications to all acoustically significant coal processing equipment. The proposed modifications primarily include the installation of acoustically effective cladding on buildings, which can be implemented using commonly available materials at modest additional capital cost and no significant ongoing maintenance cost;
- The proposed modifications have been recommended, and are understood to have been included in other similar coal processing plants in the Hunter Valley and the Gunnedah Basin. Examples include coal processing equipment installed at Bengalla Mine in the late 1990s and at Narrabri North Mine, operated by Whitehaven Coal, in 2011;
- The proposed East Tyldesley Coal Preparation Plant has been located based on noise modelling results, considering distance from residences and topographic barriers that separate the operation from those residences;
- Current best practise noise management measures designed to avoid working in acoustically exposed areas of the mine during the more sensitive time periods. The adopted strategy relies on an active management protocol that is currently in use at other mines, including the following components:
  - Real time weather monitoring at representative locations and a weather prediction system to estimate relevant weather parameters typically 24 to 48 hours in advance;
  - Ongoing calculation and prediction of environmental noise levels based on current mining areas and predicted weather conditions, with adjustments to the current working areas to avoid predicted exceedances of noise criteria on a shift by shift basis;
  - Real time noise monitoring at representative receiver locations;
  - Reactive management of working areas and equipment, to support the primary predictive system to identify and minimise the occurrence of exceedances of the criteria; and
  - Proposed restriction of working hours, including shutting down parts of the operation (depending on weather conditions) in specific mining areas where other noise control measures such as noise barriers are expected to be ineffective or insufficient.
- The proposed weather prediction system and associated mine management strategy has recently been developed while the proposed reactive noise management system supporting the predictive system is similar to the noise management system successfully used at Bengalla Mine since the late 1990s. Technology advances have made the implementation and maintenance of these systems considerably more user-friendly and has enabled mining operations to adopt this system.

The proposed noise control strategy represents current best practice in both the engineering and management components.

4.2 The Contracted Project

Noise control and management measures proposed for the Contracted Project would include all proposed measures listed above for the Exhibited Project and the following additional acoustic-related measures:

- Reduction of the open cut mining footprint in relation to the Significant Pagoda Landforms (SPL) to improve ecological outcomes and reduce blast effects; and
- Implementation of a robust blast management system specifically tailored to further minimise the potential for blasting impacts to any SPL and Sandstone Outcrop.

5. CONCLUSION

The Contracted Project differs from the Exhibited Project primarily due to the Hillcroft mining area and sand mining components being removed from the Contracted Project.

Removal of the Hillcroft mining area from the Contracted Project would reduce the number of significantly affected residences by 25% and the number of significantly affected properties by 22% would primarily benefit receivers located generally north west of the Project Boundary. Noise levels would materially reduce, by 0.5 dBA or more, at 32% of potentially affected residences and 30% of potentially affected properties.

Removal of sand mining from the Contracted Project would reduce average noise levels from truck movements within the Project Boundary, although the Contracted Project Year 2 noise model does not reflect this truck noise reduction as it includes coal truck movements over the same internal haul route. A reduction in Castlereagh Highway traffic noise levels, in the range 0.5 to 0.6 LAeq,15hr, would occur as a result of the removal of sand trucks under the Contracted Project.

Blasting under the Contracted Project would be completed in accordance with a comprehensive Blast Management Plan which would include detailed blast control measures to protect residences, significant landforms and other heritage features.

Yours faithfully,

BRIDGES ACOUSTICS

M Bridges

MARK BRIDGES BE (Mech) (Hons) MAAS
Principal Consultant

APPENDIX F

BLAST MANAGEMENT RESPONSE REPORT

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COALPAC PTY LTD

COALPAC CONSOLIDATION PROJECT PREFERRED PROJECT REPORT

BLAST MANAGEMENT RESPONSE

Adrian J. Moore
9th April, 2013

COALPAC CONSOLIDATION PROJECT
PREFERRED PROJECT REPORT

BLAST MANAGEMENT RESPONSE

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COALPAC CONSOLIDATION PROJECT

PREFERRED PROJECT REPORT

BLAST MANAGEMENT RESPONSE

EXECUTIVE SUMMARY

Since the Exhibited EA was submitted to the Department of Planning and Infrastructure and reviewed by the PAC, Coalpac has reviewed the Exhibited Project and has proposed a number of changes to further reduce noise and other environmental impacts (the Contracted Project). The most significant of the changes proposed for the Contracted Project from a blasting perspective are:

1. Removal of the Hillcroft Mining Area; and
2. Reduction in the open cut footprint adjacent to significant pagoda landforms to improve ecological outcomes.

The Department of Planning & Infrastructure (DP&I) has requested that Coalpac prepare a Preferred Project Report (PPR) that incorporates the changes made to the Exhibited Project to further minimise the environmental impacts.

Based on range of research conducted overseas and confirmed by studies in Australia the proposed limit on ground vibration of 5 mm/s will provide more than adequate protection for all Residences.

The recommendation of AS 2187.2 – 2006 is a limit of 100 mm/s PPV for unoccupied structures of reinforced concrete and steel construction. There are many successful examples of blasting in close proximity to structures and infrastructure to support this vibration level. These include Transgrid approving a 100 mm/s PPV limit for transmission towers.

The Cullen Valley Mine conducted controlled blasting as part of open cut mining operations within 32m of the railway line. The maximum vibration (93 mm/s PPV) caused no structural damage to the rail line or cutting walls.

Blasting at the Cullen Valley Mine to within 57m of the Sandstone Outcrop resulted in ground vibrations predicted to be in the range 185 to 213 mm/s without discernible impact.

Blasting at Invincible Colliery to within 205m of the base of the Significant Pagoda Landform (SPL) has resulted in ground vibration predicted to be in the range 16.4 to 24.3 mm/s without discernible impact.

Controlled blasting to within 43m of the Invincible Colliery office resulted in a PPV of 17.7 mm/s using environmental design principles. The highest PPV was 32.3 mm/s recorded at 66m from a blast. There was no discernible impact on the office complex, furniture or electronic equipment as a result of the blasting.

Review of previous blasting close to the rail lines, Sandstone Outcrops, the Invincible Colliery office and Cullen Bullen township has demonstrated:

- Blast vibration can be controlled to a specified limit using accepted blast design principles and implementation of the design;
- Blasting has been conducted to within 32m of the rail lines and 43m from the office complex without causing even threshold damage;
- Blasting has been successfully conducted to within 57m of the Sandstone Outcrops at the Cullen Valley Mine, without applying vibration reduction techniques, and
- The effectiveness of a controlled and closely monitored blasting program close to sensitive receptors at the Cullen Bullen township.

The assessment in this report shows that without any additional control measures, currently approved overpressure limits can be complied with at houses in the Cullen Bullen township. There are several aspects to representing the ground vibration contour assessment, particularly:

- Limiting ground vibration at houses to 5 mm/s;
- Limiting ground vibration at the SPL and Sandstone Outcrops to 100 mm/s;
- Limiting ground vibration at the Aboriginal Heritage Sites and the Cullen Bullen General Cemetery to 20 mm/s;
- Worst case vibration from blasting is from the thickest interburden 20 – 30m thick between the Moolarben and Irondale coal seams.

The assessment in this report demonstrates that the ANZEC guidelines can be complied with at the houses within the Cullen Bullen township. Blasts at different locations within the planned extraction will result in much lower vibration levels.

The maximum surface movement of grave furniture at the Cullen Bullen General Cemetery is predicted to be about one fifth of the thickness of a human hair, and the possible effect of ground motion is therefore considered to be negligible at the 250 m stand-off distance proposed. The risk to visitors from flyrock is addressed by the Commitment 30 and enforcement of an exclusion zone at time of blasting to ensure that no visitors are present within 500m of a blast. The spatial safety factor for the monuments from flyrock varies from 5 to 12.

Regular condition and vibration compliance monitoring and blast design to achieve the lowest 20 mm/s target PPV limit proposed for the Aboriginal Heritage Sites will ensure that the PAC's Recommendations are achieved. Areas around the rock shelters can be identified where a charge mass reduction may be required to achieve the target PPV limit.

Blast design for ground vibration (PPV) control has been proven to be effective on site and should be part of the Blast Management Plan. It has been shown that blasting closer than 100m to Sandstone Outcrops can occur without detrimental impacts.

It is logical that a PPV limit is a preferred basis for protection of the SPL and Sandstone Outcrops than a stand-off distance, because it is easy to routinely measure and report, and it is also the relevant controlling parameter.

The Proponent has demonstrated that by using environmental blast design techniques, ground vibration can be controlled to a specified target level.

Additional arrays of blast monitors should be located to the east of the proposed southern extension of Invincible Colliery to measure Peak Particle Velocity (PPV) for all blasts, and conduct sufficient strain measurements to confirm the relationship between PPV and strain for blasts on the various horizons as operations progress to the south (Site Factor Kv Exercise). The data would be gathered, collated and analysed to confirm and refine a Scaled Distance Site Law to increase the confidence of initial blast design when moving to the east towards the SPL.

Following a similar program to determine a local Scaled Distance Site Law, the Proponent also proposes to conduct a multi-disciplinary investigation (Non-damaging Limit Exercise) in the northern section of Cullen Valley Mine remote from SPL. This will include analysing the effects of controlled and closely monitored blasts to prove and demonstrate the appropriateness of the 100 mm/s non-damaging limit for SPL and Sandstone Outcrops.

The instrument of control of blast vibration for structures should be a non-damaging limit (i.e. measured as a limit of vibration), rather than an arbitrary distance (i.e. stand-off) limit. The non-damaging limit should be determined by the multi-disciplinary investigation which includes analysing the effects of controlled and closely monitored blasts.

Rather than an arbitrary distance, a more effective control mechanism would be an interim vibration limit at the base of the Sandstone Outcrop of, say 50 mm/s while the Non-damaging Limit Exercise is conducted.

The author is informed that the Proponent proposes to undertake these operations to demonstrate and prove the Site Law and Non-damaging ground vibration limit in the first year of operation of the Contracted Project. During this time, other mining faces would be advanced concurrently but would not approach within 200m of the SPL and Sandstone Outcrops before the validation program is completed. The collecting of data and developing of Site Laws at other mining locations is a routine part of a Blast Management Plan.

The author is informed that the data gathered in the proposed blasting exercise would be used to introduce a refined blast management program for operations adjacent to SPL and Sandstone Outcrops.

The blast management program should be used as the basis of Blast Management Plan to safely approach to 50m from the Sandstone Outcrops including those with the SPL, with confirmation by routine PPV measurements of all blasts coupled with observations of the response of the rock mass.

1. INTRODUCTION

Terrock Consulting Engineers were requested by Mr Dorian Walsh of Hansen Bailey to provide an additional response to address the blast design and management system for the Coalpac Consolidation Project.

Since the Exhibited EA was submitted to the Department of Planning and Infrastructure and reviewed by the PAC, Coalpac has reviewed the Exhibited Project and has proposed a number of changes to further reduce noise and other environmental impacts (the Contracted Project). The most significant of the changes proposed for the Contracted Project from a blasting perspective are:

1. Removal of the Hillcroft Mining Area; and
2. Reduction in the open cut footprint adjacent to significant pagoda landforms to improve ecological outcomes.

The Department of Planning & Infrastructure (DP&I) has requested that Coalpac prepare a Preferred Project Report (PPR) that incorporates the changes made to the Exhibited Project to further minimise the environmental impacts. This response details the recommended blast management processes for the Contracted Project now proposed to allow a staged progression of open cut mining activities to occur to avoid the potential for blasting impacts on Significant Pagoda Landforms (SPL) and Sandstone Outcrops as defined and mapped by Cumberland Ecology (2013) as well as other sensitive receptors including private residences, Cullen Bullen General Cemetery, Aboriginal and Non-aboriginal heritage sites.

It should be noted that Coalpac, in their Preferred Project Report, have defined the Narrabeen Group Sandstone Outcrops within the Project Boundary into two geomorphological units that essentially show two different topographic expressions. These are known as Significant Pagoda Landforms (SPL) and Sandstone Outcrops. These are defined elsewhere in Coalpac's PPR, however for the purposes of this report the two are treated separately.

The Contracted Project Location Plan is shown in **Figure 1**.

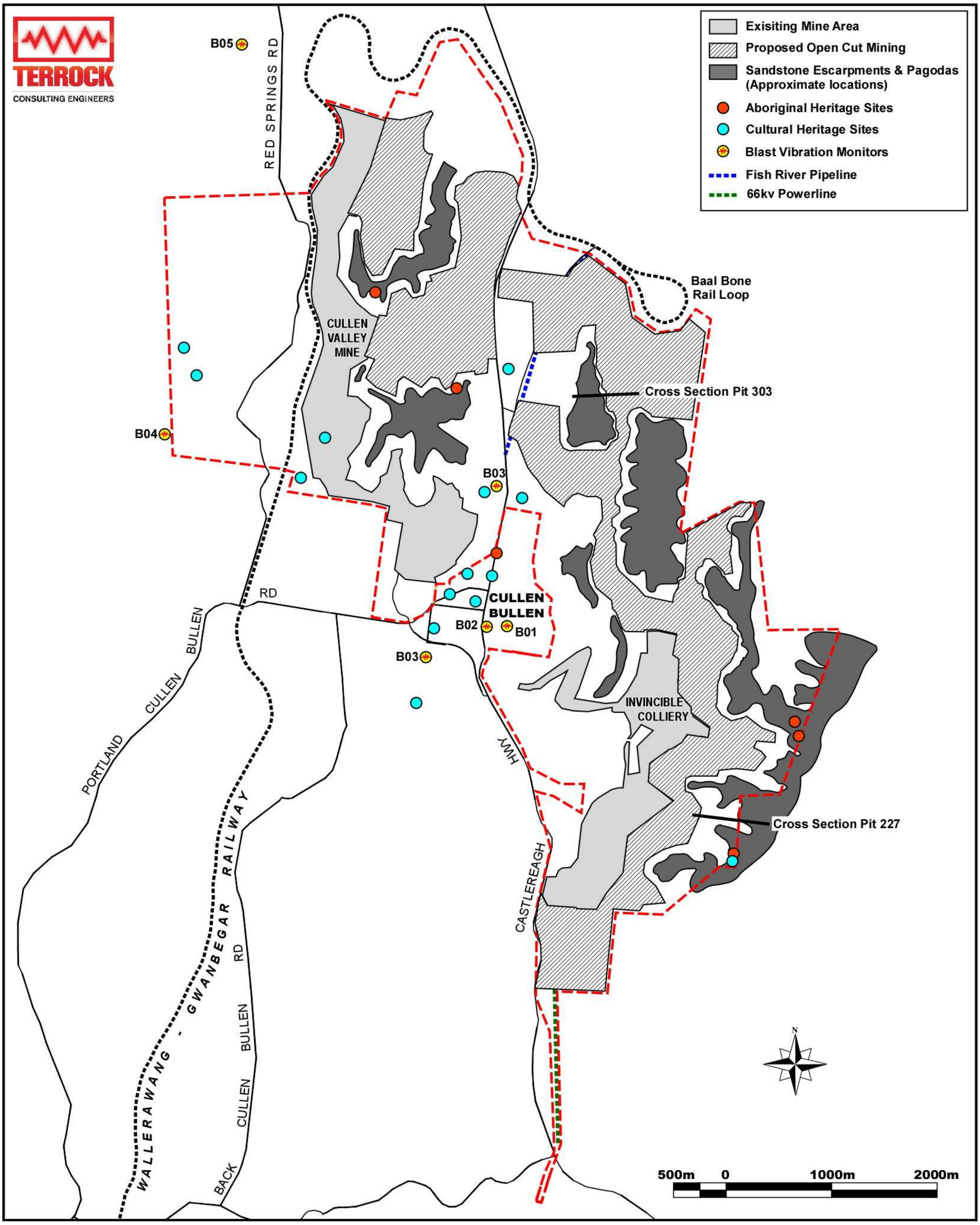

Figure 1 – Location Plan of the Contracted Project

2. BLAST VIBRATION MEASUREMENT

The vibration from blasting impacts consists of:

- Ground vibration (see Section 2.1), and;
- Air vibration (airblast, airblast overpressure).

The effect of airblast on SPL and Sandstone Outcrops will be less than pressures associated with wind events, so only ground vibration will be considered for these natural formations in this report. The Blast Management Plan will outline procedures to ensure regulatory compliance for all blasting activities.

2.1 GROUND VIBRATION

Ground vibration is energy transmitted through the ground in the form of waves in a similar manner to waves formed when a stone is dropped into a pond, as shown in **Figure 2**. As the waves spread out from the drop site, imagine a float on the surface bobbing with the wave. We can measure the frequency of the waves, which is the number of waves passing per second. We can measure the amplitude or displacement (A), the distance the float moves up and down. We can also measure velocity (v) and acceleration (a) of the float as it moves up and down.

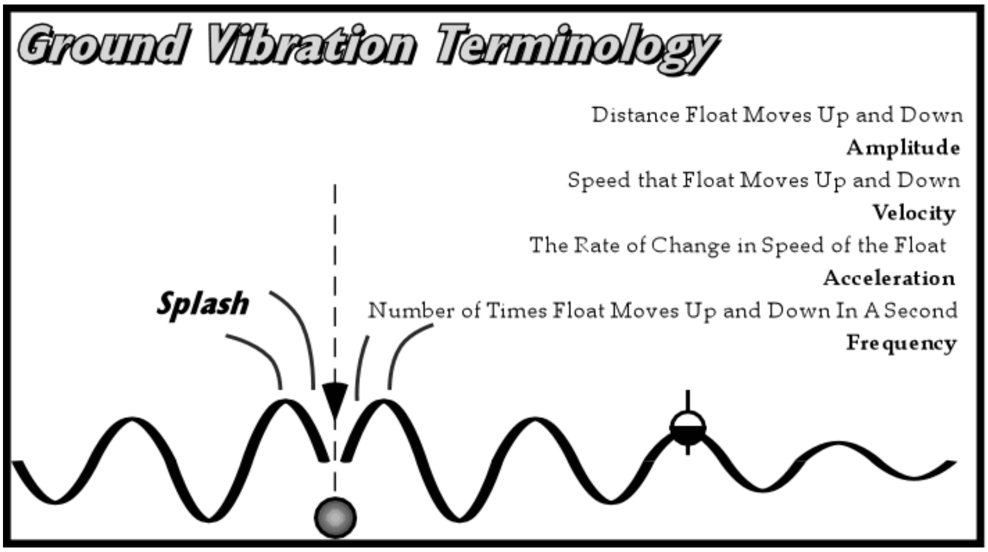

Figure 2 – Schematic of ground vibration waves

The study of blast vibration has led to the adoption of measurement of the velocity of a particle on the surface as the most common means of comparing and controlling vibration. Displacement, velocity and acceleration have the following relationships:

$a = 2 \pi f v$ and $v = 2 \pi f A$ Where: a = acceleration   [1]

f = frequency
v = velocity
A = amplitude

Ground vibration is commonly the remnant energy from a primary operation such as blasting. Significantly, the energy in the vibration wave reduces with distance and eventually diminishes to below detection levels.

Ground vibration from blasting depends upon:

- The charge mass per delay;
- Distance from the blast;
- Burden, spacing and sequential initiation timing;
- Ground conditions beyond the blast (along the transmission path);
- Degree and depth of weathering of rock at the receiver.

Ground vibration is measured with a blasting seismograph and is commonly expressed in terms of peak particle velocity (PPV) and measured in terms of millimetres per second (mm/s). Particle velocity is the velocity that a particle on the surface is subjected to by the action of the wave motion as it passes. The PPV is sometimes referred to as the peak vector sum (PVS), as it is the peak vector of the velocity measured in three mutually perpendicular directions.

Ground vibration is analysed and predicted using a Scaled Distance Site Law model whereby:

$$PPV = Kv\left(\frac{\sqrt{m}}{D}\right)^{e}$$

Where: *PPV =* Peak Particle Velocity (mm/s) [2]
m = Charge mass per hole or per delay (kg)
D = Distance from blast (m)
Kv = Site constant
e = The attenuation rate or site exponent

Previous blasting experience at the Invincible Colliery is that *e* = 1.6, giving a Site Law:

$$PPV = Kv\left(\frac{\sqrt{m}}{D}\right)^{1.6}$$ [3]

This is also the site exponent experience at most coal overburden blasting situations, but should be confirmed by site measurement and analysis.

If PPV, distance and charge mass are known, *Kv* can be determined. If *Kv* is known, a target PPV limit can be designed for by a limiting the charge mass at a particular distance.

2.2 AIRBLAST OVERPRESSURE

Airblast overpressure is the airborne shock wave generated by an explosion. The shock wave produces pressures above and below the ambient air pressure. When airblast is within the range of hearing, it is called sound. When its frequency is below the range of hearing, it is generally referred to as concussion or airblast.

Air vibration from blasting is measured with a precision sound level meter, which meets the requirements of Australian Standard 2187.2 – 2006 and is expressed in terms of decibels (Linear) or dBL.

Air vibration measurement is further complicated by the use of the decibel A (dBA) scale for audible community noise level measurement, and the use of the decibel (Linear Peak) or dBL (Peak) scale for measurement of air vibration from blasting. It is necessary to measure the air vibration from blasting on the dBL (Peak) scale because it has a considerable sub-audible component which can affect houses and other buildings.

As a comparison between the two systems, if a Precision Sound Level Meter which was set to measure air vibration from blasting measured 115 dBL (Peak), an identical Precision Sound Level Meter set to measure community noise on the dBA scale could measure approximately 90 dBA for the same blast.

Air vibration radiates outwards from the blast site in a similar manner to ground vibration, but at a slower rate. The time between the arrival of the ground vibration and air vibration depends on the distance from the blast. At one kilometre, the air vibration arrives approximately 2.5 seconds after the ground vibration.

Air vibration also attenuates with distance. The ground vibration attenuates to below perception levels faster than air vibration; at distances further than one kilometre from a blast, people may only be aware of the air vibration.

Atmospheric conditions (meteorological reinforcement) and the degree of shielding (topographical shielding) can influence the level of air vibration resulting in the area surrounding a blast. Atmospheric conditions can, on occasions, concentrate or focus air vibration in certain directions and distances from the blast, but usually greater than two kilometres.

3. EFFECTS OF BLASTING

Blasting is a controlled process that utilises explosives for the purpose of breaking the rock overburden and interburden so that it can be removed by earth moving equipment to expose the coal. The energy from the explosives produces the following effects:

- Rock shattering and displacement;
- Ground vibration;
- Air vibration.

Blasts are designed so that the energy available fragments and displaces the rock, however, some of the energy creates vibration in the surrounding rock (ground vibration) and a change of pressure above ambient in the atmosphere (airblast overpressure).

The impact of blasting on people at sensitive sites (such as residences, schools) is regulated by limiting the blast vibration to the recommended levels of the Australian and New Zealand Environmental Council (ANZEC) *"Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration".*

The ANZEC guideline limits are:

Ground Vibration	≤ 5 mm/s for 95% of blasts in a 12 month period ≤ 10 mm/s for all blasts
Airblast	≤ 115 dBL for 95% of blasts in a 12 month period ≤ 120 dBL for all blasts.

The ANZEC guideline limits are to minimise human annoyance. The vibration levels at which houses and other man-made structures may be damaged by blast vibration (structure damage levels) has also been well researched. The vibration levels at which different levels of damage may begin to occur in structures, and the mechanisms causing the damage, are understood. Damage from vibration can be prevented by limiting the overpressure and ground vibration levels to 'non-damaging' vibration levels. Non-damaging vibration levels can be determined by:

- Damage/no damage observations;
- Structural analysis methods.

An appropriate methodology to determine potentially damaging vibration levels for man-made structures is outlined as follows, using strength of materials criteria:

- Determine strain induced in the structure by the vibration – ground strain is related to ground Peak Particle Velocity (PPV). The strain in a structure is the ground strain multiplied by a response amplification factor;
- Find the tensile failure strain for the building for the building material – most building materials fail in tension before failing in compression; and
- Compare the induced strain with the tensile failure strain.

Similar methodologies are available for the effects of changes of pressure due to overpressure on structures such as windows, by comparing the effects of changes of pressure due to wind velocity.

3.1 HOUSE AND STRUCTURE DAMAGE CRITERIA

As noted above 10mm/s is the upper Human Annoyance or Amenity Criteria from the ANZEC guidelines which is not to be exceeded and applies to 5% of blasts in any year. AS 2187.2 – 2006 in Table J4.5 (B) lists the following Recommended Ground Vibration Limits for Control of Damage to Structures (included as **Table 1**).

Table 1 – from AS 2187.2 – 2006 – Table J4.5(B) Recommended Ground Vibration Limits for Control of Damage to Structures (see Note)

Category	Type of blasting operations	Peak component particle velocity (mm/s)
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction	All blasting	Frequency-dependent damage limit criteria Tables J4.4.2.1 and J4.4.2.2
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum unless agreement is reached with the owner that a higher limit may apply
Service structures, such as pipelines, powerlines and cables	All blasting	Limit to be determined by structural design methodology

NOTE: Tables J4.5(A) and J4.5(B) do not cover high-rise buildings, buildings with long-span floors, specialist structures such as reservoirs, dams and hospitals, or buildings housing scientific equipment sensitive to vibration. These require special considerations, which may necessitate taking additional measurements on the structure itself, to detect any magnification of ground vibration that might occur within the structure. Particular attention should be given to the response of suspended floors.

The frequency–dependant damage limit criteria referred to in **Table 1** (Tables J4.4.2.1 and J4.4.2.2) referred to as the limits for "*Unreinforced or light framed structure. Residential or light commercial type buildings*" (which includes houses etc.) are similar and can be summarised in Table J4.4.2.1 (reproduced as **Table 2** below).

Table 2 – from AS 2187.2 – 2006 – Table J4.4.2.1 Transient Vibration Guide Values for Cosmetic Damage (BS 7385-2) - Frequency Dependant Damage Criteria

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structure. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

NOTES:

1. Values referred to are at the base of the building.
2. For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

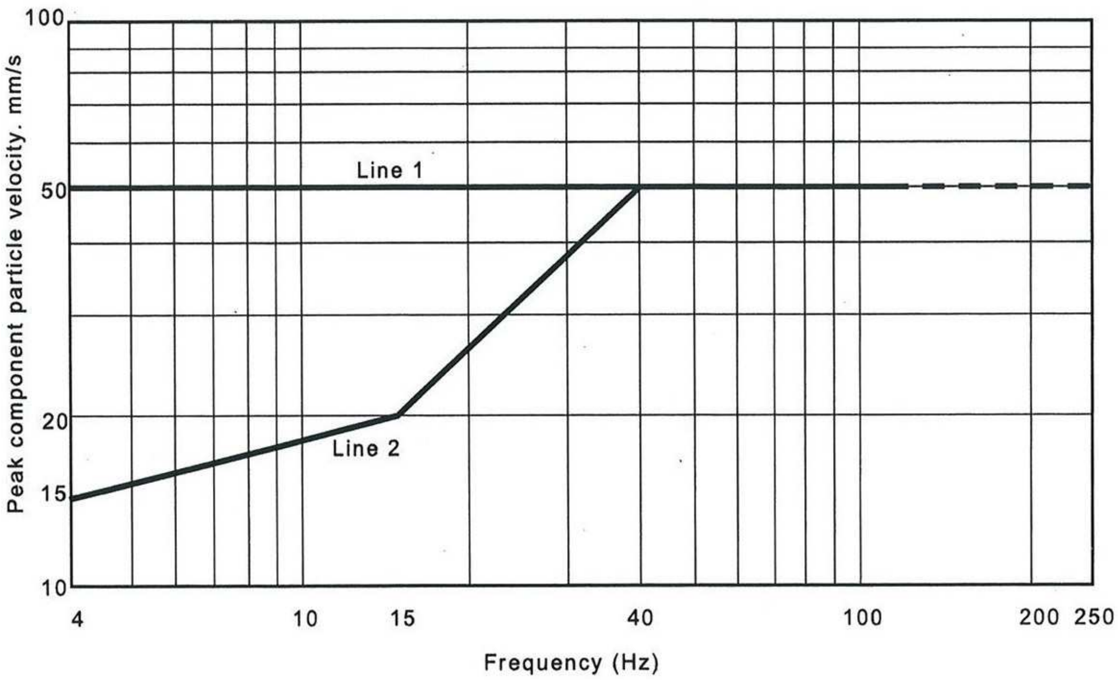

FIGURE J4.4.2.1 TRANSIENT VIBRATION GUIDE VALUES FOR COSMETIC DAMAGE (BS 7385-2)

The Damage Classification from BS 7385-2 is reproduced as **Table 3**. BS 7385-2 also states that “*Minor Damage is possible at vibration magnitudes which are greater than twice those given in Table J4.4.2.2 and minor damage to a building structure may occur at values greater than 4 times the tabulated values*”.

Table 3 - from AS 2187.2 – 2006 – Table J4.4.2.2 BS 7385-1:1990 – DAMAGE CLASSIFICATION

Damage Classification	Description
Cosmetic	The formation of hairline cracks on drywall surfaces or the growth of existing cracks on drywall surfaces; in addition, the formation of hairline cracks in the mortar joints of brick/concrete block construction
Minor	The formation of cracks or loosening and falling of plaster or drywall surfaces, or cracks through bricks/concrete blocks
Major	Damage to structural elements of the building, cracks in support columns, loosening of joints, splaying of masonry cracks etc.

For a typical house the limits for cosmetic damage are 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz.

The dominant frequency of the ground motion from overpressure is often determined by the slowest delay timings in the initiation sequence, e.g. 100 ms delays produce about 10 Hz frequency, 65 ms delays produce about 15 Hz frequency.

For the usual exposure range of 10 – 15 Hz, which is appropriate for the Contracted Project, the damage control limits for Residences range from 18 mm/s to 20 mm/s. At 18 – 20 mm/s we may expect the start of the formation of hairline cracks and the growth of existing cracks in plasterboard and mortar joints. The listed structural damage limits have proven to be conservative for houses and man-made structures and are well above the ANZEC guideline (human annoyance) limits.

It is also to be noted that the limiting values referred to are Peak Component Particle Velocity (PCPV) as distinct from Peak Vector Particle Velocity (PVPV). The PVPV is the vector of the three Component Particle Velocities. The PVPV values are usually at least 20% higher than the PCPV values and may be 70% if all the component values are equal.

e.g. 18 – 20 mm/s may be 22 – 24 mm/s as PVPV. On this basis, the 100 mm/s Peak Component Particle Velocity Limit for unoccupied structures of reinforced concrete or steel construction is the equivalent of at least 120 mm/s PVPV. The instrument of control in this guide is the Peak Component Particle Velocity, not Peak Vector Particle Velocity.

However, it is common for the PCPV limit to be applied as the PVPV limit and provide a degree of conservatism. The common use of the term PPV or a nominated vibration level implies the Peak Vector vibration.

It must be emphasised that 10 mm/s is not and never has been an accepted damage limit by Australian regulators.

Houses receiving a 10 mm/s are subjected to strains of about 2% - 10% of the failure strains of the common building materials plasterboard and masonry. On the other hand, strains due to 'natural forces' such as foundation movement and thermal expansion of the building components frequently exceed the failure strains and are responsible for many of the cracks and defects observed in houses.

In a Structure Response Investigation (Australian Coal Association Research Program [ACARP] Reference No. C9040) into the effects of blasting on brick veneer houses by Terrock in conjunction with the Universities of Newcastle and Melbourne, it was concluded that "*the stresses, due to blast vibration that are within currently enforced environmental limits, are well below damage levels*" (i.e. 10 mm/s is well below damage levels).

To put structural damage limits into perspective during this project, a 30 year old brick veneer house was subjected to highwall blasting to as close as 50m and exposed to vibration levels up to 220 mm/s. Key observations were:

- At vibration levels from 1.5 mm/s to 20.5 mm/s, no additional damage to the house was recorded;
- At 71.2 mm/s an incorrectly installed section of the plasterboard ceiling sagged and was retrofitted to accepted standards using adhesive; this remained unaffected at 220 mm/s;
- At 222 mm/s the only damage recorded was minor cosmetic damage to plasterboard such as 'popped' nail heads, hairline crack extensions and new hairline cracks at sheet joins;
- Even at 222 mm/s, there was no damage to ceramic wall and floor tiles, concrete floor and paving slabs, concrete water tanks and roof tiles and masonry walls;
- The variation to crack widths and crack lengths showed better correlation with rainfall than vibration levels;
- The floor level of the house moved up to 10mm during the project, and this movement was entirely caused by rainfall.
- The observed damage was classified as 'cosmetic' and could have been repaired simply by an amateur painter with basic plastering skills.

On this basis, the proposed limit on ground vibration of 5 mm/s will provide more than adequate protection for all Residences.

3.2 DAMAGE CRITERIA FOR PUBLIC UTILITIES

The recommendation of AS 2187.2 – 2006 is a limit of 100 mm/s for unoccupied structures of reinforced concrete and steel construction.

The concept of public infrastructure has been somewhat blurred by the corporatisation and privatisation of the public utilities. There are many examples of infrastructure owner/ managers accepting a higher limit than 50 mm/s for their assets, subject to specified conditions. Some examples are included as **Table 4** below:

Table 4 – Examples of Vibration Limits Applied to Public Infrastructure

Australian Rail Track Corporation	**PPV**
Railway lines	100 mm/s
Rail Cuttings and embankments	200 mm/s
Culverts	200 mm/s
Fibre Optic Cable & Signalling	100 mm/s
Transgrid	**PPV**
Transmission Towers	100 mm/s
Country Energy	**PPV**
Concrete & Wooden Poles	100 mm/s
Barwon Water (Victoria)	**PPV**
Buried Glass Reinforced Plastic Mains	100 mm/s
Coliban Water (Victoria)	**PPV**
Buried Concrete Lined Steel Mains	100 mm/s
Hunter Water Corporation	**PPV**
Above-ground Concrete Lined Steel Mains	100 mm/s

In the light of the above, it is recommended that any Consent Conditions relating to blasting should contain wording such as

"The vibration limits on externally owned or managed infrastructure should be 50 mm/s without an agreement; with the consent of the owner/manager of the infrastructure a higher PPV limit may apply".

Such wording, or similar, means that the limits between the proponent and the infrastructure owner/manager can be determined by agreement without the need to seek Ministerial Approval for a variation to conditions.

This approach has been adopted by many authorities and asset owners, subject to requiring vibration monitoring and testing. For example, Transgrid has approved of a 100 mm/s limit for transmission towers, subject to Non-Destructive Testing of the footings. At Hunter Valley Operations, steel towers were tested to 220 mm/s without affecting the footings.

The fact that infrastructure owner/managers permit ground vibration limits up to 100 mm/s for high value assets provides a frame of reference for consideration of rock structures such those in the SPL and Sandstone Outcrops.

4. PREVIOUS BLAST HISTORY ON SITE

4.1 BLASTING NEAR THE ARTC RAIL TRACK

The Cullen Valley Mine conducted open cut mining operations within 32m of the railway line. In order to do this Coalpac had to work closely with rail regulators to manage and minimise blasting impacts upon the rail line, as well as the rock cutting through which is passes. It should be noted that the cutting was in softer Permian strata. The process followed to manage the interaction with the rail line required predictive modelling of blasting coupled with monitoring to validate the predictions.

A photograph of the railway cutting located immediately to the west of the currently Approved mining area at the Cullen Valley Mine is shown in **Figure 3a**. The idealised section through the pit extraction and rail cutting is shown in **Figure 3b**. Blasting was conducted to within 32m of the rail track and using a Kv of 1120 in blast design, combined with a Peak Particle Velocity (PPV) limit of 100 mm/s, the maximum recorded vibration was 93 mm/s.

Figure 3a – Photograph of the railway cutting undamaged by blasting at 30m

The maximum vibration (93 mm/s) caused no structural damage to the rail line or cutting walls.

The only effect was that a small number of loose rocks were displaced and fell to the cutting floor, examples of which can be seen in **Figure 3a** (grey shale lying on rail ballast).

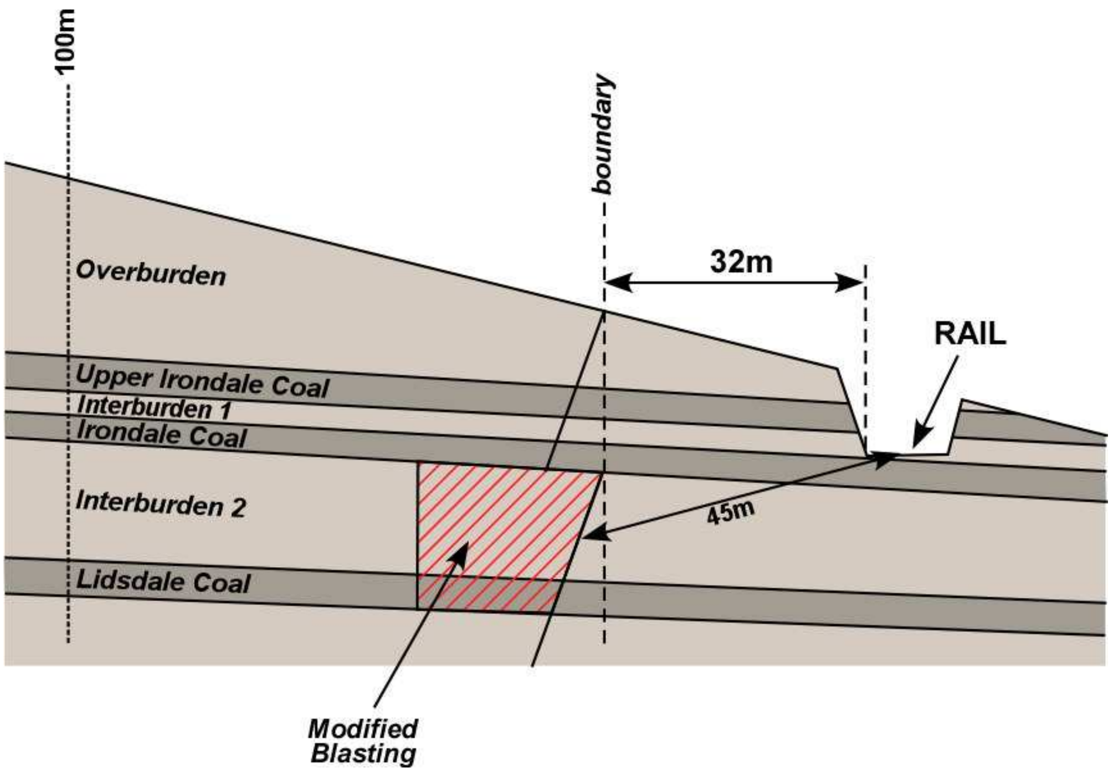

Figure 3b – Idealised cross section through the mine and rail cutting

4.2 PREVIOUS BLASTING NEAR THE SPL AND SANDSTONE OUTCROPS

In **Figure 4a**, locations where previous blasting has been conducted at the Invincible Colliery near SPLs are identified. The locations of examples of blasts near Sandstone Outcrops at the Cullen Valley Mine are shown in **Figure 4b**. The available blasting records were analysed for blasts near the SPL and Sandstone Outcrops. The blasts marked on **Figures 4a** and **4b** are summarised in **Table 5**. The peak vibration levels (PPV) were calculated using the assumed Site Constant (Kv) of 1120 which had proven to be reliable (from the blast management process adjacent to the railway cutting). The predicted range of PPVs is listed in **Table 5**.

Table 5 – Summary of records for blasts close to SPL and Sandstone Outcrops and predicted PPVs at the base of the SPL and Sandstone Outcrops

	Blast ID	Date	Distance to base (m)	Hole Depth (m)	Column Length (m)	Charge Mass (Kg)	Predicted PPV (mm/s) Kv =1120
INVINCIBLE COLLIERY SPLs	4LG42	11.06.10	216	15.1	11.1	377	23.7
	9LG43	17.03.11	205	14.5	10.3	350	24.3
	9LG1710	18.05.12	245	13.2	9.0	306	16.4
CULLEN VALLEY SANDSTONE OUTCROPS	5UI88	26.08.09	57	20.7	15.7	408	213.0
	5IR88	09.10.09	57	3.5	1.0	26	23.5
	5LG88	30.10.09	57	14.1	10.1	343	185.5
	CV2009	2002	94	15.0	10.5	230	60.5

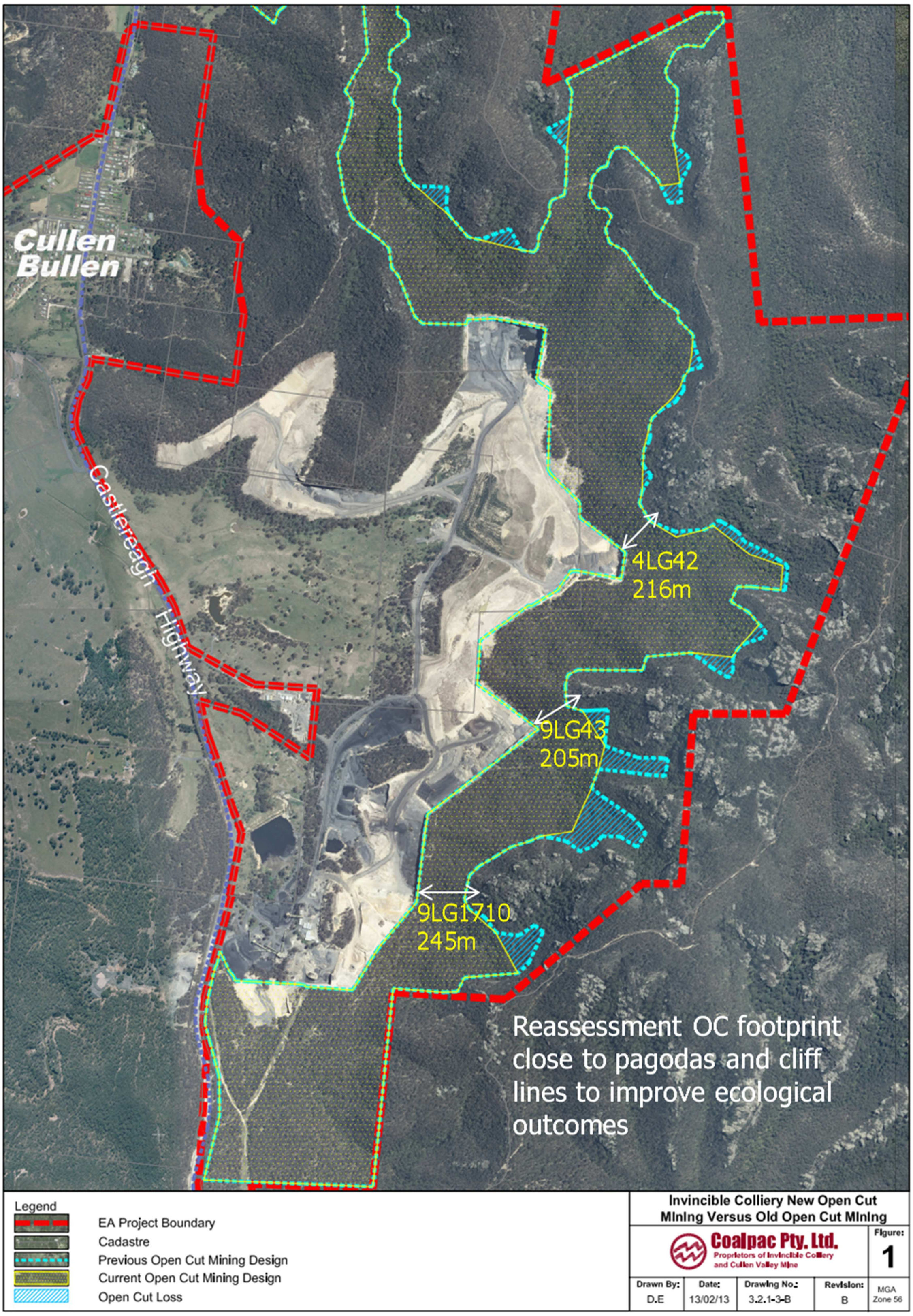

Figure 4a – Blasting locations close to the SPL at the Invincible Colliery

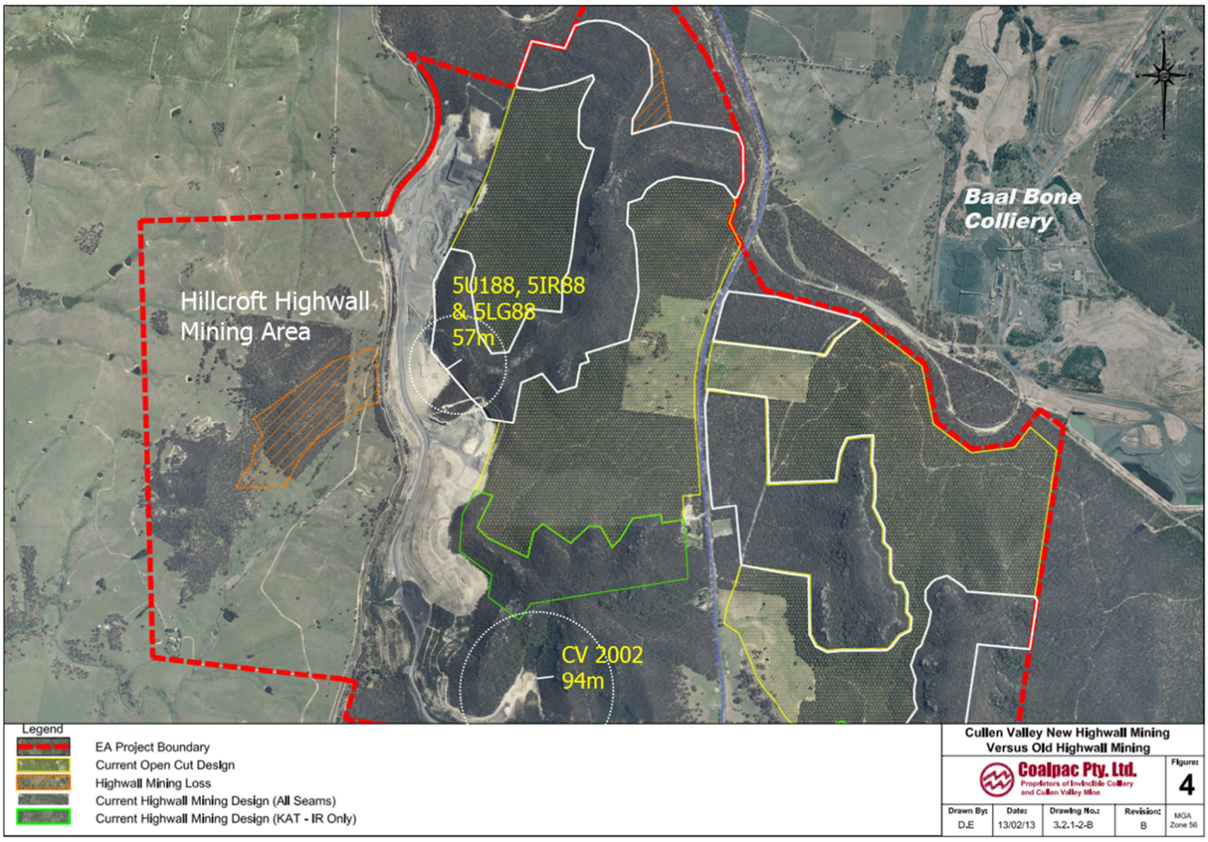

Figure 4b –Location of Cullen Valley Mine blasts near Sandstone Outcrops (57m and 94m)

Blasting at the Cullen Valley Mine to within 57m of the Sandstone Outcrop (5LG88) has resulted in ground vibration predicted to the range 185 to 213 mm/s without discernible impact (see **Figure 5**).

Blasting at Invincible Colliery to within 205m of the base of the SPL has resulted in ground vibration predicted to be in the range 16.4 to 24.3 mm/s without discernible impact (see **Figure 5**).

Figure 5 – Cullen Valley Mine (CV 2002) and Invincible Colliery (9LG1710) where blasting has approached SPL and Sandstone Outcrops with no discernible impacts

4.3 BLASTING NEAR THE INVINCIBLE COLLIERY OFFICE

Coalpac has supplied blast data summarised in **Table 6** regarding the blast vibration resulting from close order blasts near the Invincible Colliery administration block (30 year old, brick veneered and glazed structure). The location of the blasts in relation to the mine buildings is shown in **Figure 6a**. A schematic cross section is shown in **Figure 6b**. The distances range from 43m to 102m.

The derived Kv factors ranged from 400 to 900 which are considerably less than the 1120 Kv factor used for blasts near the ARTC rail track. The main reason for the reduction is that the blasts near the office buildings resulted in the vibration travelling through fill material as opposed to travelling along the stratum, as in the case of the rail cutting.

The hypothesis that the Kv factor reduces with distance is demonstrated in the regression analysis shown in **Figure 6c**. The limited data shows a clear reduction of the 1120 Kv factor with distance with the Kv factor applicable to distances from about 118 – 175m.

Table 6 – Vibration Monitoring Results near the Invincible Colliery Office

Shot No.	Location	Date	Distance from Office Monitor (m)	Vibration at Monitor (mm/s)	Overpressure at Monitor (dBL)
INV218	9LG1914	2/11/2012	99	14.0	129.8
INV219	9LG1914B	9/11/2012	102	17.6	121.6
INV220	9LG1916	16/11/2012	66	32.3	128.9
INV221	9LG2014	16/11/2012	85	19.8	128.1
INV222	9LG2016	23/11/2012	52	19.5	135.5
INV223	9LG2114	23/11/2012	88	8.9	125.6
INV224	9LG2116	30/11/2012	43	17.7	129.3

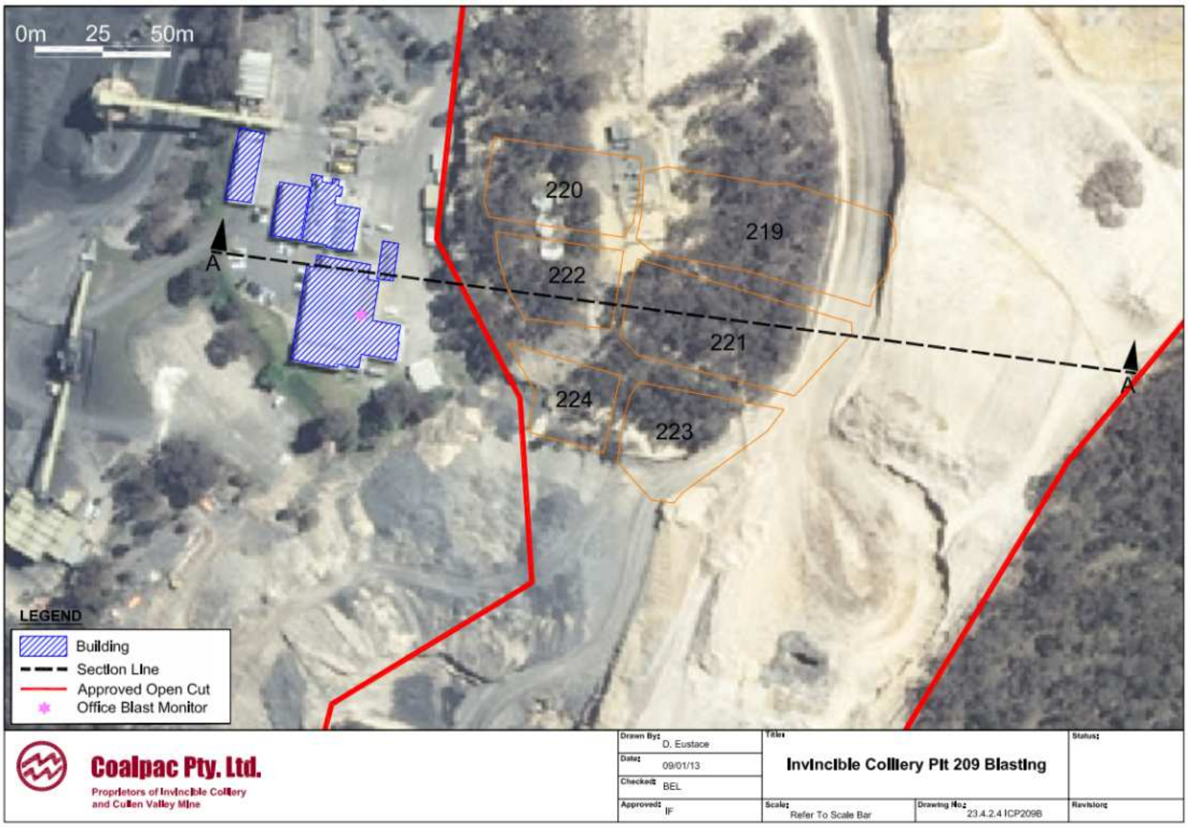

Figure 6a – Extraction limit and blast locations near the Invincible Colliery Offices and other buildings

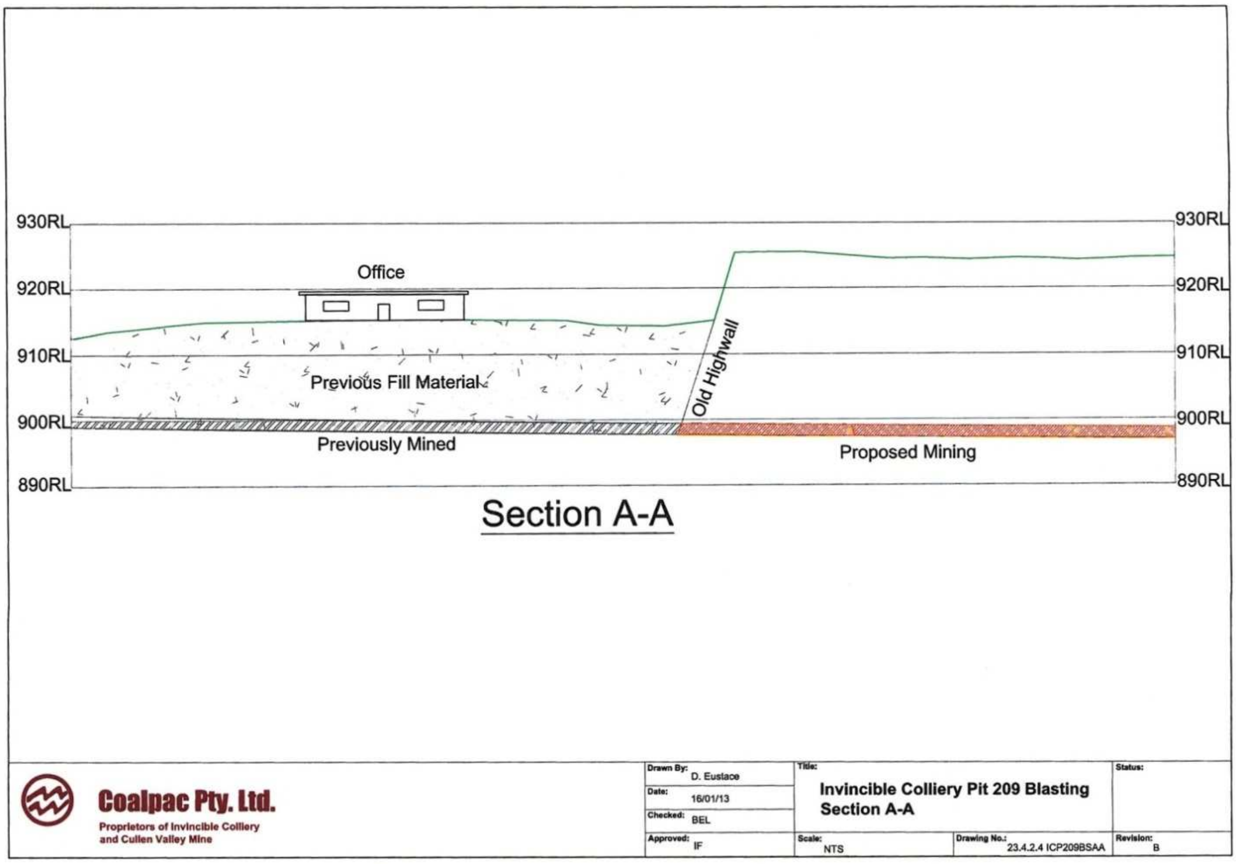

Figure 6b – Schematic cross section

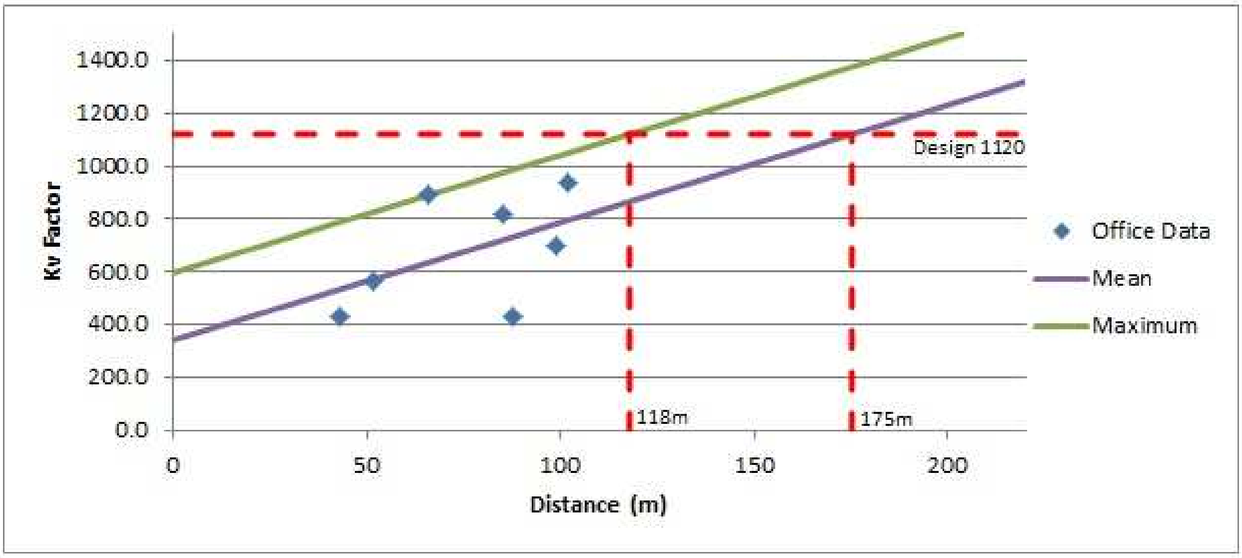

Figure 6c – Regression Analysis (Kv versus distance)

Blasting to within 43m of the Invincible Colliery office resulted in a PPV of 17.7 mm/s using managed design principles. The highest PPV was 32.3 mm/s recorded at 66m from a blast.

The results of the controlled blasting program, utilising electronic detonators and reduced MIC, close to the offices at Invincible Colliery were excellent with no discernible damage occurring to masonry nor glazing. In fact there was no discernible impact on the office complex, furniture or electronic equipment as a result of the blasting. In addition, no flyrock impacted the building.

4.4 BLAST IMPACTS CONTROL AT CULLEN BULLEN TOWNSHIP

A series of blasts were conducted in Pits 206 and 208 at the Invincible Colliery, the closest recent mining to the Cullen Bullen township. The overpressure and ground vibration from all blasts was measured by instruments BO1 and BO2 located as shown in **Figures 7a** and **7b**.

The highest vibration levels recorded at BO1 and BO2 are shown in **Table 7**. The Site Law Kv factor for the maximum ground vibration from Pit 206 and Pit 208 at the two monitors is also listed in **Table 7**.

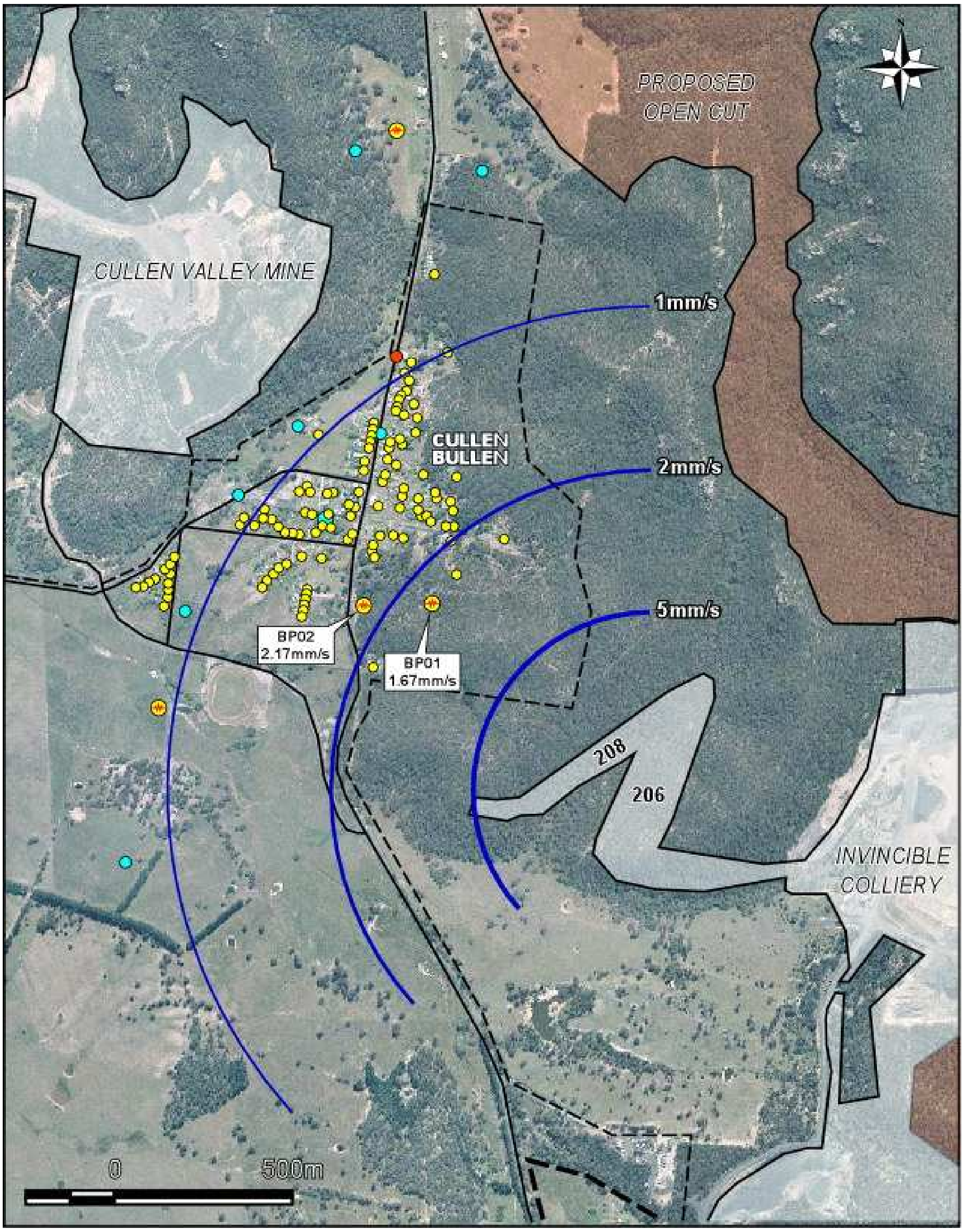

Figure 7a – Contour analysis of ground vibration from Invincible Colliery Pit 206 and 208 Blasts at Cullen Bullen (Blast monitoring locations are BP01 and BP02)

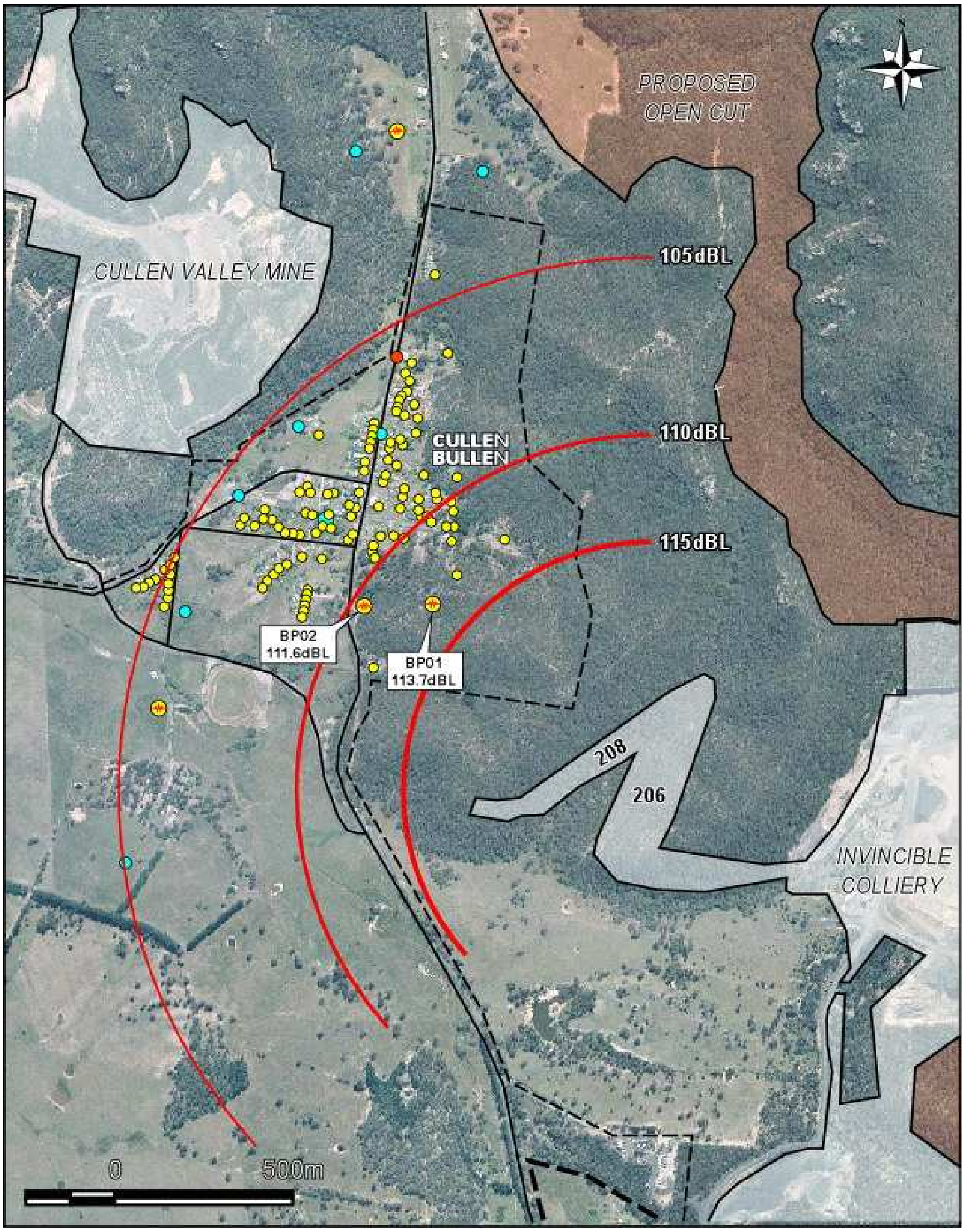

Figure 7b – Contour analysis of overpressure from Invincible Colliery Pit 206 and 208 Blasts at Cullen Bullen (Blast monitoring locations are BP01 and BP02)

Table 7 – Summary of peak ground and overpressure monitoring and analysis – Invincible Colliery Pits 206 and 208

		Monitor BO1	Kv		Monitor BO2	Kv
Pit 206 *(distance 619 – 880m)*	Peak Overpressure	113.7		**Pit 6** *(distance 619 – 880m)*	111.6	
	PPV	1.41	1044		1.23	1827
Pit 208 *(distance 615 – 705m)*	Peak Overpressure	107.6		**Pit 8** *(distance 615 – 705m)*	107.1	
	PPV	1.67	1182		2.17	2512

The Kv factors were used in environmental blast design to achieve a target limit of 2.0 mm/s at either monitor in the Cullen Bullen township and was successful, with the peak at BO2 only fractionally exceeding 2.0 mm/s, which is only 40% of the currently-approved limits.

The peak ground vibration (PPV) was plotted against distance from the blasts. The maximum distances of the 5, 2 and 1 mm/s were determined, and the contours are shown in **Figure 7a**. The contours have a reasonable match to the peak measurements. The maximum extent that the 2 mm/s and 1 mm/s contours extended into the township can be readily seen.

In total, 16 blasts were fired and the vibration levels generally controlled to the target limit of 2.0 mm/s (one measurement at BO2 was 2.17 mm/s, after which further controlled blasting practices were used in this area).

The peak overpressure contours were also plotted against distance and the maximum distances of the 115, 110 and 105 dBL contours determined. The peak readings were represented as the contours shown in **Figure 6b**. The maximum extent of the milestone contour intervals into the Cullen Bullen township can be seen in **Figure 7b**.

The overpressure levels were generally below 111 dBL (one measurement of 113.7 was considered to be an outlier, possibly affected by wind, because it was 7 dBL higher than the corresponding BO2 measurement.

4.5 SUMMARY OF PREVIOUS BLASTING

Review of previous blasting close to the rail lines, SPL, Sandstone Outcrops, the Invincible Colliery administration office and Cullen Bullen township has demonstrated:

- Blast vibration can be controlled to a specified limit using accepted blast design principles and implementation of the design;
- Blasting has been conducted to within 32m of the rail lines and 43m from the office without causing even threshold damage;
- Blasting has been conducted to within 57m of the Sandstone Outcrops at the Cullen Valley Mine, without applying vibration reduction techniques. The peak vibration was predicted to be in the range 185 to 213 mm/s without causing any discernible impacts; and
- The effectiveness of a controlled and closely monitored blasting programme close to sensitive receptors at the Cullen Bullen township.

5. SUMMARY OF BLAST OVERPRESSURE AND VIBRATION IMPACTS FOR THE CONTRACTED PROJECT

The clearest manner in which the overpressure and vibration impacts can be demonstrated is a contour approach representing the predicted worst case contours resulting in the area around the mine from blasting at the extraction limit. <u>This assumes normal production blasting with no special control measures applied.</u>

5.1 BLAST OVERPRESSURE

The blast overpressure has been assessed using the predictive methodology outlined in the Terrock report of 7th August 2012. The highest potential for overpressure comes from blasting the 4.0m parting between the Irondale seams, but this is low down within the sequence where additional topographic shielding would be provided.

The next potential is from blasting the 20 – 30m thick parting between the Moolarben and Irondale coal seams. The contours for a single blast are predicted to be as shown in **Figure 8a**. The maximum extent of the 115, 110 and 105 dBL contours around Cullen Bullen township were determined by moving the single blast contours around the pit outline while observing blast directions, and noting the maximum extent of the contour (see **Figure 8b**).

Additional topographic shielding will be provided by the topographic highs for blasts to the North and North East of the township.

<u>This assessment shows that without any additional control measures, currently approved overpressure limits can be complied with at Residences in the Cullen Bullen township.</u>

There are Residences along the Castlereagh Highway to the North of the town, including the Carleon Coach House where controlled blasting practice may be required in the extraction area to the east of the highway to comply with overpressure limits. Controlled blasting may require additional confinement of the explosives by increasing stemming height or front row burden for blasts in the 20 – 30m thick parting. These measures have been effectively applied to good effect close to the Invincible Colliery administration office as described above.

Limiting overpressure to regulatory limits by the implementation of managed blast design should be part of the Blast Management Plan.

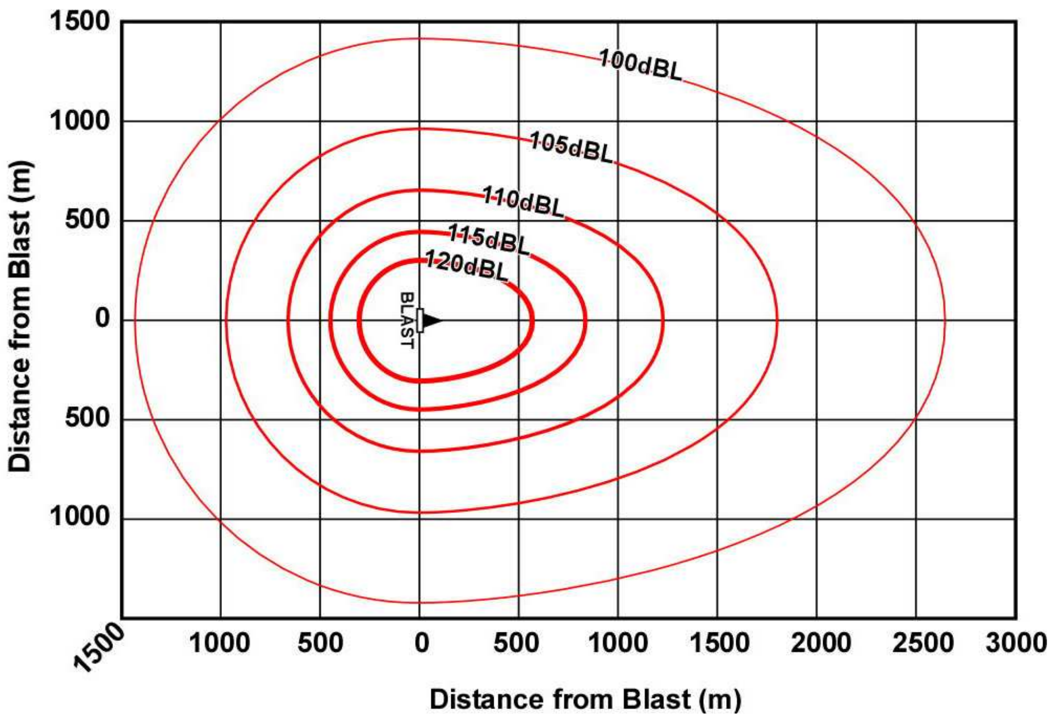

Figure 8a – Modelled Overpressure Contours for a single blast in a 20m high face with no topographic shielding

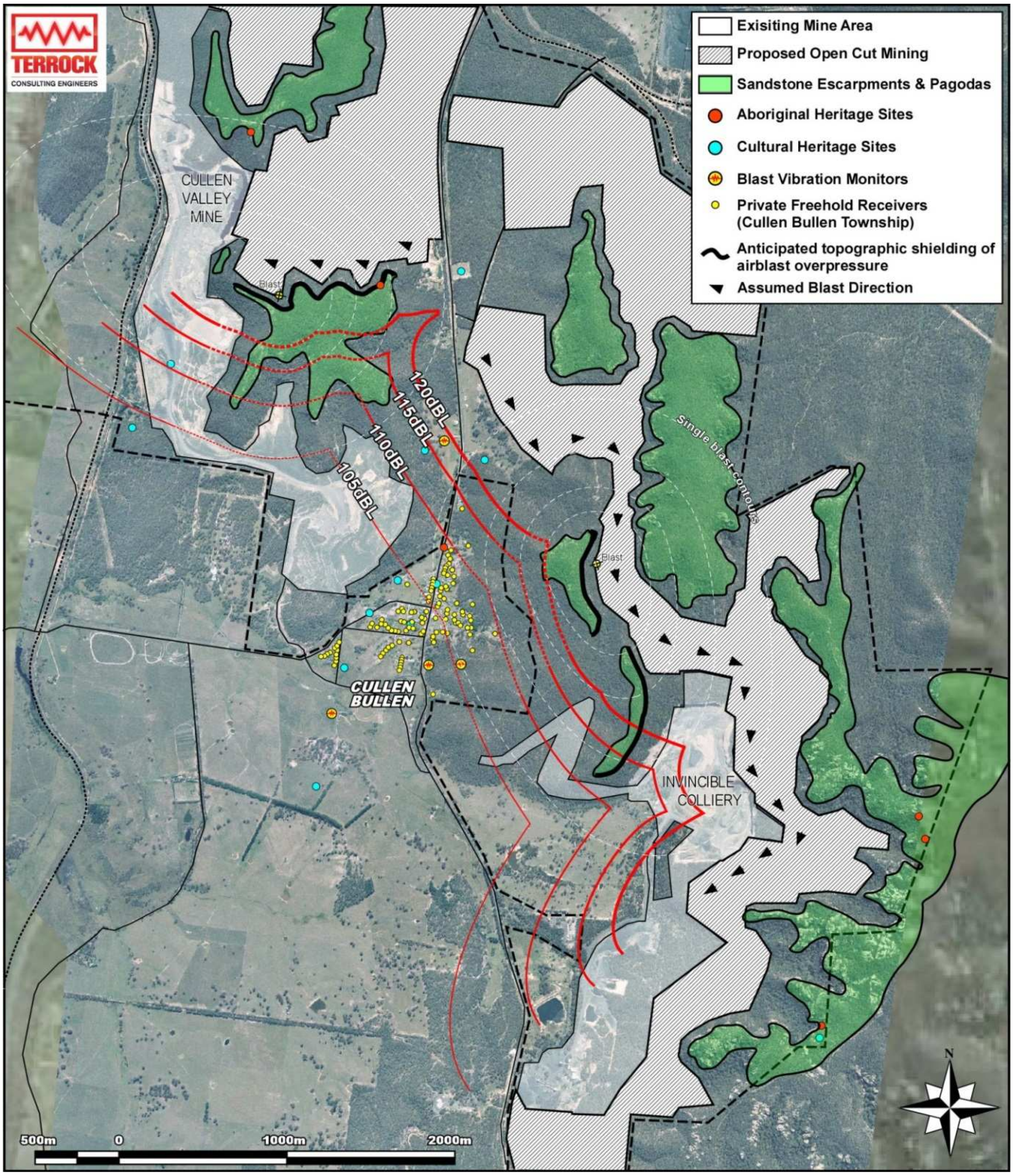

Figure 8b – Modelled Overpressure Assessment, Contracted Project – Cullen Bullen township

5.2 GROUND VIBRATION

There are several aspects to representing the ground vibration contour assessment, particularly:

- Limiting ground vibration at Residences to 5 mm/s;
- Limiting ground vibration at the SPL and Sandstone Outcrops to 100 mm/s;
- Limiting ground vibration at the Cullen Bullen General Cemetery to 20 mm/s;
- Limiting ground vibration at the Aboriginal Heritage Sites to between 20 and 100 mm/s based on the stability assessment of each location, and
- Worst case vibration from blasting is from the thickest interburden 20 – 30m thick between the Moolarben and Irondale coal seams.

The ground vibration predictions for the various interburdens, thicknesses and explosive types are shown in **Table 9(a)**. The Moolarben-Irondale interburden was selected as the worst case situation at the pit shell boundary.

Ground vibration is analysed and predicted using Scaled Distance Site Law Formula in the form:

$$PPV = Kv\left(\frac{\sqrt{m}}{D}\right)^{1.6} \qquad [3]$$

Where: *PPV =* Peak Particle Velocity (mm/s)
m = Charge mass per hole or per delay (kg)
D = Distance from blast (m)
Kv = A site constant

Table 8(a) – Predicted Milestone PPV Distances for Face Heights and 1.05 s.g. Emulsion Explosive

		Charge Mass				
Face Height (m)	**Column Height (m)**	**Charge/m (kg)**	**Mass/hole (kg)**	**5 mm/s Distance D_5 (m)**	**2 mm/s Distance D_2 (m)**	**1 mm/s Distance D_1 (m)**
30	25	34.0	850	858	1520	2350
20	15	34.0	510	665	1180	1818
14.5	9	34.0	306	515	913	1408
4.0	1.0	34.0	34	172	304	470

<u>Note</u>: The ground vibration could be reduced by the use of ANFO explosive (specific gravity 0.8, charge load 26.0 kg/m), which is normal Coalpac practice for dry blastholes.

Without any additional control measures, the ground vibration contours for a single blast are predicted to be as shown in **Figure 9a**.

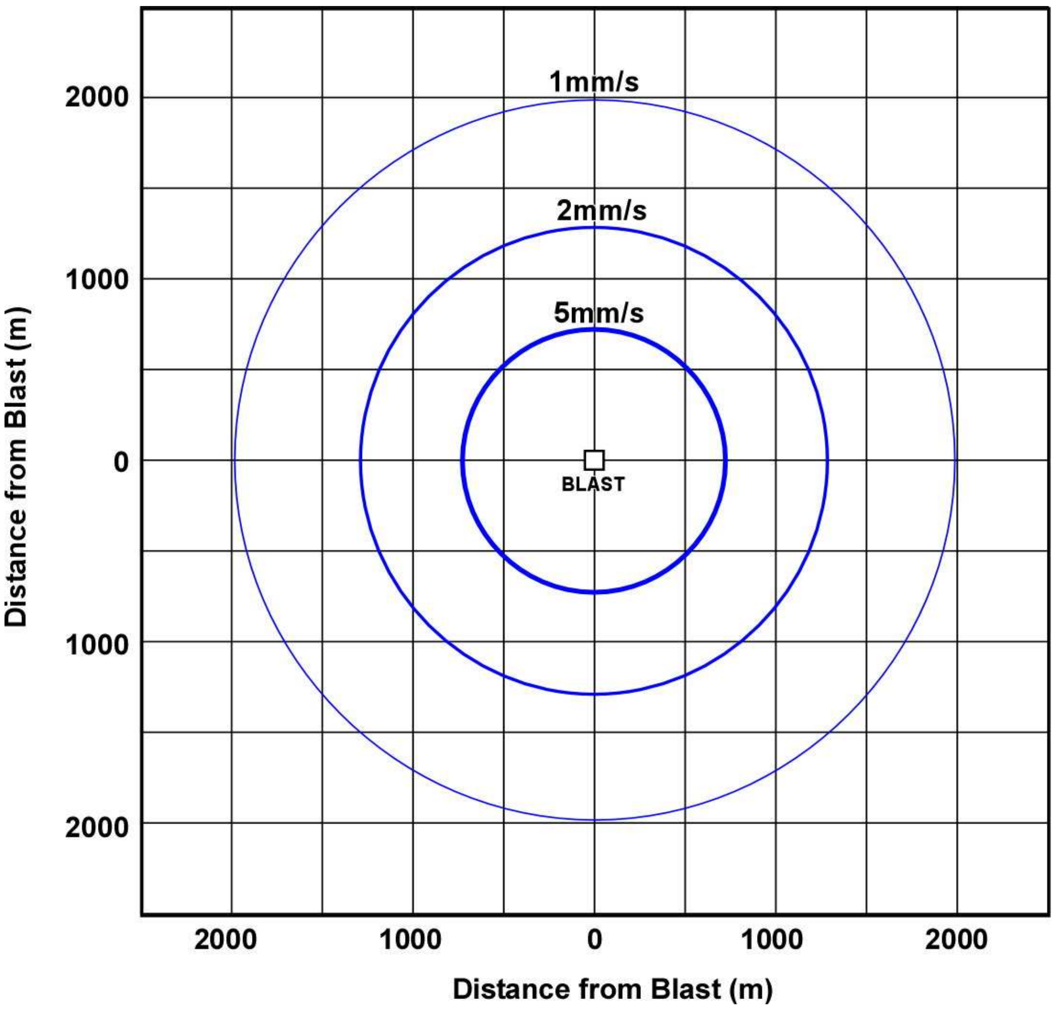

Figure 9a – Ground Vibration Contours for a 20m high face blast

To limit the PPV at the base of the SPL and Sandstone Outcrops to 100 mm/s will result in an attenuation of the ground vibration with increasing distance from the blast. This effect will mean that the bulk of the SPL and Sandstone Outcrop bodies will experience considerably lower ground vibration levels.

The resulting modelled attenuation of PPV away from the blast is represented graphically in **Figure 9b**.

The modelled results show PPV reducing by 70% within 100m away from the base of the SPL and Sandstone Outcrop travelling out from the blast centroid.

The distances shown have been used to create the contour plot shown in **Figure 9c**. Once additional control measures and blast management have been applied, these worst case levels will reduce even further.

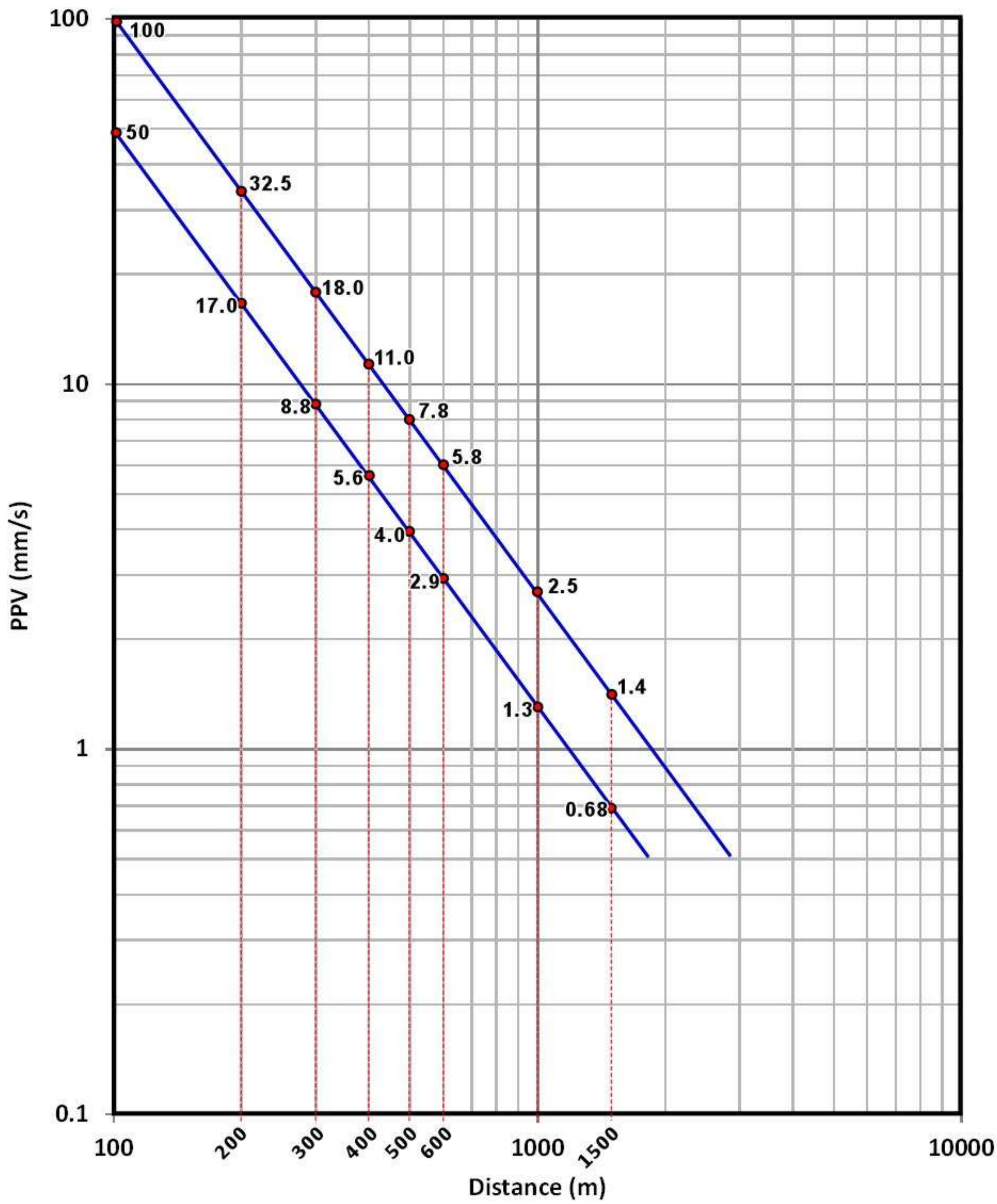

Figure 9b – Attenuation of PPV beyond SPL and Sandstone Outcrops for target limits of 50 mm/s and 100 mm/s at 100m from the blast

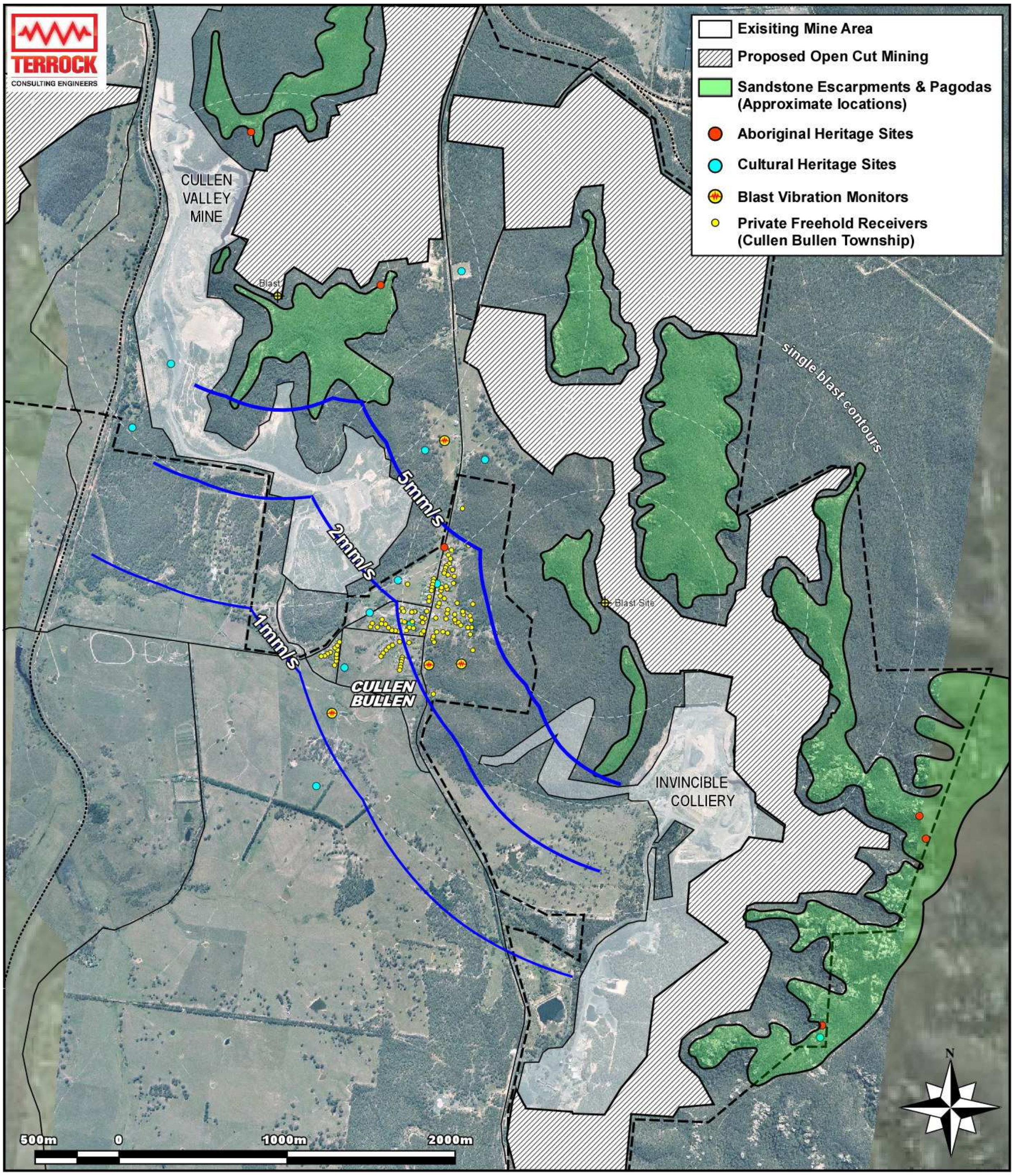

Figure 9c – Worst case ground vibration (PPV) contours from pit shell boundary with no additional control measures or blast management applied

Complying with the 100 mm/s limit is considered to be a day to day design issue for mine staff as part of the Blast Management Plan. Blasts should be designed to incorporate a charge mass appropriate for achieving target vibration limits. Charge mass can be reduced by:

- The use of a less dense explosive such as ANFO;
- Splitting the explosive charge into two or more decks.

The initiation sequence and direction of firing can also be used to control vibration to target limits.

To achieve a 20mm/s target limit at sensitive receptors such as the Cemetery from a 20m high face may require a reduction of charge mass for blasts near the sites together with other control measures.

The remaining instrument of control over ground vibration is that it must not exceed the ANZEC guideline limits at any houses. The limits are:

≤ 5 mm/s for 95% of blasts within 12 months

≤ 10 mm/s for all blasts

Figure 9c demonstrates that the ANZEC guidelines can be complied with at the houses within the Cullen Bullen township for blasts at the limit of extraction (worst case). Blasts at different locations within the planned extraction will result in much lower vibration levels. In some mining areas it may be necessary to reduce the charge mass to achieve the 5 mm/s limits at the highway Residences, and 20 mm/s at the Aboriginal Heritage Sites and the Cemetery by controlled blasting practices. Limiting the ground vibration to regulatory limits would be part of the Blast Management Plan.

6. BLASTING AND CULTURAL HERITAGE SITES

6.1 BLASTING AND THE CULLEN BULLEN GENERAL CEMETERY

In relation to the Cullen Bullen General Cemetery, Coalpac have given the following commitments:

(Commitment 46): Blasts required for any mining activities within 500m of the Cullen Bullen General Cemetery (the closest point being a distance of 250m) will be designed to manage vibration and overpressure levels.

- No blasting will occur on days when formal services are scheduled at Cullen Bullen General Cemetery; and no mining or coal haulage within a 1,500m radius will occur within two hours of formal services at Cullen Bullen General Cemetery;

(Commitment 63): To undertake a detailed archival recording and structural inspection of the Cullen Bullen General Cemetery in accordance with relevant guidelines prior to the commencement of coal extraction under this EA in consultation with LCC;

Ground vibration at the Cullen Bullen General Cemetery will be limited to 20 mm/s.

The potential blast-related issues at the Cullen Bullen General Cemetery can be summarised as:

- Disturbance, annoyance and amenity of visitors to the cemetery, especially during funeral services;
- Effect of ground vibration and overpressure on the stability of the gates and grave furniture (headstones, monuments etc);
- Potential for damage from flyrock to the grave furniture.

6.1.1 Annoyance

The human annoyance issue has been addressed in Commitment 30 in relation to the control of activities within two hours of any formal services.

6.1.2 Structure Response

From personal observations, the stability of grave furniture is largely a function of their physical dimensions and geometry, the foundation soil characteristics, surface drainage, weed and rabbit control. The main potential for damage is tilting or toppling of a tall monument when the centre of gravity extends beyond the outline of the base. Tilting and collapsing of short monuments is also a possibility if they are not adequately supported by the soil surrounding the actual grave excavation. This can be exacerbated if drainage, weeds and rabbits are not controlled.

Photos of the Cullen Bullen General Cemetery in the Historic Heritage Assessment show that there are no tall monuments or headstones. The tallest structures appear to be the brick piers of the entrance gates. An excessive response of the cemetery structures to the vibration is therefore not expected. The detailed structural inspection will identify any structures considered vulnerable to tilting or dislodgement that may require special attention.

To give an appreciation of the effect that ground vibration may have on the cemetery structures, the surface displacement can be determined from Sine Wave Theory:

Peak Particle Displacement (PPD) = $\dfrac{PPV}{2 \cdot \pi \cdot f}$ Where: PPV = Peak Particle Velocity (mm/s) [4]
f = frequency (Hz)

The frequency of the ground motion is related to the initiation sequences during firing. At close distances the frequency of the ground motion will be 10 – 15 Hz. At 20 mm/s, the maximum surface movement in any direction therefore is:

$$\text{PPD} = \frac{PPV}{2 \cdot \pi \cdot 10 \rightarrow 15} = 0.2 - 0.3\text{mm}$$

The wavelength of the motion is the seismic velocity divided by the frequency, e.g. for a shear wave velocity of 1200 m/s at 10 to 15 hz frequency, the predicted wavelength is the range 1200 ÷ 10 → 15 = 80 → 120m.

Assuming a 2.0m length for the grave furniture, the maximum actual displacement along the length of the grave is shown in **Figure 10**.

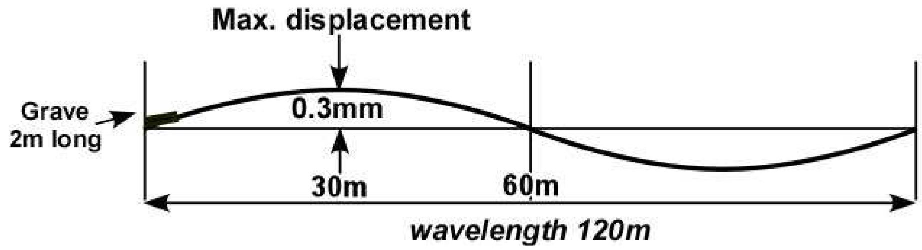

Figure 10 - Dimensions of Surface Wave Motion relative to a grave (not to scale)

The peak displacement over the length of a grave is 2.0 x 0.3 ÷ 30 = 0.02mm.

For comparison, the thickness of a human hair averages 0.1mm. The maximum surface movement of grave furniture is about one fifth of the thickness of a human hair, and the possible effect of ground motion is therefore considered to be negligible.

6.1.3 Flyrock

The risk to visitors from flyrock is addressed by the Commitment 30 and enforcement of an exclusion zone at time of blasting to ensure that no visitors are present within 500m of a blast (this is current practice).

The potential damage from flyrock is quantified in the Terrock report "*Mitigation of the Effects of Blasting in the Coalpac Consolidation Project*" (7th August, 2012). Behind face blasts, the maximum throw from standard operating practice from face blasts is 20m and for shallow parting blasts is 45m. The minimum distance to the Cullen Bullen General Cemetery boundary is 250m.

<u>Based on this geometry the Factor of Safety for the grave furniture from flyrock varies from 5 → 12.</u>

6.2 BLASTING AND ABORIGINAL HERITAGE SITES

Coalpac have given the following commitments in relation to Aboriginal Heritage Sites:

- (Commitment 59): Coalpac will conduct relevant monitoring at all rock shelters with deposit sites as shown in Figure 40 (in Exhibited EA) when blasting within 500m of each to achieve the criteria in Table 30 (Exhibited EA).

  Safe access tracks will be installed to facilitate this in accordance with the Land Disturbance Protocol to the approval of relevant regulators.

- Ground vibration at the Aboriginal Heritage Sites will be limited to between 20 mm/s and 100 mm/s based on the stability assessment for each site.

Regular condition and vibration compliance monitoring and blast design to achieve the target PPV limit will ensure that the Coalpac Commitments are achieved. Areas around the Aboriginal Heritage Sites with lower stability assessments may require a charge mass reduction to achieve the target PPV limit.

<u>Blast design for ground vibration (PPV) control should be part of the Blast Management Plan and has been proven to be effective on site.</u>

7. STAGED MONITORING AND MANAGEMENT PROCEDURE TO PROTECT THE SPL AND SANDSTONE OUTCROPS

Coalpac has shown (Section 3.2) that blasting has occurred closer than 100m to Sandstone Outcrops without detrimental impacts, but without detailed monitoring at the Sandstone Outcrop at the time.

Analysis of the records show that blasting has occurred as close as 57m to the Sandstone Outcrop in the Cullen Valley Mine. The vibration levels at the base of the Sandstone Outcrop are predicted to be in the range of 185 to 213 mm/s based on a proven site Kv factor.

There were no discernible signs of impact upon the Sandstone Outcrop from this vibration exposure. This supports the proposed vibration limit of 100 mm/s for the Sandstone Outcrops, but this must be proven to be a 'non-damaging' limit by further investigation.

The SPL has been identified as requiring a higher level of protection than the Sandstone Outcrops. To provide this higher level of protection will require refinement and further confirmation of the science on which to provide a reliable basis for determination of the distance(s) and ground vibration limits for the protection of the SPL.

It is logical that a PPV limit is a preferred basis for protection of both the SPL and Sandstone Outcrops than a stand-off distance, because it is easy to routinely measure and report, and it is also the relevant controlling parameter.

The evidence to date is that ground vibration of 100 mm/s resulting from blasting will have negligible impacts on the stability of the SPL and Sandstone Outcrops, even allowing for natural weathering processes.

<u>The Proponent has demonstrated that by using managed blast design techniques, ground vibration can be controlled to a specified limit</u>.

The instrument of control of blast vibration for structures should be a non-damaging limit (i.e. measured as a limit of vibration), rather than an arbitrary distance (i.e. stand-off) limit. The appropriateness of the 100 mm/s non-damaging limit for SPL should be proven and demonstrated by a multi-disciplinary investigation which includes analysing the effects of controlled and closely monitored blasts.

<u>This exercise should also look to further confirm and refine the site factor Kv for the strata close to the SPL.</u>

7.1 DEMONSTRATION AND PROVING BLASTING EXERCISES

There are over 12km of planned pit shell where the proximity to the SPL and Sandstone Outcrops may strongly influence the mining practice and extraction sequence over the life of the Contracted Project. Open cut mining will take place over 21 years.

As a result, the rock mechanics hazard mapping (Hazmap) classification of the SPL and Sandstone Outcrops prior to Contracted Project blasting does not have to be completed for the entire area in advance. The Hazmap classification (Commitment 8) needs to stay ahead of mining production and can therefore be staged to stay in advance of the planned extraction for the life of the Contracted Project. A review of these areas should also be conducted in conjunction with review of the condition of the SPL and Sandstone Outcrops post-mining.

The proposed extraction sequence is to advance the Invincible Colliery southern face to the south and mine out to the southern extraction limit. This is estimated to take 2 to 3 years. Extraction will then advance to the east towards the SPL. Concurrently with this advance, the Cullen Valley Mine face will be progressed to the East, before turning to the South towards the Sandstone Outcrops.

7.1.1 Site Factor Kv Exercises

The southern extension at Invincible Colliery is a suitable location to further confirm and refine the site factor (Kv) for the representative strata without impacting upon the SPL and Sandstone Outcrops. The proposed area for the Site Factor Kv Exercises is highlighted in **Figure 11**.

Additional arrays of blast monitors should be located to the east of the site to measure PPV for all blasts, and conduct sufficient strain measurements to confirm the relationship between PPV and strain for blasts on the various horizons as operations progress to the south.

The data would be gathered, collated and analysed to confirm and refine a Scaled Distance Site Law to increase the confidence of initial blast design when moving to the east towards the SPL.

A similar Site Factor Kv Exercise will be conducted in the Cullen Valley Mine to determine a Scaled Distance Site Law towards the Sandstone Outcrops. This in turn will enable the advance towards the Sandstone Outcrops to be conducted with increased confidence prior to the commencement of the Non-damaging Limit Exercise.

7.1.2 Non-damaging Limit Exercise

The Proponent proposes to conduct a multi-disciplinary investigation which includes analysing the effects of controlled and closely monitored blasts to prove and demonstrate the appropriateness of the 100 mm/s non-damaging limit initially for the Sandstone Outcrops in the Cullen Valley Mine. The proposed area for this exercise is highlighted in **Figure 12**.

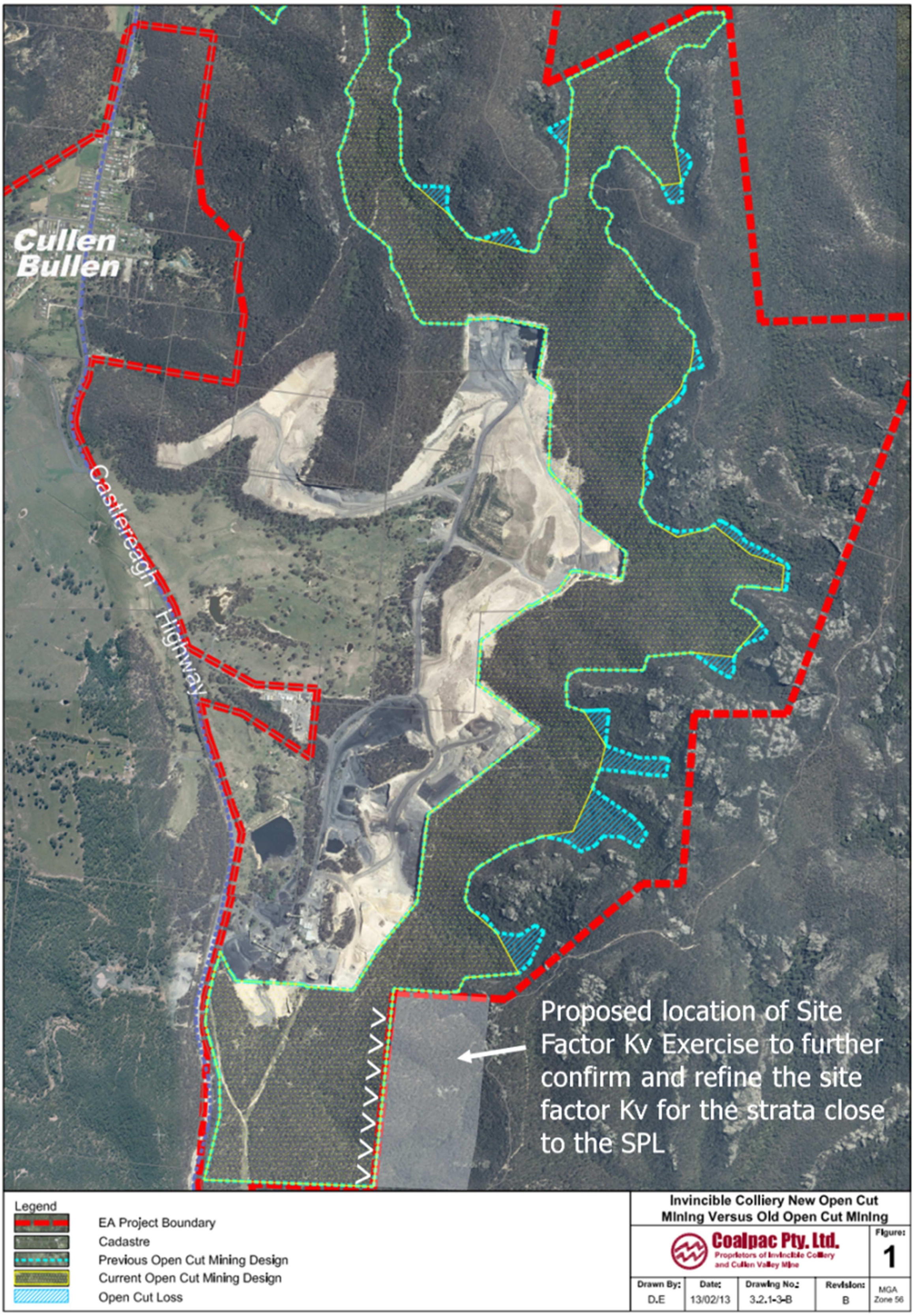

Figure 11 – Location Plan showing site of proposed Site Factor Kv Exercise

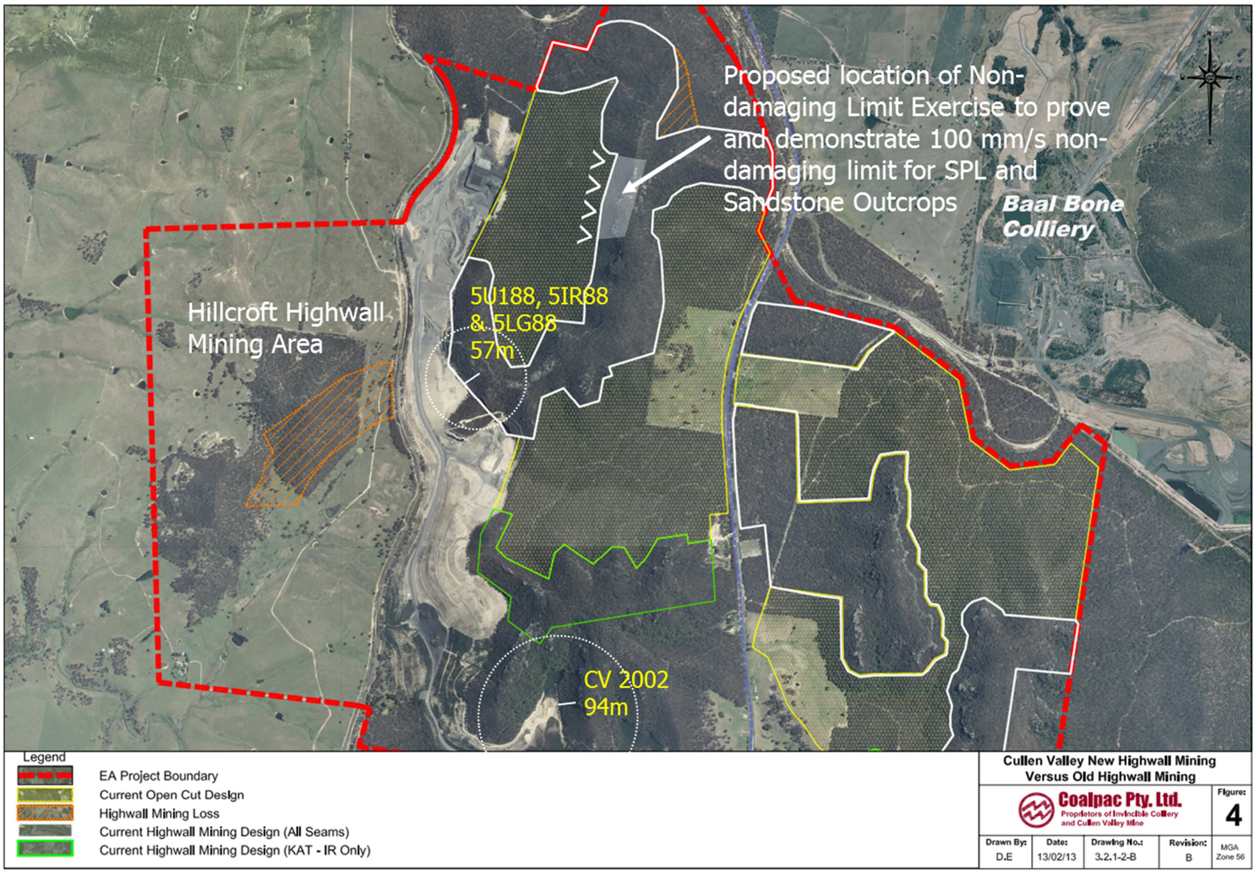

Figure 12 – Location Plan showing site of proposed Non-damaging Limit Exercise

Rather than an arbitrary distance, a more effective control mechanism would be an interim vibration limit at the base of the Sandstone Outcrop of, say 50 mm/s while the Non-damaging Limit Exercise is conducted.

A program of reduced vibration limits and intensive monitoring program (Non-damaging Limit Exercise) would permit a regulated, measured approach as each successive blast nears the Sandstone Outcrops. For example, for a full 20m face blast using a single column of explosive charge of 510 kg, the predicted ground vibration at 300m is 17.8 mm/s. At 150m, the predicted ground vibration is 54 mm/s. At 100m, the predicted range of ground vibration 103.5 mm/s. However, at 100m, if the charge is halved by decking, the range of ground vibration becomes 42.4 mm/s to 59.4 mm/s.

<u>Based on previous blasting experience, it would seem that the Non-damaging Limit Exercise could commence with blasts at 200m from the Sandstone Outcrop in question with an interim PPV limit of 50 mm/s.</u>

The Non-damaging Limit Exercise would begin at 200m from a Sandstone Outcrop and move closer until vibration trigger levels (50 mm/s) show that the rock mass is remaining stable.

Rock strength characteristics for the sandstone sequence (including Unconfined Compressive Strength, tensile strength, and Young's Modulus) should be determined from physical testing as an input to assist prediction of the rock mass response to vibration.

As information is gathered over time, and the response of the rock mass is monitored through mapping and photogrammetry (as examples), blast designers can then initiate design changes progressively, keeping below trigger levels at all times and ensuring negligible impacts. Once blasting at the interim target limit of 50 mm/s has proven to have no impact, the target limit may be incrementally increased in steps to say 75 mm/s and 100 mm/s. The stability of the Sandstone Outcrop must be established before advancing to a higher level.

The experience gained at the Sandstone Outcrops in the Cullen Valley Mine will be utilised when progressing towards the SPL in the Invincible Colliery to ensure that non-damaging target limits are applied.

The target ground vibration limits, and further monitoring should then be included in the Blast Management Plan for the Contracted Project.

7.1.3 Timing of Blasting Exercises

The Site Factor Kv Exercises at the Cullen Valley Mine and the Invincible Colliery coupled with the Non-damaging Limit Exercise will be completed within the first 12 months of the Contracted Project and before the Invincible Colliery blasts approach within 200m of the SPL.

If other faces are advanced during this period, the collecting of data and developing of Site Laws at other mining locations is a routine part of a Blast Management Plan.

8. SUGGESTED BLAST MANAGEMENT PROGRAM AS OPERATIONS APPROACH SPL AND SANDSTONE OUTCROPS

The data gathered in the proposed blasting exercises will be used to introduce a refined blast management program for all subsequent operations adjacent to the SPL and Sandstone Outcrops. The main steps of such a program are outlined below:

1. Collation and analysis of data gathered from the Site Factor Kv Exercise to provide reliable site specific parameters to support predictive modelling with confidence;
2. Predictive modelling will be carried out initially to guide blast design and limit predicted levels to 100 mm/s PPV or other agreed limit. These will be the trigger levels at which re-design or reduced design parameters will be implemented;
3. Establish the condition of the Sandstone Outcrop selected for the Non-damaging limit exercise and produce a Hazard Map to identify and classify zones in terms of stability;
4. Prior to advancing blasting towards the Sandstone Outcrops selected for the Non-damaging exercise to install vibration monitors on solid rock at the top and bottom of the rock face at the nearest point to the blasting face. Install strain gauges at the base of the rock face near the vibration monitor and record the rock mass response to blasting using photogrammetric techniques. The Non-damaging trigger levels exercise will be continued until sufficient confidence has been gained;
5. After the Non-damaging limit exercise at the Cullen Valley mining area to determine the relevant design criteria has been successfully completed, a similar exercise will be conducted while advancing towards the SPL at Invincible until sufficient confidence has been gained; and
6. Coalpac propose that an Independent Review Committee (established in collaboration with DP&I and DTIRIS-DRE) with suitable technical and regulatory representation will monitor the performance of the blast management program for any blast within 200 m of the SPL and Sandstone Outcrops but also with respect to Residences, Cullen Bullen General Cemetery, Aboriginal and Non-Aboriginal Heritage Sites on a quarterly basis for the first 2 years. It is proposed that the frequency of the meetings will reduce to biannual after 2 years.

The above program should be used as the basis of a Blast Management Plan to safely approach to 50m from the SPL and Sandstone Outcrops, with confirmation by routine PPV measurements of all blasts coupled with observations of the rock mass.

It can be argued that any extraction distances are equally arbitrary, i.e. distance is not the governing factor. The mechanisms by which the SPL and Sandstone Outcrops may be affected are ground vibration and static and dynamic instability.

In sections of the faces with no potential for instability, it could be argued that a 50m extraction limit may be appropriate if supported by the science, with ground vibration limit as the control.

9. JUSTIFICATION FOR THE PROPOSED BLAST MANAGEMENT PROGRAM

In the past blasting has occurred to within 57m of a Sandstone Outcrop at the Cullen Valley Mine without discernible damage. The ground vibration was not measured at the time but can be reasonably estimated using a proven Kv factor and actual blast records.

Analysis has concluded that the ground vibration exposure was in the range 185 – 213mm/s.

To apply a scientific approach to predicting the response of the rock mass to blasting, a methodology has been developed at other mines which compares the tensile strain induced by vibration with the strength characteristic of the rock.

The blast management program has three phases:

(1) Collect facts and information and confirm the effectiveness of current controlled blasting practice in achieving target limits;

(2) Refine existing controlled blasting practices to achieve new target limits and outcomes, and

(3) Control the blasting process to comply with new target limits and confirm ongoing compliance.

The science behind this approach can generally be summarised as follows:

- Direct strain measurements by Terrock at Ravensworth North Mine in the Hunter Valley have shown that ground strain can be determined by Plane Wave Strain Theory whereby

  $$\text{Peak Ground Strain (Tension or Compression)} = \frac{\text{PPV (Peak Particle Velocity)}}{\text{Shear Wave Velocity}}$$

- Shear wave velocity can be determined from a vibration wave trace using the speed of sound in air as a calibrator. From experience at other sites, the shear wave velocity is nominally 1200 m/s;
- The conservative range of flexural tensile strains indicated from the Tables in AusIMM Field Geologists' Manual is the range 140 $\mu\varepsilon$ to 1000 $\mu\varepsilon$. Measurement of properties of the collected sandstone specimens from site will provide actual data. Blast induced stresses that do not exceed the natural strength properties of the rock will not form new cracks;
- Typical example of Strain Comparisons is as follows:

  PPV = 100 mm/s

  $$\text{Ground Strain} = \frac{100}{1200 \times 10^3} = 83.3\ \mu\varepsilon$$

  Compared to Flexural Tensile Strain = 140 $\rightarrow$ > 1000 $\mu\varepsilon$

- This approach is reinforced by on-site measurement of an overhang failure by the author at the Mangoola Mine in the Hunter Valley. The dimensions of the failed overhang were measured and analysed as a cantilever beam failure. The flexural tension of the upper surface of the failed overhang was determined to be about 2

MPa. Using a Minimum Elasticity Modulus of 10 Gpa, the failure strain indicated is about 200 $\mu\varepsilon$, which provides order of magnitude confirmation of the previous assumption;

- The science suggests that a PPV of 100 mm/s would not exceed the tensile flexural strength of typical sandstone and has a considerable safety factor for the weakest sandstone. New cracks would therefore not develop in the sandstone. From investigations at other sites, the articulations provided by vertical and other joints allows for considerable flexure of the rock mass before new cracks are likely to form, so this approach is also considered to be conservative;
- Also, the entire rock mass flexes as an integral unit as the waves pass with no discordant motion likely to concentrate stress and cause damage or loose blocks to fall. This may be evidenced from video recording of open cut high wall blasts. Any damage to the rock face only occurs locally just beyond the extremities of the blast pattern;
- The rock mass of the SPL and Sandstone Outcrops appears to consist of sub horizontal structures (bedding/coal seams etc) and sub-vertical structures such as joints, which control the formation of the SPL and Sandstone Outcrops, and appear to be quite structurally stable. The rock faces should be closely surveyed for the presence of steep angled structures which may affect local stability by slip or wedge failure. This approach may not anticipate the falling of loose rock 'seats' shaken from unstable seats and some minor falls of small rock seats may be expected. Savely's observations (Table 5 of the Terrock 7th August 2012 report) suggest that this occurs at about 125 mm/s. The behaviour of the representative rock mass when exposed to vibration therefore needs to be assessed;
- A greater understanding of the rock mass behaviour will be gained by the proposed Site Factor Kv and Non-damaging Limit Exercise.

10. SUGGESTED CONDITION TO GIVE CERTAINTY THAT BLASTING WILL NOT DAMAGE THE SPL AND SANDSTONE OUTCROPS

A suggested condition for insertion in the Project Approval is as follows:

Blasting operations will not visibly impact or damage the Significant Pagoda Landforms and Sandstone Outcrops adjacent to the mining areas.

Ground vibration will be measured at a series of locations for each blast. Sufficient direct strain measurements will be taken to confirm the relationship with PPV (Site Factor Kv Exercise).

Blasts will be designed to achieve incrementally increasing PPV target levels (50, 75 and 100 mm/s) at the base of the Sandstone Outcrop, with assessment of the rock mass stability at each level before progressing to demonstrate and prove trigger levels (Non-damaging Limit Exercise).

Advancing the mine faces towards the pagodas will be conducted as a TARP process, after the proving Exercises are completed, beginning 200m from the base of the SPL and Sandstone Outcrops.

Prior to the blasting approaching within 200m of SPL or Sandstone Outcrops, the stability of the rock mass will be assessed and a Hazard Map produced to identify any unstable areas.

The blasting practice to achieve the target PPV limits should be detailed in a Blast Management Plan.

11. CONCLUSIONS

Blasting for the Contracted Project is to have no impact (non-damaging) on the Sandstone Outcrops and SPLs. The limits and approach recommended in the Contracted Project will achieve this outcome. However, there is little guidance for regulators in the literature as to what constitutes 'non-damaging' vibration levels that could be applied in these circumstances.

An arbitrary 'no blasting' stand-off distance, if universally applied, will sterilize coal reserves unnecessarily.

A multi-disciplinary program of investigation is proposed to establish the science on which blasting near the Sandstone Outcrops and SPL can be used to provide a rational basis for their protection, and provide greater confidence for regulators.

The methodology of the Blast Management System proposed can be summarised as:

- Before blasting approaches within 200m of the Sandstone Outcrops and SPL, specific Site Laws will be developed so blasts can be designed to confidently comply with an interim target vibration level (nominally 50 mm/s) [Site Factor Kv exercise];
- Produce a Hazard Map to classify the zones near the approaching blast faces in terms of stability/instability ;
- Determine the rock failure characteristics by sampling and laboratory testing;
- Install geophones and strain gauges on the Sandstone Outcrops to establish the relationship between PPV and strain;
- Conduct the Non-Damaging Limit exercise as the blasts approach closer than 200m to the Sandstone Outcrops;
- Observe the effect of 50 mm/s on the Sandstone Outcrops, and if proven to have no impact to progress incrementally to 75 mm/s and 100 mm/s;
- The experience gained at the Cullen Valley Mine will be utilised before advancing the SPL in the Invincible Colliery to establish non-damaging target limits.

The experience can then be expanded to provide levels of protection to other areas of Sandstone Outcrops and SPL.

Adrian J Moore.

Adrian J. Moore
9th April, 2013

APPENDIX G

ECOLOGICAL IMPACT ASSSESSMENT

COALPAC CONSOLIDATION PROJECT

ECOLOGICAL IMPACT ASSESSMENT

Preferred Project Report

For:

Hansen Bailey

April 2013

Final

CUMBERLAND ECOLOGY

PO Box 2474
Carlingford Court 2118

Report No. 13007RP2

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

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Approved by: Dr David Robertson

Position: Director

Signed: David Robertson

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Executive Summary

S1 Purpose

The purpose of this report is to fulfil part of a requirement under section 75H(6) of the Environmental Planning and Assessment Act 1979 (EP&A Act) to prepare a Preferred Project Report (PPR) that outlines any proposed changes to the Coalpac Consolidation Project (the Project) to minimise its environmental impacts. This report reassesses the ecological issues relating to the Project and considers the reduced footprint of the preferred Project, referred to hereafter as the Contracted Project.

S2 Background

Hansen Bailey was commissioned to prepare an Environmental Assessment (EA) for the Coalpac Consolidation Project under Part 3A of the EP&A Act. Cumberland Ecology was engaged by Hansen Bailey and prepared the Ecological Impact Assessment (EIA) of the Project (Appendix J of the Exhibited EA). Following exhibition of the Project EA, the Planning Assessment Commission (PAC) made a recommendation to refuse the Exhibited Project mine plan in their Review Report (the PAC Report) (NSW Planning Assessment Commission (PAC) 2012b, a). Some of the primary reasons for the PAC recommendation to refuse the project were ecological and included:

- The perceived ecological impacts of the Exhibited Project on pagoda landscapes and flora and fauna species of conservation significance considered to be dependent upon such landscapes, such as the Broad-headed Snake, cave roosting bats and a suite of Rare or Threatened Australian Plants (ROTAP plants); and

- The impacts of the project upon vegetation communities of conservation significance that occur on Permian geological landscapes.

Cumberland Ecology prepared a Response to the PAC Report (Biodiversity) (Cumberland Ecology 2013) and examined the ecological conclusions drawn by the PAC Report. Cumberland Ecology concluded that the ecological recommendations of the PAC were based on a suite of incorrect information and assumptions emanating from the Colong Foundation and the Office of Environment and Heritage (OEH). Notwithstanding that, the Cumberland Ecology report recognised the significance of pagoda landscapes in ecological and geological terms and coined the term "Significant Pagoda Landforms" (SPLs). It provided a detailed mapping of such landscapes within and adjacent to the Project Boundary, and also analysed flora and fauna that could be dependent upon them. It concluded by providing recommendations for the protection of SPLs and associated "pagoda" flora and fauna.

Subsequently on 20th March 2013 the Department of Planning and Infrastructure (DP&I) issued a letter to Coalpac requesting the provision of a PPR for the Contracted Mine Plan to be prepared under section 75H(6) of the EP&A Act. The Contracted Project mine plan was designed to and has reduced the disturbance footprint (Project Boundary) from 958 ha of the Exhibited EA to the current proposal of 762 ha. The reduced disturbance footprint centres on habitats around the Significant Pagoda Landforms (SPLs) in the south-east of the Project Boundary and completely avoids mining of the Hillcroft property as described in the Exhibited EIA.

S3 Methods

The ecological impacts of the Exhibited EIA were assessed using information from literature review, database analysis and ecological investigations within the Project Boundary. The flora investigations included vegetation mapping, quadrat sampling, random meanders and threatened flora searches and population estimates of threatened plants. The fauna investigations included habitat assessment, terrestrial and arboreal trapping, hair tube trapping, ultrasonic bat detection and harp trapping, diurnal bird census, nocturnal call playback, spotlighting, fauna survey using infrared cameras and recording of incidental observations of fauna species. Surveys of potential ecological offset sites were also undertaken as part of the Exhibited EIA.

Additional research was undertaken to prepare a Response to the PAC Report (Biodiversity) that has informed the development of the Contracted Project. That work entailed further literature review, database analysis, classification and mapping of SPLs and consultation with experts. The focus of the additional work was on ecological issues raised by the PAC Report, which included:

- The ecological impacts on pagoda landscapes and flora and fauna species of conservation significance considered to be dependent upon such landscapes, such as the Broad-headed Snake, cave roosting bats and a suite of ROTAP plants;
- the conservation significance of vegetation communities that occur on Permian geological landscapes.

S4 Results

S4.1 Vegetation Communities

The Project Boundary is generally forested and occurs across a landscape characterised by sandstone plateaus with 'pagoda' rocky out-cropping formations. The Project Boundary sits relatively high in the landscape with very few drainage lines. Most runoff would be expected to occur as overland flows, collecting at a point lower in the landscape than the Project Boundary. The vegetation of the Project Boundary is generally in good condition, with few exotic species occurring.

A suite of native vegetation communities occur within the Project Boundary. Of these communities, Capertee Rough-barked Apple Red Gum Yellow Box Grassy Woodland and Derived Native Grasslands represents a form of the White Box – Yellow Box – Blakely's Red

Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland) endangered ecological community (EEC) as listed under the Threatened Species Conservation Act 1995 (TSC Act), also listed as a critically endangered ecological community (CEEC) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

S4.2 Habitat

The Project Boundary contains a variety of habitats for flora and fauna species. These include forested steep slopes and gullies, woodlands on lower slopes with flatter topography, and sandstone outcropping with heath and woodland.

Pagoda landforms, cliffs and caves were recognised at the outset of the Project to be important habitats and it was also understood that these habitats could furnish important habitat for threatened species including the Brush-tailed Rock Wallaby, Broad-headed Snake and a variety of plant species. The pagoda shaped rock outcrops and cliff lines in and adjacent to the Project area are formed as the result of preferential and differential weathering of sedimentary rocks of the Triassic Narrabeen Formation, which overlies the Permian sedimentary rocks that form the coal measures targeted by the Project.

S4.3 Flora Species

More than 400 plant species were recorded in the Project Boundary, with a high proportion being native. The following threatened flora species were recorded within the Project Boundary:

- *Eucalyptus cannonii* (Capertee Stringybark) – TSC Act Status: Vulnerable; EPBC Act Status: Vulnerable;
- *Persoonia marginata* (Clandulla Geebung) – TSC Act Status: Vulnerable; EPBC Act Status: Vulnerable; and
- *Eucalyptus aggregata* (Black Gum) – TSC Act Status: Vulnerable; EPBC Act Status: Vulnerable.

A number of other threatened flora species known from the locality have the potential to occur within the Project Boundary. Although not listed under State or Commonwealth conservation legislation, several Rare or Threatened Australian Plant (ROTAP) species have been recorded from the Project Boundary by Cumberland Ecology or subsequently by others.

S4.4 Fauna Species

A large number of bird species, several common reptile species and eight amphibian species were recorded during the current survey. Mammal species recorded included macropods, microchiropteran bats and arboreal mammals, with very few small ground-dwelling mammals recorded. The following threatened fauna species were recorded within the Project Boundary:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*) – TSC Act Status: Vulnerable; EPBC Act Status: not listed;
- Brown Treecreeper (*Climacteris picumnus*) – TSC Act Status: Vulnerable; EPBC Act Status: not listed;
- Scarlet Robin (*Petroica boodang*) – TSC Act Status: Vulnerable; EPBC Act Status: not listed;
- Speckled Warbler (*Chthonicola sagittata*) – TSC Act Status: Vulnerable; EPBC Act Status: not listed;
- Varied Sittella (Daphoenositta chrysoptera) – TSC Act Status: Vulnerable; EPBC Act Status: not listed;
- Square-tailed Kite (*Lophoictinia isura*) – TSC Act Status: Vulnerable; EPBC Act Status: not listed;
- Powerful Owl (*Ninox strenua*) – TSC Act Status: Vulnerable; EPBC Act Status: not listed;
- Squirrel Glider (*Petaurus norfolcensis*) – TSC Act Status: Vulnerable; EPBC Act Status: not listed;
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) – TSC Act Status: Vulnerable; EPBC Act Status: not listed; and
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) – TSC Act Status: Vulnerable; EPBC Act Status: not listed.

A number of other threatened flora species known from the locality have the potential to occur within the Project Boundary including Broad-headed Snake (Hoplocephalus bungaroides), .Little Loikeet (Glossopsitta pusilla), Yellow-bellied Glider (Petaurus australis) and Eastern Freetail-bat (Mormopterus norfolkensis). Despite the extent of the sandstone exposures in the Project Boundary, the amount of potential habitat for the Broad-headed snake was quite modest in comparison.

S4.5 Impact Assessment

The Contracted Project has the potential to have a substantial impact on the ecology of the local area. It also has the potential to impact on C/EECs and several threatened flora and fauna species listed under the TSC Act and/or the EPBC Act.

The following is a summary of the predicted impacts of the Contracted Project Disturbance Boundary on threatened biodiversity:

- Approximately 15.24 ha of Box Gum Woodland and 0.27 ha of Derived Native Grassland, listed under the TSC Act and the EPBC Act (a reduction of approximately 7% of the impacts predicted in the Exhibited Project EIA);

- Approximately 1.96 ha of Box Gum Woodland Derived Native Grassland listed under the TSC Act only;

- 204 ha of known and potential *Eucalyptus cannonii* habitat, constituting an estimated 15,428 individuals (a reduction of approximately 27% of the impacts predicted in the Exhibited Project EIA);

- 762 ha of native forest, woodland and grasslands, habitat for various fauna species known to occur or considered to potentially occur will be removed (a reduction of approximately 20% of the impacts predicted in the Exhibited Project EIA); and

- No direct impact to *Persoonia marginata.*

The Contracted Project will remove approximately 762 ha of native vegetation currently providing suitable foraging, shelter and breeding habitat for a suite of known and potentially occurring threatened woodland birds including the Varied Sittella, Scarlet Robin, Speckled Warbler, Brown Treecreeper, Square-tailed Kite, Little Lorikeet and Diamond Firetail. Blossom dependant and migratory species are also expected to be impacted by the removal of these treed habitats. Species to be affected include the Regent Honeyeater, Painted Honeyeater and Black-chinned Honeyeater and the Swift Parrot. Other threatened birds expected to be impacted by habitat disturbance for the Project include the Gang-gang Cockatoo, Powerful Owl and Masked Owl.

The following threatened mammals are expected to be impacted by habitat disturbance for the Contracted Project: Yellow-bellied Glider, Squirrel Glider and Spotted-tailed Quoll. A suite of threatened microbats including the hollow dependant Eastern False Pipistrelle, Eastern Freetail-bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat and cave dwelling Large-eared Pied Bat and Eastern Bent-wing Bat are also expected to be impacted.

Since the preparation of the EA, the Project Disturbance Boundary has been significantly revised for the Contracted Project to reduce the overall area of impact and avoid key habitats. All impacts to known occurrences of Persoonia marginata have been avoided. Although no SPLs are to be directly disturbed by mining, the Contracted Project Disturbance Boundary provides further setbacks to these sensitive habitat areas. This will reduce further the level of indirect disturbance that these areas may experience, and will also provide greater foraging habitat adjoining SPLs. Some species typically shelter in the SPLs and Sandstone Outcrops and forage in the lower woodland gullies, and the Contracted Project Disturbance Boundary will avoid impacts to more extensive areas of this kind of habitat. Typically, these species such as the Broad-headed Snake and the Brush-tailed Rock Wallaby do not forage far from shelter habitat (although they are known to on occasions) and therefore the Contracted Project Disturbance Boundary will protect significantly greater habitat for these species.

Notwithstanding these expected impacts, large areas of suitable habitat will remain in the Project Boundary (1,190 ha of forest and woodland) and in the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other large remnants including Newnes State Forest, Sunny Corner State

Forest, Wolgan State Forest and some parts of adjacent Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented, including protecting and conserving suitable habitat for these species via establishing offset properties, and progressively rehabilitating impacted land to develop high quality habitat within the Project Boundary.

S5 Mitigation Measures

S5.1 Avoidance

In total the Contracted Project mine plan will avoid 61% (1,190 ha) of all native vegetation located within the Project Boundary (a reduction of 20% compared to the Exhibited Project mine plan).

Significant modification to the design of the mine plan for the Contracted Project has reduced the need for clearing large blocks of CEEC Box Gum Woodland. This was largely achieved in the northern portions of the Project Boundary, around the Cullen Valley and East Tyldesley area. The Contracted Project will avoid 31.25 ha of Box Gum Woodland listed under the EPBC Act and TSC Act. The Contracted Project will avoid larger areas of higher conservation value vegetation on Permian sediments compared to the Exhibited Project.

The Exhibited EIA contained measures to avoid some areas of Persoonia marginata habitat within the Project Boundary; however the Contracted Project Disturbance Boundary completely avoids all known Persoonia marginata habitat within the Project Boundary. This will result in 16.19 ha of habitat for this species that will not be directly impacted.

A number of ROTAP (Rare or Threatened Australian Plant) species were recorded in the Project Boundary by Special Interest groups. The majority of these species occur in Pagoda Rock Sparse Shrubland in the Project Boundary which is located well beyond the Contracted Project Disturbance Boundary and will not be removed.

Modifications to the mine plan for the Contracted Project have also led to further setbacks of open cut mining of up to 240 m in gullies adjacent to the Ben Bullen State Forest SPL (the area of SPL mapped within the south-eastern extent of the Project Boundary). This has achieved an additional avoidance of 16.17 ha of SPL gully habitat and native vegetation on Permian sediments. The Contracted Project Disturbance Boundary not only reduces the area of direct disturbance by 20% (when compared to the area of the Exhibited Project Disturbance Boundary), but also reduces the periphery by 10%. The perimeter of the Contracted Project Disturbance Boundary is 48.28 km (5.48 km smaller than the perimeter of the Exhibited Project Disturbance Boundary).

S5.2 Mitigation Measures

The following mitigation measures were described in the Exhibited Project EIA and will be utilised for the Contracted Project. These include:

- Minimisation of disturbance of native vegetation during construction and ahead of Project mining operations by clearly marked disturbance boundaries;

- Preparation of a consolidated Biodiversity Management Plan (BMP) that contains detailed mitigation measures for the Project and includes the existing Invincible Colliery and Cullen Valley Mine offsets to provide a cohesive, integrated and holistic approach. This plan should include (but not be limited to) information such as protocols for vegetation clearing (including inspection of hollows), *Phytophora cinnamomi* management, feral animal and pest control, rehabilitation objectives, and further detailed design measures;

- Conducting pre-clearance surveys and implementation of a two stage clearing protocol for all hollow-bearing trees;

- Transportation of habitat features and relocation of hollows or establishment of nest boxes in offset, revegetation or rehabilitation areas;

- Preparation and implementation of a nest box management procedure;

- Ongoing weed and feral animal management;

- Ecological monitoring program;

- Dust and noise minimisation measures;

- Management of surface water, runoff and erosion; and

- Preparation of a Biodiversity Offset Management Plan.

One of the key mitigation strategies for the Contracted Project is the rehabilitation of open cut mining areas. This includes maximising the biodiversity and connectivity within the landscape through management of existing Coalpac rehabilitation sites and the establishment of new rehabilitation sites. All land disturbed by the Contracted Project will be progressively rehabilitated in accordance with the conceptual mine plan and the BMP. A detailed rehabilitation plan will be designed for the Contracted Project with the intention of providing pre-mining biodiversity values.

- Additional species specific mitigation measures of the Contracted Project include:

Considerations to reduce potential impacts to the Broad-headed Snake include:

- Clearing forest and woodland mapped as potential habitat (mapped by Dr Arthur White in **Figure 3.1**) within the Contracted Project Disturbance Boundary during winter, when snakes may be sheltering under rocks in such habitats;

- Conducting preclearance surveys in selected areas in winter when snakes may be sheltering under rocks. Captured snakes to be relocated into suitable habitat areas to the east in the Ben Bullen State Forest;

- Ensuring that there remains undisturbed forest around some portions of the SPL and Sandstone Outcrops (as there will be to the north, east and south of the in the Ben Bullen State Forest SPL of the Contracted Project);

- Replacement of bushrock and consideration the use of artificial shelter sites on Sandstone Outcrops and the SPL in rehabilitation, as these have been shown to increase the occurrence of both snakes and their preferred food, the Velvet Gecko;

- Maintaining some hollow trees at the bases of the Sandstone Outcrops and the SPL (Cumberland Ecology have verified that hollow trees will remain within the standoff zone between the Sandstone Outcrops and the SPL and the edge of the proposed open cut);

- Rehabilitating vegetation within the mined areas to eventually replace the vegetation cleared;

- Provision of funding for an indirect offset that entails funding for additional habitat surveys of Broad-headed Snake in the wider area of the western Blue Mountains to further the knowledge of the species (as suggested by Webb pers. comm.).

i. Brush-tailed Rock Wallaby

This species has not been found on site or in the adjacent SPL area. However, a fox baiting program will be implemented for the life of the mine so as to reduce fox predation pressure on small native mammals, including, potentially the Brush-tailed Rock Wallaby, if it recolonises the SPL habitat or other Sandstone Outcrops on site. Fox predation is one of the key threatening processes for the Brush-tailed Rock Wallaby, and is likely to be one of the main reasons it does not currently inhabit rocky habitats on the Project Boundary. Details of the fox baiting program will be provided in the BMP.

ii. Cave-dependant Bats

Mining will avoid all of the major cliff lines and caves within major sandstone outcrops, and all of the SPL habitats will be protected from direct and indirect impacts of mining. This will protect habitat for cave dependent bat species such as the large-eared Pied Bat and Eastern Bentwing Bat.

S6 Biodiversity Offset Strategy

A Biodiversity Offset Strategy has been proposed and will help to compensate for ecological impacts of the Contracted Project in a strategic and meaningful way that will deliver a real biodiversity outcome. It will ensure that the Project is not conducted at a cost to biodiversity conservation. A "maintain or improve" approach is to be undertaken that retains the ecological condition of the landscape within the locality by conserving, where practically possible, and increasing representative woodland and forest communities within designated areas.

S6.1 Contracted Project Biodiversity Offset Package

In response to the PAC Report, Coalpac has revised the Exhibited Project mine plan to further avoid threatened flora, fauna, endangered ecological communities and their habitats with particular attention around further avoiding pagoda landforms and the habitat they provide. The Contracted Project mine plan completely avoids open cut mining on land within the Hillcroft property and as a result the Hillcroft property has been excluded from the Contracted BOP, giving a total area of offset land of 2,040 ha (rounded down).

In recognition of a shortfall in the quantum of offsets due to the exclusion of Hillcroft, Coalpac have committed to a 4:1 offset ratio for the Contracted Project (see below).

The BOP of the Contracted Project mine plan is provided below.

Table S.1 Contracted Project Mine Plan Biodiversity Offset Package

Vegetation Type	Yarran View (ha)	Billabong/ Hillview (ha)	Hyrock Hartley (ha)	Gulf Mountain[2] (ha)	Total
CEEC & EEC[1]	186.8	34.9	0.0	0.0	221.7
Non CEEC & EEC (native only)	256.3	48.5	236.1	1277.7	1818.6
Total	**443.1**	**83.4**	**236.1**	**1277.7**	**2040.3**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations. .

The Contracted Project mine plan Biodiversity Offset ratio excluding rehabilitation is provided below. With the exclusion mine rehabilitation (761.9 ha credited at 50%) the offset ratio is 2.7:1.

Table S.2 Contracted Project Mine Plan Biodiversity Offset Ratio (without rehabilitation)

Vegetation Type	Project Boundary Disturbance (ha)	Proposed Offset[2] (ha)	Proposed Offset Ratio[2]
CEEC & EEC[1]	17.2	221.7	12.9
Non CEEC & EEC (native only)	744.7	1818.6	2.4
Total	**761.9**	**2040.3**	**2.7**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations

The Contracted Project mine plan Biodiversity Offset ratio, including mine rehabilitation, is provided below. With the inclusion of mine rehabilitation (761.9 ha credited at 50%) the Contracted Project mine plan Biodiversity Offset ratio is 3.2:1.

Table S.3 Contracted Project Mine Plan Biodiversity Offset Ratio (with rehabilitation)

Vegetation Type	Project Boundary Disturbance (ha)	Proposed Offset[2] (ha)	Proposed Offset Ratio[2]
CEEC & EEC[1]	17.2	230.3	13.4
Non CEEC & EEC (native only)	744.7	2191.0	2.9
Total	**761.9**	**2421.2**	**3.2**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations.

S6.2 Contracted Project Biodiversity Offset Commitment

In recognition of a shortfall in the required offset ratio, Coalpac has committed to achieving a total minimum ratio of 4:1 for native vegetation excluding mine rehabilitation. This requires the acquisition of an additional 1,007 ha (rounded up) of forest and woodland so that the total Contracted Project Biodiversity Offset Package is 3,047 ha (rounded down). This is provided in the table below.

Coalpac's commitment to a minimum 4:1 offset ratio is comparable to other approved mining project in NSW, including Ulan Coal Mine (4:1 ratio), Duralie Coal Mine (3.3:1 ratio) and Maules Creek Coal Mine (4.3:1 ratio).

Table S.4 Target Biodiversity Offset Package (without rehabilitation)

Vegetation Type	Project Boundary Disturbance (ha)	Proposed Offset [2] (ha)	Proposed Offset[2] Ratio
CEEC & EEC[1]	17.2	221.7	12.9
Non CEEC & EEC (native only)	744.7	2825.7	3.8
Total	**761.9**	**3047.4**	**4.0**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations.

S7 Conclusion

The Exhibited Project as described in the EA dated March 2012 and its associated ecological impacts have been reassessed in view of the conclusions and recommendations of the PAC Report. Consequently the Contracted Project has been designed and has reduced the Disturbance Boundary assessed in the Exhibited EIA by 196 ha or 20% (from 958 ha to 762 ha).

The reduced disturbance footprint is now contracted further from habitats around the SPL in the south-east of the Project Boundary, does not include the Hillcroft mining area (avoiding 109 ha of vegetation) and avoids all Persoonia marginata habitat. It would also impact significantly less Eucalyptus cannonii habitat. It has reduced impacts on this threatened tree from 278 ha to 204 ha (a reduction of approximately 74 ha or 27% of the habitat for this species located within the Exhibited Project Disturbance Boundary).

The Contracted Project would have a negligible impact upon SPLs and no significant impact on the flora and fauna species associated with these landscapes. It should be noted that this is consistent with the findings of the ecological assessment for the Exhibited Project mine plan.

Large areas of suitable habitat will remain in the Project Boundary (1,190 ha of forest and woodland) and in the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other large remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of adjacent Ben Bullen State Forest.

In addition, mitigation measures have been enhanced for the Broad-headed Snake and other threatened species including protecting and conserving suitable habitat for these species via establishing offset properties, and progressively rehabilitating impacted land to develop high quality habitat within the Project Boundary.

Coalpac have also committed to acquiring more offsets to reach a 4:1 overall offset ratio of native vegetation. This commitment is comparable to other approved mining project in NSW, including Ulan Coal Mine (4:1 ratio), Duralie Coal Mine (3.3:1 ratio) and Maules Creek Coal Mine (4.3:1 ratio). Additional offset acquisition will prioritise the acquisition of vegetation on Permian sediments and co location with existing parks.

The proposed reduction in the disturbance footprint of the Contracted Project, together with improved mitigation measures and an increased commitment to offsetting is likely to produce an ecologically sustainable mining outcome in which ecological values are maintained or improved in the long term.

Chapter 1

Introduction

1.1 Purpose

The purpose of this report is to fulfil part of a requirement under section 75H(6) of the Environmental Planning and Assessment Act 1979 (EP&A Act) to prepare a Preferred Project Report (PPR) that outlines any proposed changes to the Coalpac Consolidation Project (the Project) to minimise its environmental impacts. This report reassesses the ecological issues relating to the Project based upon the reduced disturbance footprint of the Preferred Project, referred to hereafter as the Contracted Project.

1.2 Background

Hansen Bailey was commissioned to prepare an Environmental Assessment (EA) for the Coalpac Consolidation Project (Exhibited EA) under Part 3A of the EP&A Act. Cumberland Ecology was engaged by Hansen Bailey and prepared the Ecological Impact Assessment (EIA) of the Project (Appendix J of the Exhibited EA).

Following exhibition of the Project, the Planning Assessment Commission (PAC) made a recommendation to refuse the Exhibited Project mine plan in their Review Report (the PAC Report) (NSW PAC 2012b, a). Some of the key reasons for the recommended refusal were related to conservation values, including both geological conservation values and ecological values. The geological conservation values are related to Significant Pagoda Landforms (SPLs). The ecological values were largely but not exclusively related to the flora and fauna said to occur on and around the pagoda areas.

In response to the PAC Report, Cumberland Ecology prepared a Response to the PAC Report (Biodiversity) (Cumberland Ecology 2013). This report refuted many of the claims made ultimately by the PAC and also described changes to the Exhibited Project mine plan, which is now referred to as the Contracted Project.

On 20th March 2013 the Department of Planning and Infrastructure (DP&I) issued a letter to Coalpac requesting the provision of a Preferred Project Report (PPR) to be prepared under section 75H(6) of the EP&A Act. This letter request is provided in Appendix A.

The PPR requirements as outlined in the letter from DP&I to Coalpac are as follows:

1. A preferred project report that outlines any proposed changes to the project to minimise its environmental impact (section 75H(6)(b) of the Act); and

2. Any revised statement of commitments (section 75H(6)(c) of the Act) for environmental management and mitigation measures on the site.

1.2.1 Contracted Project Overview

The Contracted Project mine plan has undergone a number of changes to the open cut footprint to reduce impacts and address issues raised in the PAC Report (see Figure 1.1). The highwall mining footprint has also been reduced to minimise potential subsidence impacts within the SPL (see Figure 1.4).

The Contracted Project mine plan has reduced the disturbance footprint assessed in the Exhibited EIA by 196 ha (from 958 ha to 762 ha). The reduced disturbance footprint centres on habitats around the Significant Pagoda Landforms (SPLs) (see Section 1.3 for description of an SPL) in the south-east of the Project Boundary and completely avoids mining on Hillcroft.

By reducing the Contracted Project Disturbance Boundary to 762 ha, a number of changes have been made to the Project as assessed in the Exhibited EIA, resulting in key biodiversity savings. These changes include:

- Removal of the Hillcroft mining area and associated access infrastructure resulting in avoidance of 109 ha of native vegetation, including a substantial Capertee Stringybark population;

- Avoidance of all *Persoonia marginata* in the Project Boundary;

- Increased avoidance of *Eucalyptus cannonii* throughout the Project Boundary;

- Increased setbacks of open cut mining from SPLs and gully habitats (inset 2 of **Figure 1.2**):

  - setbacks up to 240 m from the Exhibited Project mine plan in gully habitats adjacent to the Ben Bullen SPL;

  - avoidance of an additional 16.17 ha of vegetation including gully habitat areas adjacent the Ben Bullen State Forest SPL;

- Enhanced Biodiversity Offset Strategy (BOS) to address any residual ecological impacts; and

- Enhanced mitigation measures for specific threatened fauna, such as the Broad-headed Snake.

Figure 1.1 shows the Contracted Project mine plan layout. Figure 1.2 compares the Exhibited Project Disturbance Boundary with the Contracted Project Disturbance Boundary and highlights the key areas where additional land has been excluded from open cut mining.

i. Recognition of SPLs in the Project Boundary

A review of the Exhibited Project mine plan was been carried out in order to review where greater certainty of protection can be afforded to the SPLs. The only SPL in the Project Boundary is the Ben Bullen State Forest Significant Pagoda Landform (see Figure 1.3). This area is at the south-eastern end of the Invincible Colliery open cut and highwall mining areas.

As shown in the Figure 1.3, the Contracted Project Disturbance Boundary avoids large areas of Ben Bullen State Forest SPL.

Coordinate System: MGA Zone 56 (GDA 94)

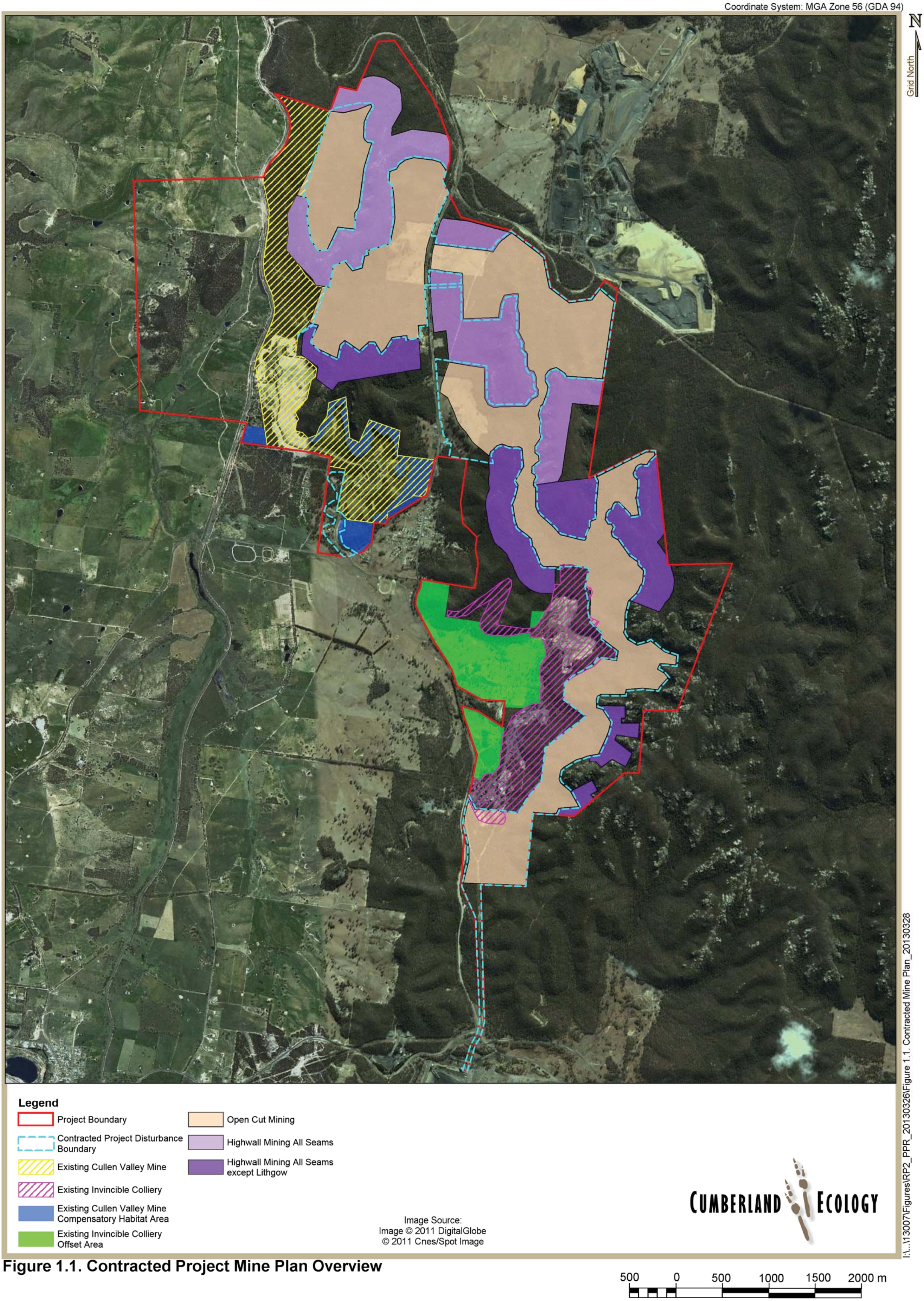

Figure 1.1. Contracted Project Mine Plan Overview

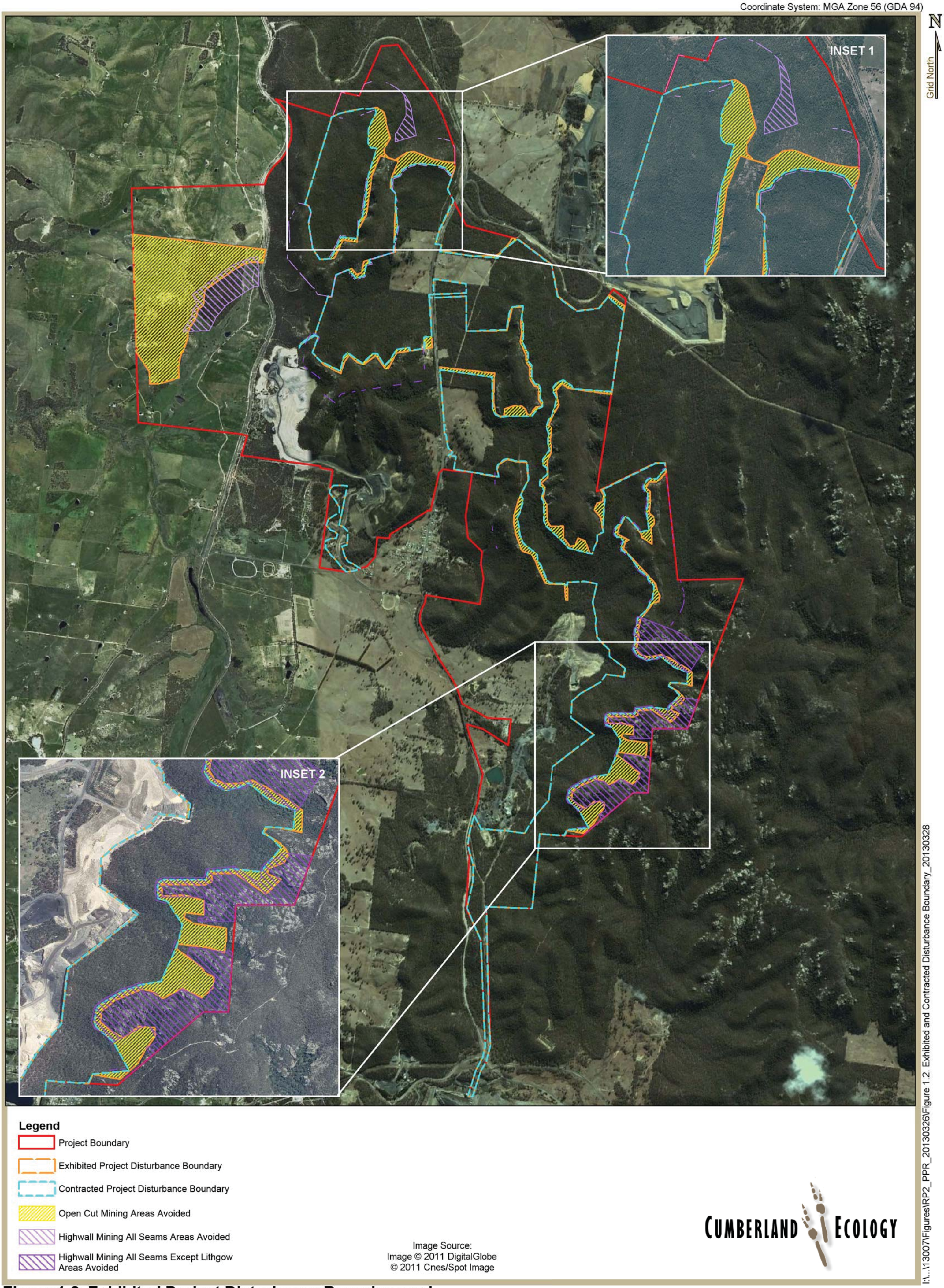

Figure 1.2. Exhibited Project Disturbance Boundary and Contracted Project Disturbance Boundary

Coordinate System: MGA Zone 56 (GDA 94)

Figure 1.3. Ben Bullen State Forest SPL and the Contracted Project Disturbance Boundary

Coordinate System: MGA Zone 56 (GDA 94)

I:\...\13007\Figures\RP2_PPR_20130328\Figure 1.4. Additional Highwall Mining.pdf

Figure 1.4. Contracted Project High Wall Mining Areas. (Note HWM restricted to lower topography areas (i.e. gullies), leaving intact blocks of coal left in place under pagoda rock formations.)

1.3 Glossary

BHS: Broad-headed Snake.

Box Gum Woodland: White Box Yellow Box Blakely's Red Gum Grassy Woodland listed under the EPBC Act and TSC Act.

BVT: Broad vegetation type.

CEEC: Critically Endangered Ecological Community.

C/EEC: Critically Endangered Ecological Community and Endangered Ecological Community.

Contracted Project: The modified project as described in Chapter 1 of this report.

Contracted Project Disturbance Boundary: includes all lands to potentially be disturbed as part of the Contracted Project within the Project Boundary. This has been modified to address concerns raised in the PAC Report.

Current Survey: refers to the survey work by Cumberland Ecology conducted in 2009, 2010 and 2011 for the Exhibited Project.

DECCW: NSW Department of Environment Climate Change and Water (the previous name for OEH, see below).

EIA: Ecological Impact Assessment.

Exhibited EIA: Exhibited Ecological Impact Assessment.

Exhibited Project: the Exhibited Coalpac Consolidation Project that was publically exhibited.

Exhibited Project Disturbance Boundary: includes all lands to potentially be disturbed as part of the Exhibited Project within the Project Boundary.

EEC: Endangered Ecological Community.

EP&A Act: NSW Environmental Planning and Assessment Act 1979.

EPBC Act: Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

KTP: Key Threatening Process, listed under the TSC and EPBC Act as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities.

LGA: Local Government Area.

Locality: is the area within a 10 km radius of the Project Boundary.

Mining Lease: means the land within the Coalpac mining tenements.

OEH: Office of Environment and Heritage, formerly DECCW.

Pagoda: (excerpt from Washington & Wray, 2011). Pagodas are conical rock formations formed by differential weathering and erosion of the local sandstones. They come in two forms. Smooth pagodas have relatively regular conical-shapes (without terraces), while platy pagodas are stepped and terraced cones that resemble Asian pagodas, ziggurats or step-pyramids.

Preferred Project Report: report prepared in accordance with section 75H(6) of the EP&A Act, which outlines the proposed changes of the Contracted Project.

Previous Surveys: refers to all previous flora and/or fauna surveys conducted within the Project Boundary and reviewed by Cumberland Ecology.

Project Boundary: refers to Project Boundary (all land subject to this EA).

ROTAP: refers to "rare or threatened Australian plants", which are not listed as threatened by either State or Commonwealth legislation. Rather these species appear in a 2005 publication by Briggs and Leigh on Rare or Threatened Australian Plants. The book predates both the TSC Act and EPBC Act.

Sandstone Outcrops: Outcrops of sandstone that are in situ and form a discontinuous landform with individual continuous outcrop areas of less than 10 hectares but occupy an area greater than 0.1 hectare. These outcrops may exhibit geomorphological features such as cliffs, caves, rock towers and isolated pagodas that do not form an aggregate or have deeply dissected wet gullies (SPL). Sandstone Outcrops do not exhibit the characteristics of SPLs, i.e. they do not exhibit clusters of pagodas or have deeply dissected wet gullies. Although rare, isolated rocks and boulders less than 0.1 ha located within the Contracted Project Disturbance Boundary are afforded no special significance.

SEWPaC: Commonwealth Department of Sustainability, Environment, Water, Population and Communities.

- **Significant Pagoda Landforms (SPLs):**
- A complex that creates a continuous landform over a substantial area (typically greater than 10 hectares), comprising (as a minimum):
    - Large, substantial in height (typically up to 60m but may be higher), towering pagodas (either platy or smooth), that are generally prominent rock formations with associated cliff faces and deeply dissected gullies, characterised by banded ironstone and associated rock structures containing numerous overhangs and crevices, with;

- Associated deeply dissected wet gullies between the pagoda formations that contain a complex of habitat types for both flora and fauna, some species of which are rarely found elsewhere (e.g. Pagoda Daisy).

Threatened flora and fauna: refers to communities, populations and species listed as threatened under the EPBC Act, the TSC Act and the NSW Fisheries Management Act 1994; and

TSC Act: NSW Threatened Species Conservation Act 1995.

Chapter 2

Methods

The purpose of this Chapter is to summarise the ecological investigative methods utilised in assessing the likely ecological impacts of the Exhibited Project and Contracted Project.

2.1 Summary of Methods: Exhibited Project

The Exhibited EIA made use of pre-existing literature from past studies of the locality as well as conducting detailed surveys within the Project Boundary. Methods utilised for the Exhibited EIA are summarised below.

2.1.1 Literature Review

Relevant literature from previous studies conducted for the existing Invincible Colliery and Cullen Valley Mine operations within the Project Boundary and for other mines in the area was reviewed for this Project. Information from previous studies has been incorporated into this report. Additionally, the "Vegetation of the Western Blue Mountains" DEC (2006) mapping project has been used to assist with identifying and describing vegetation communities.

For more information see Chapter 2 of the Exhibited EIA (Cumberland Ecology 2012).

2.1.2 Database Analysis

Database analysis was also conducted for the locality using the (then) Department of Environment, Climate Change and Water Atlas of NSW Wildlife Database and the Department of Sustainability, Environment, Water Population and Communities EPBC Protected Matters Search Tool.

For more information see Chapter 2 of the Exhibited EIA (Cumberland Ecology 2012).

2.1.3 Flora Surveys of the Project Boundary

Cumberland Ecology conducted flora and fauna surveys to comply, where possible, with standards provided in the Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities (Working Draft) (DEC (NSW) 2004).

Vegetation sampling conducted within the Project Boundary involved the following procedures:

- Quadrat sampling (20m x 20m and 20m x 50m (in Box Gum Woodland));
- Population estimates using quadrats (20m x 1m and 100m x 20m);
- Targeted searches for threatened species; and
- Random meander surveys.

For more information see Chapter 2 of the Exhibited EIA (Cumberland Ecology 2012).

2.1.4 Fauna Surveys of the Project Boundary

Fauna surveys by Cumberland Ecology were conducted over three periods in autumn and spring to cover a range of seasonal conditions, specifically from 6-8 April 2009 (preliminary survey), 7-11 September 2009 and 19-23 October 2009. The following targeted surveys for fauna were conducted:

- Amphibians: habitat assessment, diurnal and nocturnal active searches, spotlighting, call playback;
- Birds: habitat assessment, bird census surveys, visual observation and call identification, nocturnal spotlighting, nocturnal call playback, diurnal call playback;
- Mammals: habitat assessment, trapping (ground and arboreal trapping), harp trapping, trip-lining, hair tubes, ultrasonic bat call recording, spotlighting, nocturnal call playback, infra-red cameras;
- Reptiles: habitat assessment, diurnal and nocturnal active searches; and
- Threatened insects: habitat assessment, diurnal searches, and nocturnal searches.

A detailed description of these methods is provided within Chapter 2 of the Exhibited EIA (Cumberland Ecology 2012).

2.2 Surveys of Biodiversity Offset Properties

It was apparent from the outset of Project that land to be designated as compensatory offsets would be required to address the ecological impacts of the Project. Offset surveys were conducted during late 2010 and throughout 2011 and 2012. For more information see Chapter 2 of the Exhibited EIA and Appendix C.

Surveys of additional offset properties will continue into the future in order for the Contracted Project to reach an offset ratio of 4:1 (see Chapter 6).

2.3 Summary of Methods: Contracted Project

This section sets out the methods used that ultimately guided the development of the Contracted Project.

2.3.1 Literature Review

A wide range of literature was reviewed in preparation of the Contracted Project mine plan. These included:

- PAC Report, including the Main Report (NSW Planning Assessment Commission (PAC) 2012b) and Appendices (NSW Planning Assessment Commission (PAC) 2012a);
- Pagoda Landform Literature, including a paper referenced in the PAC Report by Washington and Wray (2011);
- Pagoda Flora and Fauna Species Literature, including key maps and reports relevant to understanding its distribution and habitat requirements
- Coalpac Consolidation Project Ecological Impact Assessment, prepared for Coalpac Pty. Ltd. (Cumberland Ecology 2012);
- OEH threatened species profiles (various) – see References;
- Broad-headed Snake (BHS) Literature, including key maps and reports relevant to understanding its distribution, habitat requirements and habitat restoration; and
- NSW Wildlife Atlas (OEH 2013) records for threatened species in the areas surrounding the Project and pagoda country identified by Washington and Wray (2011).

2.3.2 Database Analysis

Records were obtained from the Atlas of NSW Wildlife database (OEH 2013) on flora and fauna species mentioned to be either ‘restricted’ or closely associated with pagoda landforms in the PAC Report and supporting literature by Washington and Wray (2011).

2.3.3 Mapping Significant Pagoda Landforms

i. Pagoda Landforms Mapping

In addition to digitising the “pagoda country” identified by Washington and Wray (2011), additional areas containing SPLs were identified. These areas were identified by using topographic maps, aerial photography and local knowledge in some areas of Wollemi National Park and Buddawang National Park.

For more information see Chapter 2 of the PAC Response Report (Cumberland Ecology 2013)

a. Classification of Significant Pagoda Landforms

Prior to mapping SPLs in the Project Boundary and surrounding region, it was important to first define these features. This definition enabled SPLs to be subsequently mapped. This was based on the descriptions of pagoda country from Washington and Wray (2011), Muir (2005) and the PAC Report (NSW Planning Assessment Commission (PAC) 2012b, a).

Based on the description of pagoda landforms provided and used by Washington and Wray (2011) and the PAC, SPLs in the region surrounding the Project Boundary were identified. It is important that SPLs are defined and identified in order that they can be afforded special significance, compared to (Sandstone Outcrops) that offer a discontinuous association with each other; the latter would not create 'a complex arrangement of habitats' as defined by the PAC in the dot points above.

Therefore SPLs are described as the following.

- A complex that creates a continuous landform over a substantial area (typically greater than 10 hectares), comprising (as a minimum):
    - Large, substantial in height (typically up to 60m but may be higher), towering pagodas (either platy or smooth), that are generally prominent rock formations with associated cliff faces and deeply dissected gullies, characterised by banded ironstone and associated rock structures containing numerous overhangs and crevices, with;
    - Associated deeply dissected wet gullies between the pagoda formations that contain a complex of habitat types for both flora and fauna, some species of which are rarely found elsewhere (e.g. Pagoda Daisy).

Where sandstone outcrops and pagodas occur in isolation (and therefore do not form a complex of a continuous nature), they have been defined as Sandstone Outcrops (see Section 1.3 for definitions).

For more information on SPL classification see Chapter 2 of the PAC Response Report (Cumberland Ecology 2013).

b. Mapping SPLs

Once SPLs were defined, they were then mapped in the Project Boundary and wider region using Aerial Photographic Interpretation (API) of Google Earth, Version 6.1.0.5001. SPL mapping in the Project Boundary was aided by a series of high resolution digital photographs taken during a helicopter flight of the Project Boundary, which focused on the escarpment to east of the Invincible open cut mining area, and valleys below.

The regional mapping undertaken by Cumberland Ecology also used geo-referenced photographs available in Google Earth to confirm the presence of pagoda formations identified during API. The mapping of SPLs outside the Project Boundary was also aided through the review of literature and existing maps provided in management plans of nearby national parks. In particular the Gardens of Stone Plan of Management (DECC 2009) provided a map of the park which identified pagoda landforms that occur outside the pagoda country in Washington and Wray (2011). This was digitised and incorporated in the mapping of SPLs of the region.

For more information on SPL mapping in the region, see Chapter 2 of the PAC Response Report (Cumberland Ecology 2013).

2.3.4 Consultation with other Experts

Table 2.1 below lists the experts consulted during preparation of the Contracted Project mine plan. Cumberland Ecology consulted with Dr Jonathon Webb about his extensive knowledge and experience on the Broad-headed Snake. Dr Arthur White also conducted habitat assessment for the Broad-headed Snake in the Project Boundary. In addition, Cumberland Ecology consulted with Dr Steven Bell on Cumberland Ecology's analysis of the flora and fauna associated with pagoda landforms and with Dr Andy Markham on the geomorphology of SPLs.

For more information on expert consultation see Chapter 2 of the PAC Response Report (Cumberland Ecology 2013).

Table 2.1 Specialist Consultation

Expert	Area
Dr. Jonathon Webb; Lecturer of Environmental Scientist at University of Technology (UTS), Sydney	BSc (Hons), PhD (University of Sydney) Broad-headed Snake Expert
Dr Arthur White; Director of Biosphere Environmental Consultants Pty. Ltd.	BSc (Hons), PhD (University of NSW) Herpetologist
Dr Stephen Bell; Director of East Coast Flora Surveys Pty. Ltd	BSc (Hons); PhD (University of Newcastle) Stephen is a consultant botanist with extensive knowledge of sandstone habitats
Dr Andy Markham; Director of Hydrobiology Pty. Ltd.	BSc (Hons) in Environmental Science, University of East Anglia; PhD in Geography, Queen Mary, University of London. Andrew is a fluvial geomorphologist, surface water hydrologist and Chartered Environmental Scientist.

2.3.5 Broad-headed Snake Habitat Assessment

On 6th of February 2013, Dr Arthur White from Biosphere Environmental Consultants P.L. and Mr Ryan Sims from Cumberland Ecology P.L. surveyed the sandstone escarpment areas in and outside the Project Boundary to determine where habitat for the Broad-headed snake was present and whether habitat areas were likely to be impacted by the Contracted Project.

Aerial survey maps of the mining leases areas and immediate surrounds were examined to determine the extent of sandstone escarpment areas and to determine access to each area.

Sandstone exposures were deemed to contain potential habitat for the Broad-headed Snake if they also contained:

- Medium to tall forest within 250 m of the sandstone outcrop;
- Loose, exfoliated pieces of sandstone that were not underlain by organic matter or on soil, that could be used as refuge habitat by either the Broad-headed snake or their prey; and
- Deep fissures or cracks that could be used as shelter habitat by either the Broad-headed snake or their prey.
- Having located all potential habitat areas, the sites were visited on the 6th of February 2013 so that each area could be "ground-truthed" to validate or refute the presence of habitat for the Broad-headed Snake in each area.

For more information see Chapter 2 of the PAC Response Report (Cumberland Ecology 2013).

2.3.6 Limitations

As explained within the Flora and Fauna Assessment within the EA for the Exhibited Mine Plan, extensive flora and fauna surveys have been conducted across the Project Boundary. Moreover, as reiterated within the Response to the PAC (ecology), the vegetation mapping provided by Cumberland Ecology is accurate and provides and appropriate summary of vegetation. Currently there are no major deficiencies in information that significantly limit any of the analyses or conclusions drawn later in this report.

The quality of the aerial imagery used in some areas within the Wollemi National Park did not allow for adequate identification of SPL's, and there is a possibility for more occurrences of the SPL's to occur than that mapped in the region. Areas of currently mapped SPL's do not specifically delineate the boundary of the landform, but give an indicative view.

That notwithstanding, a conservative approach was taken to mapping and it is considered that the vast majority of the SPLs have been accurately identified.

Chapter 3

Results

The purpose of this Chapter is to summarise the results of ecological investigations of the Project Boundary and surrounds..

3.1 Vegetation Communities

The Project Boundary is generally forested and occurs across a landscape characterised by sandstone plateaus with ‘pagoda’ rocky out-cropping formations. The Project Boundary sits relatively high in the landscape with very few drainage lines. Most runoff would be expected to occur as overland flows, collecting at a point lower in the landscape than the Project Boundary. The vegetation of the Project Boundary is generally in good condition, with few exotic species occurring.

Table 3.1 lists the vegetation communities recorded within the Project Boundary. Descriptions of these communities and a map showing their distribution within the Project Boundary are provided in Chapter 3 of the Exhibited EIA (Cumberland Ecology 2012).

Of these communities, Capertee Rough-barked Apple Red Gum Yellow Box Grassy Woodland and Derived Native Grasslands represents a form of the White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland) endangered ecological community (EEC) as listed under the Threatened Species Conservation Act 1995 (TSC Act), also listed as a critically endangered ecological community (CEEC) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Table 3.1 Vegetation communities recorded within the Project Boundary

Vegetation Community	Area (ha)
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC CEEC / TSC EEC)	46.18
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC CEEC / TSC EEC)	0.27
Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy	0.12
Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	1.99
Tableland Gully Ribbon Gum Blackwood Applebox Forest	111.81
Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland	16.62
Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest	332.43
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland	13.71
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland	215.23
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	260.86
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland	57.07
Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	51.70
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland	12.84
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland	2.79
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest	0.90
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland	23.35
Pagoda Rock Sparse Shrubland	32.87
Cox's Permian Red Stringybark - Brittle Gum Woodland	92.02
Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	679.11
TOTAL	**1,951.88**

3.2 Habitat

3.2.1 General Habitat

The Project Boundary contains a variety of habitats for flora and fauna species. These include forested steep slopes and gullies, woodlands on lower slopes with flatter topography, and sandstone outcropping with heath and woodland. This outcropping forms caves and crevices that are used as refugia by some fauna species. There are very few aquatic habitats present in the Project Boundary, limited to small old farm dams, and ephemeral drainage lines. Generally there is a paucity of permanent or reliable freshwater sources within the Project Boundary.

3.2.2 Significant Fauna Habitat: Pagodas, Cliffs and Caves

Pagoda landforms, cliffs and caves were recognised at the outset of the Project to be important habitats and it was also understood that these habitats could furnish important habitat for threatened species including the Brush-tailed Rock Wallaby, Broad-headed Snake and a variety of plant species.

The pagoda shaped rock outcrops and cliff lines in and adjacent to the Project area are formed as the result of preferential and differential weathering of sedimentary rocks of the Triassic Narrabeen Formation, which overlies the Permian sedimentary rocks that form the coal measures targeted by the Project. In some places, where the Triassic sediments are of sufficient thickness1, they have been deeply incised (forming gorges and gullies), preferentially along joint and fault planes, thus splitting and isolating sections of the sandstone caps and mesas and through differential weathering of weaker and stronger horizontal sedimentary beds, to form towers of rock, known locally as pagodas. Together these features create a landform of special significance that has been recognised and defined in the Response to the PAC Review Report as a Significant Pagoda Landform (SPL).

Analysis of “pagoda-dependent” flora and fauna has shown that most such species are not restricted to pagoda landform habitats and occur much more widely in NSW.

3.2.3 Broad-headed Snake Habitat

Despite the extent of the sandstone exposures in the Project Boundary, the amount of potential habitat for the Broad-headed snake was quite modest in comparison. A lot of the sandstone areas were discounted as snake habitat as they were devoid of exfoliating rocks and lacked crevices or cracks. There appears to some variation in the integrity of the sandstone in this area: in some parts of the Project Boundary the sandstone was fine-grained and only poorly consolidated. As this sandstone weathered, it did not crack or peel, but shed sandstone grains as loose dust. Consequently, there were no surface rocks to be found, nor any talus scree (Photograph 3.1).

Photograph 3.1 Sandstone Exposures in Area 2 Devoid of Exfoliating Rocks

Broad-headed Snake habitat was present in some areas of the Project Boundary where the coarser grained sandstones were present. These rocks peeled when weathered, but in places, they also contained deep joints which had weathered out to produce crevices and narrow canyons. This sort of weathering is most noticeable around the incised gullies behind the sandstone walls (i.e. where the Newnes plateau was being actively incised).

Newell and Goldingay (Newell D. A. & Goldingay R. L. 2005.) also commented on the relative paucity of suitable habitat for the Broad-headed Snake in the northern parts of its range (although they had not surveyed the Newnes plateau or the plateaus to the east in the Cullen Bullen area). Ben Croak, a Ph.D student from the University of Sydney is undertaking studies of the Broad-headed Snake in the northern parts of their range and struggled to locate suitable habitat in the areas of Wollemi and Yengo NP where he searched (B. Croak pers. comm.; Croak *et al.* 2013). Both Yengo and Wollemi NP are renowned for the spectacular sandstone walls and canyons that make up these parks but this does not appear to constitute habitat for the snakes.

Using this understanding of the habitat requirements of the species, eight areas of potential habitat were located: six of these areas (areas 1-6) were located in the eastern areas of the Project Boundary adjacent the SPL (**Figure 3.1**); Two further sites were located in the northern portion of the Project Boundary, area 7 was located on the eastern side of the Castlereagh Highway (south of the Baal Bone Mine Precinct (**Figure 3.1**), while area 8 was located on the western side of the Castlereagh Highway, north of Tyldesley Hill (**Figure 3.1**).

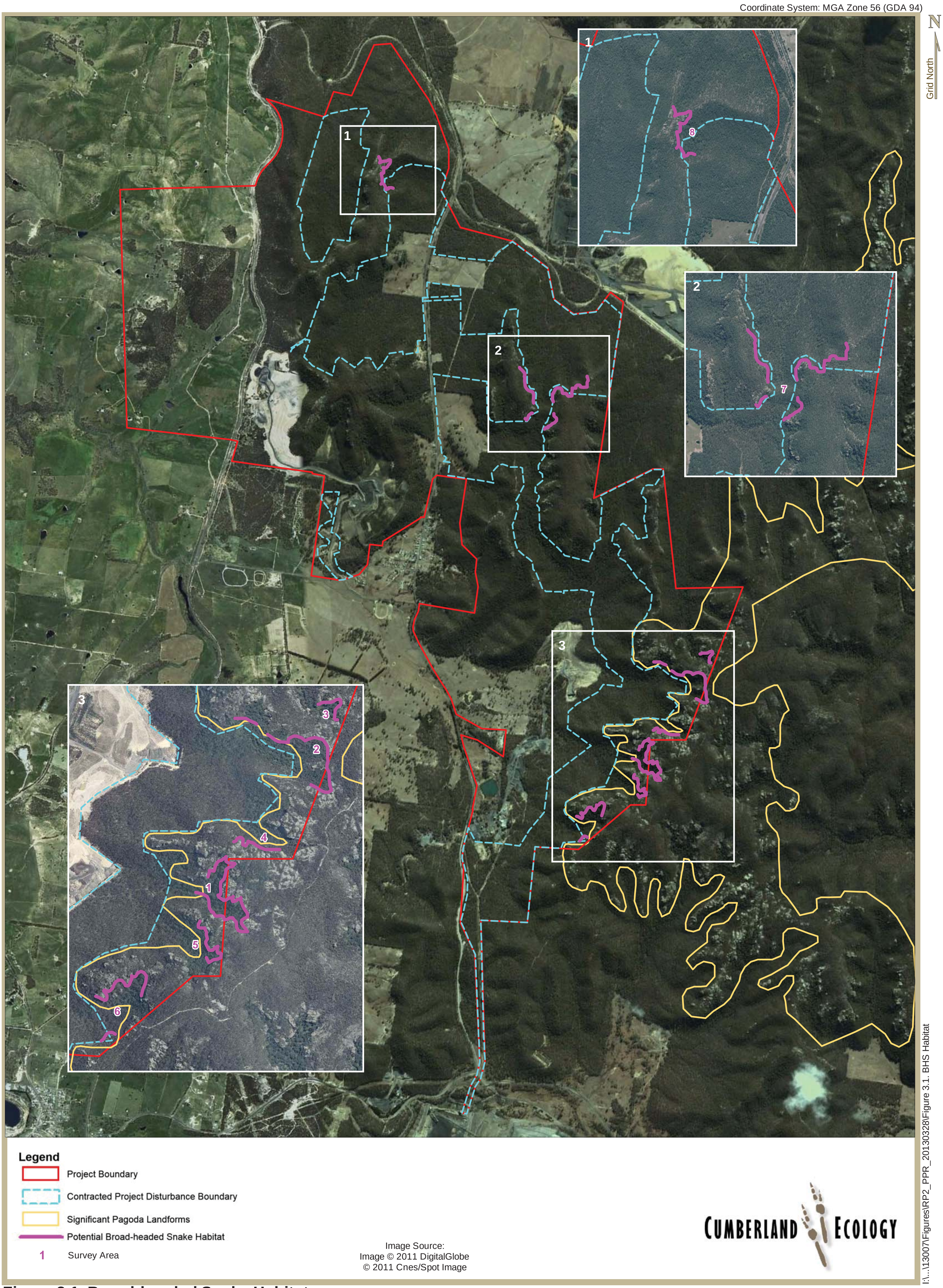

Figure 3.1. Broad-headed Snake Habitat

500 0 500 1000 1500 2000 m

3.3 Flora Species

More than 400 flora species have been recorded in the Project Boundary by Cumberland Ecology, with less than 20% of these being exotic. Additional flora species have been recorded by other groups since the completion of the surveys for the EA. This is a very high diversity that is due to the diversity of microhabitats present in the area, as outlined in more detail in above.

The dominant plant families encountered in the open forest and woodland have been consistently represented by the Myrtaceae, Fabaceae, Asteraceae and Poaceae families. The most common genera encountered are Eucalyptus and Acacia, with over 24 and 15 species respectively. Poaceae (grass family) is the family represented by the highest diversity of species, although it is not strongly represented by any one genus. Over 10 species of orchid have been recorded.

A summary of known and potentially occurring threatened flora species is provided in Table 3.2. Descriptions of these species and a map showing their distribution within the Project Boundary are provided in Chapter 3 of the Exhibited EIA.

Table 3.2 Threatened flora species known or potentially occurring within the Project Boundary

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Occurrence within Project Boundary
Eucalyptus cannonii	Capertee Stringybark	V	V	Known
Persoonia marginata	Clandulla Geebung	V	V	Known
Eucalyptus pulverulenta	Silver-leaved Mountain Gum	V	V	Potential
Grevillea evansiana	Evans Grevillea	V	V	Potential
Grevillea obtusiflora subsp. *obtusiflora*		E	E	Potential
Grevillea obtusiflora subsp. *fecunda*		E	E	Potential
Prostanthera cryptandroides subsp. *cryptandroides*		V	V	Potential
Eucalyptus aggregata	Black Gum	V		Known
Derwentia blakelyi		V		Potential

3.3.1 ROTAP Species

Although not listed under State or Commonwealth conservation legislation, several Rare or Threatened Australian Plant (ROTAP) species have been recorded from the Project Boundary by Cumberland Ecology or by others. These include the following species:

- *Gonocarpus longifolius;*
- *Acacia asparagoides;*
- *Leionema lamprophyllum subsp. orbiculare*;
- *Laucochrysum graminifolium*; and
- *Philotheca obovalis.*

3.4 Fauna Species

A large number of bird species, several common reptile species and eight amphibian species were recorded during the current survey. Mammal species recorded included macropods, microchiropteran bats and arboreal mammals, with very few small ground-dwelling mammals recorded.

A summary of known and potentially occurring threatened fauna species is provided in Table 3.3. Descriptions of these species and a map showing their distribution within the Project Boundary are provided in Chapter 3 of the Exhibited EIA.

Table 3.3 Threatened fauna species known or potentially occurring within the Project Boundary

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Occurrence within the Project Boundary
Birds				
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Known
Climacteris picumnus	Brown Treecreeper	V		Known
Petroica boodang	Scarlet Robin	V		Known
Chthonicola sagittata	Speckled Warbler	V		Known
Daphoenositta chrysoptera)	Varied Sittella	V		Known
Lophoictinia isura	Square-tailed Kite	V		Known
Ninox strenua	Powerful Owl	V		Known
Glossopsitta pusilla	Little Lorikeet	V		Potential
Melithreptus gularis	Black-chinned Honeyeater	V		Potential
Grantiella picta	Painted Honeyeater	V		Potential
Anthochaera phrygia	Regent Honeyeater	CE	E	Potential
Lathamus discolor	Swift Parrot	E	E	Potential

Table 3.3 Threatened fauna species known or potentially occurring within the Project Boundary

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Occurrence within the Project Boundary
Pomatostomus temporalis	Grey-crowned Babbler	V		Potential
Neophema pulchella	Turquoise Parrot	V		Potential
Melanodryas cucullata	Hooded Robin	V		Potential
Stagonopleura guttata	Diamond Firetail	V		Potential
Calyptorhynchus lathami	Glossy Black-cockatoo	V		Potential
Tyto novaehollandiae	Masked Owl	V		Potential
Ninox connivens	Barking Owl	V		Potential
Mammals				
Dasyurus maculatus	Spotted-tail Quoll	E	V	Potential
Petrogale penicillata	Brush-tailed Rock-wallaby	V	E	Potential
Phascolarctos cinereus	Koala	V		Potential
Petaurus norfolcensis	Squirrel Glider	V		Known
Cercartetus nanus	Eastern Pygmy-possum	V		Potential
Petaurus australis	Yellow-bellied Glider	V		Potential
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V		Known
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Known
Mormopterus norfolkensis	Eastern Freetail-bat	V		Potential
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Potential
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Potential
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Known
Reptiles				
Hoplocephalus bungaroides	Broad-headed Snake	V	E	Potential
Varanus rosenbergi	Rosenberg's Goanna	V		Potential

Chapter 4

Impact Assessment

The purpose of this Chapter is to assess the ecological impacts of the Contracted Project relative to those predicted for the Exhibited Project.

4.1 Introduction

A comprehensive impact assessment of the Project was provided in Chapter 4 of the Exhibited Project EIA. This provided detail on the expected impacts of the Project on threatened flora and fauna considered to have potential to be impacted. Since submission, receipt of public submissions and review of the Exhibited EA by the PAC, the mine plan has been revised to further reduce its ecological footprint. This reduction for the Contracted Project will affect the impact assessment calculations presented in the Exhibited EA.

The purpose of this Chapter is to present an impact assessment of the Contracted Project. The areas of impacted and retained vegetation have been updated and the significance of the alterations to biodiversity impacts is discussed.

The Exhibited EA (Hansen Bailey 2012) and EIA (Cumberland Ecology 2012) provides significant background information on the impacts predicted to occur as a result of the Project and discusses these in detail. The purpose of this chapter is not to repeat the detailed information present in the Exhibited EA; rather it summarises the revised impacts in terms of area of land to be impacted by the Contracted Project, and its effect on the biodiversity that utilise it. Further background detail on impacting processes can be found in the Exhibited EA.

4.2 Summary of the Impacts of the Contracted Project

The Contracted Project has the potential to have a substantial impact on the ecology of the local area. It also has the potential to impact on C/EECs and several threatened flora and fauna species listed under the TSC Act and/or the EPBC Act.

The following is a summary of the predicted impacts of the Contracted Project Disturbance Boundary on threatened biodiversity:

- Approximately 15.24 ha of Box Gum Woodland and 0.27 ha of Derived Native Grassland, listed under the TSC Act and the EPBC Act (a reduction of approximately 7% of the impacts predicted in the Exhibited Project EIA);

- Approximately 1.96 ha of Box Gum Woodland Derived Native Grassland listed under the TSC Act only;

- 204 ha of known and potential *Eucalyptus cannonii* habitat, constituting an estimated 15,428 individuals (a reduction of approximately 27% of the impacts predicted in the Exhibited Project EIA); and

- 762 ha of native forest, woodland and grasslands, habitat for various fauna species known to occur or considered to potentially occur will be removed (a reduction of approximately 20% of the impacts predicted in the Exhibited Project EIA).

The Contracted Project will remove approximately 762 ha of native vegetation providing suitable foraging, shelter and breeding habitat for a suite of known and potentially occurring threatened woodland birds including the Varied Sittella, Scarlet Robin, Speckled Warbler, Brown Treecreeper, Square-tailed Kite, Little Lorikeet and Diamond Firetail. Blossom dependant and migratory species are also expected to be impacted by the removal of these treed habitats. Species to be affected include the Regent Honeyeater, Painted Honeyeater and Black-chinned Honeyeater and the Swift Parrot. Other threatened birds expected to be impacted by habitat disturbance for the Contracted Project include the Gang-gang Cockatoo, Powerful Owl and Masked Owl.

The following threatened mammals are expected to be impacted by habitat disturbance for the Contracted Project: Yellow-bellied Glider, Squirrel Glider and Spotted-tailed Quoll. A suite of threatened microbats including the hollow dependant Eastern False Pipistrelle, Eastern Freetail-bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat and cave dwelling Large-eared Pied Bat and Eastern Bent-wing Bat are also expected to be impacted.

Notwithstanding these expected impacts, large areas of suitable habitat will remain in the Project Boundary (1,190 ha of forest and woodland) and in the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other large remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of adjacent Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented, including protecting and conserving suitable habitat for these species via establishing offset properties, and progressively rehabilitating impacted land to develop high quality habitat within the Project Boundary.

Since the preparation of the Exhibited EA, the Project Disturbance Boundary has been significantly revised for the Contracted Project to reduce the overall area of impact and avoid areas of key habitats. All impacts to known occurrences of *Persoonia marginata* have been avoided. Although no SPLs are to be directly disturbed by open cut mining, the Contracted Project Disturbance Boundary provides further setbacks to these sensitive habitat areas. This will reduce further the level of indirect disturbance that these areas may experience, and will also provide greater foraging habitat adjoining SPLs. Some species typically shelter in the SPLs and Sandstone Outcrops and forage in the lower lying woodland gullies, and the Contracted Project Disturbance Boundary will avoid impacts to more extensive areas of this kind of habitat. Typically, these species such as the Broad-headed Snake and the Brush-tailed Rock Wallaby do not forage far from shelter habitat (although they are known to on occasions) and therefore the Contracted Project Disturbance Boundary will protect significantly greater habitat for these species including both shelter and foraging habitat. As shown on **Figure 1.4**, the highwall mining footprint for the Contracted Project has also been reduced, particularly for those areas within the SPL. All highwall mining activities proposed in the SPL will now occur only under the lower gully areas, virtually eliminating any potential subsidence impacts to pagoda features. More detailed discussion of the impacts of the Contracted Project on vegetation communities, flora and fauna species, including indirect impacts such as edge effects and cumulative impacts is provided in **Section 4.9** onwards.

4.3 Impacts to Vegetation Communities

4.3.1 Local Impacts

The Contracted Project Disturbance Boundary will remove approximately 762 ha of native vegetation that comprises the following native plant communities:

- Tableland Gully Snow Gum - Ribbon Gum Grassy Forest;
- Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland;
- Tableland Gully Ribbon Gum Blackwood Applebox Forest;
- Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland;
- Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (Box Gum Woodland listed under the EPBC Act);
- Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (Box Gum Woodland listed under the EPBC Act);
- Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy;
- Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (Box Gum Woodland listed under the TSC Act);
- Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland
- Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest;
- Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland;
- Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland;

- Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest;
- Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland;
- Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest;
- Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland;
- Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland;
- Cox's Permian Red Stringybark - Brittle Gum Woodland; and
- Pagoda Rock Sparse Shrubland.

The area of direct impact has been calculated from the extent of the Contracted Project Disturbance Boundary as shown on Figure 4.1 (below).

A comparison of the areas of each community to be removed under the Exhibited Project Mine Plan and the Contracted Project mine plan is shown in Table 4.1.

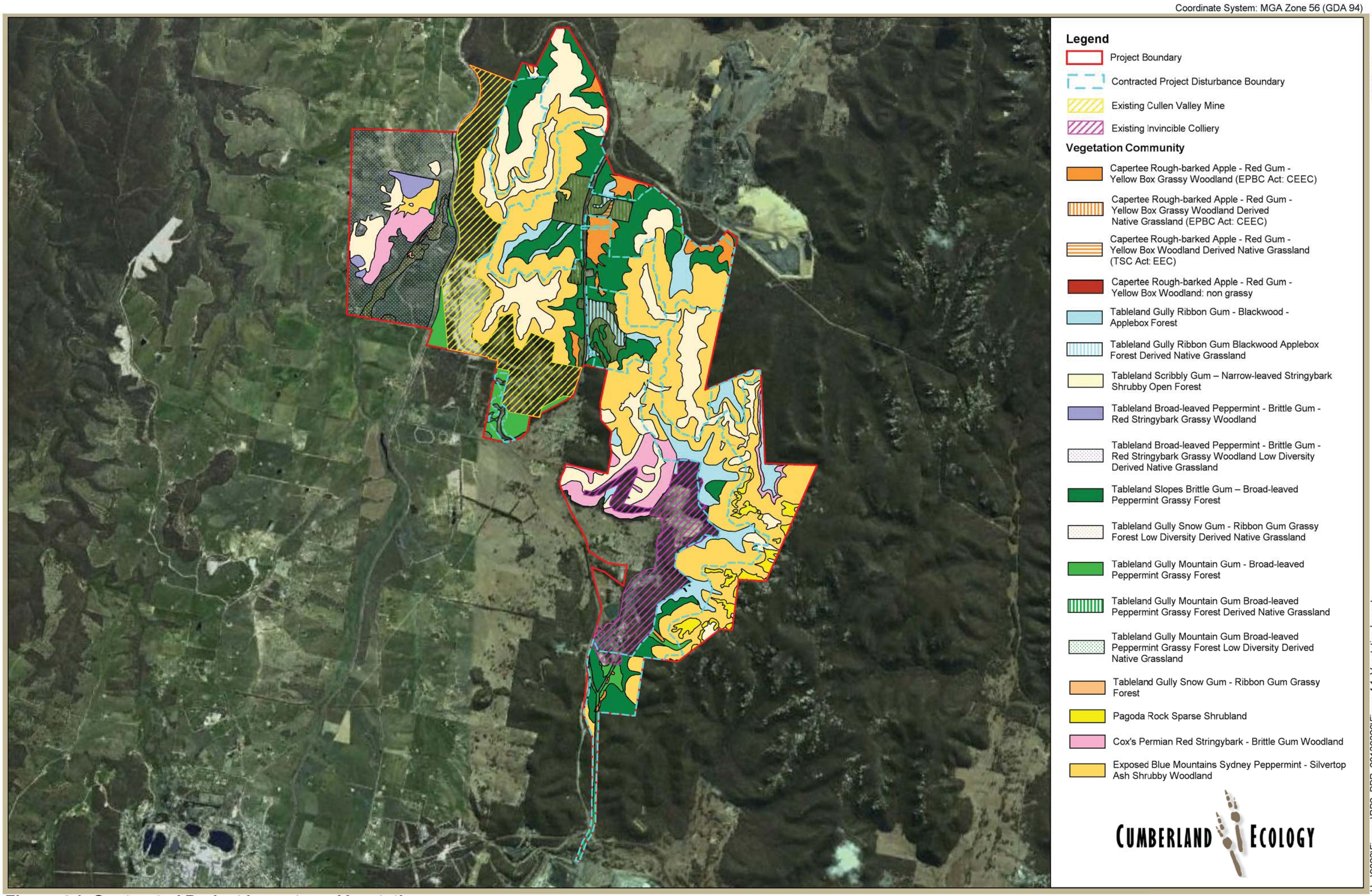

Figure 4.1. Contracted Project Impacts on Vegetation

Table 4.1 Vegetation Impact Comparison Between Exhibited Project Mine Plan and Contracted Project Mine Plan

Map Unit#	Vegetation Community	Area of Vegetation within Project Boundary (ha)	Area of Vegetation Impacted (ha) Exhibited Project Mine Plan	Area of Vegetation Impacted (ha) Contracted Project Mine Plan	Area of Vegetation Retained (ha) Contracted Project Mine Plan
MU11	Tableland Gully Snow Gum - Ribbon Gum Grassy Forest	0.90	0.00	0.00	0.90
MU11 DNG	Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland	23.35	0.00	0.00	23.35
MU13	Tableland Gully Ribbon Gum Blackwood Applebox Forest	111.81	93.94	91.15	20.66
MU13a	Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland	16.62	15.02	15.03	1.59
MU20	Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC)	46.18	16.21	14.96	31.21
MU20 DNG	Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC)	0.27	0.27	0.27	0.00
MU20a	Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy	0.12	0.11	0.11	0.01
MU20b	Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	1.99	1.96	1.96	0.03
MU30	Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	679.11	370.43	295.18	383.93
MU32	Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest	332.43	112.51	74.80	257.63
MU33	Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland	13.71	13.02	0.00	13.71
MU33 DNG	Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland	215.23	42.72	0.00	215.23

Table 4.1 Vegetation Impact Comparison Between Exhibited Project Mine Plan and Contracted Project Mine Plan

Map Unit#	Vegetation Community	Area of Vegetation within Project Boundary (ha)	Area of Vegetation Impacted (ha) <u>Exhibited Project Mine Plan</u>	Area of Vegetation Impacted (ha) <u>Contracted Project Mine Plan</u>	Area of Vegetation Retained (ha) <u>Contracted Project Mine Plan</u>
MU34	Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	260.85	185.77	182.86	78.00
MU34 DNG	Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland	57.07	50.10	49.23	7.84
MU35	Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	51.70	18.87	17.98	33.72
MGBIP DNG	Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland	12.84	12.43	12.43	0.41
MGBIP DNG	Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland	2.79	0.85	0.85	1.94
MU37	Cox's Permian Red Stringybark - Brittle Gum Woodland	92.02	23.71	5.05	86.97
MU43	Pagoda Rock Sparse Shrubland	32.87	0.05	0.00	32.87
	TOTAL	**1951.88**	**957.97**	**761.86**	**1190.02**

4.3.2 Regional and State Wide Impacts

Table 4.2 shows the area of each of these communities that is present within the Project Boundary, the area to be removed, and the area remaining in the Central West Catchment Management Authority (CMA) and within NSW as a whole.

Note that the areas of impact presented here are lower less than those presented in the Exhibited Project EA. The Exhibited Project Disturbance Boundary has been revised since the EA was exhibited to further reduce the ecological impacts of the Project which has resulted in a reduction in the area of vegetation to be removed for the Contracted Project.

As can be seen in Table 4.1 and Table 4.2, although the Contracted Project will result in the removal of approximately 762 ha of native vegetation, there are large areas of each vegetation community present in surrounding areas, and in many cases in nearby conservation reserves. The majority of the vegetation communities present in the Project Boundary are common and widespread, and for this reason are not listed under conservation legislation. No community is at the limit of its distribution and the area of each community proposed to be removed within the Contracted Project Disturbance Boundary is not critical for the survival of these communities. Taking the impacts to all vegetation communities together, the Project will impact on 0.169% of the vegetation present in the CWCMA and 0.07% of the native vegetation present in NSW (Table 4.2). Consequently, the areas to be removed are not considered to be significant in the regional or state context.

As noted in the Exhibited EA, Capertee Rough-barked Apple Red Gum Yellow Box Woodland (and derived native grassland) is listed as an EEC under the TSC Act and the EPBC Act. The conservation significance of this community and a detailed impact assessment for this community is presented in Section 4.2.3 of the Exhibited EIA. Approximately 46.57 ha of this community are present in the Project Boundary, of which 17.2 ha will be removed. This is a reduction of 1.2 ha or 7% of the impacts predicted for the Exhibited Project Disturbance Boundary. Large areas of this community occur in the CWCMA and in NSW (see Table 4.2). In the context of the large areas remaining in the CWCMA and in NSW as a whole, and taking into consideration the extensive mitigation and compensation measures proposed, this is not considered to comprise a significant impact to this community.

Table 4.2 Vegetation Impacts in a Regional and State Wide Context

Vegetation Community (DEC 2006)	Central West Broad vegetation Type	Vegetation Class (Keith 2004)	Area of Vegetation in the Project Boundary (ha)	Area within Contracted Project Disturbance Boundary (ha)	Area Retained within Project Boundary (ha)	CWCMA Extent (ha)	% Removed within CW Catchment	Extent of Vegetation within NSW (ha)	% Removed within NSW
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC)	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	46.18	14.96	31.22	224,242.13	0.007%	500,000-900,000	0.0030%
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC)	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	0.27	0.27	0.00	224,242.13	0.000%	500,000-900,000	0.0001%
Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	0.12	0.11	0.01	224,242.13	0.000%	500,000-900,000	0.0000%
Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	1.99	1.96	0.03	224,242.13	0.001%	500,000-900,000	0.0004%
Tableland Gully Ribbon Gum Blackwood Applebox Forest	Mountain Gum – Peppermint Forest at High Altitudes	Southern Tableland Grassy Woodland	111.81	91.15	20.66	28,651.11	0.318%	140,000-230,000	0.0651%
Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland	n/a	n/a	16.62	15.03	1.59	n/a	n/a	n/a	n/a

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Table 4.2 Vegetation Impacts in a Regional and State Wide Context

Vegetation Community (DEC 2006)	Central West Broad vegetation Type	Vegetation Class (Keith 2004)	Area of Vegetation in the Project Boundary (ha)	Area within Contracted Project Disturbance Boundary (ha)	Area Retained within Project Boundary (ha)	CWCMA Extent (ha)	% Removed within CW Catchment	Extent of Vegetation within NSW (ha)	% Removed within NSW
Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest	Inland Scribbly Gum Woodland	Southern Tableland Dry Sclerophyll Forests	332.43	74.80	257.63	53,049.15	0.141%	650,000-1,250,000	0.0115%
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland	Mountain Gum – Red Stringybark Open Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	13.71	0.00	13.71	81,070.92	0.000%	650,000-1,250,000	0.0000%
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland	Mountain Gum – Red Stringybark Open Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	215.23	0.00	215.23	n/a	n/a	n/a	n/a
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	Mountain Gum – Peppermint Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	260.86	182.86	78.00	81,070.92	0.226%	650,000-1,250,000	0.0281%
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland	n/a	n/a	57.07	49.23	7.84	n/a	n/a	n/a	n/a

Table 4.2 Vegetation Impacts in a Regional and State Wide Context

Vegetation Community (DEC 2006)	Central West Broad vegetation Type	Vegetation Class (Keith 2004)	Area of Vegetation in the Project Boundary (ha)	Area within Contracted Project Disturbance Boundary (ha)	Area Retained within Project Boundary (ha)	CWCMA Extent (ha)	% Removed within CW Catchment	Extent of Vegetation within NSW (ha)	% Removed within NSW
Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	Mountain Gum – Peppermint Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	51.70	17.98	33.72	28,651.11	0.063%	650,000-1,250,000	0.0028%
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland	n/a	n/a	12.84	12.43	0.41	n/a	n/a	n/a	n/a
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland	n/a	n/a	2.79	0.85	1.94	n/a	n/a	650,000-1,250,000	0.0001%
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest	Mountain Gum – Peppermint Forest at High Altitudes	Tableland Clay Grassy Woodland	0.90	0.00	0.90	28,651.11	0.000%	160,000-250,000	0.0000%
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland	n/a	n/a	23.35	0.00	23.35	n/a	n/a	n/a	n/a
Pagoda Rock Sparse Shrubland	no match	Sydney Montane Heath	32.87	0.00	32.87	no match available	n/a	60,000-100,000	0.0000%
Cox's Permian Red Stringybark - Brittle	Mountain Gum –	Southern	92.02	5.05	86.97	81,070.92	0.006%	650,000-	0.0008%

Table 4.2 Vegetation Impacts in a Regional and State Wide Context

Vegetation Community (DEC 2006)	Central West Broad vegetation Type	Vegetation Class (Keith 2004)	Area of Vegetation in the Project Boundary (ha)	Area within Contracted Project Disturbance Boundary (ha)	Area Retained within Project Boundary (ha)	CWCMA Extent (ha)	% Removed within CW Catchment	Extent of Vegetation within NSW (ha)	% Removed within NSW
Gum Woodland	Peppermint Forest at High Altitudes	Tableland Dry Sclerophyll Forest						1,250,000	
Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	Sydney Sandstone Woodland	Sydney Montane Dry Sclerophyll Forest	679.11	295.18	383.93	65,131.33	0.453%	180,000-240,000	0.1640%
TOTAL			**1951.88**	**761.86**	**1190.01**	**452,144.65**	**0.169%**	**1,690,000**	**0.0704%**

4.3.3 Impacts to Vegetation on Permian Sediments

A number of vegetation communities recorded from the Project Boundary are considered to be poorly reserved, and on this basis, OEH recommended that impacts to these communities be avoided. These communities include:

- Tableland Gully Ribbon Gum Blackwood Applebox Forest;
- Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest;
- Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland; and
- Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest.

These communities are discussed in more detail below.

i. Tableland Gully Ribbon Gum Blackwood Apple Box Forest

This forest occurs in the hills of the dry Capertee Valley along narrow gully systems, however it is likely to be distributed south to the Abercrombie Region and beyond (DEC (NSW) 2006). It is also likely to be more extensive across the adjoining catchment to the west of the Hawkesbury – Nepean. According to the DEC (2006) (now OEH), reservation status is difficult to assess given the absence of comparable mapping to the west, however it is more than likely that it is poorly reserved and suffered moderate levels of clearing.

Approximately 91 ha of this community will be removed for the Contracted Project; however a further 20 ha will be retained within the Project Boundary. While it is likely that this community is poorly reserved, this is true for many native vegetation communities that are not threatened. This community corresponds to the Central West BVT of Mountain Gum Peppermint Forest at High Altitudes. Approximately 28,651 ha of this community is present within the CWCMA outside of the Project Boundary and the Project will remove approximately 0.31% of this variant of this community in the CMA (see **Table 4.2**). It is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. Large areas of similar vegetation will be conserved within the offset areas that will provide similar values to those present in this community.

ii. Tableland Gully Mountain Gum Broad Leaved Peppermint Grassy Forest

This community occurs in the deeper gullies and sheltered slopes of the metamorphic and Permian hills of the western Cox's catchment (DEC (NSW) 2006). Reservation levels of this community are low, although improved only by the recent additions of Mt Walker to the reserve network (DEC (NSW) 2006). Clearing has been largely restricted to accessible sites, though across the range of the community levels of clearing are likely to be greater (DEC (NSW) 2006)

Approximately 18 ha of this community will be removed for the Contracted Project; however a further 33 ha will be retained within the Project Boundary. While it is likely that this community is poorly reserved, this is true for many non-listed native vegetation communities. This community corresponds to the Central West BVT of Mountain Gum Peppermint Forest at High Altitudes. Approximately 28,651 ha of this community is present within the CWCMA outside of the Project Boundary and the Project will remove approximately 0.06% of this community in the CMA. This community is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. As shown above, the Contracted Project will remove a very small proportion of this community that is present in the CMA and is not likely to threaten the long term persistence of this community. Large areas of similar vegetation will be conserved within the offset areas that will provide similar values to those present in this community.

iii. Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland

This community occurs on gentle rises, gullies and depressions in the dry Capertee Valley (DEC (NSW) 2006). This community is poorly reserved and has been heavily cleared and fragmented by past agricultural land use (DEC (NSW) 2006).

Approximately 17 ha of this community will be removed for the Contracted Project; however a further 31 ha will be retained within the Project Boundary. This community corresponds to the Central West BVT of Stringybark - Box - Gum Woodland. Approximately 224,242 ha of this community is present within the CW CMA outside of the Project Boundary and the Project will remove approximately 0.007% of this community in the CMA. This community is listed under the critically endangered under the EPBC Act and endangered TSC and thus warrants formal protection under each Act.

iv. Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest

This community favours the metamorphic slopes west of Lithgow, and is maybe more typical of the forests further west on the tablelands (DEC (NSW) 2006). The recent addition of Mount Walker to the reserve system greatly improves the reservation status of the community. However, across its range reservation status remains poor and clearing and grazing activities persist in accessible terrain (DEC (NSW) 2006).

Approximately 182 ha of this community will be removed for the Contracted Project; however a further 78 ha will be retained within the Project Boundary. While it is likely that this community is poorly reserved in the region, this is true for many non-listed native vegetation communities. This community corresponds to the Central West BVT of Mountain Gum Peppermint Forest at High Altitudes. Approximately 81,170 ha of this community is present within the CWCMA outside of the Project Boundary and the Project will remove approximately 0.23% of this community in the CMA. This community is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. As shown above, the Contracted Project will remove a very small proportion of this community that is present in the CMA and is not likely to threaten the long term persistence of this community. Large areas of similar vegetation will be conserved within the offset areas (including Hillview/Billabong) that will provide similar values to those present in this community.

4.4 Impacts to Habitat

In order to address concerns made by the PAC, the overall biodiversity values of the Project Boundary have been described as a function of the topography and landscape features present that provide a diversity of habitats, as well as its location in the region and the proximity of large areas of conserved native vegetation in State Forests and protected native vegetation in National Parks.

The Project Boundary is located in a highly biodiverse part of NSW. Large blocks of remnant native vegetation remain in the area, in particular in several National Parks and State Forests that occur in the vicinity of the Project Boundary including the following:

- Gardens of Stone National Park
- Blue Mountains National Park;
- Turon National Park;
- Wollemi National Park;
- Ben Bullen State Forest;
- Sunny Corner State Forest;
- Wolgan State Forest; and
- Newnes State Forest.

The Project Boundary is approximately 1,951 ha in size, and the areas that have not been modified by previous mining operations contain large expanses of open forest and woodland communities.

The Project Boundary encompasses a wide variety of landscapes, from rugged ridgelines containing weathered sandstone, Sandstone Outcrops and a SPL, to deep gullies and undulating rolling land. A series of steep sided gullies associated with the sandstone landscape form numerous ephemeral gullies. A range of factors including the ridge and valley topography, altitude, aspect and exposure result in small localised microclimates which provide a diverse range of habitat for both flora and fauna. The primary fauna habitats located within the Project Boundary are:

- Open forest communities;
- Woodland communities;
- Pagodas and caves; and

- Permanent water bodies such as dams and ephemeral creeks.

Within the forest and woodland communities in the Project Boundary, the following key habitat features provide suitable habitat for a wide range of fauna types including: amphibians, reptiles, birds, bats and arboreal and terrestrial mammals:

- Woodland and forest vegetation – shelter and forage for birds including raptors and microbats;
- Dense understorey vegetation – shelter and foraging habitat for amphibians, reptiles, small birds and terrestrial mammals;
- Fallen logs, debris and leaf litter – shelter habitat for amphibians, reptiles and terrestrial mammals;
- Rocky outcrops – shelter and breeding habitat for amphibians, reptiles terrestrial mammals and cave dwelling microbats;
- Hollow-bearing living trees and stags – providing shelter and breeding habitat for a range of reptiles, birds, arboreal mammals and microbats;
- Nectar-producing trees and shrubs – foraging habitat for insects, blossom-dependant birds, arboreal mammals and megachiropteran bats (flying-foxes);
- Feed trees, shrubs and grasses for a range of species – food for small birds, cockatoos and herbivorous mammals;
- Ecotonal (edge) communities – foraging habitat for many species;
- Ephemeral drainage lines - foraging, shelter and breeding habitat for amphibians, aquatic reptiles, wetland birds and aquatic mammals; and
- Constructed farm dams with limited aquatic vegetation - foraging and breeding habitat for amphibians, aquatic reptiles and wetland birds.

A key component of the biodiversity present in the Project Boundary is the ecotone between the Sandstone Outcrops and SPLs, and the lower lying gullies and woodlands on the slopes. This mosaic of habitats provides important habitat for many species. Some, such as the Brush-tailed Rock Wallaby and the Broad-headed Snake are known to shelter in the SPLs and Sandstone Outcrops, and to travel to the more fertile lower slopes to feed. It is this combination of refuge and foraging habitat that makes this area important for some fauna species.

This has been recognised by Coalpac, and the Exhibited Project Disturbance Boundary has been revised to provide a greater protection of foraging habitat around Sandstone Outcrops within the SPL . This will reduce the disturbance to shelter habitat and will provide more foraging habitat in the lower lying gullies. These gullies are important foraging areas for some species and the preservation of greater areas of these gullies will benefit those species that rely on these habitats adjacent to the Sandstone Outcrops and SPLs.

4.5 Impacts to Flora Species

This section outlines the impacts of the Contracted Project on flora species, taking into consideration the Contracted Project mine plan, which has resulted in a significant reduction in area of disturbance for many species. This section also addresses some of the issues raised by the PAC in relation to flora species; in particular it contains a broader discussion of non-listed flora species including several species listed as ROTAP that have been identified on the Project Boundary by Cumberland Ecology and others.

Several threatened flora species have been recorded from the Project Boundary including the following species;

- *Eucalyptus aggregata* (Black Gum), listed as Vulnerable under the TSC Act;
- *Eucalyptus cannonii* (Capertee Stringybark), listed as Vulnerable under both the TSC Act and the EPBC Act; and
- *Persoonia marginata* (Clandulla Geebung), listed as Vulnerable under both the TSC Act and the EPBC Act.

Although they were not recorded from the Project Boundary, several additional threatened species have been assessed as having potential to occur due to the presence of suitable habitat and occurrence in the Lithgow LGA. These include the following species:

- *Eucalyptus pulverulenta* (Silver-leaved Mountain Gum), listed as Vulnerable under the EPBC Act and TSC Act;
- *Grevillea obtusiflora ssp. obtusiflora,* listed as Endangered under the EPBC Act and TSC Act;
- *Grevillea obtusiflora ssp. fecunda,* listed as Endangered under the EPBC Act and TSC Act;
- *Prostanthera cryptandroides subsp. cryptandroides*, listed as Vulnerable under the EPBC Act and TSC Act
- *Grevillea evansiana*, listed as Vulnerable under the EPBC Act and TSC Act; and
- *Derwentia blakelyi*, listed as Vulnerable under the TSC Act.

The threatened species recorded from the Project Boundary or with potential to occur have been discussed in detail in the Exhibited EIA and a comprehensive impact assessment on threatened flora species is provided in Section 4.5 of that document. This assessment concluded that with the implementation of the proposed impact mitigation and compensation measures, no significant impact was predicted to occur to threatened flora species.

Furthermore, the Project Disturbance Boundary has been revised since the Exhibited Project EA, which has resulted in a reduction in the area of impact for all known threatened flora species in the Project Boundary. The Contracted Project Disturbance Boundary avoids all impacts to known habitat for Persoonia marginata, and has resulted in a reduction in impact to Eucalyptus cannonii habitat from 278 ha to 204 ha (a reduction of 73.94 ha or 27% of the Exhibited Project Disturbance Boundary). A comparison of the amount of habitat to be removed by the Contracted Project Disturbance Boundary and the Exhibited Project Disturbance Boundary for all the above listed species is shown in Table 4.3.

4.5.1 Impacts to ROTAP Species

i. Gonocarpus longifolius

Gonocarpus longifolius has been recorded in ranges from Armidale to the Blue Mountains, east of Rylstone, on the North and Central Coasts, Central Tablelands, and Central Western Slopes divisions. Surveys in the ranges around the Goulburn River valley have revealed considerable populations (> 1,000 plants) both within and outside of existing conservation reserves (Bell 2001). The species is particularly common in the northern portions of Wollemi National Park, stretching some 70 km from the California Trail to Cox's Gap. Other populations are also known from the Singleton Military Area, which probably represents the eastern most limit of the species (Bell 2001).

The Contracted Project Disturbance Boundary has resulted in all areas of known habitat for this species being entirely avoided (see **Table 4.3**). No specimens or areas of habitat for this species will be disturbed. Accordingly, the Contracted Project is considered unlikely to result in an increased risk of extinction for this species.

ii. Acacia asparagoides

Acacia asparagoides occurs from Newnes Junction to Lawson, in the Blue Mountains. There is a single specimen from Boonoo Boonoo River, on the North Coast, outside this distribution range. It is known to grow in dry sclerophyll forest or occasionally heath on sandstone (Botanic Gardens Trust 2013a).

It is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. Approximately 682 ha of habitat for this species will be removed by the Contracted Project, however this is a substantial reduction of 153 ha compared to that predicted for the Exhibited Project. Large areas of potential habitat will remain outside the Contracted Project Disturbance Boundary and potential habitat for this species will remain in the locality. Accordingly, the Contracted Project is considered unlikely to result in an increased risk of extinction for this species.

iii. Leionema lamprophyllum subsp. orbiculare

Leionema lamprophyllum subsp. obiculare occurs from Kandos Weir (east of Rylstone) to Lithgow, in the Blue Mountains, NSW. It occurs in the NSW botanical subdivision of Central

Coast. It grows in heath on exposed ridges at higher altitudes (Botanic Gardens Trust 2013b).

It is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. However, the Contracted Project Disturbance Boundary has resulted in all areas of known habitat for this species being avoided (see **Table 4.3**). No specimens or areas of habitat for this species will be disturbed. Accordingly, the Contracted Project is considered unlikely to result in an increased risk of extinction for this species.

iv. Leucochrysum graminifolium

Leucochrysum graminifolium grows on exposed sites on sandy soils; from Lithgow district to Newnes. (Botanic Gardens Trust 2013c) It occurs in the NSW botanical subdivisions of Central Coast and Central Tablelands.

It is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. However, the Contracted Project Disturbance Boundary has resulted in all areas of known habitat for this species being avoided (see **Table 4.3**). No specimens or areas of habitat for this species will be disturbed. Accordingly, the Contracted Project is considered unlikely to result in an increased risk of extinction for this species.

v. Philotheca obovalis

Philotheca obovalis grows in heath and dry sclerophyll forest on sandstone; chiefly in the Blue Mountains although it has also been recorded at Kydra Mountain. It occurs in the NSW botanical subdivisions of Central Coast, Central Tablelands and Southern Tablelands (Botanic Gardens Trust 2013d).

It is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. However, the Contracted Project Disturbance Boundary has resulted in all areas of known habitat for this species being avoided (see **Table 4.3**). No specimens or areas of habitat for this species will be disturbed. Accordingly, the Contracted Project is considered unlikely to result in an increased risk of extinction for this species.

4.6 Impacts to Fauna Species

This section outlines the impacts of the Contracted Project on fauna species. The revision of the mine plan has resulted in a significant reduction in area of disturbance for many species in comparison to those impacts predicted in the Exhibited Project EIA.

More than 130 fauna species have been recorded in the Project Boundary by Cumberland Ecology, and other undetected species are certainly present. This is a very high faunal diversity that is nearly certainly due to the diversity of microhabitats present in the area, as outlined in more detail in Section 3. A total of 10 threatened fauna species have been recorded from the Project Boundary and potential habitat is present for a further 24 species. These include microchiropteran bat species, terrestrial mammals, large owls and cockatoos, nectarivorous birds and woodland dependent bird species.

The precautionary principle has been enacted in the impact assessment process and all threatened species which have potential habitat present have been assessed as though they occur. As explained in detail in Chapter 5 and Chapter 6 a substantial offsets and mitigation strategy has been developed for the Contracted Project to mitigate the impacts of the Project on fauna species. This includes protecting habitat within the Project Boundary but outside of the Contracted Project Disturbance Boundary; rehabilitation of mined landscapes to woodland and forest in the long term and the provision and protection for long term conservation of large areas of offset land that will provide habitat for fauna species. With the implementation of the proposed mitigation and compensation measures, no significant impact is predicted to occur to threatened species as a result of the Contracted Project.

That notwithstanding, the Exhibited Project Disturbance Boundary has been revised since the EA was exhibited, and the areas of impact have been reduced. Approximately 152 ha of impact have been avoided through modification of the mine plan design proposed for the Contracted Project. A detailed breakdown of the changes in area of habitat for these threatened species is provided in Table 4.3. Many of the threatened fauna species are able to use the majority of the Disturbance Boundary, and therefore the Contracted Project has resulted in an increase in 152 ha or 18% of habitat relative to the Exhibited Project mine plan.

It is recognised that the Project Boundary is highly diverse and supports a wide range of habitats for native species as discussed in Chapter 3. That notwithstanding, large areas of similar habitats are protected in nearby conservation reserves, and the habitat present in the Project Boundary is not considered to be critical for the survival of any fauna species. The offsets and rehabilitation that are proposed will benefit these species as well as the threatened species, and viable populations currently present in the Project Boundary are expected to persist into the future in these areas.

4.6.1 Broad-headed Snake Impacts

The vast majority of potential Broad-headed Snake habitat falls outside the Contracted Project Disturbance Boundary (Figure 3.1). The reduced open cut footprint created to protect the SPL will mean that no potential habitat will be directly impacted in the area around the SPL.

Despite the provision of these stand-offs and protected areas, there is always some chance of minor direct or indirect impacts on the few areas of habitat within the Contracted Project Disturbance Boundary. The proportion of impacted habitat is very low in comparison to the amount of potential habitat to be avoided by the Contracted Project. Moreover there are large areas of potential habitat conserved in Ben Bullen State Forest, to the immediate east of the Project Boundary. Given the patchy distribution of suitable winter habitat, the apparent paucity of available prey habitat and accessibility to the area by snake poachers, these habitat areas would support few (if any) Broad-headed Snakes, and the impacts are not likely to be detrimental to the species in the local area.

Moreover there are large areas of potential habitat remaining in Ben Bullen State Forest, to the immediate east of the Project Boundary. Given the patchy distribution of suitable winter habitat, the apparent paucity of available prey habitat and accessibility to the area by snake poachers, these habitat areas would support few (if any) Broad-headed Snakes, and the impacts are not likely to be detrimental to the species in the local area.

A comprehensive suite of mitigation measures is proposed for the Contracted Project to further reduce impacts (see Chapter 5).

Table 4.3 provides a comprehensive summary of predicted impacts for all threatened species, vegetation communities and ROTAP species previously discussed in this chapter.

Table 4.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status			Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
		TSC	EPBC	ROTAP			TOTAL IMPACT (ha)	TOTAL IMPACT (ha)		
FLORA										
Eucalyptus cannonii	Capertee Stringybark	V	V		13, 20, 32, 34, 37, 35, 33	Y	278.00	204.06	73.94	27%
Persoonia marginata	Clandulla Geebung	V	V		32	Y	3.09	0.00	3.09	100%
Eucalyptus aggregata	Black Gum	V			11	Y	0.00	0.00	n/a	n/a
Gonocarpus longifolius				3RC	43	N	0.05	0.00	0.05	100%
Acacia asparagoides				2R	S, F, W	Y	835.63	682.09	153.54	18%
Leionema lamprophyllum subsp. orbiculare				2R	43	Y	0.05	0.00	0.05	100%
Leucochrysum graminifolium				2R	43	Y	0.05	0.00	0.05	100%
Philotheca obovalis				3RCa	43	Y	0.05	0.00	0.05	100%
Eucalyptus pulverulenta	Silver-leaved Mountain Gum	V	V		30, 32	N	482.94	369.98	112.96	23%

Table 4.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status		Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
Grevillea obtusiflora ssp. obtusiflora		E	E	F, W	N	835.63	682.09	153.54	18%
Grevillea obtusiflora ssp. fecunda		E	E	F, W	N	835.63	682.09	153.54	18%
Prostanthera cryptandroides subsp. cryptandroides		V	V	43, 32, 20	N	128.77	89.76	39.01	30%
Grevillea evansiana		V	V	43, 30	N	370.48	295.18	75.30	20%
Derwentia blakelyi		V		11, 13, 20	N	110.15	106.12	4.03	4%
FAUNA									
Reptiles									
Hoplocephalus bungaroides	Broad-headed Snake	V	V		N	see section 4.6.1			
Varanus rosenbergi	Rosenberg Goanna	V		S, F, W	N	835.63	682.09	153.54	18%
Birds									
Callocephalon fimbriatum	Gang Gang Cockatoo	V		F, W	Y	834.58	682.09	152.49	18%
Calyptorhynchus	Glossy Black Cockatoo	V		S, F, W	N	834.63	682.09	152.54	18%

Table 4.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status		Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
lathami									
Climacteris picumnus victoriae	Brown Treecreeper	V		F, W	Y	834.58	682.09	152.49	18%
Daphoenositta chrysoptera	Varied Sittella	V		F, W	Y	834.58	682.09	152.49	18%
Glossopsitta pusilla	Little Lorikeet	V		F, W	N	834.58	682.09	152.49	18%
Grantiella picta	Painted Honeyeater	V		F, W	N	834.58	682.09	152.49	18%
Lathamus discolor	Swift Parrot	E	E, M	F, W	N	834.58	682.09	152.49	18%
Lophoictinia isura	Square-tailed Kite	V		F, W	Y	834.58	682.09	152.49	18%
Melanodryas cucullata cucullata	Hooded Robin	V		F, W	N	834.58	682.09	152.49	18%
Melithreptus gularis gularis	Black-chinned Honeyeater	V		F, W	N	834.58	682.09	152.49	18%
Neophema pulchella	Turquoise parrot	V		F, W	N	834.58	682.09	152.49	18%
Ninox connivens	Barking Owl	V		F, W	N	834.58	682.09	152.49	18%
Ninox strenua	Powerful Owl	V		F, W	Y	834.58	682.09	152.49	18%
Petroica boodang	Scarlet Robin	V		F, W	Y	834.58	682.09	152.49	18%

Table 4.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status		Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
Petroica phoenicea	Flame Robin	V		F, W	N	834.58	682.09	152.49	18%
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V		F, W	N	834.58	682.09	152.49	18%
Pyrrholaemus saggitatus	Speckled Warbler	V		F, W	Y	834.58	682.09	152.49	18%
Stagonopleura guttata	Diamond Firetail	V		F, W	N	834.58	682.09	152.49	18%
Tyto novaehollandiae	Masked Owl	V		F, W	N	834.58	682.09	152.49	18%
Xanthomyza phrygiai	Regent Honeyeater	CE	E, M	F, W	N	834.58	682.09	152.49	18%
Mammals									
Cercartetus nanus	Eastern Pygmy Possum	V		S, F, W	N	834.63	682.09	152.54	18%
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	S ,F, W	Y	834.58	682.09	152.49	18%
Dasyurus maculatus	Spotted-tail Quoll	E	E	S, F, W	N	834.63	682.09	152.54	18%
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		F, W	Y	834.58	682.09	152.49	18%
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat	V		S, F, W	Y	834.58	682.09	152.49	18%

Table 4.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status		Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
Mormopterus norfolkensis	Eastern Free-tail Bat	V		F, W	Y	834.58	682.09	152.49	18%
Petaurus australis	Yellow-bellied Glider	V		F, W	N	834.58	682.09	152.49	18%
Petaurus norfolcensis	Squirrel Glider	V		F, W	Y	834.58	682.09	152.49	18%
Saccolaimus flaviventris	Yellow-bellied Sheathtailbat	V		F, W	N	834.58	682.09	152.49	18%
Scoteanax rueppellii	Greater Broad-nosed Bat	V		F, W	Y	834.58	682.09	152.49	18%
Petrogale penicillata	Brush-tailed Rock Wallaby	V	E	S, F, W	N	444.97	371.08	73.89	17%
Phascolarctos cinereus	Koala	V	V	F, W	N	142.16	124.21	17.95	13%
Ecological Communities									
MU11	Tableland Gully Snow Gum - Ribbon Gum Grassy Forest					0.00	0.00	n/a	n/a
MU11 DNG	Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland					0.00	0.00	n/a	n/a

Table 4.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status	Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
MU13	Tableland Gully Ribbon Gum Blackwood Applebox Forest				93.94	91.15	2.79	3%
MU13a	Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland				15.02	15.03	-0.01	0%
MU20	Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC)	E CE			16.21	14.96	1.25	8%
MU20 DNG	Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC)	E CE			0.27	0.27	0.00	0%
MU20a	Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy				0.11	0.11	0.00	0%
MU20b	Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	E			1.96	1.96	0.00	0%

Table 4.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status	Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
MU30	Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland				370.43	295.18	75.25	20%
MU32	Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest				112.51	74.80	37.71	34%
MU33	Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland				13.02	0.00	13.02	100%
MU33 DNG	Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland				42.72	0.00	42.72	100%
MU34	Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest				185.77	182.86	2.92	2%
MU34 DNG	Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy				50.10	49.23	0.87	2%

Table 4.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status	Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
	Forest Derived Native Grassland							
MU35	Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest				18.87	17.98	0.89	5%
MGBIP DNG	Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland				12.43	12.43	0.00	0%
MGBIP DNG	Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland				0.85	0.85	0.00	0%
MU37	Cox's Permian Red Stringybark - Brittle Gum Woodland				23.71	5.05	18.66	79%
MU43	Pagoda Rock Sparse Shrubland				0.05	0.00	0.05	100%

4.7 Edge Effects

As discussed in the Exhibited Project EA, the Project will result in habitat fragmentation which leads to "edge effects". This refers to changes in physical and biological conditions at an ecosystem boundary or interface between adjacent ecosystems (Fischer and Lindenmayer 2007), particularly between natural habitats such as forests and disturbed or developed land (Yahner 1988). Edge effects result in an extension of the potential ecological impacts of a Project beyond the areas to be cleared and into areas of forest and woodland that are being retained. The impacts of edge effects are discussed in more detail in Section 4 of the Exhibited Project EIA and in Section 4.13.8 of the Response to Submissions Report (Hansen Bailey Environmental Consultants 2012).

As edge effects extend the ecological impacts of a Project beyond the areas to be directly cleared, the overall disturbance footprint is greater than the area to be removed. Accordingly, in order for the full ecological impact of the Project to be understood, the PAC has recommended that the edge effects from the Project be quantified.

It is difficult to calculate edge effects with any degree of precision, due to the variable nature of the impacts attributed to edge effects. To quantify edge effects that have not yet occurred would be arbitrary. Edge effects have been well documented and studied extensively however the studies have been extremely site specific and cannot be accurately applied to this Project. Accurate studies can only be carried out once mining commences should the Project be approved. This can be managed via the BMP.

Cumberland Ecology is unaware of other mining projects in NSW where the proponent has been asked to quantify or estimate edge effects. Despite this, to address OEH's concerns on edge effects, the Contracted Project Disturbance Boundary not only reduces the area of direct disturbance by 20% (when compared to the area of the Exhibited Project Disturbance Boundary), but also reduces the periphery by 10%. The perimeter of the Contracted Project Disturbance Boundary is 48.28 km (5.48 km smaller than the perimeter of the Exhibited Project Disturbance Boundary). This reduction in the disturbance footprint focuses on reducing the extent of direct impacts along the SPL and associated wet gullies and thus potential indirect impacts such as edge effects. Adjacent to the BBSF SPL, this reduction in the perimeter of the open cut amounts to 25%. Similarly no open cut mining is proposed to forest and woodland west of the railway line on Hillcroft avoiding further impacts from fragmentation.

As explained in the Response to Submissions for the Exhibited Project, the EIA discussed the likely impacts of edge effects and has estimated the degree of impact. Edge effects are likely to be highly localised to the areas surrounding the Contracted Project Disturbance Boundary, based on site observations around the existing mines. Noise, light and dust levels are expected to reduce relatively rapidly with increasing distance from the area of direct disturbance. Edge effects are not expected to penetrate deep into retained vegetation as the majority of retained vegetation occur upslope of operations (except some areas of Box Gum Woodland), eliminating potential impacts from runoff and sedimentation from mining areas.

All retained native vegetation including Box Gum Woodland will be subject to strict management measures such as monitoring and controlling weed levels, diverting water from disturbed sites into water treatment basins, erecting and maintaining sediment fencing around vegetation will be implemented to reduce edge effects. Edge effects will be addressed comprehensively in the BMP to be prepared for the Contracted Project, should it be approved.

Staged rehabilitation of mined areas will also serve to address the impacts of edge effects by eventually creating new habitat, and by transferring some habitat features (hollow logs, some large rocks) into rehabilitation, where it can be used by fauna. By the time the mine has been completed, substantial areas of regenerating vegetation will have been created and so edge effects will be reduced adjacent to such rehabilitation.

4.8 Cumulative Impacts

The locality surrounding the Project Boundary contains a variety of mining and other industrial development that includes:

- Baal Bone Colliery (closed);
- Mount Piper Power Station Extension;
- Ivanhoe North Colliery (closed);
- Neubeck Coal Project Proposal; and
- Pine Dale Coal Mine;
    - Yarraboldy Extension; (in operation)
    - Stage 1 and Stage 2 Extensions(DGRs issued)

All were considered in the Exhibited EA with the exception of the Pine Dale Stage 2 Extension and Neubeck Coal Project (for which public information was not available at the time of publication).

On current information publically available, most of the surrounding projects are not seeking approval to clear large areas of vegetation.

Baal Bone Colliery proposes to continue underground mining in the northern parts of Ben Bullen State Forest. Mining has now concluded in Longwalls 28-31 and has not directly impacted vegetation through clearing.

The Mount Piper Power Station Extension proposes to avoid direct impacts to remnant native vegetation by restricting construction to pre-cleared areas containing regrowth and planted gardens.

Ivanhoe North Colliery has resulted in the clearance of approximately 12.3 ha of relatively undisturbed native vegetation and rehabilitation is now in progress.

The Neubeck Coal Project is a new proposal for an open cut coal mine at Blackmans Flats, approximately 5 km east of the Project. The only publically available information to date is a preliminary briefing paper, which does not contain details on areas of vegetation to be removed. Until more information is available to the public, it can only be noted at this stage.

The Yarraboldy Extension of Pine Dale Coal Mine will remove 27 ha of vegetation, 14 ha being native vegetation. Pine Dale Coal Mine Stage 1 Extension will remove approximately 60 ha and Stage 2 Extension will remove approximately 170 ha, the majority of which occurs The Yarraboldy Extension (Stage 1) of the pine dale coal mine has Project Approval to remove 14ha of vegetation within a 27ha site. The Stage 2 extension proposes to remove approximately 183ha of vegetation, located predominantly within the Ben Bullen State Forest.

Ben Bullen State Forest.

Collectively, the Contracted Project makes up the majority of the cumulative impacts. The cumulative impacts of Pine Dale and the Project amount to approximately 998 ha of vegetation removal. That notwithstanding, both the Contracted Project and the Pine Dale Extension projects will be required to provide offsets to compensate for the impacts of these projects. Collectively, this will result in the protection of a very large area of forest for conservation.

Areas of the Ben Bullen State Forest will be subject to open cut, highwall and underground mining within the next two to three decades, however beyond that no further disturbance is likely to occur as a result of mining. The coal proposed to be mined by the Contracted Project is the last remaining coal to be mined in the Cullen Bullen area, and as such the cumulative impacts are finite and known.

4.9 Impacts to SPLs

As outlined in Chapter 3, these areas were recognised early in the assessment process by Coalpac being significant areas, however as impacts to these areas are being avoided, they were not discussed in detail.

To provide an assessment of the potential impacts of the Contracted Project on SPLs, it is important to provide regional context. According to the mapping of “pagoda country” conducted by Washington and Wray (2011), approximately 60,000 ha of pagoda country occurs in the region.

Cumberland Ecology conducted an analysis of the extent of SPLs in the region. Approximately 25,893 ha of SPL have been recorded from the region, extending from Northern Wollemi Park to Lithgow. Much of this area (18,851 ha) is outside of the pagoda country mapped by Washington and Wray (2011), mostly to the north of the Project Boundary, north-east of the town of Kandos.

Of the total area of SPLs mapped in the region, approximately 113 ha occur in the Project Boundary. This is equivalent to approximately 0.44% of the total area of SPLs in region.

None of the major sandstone outcrops (including those of the SPLs) present in the Project Boundary were proposed to be disturbed, either under the Exhibited Project or the Contracted Project. Stand-off from open cut mining and the exclusion of highwall mining under the sandstone pagoda formations within the SPLs (highwall mining is proposed only under the gullies), as proposed in the Contracted Project, will eliminate the potential for structural damage to them. A subsidence assessment has been conducted that concludes that the sandstone pagoda formations within the SPLs will not be impacted by subsidence as a result of highwall mining and thus will be preserved in the landscape.

Taking into consideration the very small percentage of SPL that occur within the Project Boundary, and the fact that it will not be directly disturbed by open cut or highwall mining activity, it is concluded that the Contracted Project will not impact on the SPLs in the Project Boundary. Similarly, this means that the flora and fauna of conservation significance associated with the SPLs will also be substantially protected.

4.10 Impacts to Ben Bullen State Forest and Gardens of Stone Stage 2 State Conservation Area Proposal

In the Exhibited EIA, Cumberland Ecology made the point that the area of mining proposed by the Exhibited Project within Ben Bullen State Forest is small, relative to the overall area of the State Conservation Area Proposal. As discussed in this report, the proposed footprint of the open cut mine for the Contracted Project is proposed to be reduced substantially and so the area of the proposed State Conservation Area that would be to be mined and progressively rehabilitated is even smaller than was stated in the Exhibited EA. The revised figures for predicted impacts to the proposed State Conservation Area proposal are provided below.

Additionally, as covered in Section 4.10.2, the Gardens of Stone Stage 2 (GOS2) conservation proposal is for a State Conservation Area and under NSW legislation mining areas can be permitted.

4.10.1 Impacts to Ben Bullen State Forest

Ben Bullen State Forest covers approximately 6,783 ha. The Project is largely located within the State Forest, with approximately 1,442 ha of the Project Boundary (58%) lying within it. Of this, approximately 673 ha occurs within the Contracted Project Disturbance Boundary. Therefore the Project will result in the progressive removal and rehabilitation of 8% of Ben Bullen State Forest over 21 years, at an average rate of 32 ha per annum. The removal of forest and woodland will occur on the western edge of Ben Bullen State Forest, adjacent to the Castlereagh Highway.

Short term impacts to parts of Ben Bullen State Forest are expected to be high; however the progressive removal and subsequent rehabilitation will cause the long-term impacts to Ben

Bullen State Forest to be low. Further, Coalpac is committed to continuing high quality rehabilitation of open cut areas within Ben Bullen State Forest.

4.10.2 Impacts to Gardens of Stone Stage 2 Proposal

The Special Interest Group Colong Foundation for Wilderness has a proposal to expand the Gardens of Stone conservation area (Muir, 2005). The proposal, known as the GOS2 covers an area approximately 39,888 ha and consists of six divisions that are proposed to extend the Blue Mountains National Park and Gardens of Stone National Park by creation of two new conservation areas: the Gardens of Stone State Conservation Area and Western Escarpment State Conservation Area. The division that the Project Boundary lies within is the Baal Bone and Long Swamp Division (BBLSD). The BBLSD has been nominated by the Colong Foundation for inclusion into GOS2 for its “massed pagoda ‘villages’ that stand above the diverse swampy plains”.

Although parts of the Project are located within the GOS2 proposal, it constitutes 1.2% of the proposed conservation area and the clearing of this vegetation is to be rehabilitated in stages as mining progresses. Moreover the proposed biodiversity offset areas for the Project (see Chapter 6) will add to and complement some of the objectives of GOS2. The Project will have negligible impact upon Sandstone Outcrops and the Ben Bullen SPL. It will not remove any “pagoda villages” or cliff lines (i.e. SPLs) within the Project Boundary. Of the 673 ha proposed to be disturbed by the Project, approximately 470 ha are located within the BBLSD. This constitutes approximately 6.03% of the total area of BBLSD. This value (470 ha) is lower because areas of Ben Bullen State Forest to the west of the Castlereagh Highway have not been included in the BBLSD of GOS2 as proposed by Muir (2005)..

It is noted that there is no current Government policy in place to reserve the land to be disturbed by the Contracted Project in the NSW conservation estate.

A Project biodiversity offset property, Hyrock Hartley, is located within the western escarpment division in an area proposed as an extension to the Blue Mountains National Park. The western escarpment division covers 4,000 ha. The Hyrock Hartley property covers approximately 236 ha of intact native sandstone vegetation and constitutes 5.9% of the western escarpment division and 0.6% of the GOS2.

Chapter 5

Impact Mitigation Measures

The purpose of this chapter is to outline the mitigation and offsetting measures proposed to ameliorate the impacts of the Contracted Project on flora and fauna. A suite of substantial mitigation measures were presented in the Exhibited EIA to mitigate these impacts, and these are summarised in this section. As part of the development of the Contracted Project, additional measures to avoid and mitigate impacts have been identified and these are also presented in this Chapter.

5.1 Avoidance

Avoiding environmental impacts has been considered throughout the Project planning and design phases. The Project mine plan has been devised through the consideration of a number of alternatives which were developed to reduce the potential for adverse impacts to the environment, including specific impacts on threatened ecological communities and species.

Avoiding environmental impacts has been considered in the design of the Contracted Project mine plan to further reduce vegetation clearance, further avoid SPLs and associated gully habitat and to minimise clearance of threatened flora and fauna habitat. These avoidance measures were achieved through either completely excising open cut methods in some gullies below Sandstone Outcrops to the edges of the SPLs or limiting increasing setback of both open cut and highwall extraction to avoid subsidence risk to the Sandstone outcrops.

5.1.1 Avoidance of Vegetation

In total the Contracted Project mine plan will avoid 61% (1,190 ha) of all native vegetation located within the Project Boundary (a reduction of 20% compared to the Exhibited Project mine plan).

Significant modification to the design of the mine plan for the Contracted Project has reduced the need for clearing large blocks of CEEC Box Gum Woodland. This was largely achieved in the northern portions of the Project Boundary, around the Cullen Valley and East Tyldesley area. The Contracted Project will avoid 31.25 ha of Box Gum Woodland listed under the EPBC Act and TSC Act.

The alignment of the conveyor to the Mount Piper Power Station has also been located adjacent to and partially within an existing power line infrastructure alignment to reduce the amount of vegetation clearing. These avoidance measures have excluded a further 186 ha of native vegetation from surface mining disturbance within the Project Boundary over the life of the mine (21 years).

The extent of avoidance of higher conservation value vegetation on Permian sediments between the Exhibited Project and Contracted Project is provided below:

- An additional 3% of Tableland Gully Ribbon Gum Blackwood Applebox Forest (an 18% reduction in the Project Boundary);
- An additional 5% of Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest (a 65% reduction in the Project Boundary) ;
- An Additional 8% of Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (a 68% reduction in the Project Boundary); and
- An additional 2% of Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest (a 30% reduction in the Project Boundary).

In addition, 57% of Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland within the Project Boundary will also be avoided. This community occupies the talus slopes and extends down to the valley floor. Table 4.3 compares the area of each vegetation community impacted by the Exhibited Project and Contracted Project.

5.1.2 Avoidance of Flora and Fauna

The Exhibited EIA contained measures to avoid some areas of Persoonia marginata habitat within the Project Boundary, however the Contracted Project Disturbance Boundary completely avoids all Persoonia marginata habitat within the Project Boundary. This will result in 16.19 ha of habitat for this species within the Project Boundary that will not be directly impacted. The total extent of this population reaches far beyond the bounds of the Project Boundary and totals in excess of 49.77 ha.

The Contracted Project Disturbance Boundary avoids 704.65 ha (22,172 individuals) of Eucalyptus cannonii habitat within the Project Boundary.

A number of ROTAP species were recorded in the Project Boundary by Special Interest Groups. The majority of these species occur in Pagoda Rock Sparse Shrubland in the Project Boundary which is located well beyond the Contracted Project Disturbance Boundary and will not be removed.

5.1.3 Avoidance of SPLs and Gully Habitats

Open cut mining will avoid all of the major cliff lines and caves with the Sandstone Outcrops, and all of the SPL habitats will be protected from direct and indirect impacts of mining. This will protect habitat for cave dependent bat species such as the Large-eared Pied Bat and Eastern Bentwing Bat.

Modifications to the mine plan for the Contracted Project have also led to further setbacks of open cut mining of up to 240 m in gullies adjacent to the Sandstone Outcrops within the Ben Bullen State Forest SPL. This has achieved an additional avoidance of 16.17 ha of SPL gully habitat and native vegetation on Permian sediments.

Coalpac has committed to the exclusion of highwall mining under the sandstone pagoda formations within the SPLs (highwall mining is proposed only under the gullies). This will avoid impacts to the potential for highwall related subsidence impacting the pagodas and other sandstone formations within the SPL.

The Blast Management Plan will include a 200 m zone from SPLs wherein blasting will only proceed on a progression based on a Triggered Action Response Plan with defined limits for measurable blast responses (e.g. vibration limits at the SPL) (Terrock 2013).

The Contracted Project Disturbance Boundary not only reduces the area of direct disturbance by 20% (when compared to the area of the Exhibited Project Disturbance Boundary), but also reduces the periphery by 10%. The perimeter of the Contracted Project Disturbance Boundary is 48.28 km (5.48 km smaller than the perimeter of the Exhibited Project Disturbance Boundary). This reduction in the footprint size focuses on reducing the disturbance frontage along the SPL associated wet gullies and thus potential edge effects. Adjacent to the BBSF SPL, this reduction in the perimeter of the open cut amounts to 25%. Similarly no open cut mining is proposed to forest and woodland west of the railway line on Hillcroft avoiding further impacts from fragmentation.

5.2 Mitigation Measures

In addition to the avoidance measures outlined above, mitigation measures will be implemented to mitigate some of the direct and indirect impacts of the proposed construction and operation of the Project.

The following mitigation measures were described in the Exhibited Project EIA and will be utilised for the Contracted Project. These include:

- Minimisation of disturbance of native vegetation during construction and ahead of Project mining operations by clearly marked disturbance boundaries;
- Prepare a consolidated Biodiversity Management Plan (BMP) that contains detailed mitigation measures for the Project and includes the existing Invincible Colliery and Cullen Valley Mine offsets to provide a cohesive, integrated and holistic approach. This plan should include (but not be limited to) information such as protocols for vegetation clearing (including inspection of hollows), *Phytophthora cinnamomi* management, feral animal and pest control, rehabilitation objectives, and further detailed design measures (see below);
- Conducting pre-clearance surveys and implementation of a two stage clearing protocol for all hollow-bearing trees;

- Transportation of habitat features and relocation of hollows or establishment of nest boxes in offset, revegetation or rehabilitation areas;
- Preparation and implementation of a nest box management procedure;
- Ongoing weed and feral animal management;
- Ecological monitoring program;
- Dust and noise minimisation measures;
- Management of surface water, runoff and erosion; and
- Prepare a Biodiversity Offset Management Plan (see **Chapter 6**).

In addition to these measures, the Contracted Project will undertake additional mitigation measures. One of the key mitigation strategies for the Contracted Project is the rehabilitation of open cut mining areas. This includes maximising the biodiversity and connectivity within the landscape through management of existing Coalpac rehabilitation sites and the establishment of new rehabilitation sites. All land disturbed by the Contracted Project will be progressively rehabilitated in accordance with the conceptual mine plan and the BMP. The majority of disturbed land will be returned to native forest and woodland. Areas of grassland within the Contracted Project Disturbance Boundary may be rehabilitated back to grassland only.

In total, the Contracted Project will rehabilitate:

- 682.09 ha of native vegetation including:
  - 17.20 ha of Box Gum Woodland and Derived Native Grassland C/EEC;
  - 204 ha of *Eucalyptus cannonii* habitat, and
  - 77.54 ha of non-listed grasslands.

A detailed rehabilitation plan will be designed for the Contracted Project with the intention of providing pre-mining biodiversity values. The Rehabilitation/Revegetation Management Plan will include (but not be limited to) the following:

- Planting a variety of locally occurring native species, including trees, shrubs and selected herbaceous plants to compensate for any impacts to habitat;
- Increasing the overall vegetation cover;
- Incorporating existing natural vegetation and habitat features removed during clearing activities where appropriate;
- Establishing linkages between patches of remnant native vegetation;

- Developing a flora and fauna monitoring program for the Project as part of the Coalpac Biodiversity Management Plan. This monitoring plan should enhance and complement the existing monitoring plan. This plan should also include monitoring and control of exotic weeds and feral animals; and

- Preparing a consolidated Sediment and Erosion Control Plan part of the Water Management Plan; this includes leading practice erosion and sediment controls.

Coalpac's rehabilitation of previously mined areas is progressing well (Ecobiological 2010, 2012) and is expected that high quality rehabilitation will be able to be achieved.

Rehabilitation of threatened plant habitats will aim to achieve similar densities of *Eucalyptus cannonii* to that which currently occur in the disturbance area. Rehabilitation of *Eucalyptus cannonii* habitat is not expected to be difficult as seed viability appears to be high, and the species can be easily propagated from seed (NSW NPWS 2000). The ease of propagating this species is evidenced by the prevalence of nurseries supplying tubestock within its natural range. The species has been planted in existing rehabilitation which will continue for the Contracted Project.

Another key mitigation measure that is being undertaken for the Contracted Project is the preparation of a consolidated Biodiversity Management Plan that contains detailed mitigation measures for the Project. This will include the existing Invincible Colliery and Cullen Valley Mine offsets to provide a cohesive, integrated and holistic approach. This plan will contain information on all the impact avoidance and mitigation measures proposed for the Project including information such as protocols for vegetation clearing (including inspection of hollows), feral animal and pest control, rehabilitation objectives, and further detailed design measures.

5.2.1 Species Specific Mitigation Measures

In addition to the mitigation measures summarised above and described in the Exhibited Project EA, Coalpac has increased measures to further reduce impacts to specific species. These measures are described below.

i. Broad-headed Snake

Considerations to reduce potential impacts to the Broad-headed Snake include:

- Clearing forest and woodland mapped as potential habitat (mapped by Dr Arthur White in **Figure 3.1**) within the Contracted Project Disturbance Boundary during winter, when snakes may be sheltering under rocks in such habitats;

- Conducting preclearance surveys in selected areas in winter when snakes may be sheltering under rocks. Captured snakes to be relocated into suitable habitat areas to the east in the Ben Bullen State Forest;

- Ensuring that there remains undisturbed forest around some portions of the SPL and Sandstone Outcrops (as there will be to the north, east and south of the in the Ben Bullen SPL of the Contracted Project);

- Replacement of bushrock and consideration the use of artificial shelter sites on Sandstone Outcrops and the SPL in rehabilitation, as these have been shown to increase the occurrence of both snakes and their preferred food, the Velvet Gecko;

- Maintaining some hollow trees at the bases of the Sandstone Outcrops and the SPL (Cumberland Ecology have verified that hollow trees will remain within the standoff zone between the Sandstone Outcrops and the SPL and the edge of the proposed open cut);

- Rehabilitating vegetation within the mined areas to eventually replace the vegetation cleared;

- Provision of funding for an indirect offset that entails funding for additional habitat surveys of Broad-headed Snake in the wider area of the western Blue Mountains to further the knowledge of the species (as suggested by Webb pers. comm.).

ii. Brush-tailed Rock Wallaby

This species has not been found on site or in the adjacent SPL area. However, a fox baiting program will be implemented for the life of the mine so as to reduce fox predation pressure on small native mammals, including, potentially the Brush-tailed Rock Wallaby, if it recolonises the SPL habitat or other Sandstone Outcrops on site. Fox predation is one of the key threatening processes for the Brush-tailed Rock Wallaby, and is likely to be one of the main reasons it does not currently inhabit rocky habitats on the Project Boundary. Details of the fox baiting program will be provided in the BMP.

iii. Cave-dependant Bats

Open cut mining will avoid all of the major cliff lines and caves with the Sandstone Outcrops, and all of the SPL habitats will be protected from direct and indirect impacts of mining. This will protect habitat for cave dependent bat species such as the large-eared Pied Bat and Eastern Bentwing Bat.

5.2.2 Ecological Monitoring

This section provides a proposed methodology for the ecological monitoring program that will be implemented within the offset properties and areas of remnant vegetation and mine rehabilitation within the Project Boundary. The monitoring program aims to incorporate a range of methodologies that will provide various levels of information about the existing flora and fauna species and their habitats and quantify ecological changes occurring within these populations and habitats as a result of improved management, habitat re-establishment and enhancement and rehabilitation programs being implemented throughout the life of the Project.

The monitoring program will include:

- Undertaking baseline flora and fauna surveys in the Biodiversity Offset Properties to determine the flora and flora species present, estimate the population sizes and distribution of species of NES (National Environmental Significance) and determine areas and quality of potential habitat;

- Establishing permanent monitoring quadrats and photo-points in various habitat types and in various health conditions in the Biodiversity Offset Properties and remnant vegetation within the Project Boundary;

- Undertaking on-going ecological monitoring in these areas for the duration of the Project to assess changes occurring within these communities as a result of improved management or habitat enhancement programs;

- Undertaking annual ecological monitoring of Project rehabilitation, habitat re-establishment and active management areas within the Project Boundary for the duration of the action to measure changes in ecological function and sustainability and ensure these areas are comparable with a range of reference sites or trending in the right direction;

- Undertake monitoring of MNES, particularly the *Persoonia marginata* subpopulations and their habitat adjacent to the Contracted Project Disturbance Boundary for the duration of the Project to measure changes in habitat quality, potential threatening processes and overall population health;

- Identifying and addressing key threatening processes, such as limited recruitment, weed or feral animal invasion or poor rehabilitation progress based on the data, which can be used as a guide for adaptive management strategies; and

- Demonstrating that the monitoring methodology is sufficient to satisfy regulatory reporting requirements and assist and guide management intervention required to complete the desired objectives.

Chapter 6

Biodiversity Offset Strategy

6.1 Introduction

Coalpac has developed a Biodiversity Offset Strategy (BOS) for the Contracted Project with the objective of offsetting the residual impacts on biodiversity, particularly on threatened ecological communities and habitat for threatened species. The BOS has been devised to comply with the current principles for offsetting set out by SEWPaC (DEWR, 2007) and by OEH (DECC (NSW), 2008a) and also address concerns raised by OEH in the PAC Report (NSW Planning Assessment Commission (PAC) 2012b, a).

The Project will require the provision of a Biodiversity Offsets Package (BOP) to compensate for the predicted ecological impacts of the proposed open cut mine and associated infrastructure. The BOP is the combination of offsets used to compensate the outstanding residual impacts of the Project that will result after various avoidance and mitigation measures have been implemented.

The BOP addresses the impacts of the Project in a strategic and meaningful way that will deliver a real biodiversity outcome. It will ensure that the Project is not conducted at a cost to biodiversity conservation. A “maintain or improve” approach is to be undertaken that retains the ecological condition of the landscape within the locality by conserving, where practically possible, and increasing representative woodland and forest communities within designated areas.

Maintain or improve is defined as increasing the net area and condition of ecological communities within the locality of the proposed development in the medium to long term by permanently conserving and improving the condition of representative examples of vegetation communities and habitats for threatened species that are to be impacted by the proposed development. This definition has been based upon the key principles of offsetting, and particularly that:

- Offsets should be targeted to the ecological communities and threatened species that will be impacted by the Contracted Project;
- Offsets should be commensurate with the magnitude of the impacts; that is, there should be a net increase in the size and condition of the community types, populations or habitat types that will be impacted by the Contracted Project; and

- Offsets should be lasting; that is, there should be a level of legal protection for offset areas.

The BOP consists of three priorities that together will ensure the best compensatory outcomes are achieved for the predicted ecological impacts of the Project. The BOP has been designed to meet State and Commonwealth offset requirements and protect and improve biodiversity within the locality with the most efficient utilisation of resources.

6.2 Contracted Project Biodiversity Offset Package

In response to the PAC Report, Coalpac has revised the Exhibited Project mine plan to further avoid threatened flora, fauna, endangered ecological communities and their habitats with particular attention around further avoiding pagoda landforms and the habitat they provide. The Contracted Project mine plan completely avoids open cut mining on land within Hillcroft property and as a result the residual (and forested areas) of the Hillcroft property have been excluded from the Contracted Project BOP, giving a total area of offset land of 2,040 ha (rounded down).

In recognition of a shortfall in the quantum of offsets due to the exclusion of Hillcroft, Coalpac have committed to acquire additional offset land up to a 4:1 offset ratio (see Section 6.2.1).

The BOP of the Contracted Project mine plan is provided below in Table 6.3.

Table 6.1 Contracted Project Mine Plan Biodiversity Offset Package

Vegetation Type	Yarran View (ha)	Billabong/ Hillview (ha)	Hyrock Hartley (ha)	Gulf Mountain[2] (ha)	Total (ha)
CEEC & EEC[1]	186.8	34.9	0.0	0.0	221.7
Non CEEC & EEC (native only)	256.3	48.5	236.1	1277.7	1818.6
Total	**443.1**	**83.4**	**236.1**	**1277.7**	**2040.3**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations.

The Contracted Project mine plan Biodiversity Offset ratio excluding rehabilitation is provided below. With the exclusion of mine rehabilitation (761.9 ha credited at 50%) the offset ratio is 2.7:1.

Table 6.2 Contracted Project Mine Plan Biodiversity Offset Ratio (without rehabilitation)

Vegetation Type	Project Boundary Disturbance (ha)	Proposed Offset[2] (ha)	Proposed Offset Ratio[2]
CEEC & EEC[1]	17.2	221.7	12.9
Non CEEC & EEC (native only)	744.7	1818.6	2.4
Total	**761.9**	**2040.3**	**2.7**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations.

The Contracted Project mine plan Biodiversity Offset ratio, including mine rehabilitation, is provided below. With the inclusion of mine rehabilitation (761.9 ha credited at 50%) the Contracted Project mine plan Biodiversity Offset ratio is 3.2:1.

Table 6.3 Contracted Project Mine Plan Biodiversity Offset Ratio (with rehabilitation)

Vegetation Type	Project Boundary Disturbance (ha)	Proposed Offset[2] (ha)	Proposed Offset Ratio[2]
CEEC & EEC[1]	17.2	230.3	13.4
Non CEEC & EEC (native only)	744.7	2191.0	2.9
Total	**761.9**	**2421.2**	**3.2**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations.

6.2.1 Target Biodiversity Offset Package

In recognition of a shortfall in the required offset ratio, Coalpac has committed to achieving a total minimum ratio of 4:1 for native vegetation excluding mine rehabilitation. This requires the acquisition of an additional 1,007 ha (rounded up) of forest and woodland (as described in Table 6.4) so that the total Contracted Project BOP is 3,047 ha (rounded down). This is provided in the table below.

Coalpac's commitment to a minimum 4:1 offset ratio is comparable to other approved mining project in NSW, including Ulan Coal Mine (4:1 ratio), Duralie Coal Mine (3.3:1 ratio) and Maules Creek Coal Mine (4.3:1 ratio).

Table 6.4 Target Biodiversity Offset Package (without rehabilitation)

Vegetation Type	Project Boundary Disturbance (ha)	Proposed Offset [2] (ha)	Proposed Offset[2] Ratio
CEEC & EEC*1*	17.2	221.7	12.9
Non CEEC & EEC (native only)	744.7	2825.7	3.8
Total	**761.9**	**3047.4**	**4.0**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations.

6.2.2 Contracted Project BOP Property Descriptions

A brief description of offset properties that make up the Contracted Project BOP to date is provided below.

i. Yarran View Offset

The property borders the Wollemi National Park (see Figure 6.1) and covers approximately 450 ha. The primary objective for acquiring Yarran View is to conserve and rehabilitate CEEC Box Gum Woodland and Derived Native Grassland. The Yarran View property contains an array of different habitats such as rocky exposed ridge tops; steep slopes, cleared and semi cleared woodlands on undulating lower slopes and a small creek (Lee Creek). Almost half of the property contains remnant vegetation in good condition. This offset property is in Bylong Valley and is located within a Regent Honeyeater hotspot.

For more detailed information on Yarran View see Chapter 6 of the Exhibited EIA.

ii. Hillview/Billabong Offset Property

The Hillview/Billabong property covers an area of approximately 83 ha and is situated on the western side of the Castlereagh Highway west of the Invincible Colliery (see Figure 6.1). The primary objective for acquiring Hillview/Billabong is to conserve and rehabilitate similar vegetation to that located within the Project Disturbance Boundary and conserved Eucalyptus cannonii habitat. Hillview/Billabong covers 83 ha and contains 41 ha of Eucalyptus cannonii habitat, 48.5 ha of impacted vegetation on Permian sediments and 35 ha of CEEC Box Gum Woodland and Derived Native Grassland.

For more detailed information on Hillview/Billabong see Chapter 6 of the Exhibited EIA.

iii. Hyrock Hartley Property

This property is located 35 km south-east of the Project Boundary in Hartley Vale (see Figure 6.1) and is across the road from the Blue Mountains National Park. It is covered in high quality remnant sandstone vegetation supporting similar habitats to those found within the Project Boundary. Hyrock Hartley has varying habitats that resemble the Project Boundary such habitat associated with rocky cliff and caves exposed heathlands and shrub lands, sheltered deep soiled gullies. In addition, the property also contains riparian habitats.

This property supports sandstone and Permian sediments similar to that within the Project Boundary. Threatened species known to occur on the property include the Spotted-tailed Quoll, Giant Dragonfly and Blue Mountains Water Skink. The property also provides suitable habitat for the Brush-tailed Rock-wallaby, Large-eared Pied Bat, Eastern Bentwing-bat and Broad-headed Snake. This property will complete a gap in the Blue Mountain National Park extension as part of the GOS2.

For more detailed information on Hyrock Hartley see Chapter 6 of the Exhibited EIA.

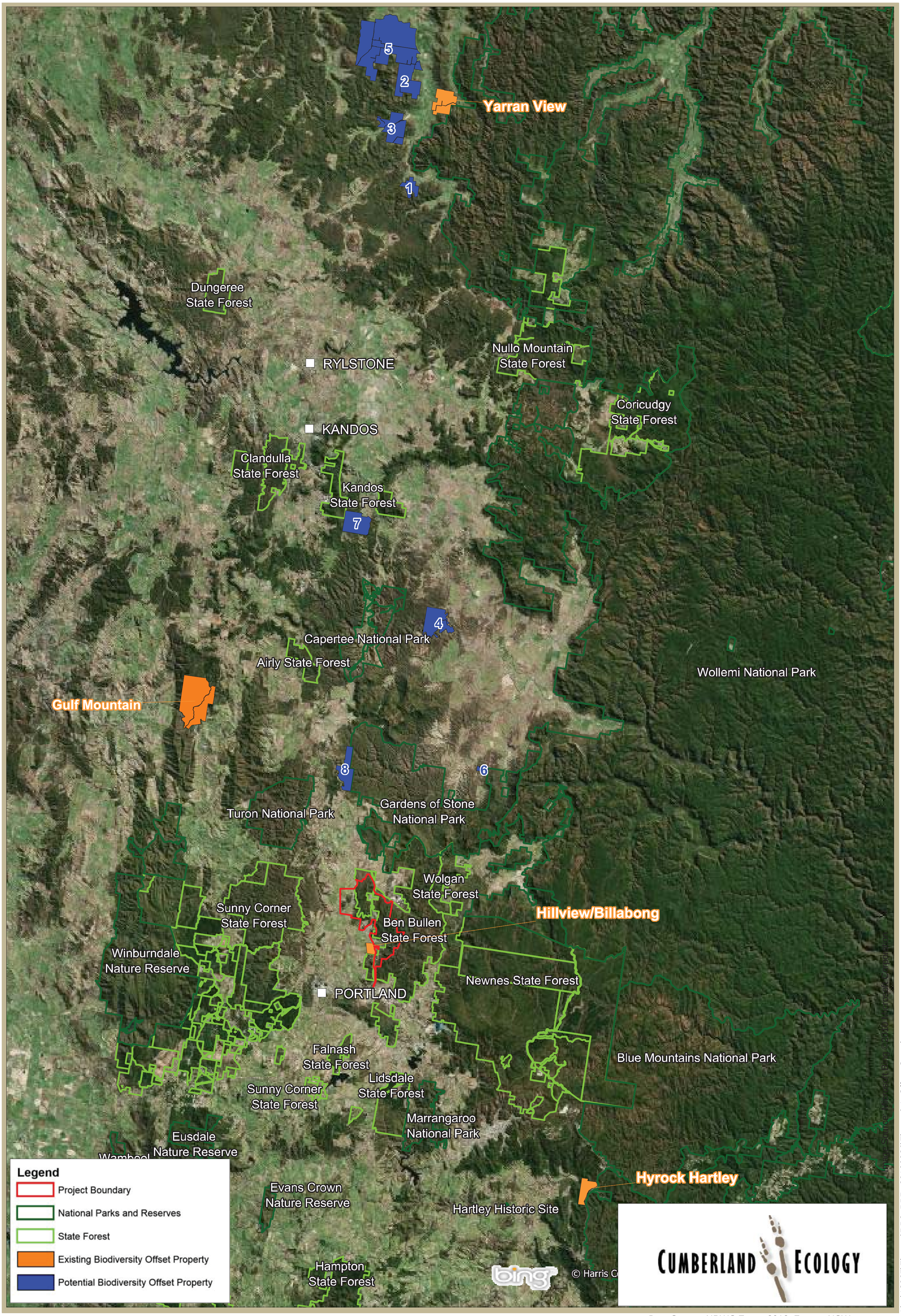
iv. Gulf Mountain

This property is located approximately 24 km north-west of the Project Boundary and is 1,277 ha in size (see Figure 6.1). The property is mountainous and is covered in remnant native vegetation of good condition with few weeds. The vegetation resembles tableland vegetation and has affinities with the Project Boundary. The dominant tree species found on Gulf Mountain are similar to those within the Project Disturbance Boundary and include Scribbly Gum (Eucalyptus rossii), Red Stringybark (Eucalyptus macrorhyncha), Broad-leaved Peppermint (Eucalyptus dives), Brittle Gum (Eucalyptus mannifera), Mountain Gum, (E. dalrympleana) and Ribbon Gum (E. viminalis). In addition, the property also contains riparian habitats.

Threatened species known to occur on the property include the impacted threatened fauna such as the Squirrel Glider (Petaurus norfolcensis), Powerful Owl (Ninox strenua), Gang-gang Cockatoo (Callocephalon fimbriatum), Scarlet Robin (Petroica boodang) and Varied Sittella (Daphoenositta chrysoptera). The detection of such species, in particular the Powerful Owl and Squirrel Glider, is significant as these species are likely to utilise the Property for breeding which reflects the quality of habitat the property provides.

For more detailed information on the Gulf Mountain see Appendix C.

Coordinate System: MGA Zone 56 (GDA 94)



I:\...\13007\Figures\RP2_PPR_20130326\Figure 6.1. Offset Overview

Figure 6.1. Contracted Project Biodiversity Offset Package Overview

Data Source: NPWS Estate 2012; Forests NSW

5 0 5 10 15 20 km

6.2.3 Additional Offset Property Acquisition

To ensure the Contracted Project BOP adequately compensates residual impacts and expected time lags between mine rehabilitation and vegetation clearing, a specific offset selection criterion was developed.

Firstly the selection criterion considered the quantum of land required to reach a minimum of 4:1 offset ratio as well as concerns raised by OEH in the PAC Report. Therefore the offset criterion considered the following:

- Reach a 4:1 offset ratio;
- The loss of vegetation (corresponding to Tableland Wet Sclerophyll Forest and Southern Tableland Dry Sclerophyll Forest by Keith (2004)) on Permian sediments;
- Low likelihood of finding ROTAPs on offset properties; and
- Potential impacts to the Broad-headed Snake, Brush-tailed Rock Wallaby and cave-dwelling bats.
- Co location with other conservation areas where available

It has already been demonstrated that the majority of ROTAPs recorded in the Project Boundary occur beyond the Contracted Project Disturbance Boundary and will not be directly impacted (see Chapter 4). Hence the need to offset residual impacts to ROTAPs is neither warranted nor necessary and has therefore not been included in the selection criteria below.

The Broad-headed Snake, Brush-tailed Rock Wallaby, Large-eared Pied Bat and Eastern Bentwing-bat would be secure in the future, even in a worst case scenario whereby the entire mine site is not rehabilitated (which is not proposed). Firstly, there is no population of Brush-tailed Rock Wallaby in the Project Boundary to be impacted. For the other species, extensive habitats are conserved to the east, and broad areas of forest and woodland will remain unmined in the Project Boundary (e.g. the areas containing CEEC that have been avoided by the Contracted Project mine plan), areas around Cullen Bullen and Cullen Valley Mine, and areas west of the railway line that are not proposed for mining under the Contracted Project. Furthermore, extensive areas of undisturbed forest and woodland will also be retained in Ben Bullen State Forest and other areas to the north and north east of the Project Boundary in National Parks. In addition, clearing for mining is progressive over the Project duration of 21 years, so that habitat is not immediately removed, thereby minimising impact. Hence the need to offset residual impacts to foraging habitat of the Broad-headed Snake and cave-dwelling bats (Large-eared Pied Bat and Eastern Bentwing-bat) has been greatly reduced through avoidance and mitigation measures.

An offset property or properties that would adequately compensate residual impacts should contain the following attributes:

1. At least 1,007 ha of forest and woodland preferably corresponding to vegetation classes Tableland Wet Sclerophyll Forest and/or Southern Tableland Dry Sclerophyll Forest by Keith (2004); and

2. Property or portions of the property should occur on Permian sediments;

- The selection criteria follows the offset policy documents for both Commonwealth and State Agencies (DEWR 2007, DECCW 2010).

- Coalpac has sought further consultation with OEH in January and February 2013 to provide an updated list of potential offset properties deemed suitable by OEH. On the 28th February 2013 OEH supplied a list of potential offset properties to Cumberland Ecology. Cumberland Ecology has not been able to assess each property as per the selection criteria below, but will consider the list of properties during ongoing investigations and will consult OEH throughout this process.

6.2.4 Summary of Potential Offset Properties Using the Selection Criteria

This section summarises the results of desktop assessments of potential offset properties using the “selection criteria” above.

For more detailed property information including aerial photography (see Appendix A).

Figure 6.1 provides an overview of the Contracted Project mine plan Biodiversity Offset Package, including existing offsets and potential offset properties that could be acquired. These are discussed in a summary table below.

As can be seen in Figure 6.1 and Table 6.5 (below), a number of potential offset properties have been considered in the preparation of this report. Coalpac has found a number of potential offset properties that address some of the selection criteria. Further investigation would be required to verify and quantify vegetation communities and threatened species habitats.

The table below summaries the key values as per the aforementioned selection criteria for the potential offset properties.

A more detailed analysis of each potential biodiversity offset property is provided in Appendix B.

Table 6.5 Summary of Biodiversity Values of Potential Offset Properties

Potential Offset Property	Biodiversity Values According to Selection Criteria
Potential Offset Property 1*	This property is 200 ha in size and does not border a National Park. It contains approximately 140 ha of intact vegetation and 60 ha of cleared and semi-cleared land. The intact vegetation does not correspond to any impacted vegetation classes by Keith (2004). Property occurs on Permian and Triassic sediments. The Broad-headed Snake and Brush-tailed Rock Wallaby have been recorded within 5 km of the property. A full list of other threatened species recorded within 5 km are provided in Appendix H.
Potential Offset Property 2*	This property is 540 ha in size and does not border a National Park. Property occurs on Permian and Triassic sediments. Project contains approximately 260 ha of intact vegetation and 280 ha of cleared land. Vegetation classes do not correspond to impacted vegetation classes in the Project Boundary and valleys would require revegetation. *Eucalyptus cannonii* has been recorded within 5 km of the property. This property adjoins Braithwaite. A full list of threatened species recorded within 5 km are provided in Appendix H.
Potential Offset Property 3*	This property is 580 ha in size and does not border a National Park. Property occurs on Permian and Triassic sediments. The property contains approximately 135 ha of intact vegetation and 409 ha of cleared land. Vegetation classes do not correspond to impacted vegetation classes in the Project Boundary and valleys would require revegetation. This property adjoins vegetation with rock outcrops occurring between Property 2 and Property 3. *Eucalyptus cannonii,* Broad-headed Snake and Brush-tailed Rock Wallaby have been recorded within 5 km of the property. A full list of other threatened species recorded within 5 km are provided in Appendix H.
Potential Offset Property 4*	This property is 579 ha in size and does not border a National Park, though adjoins intact vegetation that connects to Capertee National Park. The property contains approximately 529 ha of intact vegetation and 50 ha of cleared land. Property occurs on Permian and Lower to middle Devonian. Vegetation classes do not correspond to impacted vegetation classes in the Project Boundary. A full list of threatened species recorded within 5 km are provided in Appendix H.
Potential Offset Property 5*	This property is 2,559 ha in size and does not border a National Park though is of adequate size to become one in its own right. Property occurs on Tertiary, Triassic and Quaternary (overlying Permian). The majority of the valley floor is cleared and covers 1200ha and would require revegetation. The slopes and higher country have not been cleared and cover 1359 ha of native vegetation. Some of the vegetation corresponds to Southern Tableland Dry Sclerophyll Forest, an impacted vegetation class in the Project Boundary. A full list of threatened species recorded within 5 km are provided in Appendix H including *Eucalyptus cannonii*.
Potential Offset Property 6*	This property is 50 ha in size and borders on Gardens of Stone National Park. Property occurs on Permian and Lower to middle Devonian. This property is completely forested. Vegetation classes on the property do not correspond to

Table 6.5 Summary of Biodiversity Values of Potential Offset Properties

Potential Offset Property	Biodiversity Values According to Selection Criteria
	impacted vegetation classes in the Project Boundary. *Eucalyptus cannonii*, Large-eared Pied Bat has been recorded within 5km of the property. A full list of other threatened species recorded within 5 km are provided in Appendix H.
Potential Offset Property 7*	This property is 236 ha in size and borders Kandos State Forest. Property occurs on Permian and Lower to middle Devonian. The property contains approximately 20 ha of cleared land and 216 ha of native vegetation. Some of the vegetation on the property corresponds to Southern Tableland Dry Sclerophyll Forest, a class of vegetation impacted by the Project. *Eucalyptus cannonii*, Eastern Bentwing-bat and Large-eared Pied Bat has been recorded within 5 km of the property. A full list of other threatened species recorded within 5km are provided in Appendix H.
Potential Offset Property 8*	This property is 400 ha in size and borders Gardens of Stone National Park. Located approximately 8km north of the Project Boundary. The property occurs on Permian and Lower to middle Devonian. The property contains approximately 93 ha of cleared land and 306.83 ha of native vegetation. Some of the vegetation on the property corresponds to Southern Tableland Dry Sclerophyll Forest, a class of vegetation impacted by the Project. Valleys would require revegetation. *Eucalyptus cannonii* has been recorded within 5 km of the property. A full list of other threatened species recorded within 5km are provided in Appendix H.

* Property names and Lot and DPs have been excluded for confidentiality reasons. Further property details can be supplied upon request by DP&I and/or other NSW regulators.

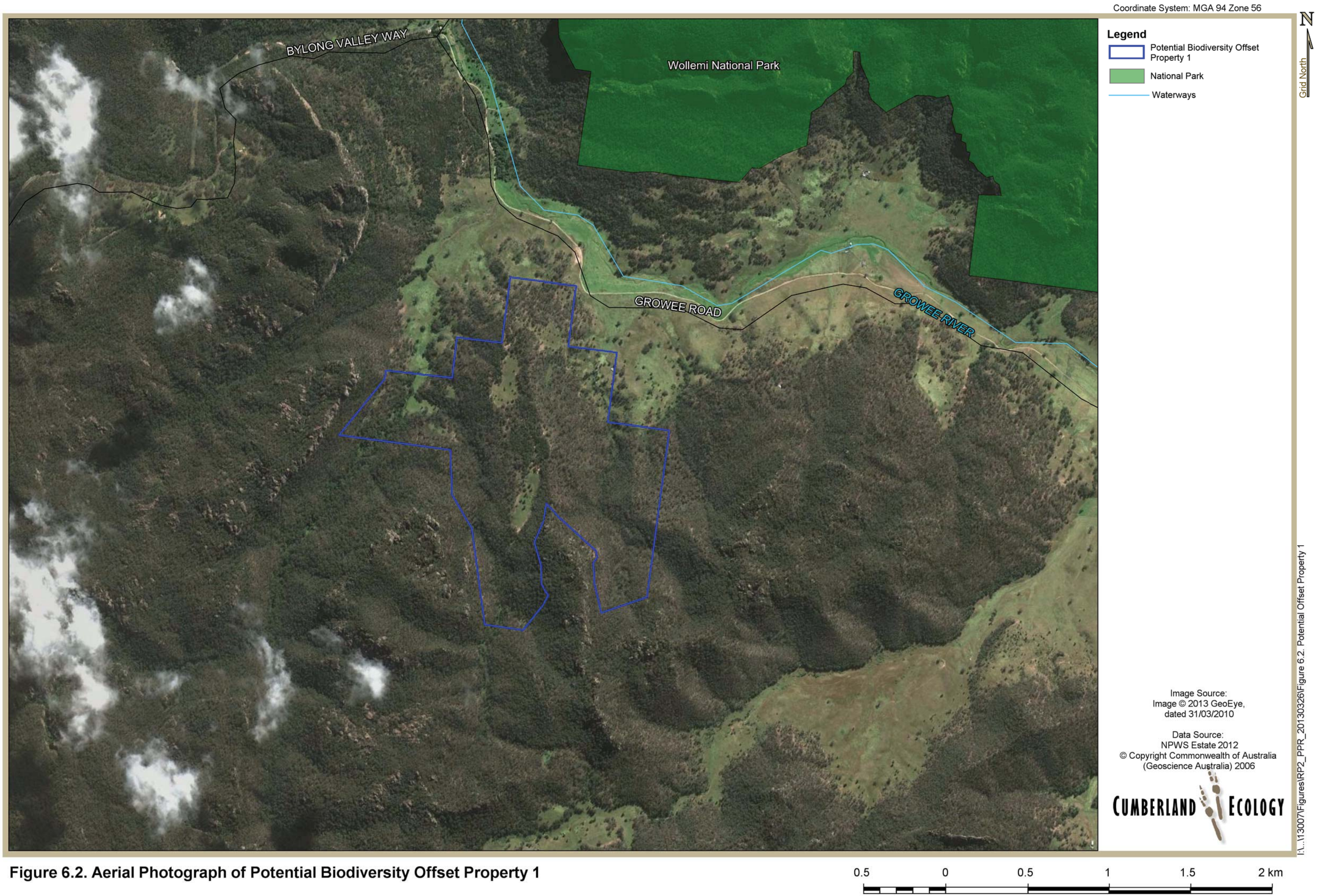
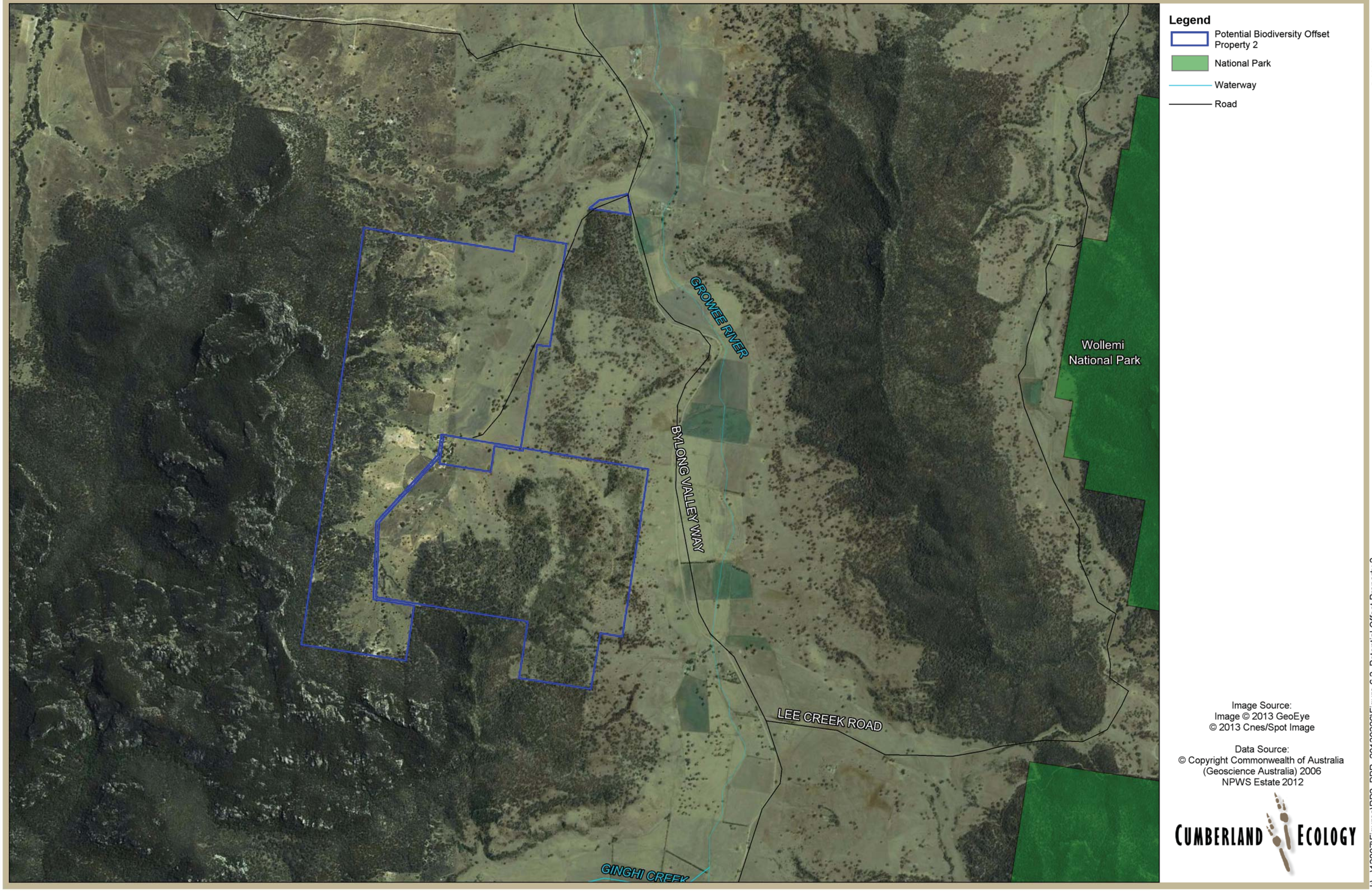


Figure 6.2. Aerial Photograph of Potential Biodiversity Offset Property 1

Coordinate System: MGA 94 Zone 56



I:\...\13007\Figures\RP2_PPR_20130326\Figure 6.3. Potential Offset Property 2

Figure 6.3. Aerial Photograph of Potential Biodiversity Offset Property 2

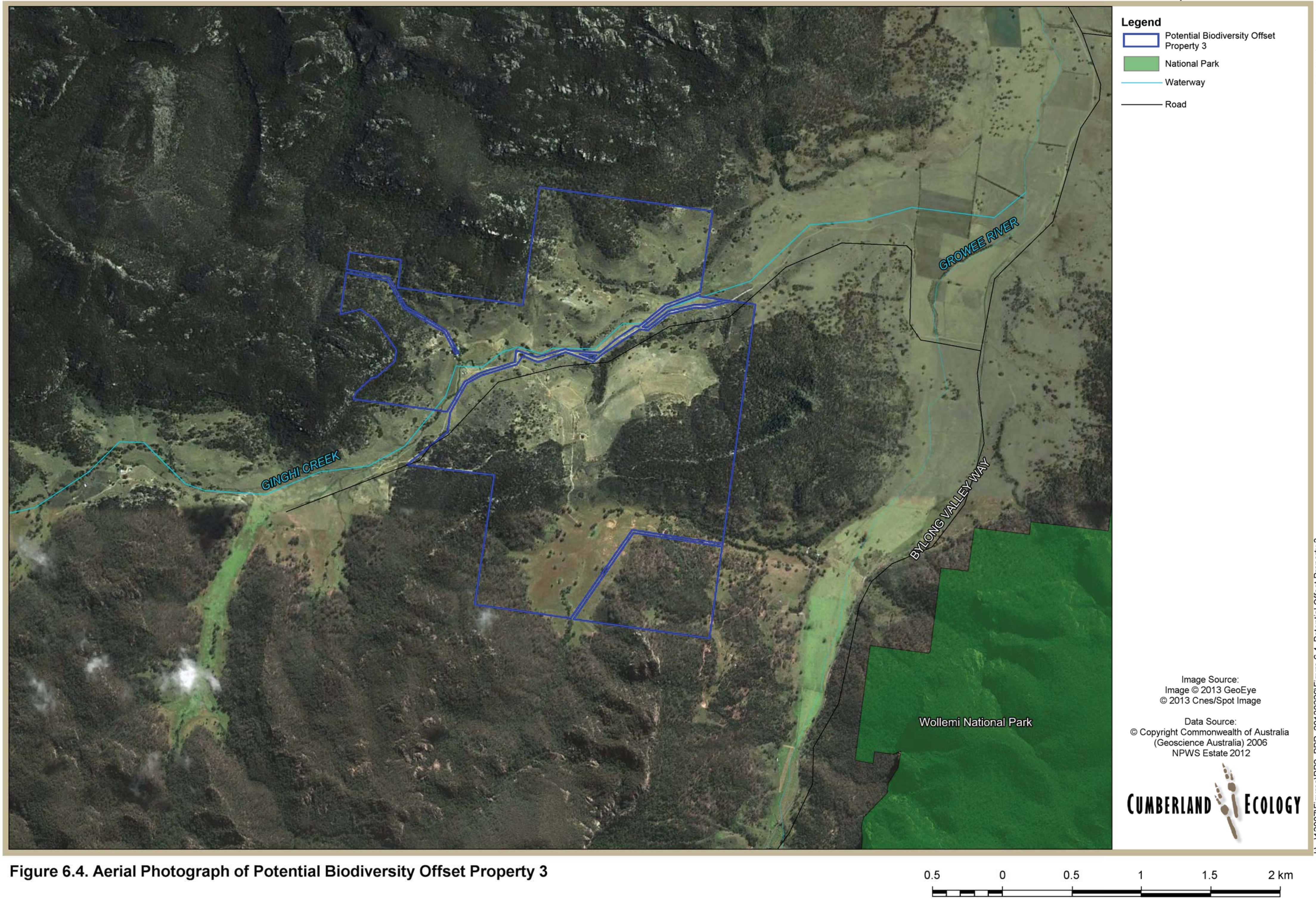
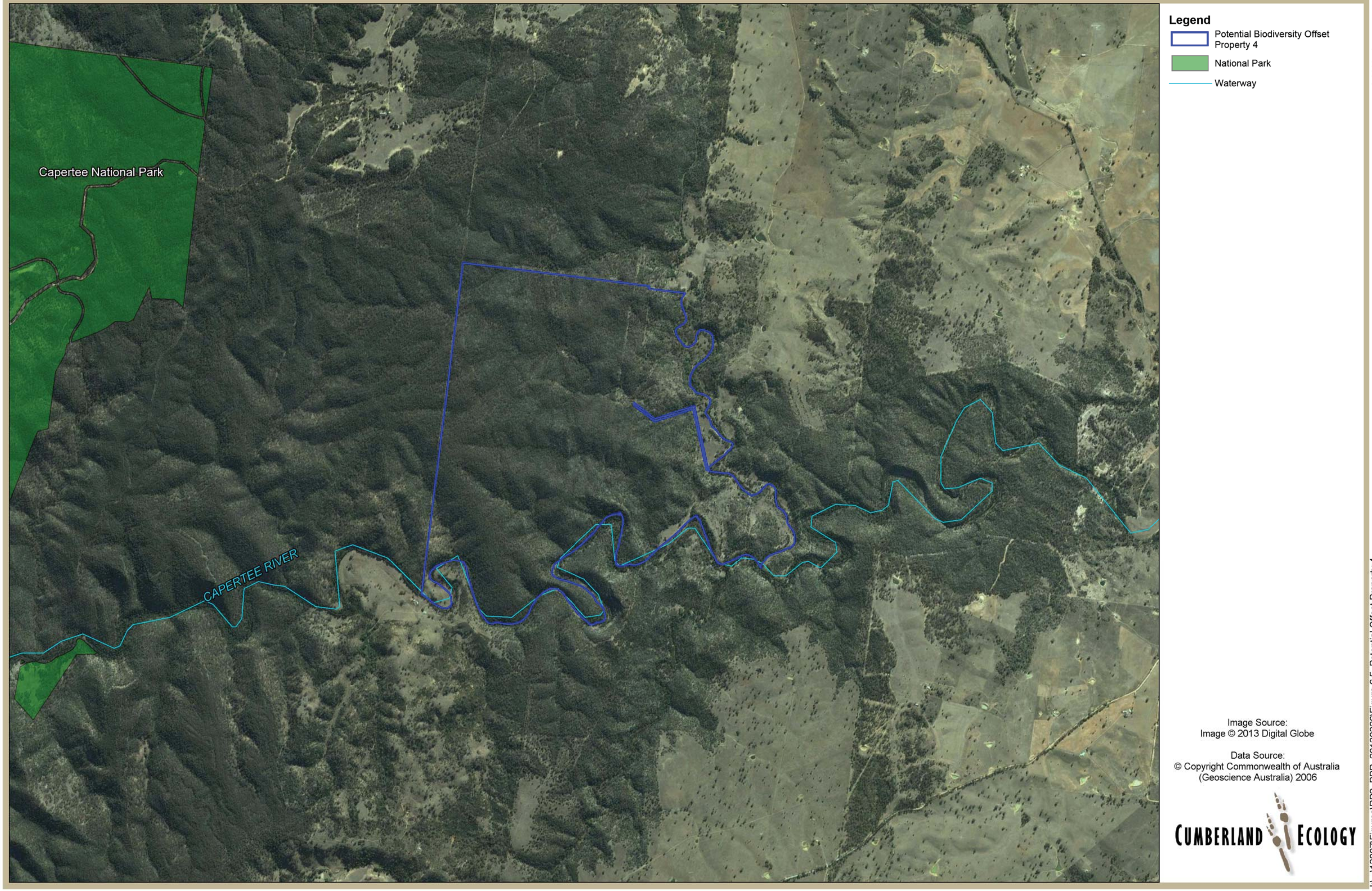


Figure 6.4. Aerial Photograph of Potential Biodiversity Offset Property 3



I:\...\13007\Figures\RP2_PPR_20130326\Figure 6.5. Potential Offset Property 4

Figure 6.5. Aerial Photograph of Potential Biodiversity Offset Property 4

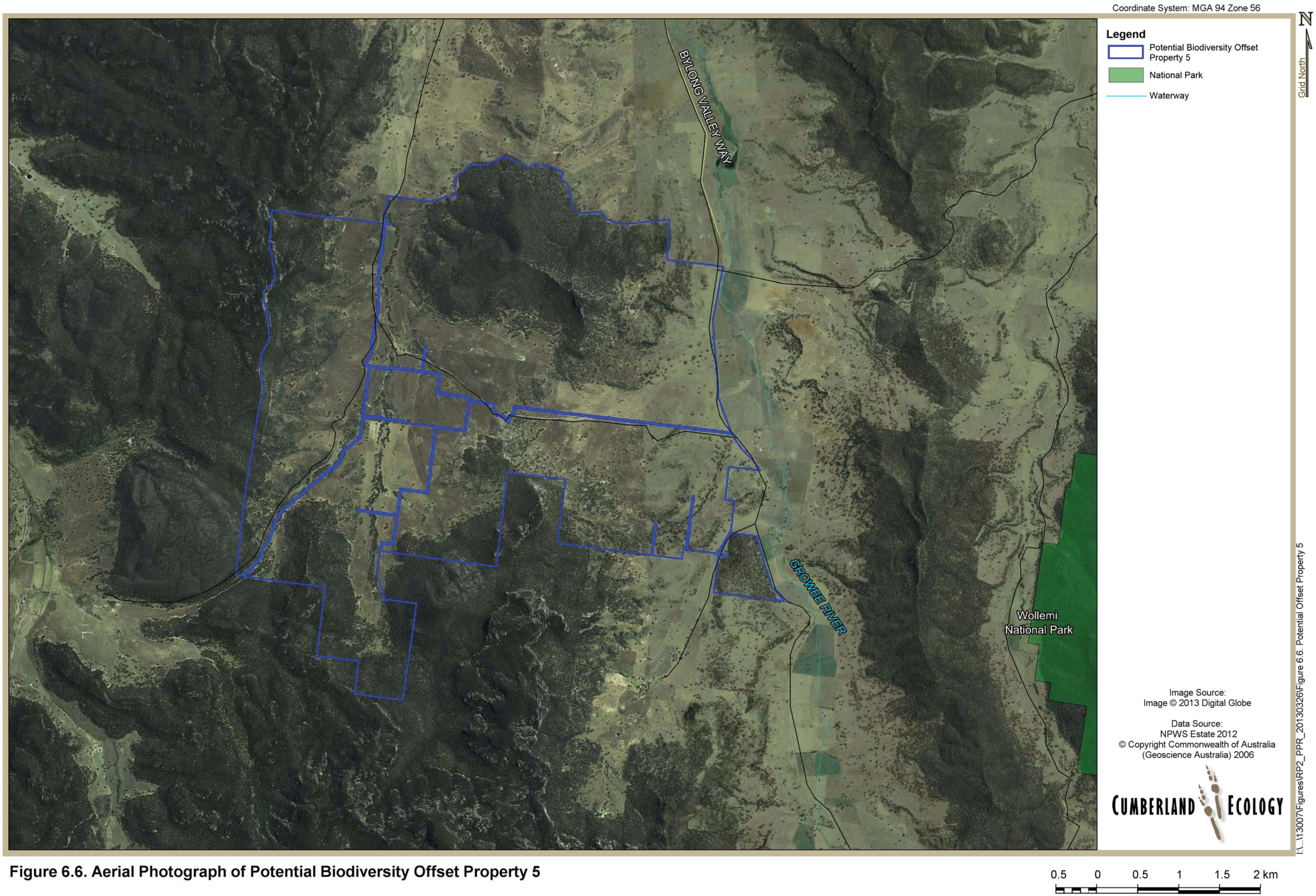


Figure 6.6. Aerial Photograph of Potential Biodiversity Offset Property 5

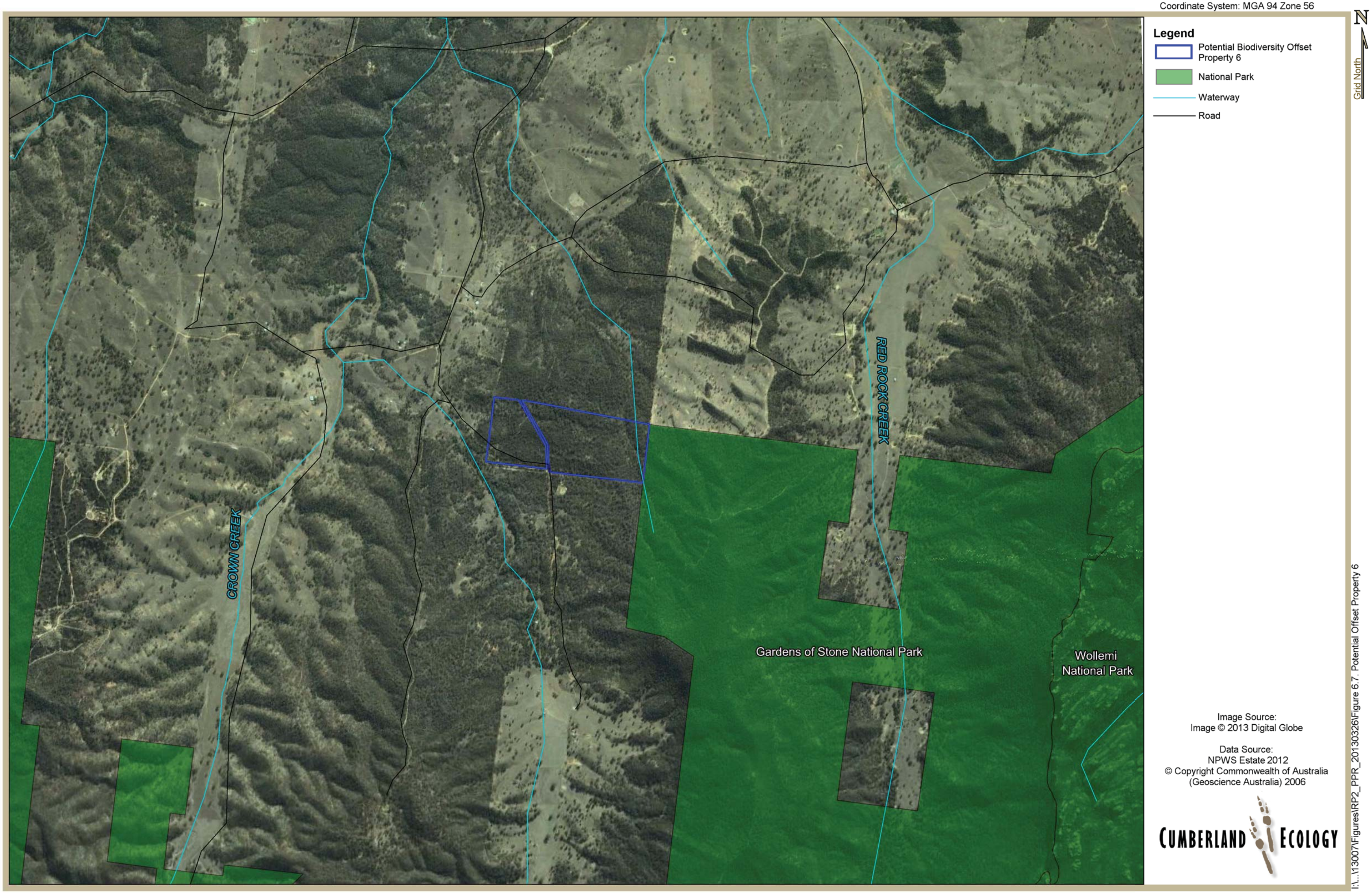
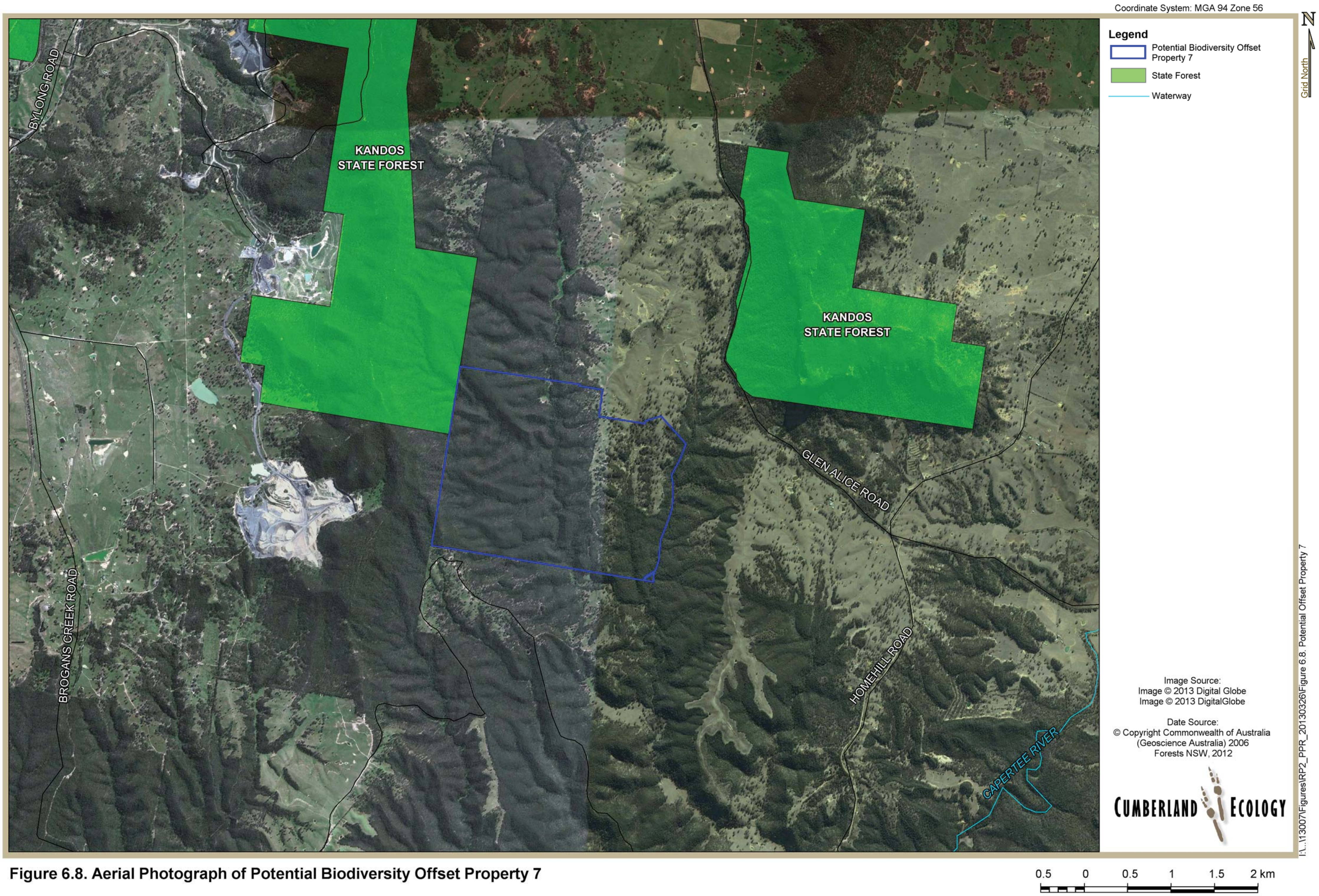


Figure 6.7. Aerial Photograph of Potential Biodiversity Offset Property 6

Coordinate System: MGA 94 Zone 56



I:\...\13007\Figures\RP2_PPR_20130326\Figure 6.8. Potential Offset Property 7

Figure 6.8. Aerial Photograph of Potential Biodiversity Offset Property 7

Figure 6.9. Aerial Photograph of Potential Biodiversity Offset Property 8

6.2.5 *Contracted Project Biodiversity Offset Package Commitment*

For the Biodiversity Offset Package to achieve a 4:1 ratio, Coalpac will commit to finding at least an additional 1,007 ha of forest and woodland as described below. Coalpac shall implement the biodiversity offset strategy summarised in the table below to the satisfaction of the Director-General.

Table 6.6 Summary of Contracted Project Biodiversity Offset Package

Biodiversity Offset Property	Offset Type	Minimum Size (ha)
Yarran View	Existing vegetation to be managed and additional vegetation to be established. Protect and manage 43.01 ha of Box Gum Woodland CEEC and restore 143.77 ha of Box Gum Woodland and Derived Native Grassland CEEC	443.1
Hillview/Billabong	Existing vegetation to be managed and additional vegetation to be established. Protect and manage 5.53 ha of Box Gum Woodland CEEC and restore 29.34 ha of Box Gum Woodland Derived Native Grassland CEEC	83.4
Hyrock Hartley	Existing vegetation to be protected and managed	236.1
Gulf Mountain	Existing vegetation to be protected and managed	1277.7
Additional Offset Property	Protect and manage forest and/or woodland adjoining a conservation area that is not on a mining tenement. Protect and manage vegetation that corresponds to Southern Tableland Wet Sclerophyll Forest (Keith 2004) and/or Southern Tableland Dry Sclerophyll Forest (Keith 2004).	1007.1
Total		**3047.4**

6.3 Biodiversity Offset Management Plan

A key component of the BOP is the establishment and future ongoing management of the vegetation and habitats on the offset properties. Biodiversity management of the properties will ensure that there is an improvement in the biodiversity values of the offset properties. On this basis, Coalpac intends to implement a Biodiversity Offset Management Plan (BOMP) to achieve a 'maintain and improve' outcome for the Project and associated offsets.

The Biodiversity Offset Handbook (Business and Biodiversity Offsets Programme (BBOP), 2009) is guide that provides suggestions on designing offsets. It was developed by the Business and Biodiversity Offsets Programme (BBOP), which is a partnership between companies, governments, conservation experts and financial institutions. Their aim is to explore whether biodiversity offsets can help achieve better and more cost effective conservation outcomes. According to the Biodiversity Offset Handbook:

An offset should deliver conservation gains over and above planned or predicted conservation actions being taken by other parties (otherwise the offset is making no difference). In practice, biodiversity gains can be achieved in a number of ways, such as undertaking positive management interventions to restore an area or stop degradation: improving the conservation status of an area of land by restoring habitats or ecosystems and reintroducing native species. Where proven methods exist or there are no other options, reconstructing or creating ecosystems. Also, reducing or removing current threats or pressures by, for instance, introducing sustainable livelihoods or substitute materials.

The aforementioned BOMP will prescribe management of each offset property. Different properties and different areas within a single property will inevitably require varying levels and methods of management. The baseline survey information will be used to identify site specific issues; formulate scope of works and indicator performance criteria; prepare a series of site specific management actions; and prepare a set of implementation timeframes and key milestones.

The BOMP is intended to be adaptive and regular ecological monitoring will be prescribed to guide the adaptive management of offset properties.

The preparation of the BOMP will be guided by a number of relevant texts, including the draft National Recovery Plan for Box Gum Woodland and Derived Native Grasslands (DECCW (NSW) 2010) and (Rawlings et al. 2010). Other references that will guide the development of the BOMP and the rehabilitation of the offset properties also relate to the restoration of grassy temperate woodlands and will include (McIntyre et al. 2002, Spooner et al. 2002, Lindenmayer et al. 2010).

6.3.1 Implementation Objectives

The objectives for regeneration of vegetation within the offsets will include but not be limited to the following:

- Maintenance and improvement of the condition of existing forest and woodland within all offset areas, specifically to improve conditions for threatened flora and fauna;
- Maintenance and improvement of derived native grassland to promote, through management of grazing pressure, natural succession towards woodland and or open forest;
- Rehabilitation of selected areas of low diversity native grassland by replanting trees and shrubs to promote a more rapid regeneration towards forest or woodland; and

- Improvement of habitat connectivity across offset lands, and from offset lands to adjacent native vegetation and mine rehabilitation in order to improve wildlife movement in the long term.

The land within the offsets contains extensive areas of existing woodland and open forest that will form nuclei for ongoing regeneration of trees and shrubs into grassland areas. Such habitats will provide immediate and ongoing habitats for native plants and animals. Existing forest and woodland areas are currently mature, functioning examples of natural ecosystems, but their condition is expected to improve with time as trees mature, tree hollows are generated and as regeneration of understorey takes place when livestock are progressively removed (McIntyre et al., 2002).

Derived Native Grassland within the offsets has significant floral diversity, including scattered trees and shrubs. It is intended that the cessation of grazing on Yarran View and Hillview/Billabong combined with the management of weeds and feral animals will be able to accelerate regeneration of Derived Native Grassland to forest and woodland areas. Such habitats are semi-natural and cannot currently be considered fully functional as they generally lack trees and shrubs. However, in the medium to long term, trees and shrubs are expected to regenerate into such areas if the condition of the land is improved through grazing and weed management (Lindenmayer et al. 2010). It is expected that substantial regeneration will occur within the life of the mine and a mature, functional ecosystem will be established across much of the grassland areas within 50 years.

Low diversity native grasslands have low diversity of native ground covers and essentially no trees and shrubs. However, to overcome this, trees and shrubs will be planted into such areas to form nuclei of regenerating woody habitats that will then be able to progressively grow back into woodland or open forest. Replanting of such areas will take place early in the life of the Project (within the first five years) and it is expected that substantial regeneration of woody plants will occur within the life of the mine (21 years). It is expected that substantial regeneration will occur within the life of the mine and a mature, functional ecosystem will be established across much of the grassland areas within 50 years.

6.3.2 Monitoring

The BOMP will establish key performance objectives for various areas and vegetation types within the offsets, consistent with the objectives listed above, and with the objectives of the draft National Recovery Plan for Box Gum Woodland and Derived Native Grassland (DECCW (NSW) 2010).

The BOMP will include a monitoring program that tracks the progress of regeneration of open forest, woodland and grassland areas on site, and which identifies problems that require active management, such as infestations of weeds and feral animals, or failure of some areas of plant species to regenerate.

Chapter 7

Conclusion

The Contracted Project has been designed to reduce the footprint of the mine in sensitive areas and has achieved a reduction of 196 ha or 20% of the disturbance footprint of the Exhibited EA (from 958 ha to 762 ha).

The reduced disturbance footprint has reduced impacts on habitats of conservation significance, including SPLs and other threatened species habitats. SPL habitats are completely and substantially avoided as is the Hillcroft mining area (avoidance of 109 ha of vegetation), and all Persoonia marginata habitat. The Contracted Project also avoids larger areas of Eucalyptus cannonii habitat. The Contracted Project has reduced impacts to Eucalyptus cannonii from 278 ha to 204 ha (a reduction of 73.94 ha or 27% of the Exhibited Project Disturbance Boundary).

It has also been concluded that the Contracted Project, would have a negligible impact upon SPLs and no significant impact on the flora and fauna associated with them.

Large areas of suitable habitat will remain in the Project Boundary (1,190 ha of forest and woodland) and in the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other large remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of adjacent Ben Bullen State Forest.

Mitigation measures proposed for the Exhibited Project have been augmented for selected species of concern to the PAC. These include measures for the Broad-headed Snake, Brush-tailed Rock Wallaby and cave-roosting bats.

Coalpac have also committed to acquiring more biodiversity offsets to reach a 4:1 overall offset ratio of native vegetation – larger than the ratio proposed in the Exhibited Project. This commitment is comparable to other approved mining project in NSW, including Ulan Coal Mine (4:1 ratio), Duralie Coal Mine (3.3:1 ratio) and Maules Creek Coal Mine (4.3:1 ratio). Additional offset acquisition will consider vegetation on Permian sediments.

There is sufficient evidence that woodland and open forests can be regenerated to maturity on disturbed land including previously mined sandstone landscapes. Evidence to date from nearby sandstone landscapes, based on annual biodiversity surveys, of rehabilitation work at Cullen Valley Mine and Mt Piper Power Station has shown that species diversity and vegetation structure is maturing to approach that of adjacent, unmined mature woodland.

The mine rehabilitation proposed is likely to restore forest and woodland habitats within the Project Boundary in the long term.

There will be minimal impacts from the Contracted Project to the area currently proposed as the GOS2. Although some of the mining proposal is within the area, all will be rehabilitated in the long term and the proposed biodiversity offset areas will add to and complement some of the stated objectives of GOS2.

The proposed reduced footprint of the Contracted Project, together with improved mitigation measures and an increased commitment to offsetting is likely to produce an ecologically sustainable mining outcome in which ecological values are maintained or improved in the long term.

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Appendix A

DP&I Letter Request for PPR

NSW GOVERNMENT | Planning & Infrastructure

Development Assessment
Systems and Approvals
Mining & Industry Projects
Contact: Mike Young
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Dr Ian Follington
Chief Executive Officer
Coalpac Pty Limited
Invincible Colliery
Castlereagh Highway
CULLEN BULLEN NSW 2790

Dear Dr Follington

Coalpac Consolidation Project (10_0178)

In accordance with section 75H(6) of the *Environmental Planning and Assessment Act 1979* ("Act"), as it applies to the project, the Director-General requires the proponent, Coalpac Pty Limited, to submit to the Director-General:

1) a preferred project report that outlines any proposed changes to the project to minimise its environmental impact (section 75H(6)(b) of the Act); and
2) any revised statement of commitments (section 75H(6)(c) of the Act) for environmental management and mitigation measures on the site.

The preferred project report and revised statement of commitments must be submitted to the Director-General no later than **Wednesday 3 April 2013**.

If you wish to discuss this matter further, please contact Mike Young on 9228 2091.

DKitto 20/3/13

David Kitto
Director
Mining & Industry Projects
(as delegate of the Director-General)

Appendix B

Results of Desktop Assessment of Potential Offset Properties

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
Potential Offset Property 1*	200.31	No - Mid-Western Regional Council	No - Hunter/ Central Rivers	No - 1km west of Wollemi NP	Yes – Permian and Triassic	Permian Capertee Talus Woodland Narrabeen West	Sydney Montane Dry Sclerophyll Forests	**Flora**
						Wollemi Sheltered Dry Forest Narrabeen Wollemi Woodland Complex	Sydney Hinterland Dry Sclerophyll Forest .	Pultenaea sp. Olinda
						Agricultural	North-west Slopes Dry Sclerophyll Forest	**Fauna**
								Broad-headed Snake
								Brush-tailed Rock-wallaby
								Powerful Owl
								Regent Honeyeater
								Spotted-tailed Quoll,
Potential Offset Property 2*	540.55	No - Mid-Western Regional	No - Hunter/ Central Rivers	No - 3.5km west of Wollemi NP	Yes – Permian and Triassic	Narrabeen Upper Cudgegong Sandslope Woodland	Sydney Hinterland Dry Sclerophyll Forest	**Flora**

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
		Council				Permian Capertee Talus Woodland	Sydney Montane Dry Sclerophyll Forests	Eucalyptus cannonii,
						Narrabeen West-Wollemi Sheltered Dry Forest	North-west Slopes Dry Sclerophyll Forest	**Fauna**
						Narrabeen Bylong Arid Woodland,		Black-chinned Honeyeater
						Narrabeen Wollemi Woodland Complex		Brown Treecreeper
						Agricultural		Diamond Firetail
								Gang-gang Cockatoo
								Little Lorikeet,
								Speckled Warbler
								Squirrel Glider
								Turquoise Parrot
Potential Offset Property 3*	580.98	No - Mid-Western Regional Council	No - Hunter/ Central Rivers	No - 1.2km west of Wollemi NP	Yes – Permian and Triassic	Permian Capertee Talus Woodland	Western Slopes Dry Sclerophyll Forest	Flora
						Narrabeen Bylong Arid Woodland,	Western Slopes Dry Sclerophyll Forests	Eucalyptus cannonii

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
						Narrabeen Wollemi Woodland Complex,	Sydney Hinterland Dry Sclerophyll Forest	**Fauna**
						Cleared,	North-west Slopes Dry Sclerophyll Forest	Broad-headed Snake
						Agricultural.		Brush-tailed Rock-wallaby
								Powerful Owl
								Regent Honeyeater
								Spotted-tailed Quoll
								Turquoise Parrot.
Potential Offset Property 4*	578.84	Yes - Lithgow City Council	No - Hawkesbury/ Nepean	No - 2.5km east of Capertee NP, 4km west of Wollemi NP	Yes – Permian and Lower to middle Devonian	Capertee - Wolgan Riparian Rough-barked Apple - River Oak Open Forest	Western Slopes Grassy Woodland	**Flora**
						Capertee Grey Gum - Narrow-leaved Stringybark - Scribbly Gum - Callitris - Ironbark Shrubby Open Forest	Eastern Riverine Forests	Phebalium bifidum,
						Narrow-leaved Ironbark - Callitris	Western Slopes Dry	Grevillea obtusiflora,

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
						Riparian Grassy Woodland	Sclerophyll Forests.	
						Narrow-leaved Ironbark - Callitris Shrubby Woodland		Acacia bynoeana
						Narrow-leaved Ironbark - Tumbledown Red Gum - Callitris Shrubby Woodland		**Fauna**
						White Box - Narrow-leaved Ironbark Woodland		Barking Owl
						Exotic Grasslands		Black-chinned Honeyeater
						Native Grassland,		Brown Treecreeper
						Cleared and Severely Disturbed Land.		Diamond Firetail
								Gang-gang Cockatoo
								Hooded Robin
								Little Eagle
								Little Lorikeet
								Powerful Owl
								Regent Honeyeater

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
								Scarlet Robin
								Speckled Warbler
								Swift Parrot
								Varied Sittella
								White-fronted Chat.
Potential Offset Property 5*	2,559.41	No - Mid-Western Regional Council	No - Hunter/ Central Rivers	3km west of Wollemi NP	No – Tertiary, Triassic and Quaternary	Dry Basalt Cap Woodland	Western Slopes Grassy Woodland	**Flora**
						Dry Basalt Diatreme Forest	Western Slopes Dry Sclerophyll Forest	Eucalyptus cannonii,
						Narrabeen Arid Acacia Woodland	Southern Tableland Dry Sclerophyll Forest	Leucopogon confertus
						Narrabeen Bylong Arid Woodland	Sydney Hinterland Dry Sclerophyll Forest	**Fauna**
						Narrabeen Goulburn Valley Exposed Woodland	North-west Slopes Dry Sclerophyll Forest	Black-chinned Honeyeater
						Narrabeen Upper Cudgegong Sandslope Woodland		Brown Treecreeper
						Narrabeen West-Wollemi		Diamond Firetail

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
						Sheltered Dry Forest		
						Narrabeen Wollemi Woodland Complex		Gang-gang Cockatoo
						Permian Capertee Talus Woodland		Little Lorikeet,
						Permian Grey Box Woodland		Speckled Warbler
						Permian Widden Talus Woodland		Squirrel Glider
								Turquoise Parrot
Potential Offset Property 6*	50.56	Yes - Lithgow City Council	No - Hawkesbury/ Nepean	Yes - Gardens of Stone National Park	Yes – Permian and Lower to middle Devonian	Capertee Box - Kurrajong - Grey Gum Grassy Woodlands	Western Slopes Grassy Woodland	**Flora**
						Capertee Marl Box Grassy Woodlands	Western Slopes Dry Sclerophyll Forest	Prostanthera cryptandroides subsp. cryptandroides
						Capertee Box - Narrow-leaf Ironbark - Callitris Grassy Woodland		Eucalyptus cannonii

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
						Capertee Grey Gum - Narrow-leaved Stringybark - Scribbly Gum - Callitris - Ironbark Shrubby Open Forest		Grevillea obtusiflora
						Cleared and Severely Disturbed Lands		Phebalium bifidum
								Fauna
								Black-chinned Honeyeater
								Brown Treecreeper
								Brown Treecreeper
								Diamond Firetail
								Gang-gang Cockatoo
								Glossy Black-Cockatoo
								Grey-crowned Babbler
								Hooded Robin
								Hooded Robin
								Large-eared Pied Bat

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
								Little Eagle Little Lorikeet Regent Honeyeater Scarlet Robin Speckled Warbler Square-tailed Kite Swift Parrot Turquoise Parrot
Potential Offset Property 7*	507.74522	Yes - Lithgow City Council	Hawkesbury/Nepean (only 600m from CMA border Central West)	Adjacent to Kandos State Forest	Yes – Permian and Lower to middle Devonian	Tableland Gully Ribbon Gum - Blackwood - Apple Box Forest	Southern Tableland Dry Sclerophyll Forest	**Flora**
						Capertee Rough-barked Apple - Redgum - Yellow Box Grassy Woodlands	Western Slopes Grassy Woodland	Eucalyptus cannonii
						Capertee - Wolgan Slopes Red Box - Grey Gum - Stringybark Grassy Open Forest	Central Gorge Dry Sclerophyll Forest	Grevillea obtusiflora

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
						Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest	Southern Escarpment West Sclerophyll Forest	**Fauna**
						Capertee Grey Gum - Narrow-leaved Stringybark - Scribbly Gum - Callitris - Ironbark Shrubby Open Forest	Western Slopes Dry Sclerophyll Forest	Barking Owl
						Capertee Hills White Box - Tumbledown Redgum - Ironbark - Callitris Shrubby Woodland	Eastern Riverine Forests	Black-chinned Honeyeater (eastern subspecies)
						Capertee - Wolgan Riparian Rough-barked Apple - River Oak Open Forest		Brown Treecreeper (eastern subspecies)
						Unclassified (<1ha patch of remnant vegetation adjacent / within cleared lands)		Diamond Firetail
						Cleared and Severely Disturbed Lands		Eastern Bentwing-bat
								Eastern Cave Bat
								Eastern False Pipistrelle

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
								Gang-gang Cockatoo Greater Broad-nosed Bat Large-eared Pied Bat Little Eagle Powerful Owl Regent Honeyeater Scarlet Robin Speckled Warbler Turquoise Parrot Varied Sittella Yellow-bellied Sheathtail-bat
Potential Offset Property 8*	399.83 ha	Yes - Lithgow City Council	Hawkesbury/Nepean (only approx. 200m from CWCMA border)	Adjacent to Gardens of Stone National Park	Yes – Permian and Lower to middle Devonian	Tableland Gully Ribbon Gum - Blackwood - Apple Box Forest	Southern Tableland Dry Sclerophyll Forest	**Flora**
						Capertee Rough-barked Apple -	Western Slopes Grassy	Eucalyptus cannonii

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
						Redgum - Yellow Box Grassy Woodlands	Woodland	
						Capertee - Wolgan Slopes Red Box - Grey Gum - Stringybark Grassy Open Forest	Central Gorge Dry Sclerophyll Forest	Grevillea obtusiflora
						Capertee Grey Gum - Narrow-leaved Stringybark - Scribbly Gum - Callitris - Ironbark Shrubby Open Forest	Western Slopes Dry Sclerophyll Forest	Persoonia marginata
						Pagoda Rock Sparse Shrubland	Sydney Montane Heath	**Fauna**
						Non-native Vegetation - Pine plantation / woodlot / shelter		Little Eagle
						Unclassified (<1ha patch of remnant vegetation adjacent / within cleared lands)		Square-tailed Kite
						Cleared and Severely Disturbed Lands		Gang-gang Cockatoo
						Other mapping		Glossy Black-Cockatoo
								Little Lorikeet
								Turquoise Parrot

Table B.1 Results of Desktop Assessment of Potential Offset Properties

Property Name	Size (ha)	Located in Project LGA (Lithgow) ?	located in Project CMA (Central West) ?	Adjoins Conservation Area ?	Underlying Geology is Permian?	Vegetation	Vegetation Class by Keith (2004)	Threatened Species within 5 km
								Powerful Owl
								Brown Treecreeper
								Regent Honeyeater
								Varied Sittella
								Flame Robin
								Eastern False Pipistrelle
								Little Bentwing-bat

Appendix C

Gulf Mountain Biodiversity Values

2 November 2012

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FAUNA HABITAT VALUES OF GULF MOUNTAIN. A PROPOSED BIODIVERSITY OFFSET PROPERTY FOR THE COALPAC CONSOLIDATION PROJECT

Dear Dorian

The purpose of this letter is to summarise the results of spring 2012 fauna investigations on "Gulf Mountain" (the Property), a proposed Biodiversity Offset Property for the Coalpac Consolidation Project (the Project).

The key findings are summarised below, whilst detailed survey information is provided in **Appendix A**. **Appendix B** provides a full list of fauna species detected during surveys, while **Appendix C** contains an earlier letter about the vegetation of Gulf Mountain by Cumberland Ecology based upon preliminary surveys undertaken in July 2012.

1. Background

Gulf Mountain comprises 1,277 ha of native forest and woodland. It is a recent addition to the Revised Biodiversity Offset Proposal (BOP) of the Project. It was added to the BOP to increase the area of intact forest and woodland within the offset package, particularly gully forest habitats and the threatened species that inhabit them.

Earlier in 2012, Cumberland Ecology conducted a preliminary site investigation of Gulf Mountain and mapped vegetation within it. However, no vertebrate fauna surveys were conducted at the time. The results of the preliminary site investigation were reported in Cumberland Ecology Letter 19 dated 16 July 2012 (**Appendix C**). The letter was submitted to the NSW Department of Planning and Infrastructure (DP&I) as part of the Project's Response to Submissions (RTS) process.

During review of the Project's RTS, the NSW Office of Environment and Heritage (OEH) and the Planning Assessment Commission (the PAC) requested further information in order to fully assess the value of the BOP in providing adequate compensatory habitat for threatened species predicted to be impacted by the Project, such as the Squirrel Glider, Broad-Headed Snake, Brush-tailed Rock Wallaby, and Powerful Owl. The PAC also queried the impacts of the project upon Superb Lyrebird, which is not a threatened species, but is a species of concern within some non-government submissions.

Coalpac commissioned Cumberland Ecology to conduct targeted threatened fauna investigations of the Property to provide data about the faunal values of the proposed offset and to verify the presence of threatened species on the Property. The fauna investigations were completed in spring, on 15-19 October 2012.

2. Key Findings

The forest and woodland habitats of Gulf Mountain are intact and the faunal habitats are in good condition. The majority of vegetation comprises low open forest and woodland on slopes with areas of tall forest along sheltered gullies. The land includes frontage to the Turon River and therefore provides riparian habitats that are not represented within the Project Disturbance Boundary.

The October surveys detected a suite of fauna species that are predicted to be impacted by the Project, including the following threatened fauna species listed as Vulnerable under the NSW *Threatened Species Conservation Act 1995* (TSC Act):

- Powerful Owl (*Ninox strenua*);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Scarlet Robin (*Petroica boodang*);
- Varied Sittella (*Daphoenositta chrysoptera*); and
- Squirrel Glider (*Petaurus norfolcensis*).

One threatened frog and two migratory birds that are not predicted to be impacted by the Project were also found on Gulf Mountain:

- Booroolong Frog (*Litoria booroolongensis*) listed Endangered under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- Rainbow Bee-eater (*Merops ornatus*) listed Migratory under the (EPBC Act); and
- Satin Flycatcher (*Myiagra cyanoleuca*) listed Migratory under the (EPBC Act).

The Property also supports the Superb Lyrebird (*Menura novaehollandiae*), within gully forest.

Given the size of the Property and the quality of faunal habitats within it, more species of conservation significance are likely to be detected with additional survey effort. Based upon habitat types and database records for the locality surrounding Gulf Mountain, the following species may also occur: Rosenberg's Goanna, Eastern Bentwing Bat, Eastern False Pipistrelle, Large eared Pied Bat, Greater Broad-nosed Bat, Large-footed Myotis, Masked Owl, Barking Owl, Square-tailed Kite, Turquoise Parrot, Regent Honeyeater, Flame Robin, Koala and Spotted-tail Quoll. Please note that bat calls are currently being identified.

3. Conclusion

Based upon the October survey data, the gully forest and riparian forests of Gulf Mountain contain important habitat for many of the threatened species that have the potential to be impacted by the Project including: Scarlet Robin, Varied Sittella, Powerful Owl, Gang Gang Cockatoo and Squirrel Glider. Other listed species detected on the Property that are not predicted to be impacted by the Project include the Booroolong Frog. Given the size of the Property and the quality of faunal habitats within it, more species of conservation significance are likely to be detected with additional survey effort.

The gully forests, although different in species composition, contain important habitat features for a number of threatened species, such as the Powerful Owl, Gang-gang Cockatoo and Squirrel Glider. The detection of such species, in particular the Powerful Owl and Squirrel Glider, is significant as these species are likely to utilise the Property for breeding which reflects the quality of habitats provided.

The spring fauna surveys have verified the existence of key threatened species and demonstrate the suitability of Gulf Mountain as an offset to contribute towards compensating for impacts to forest fauna. We remain of the view that this large, forested Property can be a valuable part of the Revised BOP.

Yours sincerely,

David Robertson

Dr David Robertson
Director

Appendix A

Results of Spring Fauna Surveys of Gulf Mountain

A.1 Introduction

During Review of the Project's Response to Submissions (RTS), the NSW Office of Environment and Heritage (OEH) required further information in order to fully assess the value of the Revised Biodiversity Offset Proposal (BOP) in providing adequate compensatory habitat for threatened species predicted to be impacted by the Project, such as the Squirrel Glider. During their review, the NSW PAC also requested additional information on the Gulf Mountain Property (the Property), a recent addition to the BOP of the Project. Subsequently, Coalpac commissioned Cumberland Ecology to conduct targeted threatened fauna surveys on the Property to verify the presence of threatened species.

This letter provides the results of threatened fauna surveys conducted on 15-19 October 2012. This survey follows an initial site inspection that was conducted on 9-10 July 2012, the results of which are provided in Cumberland Ecology Letter 19 (**Appendix C**). Cumberland Ecology Letter 19 was submitted to the NSW Department of Planning and Infrastructure (DP&I) as part of the Project's RTS.

A.2 Property Description

The key features of the Property are provided below.

Lot & DP: Lot 56 DP 755791.

Size: 1,277 ha.

Bioregion: South Eastern Highlands Bioregion.

Location/Context: Adjoins private forested land. It is not connected directly to OEH land, but links indirectly through to Winburndale Nature Reserve via a strip of uncleared forest and woodland to the south of the Property. Winburndale Nature Reserve connects to Turon State Forest and Sunny Corner State Forest. The Property has 5.4 km of Turon River frontage.

Geology: A suite of conglomerate, sandstone, mudstone and siltstone geological units, including similar geological formations to those that occur in parts of the Project Boundary.

Topography: The terrain of the Property is very steep and rugged. The Property drops from approximately 1,100 m above sea level to approximately 700 m above sea level where it meets the Turon River.

Vegetation & Habitat Condition: Good condition with localised impacts from pigs and goats.

Four vegetation types were mapped during the site inspection (9-10 July 2012) and occur across the Property. These are:

- Riparian River Oak Forest;

- Sheltered Gully Ribbon Gum Open Forest;
- Broad-leaved Peppermint -Brittle Gum Woodland; and
- Scribbly Gum Woodland.

More information on vegetation descriptions is provided in **Appendix C**.

A.3 Methods

A.3.1 Literature Review and Database Review

A literature review was completed on the Ecological Impact Assessment for the Project (Cumberland Ecology, 2012) to create a list of threatened fauna species predicted to be impacted. Threatened species that occur or have potential to occur within the Project Boundary were deemed “subject species”.

In addition, a search of the OEH Atlas of NSW Wildlife database (OEH 2012a) was conducted in the locality (10km x 10km square) of the Property. The Atlas of NSW Wildlife search was used to generate records of threatened fauna species listed under the EPBC Act and the TSC Act that have been recorded in the locality of the Property.

A.3.2 Field Surveys

Field surveys were conducted for five days and three nights by two ecologists on 15-19 October 2012. Surveys were undertaken in accordance with federal survey guidelines for threatened species (DEWHA 2010c, a, b, SEWPaC 2011b, c) and NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DEC (NSW) 2004). Federal survey guidelines were generally followed as these are more comprehensive.

The methods used during surveys are described in the following subsections.

i. Amphibian Surveys

a. Diurnal Active Surveys

Diurnal active searches were conducted in suitable habitat for amphibians throughout the Property. Diurnal active searches were conducted along a 500 m transect of the Turon River (see **Figure 1**). These surveys were undertaken over a one hour period per transect. Opportunistic active searches were also conducted during other diurnal and nocturnal activities, including spotlighting along tracks and searches of debris in watercourses. Searches involved the lifting of rocks, bark, fallen logs and bushrock and the scraping of top soil. Captured animals were identified and then released.

b. Nocturnal Surveys

Visual Encounter Surveys were undertaken along the Turon River (see **Figure 1**). These surveys involved walking 500 m transects of the river at night with torches, searching for frogs on and under rocks and listening to calls. Surveys were undertaken over a one hour period per transect. Any amphibians detected were caught, identified and released. In addition to the Visual Encounter Surveys, searches were undertaken for egg masses and tadpoles of the target species. Call detection was also undertaken throughout the survey period.

ii. Bird Surveys

a. Diurnal Surveys

Bird census surveys were conducted at several points throughout the Property (see **Figure 1**). Bird census surveys involved looking and listening for birds from a central point for a period of 30 minutes, and recording all birds that were detected during these surveys. Diurnal birds were also identified and recorded as they were encountered incidentally throughout the Property during the survey periods.

b. Nocturnal Surveys

Spotlighting and call playback was conducted for nocturnal birds (see **Figure 1**). Spotlighting transects were focussed on and around the Turon River and woodland patches throughout the Property.

Nocturnal surveys were conducted using a hand-held spotlight while walking or from a slow moving vehicle. Handheld spotlights were used to pick up animal movement and eye shine. Spotlights (100 watt) with dimmer knobs were used. Reflective eye-shine was used to pick out any animals. Incidental spotlighting was also conducted while travelling between transects at night.

Spotlighting and call playback were conducted for two hours per night on two nights to detect the presence of nocturnal fauna species at the Property. During this time, call playback was also used to elicit a vocal response from the following nocturnal birds:

- Powerful Owl (*Ninox strenua*);
- Masked Owl (*Tyto novaehollandiae*); and
- Barking Owl (*Ninox connivens*).

Calls were played for 2-minute periods at 5-minute intervals. This was followed with quiet listening and spotlighting.

iii. Bat Surveys

Anabat Z-CAIM units (anabats) were used at four sites for two nights per site to record calls of microbats that could fly through or potentially roost or forage in different woodlands and rocky outcrops within the Property (see **Figure 1**). Anabats were angled upwards towards large stags, live hollow-bearing trees, rocky outcrops and cliffs, or in potential flyways. The recorders were housed in plastic containers and left out for two nights per site. Units were placed in varying locations, including adjacent to the Turon River, adjacent to steep rocky cliffs, within a rocky outcrop, and within a forested gully containing a watercourse. The sites chosen for the placement of Anabat units are considered to accurately represent the diversity of microbat habitats within the Property.

Anabats were programmed to automatically turn on one hour before dusk each evening and switch off one hour after dawn. Call data is currently being analysed by a bat specialist. Echolocation calls will be identified to one of two confidence levels: positive identification and possible species detection. As a precautionary measure, species not positively identified will not be considered to occur.

iv. Arboreal Mammal Surveys

a. Nocturnal Surveys

Spotlighting and call playback surveys to detect nocturnal mammals were conducted concurrently with nocturnal bird surveys (2 hours per night on two nights). Spotlighting transects were focussed on and around the Turon River and woodland patches throughout the Property (see **Figure 1**).

Nocturnal surveys were conducted using a hand-held spotlight while walking or from a slow moving vehicle. Handheld spotlights were used to pick up animal movement and eye shine. Spotlights (100 watt) with dimmer knobs were used. Reflective eye-shine was used to pick out any animals. Incidental spotlighting was also conducted while travelling between transects at night.

Spotlighting and call playback surveys for were conducted at several locations to detect the presence of nocturnal arboreal mammal species on the Property. During this time, call playback was also used to elicit a vocal response from the following nocturnal mammals:

- Koala (*Phascolarctos cinereus*);
- Squirrel Glider (*Petaurus norfolkensis*).

Calls were played for 2-minute periods at 5-minute intervals. This was followed with quiet listening and spotlighting.

v. *Incidental Observations*

Any incidental vertebrate fauna species that were observed, heard calling, or otherwise detected on the basis of tracks or other signs was recorded.

vi. *Habitat Assessment*

The characteristic attributes of different types of fauna habitat generally influence the assemblage of fauna species that can be found and also affects the general value of the habitat for fauna. The Property contains diverse habitat types that various fauna species would use. These are:

- Woodland and open forest on slopes and ridgelines;
- Cliff and caves;
- Riparian forest along Turon River; and
- Gully forest.

Fauna habitat assessments also included consideration of important indicators of habitat condition and complexity such as tree hollows and their sizes, age of trees, fallen logs, bush rock, cliffs and caves, riparian habitats such as rivers or ephemeral creeks. Signs of fauna usage such as scats and scratches were also noted.

A.3.3 Limitations

The fauna surveys, whilst undertaken in accordance with OEH (DEC (NSW), 2004) and SEWPaC guidelines (DEWHA 2010c, a, b, SEWPaC 2011b, c) only provide a “snapshot” investigation in time and illustrate a view of the fauna that were active during the time of the surveys. Fauna surveys may be pre-disposed to favour conspicuous, active, or common fauna. It is likely that more cryptic fauna may utilise the Property despite not being detected to date.

For this reason, where suitable habitat was recorded for subject species, the subject species was considered to have the potential to occur. This was a precautionary measure as database searches did not reveal an abundance of known threatened species records in the locality. This is more likely due to the remoteness of the Property and surrounding area and a lack of surveys that have been conducted, rather than the quality of habitat present.

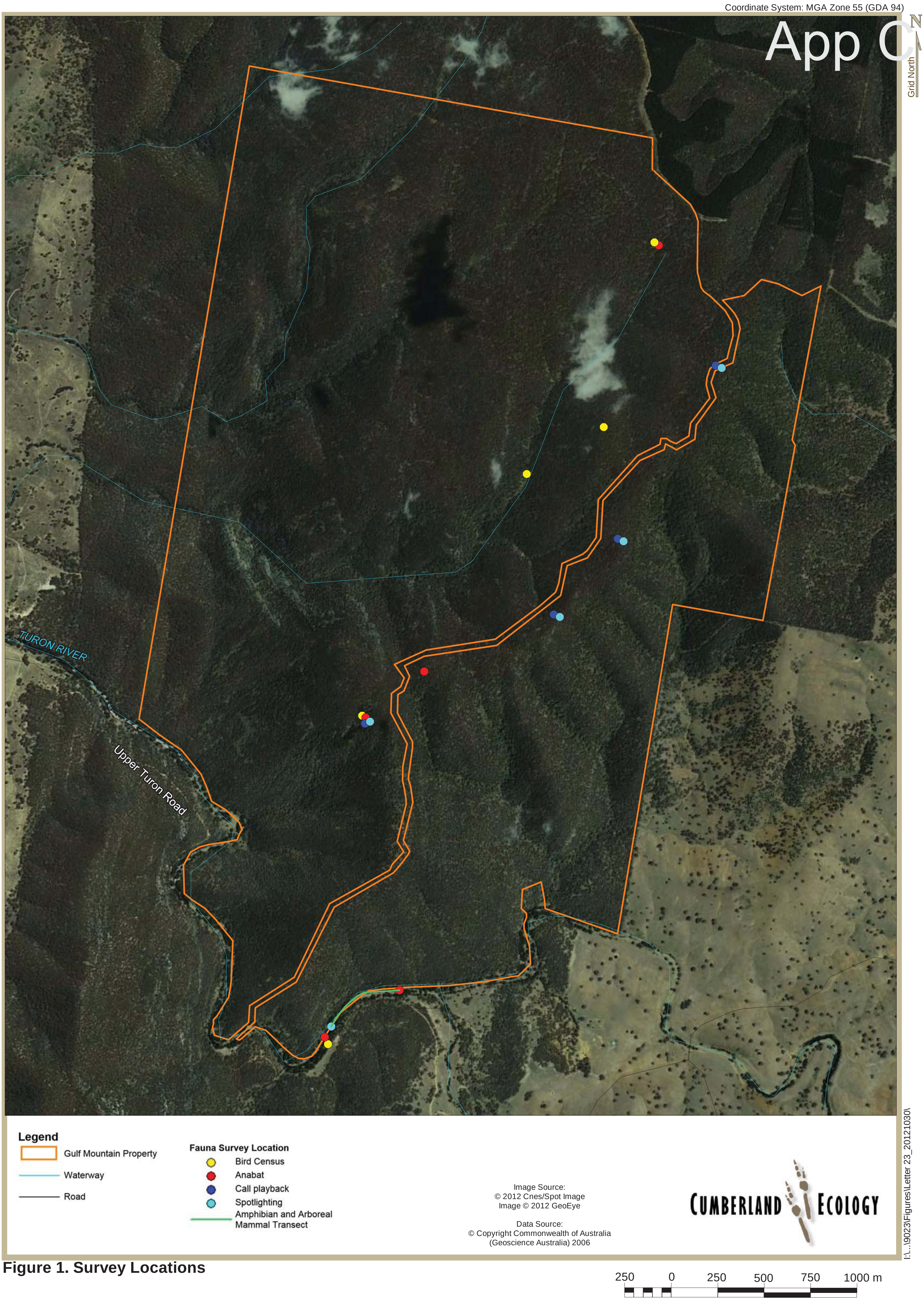

Figure 1. Survey Locations

A.4 Results

A.4.1 Literature Review and Database Searches

Table 1 below presents the threatened species listed under the EPBC Act and TSC Act that are predicted to be impacted by the Project (subject species). The list includes records of threatened species recorded in the locality, or species that are considered likely to occur due to the availability of suitable habitat and information on species' ranges. This literature review and database analysis identifies that a number of subject species have potential to occur on the Property.

Table 1 Subject Species and Likelihood of Occurrence on Gulf Mountain Property

Scientific Name	Common Name	Status		General Habitat Requirements	Subject Species		Known to Occur *	Detected on Gulf Mountain	Likelihood of Occurrence on Gulf Mountain
		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
FAUNA									
Amphibians									
Litoria booroolongensis	Booroolong Frog	E	E	Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge.	N	N	Y	Y	Present, recorded during frog surveys. Records occur upstream and downstream of the Property. Suitable habitat occurs along Turon River.
Reptiles									
Hoplocephalus bungaroides	Broad-headed Snake	V	V	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to in hollows in large trees in summer.	N	Y	N	N	Low, Property occurs on the western edge of known extent. Species occurs patchily throughout its known range.
Varanus	Rosenberg's	V		Found in heath, open forest and woodland.	N	Y	Y	N	Moderate, Property is an

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rosenbergi	Goanna			Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens.					extensive area of intact forest and woodland on sandstone soils. Property is also connected to large areas of intact native vegetation to the north and south.
Birds									
Daphoenositta chrysoptera	Varied Sittella	V		Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	Y	Y	Y	Y	Present, recorded during site inspection (9-10 July 2012) and fauna surveys (15-19 October 2012).

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		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
Pyrrholaemus saggitatus	Speckled Warbler	V		Lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. Pairs are sedentary, occupying a breeding territory of about 10ha, with a slightly larger home-range when not breeding.	Y	Y	N	N	Moderate, not known in the area, though suitable habitat occurs within occurs in gully forests.
Climacteris picumnus victoriae	Brown Treecreeper	V		Found in eucalypt woodlands and dry open forests of the inland slopes and plains inland of the Great Dividing Range. Also	Y	Y	Y	N	Low, marginal habitat occurs along gully forest adjacent Turon River

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				occasionally occurs in suitable habitat in coastal areas. Mainly inhabits woodlands dominated by stringybarks and other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. Usually not found in woodland with a dense shrub understorey. Fallen timber is an important habitat component for foraging. Sedentary, with home-ranges from 1.1ha to 10.7ha. Hollows in standing dead or living trees and tree stumps are essential for nesting.					
Petroica boodang	Scarlet Robin	V		The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in	Y	Y	Y	Y	Present, recorded during site inspection (9-10 July 2012) and fauna surveys (15-19 October 2012).

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				wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude. The Scarlet Robin is primarily a resident in forests and woodlands, but some adults and young birds disperse to more open habitats after breeding					
Callocephalon fimbriatum	Gang Gang Cockatoo	V		In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet eucalypt forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or	Y	Y	Y	Y	Present, heard during bird census (15-19 October 2012). Potential nesting in large *Eucalyptus viminalis* in gully forest and forage within forest and woodland of Property.

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Table 1 Subject Species and Likelihood of Occurrence on Gulf Mountain Property

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				in dry forest in coastal areas. Often found in urban areas. Favours old-growth attributes for nesting and roosting.					
Lophoictinia isura	Square-tailed Kite	V		Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Appears to occupy large hunting ranges of more than 100km2.	Y	Y	N	N	Moderate, suitable forage and nesting habitat within forest and woodland of Property
Ninox strenua	Powerful Owl	V		Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented	Y	Y	Y	Y	Present, a pair (male and female) recorded during call playback. Roosting and potential nesting in is present in *Eucalyptus viminalis* in gully

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		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
				landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats shelters.					forest.
Xanthomyza phrygia	Regent Honeyeater	CE	E, M	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	N	Y	Y	N	Low-moderate, marginal forage habitat along riparian forest. *Casuarina cunninghamiana* mistletoe (*Amyena cambadgei*) was recorded in low abundance.
Calyptorhynchus lathami	Glossy Black Cockatoo	V		Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur. Feeds almost exclusively on the seeds of	N	Y	N	N	Low, no suitable habitat recorded

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		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
				several species of she-oak (*Casuarina* and *Allocasuarina* species). Dependent on large hollow-bearing eucalypts for nest sites.					
Lathamus discolor	Swift Parrot	E	E, M	Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculate*), Red Bloodwood (*Corymbia gummifera*), Mugga Ironbark (*Eucalyptus sideroxylon*), and White Box (*Eucalyptus albens*). Commonly used lerp infested trees include Grey Box (*Eucalyptus microcarpa*), Grey Box (*Eucalyptus moluccana*) and Blackbutt	N	Y	N	N	Low, marginal forage habitat along riparian forest. Limited preferred and winter flowering species.

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				(*Eucalyptus pilularis*).					
Glossopsitta pusilla	Little Lorikeet	V		Mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes.	N	Y	Y	N	Low, marginal forage along riparian forest
Grantiella picta	Painted Honeyeater	V		Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema*. Insects and nectar from mistletoe or	N	Y	N	N	Low, marginal forage habitat along riparian forest

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		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
				eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.					
Melithreptus gularis gularis	Black-chinned Honeyeater	V		Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*Eucalyptus albens*), Grey Box (*Eucalyptus microcarpa*), Yellow Box (*Eucalyptus melliodora*) and Forest Red Gum (*Eucalyptus tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	N	Y	N	N	Low, marginal forage habitat along riparian forest
Pomatostomus temporalis	Grey-crowned Babbler	V		Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box	N	Y	N	N	Low, marginal forage habitat in gullies. Species is less

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temporalis				Woodlands on alluvial plains. Flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. Build and maintain several dome-shaped stick nests used for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts.					common at high altitudes.
Neophema pulchella	Turquoise parrot	V		Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Nests in tree hollows, logs or posts, from August to December.	N	Y	N	N	Moderate, suitable habitat for forage in eucalypt forest and woodland

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Melanodryas cucullata cucullata	Hooded Robin	V		Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season.	N	Y	N	N	Low, species prefers lightly wooded country.
Petroica phoenicea	Flame Robin	V		Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields,	N	Y	N	N	Moderate, suitable habitat within gully forest.

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		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
				heathlands, shrublands and sedgelands at high altitudes.					
Stagonopleura guttata	Diamond Firetail	V		Found in grassy eucalypt woodlands, including Box-Gum Woodlands. Also occurs in open forest, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas, and sometimes in lightly wooded farmland. Feeds exclusively on the ground, primarily on grass and herb seed. Nests and roosts mainly in dense shrubs.	N	Y	N	N	Low, marginal habitat confined to riparian forest along Turon River
Tyto novaehollandiae	Masked Owl	V		Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-	N	Y	N	N	Moderate, roosting and potential nesting in gully forest and riparian forests.

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		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
				range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.					
Ninox connivens	Barking Owl	V		Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or the dense clumps of canopy leaves in large Eucalypts. Feeds on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals such as smaller gliders, possums, rodents and rabbits becoming important during breeding	N	Y	N	N	Moderate, roosting and potential nesting in gully forest and riparian forest

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		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
Mammals									
Petaurus norfolcensis	Squirrel Glider	V		Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia mid-storey. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	Y	Y	Y	Y	Present, recorded during survey in riparian/gully forest along Turon River. Nesting habitat in *Eucalyptus viminalis* in gully forest.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Found in well-timbered areas containing gullies. Roosts in caves, crevices in cliffs and old mine workings frequenting low to mid-elevation dry open forest and woodland close to these features.	Y	Y	N	TBC	Moderate, potential roost sites in cliffs and caves, though marginal forage confined to gully forest on fertile soils

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		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat	V		Hunts in forested areas, catching moths and other flying insects above the tree tops. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.	Y	Y	Y	TBC	High, potential roost sites in cliffs and caves and forage in gully forest and other drier forest and woodlands of Property.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	Y	Y	Y	TBC	High, potential roost sites in hollow trees of wetter gully forest and forage in forest and woodland of Property.
Mormopterus norfolkensis	Eastern Free-tail Bat	V		Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures	Y	Y	N	TBC	High, potential roost sites in hollow trees of wetter gully forest and forage in forest and woodland of Property.
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Forages after sunset, flying	Y	Y	N	TBC	High, potential roost sites in hollow trees of wetter gully forest and forage along Turon River

Table 1 Subject Species and Likelihood of Occurrence on Gulf Mountain Property

Scientific Name	Common Name	Status		General Habitat Requirements	Subject Species		Known to Occur *	Detected on Gulf Mountain	Likelihood of Occurrence on Gulf Mountain
		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
				slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Although this species usually roosts in tree hollows, it has also been found in buildings. Females congregate at maternity sites located in suitable trees.					
Dasyurus maculatus	Spotted-tail Quoll	E	E	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	N	Y	N	N	High, Property is an extensive tract of intact vegetation with many caves, hollow logs, suitable for den sites. Property forms part of a large tract of connected remnants to the north and south.
Petaurus australis	Yellow-bellied Glider	V		Den, often in family groups, in hollows of large trees. Occur in tall mature eucalypt forest generally in areas with high rainfall and	N	Y	N	N	Low, Property occurs beyond known distribution. Species distribution extends to the

Table 1 **Subject Species and Likelihood of Occurrence on Gulf Mountain Property**

Scientific Name	Common Name	Status		General Habitat Requirements	Subject Species		Known to Occur *	Detected on Gulf Mountain	Likelihood of Occurrence on Gulf Mountain
		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
				nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.					tablelands.
Cercartetus nanus	Eastern Pygmy Possum	V		Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes .	N	Y	N	N	Low, marginal habitat occurs. Limited food resources - no banksias. Reliant on eucalypts, fruits and insects for forage.
Saccolaimus flaviventris	Yellow-bellied Sheathtailbat	V		Roosts in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Forages in most habitats,	N	Y	Y	TBC	High, potential roost sites in hollow trees of wetter gully forest and forage in forest and

Table 1 Subject Species and Likelihood of Occurrence on Gulf Mountain Property

Scientific Name	Common Name	Status		General Habitat Requirements	Subject Species		Known to Occur *	Detected on Gulf Mountain	Likelihood of Occurrence on Gulf Mountain
		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
				with and without trees.					woodland of Property, roosting in gully forest and forage in forest and woodland of Property.
Myotis macropus	Large-footed Myotis	V		Most habitats near water, including mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland. Forage over streams and pools catching insects and small fish. Generally roost close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	N	N	N	TBC	High, tree hollows and caves are located close to the Turon River a permanent water body.
Petrogale penicillata	Brush-tailed Rock Wallaby	V	E	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north.	N	Y	N	N	Low, Property occurs west beyond known distribution.

Table 1 Subject Species and Likelihood of Occurrence on Gulf Mountain Property

Scientific Name	Common Name	Status		General Habitat Requirements	Subject Species		Known to Occur *	Detected on Gulf Mountain	Likelihood of Occurrence on Gulf Mountain
		TSC	EPBC		Detected in the Project Boundary	Potential to Occur in the Project Boundary			
				Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. .					
Phascolarctos cinereus	Koala	V	V	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	N	Y	Y	N	High, recorded along Turon River to the south-east. Gully forest and riparian forest contain *Eucalyptus viminalis* a primary food tree.

Notes: TBC refer to bat species that are yet to be identified from Anabat data.

** Known to occur within 10 km of Gulf Mountain Property*

A.4.2 Field Surveys

i. Amphibians

Booroolong Frog (*Litoria booroolongensis*) is listed as Endangered under both the NSW TSC Act and EPBC Act and is not a subject species. Seven individuals were recorded during transect surveys along the Turon River (see **Figure 2**). All records of the species were detected during the nocturnal Visual Encounter Survey. The species was predominantly found perched on prominent large rocks adjacent to shallow reaches of the Turon River. Each individual was captured and identified to species level by a suitably qualified ecologist. One possible call record was also detected in the vicinity of one of the released individuals; however the species is known to have a soft call (OEH 2012b) and was not positively identified. No eggs or larvae were detected during the surveys.

Photograph 1 Booroolong Frog (*Litoria booroolongensis*) recorded during Gulf Mountain surveys

A full species list including frog species recorded can be found in **Appendix B**.

ii. Birds

The following threatened and migratory bird species were detected during surveys. These are:

- Powerful Owl (*Ninox strenua*);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);

- Varied Sittella (*Daphoenositta chrysoptera*);
- Scarlet Robin (*Petroica boodang*);
- Satin Flycatcher (*Myiagra cyanoleuca*); and
- Rainbow Bee-eater (*Merops ornatus*).

The aforementioned species are discussed in more detail below.

The Powerful Owl (*Ninox strenua*) is listed Vulnerable under the TSC Act and is a subject species. A pair (one male and one female) was heard calling from a gully in the central/west area of the Property. The female flew in from the gully in response to call playback that was broadcast from the ridgeline in the centre of the Property (see **Figure 2**). It is likely that this species roosts and could potentially breed in vegetation within the lower parts of the gullies and in riparian vegetation along the Turon River. These habitats contain large trees of *Eucalyptus viminalis* (Ribbon Gum), potential nest sites if large hollows exist and also *Casuarina cunninghamiana* (River Oak), suitable for roosting. The pair are likely to forage throughout the Property as it would make up part of a larger home range. Given that there are relatively few records for Powerful Owls in this area, this pair is significant. There are large areas of habitat to the north and south of the Property in conservation areas such as Winburndale NP and Sunny Corner State Forest. The Property would form a component of habitat corridors for juvenile owls to disperse into and form their own territories.

Photograph 2 Powerful Owl (*Ninox strenua*) recorded during Gulf Mountain surveys

The Gang-gang Cockatoo (*Callocephalon fimbriatum*) is listed as Vulnerable under the TSC Act and is a subject species. The species was heard calling in the north-eastern portion of the Property (see **Figure 2**). Similarly to the Powerful Owl, it is likely that the Gang-gang Cockatoo roosts and could potentially breed in vegetation within lower parts of gullies and in riparian vegetation along the Turon River. These habitats contain large trees of *Eucalyptus viminalis* (Ribbon Gum) suitable for roosting and nesting (if large hollows exist). The species would forage throughout the Property and it would make up part of a larger home range.

The Varied Sittella (*Daphoenositta chrysoptera*) is listed as Vulnerable under the TSC Act and is a subject species. This species has been recorded on both visits to the Property (9-10 July 2012 and 15-19 October 2012) (see **Figure 2**). The species inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland (NSW Scientific Committee 2010b). The Property provides extensive habitat for the species. It is likely that a population of the species occurs within the locality of the Property.

The Scarlet Robin (*Petroica boodang*) is listed as Vulnerable under the TSC Act and is a subject species. This species has been recorded on both visits to the Property (9-10 July 2012 and 15-19 October 2012) (see **Figure 2**). The species occupies open forests and woodlands from the coast to the inland slopes and breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas (DECCW (NSW) 2010). Within the Property, extensive areas of suitable habitat for the species exist. It is likely that a population of the species occurs within the locality of the Property.

Photograph 3 **Scarlet Robin (*Petroica boodang*) recorded during Gulf Mountain surveys**

The Satin Flycatcher (*Myiagra cyanoleuca*) is listed as Migratory under the EPBC Act is a subject species. This species was observed within suitable gully forest of the Property (see **Figure 2**). It is likely that the *E. viminalis* in the gully forest provides suitable nesting habitat for this species.

The Rainbow Bee-eater (*Merops ornatus*) is listed as Migratory under the EPBC Act and is a subject species. This species was heard at the edge of a steep slope to the east of the Property (see **Figure 2**). The steep slopes and cliff faces would provide nesting habitat for the species to excavate their burrows.

A full list of bird species recorded during surveys can be found in **Appendix B**. This includes the non-threatened, Superb Lyrebird (*Menura novaehollandiae)*.

iii. Mammals

The Squirrel Glider (*Petaurus norfolcensis*) is listed as Vulnerable under the TSC Act and is a subject species. One individual was heard calling while spotlighting along the Turon River in the south of the Property (see **Figure 2**). The mosaic of intact riparian vegetation, gully forest and slope forest/woodland provides suitably large areas of habitat for this species. Suitable hollows are present in most communities, and the Squirrel Glider would travel throughout the Property to take advantage of blossom periods of different tree species.A full list of mammal species (except microbats) recorded on the Property can be found in **Appendix B**. Bat calls are currently being identified.

A.4.3 Potentially Occurring Subject Species

This section describes threatened fauna species that have not been recorded within the Property, but are considered to have a moderate or high potential to occur due to the presence of suitable habitat and/or nearby sightings indicated by NSW Atlas of Wildlife database search. These results are summarised in **Table 1**.

i. Reptiles

a. Rosenberg’s Goanna

The Rosenberg’s Goanna (*Varanus rosenbergi*) is listed as Vulnerable under the TSC Act and is a subject species. It was not detected on the Property, though one record occurs to the south-east of the Property near the Turon National Park.

Rosenberg’s Goanna is known to be associate with sandstone environments, and is usually found in heath and woodlands where it shelters in burrows, hollow logs and rock crevices (Cogger 2000). These habitat features were recorded in high abundance across the Property. Termite mounds, which house their eggs, were recorded occasionally on the plateaus and ridgelines of the Property. Although this species was not recorded on the Property, it is considered to have potential to occur as suitable habitat is available and it is known to occur in the area.

ii. Birds

a. Speckled warbler

The Speckled Warbler (*Chthonicola sagittata*) is listed as Vulnerable under the TSC Act and is a subject species. It was not detected on the Property, nor is it known in the area.

Speckled Warblers inhabit both grassy and shrubby woodlands, often on ridges or gullies and feed on insects and seeds (NSW Scientific Committee 2001, Gardner and Heinsohn 2007). Although this species was not recorded on the Property it is considered to have potential to occur as suitable habitat is available within Sheltered Gully Ribbon Gum Forest.

b. Square-tailed Kite

The Square-tailed Kite (*Lophoictinia isura*) is listed as Vulnerable under the TSC Act and is a subject species. It was not detected on Property, nor is it known in the area.

The species is a wide ranging species with large home ranges of up to 50 km^2 (Lutter et al. 2004) and forages over a variety of habitats (NSW Scientific Committee 2004d). Being a specialist hunter of passerines, particularly honeyeaters, it is likely that the blossom periods of dominant trees within the Property would attract prey species for the Square-tailed Kite and thus provide forage.

c. Turquoise Parrot

The Turquoise Parrot (*Neophema pulchella*) is listed as Vulnerable under the TSC Act and is a subject species. It has not been detected on the Property, nor is it known in the area.

The Turquoise Parrot inhabits eucalypt and cypress-pine open forests and woodlands (commonly box or box-ironbark) with native grasses, sometimes with a low shrubby understorey, often in undulating or rugged country, or on foot slopes (NSW Scientific Committee 2004e). It also lives in open woodland or riparian gum woodland, and often near ecotones between woodland and grassland, or coastal forest and heath (NSW Scientific Committee 2004e). The richer habitat types on creek or river flats and foothills are preferred (DEC (NSW) 2005f). The Turquoise Parrot nests hollows of live or dead trees or stumps and feeds mostly on seeds of grasses, forbs and native shrubs, taken on or near the ground; also on some flowers, nectar, fruits, leaves and scale-insects (NSW Scientific Committee 2004e).

Although this species was not recorded on the Property it is considered to have potential to occur as suitable habitat is available. The Property is very rugged and contains richer habitats (i.e. Riparian River Oak Forest) along the Turon River and Sheltered Gully Ribbon Gum Forest in the gullies.

d. Regent Honeyeater

The Regent Honeyeater (*Anthochaera phrygia*) is listed as Endangered under both the EPBC Act and the TSC Act and is a subject species. It was not detected on the Property, though one record is located along the Turon River to the west of the Property.

Regent Honeyeaters are a nomadic species that will move to areas where food is abundant; however, the exact nature of these movements is still poorly understood. The Capertee Valley and Wolgan Valley are known breeding locations for this species. The species prefers box-ironbark eucalypt associations and it seems to prefer wetter, more fertile sites within these associations, such as along creek flats, broad river valleys and lower slopes (Department of Environment and Conservation NSW 2004).

Among the documented mistletoes favoured by the species, *Amyema cambagei* on *Casuarina cunninghamiana* was recorded in low abundance in Riparian River Oak Forest of the Property. This mistletoe, though present, was not flowering during the time of survey. It is possible the mistletoe may flower at a slightly different time of spring to Capertee Valley populations and would provide some forage at that time.

e. Flame Robin

The Flame Robin (*Petroica phoenicea*) is listed as Vulnerable under the TSC Act and is a subject species. It was not detected on the Property, nor is it known in the area.

In NSW the Flame Robin breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey (NSW Scientific Committee 2010a). In winter it migrates to more open lowland habitats (NSW Scientific Committee 2010a). Although this species was not recorded on the Property it is considered to have potential to occur. The Property contains upland moist eucalypt forest in the form of Sheltered Gully Ribbon Gum Forest.

f. Barking Owl

The Barking Owl (*Ninox connivens*) is listed as Vulnerable under the TSC Act and is a subject species. It was not recorded on the Property, nor is it known in the area.

The species occupies forest and woodland typically dominated by eucalypts (NSW NPWS 2003, DEC (NSW) 2005a). Although Barking Owls have been recorded in remnants of forest and woodland and in clumps of trees at farms, towns and golf courses (NSW NPWS 2003), their primary habitat is woodland (NSW Scientific Committee 2004a). Barking Owls usually roost in or under dense foliage including rainforest species of streamside gallery forests, River She-oak (*Casuarina cunninghamianal*), other *Casuarina* and *Allocasuarina* species, eucalypts, *Angophora* or *Acacia* species, often near watercourses or wetlands (NSW NPWS 2003). The species typically breeds in hollows of large eucalypts or paperbarks, usually near watercourses or wetlands (NSW NPWS 2003).

The Property contains Riparian River Oak Forest which is dominated by *Casuarina cunninghamiana,* a roost tree. The Sheltered Gully Ribbon Gum Forest has large *Eucalyptus viminalis* that are an appropriate age to support large hollows for nesting. The entire Property would likely make up part of a much larger home range.

g. Masked Owl

The Masked Owl (*Tyto novaehollandiae*) is listed as Vulnerable under the TSC Act and is a subject species. It was not detected on the Property, nor is it known in the area.

Habitat for this forest owl is widespread throughout the dry eucalypt forests of the tablelands, western slopes and the undulating wet-dry forests of the coast (DEC (NSW) 2006). Optimal habitat includes an open understorey and a mosaic of grassy and shrubby ground cover on gentle terrain (DEC (NSW) 2006). Roost and nest sites can be in a variety of topographic positions, from dense foliage in gullies to upper slopes. Nest sites require large hollows (greater than 40 cm wide and greater than 100 cm deep) and do not require proximity to streams (DEC (NSW) 2006).

The Sheltered Gully Ribbon Gum Forest has large *Eucalyptus viminalis* that are an appropriate age to support large hollows for nesting. The entire Property would likely make up part of a much larger home range.

iii. Mammals

a. Spotted-tail Quoll

Spotted-tailed Quoll (*Dasyurus maculatus maculatus*) is listed as Vulnerable under the TSC Act and as Endangered under the EPBC Act and is a subject species. It was not recorded on the Property, nor is it known in the area.

The Spotted-tail Quoll has been recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline (NSW NPWS 1999). This species creates dens in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields or rocky-cliff faces (DEC (NSW) 2005e). Numbers of the Spotted-tail Quoll are low, and males of the species are known to have extensive home ranges up to 3500 ha [or 35 km2] (NSW NPWS 1999).

The Property is an extensive tract of intact vegetation with many caves, hollow logs and hollow bearing trees suitable for den sites. Although not known in the area, the Property would likely form part of a much larger home range that occupies vegetation to north and south of the Property.

b. Koala

The Koala (*Phascolarctos cinereus*) is listed as Vulnerable under the EPBC Act and the TSC Act and is a subject species. It was not detected on the Property, though it is known in the area. One record is located along the Turon River to the south-east of the Property.

This species inhabits eucalypt woodland and forest (DECC (NSW) 2008). The species feeds almost exclusively on the leaves of more than 66 eucalypt species (DECC (NSW) 2008) and six non eucalypt species (Phillips 2000), but in any one area will select primary species (DECC (NSW) 2008).

Habitat assessment indicates that some portions of the Property support primary food trees (*Eucalyptus viminalis*) within the Sheltered Gully Ribbon Gum Forest in gullies and along the Turon River.

c. Bats

Cave-dwelling Bats

Call data collected during the October 2012 survey is currently being analysed by a bat specialist. Two threatened cave-dwelling bats have the potential to occur on the Property. These are:

- Large-eared Pied Bat (*Chalinobus dwyeri*) is listed as Vulnerable under both the EPBC Act and the TSC Act; and
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) is listed as Vulnerable under the TSC Act.

The Large-eared Pied Bat is a subject species and roosts in caves and overhangs in sandstone cliffs and forages in fertile woodland valley habitat within close proximity of each other as almost all records occur within kilometres of rocky terrain (SEWPaC 2011a). This species has been recorded foraging in a range of vegetation types, including dry and wet sclerophyll forest, grassy woodland, *Callitris* dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country (SEWPaC 2011a).

The Eastern Bent-wing Bat is a subject species and occurs to the south-east of the Property near the Turon National Park. This species is an insectivorous species that forages above the canopy of forest and woodland (DEC (NSW) 2005b) and almost exclusively roosts in caves and artificial constructions such as mines along the east coast of Australia (Churchill 2008) It requires very specific conditions in terms of temperature and humidity for maternity sites (Van Dyck and Strahan 2008), which house up to 150,000 individuals (DEC (NSW) 2005b).

The cliffs and overhangs of the Property provide potential roosting and breeding habitat while the forests and woodlands, particularly the Riparian River Oak Forest and Sheltered Gully Ribbon Gum Forest provide optimal forage for the Large-eared Pied Bat and Eastern Bent-wing Bat on the Property.

Hollow-dwelling Bats

Call data is currently being analysed by a bat specialist. Five threatened hollow-dwelling bats, listed Vulnerable under the TSC Act have high potential to occur on the Property. These are:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*);
- Yellow-bellied Sheathtail-bat *(Saccolaimus flaviventris*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*); and
- Large-footed Myotis (*Myotis macropus*).

The Eastern False Pipistrelle is a subject species and is known to occur along the Turon River to the south-east of the Property near Turon National Park. It generally prefers moist habitats, with trees taller than 20 m (DEC (NSW) 2005c). This species generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings (NSW Scientific Committee 2004b).

The Eastern Freetail-bat is a subject species and is a solitary, insectivorous bat most commonly found in open spaces in dry sclerophyll forests, woodland and swamp forests in eastern NSW. The species mainly roost in spout hollows of large mature trees and sometimes under bark or in man-made structures (NSW NPWS 2004). They tend to forage in gaps in upper-slope vegetation and over larger waterways.

The Yellow-bellied Sheathtail-bat is a subject species and is known to occur along the Turon River to the south-east of the Property near Turon National Park. Very little is known about the Yellow-bellied Sheathtail-bat (DEC 2006). Fertile low-elevation forests and woodlands of plains and valleys are the likely to be the preferred habitat of the Yellow-bellied Sheathtail-bat (DEC 2006); though the species has been recorded in cleared grazing areas (Shelley 2004). The species forages for airborne insects (mainly beetles and moths) above the tree canopy, although in more open habitats also feeds closer to the ground (DEC 2006). It usually roosts in tree hollows (DEC (NSW) 2005g).

The Greater Broad-nosed Bat is a subject species and utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest (NSW Scientific Committee 2004c). It forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m (DEC (NSW) 2005d). Although this species usually roosts in tree hollows, it has also been found in buildings (DEC (NSW) 2005d).

The Large-footed Myotis (*Myotis macropus*), listed Vulnerable under the TSC Act, is not a subject species, though has the potential to occur on the Property. Tree hollows and caves occur in close proximity to suitable forage along the Turon River.

Habitat for all of the above species is present on the Property and all have the potential to occur.

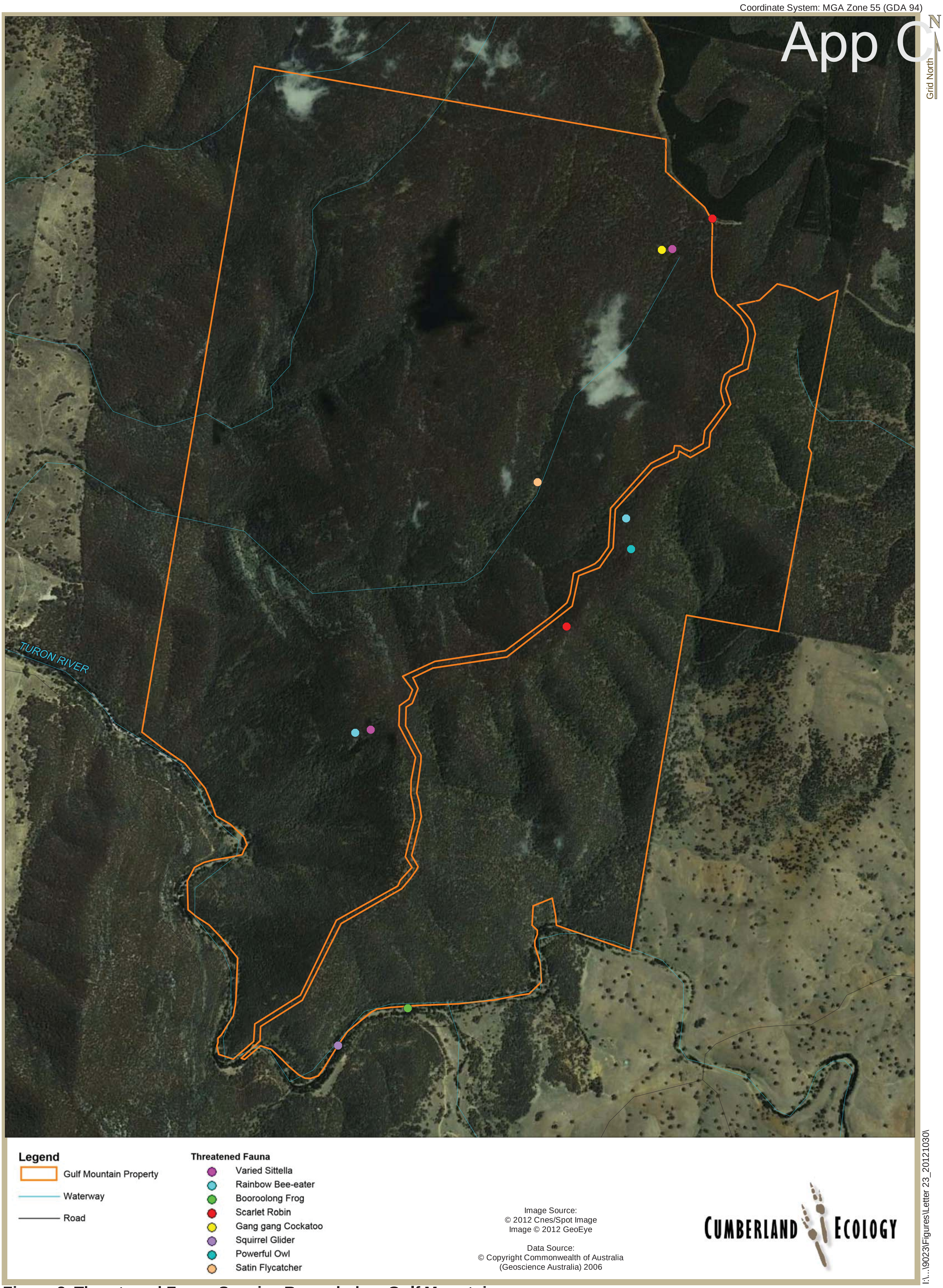

Figure 2. Threatened Fauna Species Recorded on Gulf Mountain

250 0 250 500 750 1000 m

A.5 Discussion and Conclusion

Gulf Mountain is a large Property containing a diverse range of relatively intact forest and woodland habitats. The majority of vegetation comprises low open forest and woodland on slopes with areas of tall forest along sheltered gullies and the Turon River.

The fauna survey results show that the Property definitely contains habitats that support a suite of threatened species that are predicted to be impacted by the Project. This includes the Scarlet Robin, Varied Sittella, Powerful Owl, Gang Gang Cockatoo and Squirrel Glider. The Property also supports a considerable diversity of non-threatened fauna, including the Superb Lyrebird, which was of interest in considerations by the PAC.

The terrain of the Property is very steep and somewhat similar to parts within the Project Boundary. The gully forests contain important habitat features for a number of threatened species, such as the Powerful Owl, Gang-gang Cockatoo and Squirrel Glider. The detection of such species, in particular the Powerful Owl and Squirrel Glider, is significant as these species are likely to utilise the Property for breeding which reflects the quality of habitats provided.

The Property contains some high quality habitats that are not found in the Project Disturbance Boundary, including riparian forest. Consequently it supports one threatened frog not likely to be impacted by the Project: the Booroolong Frog.

Given the size and intactness of forest and woodland habitats, it is considered likely that other threatened species may also occur within the Property. Based upon habitat types and database records for the locality surrounding the Property, the following species may also occur: Rosenberg's Goanna, Eastern Bentwing Bat, Eastern False Pipistrelle, Large eared Pied Bat, Greater Broad-nosed Bat, Large-footed Myotis, Masked Owl, Barking Owl, Square-tailed Kite, Turquoise Parrot, Regent Honeyeater, Flame Robin, Koala and Spotted-tail Quoll.

The Gulf Mountain Property does not afford habitat for some species with potential to be impacted by the Project including: Brush-tailed Rock Wallaby, Broad-headed Snake, and some woodland bird species. The Property is located on the western edge of the Broad-headed Snake's range and the closest Brush-tailed Rock Wallaby record occurs more than 20km east of the Property near the Project Boundary. Unlike the offset Property Yarran View, this Property does not contain large areas of grassy Box Gum Woodland for woodland birds such as Brown Treecreeper, Diamond Fire-tail and Swift Parrot.

The results of the October surveys and subsequent data analysis confirm the suitability of Gulf Mountain Property as an offset to compensate for impacts to a suite of forest fauna, particularly those of gully forest. It is therefore worthy of inclusion within the Revised BOP.

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Appendix B

Fauna Species Recorded on Gulf Mountain

Table 2 Fauna Species Recorded on Gulf Mountain

Common Name	Scientific Name	Bird Survey	Spotlighting	Anabat	Active Searches	Incidental
AMPHIBIANS						
Myobatrachidae						
Booroolong Frog	*Litoria booroolongensis*		x			
Common Eastern Froglet	*Crinia signifera*		x		x	x
Eastern Banjo Frog	*Limnodynastes dumerilii*		x			
REPTILES						
Blue-tongue Lizard						x
BIRDS						
Columbidae						
Common Bronzewing	*Phaps chalcoptera*	x				
Wonga Pigeon	*Leucosarcia picata*	x				
Accipitridae						
Wedge-tailed Eagle	*Aquila audax*	x				
Cacatuidae						
Gang-gang Cockatoo	*Callocephalon fimbriatum*	x				
Psittacidae						
Australian King-Parrot	*Alisterus scapularis*	x				
Crimson Rosella	*Platycercus elegans*	x				
Eastern Rosella	*Platycercus eximius*					x
Cuculidae						
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	x				
Shining Bronze-cuckoo	*Chrysococcyx lucidus*	x				
Strigidae						
Powerful Owl	*Ninox strenua*		x			
Southern Boobook	*Ninox novaeseelandiae*		x			
Halcyonidae						
Laughing Kookaburra	*Dacelo novaeguineae*	x				
Sacred Kingfisher	*Todiramphus sanctus*					x
Meropidae						
Rainbow Bee-eater	*Merops ornatus*	x				
Estrildidae						
Red-browed Finch	*Neochmia temporalis*	x				

Table 2 Fauna Species Recorded on Gulf Mountain

Common Name	Scientific Name	Bird Survey	Spotlighting	Anabat	Active Searches	Incidental
Menuridae						
Superb Lyrebird	*Menura novaehollandiae*	x				
Climacteridae						
White-throated Treecreeper	*Cormobates leucophaea*	x				
Maluridae						
Superb Fairy-wren	*Malurus cyaneus*	x				
Acanthizidae						
Rockwarbler	*Origma solitaria*	x				
White-browed Scrubwren	*Sericornis frontalis*	x				x
Striated Thornbill	*Acanthiza lineata*	x				x
Brown Thornbill	*Acanthiza pusilla*	x				x
Pardalotidae						
Spotted Pardalote	*Pardalotus punctatus*	x				
Striated Pardalote	*Pardalotus striatus*	x				
Meliphagidae						
Yellow-faced Honeyeater	*Lichenostomus chrysops*	x				
Red Wattlebird	*Anthochaera carunculata*	x				
Noisy Friarbird	*Philemon corniculatus*	x				
Neosittidae						
Varied Sittella	*Daphoenositta chrysoptera*	x				
Campephagidae						
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	x				
Pachycephalidae						
Golden Whistler	*Pachycephala pectoralis*	x				
Rufous Whistler	*Pachycephala rufiventris*	x				
Grey Shrike-thrush	*Colluricincla harmonica*	x				
Oriolidae						
Olive-backed Oriole	*Oriolus sagittatus*	x				
Artamidae						
Australian Magpie	*Cracticus tibicen*	x				

Table 2 Fauna Species Recorded on Gulf Mountain

Common Name	Scientific Name	Bird Survey	Spotlighting	Anabat	Active Searches	Incidental
Pied Currawong	*Strepera graculina*	x				
Grey Currawong	*Strepera versicolor*					x
Rhipiduridae						
Grey Fantail	*Rhipidura albiscapa*	x				
Corvidae						
Australian Raven	*Corvus coronoides*					x
Little Raven	*Corvus mellori*					x
Monarchidae						
Leaden Flycatcher	*Myiagra rubecula*	x				
Satin Flycatcher	*Myiagra cyanoleuca*	x				
Petroicidae						
Scarlet Robin	*Petroica boodang*					
Eastern Yellow Robin	*Eopsaltria australis*					x
Timaliidae						
Silvereye	*Zosterops lateralis*	x				
Hirundinidae						
Welcome Swallow	*Hirundo neoxena*	x				
MAMMALS						
Phalangeridae						
Common Brushtail Possum	*Trichosurus vulpecula*		x			
Petauridae						
Squirrel Glider	*Petaurus norfolcensis*		x			
Pseudocheiridae						
Common Ringtail Possum	*Pseudocheirus peregrinus*		x			
Swamp Wallaby	*Wallabia bicolor*		x			
Bovidae						
Goat	*Capra aegagrus hircus*		x			

Appendix C

Biodiversity Values of the Gulf Mountain Property

CUMBERLAND ECOLOGY

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RE: BIODIVERSITY VALUES OF GULF MOUNTAIN:
A POTENTIAL OFFSET PROPERTY FOR THE COALPAC CONSOLIDATION PROJECT AMENDED BIODIVERSITY OFFSET STRATEGY

Dear Dorian

The purpose of this letter is to summarise the biodiversity values of the aforementioned property that is being considered for inclusion in the Coalpac Consolidation Project (the Project) Biodiversity Offset Strategy.

We have completed a two day site investigation of the Gulf Mountain property and this letter summarises our findings.

The primary aim of site investigations was to verify and quantify vegetation communities and flora and fauna habitat for, but not limited to, threatened species predicted to be impacted by the Project. We have concluded that the 1,277 ha Gulf Mountain property could add substantially to the current biodiversity offset package proposed for the Project.

Appendix A summarises the biodiversity values of Gulf Mountain property.

Yours sincerely

David Robertson

David Robertson
Director
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Appendix A

Biodiversity Values of Gulf Mountain

A.1 Background

An Environmental Assessment was prepared and exhibited for the Project by Hansen Bailey (2012). The Project included an offset package to compensate for predicted impacts to flora and fauna and currently includes the features shown in the table below:

Table A.1 Pre-existing Offset Package

Vegetation Type	Project Disturbance Boundary (ha)	Proposed Offset (ha)	Proposed Offset Ratio
CEEC and EEC[1]	18.44	221.7	12.0
Non C/EEC (native only)	818.41	1,530	1.9
TOTAL	**836.85**	**1,752**	**2.1**

Notes: 1 includes the area of EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

Following exhibition, discussions were held with key Government agencies to progress work on preparation of a Response to Submissions report. One of the key concerns raised by government representatives was the size of pre-existing offsets. Consequently, the proponent has commissioned subsequent searches for offsets and has proposed additions to the proposed biodiversity offset package.

This report provides a summary of biodiversity values from preliminary site investigations of a potential offset property, Gulf Mountain.

A.2 Methods

Prior to the site inspection of the Gulf Mountain property, a database analysis of threatened species recorded in the area (10km radius) was undertaken. The species recorded in the area were among a suite of species considered during habitat assessment of the property. During the two day site inspection on 9-10 July 2012, existing vegetation mapping was ground-truthed by recording the changes in vegetation composition and structure during random meanders and using aerial photography, topographic maps, a hand-held GPS unit and photographs. Notes and photographs were recorded during habitat assessment. Incidental fauna sightings and scats were also recorded during the site inspection.

A.3 Key Findings – Gulf Mountain

The key features of this property for consideration as a biodiversity offset are as follows:

<u>Lot & DP</u>: Lot 56 DP 755791.

<u>Size: </u>1,277 ha.

Bioregion: South Eastern Highlands Bioregion.

Location/Context: adjoins private forested land. It is not connected directly to OEH land, but links indirectly through to Winburndale Nature Reserve via a strip of uncleared forest and woodland to the south of the property. Winburndale Nature Reserve connects to Turon State Forest and Sunny Corner State Forest. The property has 5.4 kilometres of Turon River frontage.

Geology: A suite of conglomerate, sandstone, mudstone siltstone geological units, including similar geological formations to those that occur in parts of the Project Boundary.

Topography: The terrain of this property is very steep and rugged. The property drops from 1,100 m above sea level to approximately 700m above sea level where it meets the Turon River.

Vegetation & Habitat Condition: good condition with local impacts from pigs and goats.

A.3.1 Vegetation

Three vegetation types that occur in the Project Boundary (impact area) predominate across Gulf Mountain, including Sheltered Gully Forest, Broad-leaved Peppermint – Brittle Gum Woodland and Scribbly Gum Woodland.

Aspect and topography seem to dictate the distribution and occurrence of vegetation communities. Very steep, rocky and west facing slopes generally supported Scribbly Gum Woodland where Scribbly Gum (*Eucalyptus rossii*) and Red Stringybark (*Eucalyptus macrorhyncha*) were most common (**Photograph A.1** and **A.2**). The understorey varied in structure and composition depending on aspect. Exposed slopes were sparsely vegetated and species poor; some steep south facing slopes had a rich grassy ground layer. On less steep slopes, mountain saddles and in sheltered dry gullies, Broad-leaved Peppermint (*Eucalyptus dives)* and Brittle Gum (*Eucalyptus mannifera*) Woodland occurred with a grassy and herbaceous ground layer. At some gully heads on gentle slopes, Mountain Gum (*E. dalrympleana*) and Ribbon Gum (*E. viminalis*) were common and sometimes dominated the canopy (**Photograph A.7**). Riparian River Oak Forest dominated by River oak (*Casuarina cunninghamiana)* was confined to the Turon River (**Photograph A.5**) with creek flats and upland drainage lines supporting Sheltered Ribbon Gum (*Eucalyptus viminalis*) Open Forest with the understorey varying from shrubby to grassy (**Photograph A.6**). There is also potential for some small areas of Sheltered Ribbon Gum Open Forest along creek flats to resemble CEEC Box Gum Woodland.

The extent of each vegetation community recorded on the property during the preliminary site investigation is estimated below in **Table A.2**.

Table A.2 Vegetation Communities in Gulf Mountain

Vegetation Community	Area (ha)
Riparian River Oak Forest	6.98
Sheltered Gully Ribbon Gum Open Forest*	44.96
Broad-leaved Peppermint -Brittle Gum Woodland*	478.25
Scribbly Gum Woodland*	747.55
TOTAL	**1,277.73**

*Notes * = plant communities found within the Project Disturbance Boundary* (impact area)

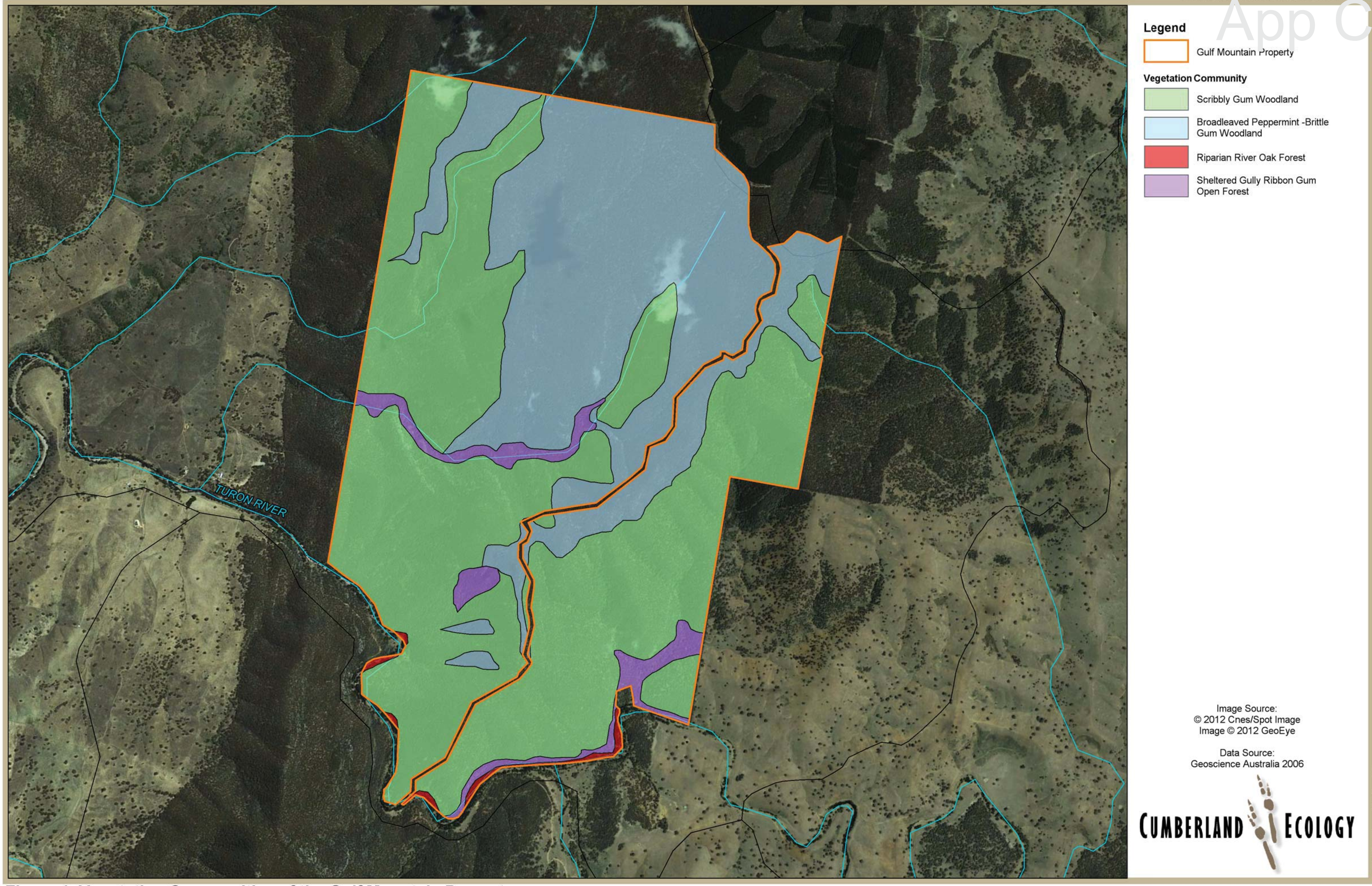


Figure 1. Vegetation Communities of the Gulf Mountain Property

A.3.2 Flora Values

No threatened flora species were recorded during the site investigation; though the property provides potential habitat in gullies and slopes for a number of threatened plants known in the area, including *Derwentia blakelyi* and *Eucalyptus cannonii.* The latter is a species that will be impacted by the Project.

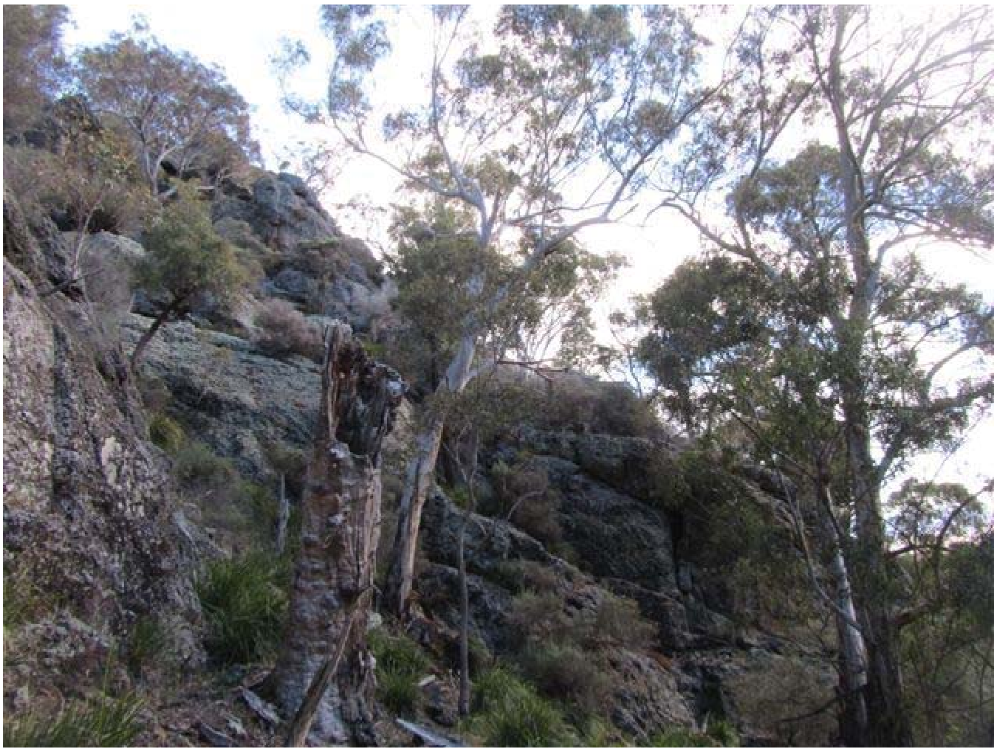
A.3.3 Fauna Values

The fauna habitats within the Gulf Mountain property occur within the woodland and open forest vegetation communities and within the permanent and ephemeral water resources. The majority of vegetation comprises low open forest and woodland with areas containing a tall canopy being restricted to drainage lines and gully heads. The canopy species present within the property include both smooth and rough-barked species. The plant diversity within the exposed Scribbly Gum Woodland was low, resulting from a sparse understorey. This community occupied extensive rocky outcrops. The upland drainage lines are lined with thick shrubs providing habitat for small woodland birds. Other key habitat features recorded within the property include an abundance of fallen logs and debris (**Photograph A.3** and **A.4**), permanent and ephemeral drainage lines (including the Turon River) (**Photograph A.5** and **A.6**), hollow-bearing trees (including hollows of various sizes), stags, extensive rocky outcrops (**Photograph A.2**), nectar-producing trees, mistletoes and Koala feed trees (including *Eucalyptus viminalis* and a variety of secondary feed species). These habitats occur at a range of altitudes including along ridgelines, steep and gently sloping topography and along the Turon River.

The habitats available within the property provide known and potential habitat for a suite of species listed under the TSC Act and/or EPBC Act. The Scarlet Robin (*Petroica boodang*), that is listed as Vulnerable under the TSC Act, was observed at numerous locations within the upper slopes and ridgelines. The Varied Sittella (*Daphoenositta chrysoptera*), that is listed as Vulnerable under the TSC Act was recorded in Scribbly Gum Woodland at one location within the property. Extensive areas of the property support suitable habitat features, such as an abundance of fallen logs and stags, for these species.

Good potential habitat exists for threatened microchiropteran bats, birds and amphibians. The tree hollows and stags within the property provide potential shelter, roosting and nesting habitat for threatened microchiropteran bats such as the Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), which is known in the area. Although not recorded in the area, the rocky escarpments could provide potential habitat for the Large-eared Pied Bat (*Chalinolobus dwyeri*) and Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*). The property supports foraging habitat for owl species, such as the Powerful Owl (*Ninox strenua*) and Barking Owl (*Ninox connivens*), however there is limited roosting and nesting habitat for these species as the vegetation lacks a dense or multilayered understorey, and hollows of a suitable size were not observed. Foraging and nesting resources are also available for a range of other threatened bird species such as the Little Lorikeet (*Glossopsitta pusilla*) and Brown Treecreeper (*Climacteris picumnus victoriae*). Potential habitat for the Booroolong Frog (*Litoria booroolongensis*) was observed along the Turon River with known records occurring upstream and downstream of the property.

Photograph A.1 Overview of south-western hillside. River Oak in foreground and Scribbly Gum in background



Photograph A.2 Scribbly Gum Woodland on rocky outcrops

Photograph A.3 Broad-leaved Peppermint – Brittle Gum Woodland with abundant fallen timber

Photograph A.4 Scribbly Gum Woodland with abundant fallen timber and hollows

Photograph A.5 Riparian River Oak Forest along the Turon River. Potential Booroolong Frog habitat

Photograph A.6 Ribbon Gum Open Forest in drainage line

Photograph A.7 Ribbon Gum & Mountain Gum at gully head

The table below provides a summary of the revised biodiversity offset strategy for the Project if Gulf Mountain is included.

Table A.3 Proposed Offset Package including Gulf Mountain

Vegetation Type	Project Disturbance Boundary (ha)	Proposed Offset (ha)	Proposed Offset Ratio
CEEC & EEC[1]	18.44	221.7	12.0
Non C/EEC (native only)	818.41	2,808	3.4
TOTAL	**836.85**	**3,030**	**3.6**

Notes: 1 includes the area of EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

A.4 Conclusions and Recommendations

The Gulf Mountain property would contribute significantly if incorporated into the offset package that is proposed for the Project. Three vegetation types that occur in the Project Disturbance Boundary (impact area) predominate across Gulf Mountain, including Sheltered Ribbon Gum Open Forest, Broad-leaved Peppermint – Brittle Gum Woodland and Scribbly Gum Woodland. The property does not directly adjoin conservation reserves, but indirectly connects to Winburndale Nature Reserve via intact forest and woodland. Moreover, it is large enough to form a conservation area in its own right.

The terrain of Gulf Mountain is very steep and somewhat similar to parts of the Project Boundary. Rocky outcrops are extensive throughout the property. It is also an appropriate large size (1,277 ha) and provides habitat for a suite of threatened fauna, particularly woodland birds and micro bats. For example Scarlet Robin and Varied Sittella were detected during the site inspection and based upon habitat other species would almost certainly occur.

The acquisition Gulf Mountain for inclusion in the biodiversity offset package proposed for the Project will achieve a 3.6:1 ratio and the vegetation within the property has close affiliations (floristically and physically) with those in the Project Boundary.

APPENDIX H

ECONOMIC IMPACT ASSESSMENT

Coalpac Consolidation Project
Preferred Project Report
Economic Assessment

Final Report

Prepared for

Coalpac Pty Ltd

By

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March 2013

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1 INTRODUCTION

Cullen Valley Mine and Invincible Colliery are located approximately 25 km north-west of Lithgow, NSW. Coalpac Pty Ltd (Coalpac) is seeking a Project Approval under Part 3A of the *Environmental Planning & Assessment Act 1979* to consolidate the operations and management of these sites under a single, contemporary planning approval, to allow coal mining operations within its current mining tenements to continue for a further period of 21 years (the Project).

In response to the Planning Assessment Commissions (PACs) consideration of the Project, Coalpac is proposing a number of contractions to the scale of the Project to further reduce its environmental impacts (Contracted Project).

Hansen Bailey advises that the proposed contractions to the Project as reviewed by the PAC include:

1. Removal of the Hillcroft Mining Area and associated access infrastructure (including the Wallerawang-Gwabegar Rail Line overpass bridge and Red Springs Road crossing);
2. Removal of the sand extraction component of the Exhibited Project located in the Cullen Valley mining area, including the requirement for associated crushing and screening infrastructure and the transport of product sand by road from the site to market;
3. Reduction of the open cut mining footprint to avoid the area of Clandulla Geebung habitat previously located in the north western mining area at Cullen Valley Mine;
4. Reduction of the open cut mining footprint in relation to the Significant Pagoda Landforms (SPL) to improve ecological outcomes;
5. Reduction of the highwall mining footprint to avoid rock formations within the SPL to improve perceived ecological, heritage and geotechnical outcomes;
6. Implementation of a robust blast management system specifically tailored to further minimise the potential for blasting impacts to any SPL and Sandstone Outcrop;
7. Enhancement of the Biodiversity Offset Strategy (BOS) proposed for any residual ecological impacts; and
8. Commitments with regard to the monitoring, management and operation of the Contracted Project.

This report undertakes an economic assessment of the Contracted Project.

2 BACKGROUND

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

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

The NSW Department of Planning and Infrastructure (NSW DP&I) draft *Guideline for Economic Effects and Evaluation in EIA* (James and Gillespie, 2002) identifies 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 identifies 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 NSW Government (2012) draft *Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals* also identifies BCA as the appropriate method for evaluating mining proposals.

The draft *Guideline for Economic Effects and Evaluation in EIA* considers that regional economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Economic stimulus to the region can be estimated using input-output modelling of the regional economy (regional economic impact assessment).

This assessment report provides:

- A BCA of the Contracted Project (Section 3);
- Identification of the distribution of impacts between stakeholder groups (Section 4);
- A regional economic impact assessment of the Contracted Project (Section 5);
- Consideration of the impacts of mine cessation (Section 6); and
- A conclusion summarising the above (Section 7).

3 ECONOMIC EFFICIENCY

3.1 Introduction

Guidelines and Decision Criteria

BCA has its theoretical underpinnings in neoclassical welfare economics and 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 guided by NSW DP&I *Draft Guidelines for Economic Effects and Evaluation in EIA* (James and Gillespie 2002). There are also NSW Government (2012) *Draft Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals*.

BCA is primarily concerned with comparison of the present value of aggregate benefits to society, as a result of a project, 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, a project is considered to improve the economic welfare of society and hence is desirable from an economic efficiency perspective.

Definition of Society

BCA includes the consideration of costs and benefits to all members of society i.e. consumers, producers and the broader society as represented by the government.

As a tool of investment appraisal for the public sector, BCA can potentially be applied across different spatial definitions of society. Depending on agency jurisdiction and the geographical spread of benefits and costs, this could range from the population of a Council area through to the whole world. However, most applications of BCA are at the national level. This national focus extends the analysis beyond that which is strictly relevant to a NSW government planning authority. However, the interconnected nature of the Australian economy and society creates significant spillovers between states. These include transfers between States associated with the tax system and the movement of resources over state boundaries.

Nevertheless, as identified by Boardman et al (2001), *"where major impacts spill over national borders, then the BCA should be undertaken from the global as well as the national perspective".* For mining projects, impacts that spill over national borders include greenhouse gas impacts of the Modification and returns to foreign ownership.

Adopting a sub-national perspective is not recommended (Boardman et al 2001), as it can result in a range of costs and benefits from a project being excluded, making BCA a less valuable tool for decision-makers. This is particularly the case for major projects which involve the use of resources drawn from across the nation as well as internationally and which generate benefits that are enjoyed by people who are resident in NSW and beyond.

BCAs of mining projects are therefore normally undertaken from a global perspective i.e. including all the costs and benefits of a project, no matter who they accrue to and then truncating the analysis to Australia, to assess whether there are net benefits to Australia from a project. A consideration of the distribution of costs and benefits can then be undertaken to give consideration to the benefits and costs that accrue to NSW and other regions. However, desirability of a project from an economic efficiency perspective does not require that there are net benefits at a local, regional, state, national and global level. The primary consideration is the net benefits of the project from a national perspective.

Definition of the Project Scope

The definition of the project for which approval is being sought has important implications for the identification of the costs and benefits of a project. Even when a BCA is undertaken from a global perspective, and includes costs and benefits of a project that accrue outside the national border, only the costs and benefits associated with the defined project are relevant. For mining projects, typically only the costs and benefits from the mining of the coal and its delivery to Port or domestic users, are relevant.

Coal is an intermediate good i.e. it is an input to other production processes such as production of electricity and steel making. However, these other production processes themselves require approval and, in BCA, would be assessed as separate projects.

Net Production Benefits

BCA of mining proposals invariably involve a trade-off between the net production benefits of a project and the non-market (environmental, social and cultural) impacts (most of which are economic costs of the mining but some of which may be economic benefits).

Net production benefits can be estimated based on market data on the projected economic value of coal less the capital and operating costs of projects, including opportunity costs of capital and land already in the ownership of mining companies. Production costs and benefits over time are discounted to a present value.

Environmental, Social and Cultural Costs

The consideration of non-market impacts in BCA relies on the assessment of other experts contributing information on the biophysical impacts. The EA process results in detailed (non-monetary) consideration of the potential non-market impacts of a project and the proposed means of mitigating the impacts.

This information can then be incorporated into the BCA via an assessment of the per unit values society holds for the various impacts. These per unit values can be potentially be estimated using benefit transfer or primary non-market valuation methods. Benefit transfer involves using information on the physical magnitude of impacts e.g. area of vegetation cleared or number of properties impacted by dust, obtained from the EA specialists and applying value estimates of the cleared vegetation per hectare or dust impacts per property, obtained from non-market valuation studies undertaken in other contexts.

Primary non-market valuation methods include choice modelling and the contingent valuation method where a sample of the community is surveyed to ascertain their willingness to pay to avoid a unit change in the level of a biophysical attribute. Other methods include the property valuation approach where changes in environmental quality may result in changes in property value.

The estimate of net production benefits of a project generally includes accounting for costs aimed at mitigating, offsetting or compensating for the main environmental, social and cultural impacts. This includes the costs of purchasing properties adversely affected by noise and dust, providing mitigation measures for properties moderately impacted by noise and dust, the costs of providing ecological offsets and the cost of purchasing groundwater and surface water entitlements in the water market etc. Including these costs effectively internalizes the respective and otherwise, non-monetary environmental, social and cultural costs.

Only residual impacts, after mitigation, offset and compensation, require additional consideration.

There is also the practical principle of materiality. Only those impacts that are likely to have a material bearing on the decision, need to be considered in BCA (NSW Government, 2012). For example, the net present value of a project is $20 million, costs or benefits valued at less than $1 million are unlikely to be material (NSW Government, 2012).

Consideration of Net Social Benefits

The consideration of the net social benefits of a project combines the value estimate of net production benefits and the value estimates of residual environmental, social and cultural impacts. Provided a project has a net present value of greater than zero, it is considered to improve the economic welfare of society and hence is desirable from an economic efficiency perspective.

BCA guidelines are not prescriptive about the level of monetisation that should be undertaken of non-market impacts of projects. This will depend on the time, information and budget limitations.

However, even without any monetisation of impacts, BCA still provides important information to the decision-maker about the trade-offs involved with a project.

At its simplest level, BCA can utilise the threshold value method where the net production benefits of a project are estimated in monetary terms and this provides the threshold value that the residual non-market costs of the project, after mitigation, offset and compensation by the proponent (as evaluated in a non-monetary way by specialists in the EA), would need to exceed for the non-market costs of the project to outweigh the net production benefits.

Where non-market impacts are internalised into the costs of production of a project or some form of non-market valuation of residual environmental impacts is made, stronger conclusions can be drawn about the net social benefits of a project

Distribution of Costs and Benefits

While BCA is concerned with a comparison of aggregate benefits with aggregate costs, the distribution of costs and benefits may also be of interest to decision makers and can be provided in text or tabular form, indicating which groups obtain the benefits and bear the costs and the level of costs and benefits that accrue to each group.

Steps in BCA

BCA involves the following key steps:

- identification of the base case (the "without" project case defined as the currently approved operations over time);
- definition of the project (the "with" project case);
- identification and valuation of the incremental benefits and costs associated with the project relative to the base case;
- 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.

This BCA of the Contracted Project is based on financial, technical and environmental advice provided by the proponent and its specialist consultants

3.2 Identification of the "With" and "Without" Project Scenarios

Cullen Valley Mine and Invincible Colliery currently have approval for extraction of up to 1.0 Mtpa and 1.2 Mtpa of product coal, respectively. Most of this supplies the Mount Piper Power Station (MPPS), with provision for some emergency supply to the Wallerawang Power Station (WPS) and the remainder to other domestic customers. Prior to the recent suspension of operations at the Cullen Valley Mine, approximately 90 full-time personnel and contractors were employed across Cullen Valley Mine and Invincible Colliery (26 full time personnel plus contractors at the Cullen Valley Mine and 20 full-time personnel plus contractors at the Invincible Colliery). "Without" the Contracted Project, Invincible Colliery is due to suspend its operations in March 2013. The suspension of both operations is due solely to the exhaustion of currently approved coal reserves and they will remain suspended until further approvals are granted i.e. the 'without' project scenario is cessation of all coal mining by the end of March 2013.

In contrast, the Contracted Project involves the following, over a period of 21 years:

- Continuation of mining operations at:
  - Cullen Valley Mine (west of the Castlereagh Highway) by both open cut and highwall mining methods to access an additional resource of approximately 35 Mt ROM coal; and
  - Invincible Colliery (including an extension north into the East Tyldesley area) by open cut and highwall mining methods to access an additional resource of approximately 63 Mt ROM coal;
- Continuation of coal supply to the local MPPS by a dedicated coal conveyor over the Castlereagh Highway with emergency supply to MPPS and WPS by road, with flexibility for supply to additional domestic destinations and Port Kembla by rail for export;
- Upgrade of the existing Invincible Colliery Preparation Plant, administration and other infrastructure;
- Construction and operation of additional offices at Cullen Valley Mine;

- Construction and use of the East Tyldesley Coal Preparation Plant (incorporating the previously approved Coal Deshaling Plant at Cullen Valley Mine);
- Construction of a rail siding and associated infrastructure for transport of product coal;
- Integration of water management infrastructure on both sites into a single system; and
- Integration of the management of mine rehabilitation and conceptual final landform outcomes for Cullen Valley Mine and Invincible Colliery.

Employment for the Contracted Project would be approximately 120 full-time personnel and contractors.

3.3 Decommissioning Costs, Residual Capital Costs and Residual Land Costs

The Contracted Project would extend the life of the existing Cullen Valley Mine and Invincible Colliery as a consolidated operation and hence the approximately $18M of decommissioning costs that would have been incurred in 2013 following cessation of the current operations are deferred to the end of the Contracted Project. Due to discounting used in BCA, deferment of this cost is an economic benefit of the Contracted Project.

However, the $11M of residual capital value and $8M of land value that would have been realised in 2013 would be deferred to after cessation of the Project. Due to discounting used in BCA, this deferment is an economic cost of the Contracted Project.

3.4 Capital Costs

The Contracted Project is associated with capital investment, including sustaining capital, of $384M over the life of the Contracted Project. This includes capital for construction of the East Tyldesley Coal Preparation Plant, construction of haul roads and road crossings, rail siding and crossing, electricity infrastructure, conveyor from the existing Invincible Colliery Preparation Plant to MPPS, land purchases and establishment of biodiversity offsets.

3.5 Operating Costs

Average operating costs of the Contracted Project are estimated at in the order of $124M per annum. While royalties are a cost to Coalpac, 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 Contracted Project. Nevertheless, it should be noted that the Contracted Project would generate total royalties to NSW in the order of $371M ($199M, present value).

3.6 Value of Coal

The Contracted Project will result in incremental coal production for:

- local industrial purposes;
- export (15% ash coal and 20% to 25% ash coal);
- supply to the MPPS (27-29% ash coal).

Consistent with NSW Treasury (2007), the economic value of a product coal for local industrial purposes and export, which is supplied into a competitive market, can be taken as the revenue generated from its sale. The higher ash coal for export is predicted to have a lower value than the lower ash coal for export.

While the Contracted Project would supply coal to MPPS (and WPS), at a negotiated financial price, the appropriate estimate of the economic value for thermal coal from the Contracted Project is the world price for this quality of coal (Sinden and Thampapillai 1995). While the coal from the Contracted Project, that would be supplied to MPPS, has a high ash content, Coalpac advises that it is still suitable for export and for use in overseas power generation as a blend with other coal. Coalpac has also advised that if the coal being supplied to the MPPS were blended with other product coal from the Contracted Project, it would have an ash content of 21% and could be exported at the world price for coal of this ash level. This is the basis on which all coal from the Contracted Project is valued in the analysis.[1]

There is obviously considerable uncertainty around future coal values and hence assumed coal values have been subjected to sensitivity testing (see Section 3.10).

3.7 Net Production Benefits

At the NSW Treasury recommended central discount rate of 7%, the Contracted Project is estimated to have total net production benefits to Australia of $1,330M (refer to Table 1).

3.8 Consideration of Environmental, Cultural and Social Impacts

The main potential environmental impacts of the Contracted Project relate to dust and noise impacts on properties, greenhouse gas generation, visual impacts and the clearing of native vegetation. There will also be some road externalities, mainly associated with road transport of minor quantities of coal to other domestic customers.

Dust and noise impacts are internalised into the costs of the Contracted Project by including the acquisition costs of affected properties and mitigation measures for properties in the management zones. Residual dust and noise impacts are therefore likely to be negligible.

Using a carbon value of $23/t CO_2-e[2], the incremental global damage costs from greenhouse gas emissions of the Contracted Project are valued at $17M present value[3]. The Australian damage costs from the Contracted Project greenhouse gas emissions are estimated at in the order of $0.2M. The carbon tax internalises the global greenhouse gas costs into Coalpac's operating costs. Residual greenhouse gas impacts are therefore likely to be negligible.

[1] All coal is valued free-on-board. For coal that would be supplied to the MPPS the coal value has been adjusted backwards for rail and port costs.

[2] This carbon value is conservatively high, compared to forward market price forecasts of carbon prices post linkage to the international market at the end of the fixed price period in the Australian carbon scheme.

[3] 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 Contracted Project. [4] 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 Varied Project.

Properties identified as experiencing high visual impacts because of the mine operating would be eligible for at-receptor mitigation works. The cost of these mitigation works is included in the capital costs of the Contracted Project. Residual visual impacts are therefore likely to be negligible.

The costs of biodiversity offset actions have been included in the estimation of net production benefits. Provided offsets that are negotiated with Office of Environment and Heritage offset the biodiversity values that will be lost from the Contracted Project, there would be no additional ecological costs for inclusion in the BCA. To include an economic cost for cleared vegetation and lost habitat of threatened species in the BCA would result in double counting.

3.9 Net Social Benefit

Overall, the Contracted Project is estimated to have net benefits to Australia of in the order of $1,330M (refer to Table 1) and hence is desirable and justified from an economic efficiency perspective.

This is a minimum estimated net social benefit because the Contracted Project would also provide employment benefits to the community in the form of at least 120 direct full-time jobs for up to 21 years. Studies have shown that the community may have non-use economic values for these employment effects (Gillespie 2008, Gillespie 2009). However, conservatively, no values for these benefits have been included in the analysis.

3.10 Threshold Value Analysis

The estimated net social benefit of the Contracted Project of $1,330M provides a threshold value that any unquantified residual impacts of the Contracted Project would need to exceed to make the Contracted Project questionable from an Australian economic efficiency perspective. Because the major environmental, cultural and social impacts of the Contracted Project have been quantified and included in the BCA, any other residual environmental, cultural or social impacts would be unlikely to exceed the quantified net social benefits of the Contracted Project.

Table 1
Benefit Cost Analysis Results of the Contracted Project ($M Present Values at 7% Discount Rate)

	COSTS		BENEFITS	
	Description	**Value ($M)**	**Description**	**Value ($M)**
Net Production Benefits	Opportunity cost of land	7	Avoided decommissioning costs 2013	17
	Opportunity cost of capital equipment	10	Economic value of coal	2,918
	Capital costs	275	Residual value of land at the cessation of the project	1
	Operating costs less royalties	1,316	Residual value of capital equipment at the cessation of the project	2
	Decommissioning and rehabilitation costs	4		
	Production Sub-total	***$1,608M***	-	***$2,938M***
	Net Production Benefits		-	***$1,330M***
Environmental, cultural and social impacts	Greenhouse gas emissions	$17 ($0.2)	Non-market benefits of employment	Unquantified
	Agricultural production	Value included in opportunity cost of land and capital costs	-	-
	Operational noise	Cost of acquisition of adversely impacted properties and noise management included in capital costs and opportunity cost of land	-	-
	Air quality	Cost of acquisition of adversely impacted properties included in capital costs and opportunity cost of land	-	-
	Surface water	Insignificant	-	
	Groundwater	Insignificant	-	-
	Flora and fauna	Some values lost but offset. The cost of offset is included in capital cost, opportunity cost of land and operating cost	-	-
	Road transport	Insignificant		-
	Aboriginal and non-Aboriginal heritage	Insignificant	-	-
	Visual impacts	Insignificant. Cost of mitigation to high visual impact properties included in capital costs	-	-
	Pagoda landforms	Insignificant	-	**-**
	Tourism and recreation	Insignificant		
	Externalities sub-total	***$17M($0.2M)***		
	Net externalities	***$17M($0.2M)***	-	-
NET BENEFITS				**$1,313M** **($1,330M)**

*Where impacts occur globally, the impact occurring to Australia is provided in brackets.

3.11 Sensitivity Testing

The estimate of the net social benefit of the Contracted Project presented in Table 1 is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a BCA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie, 2002) to determine the effect on the estimate of net social benefit.

In Table 2, the BCA result was tested for 20% (+ and -) changes to the following variables at a 4%, 7% and 10% discount rate:

- Opportunity costs of land;
- Opportunity cost of capital;
- Capital costs;
- Operating costs;
- Value of coal;
- Decommissioning and rehabilitation costs;
- Residual value of land and capital; and
- Greenhouse costs.

Table 2
Benefit Cost Analysis Sensitivity Testing, Project Australian Net Present Value ($Millions)

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS	$1,746	$1,330	$1,122
INCREASE 20%			
Opportunity cost of land	$1,745	$1,329	$1,122
Opportunity cost of capital	$1,744	$1,328	$1,122
Capital costs	$1,684	$1,275	$1,086
Operating costs	$1,402	$1,067	$909
Coal value	$2,633	$2,019	$1,682
Decommissioning and rehabilitation costs	$1,750	$1,334	$1,122
Residual value of land and capital	$1,748	$1,331	$1,122
GREENHOUSE COSTS @ $40/TONNE (T)	$1,746	$1,330	$1,122

	4% Discount Rate	7% Discount Rate	10% Discount Rate
DECREASE 20%			
Opportunity cost of land	$1,748	$1,332	$1,122
Opportunity cost of capital	$1,748	$1,332	$1,122
Capital costs	$1,809	$1,385	$1,157
Operating costs	$2,090	$1,593	$1,335
Coal value	$860	$641	$561
Decommissioning and rehabilitation costs	$1,743	$1,327	$1,122
Residual value of land and capital	$1,745	$1,329	$1,121
GREENHOUSE COSTS @ $8/TONNE (T)	$1,746	$1,330	$1,122

What this analysis indicates is that estimated net social benefit to Australia of $1,330M is most sensitive to assumptions about the economic value of coal. If coal value reduced by 20% for the entire life of the Contracted Project then the net benefit to Australia would reduce to $641M. Alternatively, if coal value increased by 20% for the entire life of the Contracted Project the estimated net benefit to Australia would increase to $2,019M. The results are not sensitive to changes in other variables.

4 DISTRIBUTION OF IMPACTS

The net production benefits of the Contracted Project would be distributed between a number of stakeholders including:

- Coalpac shareholders in the form of net profits;
- The MPPS (and WPS), in the form of lower cost coal ($744M, present value) which is ultimately passed on to electricity consumers through lower priced electricity;
- The NSW government, in the form of royalties (estimated at $199M, present value) which is subsequently used to fund provision of government infrastructure and services across NSW, including the region;
- The Commonwealth Government, in the form of company tax (estimated at $116M, present value) which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the region; and
- The local region, from the establishment of a Voluntary Planning Agreement to fund local community projects.

Without mitigation and compensation, the environmental impacts of the Contracted Project such as noise and dust and visual impacts would be borne by members of the local community. Greenhouse gas emission impacts would be borne globally and clearing of native vegetation would be borne by those members of the NSW and Australian community who value the native vegetation that would be impacted.

However, noise and dust impacts will be internalised by Coalpac through the acquisition of (provision of compensation for) adversely affected properties and provision of mitigation measures for those located in noise management zones or considered to be in the high visual impact zone. Impacts on native vegetation will also be internalised through a biodiversity offset package of land deemed suitable by NSW Office of Environmental and Heritage. The global greenhouse gas costs from the Contracted Project would be internalised into the operating costs of Coalpac via the carbon tax.

Consequently, as well as resulting in net benefits to Australia the Contracted Project is also considered to provide net benefits to NSW.

5 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 Contracted Project is the expenditure in the regional economy of Lithgow and Bathurst local government areas, and NSW, as a result of an extension in the life of Coalpac operations.

The average annual expenditure of the Contracted Project will be at least as great as for the original Project and the estimated direct employment level will be the same as for the original Project. Consequently, the estimated regional and NSW impacts of the original Project are considered to be also representative of the Contracted Project.

Table 3
Estimated Annual Regional Economic Impacts of the Contracted Project

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($000)	168,659	34,739	15,973	50,713	219,372
Type 11A Ratio	*1.00*	*0.21*	*0.10*	*0.30*	*1.30*
VALUE ADDED ($000)	78,028	19,622	7,687	27,310	105,338
Type 11A Ratio	*1.00*	*0.25*	*0.10*	*0.35*	*1.35*
INCOME ($000)	14,400	10,698	5,733	16,432	30,831
Type 11A Ratio	*1.00*	*0.74*	*0.40*	*1.14*	*2.14*
EMPLOYMENT (No.)	120	98	75	173	293
Type 11A Ratio	*1.00*	*0.82*	*0.62*	*1.44*	*2.44*

Note: Totals may have minor discrepancies due to rounding.

The annual regional economic impact associated with the Contracted Project (refer to Table 2) is estimated at up to:

- $219M in annual direct and indirect regional output or business turnover;
- $105M in annual direct and indirect regional value added;
- $30M in annual direct and indirect household income; and

- 293 direct and indirect jobs.

Table 4
Estimated Annual NSW Economic Impacts of the Contracted Project

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($000)	168,659	51,516	55,226	106,742	275,401
Type 11A Ratio	*1.00*	*0.31*	*0.33*	*0.63*	*1.63*
VALUE ADDED ($000)	78,028	27,274	28,130	55,404	133,432
Type 11A Ratio	*1.00*	*0.35*	*0.36*	*0.71*	*1.71*
INCOME ($000)	14,400	17,119	16,098	33,217	47,617
Type 11A Ratio	*1.00*	*1.19*	*1.12*	*2.31*	*3.31*
EMPLOYMENT (No.)	120	178	222	399	519
Type 11A Ratio	*1.00*	*1.48*	*1.85*	*3.33*	*4.33*

Note: Totals may have minor discrepancies due to rounding.

The annual NSW economic impact associated with the Contracted Project (refer to Table 3) is estimated at up to:

- $275M in annual direct and indirect regional output or business turnover;
- $133M in annual direct and indirect regional value added;
- $48M in annual direct and indirect household income; and
- 519 direct and indirect jobs.

These estimated annual regional and NSW impacts would be felt for the life of the Contracted Project.

6 MINE CESSATION

Cessation of mining after the Contracted Project will lead to a reduction in economic activity in the region. The significance of these Contracted Project cessation impacts would depend on:

- The degree to which any displaced workers and their families remain within the region, even if they remain unemployed. This is because continued expenditure by these people in the regional economy (even at reduced levels) contributes to final demand;
- The economic structure and trends in the regional economy at the time. For example, if cessation of the mine takes place in a declining economy the impacts might be felt more greatly than if it takes place in a growing, diversified economy; and
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

Without approval for the Contracted Project, the Cullen Valley Mine would remain closed and the Invincible Colliery would suspend operations in March 2013, with an associated decline in economic activity to the regional and NSW economies.

7 CONCLUSION

The Contracted Project is estimated to have total net production benefits of $1,330M.

The main potential environmental impacts of the Contracted Project relate to dust and noise impacts on properties, greenhouse gas generation, visual impacts and the clearing of native vegetation. There will also be some road externalities, mainly associated with road transport of minor quantities of coal to other domestic customers.

Dust and noise impacts are internalised into the costs of the Contracted Project by including the acquisition costs of affected properties and mitigation measures for properties in the management zones. Residual dust and noise impacts are therefore likely to be negligible.

Using a carbon value of $23/t CO_2-e, the incremental global damage costs from greenhouse gas emissions of the Contracted Project are valued at $17M present value[4]. The Australian damage costs from the Contracted Project greenhouse gas emissions are estimated at in the order of $0.2M. The carbon tax internalises the global greenhouse gas costs into Coalpac's operating costs. Residual greenhouse gas impacts are therefore likely to be negligible.

Properties identified as experiencing high visual impacts because of the mine operation would be eligible for at receptor mitigation works. The cost of these mitigation works is included in the capital costs of the Contracted Project. Residual visual impacts are therefore likely to be negligible.

The costs of biodiversity offset actions have been included in the estimation of net production benefits. Provided that offset properties are negotiated with the NSW Office of Environment and Heritage and offset the biodiversity values that will be lost as a result of the Contracted Project, there would be no additional ecological costs for inclusion in the BCA. To include an economic cost for cleared vegetation and lost habitat of threatened species in the BCA would result in double counting.

Overall, the Contracted Project is estimated to have net social benefits to Australia in the order of $1,330M. Because the major environmental, cultural and social impacts of the Contracted Project have been quantified and included in the BCA, any other unquantified residual environmental, cultural or social impacts would be unlikely to exceed the quantified net social benefits of the Contracted Project. Consequently, the Contracted Project is hence is considered to be desirable and justified from an economic efficiency perspective.

The Contracted Project would provide an ongoing stimulus to the economy of the Lithgow and Bathurst region for the life of the Contracted Project. The annual regional economic impact associated with the Contracted Project is estimated at up to:

- $219M in annual direct and indirect regional output or business turnover;
- $105M in annual direct and indirect regional value added;
- $30M in annual direct and indirect household income; and

[4] 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 Varied Project.

- 293 direct and indirect jobs.

The annual NSW economic impact associated with the Contracted Project is estimated at up to:

- $275M in annual direct and indirect regional output or business turnover;
- $133M in annual direct and indirect regional value added;
- $48M in annual direct and indirect household income; and
- 519 direct and indirect jobs.

Without approval of the Contracted Project, the Cullen Valley Mine would remain closed and the Invincible Colliery would suspend operations in March 2013, with an associated decline in economic activity to the regional and NSW economies.

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ENVIRONMENTAL & RESOURCE ECONOMICS

Mr Bret Leisemann
Coalpac Pty Limited
PO Box 330 Indooroopilly, QLD 4068.

27 March 2013

Dear Mr Leisemann,

Following on from my review of the economic assessment of the original Coalpac proposal, I have now reviewed Gillespie Economics' 'Coalpac Consolidation Contracted Project Economic Assessment'.

The Assessment uses cost benefit analysis (CBA) to assess the impact of the Contracted Project on the well-being of the Australian people and an input-output analysis to predict the project's effects on the structure of the regional and state economies.The primary difference between the assessments of the initial and the revised projects is the reduction in the net social benefit predicted. While the initial project was assessed to produce a net social benefit under assumed conditions of around $1.5b, the Contracted Project is estimated to have net social benefits of around $1.3b. The difference arises because the Contracted Project does not include the mining of coal in areas identified by the PAC as having special environmental significance. Other causes of the difference are revisions to the cost structure of the project and the likely trajectory of the export price of coal.

Because the assessment performed by Gillespie Economics for the Contracted Project follows the same principles and practice as those used in the initial assessment, my findings are fundamentally the same for both. It is however worth noting two additional points:

1. The treatment of the price of coal in the estimation of benefits in the Contracted Project assessment has been refined to provide a better representation of the shadow price of coal. Specifically the varying ash content in the differing types of coal that will be mined under the project has been recognised and accounted for through an adjustment in the free-on-board export price of the resource.
2. The changes in the mine plan caused by the additional environmental restrictions embedded in the Contracted Project will have the effect of reducing any uncompensated environmental costs relating to the Contracted Project. The decision facing policy makers is now whether or not any remaining and uncompensated environmental costs are sufficient to out-weigh the $1.3b net social benefits generated by the Contracted Project. This decision cannot be directed by the Gillespie Economics CBA alone as it involves a qualitative assessment of any remaining uncompensated environmental costs against the $1.3b net social benefit of mining. However, that qualitative assessment should be made recognising the compensation payments made to those experiencing noise, dust and visual impacts from the mining operation and the biodiversity offset measures proposed. Payments made for these elements of the mining environmental impact are already included in the financial costs of the mine operation and are thus included in the Gillespie Economics estimate of mine net social benefit. A cost has also been included in the CBA for the impact of greenhouse gas emissions from the Contracted Project. The qualitative assessment of any residual environmental costs should therefore exclude these elements. From my experience of applying non-market valuation techniques to estimate environmental benefits and costs in a variety of natural resource management contexts, including coal mining, in NSW and elsewhere in Australia, it is my opinion that any remaining and uncompensated environmental costs of the Contracted Project would be less than the $1.3b net social benefit of the Project as estimated by the Gillespie Economics CBA.

In summary, the Gillespie Economics economic assessment of the Contracted Project has used conceptually appropriate tools of economic analysis and that those tools have been applied in an acceptable manner. I therefore find that the assessment delivers an accurate picture of the economic impacts of the proposed mine. My opinion is that any environmental costs of the Contracted Project that are not incorporated into the Gillespie Economics CBA are less than the $1.3b net social benefit estimated by that CBA of the proposed mine.

Yours sincerely

Prof Jeff Bennett, Principal

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